STREAMFLOW AND WATER-QUALITY DATA FOR MEADOW RUN BASIN, FAYETTE COUNTY, PENNSYLVANIA, DECEMBER 1987 — NOVEMBER 1988

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CONVERSION FACTORS AND ABBREVIATIONS

For the convenience of readers who may prefer metric (International system) units rather than the inch-pound units used in this report, values may be converted by using the following factors:

Multiply Inch-Pound Unit	By	To obtain Metric Unit
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	0.004047	square kilometer (km^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
	Volume	
gallon (gal)	3.785	liter (L)
	3,785	milliliter (mL)
cubic feet per second-days (ft^3/s-d)	2.447	cubic kilometers (km^3)
	Temperature	
degree Fahrenheit (°F)	°C=5/9 (°F-32)	degree Celsius (°C)

Other Abbreviations

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

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929) -- a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

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ABSTRACT

Streamflow and water-quality data were collected throughout the Meadow Run basin, Fayette County, Pennsylvania, from December 7, 1987 through November 15, 1988, to determine the prevailing quality of surface water over a range of hydrologic conditions. This data will assist the Pennsylvania Department of Environmental Resources during its review of coal-mine permit applications. A water-quality station near the mouth of Meadow Run provided continuous-record of stream stage, pH, specific conductance, and water temperature. Monthly water-quality samples collected at this station were analyzed for total and dissolved metals, nutrients, major cations and anions, and suspended-sediment concentrations. Fourteen partial-record sites, located throughout the basin, were similarly sampled four times during the study. Streamflow and water-quality data obtained at these sites during a winter base flow, a spring rainfall event, a summer rainfall event, and a low summer base flow also are presented.

INTRODUCTION

Background

Acid mine drainage, which can degrade stream quality, has commonly been associated with surface mining throughout the coal regions of Pennsylvania. The Pennsylvania Department of Environmental Resources (PaDER) is responsible for maintaining acceptable water quality for both surface- and ground-water systems throughout Pennsylvania. The PaDER, Bureau of Mining and Reclamation, conducts a Cumulative Hydrologic Impact Assessment (CHIA) during their appraisal of mine permits in order to assess possible adverse environmental impacts resulting from existing and anticipated mining operations. The Bureau requires that coal-mine permit applications contain information on the existing water-quality conditions for areas applied.

The time frame associated with the review of mine-permit applications does not allow for extensive collection of water-quality and quantity data once a permit has been requested. Only a limited amount of background data can be collected and evaluated before the Bureau must respond to an application. Therefore, surface water-quality and quantity data bases for basins within the coal regions of Pennsylvania need to be established.

Purpose and Scope

This report presents hydrologic and water-quality data for the Meadow Run basin. This data was collected over a range of hydrologic conditions from December 7, 1987 through November 15, 1988. An in-depth interpretative analysis of these water-quality data is not within the scope of this report.

This information will be incorporated by the Bureau into a CHIA of the Meadow Run basin. CHIA will involve a more detailed interpretative analysis of the basin's geology, biology, and cultural characteristics as well as the water-quality data in this report.

Acknowledgments

The cooperation of Larry Adams and the Ohiopyle State Park is greatly appreciated for granting permission for the installation of the water-quality station on park property for the duration of this study.

DESCRIPTION OF STUDY AREA

Location

Meadow Run basin is located in Fayette County within the Laurel Highlands of Pennsylvania and encompasses a 41.5-square-mile drainage area (fig. 1). This basin is within the U.S. Geological Survey Hydrologic Unit 05020006. The surface-water drainage of the study basin, dominated in the western half by Meadow Run and in the eastern half by Beaver Creek, discharges into the Youghiogheny River at Ohiopyle.

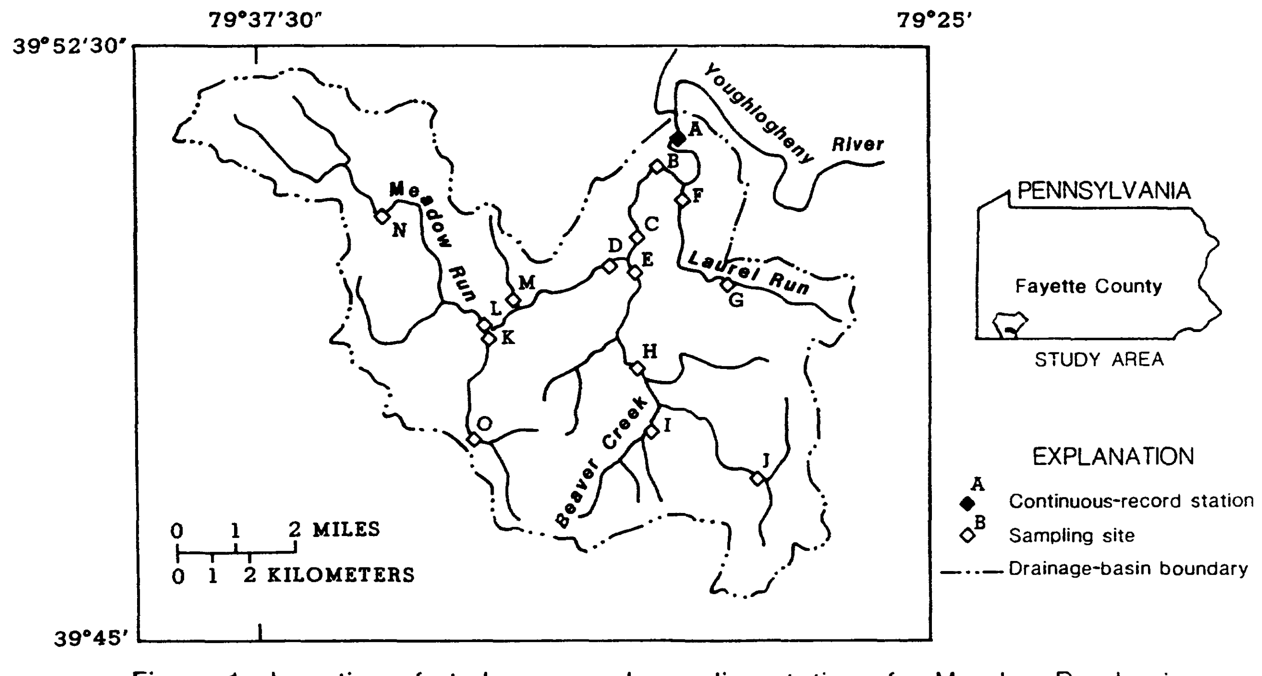

Figure 1.--Location of study area and sampling stations for Meadow Run basin.

Physiography and Geology

Meadow Run is located within the Appalachian Plateau physiographic province. The underlying rock involves the Mauch Chunk formation of the Mississippian system and the Allegheny Group and the Glenshaw formation of the Conemaugh Group of the Pennsylvanian system (Berg and others, 1983; 1980). Mining operations have been performed within the basin on the Lower Kittanning, Clarion/Brookville, and the Upper and Lower Bakerstown coal seams. A clay mining operation also was located within the basin (Pennsylvania Department of Environmental Resources, written commun., 1988).

The lower part of the basin is dominated by narrow valleys and steep to moderate slopes. Basin elevation ranges from 1,150 feet above sea level near the basin outflow to about 2,670 feet at its highest point.

The upper part of the basin has more moderate slopes and wetland areas. A dendritic drainage pattern is well developed in the basin. The irregular channel has an overall length of about 15 miles and a slope averaging 56.7 feet per mile (Shaw, 1984; Shaw and Busch, 1970).

Air Temperature

The temperate climate associated with this study area is representative of the climatic conditions found throughout the Laurel Highlands of Pennsylvania. Air temperatures range from near 32 °F (degrees Fahrenheit) in December, January, and February, to 100 °F in June, July, and August. Although freezing temperatures are common during the winter months, periodic warming trends tend to minimize the development of a persistent snowpack throughout the basin.

Precipitation

Annual precipitation for the Meadow Run area averaged 45.9 inches during the period from 1970-83. Precipitation amounts for this period were measured about 5 miles away from the basin at the Youghiogheny Dam, near Confluence, Pa. (U.S. Department of Commerce, 1970-88). Precipitation for the 11-month period of study was measured about 7 miles from the basin at the Stony Fork Tributary near Gibbon Glade. Precipitation from December 1987 to November 1988 totaled 27.3 inches, 40 percent below normal. The distribution of precipitation for the period of study has been compared with the historic monthly distribution in figure 2. Precipitation at the Meadow Run basin has typically been evenly distributed throughout the year. During the period of study, however, precipitation was unevenly distributed and below normal for all months except November.

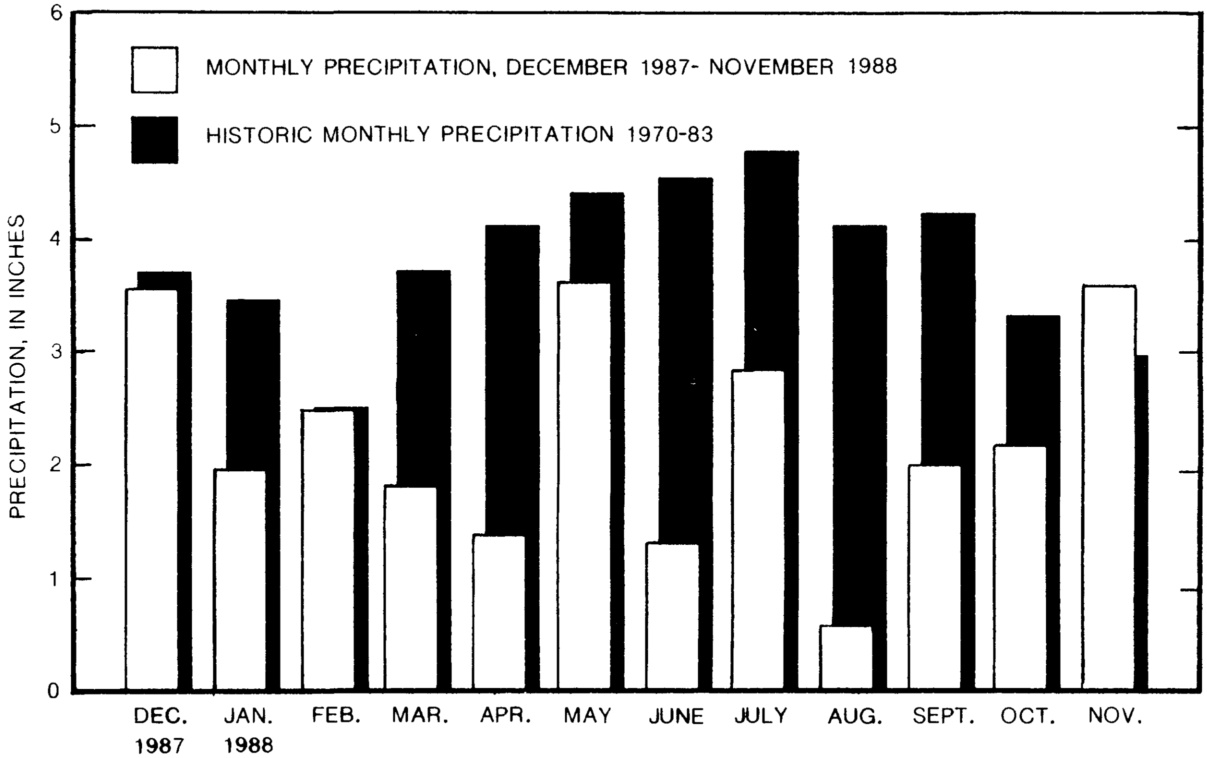

Figure 2.--Distribution of monthly precipitation for Meadow Run basin.

Land Use

Meadow Run basin experiences significant recreational use by area sportsmen. Fort Necessity State Park and part of Ohiopyle State Park lie within the drainage basin. The lower part of the study area is forested while the upper part consists of woodlands interspersed with small farms.

Mining operations, prior to 1977, affected about 1 percent of the total basin. Since then an additional 2.3 percent of the basin has been permitted for surface mining (Pennsylvania Department of Environmental Resources, oral commun., 1989). Although the extent of future surface mining is difficult to predict, additional mine-permit requests are anticipated.

Water Use

No public water-supply systems are located within the Meadow Run basin. Local water sources are private wells utilizing ground water (Pennsylvania Department of Environmental Resources, written commun., 1988).

Meadow Run discharges into the Youghiogheny River at Ohiopyle, Pa., a major recreational resource. Meadow Run has been classified as a High Quality Cold Water Fishery by the PaDER. The Pennsylvania Fish Commission currently stocks trout within certain reaches of Meadow Run (Pennsylvania Department of Environmental Resources, written commun., 1988).

METHODS AND PROCEDURES

Sampling Design

One continuous-record water-quality gaging station was installed near the mouth of Meadow Run. Fourteen partial-record water-quality sampling sites were established throughout the basin. This sampling design provided an opportunity to assess the water quality throughout the drainage basin during a range of hydrologic conditions. The name of each sampling site, its latitude and longitude, and drainage areas, are listed in table 1. The location of each sampling site is shown on figure 1.

Table 1.--Description of sampling sites within Meadow Run basin
[mi^2, square miles]

ID	Station name	Latitude	Longitude	Drainage area(mi^2)
A.	Meadow Run Gaging Station at Ohiopyle	39°51'51"	79°29'43"	41.5
B.	Meadow Run at Ohiopyle State Park Office	39°51'08"	79°29'57"	35.7
C.	Meadow Run at Meadow Run Valley Church	39°50'07"	79°30'29"	34.3
D.	Meadow Run at the confluence of Beaver Creek	39°49'57"	79°30'37"	19.6
E.	Beaver Creek at the confluence of Meadow Run	39°49'57"	79°30'35"	14.6
F.	Laurel Run at the confluence of Meadow Run	39°50'54"	79°29'34"	4.3
G.	Laurel Run headwaters near Sugarloaf Karab	39°49'36"	79°28'51"	2.0
H.	Beaver Creek near Farmington	39°48'30"	79°30'27"	11.1
I.	Noahs Glade near Farmington	39°47'47"	79°30'12"	3.2
J.	Beaver Creek near Flat Rock	39°47'06"	79°28'08"	3.2
K.	Deadman Run near Farmington	39°49'00"	79°33'10"	4.7
L.	Meadow Run at Confluence of Deadman Run	39°49'02"	79°33'08"	11.0
M.	Unnamed Tributary near Farmington	39°49'24"	79°32'43"	0.9
N.	Meadow Run outlet of Deer Lake	39°50'31"	79°35'21"	5.0
O.	Deadman Run headwaters above Oak Lake	39°47'36"	79°36'47"	2.0

The water-quality station at the mouth of Meadow Run was instrumented to provide a continuous record of stream stage, pH, specific conductance, and water temperature. The station was visited monthly for the collection of water-quality samples and discharge measurements. This station was equipped with a water-stage servo-manometer bubble gage, which was coupled with an analog digital recorder (ADR), to measure and record stream stage at 15-minute intervals. A U.S. Geological Survey Minimonitor recorded pH, specific conductance, and temperature at 1-hour intervals (see Craig 1983, and Ficken and Scott, 1983, for a discussion of the operation and maintenance of these instruments).

The partial-record stations were visited four times from December 1987 through November 1988 to collect water-quality samples and discharge measurements during different hydrologic conditions. The continuous-record station also was sampled during these basinwide samplings. All discharge measurements were performed according to U.S. Geological Survey procedures (Rantz and others, 1982). All water-quality samples were collected and preserved according to U.S. Geological Survey procedures (Brown and others, 1970; Skougstad and others, 1979).

The initial basinwide sampling at all stations was done on December 7-8, 1987. This sampling occurred during winter base-flow conditions. The second set of basinwide samples was collected during a spring storm on April 7, 1988, which produced substantial runoff. All water-quality samples were collected along the rising limb of the hydrograph. Samples were again collected basinwide on June 9-10, 1988. This basinwide sampling coincided with a summer rainfall event which occurred June 9. The fourth basinwide sampling was done on August 15-16, 1988 during a late summer base flow. These data represent extremely low base-flow conditions caused by the lack of precipitation to this basin during the summer.

Field Measurements

Field measurements associated with all water-quality sampling included pH, specific conductance, water temperature, and dissolved oxygen. Alkalinity titrations of the monthly samples collected at the continuous-record station were done in the field according to standard U.S. Geological Survey methods (Pickering, R.J., U.S. Geological Survey, written commun., 1981). The alkalinity and acidity values for the partial-record sites were determined by PaDER Water Quality Laboratory titrations. Field pH was measured with an Orion Ionalyzer Model 399A pH meter[1]. A Beckman Solu-Bridge Conductivity Meter[1] was utilized for specific conductance measurements. Water temperature was determined with a certified mercury thermometer. Dissolved oxygen measurements were determined with a Hydrolab Model 4041[1]. All field meters were calibrated daily according to the manufacturers specifications, prior to field measurements.

Sample Preparation

After collection, water-quality samples were divided into splits for various analyses. Splits intended for dissolved constituents were filtered through 0.45 micrometer cellulose nitrate membranes. Splits intended for metal analyses, both total and dissolved, were preserved with nitric acid to reduce the sample pH to 2. Splits for nutrient analyses were preserved with mercuric chloride. All samples were stored on ice until delivered to the PaDER Water Quality Laboratory, usually within 24 to 48 hours after collection. Suspended-sediment samples were delivered for analysis to the U.S. Geological Survey's Pennsylvania Sediment Lab, Harrisburg Office.

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[1] Use of trade names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

Laboratory Schedules

Two PaDER Water Quality Laboratory analysis schedules were developed for this project. Monthly samples collected at the continuous-record station were submitted to the laboratory under lab schedule 432. This schedule included analyses for total and dissolved metals, base cations, major anions, and nutrients. The water-quality samples collected basinwide were submitted for laboratory analyses according to lab schedule 431. This schedule included analysis for total metals, total base cations, and total anions. The constituents and analysis techniques involved with each of these two schedules are listed in table 2.

Table 2.--Analytical techniques and laboratory schedules for water-quality samples

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

Parameter	Code	Schedule	Analysis technique	Detection limit	
Acidity, Total as $CaCO_3$	00435	431,432	Titrimetric	0.1	mg/L
Alkalinity, Total as $CaCO_3$	00410	431,432	Titrimetric	.1	mg/L
Aluminum, Dissolved	01106	432	ICP Emission	50	μg/L
Aluminum, Total	01105	431,432	ICP Emission	50	μg/L
Calcium, Dissolved	00915	432	ICP Emission	.03	mg/L
Chloride, Total	00940	431,432	Ferricyanide	1	mg/L
Iron, Dissolved	01046	432	ICP Emission	10	μg/L
Iron, Total	01045	431,432	ICP Emission	10	μg/L
Magnesium, Dissolved	00925	432	ICP Emission	.01	mg/L
Manganese, Dissolved	01056	432	ICP Emission	10	μg/L
Manganese, Total	01055	431,432	ICP Emission	10	μg/L
Nitrite, Dissolved as N	00613	432	Sulfanilamide	.01	mg/L
Nitrite + Nitrate, Dis. as N	00631	432	Cadmium Reduction	.02	mg/L
pH	00400	431,432	Electrometric	Standard units	
Phosphorus, Diss. Ortho as P	00671	432	Ascorbic Acid	0.01	mg/L
Potassium, Dissolved	00935	432	ICP Emission	0.135	μg/L
Sediment, Suspended	80180	431,432	Filtration	1	mg/L
Sodium, Total	00929	431	ICP Emission	0.2	mg/L
Sodium, Dissolved	00930	432	ICP Emission	0.2	mg/L
Specific Conductance	00095	431,432	Electrometric	1	μS/cm
Sulfate, Total	00945	431,432	Methyl Thymol Blue	10	mg/L
Solids, Suspended	00530	431,432	Glass-Fiber	2	mg/L
Solids, Dissolved	00515	431,432	Evaporation	2	mg/L
Zinc, Dissolved	01090	432	ICP Emission	10	μg/L
Zinc, Total	01092	431,432	ICP Emission	10	μg/L

Quality Assurance and Quality Control

A quality-assurance plan was developed and maintained to assure accurate and consistent laboratory results. Water-quality duplicate samples were collected and submitted for analysis throughout the study to test laboratory consistency. Duplicate water-quality samples collected under identical procedures for two additional CHIA projects during the same period of study were used so a more thorough statistical evaluation of the laboratory analyses could be performed. A Wilcoxon Two-Sample Test was used to compare the duplicate pairs as two independent groups. Results of this test failed to indicate significant differences between groups for any of the constituents. A more precise test of duplicate repeatability also was performed. The differences between duplicate pairs were calculated for each constituent. Ideal consistency would result in a difference of zero for each constituent. A nonparametric Signed-Rank Test was used to test whether the median difference of the duplicate pairs for each constituent was significantly different from zero. The results, shown in table 3, indicate that, at the 95-percent confidence level, there was no significant difference between zero and the median difference of the duplicate pairs for all constituents except sulfate. The median difference between sulfate duplicates was 2 mg/L. Although statistically significant, because one group routinely contained the larger values, this difference was not sufficient to be of practical significance. Therefore, an acceptable degree of laboratory repeatability was concluded.

The routine retrieval and evaluation of preliminary laboratory results identified questionable laboratory samples with questionable results at an early stage. Requests were submitted for the reanalysis of these samples. Depending on the constituents involved, the samples were either reanalyzed or the resulting calculations were checked and recalculated. No sample analyses were discarded because of questionable results.

Table 3.--Comparison of duplicate water-quality sample analyses

[mg/L, milligrams per liter; µg/L, micrograms per liter]

Constituent	Detection limit		Number of samples	Median difference
Acidity, Total as $CaCO_3$	0.1	mg/L	12	0
Alkalinity, Total as $CaCO_3$	.1	mg/L	13	0
Aluminum, Total	50	µg/L	13	12
Calcium, Dissolved	.03	mg/L	2	-2.3
Chloride, Total	1	mg/L	14	0
Iron, Total	10	µg/L	14	-1
Magnesium, Dissolved	.01	mg/L	2	0
Manganese, Total	10	µg/L	14	.5
Nitrite, Dissolved as N	.01	mg/L	2	0
Nitrite + Nitrate, Dissolved	.02	mg/L	2	0
Phosphorus, Diss. Ortho as P	.01	mg/L	2	0
Potassium, Dissolved	.135	mg/L	2	.05
Sodium, Total	.2	mg/L	14	-.5
Sulfate, Total	10	mg/L	14	2
Solids, Suspended	2	mg/L	14	-4
Solids, Dissolved	2	mg/L	14	-2
Zinc, Total	10	µg/L	14	0

Data Analysis

The water-quality data were reviewed and evaluated to ensure accuracy and validity of the laboratory results. These data have been rounded to the appropriate number of significant figures according to U.S. Geological Survey procedures (U.S. Department of Interior, 1976). These laboratory results, the water-quality field measurements, and stream-discharge calculations are presented in a variety of summary statistics. These statistics were performed by procedures outlined in P-STAT, Inc. (1986) and SAS, Inc. (1982). Graphical representation of the data were performed with TELAGRAF procedures (Issco, 1984). Average or mean pH refers to the mean hydrogen ion concentration expressed as a pH value.

STREAMFLOW

Monthly Discharge Records

Routine monthly discharge measurements were made at the continuous-record station on Meadow Run at Ohiopyle. Although 17 discharge measurements were available for determining the stage-discharge relation for this station, only those measurements associated with monthly water-quality samples are listed in table 4 along with their respective water-quality results. A step-backwater analysis also was performed to help define the stage-discharge relation (Davidian, 1984). This relation was computed according to U.S. Geological Survey methods described in Rantz and others (1982). Results of these computations were used to develop an expanded rating table for the stage-discharge relation for the period of study and are listed in table 5. Although the control section, composed of bedrock and large boulders, showed no significant shift during the period of study, the reliability of this rating table for future measurements is dependent on the stability of the control area.

Table 4.--Monthly discharge measurements and water-quality samples at Meadow Run at Ohiopyle

[Deg C, degrees Celsius; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25 Deg C; mg/L, milligrams per liter; µg/L, micrograms per liter; L, Laboratory result; <, less than; double dash indicates no data]

Date	Time	Water temperature, field (Deg C)	Streamflow, instantaneous, field (ft^3/s)	Specific conductance, field (µS/cm)	Oxygen, dissolved, field (mg/L)	pH, field (standard units)	Alkalinity total, field (mg/L as $CaCO_3$)	Acidity, total (mg/L as $CaCO_3$)	Solids at 105 Deg C, dissolved (mg/L)	Solids at 105 Deg C, suspended (mg/L)	Nitrogen, nitrite dissolved (mg/L as N)	Nitrogen, NO_2+NO_3 dissolved (mg/L as N)	Phosphorus ortho, dissolved (mg/L as P)	Calcium, dissolved (mg/L as Ca)
JAN 1988														
11...	1100	0.0	37	43	--	7.1	14 L	10	132	<2	<0.01	0.60	<0.01	11
FEB														
01...	1200	5.0	136	109	--	6.9	14 L	4.0	98	2	<.01	.60	<.01	8.8
MAR														
02...	1315	4.5	72	148	13.5	6.9	5	2.0	88	4	<.01	.50	<.01	10
MAY														
03...	1600	12.0	104	92	11.1	7.1	12	11	62	<2	<.01	.48	<.01	8.5
JUN														
02...	0915	16.0	27	150	13.5	6.8	14	5.0	138	16	<.01	.50	<.01	14
JUL														
06...	1200	19.5	1.8	475	7.0	6.6	8	26	388	48	<.01	.72	<.01	50
AUG														
04...	1000	22.5	1.0	450	10.5	6.2	5	26	358	<2	<.01	.46	<.01	53
SEP														
07...	1100	12.0	11	205	9.8	6.9	24 L	2.0	146	16	<.01	.36	<.01	19
OCT														
05...	1030	10.5	8.2	251	9.5	7.1	22	12	192	8	<.01	.22	<.01	25
NOV														
16...	0845	6.5	69	96	11.6	6.6	14 L	0.0	30	<2	<.01	.32	<.01	7.5

Table 4.--Monthly discharge measurements and water-quality samples at Meadow Run at Ohiopyle--Continued

[Deg C, degrees Celsius; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25 Deg C; mg/L, milligrams per liter; µg/L, micrograms per liter; L, Laboratory result; <, less than; double dash indicates no data]

Date	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, total (mg/L as Cl)	Sulfate, total (mg/L as SO_4)	Iron, total (µg/L as Fe)	Iron, dissolved (µg/L as Fe)	Manganese, total (µg/L as Mn)	Manganese, dissolved (µg/L as Mn)	Zinc, total (µg/L as Zn)	Zinc, dissolved (µg/L as Zn)	Aluminum, total (µg/L as Al)	Aluminum, dissolved (µg/L as Al)	Sediment, suspended, total (mg/L)
JAN 1988														
11...	5.3	4.8	0.97	7.0	53	440	300	790	700	100	70	330	220	1
FEB														
01...	2.7	4.8	.99	11	30	560	100	320	270	40	40	570	70	6
MAR														
02...	3.7	5.0	.91	10	34	470	160	460	450	40	40	450	450	16
MAY														
03...	2.8	3.5	.74	5.0	27	330	330	310	300	40	30	130	<50	3
JUN														
02...	6.6	4.8	1.2	6.0	62	630	50	980	950	<10	<10	440	<50	7
JUL														
06...	27	7.4	1.5	4.0	130	100	80	3,300	3,000	220	220	60	<50	6
AUG														
04...	22	14	2.0	8.0	280	50	30	1,800	1,800	90	90	<50	<50	5
SEP														
07...	5.7	--	--	16	56	850	70	760	710	210	10	440	90	7
OCT														
05...	10	8.1	1.2	12	96	620	30	1,700	1,500	60	60	340	60	4
NOV														
16...	2.2	3.8	0.92	6.0	29	360	320	250	220	40	30	220	190	1

Table 5.--Stage-discharge relation for Meadow Run at Ohiopyle, January - November 1988

[ft^3/s, cubic feet per second]

Gage height (feet)	Discharge (ft^3/s)									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.50	0.47	0.52	0.58	0.63	0.69	0.75	0.82	0.89	0.96	1.0
.60	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
.70	2.2	2.3	2.4	2.5	2.7	2.8	3.0	3.1	3.3	3.5
.80	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.5
.90	5.7	5.9	6.2	6.4	6.7	7.0	7.2	7.5	7.8	8.1
1.00	8.4	8.7	9.0	9.4	9.7	10	10	11	11	12
1.10	12	12	13	13	13	14	14	15	15	16
1.20	16	17	17	18	18	19	19	20	20	21
1.30	21	22	22	23	24	24	25	26	26	27
1.40	27	28	29	29	30	31	32	32	33	34
1.50	34	35	36	36	37	38	39	39	40	41
1.60	41	42	43	44	44	45	46	47	47	48
1.70	49	50	50	51	52	53	53	54	55	56
1.80	56	57	58	59	59	60	61	62	62	63
1.90	64	65	65	66	67	68	69	70	70	71
2.00	72	73	74	75	76	77	78	79	80	81
2.10	81	82	83	84	85	86	88	89	90	91
2.20	92	93	94	95	96	97	98	99	100	101
2.30	102	104	105	106	107	108	109	110	112	113
2.40	114	115	116	118	119	120	122	123	124	126
2.50	127	128	130	131	132	134	135	137	138	140
2.60	141	142	144	145	146	148	149	151	152	154
2.70	155	156	158	159	160	162	163	165	166	168
2.80	169	170	172	173	174	176	177	179	180	182
2.90	183	184	186	187	188	190	191	193	194	196
3.00	197	198	200	201	203	204	206	207	209	210
3.10	212	213	215	217	218	220	221	223	224	226
3.20	227	229	231	232	234	236	237	239	241	242
3.30	244	245	247	249	250	252	254	256	257	259
3.40	261	262	264	266	267	269	271	273	274	276

Table 5.--Stage-discharge relation for Meadow Run at Ohiopyle, January - November 1988--Continued

[ft^3/s, cubic feet per second]

Gage height (feet)	Discharge (ft^3/s)									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
3.50	278	280	281	283	285	287	288	290	292	294
3.60	295	297	299	301	302	304	306	308	310	311
3.70	313	315	317	319	320	322	324	326	328	330
3.80	332	333	335	337	339	341	343	345	347	349
3.90	350	352	354	356	358	360	362	364	366	368
4.00	370	372	374	376	378	380	382	384	386	388
4.10	390	392	394	396	398	400	402	403	405	407
4.20	409	411	413	415	417	419	421	423	425	427
4.30	429	431	433	435	437	439	441	443	445	447
4.40	449	451	453	455	457	459	461	464	466	468
4.50	470	472	474	476	478	480	482	485	487	489
4.60	491	493	495	497	499	502	504	506	508	510
4.70	512	514	517	519	521	523	525	528	530	532
4.80	534	536	539	541	543	545	548	550	552	554
4.90	557	559	561	563	566	568	570	573	575	577
5.00	579	582	584	586	589	591	593	596	598	600
5.10	603	605	607	610	612	614	617	619	622	624
5.20	626	629	631	634	636	638	641	643	646	648
5.30	650	653	655	658	660	663	665	668	670	673
5.40	675	677	680	682	685	687	690	692	695	697
5.50	700	702	705	707	710	712	715	717	720	722
5.60	724	727	729	732	734	737	739	742	744	747
5.70	749	752	754	757	759	762	764	767	769	772
5.80	774	777	779	782	785	787	790	792	795	797

Continuous Discharge Record

The daily mean discharge for Meadow Run at Ohiopyle is listed in table 6. These daily mean values, computed from the continuous stream discharge records, and the daily precipitation record at the Stony Fork Tributary near Gibbon Glade, for the period of study, are illustrated in figure 3. Extremely low flows persisted at Meadow Run during much of the summer as a direct result of the lack of substantial precipitation from mid-May through September. The minimum flow, 0.52 ft^3/s (cubic feet per second), for the period of record occurred August 17, 1988, while the peak flow of 780 ft^3/s, occurred on March 4, 1988.

Because of equipment malfunctions, it was necessary to estimate discharge for the periods of February 14, April 1-6, and April 26, 1988. Discharge also was estimated for periods of low flow from June 6-8 and June 11-14, 1988. Adjustments were then made to the gaging station equipment to account for subsequent low flow conditions. Estimated discharges were computed on the basis of gage height observations, high water marks, field measurements, weather records, and hydrograph comparisons (Kennedy, 1983).

Partial-Record Discharges

The fourteen partial-record sites were visited four times over the course of the project during different hydrologic conditions and events. Discharge measurements were made during each visit. The scope of this study, however, did not permit for a thorough evaluation of the stage-discharge relation at each of these sites. The discharge measurements are listed in tables 11, 12, 13, and 14 along with the respective water-quality data. The fourth basinwide sampling occurred during extremely low base-flow conditions on August 15-16, 1988. Discharges for this event may be viewed more as approximate rather than absolute values. Two stations, Meadow Run at the confluence of Deadman Run (L) and Deadman Run headwaters above Oak Lake (O), were dry during this sampling period.

Table 6.--Daily mean discharge of Meadow Run at Ohiopyle, from February 1 through November 15, 1988

[e, estimated; double dash indicates no data]

Day	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
1	e125	71	e71	192	39	2.2	1.7	5.0	11	27
2	220	74	e67	154	40	2.1	1.6	3.4	9.5	27
3	229	121	e65	127	34	2.1	1.4	2.5	13	28
4	216	542	e91	110	28	2.0	1.2	36	10	27
5	155	376	e84	152	22	2.0	1.1	38	8.2	92
6	121	234	e77	204	e17	1.8	4.4	20	8.1	164
7	116	172	199	167	e15	1.6	3.5	10	7.8	117
8	114	138	197	139	e13	1.6	2.3	5.9	6.7	91
9	98	124	159	123	49	1.5	1.6	4.1	6.2	77
10	87	124	131	133	32	1.4	1.3	3.2	6.0	70
11	78	106	111	113	e22	3.1	1.1	2.9	9.4	67
12	75	94	97	99	e16	3.2	.97	2.6	10	57
13	59	116	86	90	e12	2.2	.91	23	7.3	104
14	e60	103	78	85	e9.0	1.9	.70	54	6.1	117
15	72	93	70	78	7.3	1.8	.71	19	5.8	92
16	81	88	61	71	6.4	1.5	.76	9.5	5.7	--
17	68	84	54	62	6.0	1.5	.59	40	5.7	--
18	71	82	86	95	5.8	1.3	.62	59	9.5	--
19	106	82	98	240	5.0	1.6	4.3	30	19	--
20	205	81	85	220	4.5	6.4	13	30	13	--
21	167	76	80	171	4.2	15	6.5	31	12	--
22	131	76	73	139	3.8	11	3.2	17	73	--
23	124	113	74	113	3.6	13	5.3	19	158	--
24	111	180	135	165	3.3	13	18	28	157	--
25	96	149	104	125	3.1	5.4	9.6	79	118	--
26	87	215	e93	102	2.9	3.5	4.5	74	83	--
27	82	172	85	90	2.8	2.7	2.9	44	64	--
28	74	128	86	77	2.6	2.3	2.5	26	54	--
29	71	102	207	64	2.5	2.1	49	17	46	--
30	--	86	263	55	2.3	1.8	30	13	37	--
31	--	76	--	47	--	1.6	9.7	--	30	--
TOTAL	3,299	4,278	3,167	3,802	414	114	185	746	1,010	--
MEAN	114	138	106	123	13.8	3.68	5.97	24.9	32.6	--
MAX	229	542	263	240	49	15	49	79	158	--
MIN	59	71	54	47	2.3	1.3	.59	2.5	5.7	--

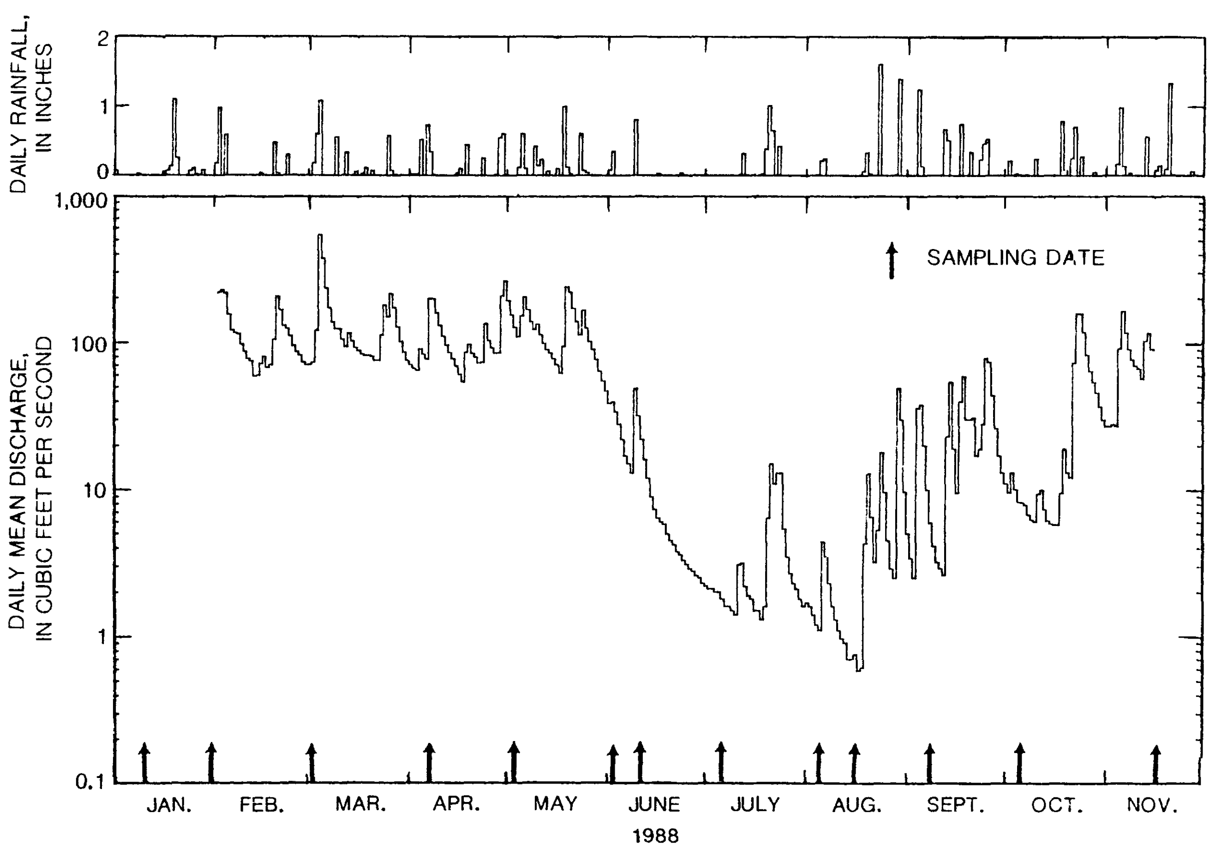

Figure 3.--Continuous stream discharge for Meadow Run at Ohiopyle and daily precipitation at Stony Fork Tributary near Gibbon Glade.

WATER QUALITY

<u>Monthly Water-Quality Samples</u>

The chemical analyses for the monthly water-quality samples collected at Meadow Run at Ohiopyle, including both field and laboratory analyses, are listed in table 4. These water-quality results appeared fairly consistent throughout the study period as they generally reflected seasonal base-flow conditions. Summary statistics of these results are listed in table 7.

The two water-quality samples collected during the extremely low base-flow conditions of July and August recorded the maximum total and dissolved manganese and zinc concentrations. The maximum concentration of several of the base cations also were associated with these samples. Conversely, total and dissolved iron and aluminum concentrations were observed to be at or near their minimum during these same monthly samples.

Table 7.--Summary of the monthly water-quality sampling of Meadow Run at Ohiopyle, from January - November, 1988

[Deg C, degrees Celsius; ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25 Deg C; mg/L, milligrams per liter; µg/L, micrograms per liter; <, less than]

Parameter	N	Median	Mean	Minimum	Maximum	Units
Water Temperature	10	11.2	10.9	0	22.5	Deg C
Stream Discharge	10	42	46.7	1.0	136	ft^3/s
Specific Conductance	10	149	201.9	43	475	µS/cm
Dissolved Oxygen	10	11.4	10.8	7.0	13.5	mg/L
pH	10	6.9	6.8	6.2	7.1	standard
Alkalinity, Total	10	14	13.2	5	24	mg/L
Acidity, Total	10	7.5	9.8	0	26	mg/L
Solids, Dissolved	10	135	163.2	30	388	mg/L
Solids, Suspendeded	10	3	9.8	<2	48	mg/L
Nitrite, Dissolved	10	<.01	<.01	<.01	<.01	mg/L
Nitrite+Nitrate, Dis.	10	.49	.48	.22	.72	mg/L
Phosphorus, Ortho	10	<.01	<.01	<.01	<.01	mg/L
Calcium, Dissolved	10	12.5	20.7	7.5	53	mg/L
Magnesium, Dissolved	10	5.5	8.8	2.2	27	mg/L
Sodium, Total	10	4.8	5.6	3.5	14	mg/L
Potassium, Dissolved	10	.99	1.0	.74	2.0	mg/L
Chloride, Total	10	7.5	8.5	4.0	16	mg/L
Sulfate, Total	10	54.5	80	27	280	mg/L
Iron, Total	10	455	441	50	850	µg/L
Iron, Dissolved	10	90	147	30	330	µg/L
Manganese, Total	10	775	1,067	250	3,300	µg/L
Manganese, Dissolved	10	705	990	220	3,000	µg/L
Zinc, Total	10	50	84.5	<10	220	µg/L
Zinc, Dissolved	10	40	59.5	<10	220	µg/L
Aluminum, Total	10	335	300	<50	570	µg/L
Aluminum, Dissolved	10	65	118	<50	450	µg/L
Sediment, Suspended	10	5.5	5.7	1	16	mg/L

Continuous Water-Quality Record

The station on Meadow Run at Ohiopyle recorded pH, specific conductance, and water temperature at 1-hour intervals from January 14 to November 15, 1988. These hourly data were used to calculate daily mean values, which are listed in tables 8, 9, and 10. The hourly pH values were first converted to hourly hydrogen ion concentrations. Daily mean concentrations were then calculated and these values were converted back to pH. The daily mean values, for the period of study, also are shown in figure 4. Periods of missing record were a result of equipment malfunctions. Water-quality data were not estimated for these missing periods.

Partial-Record Water Quality

Water-quality results from the four basinwide samplings are listed by event in tables 11, 12, 13, and 14. These results include both field and laboratory analyses. Water-quality samples were collected over a range of hydrologic conditions during the 1988 water year. The first sampling event reflects winter base-flow conditions. The second sampling was done during a spring rainfall event which produced substantial runoff. The third sampling event occurred during a summer rainfall event. Dry conditions present throughout the basin at this time reduced runoff from this event. Water-quality samples from June 9 were collected along the rise of the hydrograph, while those collected on June 10 were from the recession side of the hydrograph. The fourth sampling event reflects extremely low base-flow conditions which persisted throughout this basin during mid to late summer.

The most pronounced observation obtained from the basinwide base-flow samplings was the elevated metal concentrations associated with Laurel Run (F) at the confluence with Meadow Run. This station was located downstream from an area disturbed by mining activities. These conditions were less pronounced but still observed during storm flows. The contribution of mining activities may be somewhat assessed by comparing these data with the Laurel Run headwaters station (station G, figure 1) located above all mining activities.

SUMMARY

Meadow Run basin, located in Fayette County, Pa., was selected for this study because future mine-permit applications for areas within this basin were anticipated. In an effort to document existing surface water conditions, a streamflow and water-quality assessment of the entire basin was done from December 1987 to November 1988. Two rainfall events, one occurring in the spring and the second during early summer, were sampled throughout the basin as part of this assessment. Two sets of base-flow conditions also were documented, one during winter and the other in summer.

Precipitation to this area was 40 percent below normal for the 11-month period of study. As a result, extremely low base-flow conditions were found to persist during mid to late summer throughout the basin and were well documented. The minimum flow of 0.52 ft^3/s, for the period of study occurred on August 17, 1988, one day after the final basinwide sampling. Peak flow for the period of record, 780 ft^3/s, occurred on March 4, 1988.

Stream quality at points downstream of areas disturbed by mining revealed elevated metal concentrations. However, the complexity of a basin, including its geology, and the extent of all previous mining must be considered in great detail to improve the interpretation of the available water-quality data.

Table 8.--Daily mean pH of Meadow Run at Ohiopyle, from January 14 through September 13, 1988

[double dash indicates no data]

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1	--	7.0	6.9	6.7	7.1	6.8	6.8	6.2	7.1
2	--	6.9	6.9	6.7	7.1	6.8	6.6	6.2	7.1
3	--	6.8	7.0	6.7	--	6.9	6.5	6.3	6.8
4	--	6.7	6.5	6.7	7.0	7.0	6.5	6.1	6.9
5	--	6.6	6.2	6.6	6.9	6.9	6.5	--	7.0
6	--	6.6	6.2	6.7	6.8	7.0	--	--	6.9
7	--	6.6	6.2	7.0	6.7	7.2	6.7	--	--
8	--	6.6	6.3	6.9	6.7	7.3	6.5	--	6.9
9	--	6.7	6.4	6.9	6.6	7.1	6.4	--	7.1
10	--	6.8	6.6	7.0	6.6	--	6.2	--	7.1
11	--	6.9	6.6	7.0	6.5	7.0	6.1	--	7.1
12	--	6.9	6.6	7.0	6.7	7.0	5.8	--	6.8
13	--	6.8	6.6	7.1	6.8	7.1	6.0	--	6.7
14	7.1	6.8	6.6	7.1	6.7	--	6.4	--	--
15	7.1	6.8	6.5	7.1	6.7	7.1	6.5	--	--
16	7.1	6.9	6.6	7.1	6.7	7.1	6.6	--	--
17	7.0	6.9	6.6	7.1	6.6	7.1	6.4	--	--
18	--	6.9	6.6	7.1	6.6	7.2	6.3	--	--
19	--	7.0	6.6	7.1	6.6	7.2	6.4	--	--
20	6.8	6.9	6.6	7.1	6.6	7.0	6.3	--	--
21	6.8	6.8	6.6	7.1	6.6	7.0	7.2	--	--
22	6.8	6.7	6.7	7.2	6.5	7.1	7.4	--	--
23	6.8	6.8	6.7	7.4	6.5	7.1	7.3	--	--
24	6.9	6.7	6.7	7.3	6.7	7.1	7.2	6.3	--
25	6.9	6.8	6.6	7.2	6.7	7.0	7.1	7.3	--
26	6.9	6.8	6.7	7.2	6.7	7.0	7.0	7.2	--
27	6.8	6.8	6.6	7.2	6.7	7.0	6.9	7.1	--
28	6.9	6.8	6.6	7.2	6.7	6.9	6.7	7.0	--
29	6.9	6.8	6.6	7.2	6.8	7.0	6.6	7.1	--
30	6.9	--	6.7	7.1	6.9	6.9	6.6	7.2	--
31	6.9	--	6.7	--	6.9	--	6.4	7.2	--
MEAN	6.9	6.9	6.6	7.0	6.7	7.0	6.6	6.8	7.0
MAX	7.1	7.0	7.0	7.4	7.1	7.3	7.4	7.3	7.1
MIN	6.8	6.6	6.2	6.6	6.5	6.8	5.8	6.1	6.7

Table 9.--Daily mean specific conductance of Meadow Run at Ohioplyle, from January 14 through November 4, 1988

[microsiemens per centimeter at 25 Deg C; double dash indicates no data]

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
1	--	109	126	127	84	192	428	468	306	226	156
2	--	110	137	131	87	180	446	542	324	242	162
3	--	102	140	134	--	160	455	466	344	242	164
4	--	102	105	133	99	154	454	--	304	234	174
5	--	101	91	125	102	--	457	--	223	--	--
6	--	101	94	132	93	--	--	--	210	251	--
7	--	102	100	117	95	--	441	--	--	240	--
8	--	102	104	98	99	--	450	--	247	237	--
9	--	102	--	96	104	--	460	--	274	249	--
10	--	104	127	99	107	--	468	--	305	269	--
11	--	107	131	104	104	--	522	--	324	292	--
12	--	108	134	105	106	--	461	--	343	224	--
13	--	110	129	108	107	--	425	--	358	231	--
14	136	109	127	114	114	--	466	--	--	249	--
15	159	113	127	117	122	244	494	--	196	268	--
16	164	117	133	120	128	250	500	682	217	278	--
17	166	120	140	123	134	265	462	697	215	279	--
18	150	122	143	122	140	266	468	686	173	295	--
19	140	122	150	106	127	277	496	657	181	191	--
20	86	122	151	107	128	285	507	387	205	216	--
21	99	118	155	104	133	301	260	395	198	226	--
22	105	115	157	103	140	314	251	431	209	213	--
23	107	115	151	122	152	320	310	463	236	141	--
24	107	115	116	102	154	335	224	403	228	137	--
25	108	116	112	103	153	292	287	374	195	133	--
26	107	117	114	105	156	290	307	381	171	137	--
27	109	120	110	106	163	303	319	361	173	141	--
28	115	122	112	111	171	356	303	369	177	144	--
29	112	124	115	103	180	449	337	331	195	146	--
30	109	--	120	86	191	425	409	281	212	151	--
31	109	--	124	--	199	--	453	288	--	154	--
MEAN	--	112	130	112	129	--	411	--	241	214	--
MAX	--	124	157	134	199	--	522	--	358	295	--
MIN	--	101	91	86	84	--	224	--	171	133	--

Table 10.--Daily mean water temperature of Meadow Run at Ohiopyle, from January 14 through November 4, 1988

[double dash indicates no data]

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
1	--	5.0	3.0	13.5	9.0	18.5	14.0	22.0	17.5	14.5	5.0
2	--	6.5	3.5	14.0	10.5	17.0	15.0	22.0	18.0	14.5	5.5
3	--	5.5	5.5	14.5	--	13.5	16.5	23.0	18.5	14.0	5.5
4	--	5.0	5.5	15.0	11.0	10.5	18.0	22.0	19.5	12.5	7.5
5	--	3.0	5.0	14.5	11.5	11.5	19.5	23.5	17.5	--	--
6	--	1.0	6.0	14.5	12.0	16.5	--	24.0	15.0	9.5	--
7	--	1.0	7.0	12.0	13.0	18.5	21.0	24.0	--	9.0	--
8	--	1.0	7.5	11.0	14.5	18.0	21.5	23.5	14.5	8.5	--
9	--	1.5	--	9.5	15.5	17.5	21.5	23.0	15.0	8.5	--
10	--	2.5	7.5	10.0	15.5	--	21.0	23.0	16.0	9.5	--
11	--	2.5	6.0	10.5	14.5	12.5	22.5	22.0	16.5	9.5	--
12	--	2.0	7.0	10.5	14.0	14.0	24.0	22.5	17.0	8.0	--
13	--	1.0	7.5	11.0	16.0	18.5	23.5	23.0	19.0	6.0	--
14	1.0	1.0	4.0	11.0	17.0	--	24.0	23.0	14.5	5.0	--
15	1.0	1.0	2.5	10.0	17.5	22.0	24.0	23.0	11.0	7.0	--
16	1.0	1.5	2.0	8.0	19.0	22.0	23.0	24.0	10.5	9.0	--
17	1.0	2.0	3.5	9.5	19.0	22.0	23.5	24.0	11.5	11.0	--
18	1.0	3.5	3.0	10.5	16.0	20.0	23.0	24.5	12.5	12.0	--
19	1.0	3.5	4.0	9.0	15.0	20.5	23.5	24.0	13.5	10.0	--
20	3.5	4.5	4.0	9.0	14.5	21.5	24.5	22.5	14.0	8.5	--
21	4.5	2.0	3.5	10.0	14.5	23.0	24.0	21.5	12.0	8.0	--
22	3.0	2.5	3.5	9.5	15.5	23.5	24.0	20.0	12.5	7.5	--
23	2.5	4.0	6.0	11.5	16.5	23.0	22.5	20.0	13.0	9.0	--
24	3.5	2.0	9.0	10.0	16.5	20.5	22.0	20.5	11.5	9.0	--
25	3.5	1.5	10.0	10.0	14.0	21.5	22.5	19.5	10.5	8.0	--
26	1.0	1.5	11.0	11.0	12.5	22.5	22.5	19.5	11.0	7.0	--
27	1.0	2.5	8.5	11.0	14.0	18.5	22.0	20.0	10.5	5.5	--
28	1.0	2.5	8.0	9.0	15.5	18.0	22.5	21.0	10.5	6.5	--
29	1.0	3.0	10.0	7.5	16.0	18.5	23.5	20.5	11.5	5.5	--
30	1.0	--	11.0	8.5	17.0	16.0	23.0	19.0	11.0	5.0	--
31	1.5	--	11.5	--	18.5	--	22.0	18.0	--	4.0	--
MEAN	--	2.5	6.2	10.8	14.9	18.5	21.8	22.0	14.0	8.7	--
MAX	--	6.5	11.5	15.0	19.0	23.5	24.5	24.5	19.5	14.5	--
MIN	--	1.0	2.0	7.5	9.0	10.5	14.0	18.0	10.5	4.0	--

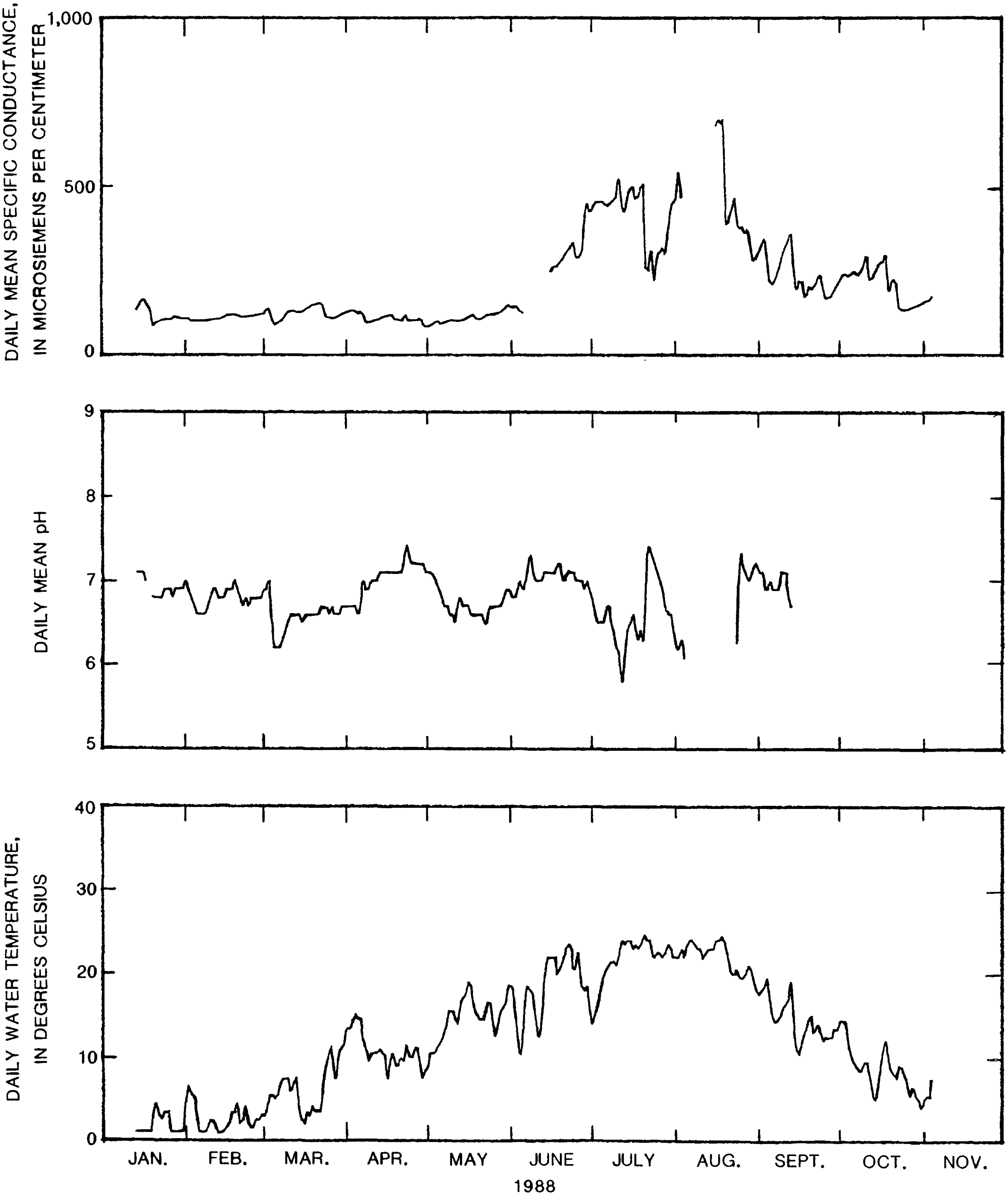

Figure 4.--Daily mean pH, specific conductance, and water temperature for Meadow Run at Ohiopyle.

Table 11.--Results of the winter base flow sampling of Meadow Run basin on December 7-8, 1987

[Deg C, degrees Celsius; ft^3/s, cubic feet per second; μS/cm, microsiemens per centimeter at 25 Deg C; mg/L, milligrams per liter; μg/L, micrograms per liter; <, less than]

Site	Date	Time	Water temper- ature field (Deg C)	Stream- flow instan- taneous, field (ft^3/s)	Spe- cific con duct- ance, field (μS/cm)	pH, field (Stand- ard units)	Alka- linity, total (mg/L as $CaCO_3$)	Acid- ity, total (mg/L as $CaCO_3$)	Solids at 105 Deg C, dis- solved (mg/L)	Solids at 105 Deg C, sus- pended (mg/L)	Sodium, total (mg/L as Na)	Chlo- ride, total (mg/L as Cl)	Sulfste, total (mg/L as SO_4)	Iron, total (μg/L as Fe)	Manga- nese, total (μg/L as Mn)	Zinc, total (μg/L as Zn)	Alum- inum, total (μg/L as Al)
A	120787	1310	2.0	73	130	6.8	14	0	70	<2	3.5	9.0	33	340	350	20	470
B	120787	0930	.5	68	90	6.9	14	0	56	<2	4.9	10	12	160	33	<10	120
C	120787	1100	1.0	60	95	6.9	14	0	40	<2	5.2	11	<10	150	22	<10	150
D	120787	1200	1.5	35	100	6.9	14	0	<2	<2	3.6	11	<10	230	48	<10	190
E	120787	1250	2.0	25	75	6.8	14	0	24	<2	3.5	7.0	<10	120	38	10	110
F	120787	1115	3.0	7.4	390	5.7	8	26	308	<2	7.4	3.0	180	2,700	4,100	190	2,800
G	120787	1415	5.0	2.6	90	7.3	32	0	28	<2	1.0	2.0	<10	70	<10	<10	70
H	120787	1000	1.5	20	80	6.9	16	0	44	<2	3.4	7.0	<10	250	29	<10	150
I	120787	0825	2.5	7.8	85	6.5	10	0	42	<2	6.2	12	<10	150	100	20	320
J	120787	1520	5.0	4.7	85	6.9	20	0	58	<2	3.3	6.0	<10	150	37	<10	270
K	120787	1400	3.0	8.7	130	7.0	18	0	56	<2	6.0	16	<10	280	67	10	230
L	120787	1400	1.5	21	100	6.8	12	0	58	<2	8.1	13	<10	290	99	180	350
M	120887	0820	3.0	1.6	90	7.1	22	0	22	<2	0.74	2.0	16	150	<10	<10	150
N	120887	1020	1.5	8.7	60	6.7	12	0	<2	<2	1.6	4.0	<10	340	100	<10	<50
O	120887	0935	5.5	3.0	85	6.6	10	0	30	<2	5.4	11	<10	130	110	<10	260

Table 12.--Results of the spring storm sampling of Meadow Run basin on April 7, 1988

[Deg C, degrees Celsius; ft^3/s, cubic feet per second; μS/cm, microsiemens per centimeter at 25 Deg C; mg/L, milligrams per liter; μg/L, micrograms per liter; <, less than]

Site	Date	Time	Water temperature, field (Deg C)	Streamflow, instantaneous, field (ft^3/s)	Specific conductance, field (μS/cm)	Oxygen, dissolved, field (mg/L)	pH, field (standard units)	Alkalinity, total (mg/L as $CaCO_3$)	Acidity, total (mg/L as $CaCO_3$)	Solids at 105 Deg C, dissolved (mg/L)	Solids at 105 Deg C, suspended (mg/L)	Sodium, total (mg/L as Na)	Chloride, total (mg/L as Cl)	Sulfate, total (mg/L as SO_4)	Iron, total (μg/L as Fe)	Manganese, total (μg/L as Mn)	Zinc, total (μg/L as Zn)	Aluminum, total (μg/L as Al)	Sediment, Suspended (mg/L)
A	040788	1500	9.5	233	100	11.7	6.9	16	0	64	20	4.4	8.0	28	1,600	310	50	1,300	33
B	040788	1400	9.5	245	83	11.4	6.5	16	0	36	38	4.6	9.0	26	1,600	130	40	710	38
C	040788	1500	10.0	215	83	8.8	7.2	16	0	38	42	4.3	11	18	1,100	98	40	1,200	26
D	040788	1400	10.0	114	78	8.9	7.0	24	0	70	4	5.0	11	20	1,500	120	40	1,300	28
E	040788	1430	9.0	101	65	8.9	7.1	16	0	42	<2	2.7	6.0	19	910	91	50	1,200	28
F	040788	0900	8.5	40	264	12.3	6.6	10	26	186	<2	4.5	3.0	110	1,900	2,600	180	3,300	51
G	040788	0920	8.0	14	65	11.7	7.1	24	0	50	<2	0.9	2.0	21	490	59	30	450	24
H	040788	1300	8.5	41	75	11.8	6.9	16	0	50	18	3.6	6.0	20	1,100	130	30	1,000	35
I	040788	1155	8.0	23	61	11.6	6.5	10	26	34	26	6.2	11	21	1,200	180	50	1,200	54
J	040788	1111	8.0	31	80	11.3	6.8	18	0	30	44	3.8	6.0	25	850	110	30	2,200	50
K	040788	1100	10.0	24	120	8.5	7.2	26	0	46	34	9.2	16	20	1,500	200	30	1,700	30
L	040788	1020	10.0	74	85	9.0	6.9	16	0	50	30	5.8	12	22	2,000	160	30	1,700	35
M	040788	0945	8.5	7.4	87	10.3	7.3	26	0	106	46	0.9	2.0	16	2,400	75	30	2,500	47
N	040788	1300	14.5	22	56	7.8	7.2	12	0	120	<2	1.7	4.0	18	560	210	20	160	2
O	040788	1145	8.5	15	82	9.0	6.6	10	24	40	30	7.1	12	18	1,200	210	50	1,600	29

Table 13.--Results of the summer sampling of Meadow Run basin on June 9-10, 1988

[Deg C, degrees Celsius; ft^3/s, cubic feet per second; μS/cm, microsiemens per centimeter at 25 Deg C; mg/L, milligrams per liter; μg/L, micrograms per liter; <, less than; double dash indicates no data]

Site	Date	Time	Water temperature, field (Deg C)	Streamflow, instantaneous, field (ft^3/s)	Specific conductance, field (μS/cm)	Oxygen, dissolved, field (mg/L)	pH, field (standard units)	Alkalinity, total (mg/L as $CaCO_3$)	Acidity, total (mg/L as $CaCO_3$)	Solids at 105 Deg C, dissolved (mg/L)	Solids at 105 Deg C, suspended (mg/L)	Sodium, total (mg/L as Na)	Chloride, total (mg/L as Cl)	Sulfate, total (mg/L as SO_4)	Iron, total (μg/L as Fe)	Manganese, total (μg/L as Mn)	Zinc, total (μg/L as Zn)	Aluminum, total (μg/L as Al)	Sediment, Suspended (mg/L)
A	061088	1155	12.5	32	160	9.1	7.1	18	0	124	6	6.3	8.0	50	740	850	30	450	12
B	060988	0930	15.0	28	80	--	7.0	20	0	46	16	3.0	6.0	20	420	40	<10	260	13
C	060988	1035	14.5	28	81	--	7.3	20	0	56	20	3.0	6.0	16	880	93	10	420	14
D	060988	1055	14.5	16	100	--	7.3	22	0	80	8	4.3	8.0	21	620	68	<10	170	15
E	060988	1105	14.0	12	68	--	7.3	20	0	46	22	2.3	4.0	15	950	95	20	890	24
F	061088	1110	10.5	3.6	750	9.6	5.9	10	22	772	46	23	3.0	460	5,100	13,000	640	6,100	39
G	061088	1025	9.5	1.3	85	9.9	7.4	40	0	64	6	1	3.0	21	110	<10	<10	60	6
H	060988	1640	13.5	15	87	8.7	7.2	20	0	62	22	5.3	7.0	18	860	66	30	1,000	23
I	060988	1520	13.0	3.7	83	8.7	6.8	14	4.0	54	12	6.4	11	15	600	100	10	400	15
J	060988	1600	14.0	5.0	92	8.3	7.1	22	0	64	34	6.8	8.0	18	830	81	10	1,100	33
K	060988	1325	17.0	5.8	138	8.4	7.1	32	0	112	50	7.8	13	18	2,520	320	30	2,200	49
L	060988	1255	15.0	9.9	97	9.4	7.1	16	0	76	6	6.8	13	15	920	98	10	430	13
M	060988	1150	13.0	.68	180	--	7.4	50	0	120	12	0.9	3.0	41	920	33	20	400	16
N	061088	0935	18.5	2.5	52	8.7	7.0	14	4.0	44	2	1.4	4.0	13	540	59	<10	50	3
O	060988	1440	13.5	1.6	82	8.9	6.8	8	10	48	16	5.0	9.0	14	570	200	10	670	16

Table 14.--Results of the low base flow sampling of Meadow Run basin on August 15-16, 1988

[Deg C, degrees Celsius; ft^3/s, cubic feet per aecond; µS/cm, microsiemens per centimeter at 25 Deg C; mg/L, milligrams per liter; µg/L, micrograms per liter; <,less than; double dash indicates no data]

Site	Date	Time	Water temperature, field (Deg C)	Streamflow, instantaneous, field (ft^3/s)	Specific conductance, field (µS/cm)	Oxygen, dissolved, field (mg/L)	pH, field (standard units)	Alkalinity, total (mg/L aa $CaCO_3$)	Acidity, total (mg/L as $CaCO_3$)	Solids at 105 Deg C, dissolved (mg/L)	Solids at 105 Deg C, suspended (mg/L)	Sodium, total (mg/L as Na)	Chloride, total (mg/L as Cl)	Sulfate, total (mg/L as SO_4)	Iron, total (µg/L as Fe)	Manganese, total (µg/L as Mn)	Zinc, total (µg/L as Zn)	Aluminum, total (µg/L as Al)
A	081588	0945	25.5	0.68	655	7.6	5.5	8	24	484	<2	14	5.0	350	150	3,500	270	240
B	081588	1250	28.0	.17	128	6.9	7.2	36	0	84	4	4.2	8.0	25	90	36	10	90
C	081588	1325	25.0	.22	116	7.0	7.1	32	0	80	4	3.5	7.0	22	200	45	20	160
D	081588	1400	24.5	.01	189	4.9	6.8	34	0	138	6	6.0	16	32	260	210	30	110
E	081588	1415	24.5	.62	118	7.8	7.3	38	0	86	<2	3.6	6.0	17	300	20	20	160
F	081688	0835	18.5	.50	1,220	9.3	3.5	0	90	1,020	32	21	3.0	700	14,000	12,000	550	4,400
G	081588	1455	20.5	.34	123	8.3	7.3	52	0	106	10	1.0	2.0	27	640	<10	<10	300
H	081688	0935	19.0	.18	128	8.3	7.2	54	0	76	<2	3.8	5.0	19	110	44	<10	150
I	081688	1000	18.0	<.01	95	6.2	6.6	20	0	78	4	5.6	12	19	420	300	10	150
J	081588	1545	23.0	.03	147	7.2	7.2	66	0	132	2	4.5	4.0	16	240	110	<10	140
K	081688	1130	21.0	.05	309	4.8	7.4	78	0	202	10	20	36	25	500	670	<10	220
L	081688	--	--	.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
M	081688	1230	20.5	.11	382	8.2	7.6	92	0	282	18	1.3	3.0	110	430	38	10	260
N	081688	1047	22.0	<.01	242	4.9	6.8	62	0	86	84	1.7	6.0	20	31,000	7,100	<10	120
O	081688	--	--	.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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