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Ohio Department of Natural Resources, Division of Water,
Department of Transportation, and the
U.S. Department of Transportation, Federal Highway Administration

Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio

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U.S. Geological Survey

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16. Abstract

This report provides equations for estimating mean annual streamflow, mean monthly streamflows, harmonic mean streamflow, and streamflow quartiles (the 25th-, 50th-, and 75th-percentile streamflows) as a function of selected basin characteristics for rural, unregulated streams in Ohio. The equations were developed from streamflow statistics and basin-characteristics data for as many as 219 active or discontinued streamflow-gaging stations on rural, unregulated streams in Ohio with 10 or more years of homogenous daily streamflow record. Streamflow statistics and basin-characteristics data for the 219 stations are presented in this report.

Simple equations (based on drainage area only) and best-fit equations (based on drainage area and at least two other basin characteristics) were developed by means of ordinary least-squares regression techniques. Application of the best-fit equations generally involves quantification of basin characteristics that require or are facilitated by use of a geographic information system. In contrast, the simple equations can be used with information that can be obtained without use of a geographic information system; however, the simple equations have larger prediction errors than the best-fit equations and exhibit geographic biases for most streamflow statistics. The best-fit equations should be used instead of the simple equations whenever possible.

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CONVERSION FACTORS AND ABBREVIATIONS

Multiply	By	To obtain
Length		
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
Area		
acre	0.4047	hectare
square foot (ft^2)	0.0929	square meter
square mile (mi^2)	2.590	square kilometer
Volume		
acre-foot (acre-ft)	1,233	cubic meter
cubic foot (ft^3)	28.32	liter
cubic foot (ft^3)	0.02832	cubic meter
million gallons (Mgal)	3,785	cubic meter
Flow rate		
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
million gallons per day (Mgal/d)	0.04381	cubic meter per second

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ABSTRACT

This report provides equations for estimating mean annual streamflow, mean monthly streamflows, harmonic mean streamflow, and streamflow quartiles (the 25th-, 50th-, and 75th-percentile streamflows) as a function of selected basin characteristics for rural, unregulated streams in Ohio. The equations were developed from streamflow statistics and basin-characteristics data for as many as 219 active or discontinued streamflow-gaging stations on rural, unregulated streams in Ohio with 10 or more years of homogenous daily streamflow record. Streamflow statistics and basin-characteristics data for the 219 stations are presented in this report.

Simple equations (based on drainage area only) and best-fit equations (based on drainage area and at least two other basin characteristics) were developed by means of ordinary least-squares regression techniques. Application of the best-fit equations generally involves quantification of basin characteristics that require or are facilitated by use of a geographic information system. In contrast, the simple equations can be used with information that can be obtained without use of a geographic information system; however, the simple equations have larger prediction errors than the best-fit equations and exhibit geographic biases for most streamflow statistics. The best-fit equations should be used instead of the simple equations whenever possible.

INTRODUCTION

The U.S. Geological Survey (USGS) has operated continuous-record streamflow-gaging stations in Ohio since 1898. Statistics of long-term streamflow data collected at these gaging stations frequently are used to guide the design and operation of hydraulic structures and water- and wastewater-treatment facilities.

Streamflow data are available for a relatively small number of streams and stream locations around the State. Consequently, methods for estimating streamflow statistics are needed to answer questions about design and operation of hydraulic structures and water- and wastewater-treatment facilities where streamflow measurements are lacking. To meet this need, the USGS, in cooperation with the Ohio Department of Natural Resources, Division of Water, and the Ohio Department of Transportation, did a study to compute or compile selected streamflow statistics and to develop equations for estimating those statistics as a function of selected basin characteristics.

Purpose and Scope

The purpose of this report is to (1) present statistics of mean annual streamflow, mean monthly streamflows, harmonic mean streamflow, and the 25th-, 50th-, and 75th-percentile (quartile) streamflows for all active and discontinued rural, unregulated[1] streamflow-gaging stations in Ohio with 10 or more years of homogenous daily streamflow record and (2) present equations from which those streamflow statistics can be estimated as a function of selected basin characteristics.

Data from 219 streamflow-gaging stations were used to develop equations for estimating mean annual streamflow

[1]In this report, "unregulated" refers to the absence of appreciable direct human influence on the streamflow statistic being considered. Streamflow at a given gaging station may be unregulated with respect to one or more streamflow statistics and regulated with respect to others.

as a function of drainage area only. Data from 215 stations were used to develop the best-fit equations for estimating mean annual streamflow. Depending on the streamflow statistic being considered and the combination of explanatory variables used, data from 109 to 129 stations were used to develop equations for estimating mean monthly streamflows, harmonic mean streamflow, and 25th-, 50th-, and 75th-percentile streamflows.

The eligible record period used to compute the streamflow statistics varied by statistic because the statistics were not all determined at the same time. Harmonic mean streamflow statistics used in this report were based on applicable streamflow data collected through September 1997. Mean monthly streamflows and the 25th-, 50th-, and 75th-percentile streamflow statistics were based on applicable streamflow data collected through September 1998. Mean annual streamflow statistics were based on applicable streamflow data collected through September 1999.

Previous Studies

Antilla (1970) presented equations for estimating a variety of streamflow statistics for rural, unregulated streams in Ohio. That report provided equations for estimating mean annual streamflow and mean monthly streamflows; however, equations for estimating the harmonic mean streamflow and the 25th-, 50th-, and 75th-percentile streamflows have not been published previously for Ohio. Several other studies have been done in which equations were presented for estimating streamflow statistics for Ohio streams (Johnson and Metzker, 1981; Koltun and Schwartz, 1987; Koltun and Roberts, 1990; Sherwood, 1993a,b; Straub, 2001); however, the Antilla study was the only one that provided equations for estimating any of the streamflow statistics considered in this study.

Acknowledgments

The authors wish to acknowledge the many local, state, and federal agencies who have cooperated in funding the operation and maintenance of streamflow-gaging stations over the years.

COMPILATION OF STREAMFLOW DATA

The USGS Automated Data Processing System (Bartholoma, 1997) was used to retrieve daily average streamflow data for 219 streamflow-gaging stations throughout Ohio (fig. 1; table 1). Selection of these 219 stations was based upon availability of 10 or more years of daily streamflow record that was unregulated with respect to one or more of the streamflow statistics of interest. Some streamflow statistics are insensitive to certain types of regulation, whereas other streamflow statistics are not. For example, streamflow at a gaging station downstream from a reservoir may be appreciably regulated with respect to mean monthly streamflows because water that enters the reservoir during high-flow months can be stored and released during low-flow months; however, streamflow at that same gaging station effectively may be unregulated with respect to the mean annual streamflow if the volume of water that is placed into storage is released during the same year.

DETERMINATION OF STREAMFLOW STATISTICS

Mean monthly and annual mean streamflows were computed by means of the National Water Information System program DVMAS (Daily Values Monthly and Annual Statistics) (Bartholoma, 1997). The mean annual streamflow ($\overline{Q_A}$) is defined as

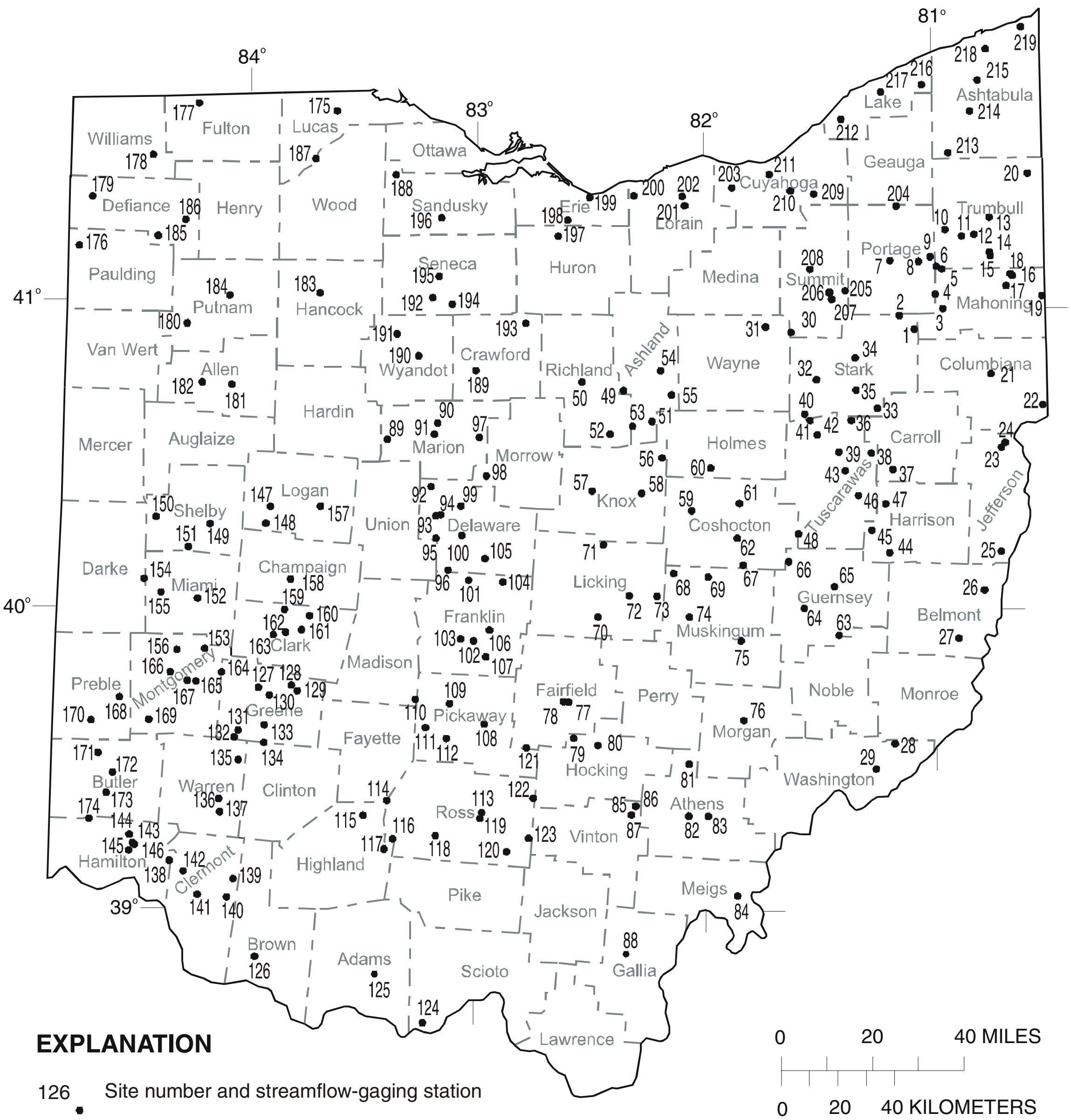
$$\overline{Q_A} = \left(\sum_{i=1}^{N_A} Q_{A_i} \right) / N_A , \quad (1)$$

where Q_{A_i} is annual mean streamflow for the *i*th year and N_A is the number of annual mean streamflows. Similarly, the mean monthly streamflow ($\overline{Q_M}$) is defined as

$$\overline{Q_M} = \left(\sum_{i=1}^{N_M} Q_{M_i} \right) / N_M , \quad (2)$$

where Q_{M_i} is the monthly mean streamflow (for a given month) for the *i*th year and N_M is the number of monthly mean streamflows.

The harmonic mean streamflow was computed by means of the USGS BIOFLO (version 2.0) program (Straub, 2001), which is an interactive version of the U.S. Environmental Protection Agency's DFLOW program (Rossman, 1990). The harmonic mean streamflow has been employed in studies of the effects of contaminants on human health because it can be used to compute the average exposure concentration of a contaminant given an average contaminant loading rate. The Ohio Environmental Protection Agency (1996) uses the harmonic mean streamflow as the design flow for human health criteria.



Base map from U.S. Geological Survey
digital data 1:2,000,000
State Plane projection, Ohio South

Figure 1. Location of streamflow-gaging stations used in the analyses.

Table 1. Streamflow-gaging stations and corresponding years and periods of record used in the analyses

[Stations are in downstream order. –, not applicable; wy, water year (the period Oct.1–Sept. 30, designated by the calendar year in which it ends); PR, present (September 30, 1999)]

Site number	Station number	Station name	Period of continuous gage operation (wy)	Number of years and period of record used in the analyses of			
				Mean annual streamflow		Mean monthly, harmonic mean, and 25th-, 50th-, and 75th-percentile streamflows	
				years	wy	years	wy
1	03086500	Mahoning River at Alliance	1941-93	52	1942-93	0	–
2	03088000	Deer Creek at Limaville	1942-51	10	1942-51	0	–
3	03089500	Mill Creek near Berlin Center	1942-72	30	1942-71	30	1943-71
4	03090500	Mahoning River below Berlin Dam near Berlin Center	1931-92	61	1931-91	0	–
5	03091500	Mahoning River at Pricetown	1929-PR	69	1930-98	0	–
6	03092000	Kale Creek near Pricetown	1941-93	48	1942-89	48	1942-89
7	03092090	West Branch Mahoning River near Ravenna	1966-93	28	1966-93	28	1966-93
8	03092460	West Branch Mahoning River at Wayland	1969-92	23	1969-91	0	–
9	03092500	West Branch Mahoning River near Newton Falls	1927-82	55	1927-81	40	1927-66
10	03093000	Eagle Creek at Phalanx Station	1926-34, 1938-PR	69	1927-34, 1938-98	69	1927-34, 1939-98[a]
11	03094000	Mahoning River at Leavittsburg	1941-PR	57	1942-98	0	–
12	03094500	Mahoning River at Warren	1925-35	11	1925-35	0	–
13	03095500	Mosquito Creek below Mosquito Creek Dam near Cortland	1926-29, 1943-92	51	1927-29, 1944-91	0	–
14	03096000	Mosquito Creek at Niles	1929-51	22	1930-51	13	1930-43
15	03097550	Mahoning River at Ohio Edison Power Plant at Niles	1988-PR	10	1988-98	0	–
16	03098000	Mahoning River at Youngstown	1922-82	61	1922-82	0	–
17	03098500	Mill Creek at Youngstown	1944-71	28	1944-71	0	–
18	03098600	Mahoning River below West Avenue at Youngstown	1988-PR	10	1988-98	0	–
19	03099500	Mahoning River at Lowellville	1943-71, 1973-92	47	1944-71, 1973-91	0	–
20	03102950	Pymatuning Creek at Kinsman	1966-94	29	1966-94	29	1966-94
21	03109000	Lisbon Creek at Lisbon	1947-62	16	1947-62	16	1947-62
22	03109500	Little Beaver Creek near East Liverpool	1916-PR	82	1916-98	82	1916-98
23	03110000	Yellow Creek near Hammondsville	1941-PR	57	1942-98	57	1942-98[a]
24	03110500	Yellow Creek at Hammondsville	1915-35	20	1916-35	20	1916-35
25	03111500	Short Creek near Dillonvale	1942-PR	57	1942-98	57	1942-98[a]
26	03111548	Wheeling Creek below Blaine	1983-87, 1989-PR	14	1984-87, 1989-98	14	1984-87, 1989-98[a]
27	03114000	Captina Creek at Armstrongs Mills	1927-35, 1959-PR	49	1927-35, 1959-98	49	1927-35, 1959-98[a]
28	03115400	Little Muskingum River at Bloomfield	1959-81, 1996-PR	26	1959-81, 1996-98	26	1959-81, 1996-98[a]

Table 1. Streamflow-gaging stations and corresponding years and periods of record used in the analyses—Continued

[Stations are in downstream order. –, not applicable; wy, water year (the period Oct.1–Sept. 30, designated by the calendar year in which it ends); PR, present (September 30, 1999)]

Site number	Station number	Station name	Period of continuous gage operation (wy)	Number of years and period of record used in the analyses of: Mean annual streamflow		Mean monthly, harmonic mean, and 25th-, 50th-, and 75th-percentile streamflows	
				years	wy	years	wy
29	03115500	Little Muskingum River at Fay	1915-18, 1926-35	13	1916-18, 1926-35	11	1916-18, 1926-35
30	03116000	Tuscarawas River at Clinton	1926-79	52	1927-78	0	–
31	03116200	Chippewa Creek at Easton	1961-82	21	1961-81	0	–
32	03117000	Tuscarawas River at Massillon	1938-PR	60	1939-98	0	–
33	03117500	Sandy Creek at Waynesburg	1939-PR	59	1940-98	59	1940-98[a]
34	03118000	Middle Branch Nimishillen Creek at Canton	1942-PR	56	1942-93, 1995-98	0	–
35	03118500	Nimishillen Creek at North Industry	1922-PR	77	1922-98	0	–
36	03119000	Sandy Creek at Sandyville	1924-47	24	1924-47	24	1924-47
37	03120500	McGuire Creek near Leesville	1939-90, 1992	52	1939-90	0	–
38	03121500	Indian Fork below Atwood Dam near Cumberland	1961-75	15	1961-75	0	–
39	03122500	Tuscarawas River below Dover Dam near Dover	1924-92	68	1924-91	13	1924-36
40	03123000	Sugar Creek above Beach City Dam at Beach City	1945-75	30	1946-75	0	–
41	03124000	Sugar Creek below Beach City Dam near Beach City	1939-91	53	1939-91	0	–
42	03124500	Sugar Creek at Strasburg	1932, 1936-38, 1962-PR	41	1932, 1936-38, 1962-98	0	–
43	03125000	Home Creek near New Philadelphia	1937-80	42	1938-79	42	1938-79
44	03126000	Stillwater Creek at Piedmont	1939-93	52	1940-91	0	–
45	03127000	Stillwater Creek at Tippecanoe	1939-93	52	1940-91	0	–
46	03127500	Stillwater Creek at Uhrichsville	1922-93	68	1923-91	14	1922-36
47	03128500	Little Stillwater Creek below Tappan Dam at Tappan	1939-93	53	1939-91	0	–
48	03129000	Tuscarawas River at Newcomerstown	1922-PR	77	1922-98	13	1924-36
49	03130000	Black Fork below Charles Mill Dam near Mifflin	1939-93	52	1940-91	0	–
50	03130500	Touby Run at Mansfield	1947-78	32	1947-78	32	1947-78
51	03131500	Black Fork at Loudonville	1931-93	60	1932-91	0	–
52	03132000	Clear Fork at Butler	1945-75	30	1946-75	0	–
53	03133500	Clear Fork below Pleasant Hill Dam near Perrysville	1939-86, 1988-93	51	1940-86, 1988-91	0	–
54	03134000	Jerome Fork at Jeromeville	1926-49	24	1926-49	24	1926-49
55	03135000	Lake Fork below Mohicanville Dam near Mohicanville	1939-93	55	1939-93	0	–
56	03136000	Mohican River at Greer	1922-82	60	1922-81	15	1922-36
57	03136500	Kokosing River at Mount Vernon	1954-PR	45	1954-98	45	1954-98[a]

Table 1. Streamflow-gaging stations and corresponding years and periods of record used in the analyses—Continued

[Stations are in downstream order. –, not applicable; wy, water year (the period Oct.1–Sept. 30, designated by the calendar year in which it ends); PR, present (September 30, 1999)]

Site number	Station number	Station name	Period of continuous gage operation (wy)	Number of years and period of record used in the analyses of: Mean annual streamflow		Mean monthly, harmonic mean, and 25th-, 50th-, and 75th-percentile streamflows	
				years	wy	years	wy
58	03137000	Kokosing River at Millwood	1922-74	53	1922-74	53	1922-74
59	03138500	Walhonding River below Mohawk Dam at Nellie	1922-92	70	1922-91	15	1922-36
60	03139000	Killbuck Creek at Killbuck	1931-PR	68	1931-98	68	1932-98[a]
61	03140000	Mill Creek near Coshocton	1937-PR	61	1938-98	61	1938-98[a]
62	03140500	Muskingum River near Coshocton	1937-PR	62	1937-98	0	–
63	03141500	Seneca Fork below Senecaville Dam near Senecaville	1938-93	52	1939-91	0	–
64	03142000	Wills Creek at Cambridge	1927-28, 1938-PR	62	1927-28, 1938-97	0	–
65	03142200	Salt Fork near Cambridge	1956-68	11	1957-67	11	1957-67
66	03142500	Wills Creek at Birds Run	1928-39	10	1929-38	0	–
67	03143500	Wills Creek below Wills Creek Dam at Wills Creek	1939-92	53	1939-91	0	–
68	03144000	Wakatomika Creek near Frazeysburg	1937-PR	63	1937-98	63	1937-98[a]
69	03144500	Muskingum River at Dresden	1922-85	63	1922-84	15	1922-36
70	03145000	South Fork Licking River near Hebron	1940-48, 1969-PR	39	1940-48, 1969-98	0	–
71	03146000	North Fork Licking River at Utica	1940-48, 1970-83	22	1940-48, 1970-82	22	1940-48, 1970-82
72	03146500	Licking River near Newark	1940-PR	59	1940-98	59	1940-98[a]
73	03147000	Licking River at Toboso	1903-06, 1922-61	41	1905, 1922-61	41	1905, 1922-61
74	03147500	Licking River below Dillon Dam near Dillon Falls	1940-92	53	1940-92	20	1940-59
75	03149500	Salt Creek near Chandlersville	1936-47	12	1936-47	12	1936-47
76	03150000	Muskingum River at McConnelsville	1922-93	71	1922-92	14	1922-35
77	03156000	Hunters Run at Lancaster	1956-80	23	1957-79	0	–
78	03156400	Hocking River at Lancaster	1956-75	18	1957-74	0	–
79	03157000	Clear Creek near Rockbridge	1940-PR	59	1940-98	59	1940-98[a]
80	03157500	Hocking River at Enterprise	1931-PR	67	1932-98	67	1932-98[a]
81	03159000	Sunday Creek at Glouster	1952-81	27	1952-78	0	–
82	03159500	Hocking River at Athens	1916-PR	66	1916-76, 1994-98	37	1916-52
83	03159510	Hocking River below Athens	1977-93	16	1977-92	0	–
84	03159540	Shade River near Chester	1966-PR	32	1966-98	32	1966-84, 1986-98[a]
85	03201600	Sandy Run above Big Four Hollow Creek near Lake Hope	1971-82	11	1971-81	11	1971-81
86	03201700	Big Four Hollow Creek near Lake Hope	1971-83	12	1971-82	12	1971-82

Table 1. Streamflow-gaging stations and corresponding years and periods of record used in the analyses—Continued

[Stations are in downstream order. –, not applicable; wy, water year (the period Oct.1–Sept. 30, designated by the calendar year in which it ends); PR, present (September 30, 1999)]

Site number	Station number	Station name	Period of continuous gage operation (wy)	Number of years and period of record used in the analyses of: Mean annual streamflow		Mean monthly, harmonic mean, and 25th-, 50th-, and 75th-percentile streamflows	
				years	wy	years	wy
87	03201800	Sandy Run near Lake Hope	1958-79	21	1958-78	0	–
88	03202000	Raccoon Creek at Adamsville	1916-35, 1939-85, 1992-PR	74	1916-35, 1939-86, 1992, 1994-98	74	1916-35, 1939-85, 1992-98[a]
89	03217500	Scioto River at LaRue	1927-35, 1939-51	22	1927-35, 1939-51	22	1927-35, 1939-51
90	03218000	Little Scioto River above Marion	1939-72	33	1939-71	33	1939-71
91	03218500	Little Scioto River at sewage treatment plant near Marion	1925-36, 1938-39	10	1926-35	0	–
92	03219500	Scioto River near Prospect	1926-32, 1940-PR	66	1926-32, 1940-98	66	1926-32, 1940-98[a]
93	03219590	Bokes Creek near Warrensburg	1983-PR	15	1983-97	15	1983-97
94	03219600	Eagon Run near Warrensburg	1950-62	12	1950-52, 1954-62	12	1950-52, 1954-62
95	03220000	Mill Creek near Bellepoint	1943-PR	55	1944-98	55	1944-98[a]
96	03221000	Scioto River below O'Shaughnessy Dam near Dublin	1922-PR	77	1922-98	0	–
97	03223000	Olentangy River at Claridon	1947-PR	52	1947-98	52	1947-98[a]
98	03224500	Whetstone Creek near Ashley	1955-74	20	1955-74	20	1955-74
99	03225500	Olentangy River near Delaware	1924-34, 1939-PR	70	1925-34, 1939-98	18	1925-34, 1940-47
100	03226500	Olentangy River at Stratford	1934-36 1938-58	21	1935, 1939-58	12	1939-50
101	03226800	Olentangy River near Worthington	1956-85, 1992, 1996-PR	29	1956-84	0	–
102	03227500	Scioto River at Columbus	1921-PR	77	1922-98	0	–
103	03228000	Scioto Big Run at Briggsdale	1947-58	12	1947-58	12	1947-58
104	03228500	Big Walnut Creek at Central College	1939-PR	60	1939-98	15	1939-53
105	03228805	Alum Creek at Africa	1964-PR	35	1964-98	10	1964-73
106	03229000	Alum Creek at Columbus	1924-35, 1939-PR	72	1924-35, 1939-98	44	1924-35, 1939-73
107	03229500	Big Walnut Creek at Rees	1922-35, 1939-PR	73	1922-35, 1940-98	28	1922-35, 1940-53
108	03230000	Scioto River near Circleville	1939-56	17	1940-56	0	–
109	03230500	Big Darby Creek at Darbyville	1922-35, 1939-PR	74	1922-35, 1939-98	74	1922-35, 1939-98[a]

Table 1. Streamflow-gaging stations and corresponding years and periods of record used in the analyses—Continued

[Stations are in downstream order. –, not applicable; wy, water year (the period Oct.1–Sept. 30, designated by the calendar year in which it ends); PR, present (September 30, 1999)]

Site number	Station number	Station name	Period of continuous gage operation (wy)	Number of years and period of record used in the analyses of: Mean annual streamflow		Mean monthly, harmonic mean, and 25th-, 50th-, and 75th-percentile streamflows	
				years	wy	years	wy
110	03230800	Deer Creek at Mount Sterling	1967-81, 1996-PR	18	1967-81 1996-98	18	1967-81 1996-98[a]
111	03230900	Deer Creek near Pancoastburg	1967-PR	31	1967-97	0	–
112	03231000	Deer Creek at Williamsport	1927-35, 1939-56, 1962-92	56	1927-35, 1939-56, 1963-91	29	1927-35, 1939-56, 1964-67
113	03231500	Scioto River at Chillicothe	1921-PR	78	1921-98	0	–
114	03232000	Paint Creek near Greenfield	1927-35, 1940-56, 1967-81, 1996-PR	44	1927-35, 1940-56, 1967-81 1996-98	44	1927-35, 1940-56, 1967-81 1996-98[a]
115	03232300	Rattlesnake Creek at Centerfield	1971-82	10	1972-81	10	1972-81
116	03232470	Paint Creek near Bainbridge	1968-92	24	1968-91	0	–
117	03232500	Rocky Fork near Barretts Mills	1940-PR	58	1940-98	13	1940-52
118	03234000	Paint Creek near Bourneville	1922-36, 1939-PR	72	1924-36, 1940-98	26	1924-36, 1940-52
119	03234300	Paint Creek at Chillicothe	1986-PR	13	1986-98	0	–
120	03234500	Scioto River at Higby	1931-PR	68	1931-98	0	–
121	03235000	Salt Creek at Tarlton	1947-61	15	1947-61	15	1947-61
122	03235500	Tar Hollow Creek at Tar Hollow State Park	1947-79	32	1947-78	32	1947-78
123	03236000	Salt Creek near Londonderry	1939-50	12	1939-50	12	1939-50
124	03237280	Upper Twin Creek at McGaw	1964-PR	35	1964-98	30	1964-93
125	03237500	Ohio Brush Creek near West Union	1927-35, 1941-PR	67	1927-35, 1941-98	65	1927-35, 1941-97
126	03238500	Whiteoak Creek near Georgetown	1924-35, 1940-PR	70	1925-35, 1940-98	70	1925-35, 1940-98[a]
127	03240000	Little Miami River near Oldtown	1953-PR	46	1953-98	46	1953-98[a]
128	03240500	North Fork Massie Creek at Cedarville	1954-68	14	1955-68	14	1955-68
129	03241000	South Fork Massie Creek near Cedarville	1954-68	14	1955-68	14	1955-68
130	03241500	Massies Creek at Wilberforce	1953-PR	46	1953-98	46	1953-98[a]
131	03242000	Little Miami River at Spring Valley	1926-35, 1940-51	22	1926-35, 1940-51	0	–
132	03242050	Little Miami River near Spring Valley	1968-85	15	1969-83	15	1969-83
133	03242150	Caesar Creek near Xenia	1900, 1968-84	15	1969-83	0	–
134	03242200	Anderson Fork near New Burlington	1968-84	15	1969-83	15	1969-83
135	03242300	Caesar Creek at Harveysburg	1961-75	14	1961-74	14	1961-74

Table 1. Streamflow-gaging stations and corresponding years and periods of record used in the analyses—Continued

[Stations are in downstream order. –, not applicable; wy, water year (the period Oct.1–Sept. 30, designated by the calendar year in which it ends); PR, present (September 30, 1999)]

Site number	Station number	Station name	Period of continuous gage operation (wy)	Number of years and period of record used in the analyses of: Mean annual streamflow		Mean monthly, harmonic mean, and 25th-, 50th-, and 75th-percentile streamflows	
				years	wy	years	wy
136	03242500	Little Miami River at Fort Ancient	1940-51	12	1940-51	12	1940-51
137	03244000	Todd Fork near Roachester	1952-75	22	1953-74	0	–
138	03245500	Little Miami River at Milford	1916-17, 1926-36, 1939-PR	73	1916-17, 1926-36, 1939-98	49	1916-17, 1926-36, 1939-74
139	03246200	East Fork Little Miami River near Marathon	1968-84	15	1969-83	15	1969-83
140	03246500	East Fork Little Miami River at Williamsburg	1949-53, 1961-74	18	1950-53, 1961-74	18	1950-53, 1961-74
141	03247050	East Fork Little Miami River near Batavia	1965-94	29	1966-94	11	1966-76
142	03247500	East Fork Little Miami River at Perintown	1916-17, 1926-PR	75	1916-17, 1926-98	26	1916-17, 1926-49
143	03255500	Mill Creek at Reading	1939-93	52	1940-91,	0	–
144	03257500	West Fork Mill Creek at Woodlawn	1953-86	28	1956-83	0	–
145	03258000	West Fork Mill Creek at Lockland	1939-57	17	1940-41 1943-57	0	–
146	03259000	Mill Creek at Carthage	1948-PR	51	1948-98	0	–
147	03260700	Bokengehalas Creek near De Graff	1958-96	34	1958-91	34	1958-91
148	03260800	Stony Creek near De Graff	1958-76	18	1958-75	18	1958-75
149	03261500	Great Miami River at Sidney	1915-PR	84	1915-98	0	–
150	03261950	Loramie Creek near Newport	1965-PR	34	1965-98	0	–
151	03262000	Loramie Creek at Lockington	1916-PR	82	1916-18, 1920-98	0	–
152	03262700	Great Miami River at Troy	1963-PR	36	1963-98	0	–
153	03263000	Great Miami River at Taylorsville	1915-17, 1922-PR	76	1923-98	0	–
154	03264000	Greenville Creek near Bradford	1931-PR	66	1932-98	62	1932-54, 1958-98[a]
155	0326500	Stillwater River at Pleasant Hill	1917-28 1935-PR	75	1917-28, 1936-98	75	1917-28 1936-98[a]
156	03266000	Stillwater River at Englewood	1926-PR	72	1926-98	0	–
157	03266500	Mad River at Zanesfield	1947-78	33	1947-79	33	1947-79
158	03267000	Mad River near Urbana	1926-31, 1940-PR	65	1926-31, 1940-98	65	1926-31, 1940-98[a]
159	03267500	Mad River at Tremont City	1931-33 1966-75	10	1932, 1966-74	0	–
160	03268000	Buck Creek at New Moorefield	1943-58, 1973-76	16	1943-58	16	1943-58

Table 1. Streamflow-gaging stations and corresponding years and periods of record used in the analyses—Continued

[Stations are in downstream order. –, not applicable; wy, water year (the period Oct.1–Sept. 30, designated by the calendar year in which it ends); PR, present (September 30, 1999)]

Site number	Station number	Station name	Period of continuous gage operation (wy)	Number of years and period of record used in the analyses of: Mean annual streamflow		Mean monthly, harmonic mean, and 25th-, 50th-, and 75th-percentile streamflows	
				years	wy	years	wy
161	03268500	Beaver Creek near Springfield	1943-58, 1973-76	19	1943-58, 1974-76	19	1943-58, 1974-76
162	03269000	Buck Creek at Springfield	1915-21, 1925-49, 1973-74	33	1915-21, 1925-49, 1974	0	–
163	03269500	Mad River near Springfield	1905-06, 1915-PR	85	1905, 1915-98	0	–
164	03270000	Mad River near Dayton	1915-PR	80	1916-21, 1925-98	0	–
165	03270500	Great Miami River at Dayton	1914-PR	85	1914-98	0	–
166	03270800	Wolf Creek at Trotwood	1963-86	24	1963-86	24	1963-86
167	03271000	Wolf Creek at Dayton	1939-50, 1987-96	22	1939-50, 1987-96	22	1939-50, 1987-96
168	03271800	Twin Creek near Ingomar	1963-PR	36	1963-98	36	1963-98[a]
169	03272000	Twin Creek near Germantown	1915-23, 1927-PR	80	1915-23, 1928-98	80	1915-23, 1928-98[a]
170	03272700	Sevenmile Creek at Camden	1972-PR	27	1972-98	27	1972-98[a]
171	03272800	Sevenmile Creek at Collinsville	1960-72	12	1961-72	12	1961-72
172	03273500	Fourmile Creek near Hamilton	1938-60	23	1938-60	17	1938-55
173	03274000	Great Miami River at Hamilton	1911-18 1928-PR	70	1928-98	0	–
174	03274500	Great Miami River at Venice	1915-27, 1932-33	12	1916-27	0	–
175	04177000	Ottowa River at University of Toledo	1946-48, 1977-PR	23	1946-48, 1977-86, 1988-98	23	1946-48, 1977-86, 1988-98[a]
176	04183500	Maumee River at Antwerp	1922-35, 1939-82	56	1922-35, 1940-81	0	–
177	04184500	Bean Creek at Powers	1941-81	41	1941-81	41	1941-81
178	04185000	Tiffin River at Stryker	1922-28, 1941-PR	64	1922-28, 1941-98	0	–
179	04185440	Unnamed tributary to Lost Creek near Farmer	1986-PR	13	1986-98	13	1986-98[a]
180	04186500	Auglaize River near Fort Jennings	1922-35, 1941-PR	72	1922-35, 1941-98	0	–
181	04187100	Ottawa River at Lima	1989-PR	10	1989-98	0	–
182	04187500	Ottawa River at Allentown	1924-36, 1943-82	50	1924-35, 1944-81	0	–

Table 1. Streamflow-gaging stations and corresponding years and periods of record used in the analyses—Continued

[Stations are in downstream order. –, not applicable; wy, water year (the period Oct.1–Sept. 30, designated by the calendar year in which it ends); PR, present (September 30, 1999)]

Site number	Station number	Station name	Period of continuous gage operation (wy)	Number of years and period of record used in the analyses of: Mean annual streamflow		Mean monthly, harmonic mean, and 25th-, 50th-, and 75th-percentile streamflows	
				years	wy	years	wy
183	04189000	Blanchard River near Findlay	1924-35, 1941-PR	70	1924-35, 1941-98	70	1924-35, 1941-98[a]
184	04189500	Blanchard River at Glandorf	1921-28, 1947-52	10	1922-27, 1948-51	10	1922-27, 1948-51
185	04191500	Auglaize River near Defiance	1916-PR	84	1913, 1915-98	0	–
186	04192500	Maumee River near Defiance	1925-35, 1940-74, 1979-PR	64	1926-35, 1940-74, 1979-98	0	–
187	04193500	Maumee River at Waterville	1899-01, 1922-35 1940-PR	74	1900-01, 1922-35, 1940-98	0	–
188	04195500	Portage River at Woodville	1929-35, 1940-PR	65	1929-35, 1940-98	19	1929-35, 1940-98[a]
189	04196000	Sandusky River near Bucyrus	1926-35, 1939-51, 1965-81, 1996-PR	44	1926-35, 1939-51, 1965-81 1995-98	44	1926-35, 1939-51, 1965-81, 1995-98[a]
190	04196500	Sandusky River near Upper Sandusky	1922-35, 1938-82	57	1922-35, 1939-81	57	1922-35, 1939-81
191	04196800	Tymochtee Creek at Crawford	1965-PR	34	1965-98	0	–
192	04197000	Sandusky River near Mexico	1923-36, 1938-83	56	1924-35, 1939-82	56	1924-35, 1939-82
193	04197020	Honey Creek near New Washington	1976-90	10	1980-89	10	1980-89
194	04197100	Honey Creek at Melmore	1977-PR	22	1977-98	22	1977-98[a]
195	04197170	Rock Creek at Tiffin	1984-PR	15	1984-98	10	1984-95
196	04198000	Sandusky River near Fremont	1899-01, 1924-35 1939-PR	72	1924-35, 1939-98	72	1924-35, 1939-98[a]
197	04198500	East Branch Huron River near Norwalk	1924-35	11	1925-35	11	1925-35
198	04199000	Huron River at Milan	1951-80, 1988-PR	42	1951-81, 1988-98	42	1951-81, 1988-98[a]
199	04199155	Old Woman Creek at Berlin Road near Huron	1988-94, 1996-PR	11	1988-98	10	1988-98[a]
200	04199500	Vermilion River near Vermilion	1950-81	31	1951-81	31	1951-81
201	04200000	East Branch Black River at Elyria	1922-36	13	1923-35	13	1923-35
202	04200500	Black River at Elyria	1945-PR	54	1945-98	0	–

Table 1. Streamflow-gaging stations and corresponding years and periods of record used in the analyses—Continued

[Stations are in downstream order. –, not applicable; wy, water year (the period Oct.1–Sept. 30, designated by the calendar year in which it ends); PR, present (September 30, 1999)]

Site number	Station number	Station name	Period of continuous gage operation (wy)	Number of years and period of record used in the analyses of: Mean annual streamflow		Mean monthly, harmonic mean, and 25th-, 50th-, and 75th-percentile streamflows	
				years	wy	years	wy
203	04201500	Rocky River near Berea	1924-35, 1944-PR	66	1925-35, 1944-98	0	–
204	04202000	Cuyahoga River at Hiram Rapids	1928-35, 1945-PR	62	1928-35, 1945-98	0	–
205	04204000	Little Cuyahoga River at Mogadore	1946-79	32	1947-78	0	–
206	04204500	Little Cuyahoga River at Massillon Rd Akron	1946-74	28	1947-74	0	–
207	04205000	Springfield Lake Outlet at Akron	1946-49, 1961-74	17	1947-49, 1961-74	0	–
208	04206000	Cuyahoga River at Old Portage	1922-35, 1940-PR	73	1922-35, 1940-98	0	–
209	04207200	Tinkers Creek at Bedford	1963-PR	35	1964-98	35	1964-98[a]
210	04208000	Cuyahoga River at Independence	1922-23, 1928-35, 1941-PR	67	1922, 1928-35, 1941-98	0	–
211	04208502	Big Creek at Cleveland	1973-86	14	1973-86	0	–
212	04209000	Chagrin River at Willoughby	1926-35, 1940-84, 1989-94, 1996-PR	65	1926-35, 1940-84, 1989-98	10	1989-98[a]
213	04210000	Phelps Creek near Windsor	1942-59	16	1943-58	16	1943-58
214	04211000	Rock Creek near Rock Creek	1942-66	24	1943-66	24	1943-66
215	04211500	Mill Creek near Jefferson	1942-75	32	1943-74	0	–
216	04212000	Grand River near Madison	1923-35, 1938-74	49	1923-35, 1939-74	49	1923-35, 1939-74
217	04212100	Grand River near Painesville	1975-PR	24	1975-98	24	1975-98[a]
218	04212500	Ashtabula River near Ashtabula	1924-36, 1939-48, 1950-80	48	1925-35, 1940-47, 1951-79	48	1925-35, 1940-47, 1951-79
219	04213000	Conneaut Creek at Conneaut	1923-35, 1951-PR	60	1923-35, 1951-98	60	1923-35, 1951-98[a]

[a]1997 was the last water year of record used to calcuate harmonic mean streamflows

The harmonic mean streamflow (Q_h) is defined as

$$Q_h = \left(\frac{N_{nz}}{N_t}\right)\left(N_{nz} / \sum_{i=1}^{N_{nz}} \frac{1}{Q_i}\right), \tag{3}$$

where Q_i is the mean streamflow for a given day, N_{nz} is the number of non-zero daily mean streamflows, and N_t is the total number of daily mean streamflows. If no zero-flow days are in the record, the harmonic mean flow is equal to the reciprocal of the mean of the reciprocals of the daily mean streamflow data.

The 25th-, 50th-, and 75th-percentile streamflows were computed by means of the USGS SWSTAT program (version 4.0). The 25th-, 50th-, and 75th-percentile streamflows are defined as the streamflows that are greater than or equal to 25, 50, and 75 percent of the daily mean streamflows, respectively.

Streamflow statistics computed for the 219 streamflow-gaging stations considered in this study are presented in appendixes 1 and 2.

BASIN CHARACTERISTICS

Several basin characteristics were used as potential explanatory variables in the regression models. The choice of basin characteristics to consider was based primarily on the authors' expectation that the characteristics might directly or indirectly explain the observed variation in the streamflow statistics of interest. Of course, for a characteristic to be of use, one must be able to compute the characteristics for most basins with applicable streamflow data.

Unlike previous Ohio studies in which regression models were developed for streamflow statistics, this study includes some basin characteristics that were calculated by means of a geographic information system (GIS). Use of GIS-based characteristics offers advantages but also has disadvantages. Two of the more important advantages are (1) the ability to use current coverages (GIS data sets) that contain accurate, high-resolution basin-characteristics data and (2) the ability to rapidly and efficiently compute statistics (for example sums, percentages, and averages) of those characteristics for basins of any size. Some disadvantages include dependence on a GIS for use of a regression model containing GIS-derived characteristics, and limitations imposed by data coverages that have restricted spatial extent. The authors believe that the advantages outweigh the disadvantages and that the disadvantages will lessen over time as GIS hardware and software become more affordable and commonplace and as more national and regional data coverages become available. GIS-based basin characteristics used in this report were determined using ARC/INFO and ArcView[2] software. All coverages used in this study were projected to U.S. State Plane coordinates, zone 5001, and used the North American Datum of 1927.

The basin characteristics that were determined can be separated into five categories: physical characteristics, location characteristics, hydrologic characteristics, land cover, and climate. The basin characteristics are listed by category in table 2 and are described more fully in subsequent sections. Basin characteristics determined for streamflow-gaging stations used in this study are listed in appendix 3.

Drainage Area

The drainage area (in square miles) is the area, measured in a horizontal plane, that is enclosed by a drainage divide. Drainage areas for this study were determined by manually delineating the drainage divide on USGS 7.5-minute topographic maps and measuring the enclosed area by means of an electronic digitizer.

Precipitation

Mean annual precipitation coverages were created by digitizing Harstine's (1991) isoline map of mean annual precipitation (fig. 2) and then processing the isoline coverage to obtain both a triangulated irregular network (TIN[3]) (Whitehead, 2002a) and a grid coverage with cell sizes of 1,000 ft^2.

Two mean annual precipitation characteristics were computed for each basin. The mean annual precipitation at a basin centroid (P_c) was determined using the "tinspot" function on the mean annual precipitation TIN in ARC/INFO. The location of the basin centroid was determined by means of the "centroidlabels" command as applied to the basin-boundary polygons in ARC/INFO. A basin-averaged mean annual precipitation (P_{avg}) was computed by intersecting the gridded precipitation coverage with the basin-boundary coverage to select all grid cells that lie wholly or partially within the basin, and then computing the average of the grid values. The differences between P_c and P_{avg} generally proved to be small, with all differences (relative to P_c) less than 5 percent and most differences (86 percent) less than 1 percent.

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[2]ARC/INFO and ArcView are trademarks of Environmental Systems Research Institute, Inc., Redlands, Calif.

[3]A TIN is a surface representation based on irregularly spaced data points that have x, y, and z coordinates. In this case, the x and y coordinates were the geographic coordinates and the z coordinate was the value of mean annual precipitation. The points are connected by edges to form a set of non-overlapping triangles used to represent the surface.

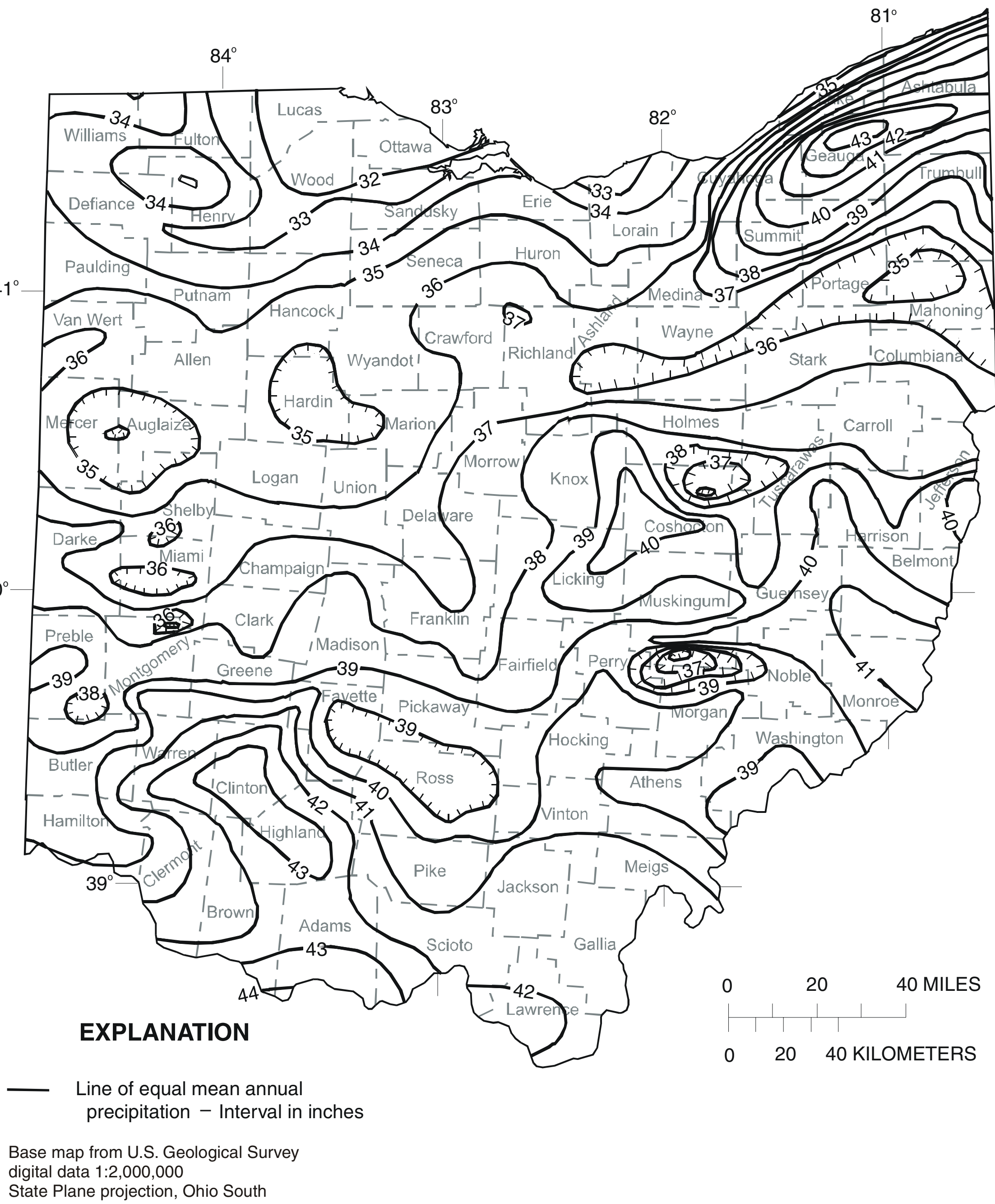

Figure 2. Mean annual precipitation for Ohio, 1931—80 (modified from Harstine, 1991).

Table 2. Basin characteristics used as potential explanatory variables

Characteristic category	Basin characteristic	Unit	Notation used
Physical	Drainage area at streamflow-gaging station	square miles	A
	Physiographic section containing majority of basin area	unitless binary indicator variable	*LP, TP, SNY, KA*
Land cover	Percentage of contributing basin area covered by water and wetlands	percent	W
	Percentage of contributing basin area covered by forest	percent	F
Climate	Mean annual precipitation at the basin centroid	inches	P_c
	Basin-averaged mean annual precipitation	inches	P_{avg}
Hydrologic	Streamflow-variability index at basin centroid	base 10 logarithm of cubic feet per second	V_c
	Streamflow-variability index at streamflow-gaging station	base 10 logarithm of cubic feet per second	V_g
Location	Latitude of the basin centroid	decimal degrees	Lat_c
	Longitude of the basin centroid	decimal degrees	$Long_c$
	Latitude of the streamflow-gaging station	decimal degrees	Lat_s
	Longitude of the streamflow-gaging station	decimal degrees	$Long_s$
	Location of basin centroid relative to 41.2 degrees latitude	unitless binary indicator variable	$N_{41.2}$

Land Cover

Land-cover data were obtained from a National Land Cover Data (NLCD) set (U.S. Geological Survey, 2000). The NLCD data sets are based on a 21-class modified Anderson level II land-cover classification scheme applied consistently over the United States. Satellite data and a variety of supporting information including topography, census, agricultural statistics, soil characteristics, other land-cover maps, and wetlands data were used to determine and label the land-cover types at a resolution of 30 m^2 (approximately 323 ft^2).

The percentages of the drainage basins covered in forest and in water and wetlands were determined from the NLCD for Ohio by (1) converting the NLCD coverage to a grid with 30-m^2 cells, (2) intersecting the gridded NLCD coverage with the basin-boundary coverage to select all grid cells that lie wholly or partially within the basin, and then (3) summing the areas in each land-cover class. The percentage of the drainage basin covered in forest (F) was determined by summing areas classified as deciduous, evergreen, and mixed forest, dividing by the total drainage area, then multiplying by 100. In a like fashion, the percentage of the drainage basin covered in water and wetlands (W) was determined by summing areas classified as open water and woody and emergent herbaceous wetlands, dividing by the total drainage area, then multiplying by 100.

Physiography

Physiographic divisions, provinces, and sections are increasingly uniform regions that are delineated on the basis of similarities in geology and topography. The physiographic coverage used in this study (fig. 3) was derived from a USGS 1:7,000,000-scale coverage of physiography in the conterminous United States (Fenneman and Johnson, 1946a). The base physiographic coverage, which delineates physiographic divisions, provinces, and sections, was created by digitizing a scale-stable mylar 1:7,000,000-scale map by Fenneman and Johnson (1946b).

The physiographic coverage was converted to a grid with cell sizes of 1,000 ft^2. Grid cells were assigned a number code of 1 to 5 depending on whether the grid cell lay within the Eastern Lake Section of the Central Lowland Province, the Till Plains Section of the Central Lowland Province, the Lexington Plain Section of the Interior Low Plateaus Province, the Southern New York Section of the Appalachian Plateaus Province, or the Kanawha Section of the Appalachian Plateaus Province, respectively. The gridded physiographic coverage was intersected with the basin-boundary coverage to select all grid cells that lie wholly or partially within the basin. The most frequently occurring grid value was assigned as the basin code.

Figure 3. Physiographic sections in Ohio (modified from Fenneman and Johnson, 1946a,b).

It was assumed that the physiographic information, if significant, would help explain regional variation in the streamflow statistics. Consequently, a series of binary indicator variables were used in the regression analyses to evaluate the relation between physiography and the various streamflow statistics. Four indicator variables were used. For a given basin, an indicator variable, designated *LP*, *TP*, *SNY*, and *KA*, was assigned a one (1) if the basin code was equal to 1, 2, 4, or 5, respectively; otherwise, it was assigned a zero (0). For example, if the basin code was four (4), the following assignments were made: *LP*=0, *TP*=0, *SNY*=1, and *KA*=0. If the basin code was three (3), then all four of the indicator variables were set to zero (0).

Location

Geographic coordinates of the streamflow-gaging stations and of the centroids of their contributing drainage areas were compiled for use in the regression analyses. The latitude and longitude of a streamflow-gaging station (variables Lat_s and $Long_s$, respectively) are determined (commonly from USGS 7.5 minute topographic maps) when the gaging station is established, and those coordinates are entered into the USGS National Water Information System (NWIS) (Mathey, 1997) in units of degrees, minutes, and seconds. Geographic coordinates of the streamflow-gaging stations were retrieved from NWIS and converted to decimal form for use in this analysis. As mentioned earlier, the centroids of the streamflow-gaging stations contributing drainage areas were determined by means of the “centroidlabels” command as applied to the basin-boundary polygons in ARC/INFO. The latitudes and longitudes of the centroids (variables Lat_c and $Long_c$, respectively) also were converted to decimal form for use in this analysis.

Subsequent analyses (described beginning on page 19) indicated the need for an additional location variable. The binary variable $N_{41.2}$ was used to distinguish between streamflow-gaging stations with drainage-basin centroids north of 41.2 degrees latitude and those with centroids at or south of 41.2 degrees latitude. Streamflow-gaging stations with drainage-basin centroids north of 41.2 degrees latitude were designated by setting $N_{41.2}$ equal to one (1); otherwise, $N_{41.2}$ was set to zero (0).

Streamflow-Variability Index

A generalized streamflow-variability index coverage (Whitehead, 2002b) was created by interpolating a grid (with 6,066-ft^2 cells) from at-site values of the streamflow-variability index computed for 133 rural, unregulated streamflow-gaging stations in Ohio and nearby areas of adjacent states. Grid interpolation was done by means of the “interpolate surface” routine contained in the Spatial Analyst[4] extension of ArcView. The inverse distance weighting (IDW) algorithm, based on the 12 nearest neighboring stations, was used.

Lane and Lei (1950) originally proposed that a streamflow-variability index be used to help produce synthetic flow-duration curves. Subsequently, a generalized streamflow-variability index has been used in a regression model for estimating harmonic mean streamflows in Kentucky (Martin and Ruhl, 1992).

The streamflow-variability index at a streamflow-gaging station is defined as the standard deviation of the logarithms of the 19 streamflow values at 5-percent class intervals from 5 to 95 percent on the flow-duration curve (Searcy, 1959) of daily mean streamflow for the analysis period. The formula for the streamflow-variability index is

$$V = \sqrt{\frac{\sum_{i=5,5}^{95} \left(\log(Qc_i) - \overline{\log(Qc)}\right)^2}{18}} , \qquad (4)$$

where V is the streamflow-variability index, $\log(Qc_i)$ is the base 10 logarithm of the i-percent duration streamflow (i=5, 10, 15, 20 ... 95), and $\overline{\log(Qc)}$ is the mean of the logs of the 19 streamflow values at 5-percent class intervals from 5 to 95 percent on the flow-duration curve of daily mean streamflow.

The generalized streamflow-variability index coverage was used to determine new estimates of the streamflow-variability index at the streamflow-gaging station location (V_g) and at the centroid of the contributing drainage area (V_c). These estimates were determined by identifying the streamflow-variability index values for grid cells coincident with the locations of the streamflow-gaging station and drainage area centroid. Determination of V_g and V_c was done by application of the “latticespot” function to the streamflow-variability index coverage in ARC/INFO.

DEVELOPMENT OF EQUATIONS FOR ESTIMATING STREAMFLOW STATISTICS

This section describes the development of equations for estimating selected streamflow statistics as a function of basin characteristics. Two equations were developed for each streamflow statistic; one equation was based on use of drainage area as the sole explanatory variable, and a second, best-fit equation, was based on use of drainage area and from two to four other basin characteristics as the explanatory variables.

[4]Spatial Analyst is a trademark of Environmental Systems Research Institute, Inc., Redlands, Calif.

Ordinary least-squares regression techniques were used to relate selected basin characteristics to mean annual streamflow, mean monthly streamflows, harmonic mean streamflow, and the 25th-, 50th-, and 75th-percentile streamflows. Basin characteristics considered in the analyses were selected on the basis of their potential for explaining the observed variation in the streamflow statistics and (or) to correct for biases observed with some regression models. The selection of basin characteristics ultimately used in a best-fit equation was based on a combination of factors including (1) the proportion of variation in the dependent variable explained by the characteristic, (2) the standard error of estimate of the regression model, (3) the prediction residual error sum of squares (PRESS, a measure of model prediction error) (SAS Institute, 1989), (4) the attained significance level (p-value) of the regression coefficient associated with the characteristic, and (5) a subjective assessment of worth based on a comparison of the effort required to determine the basin characteristic and the proportion of the variation in the dependent variable explained by the characteristic.

All basin characteristics were log transformed with the exception of the binary indicator variables. Prior to the log transformation, a 1 was added to values of the percentage of the drainage basin covered in forest (F) and the percentage of the drainage basin covered in water and wetlands (W) to avoid taking the logarithm of zero. Before they were log transformed, all decimal latitude and longitude values were rescaled by subtracting the numbers 37 and 79, respectively, to avoid large-value multipliers in the regression equations. The number 27 was subtracted from the mean annual precipitation at a basin centroid (P_c) and the basin-averaged mean annual precipitation (P_{avg}) before they were log transformed to maintain historical consistency with previously developed equations for estimating streamflow statistics in Ohio.

The general form of the regression models used in this study is

$$\log(Q) = b_o + b_1 X_1 + b_2 X_2 + \ldots + b_p X_p + \varepsilon , \qquad (5)$$

where Q is a streamflow statistic, b_0 is a constant, b_i (i=1 to p) is the regression coefficient for the ith regressor variable, X_i (i=1 to p) is the ith regressor variable, ε is a random error component, and p is the total number of regressor variables. The regressor variables commonly were log transformed; however, some binary indicator variables were used. For computational convenience, equation 5 is presented in this report in one of two algebraically equivalent forms. If all of the explanatory variables in the equation are log (base 10) transformed, then the equation is presented as

$$Q = 10^{b_0} X_1^{b_1} X_2^{b_2} \ldots X_p^{b_p} . \qquad (6)$$

In those cases where a single binary regressor variable was used (assumed here to be the pth regressor variable) and the remainder of the regressor variables in the equation are log (base 10) transformed, the equation is presented as

$$Q = 10^{(b_0 + X_p b_p)} X_1^{b_1} X_2^{b_2} \ldots X_{p-1}^{b_{p-1}} . \qquad (7)$$

The regression equations developed for this study are presented in tables 3 and 4. Table 3 contains equations developed with drainage area as the sole regressor variable, whereas table 4 contains the best-fit equations. In table 4, for equations of the form shown in equation 6, the antilog of b_0 has been calculated and is reported in the equation as a constant. For equations of the form shown in equation 7, the antilog of $b_0 + X_p b_p$ can take one of two forms, as shown below:

$$C = \begin{pmatrix} 10^{b_0}, & \text{if } X_p = 0 \\ 10^{(b_0 + b_p)}, & \text{if } X_p = 1 \end{pmatrix} , \qquad (8)$$

where C is a constant resulting from the calculation.

The estimated average standard error of prediction (SEP_{est}) of the log-transformed statistic was computed as

$$SEP_{est} = \sqrt{\frac{PRESS}{n}} , \qquad (9)$$

as described by Gilroy and Tasker (1989).

The best-fit equations listed in table 4 include drainage area as an explanatory variable as well as from two to four other basin-characteristic variables. Regression coefficients associated with basin characteristics in all equations are statistically different from zero (p-value less than 0.05). All regression models were tested to ensure that there was no harmful multicollinearity between regressor variables. Analyses of regression residuals were done to (1) verify normality of residuals and homogeneity of variance, (2) ensure that there was no significant autocorrelation or correlation with predicted values or regressor variables, and (3) identify and correct for spatial biases.

Depending on the streamflow statistic of interest and on the combination of explanatory variables selected, data from different combinations and numbers of streamflow-gaging stations were used to develop the regression equations. These differences resulted from unavailability of some basin-characteristic measures for certain streamflow-gaging stations or from regulation that affected some, but not all streamflow statistics at certain gaging stations. The number of observations used to develop each equation is listed in table 4. The minimum number of observations used to develop any of the best-fit regression equations was 109.

Table 3. Drainage-area-only equations for estimating selected streamflow statistics in Ohio

[All streamflow statistics are in units of cubic feet per second; $\overline{Q_A}$, mean annual streamflow; $\overline{Q_{Jan}}$ to $\overline{Q_{Dec}}$, mean monthly streamflow for indicated month; Q_h, harmonic mean streamflow, Q_{P25}, Q_{P50}, and Q_{P75}, 25th-, 50th-, and 75th-percentile streamflows, respectively; *A*, drainage area, in square miles]

Equation number	Drainage-area-only equations	Average standard error of estimate (percent)	Approximate average standard error of prediction (percent)	Number of observations used to develop equation
1	$\overline{Q_A} = 1.01A^{1.00}$	15.6	15.7	219
2	$\overline{Q_{Jan}} = 1.37A^{1.02}$	22.9	23.0	129
3	$\overline{Q_{Feb}} = 1.83A^{0.99}$	18.5	18.6	129
4	$\overline{Q_{Mar}} = 2.01A^{1.01}$	18.1	18.2	129
5	$\overline{Q_{Apr}} = 1.88A^{0.99}$	15.3	15.4	129
6	$\overline{Q_{May}} = 1.19A^{0.99}$	22.8	23.1	129
7	$\overline{Q_{Jun}} = 0.69A^{1.02}$	29.6	29.8	129
8	$\overline{Q_{Jul}} = 0.40A^{1.03}$	35.4	35.9	129
9	$\overline{Q_{Aug}} = 0.27A^{1.03}$	47.2	47.6	129
10	$\overline{Q_{Sep}} = 0.18A^{1.07}$	54.1	54.6	129
11	$\overline{Q_{Oct}} = 0.20A^{1.05}$	62.4	63.2	129
12	$\overline{Q_{Nov}} = 0.50A^{1.03}$	44.2	44.9	129
13	$\overline{Q_{Dec}} = 1.06A^{1.01}$	29.2	29.6	129
14	$Q_h = 0.07A^{1.12}$	129.0	130.4	109
15	$Q_{P25} = 0.14A^{0.96}$	86.6	89.1	129
16	$Q_{P50} = 0.40A^{0.97}$	52.5	54.6	129
17	$Q_{P75} = 1.00A^{0.99}$	32.8	34.4	129

Some interesting patterns can be observed with the best-fit equations. The streamflow-variability index variable, V_g, appears in best-fit equations for estimating statistics that are associated with low flows. This pattern suggests that V_g may also be useful for estimating other low-flow statistics. The north indicator variable ($N_{41.2}$) appears in equations for estimating mean monthly streamflows for most fall, winter, and spring months. This variable was constructed to account for geographic bias that was observed in residuals from alternative regression models (models that did not include this variable). The physical significance of $N_{41.2}$ is not known for certain; however, given the alternative-model residual patterns and the months for which $N_{41.2}$ is significant, $N_{41.2}$ may be related to regional climatic patterns (such as greater snowfall amounts) that are characteristic of northern Ohio.

In addition to best-fit equations, simpler equations were developed that used drainage area as the sole explanatory variable (table 3). The drainage-area-only equations were developed because they can be used with information that can be gathered without use of a GIS; however, the simplicity of the equations comes at the expense of larger prediction errors (than for the best-fit equations) and, for most streamflow statistics, geographic biases. Regression coefficients associated with the drainage-area variable in all equations are statistically different from zero (p-value less than 0.05). Because the drainage-area-only equations exhibit geographic bias for some streamflow statistics, the average standard errors of prediction (listed in table 3) may poorly estimate the true prediction errors depending on where the equations are applied in the State.

Table 4. Best-fit equations for estimating selected streamflow statistics in Ohio

[All streamflow statistics are in units of cubic feet per second; $\overline{Q_A}$, mean annual streamflow; $\overline{Q_{Jan}}$ to $\overline{Q_{Dec}}$, mean monthly streamflow for indicated month; Q_h, harmonic mean streamflow, Q_{P25}, Q_{P50}, and Q_{P75}, 25th-, 50th-, and 75th-percentile streamflows, respectively; *A*, drainage area, in square miles; F, percentage of contributing basin area covered by forest; W, percentage of contributing basin area covered by water and wetlands; P_c, mean annual precipitation at the basin centroid; V_g, streamflow-variability index at streamflow-gaging station; Lat_c, latitude of the basin centroid, in decimal degrees; $Long_c$, longitude of the basin centroid, in decimal degrees]

Equation number	Best-fit equations	Average standard error of estimate (percent)	Approximate average standard error of prediction (percent)	Number of observations used to develop equation
1	$\overline{Q_A} = 0.17(A)^{1.01}(Lat_c - 37)^{0.26}(P_c - 27)^{0.62}$	11.2	11.4	215
2	$\overline{Q_{Jan}} = 0.36(A)^{1.01}(W + 1)^{0.10}(P_c - 27)^{0.55}$	16.3	16.6	109
3	$\overline{Q_{Feb}} = 0.49(A)^{0.98}(F + 1)^{0.04}(P_c - 27)^{0.50}$; if $Lat_c \leq 41.2$ $\overline{Q_{Feb}} = 0.61(A)^{0.98}(F + 1)^{0.04}(P_c - 27)^{0.50}$; if $Lat_c > 41.2$	11.6	11.9	109
4	$\overline{Q_{Mar}} = 0.66(A)^{1.00}(F + 1)^{0.05}(P_c - 27)^{0.40}$; if $Lat_c \leq 41.2$ $\overline{Q_{Mar}} = 0.80(A)^{1.00}(F + 1)^{0.05}(P_c - 27)^{0.40}$; if $Lat_c > 41.2$	13.6	14.0	109
5	$\overline{Q_{Apr}} = 0.57(A)^{0.98}(F + 1)^{0.04}(P_c - 27)^{0.45}$; if $Lat_c \leq 41.2$ $\overline{Q_{Apr}} = 0.63(A)^{0.98}(F + 1)^{0.04}(P_c - 27)^{0.45}$; if $Lat_c > 41.2$	10.9	11.2	109
6	$\overline{Q_{May}} = 1.95(A)^{1.00}(F + 1)^{0.06}(Lat_c - 37)^{-0.59}$; if $Lat_c \leq 41.2$ $\overline{Q_{May}} = 2.52(A)^{1.00}(F + 1)^{0.06}(Lat_c - 37)^{-0.59}$; if $Lat_c > 41.2$	18.9	19.5	109
7	$\overline{Q_{Jun}} = 0.81(A)^{1.01}(Lat_c - 37)^{-0.29}(V_g)^{-0.43}$	26.6	27.0	129
8	$\overline{Q_{Jul}} = 0.32(A)^{1.02}(W + 1)^{-0.09}(V_g)^{-0.63}$	27.2	28.2	109
9	$\overline{Q_{Aug}} = 0.02(A)^{1.01}(P_c - 27)^{0.94}(V_g)^{-0.87}$	35.9	36.8	127
10	$\overline{Q_{Sep}} = 0.01(A)^{1.03}(F + 1)^{0.10}(P_c - 27)^{0.89}(V_g)^{-0.92}$	42.2	43.6	109
11	$\overline{Q_{Oct}} = 0.12(A)^{1.04}(V_g)^{-0.83}$; if $Lat_c \leq 41.2$ $\overline{Q_{Oct}} = 0.32(A)^{1.04}(V_g)^{-0.83}$; if $Lat_c > 41.2$	50.0	50.8	129
12	$\overline{Q_{Nov}} = 0.19(A)^{1.04}(P_c - 27)^{0.37}$; if $Lat_c \leq 41.2$ $\overline{Q_{Nov}} = 0.38(A)^{1.04}(P_c - 27)^{0.37}$; if $Lat_c > 41.2$	36.5	37.5	127
13	$\overline{Q_{Dec}} = 0.33(A)^{1.01}(F + 1)^{0.06}(P_c - 27)^{0.39}$; if $Lat_c \leq 41.2$ $\overline{Q_{Dec}} = 0.52(A)^{1.01}(F + 1)^{0.06}(P_c - 27)^{0.39}$; if $Lat_c > 41.2$	20.9	21.8	109
14	$Q_h = 0.05(A)^{1.02}(W + 1)^{0.47}(Lat_c - 37)^{-0.94}(V_g)^{-2.88}$	63.4	65.9	109
15	$Q_{P25} = 0.18(A)^{0.88}(W + 1)^{0.37}(Lat_c - 37)^{-1.17}(V_g)^{-2.31}$	44.0	47.9	109
16	$Q_{P50} = 1.19(A)^{0.93}(W + 1)^{0.23}(Lat_c - 37)^{-1.10}(Long_c - 79)^{-0.38}(V_g)^{-1.26}$	35.7	40.3	109
17	$Q_{P75} = 2.87(A)^{0.97}(W + 1)^{0.23}(Lat_c - 37)^{-0.88}(Long_c - 79)^{-0.32}(V_g)^{-0.50}$	25.7	29.2	109

TECHNIQUES FOR ESTIMATING SELECTED STREAMFLOW CHARACTERISTICS

Proper use of equations presented in this report requires an understanding of the conditions for which the equations are applicable, knowledge of their limitations, and an understanding of the mechanics of their application. To help the user gain the necessary understanding and skills, the following two sections describe the applicability and limitations of the equations and present examples of their use.

Applicability and Limitations of Equations

The equations presented for estimating streamflow statistics in Ohio are applicable to streams draining rural basins that are unregulated with respect to the statistic being estimated. Because the equations are calibrated to data from a specific set of streamflow-gaging stations, they should not be applied to drainage basins whose characteristics differ substantially from those employed in that calibration. In order to determine whether the equations can be used for a prospective site, the applicable basin characteristics for that site should be compared with those listed in table 5 or 6 (depending on the form of the equation being used and the statistic being estimated) to ensure that its characteristics fall within the range of characteristic values employed in development of the equation. The ranges of characteristics that were used in the derivation of equations for estimating all statistics for the drainage-area-only equations and the mean annual streamflow for the best-fit equations are listed in table 5. Table 6 lists the ranges of characteristics that were used in the derivation of the best-fit equations for estimating the mean monthly streamflows, the harmonic mean streamflow, and the 25th-, 50th-, and 75th-percentile streamflows.

Table 5. Ranges of basin characteristics for stations used to develop all drainage-area-only equations and equations for estimating mean annual streamflows

[A, drainage area, in square miles; P_c, mean annual precipitation at the basin centroid, in inches; Lat_c, latitude of the basin centroid, in decimal degrees]

Basin characteristic	Minimum	Maximum
A	0.12	7,422
P_c	32.0	43.2
Lat_c	38.68	41.86

Table 6. Ranges of basin characteristics for stations used to develop best-fit equations for estimating the mean monthly streamflows, the harmonic mean streamflow, and the 25th-, 50th-, and 75th-percentile streamflows

[A, drainage area, in square miles; F, percentage of contributing basin area covered by forest; W, percentage of contributing basin area covered by water and wetlands; P_c, mean annual precipitation at the basin centroid, in inches; V_g, streamflow-variability index at streamflow-gaging station; Lat_c, latitude of the basin centroid, in decimal degrees; $Long_c$, longitude of the basin centroid, in decimal degrees]

Basin characteristic	Minimum	Maximum
A	0.12	7,422
P_c	34.0	43.2
Lat_c	38.68	41.59
$Long_c$	80.53	84.6
W	0	19.0
F	0	99.1
V_g	0.25	1.13

As previously stated, the drainage-area-only equations have larger prediction errors than the best-fit equations and exhibit geographic biases for most streamflow statistics. For equations with geographic bias, the average standard errors of prediction (listed in table 3) may poorly estimate the true prediction errors depending on where they are applied in the State. Because of the geographic biases and larger prediction errors associated with the drainage-area-only equations, the best-fit equations should be used whenever possible.

Example Applications of Equations

The equations presented in this report can be applied to rural, ungaged streams by (1) ensuring that the stream is unregulated with respect to the streamflow statistic of interest, (2) determining the basin characteristics required for the appropriate estimation equation, (3) checking to ensure that the basin characteristics fall within the range of characteristic values employed in development of the equation, and (4) using the measured basin characteristics values with the appropriate equation to compute the estimate. For example, assume that an estimate of the mean April streamflow is desired for an ungaged rural, unregulated stream with a drainage area of 20 mi^2, 23 percent of its contributing area covered by forest, and a mean annual precipitation of 34.5 in. at the basin centroid of 41.3 degrees latitude and 82.4 degrees longitude. A comparison of the measured basin characteristics with those listed in table 6 shows that this basin's characteristics fall within the range used to develop the best-fit equation for estimating mean April streamflow. Because the latitude of the basin centroid is north of 41.2 degrees, the following form of equation 5 from table 4 would be used to estimate the mean April streamflow:

$$\overline{Q_{Apr}} = 0.63(A)^{0.98}(F+1)^{0.04}(P_c-27)^{0.45}.$$

Substituting the measured basin characteristics into the above equation yields the following result:

$$\overline{Q_{Apr}} = 0.63(20)^{0.98}(23+1)^{0.04}(34.5-27)^{0.45}$$

$$\overline{Q_{Apr}} = 33.4\frac{ft^3}{s}.$$

If, for some reason, it is desired to use the drainage-area-only equation instead, then equation 5 from table 3 can be used to estimate the mean April streamflow:

$$\overline{Q_{Apr}} = 1.88A^{0.99}.$$

Substituting the measured drainage area into the above equation yields the following result:

$$\overline{Q_{Apr}} = 1.88(20)^{0.99} = 36.5\frac{ft^3}{s}.$$

If a streamflow-gaging station is located at a different point on the same stream for which an estimate of a streamflow statistic is desired, and if the contributing drainage area at the point of interest is between 50 and 150 percent of the contributing area of the gaged site, then the following method of adjusting the estimated streamflow statistic is suggested:

$$Q_{u_a} = Q_{u_r}\left[R-\left(\frac{2(|\Delta A|)(R-1)}{A_g}\right)\right], \qquad (10)$$

where $R = Q_g/Q_{g_r}$

and Q_{u_a} is the adjusted flow statistic for the ungaged site,
Q_{u_r} is the regression estimate of the flow statistic for the ungaged site,
Q_g is the flow statistic determined for the gaged site from measured streamflow data,
Q_{g_r} is the regression estimate of the flow statistic for the gaged site,
$|\Delta A|$ is the absolute value of the difference between the drainage areas of the gaged site and the ungaged site, and
A_g is the drainage area of the gaged site.

To illustrate use of equation 10, assume that there is a streamflow-gaging station downstream on the same stream used for the earlier example, but with a drainage area of 22.1 mi^2, 22 percent of its contributing area covered by forest, and a mean annual precipitation of 34.5 in. at the basin centroid of 41.31 degrees latitude and 82.38 degrees longitude. The mean April streamflow, as determined from the long-term streamflow record at the gaged site is 43.5 ft^3/s. The regression estimate of mean April streamflow for the gaged site is:

$$\overline{Q_{Apr}} = 0.63(22.1)^{0.98}(22+1)^{0.04}(34.5-27)^{0.45}$$

$$\overline{Q_{Apr}} = 36.7\frac{ft^3}{s}.$$

The coefficient R is determined as:

$$R = \frac{Q_g}{Q_{g_r}} = \frac{43.5}{36.7} = 1.19.$$

With R determined, the adjusted mean April flow statistic for the ungaged site is computed as follows:

$$Q_{u_a} = Q_{u_r}\left[R-\left(\frac{2(|\Delta A|)(R-1)}{A_g}\right)\right]$$

$$Q_{u_a} = 33.4\left[1.19-\left(\frac{2(|22.1-20|)(1.19-1)}{22.1}\right)\right]$$

$$Q_{u_a} = 38.5\frac{ft^3}{s}$$

In this case, the adjusted estimate of the mean April streamflow at the ungaged site is 38.5 ft^3/s as compared to the observed mean April streamflow of 43.5 ft^3/s at the downstream site. The estimated mean April streamflow at the ungaged site is approximately 89 percent of the observed mean April streamflow at the gaged site. This results seems reasonable given that the drainage area at the ungaged site is approximately 90 percent of the drainage area at the gaged site.

SUMMARY

Methods for estimating streamflow statistics are needed to answer questions about design and operation of hydraulic structures and water- and wastewater-treatment

facilities where streamflow measurements are lacking. To meet this need, the USGS, in cooperation with the Ohio Department of Natural Resources, Division of Water, and the Ohio Department of Transportation, did a study to compute or compile selected streamflow statistics and to develop equations for estimating those statistics as a function of selected basin characteristics.

Streamflow statistics and basin-characteristics data for 219 active or discontinued streamflow-gaging stations on rural, unregulated streams in Ohio with 10 or more years of homogenous daily streamflow record were computed or compiled and presented in this report. Those data were used to develop equations for estimating mean annual streamflow, mean monthly streamflows, harmonic mean streamflow, and the 25th-, 50th-, and 75th-percentile streamflows as a function of selected basin characteristics.

Simple equations (based on drainage area only) and best-fit equations (based on drainage area and at least two other basin characteristics) were developed by means of ordinary least-squares regression techniques. Application of the best-fit equations generally involves quantification of basin characteristics that require (or are facilitated by) use of a geographic information system (GIS). In addition to drainage area, the best-fit equations may require information on one or more of the following: selected land-cover characteristics of the basin, coordinates of the basin centroid, mean annual precipitation at the basin centroid, and streamflow-variability index at the point of interest. In contrast, the simple equations can be used with information that can be gathered without use of a GIS; however, these equations have larger prediction errors than the best-fit equations and exhibit geographic biases for most streamflow statistics. Because of the geographic biases and larger prediction errors associated with the simple equations, the best-fit equations should be used whenever possible.

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APPENDIXES

1. Mean annual streamflow, harmonic mean streamflow, and the 25th-, 50th-, and 75th- percentile streamflows for selected streamflow-gaging stations in Ohio
2. Mean monthly streamflow statistics for selected streamflow-gaging stations in Ohio
3. Basin characteristics for selected streamflow-gaging stations in Ohio

Appendix 1. Mean annual streamflow, harmonic mean streamflow, and the 25th-, 50th-, and 75th- percentile streamflows for selected streamflow-gaging stations in Ohio

[–, no value computed because of significant regulation with respect to indicated statistic; ft^3/s, cubic feet per second]

Site number	Station ID	Mean annual streamflow (ft^3/s)	Harmonic mean streamflow (ft^3/s)	Percentile streamflow (in ft^3/s) for indicated percentage		
				25	50	75
1	03086500	90.3	–	–	–	–
2	03088000	32	–	4.60	8.85	26.2
3	03089500	16.7	1.03	0.97	2.83	11.4
4	03090500	241	–	–	–	–
5	03091500	269	–	–	–	–
6	03092000	23.3	0.70	0.89	3.72	14.7
7	03092090	28.3	5.08	4.55	11.5	26.3
8	03092460	106	–	–	–	–
9	03092500	99.3	53.7	16.5	39.5	101
10	03093000	115	30.3	22.2	45.5	107
11	03094000	606	–	–	–	–
12	03094500	501	–	–	–	–
13	03095500	89.1	–	–	–	–
14	03096000	119	–	5.40	32.4	161
15	03097550	935	–	–	–	–
16	03098000	873	–	–	–	–
17	03098500	58.1	–	–	–	–
18	03098600	1090	–	–	–	–
19	03099500	1130	–	–	–	–
20	03102950	129	9.31	17.3	56.1	159
21	03109000	5.84	0.69	0.70	2.10	6.26
22	03109500	523	–	101	253	596
23	03110000	162	26.8	26.1	76.1	194
24	03110500	199	16.7	27.2	84.5	222
25	03111500	130	50.9	38.9	80.1	160
26	03111548	113	51.9	41.7	74.2	133
27	03114000	165	7.00	18.4	68.5	182
28	03115400	276	8.31	22.8	98.4	287
29	03115500	344	7.04	23.2	114	350

Appendix 1. Mean annual streamflow, harmonic mean streamflow, and the 25th-, 50th-, and 75th- percentile streamflows for selected streamflow-gaging stations in Ohio—Continued

[–, no value computed because of significant regulation with respect to indicated statistic; ft^3/s, cubic feet per second]

Site number	Station ID	Mean annual streamflow (ft^3/s)	Harmonic mean streamflow (ft^3/s)	Percentile streamflow (in ft^3/s) for indicated percentage		
				25	50	75
30	03116000	149	–	–	–	–
31	03116200	136	–	–	–	–
32	03117000	459	–	–	–	–
33	03117500	272	86.4	62.2	141	325
34	03118000	37.5	–	–	–	–
35	03118500	194	–	–	–	–
36	03119000	500	209	141	262	570
37	03120500	53.4	–	–	–	–
38	03121500	72.4	–	–	–	–
39	03122500	1440	658	434	805	1780
40	03123000	141	–	–	–	–
41	03124000	276	–	–	–	–
42	03124500	303	–	–	–	–
43	03125000	1.28	0.12	0.36	0.72	1.24
44	03126000	139	–	–	–	–
45	03127000	325	–	–	–	–
46	03127500	428	44.2	57.5	206	584
47	03128500	77.5	–	–	–	–
48	03129000	2550	1060	689	1490	3290
49	03130000	207	–	–	–	–
50	03130500	5.12	0.87	0.73	1.54	4.43
51	03131500	361	–	–	–	–
52	03132000	142	–	–	–	–
53	03133500	199	–	–	–	–
54	03134000	100	14.4	10.2	26.8	82.2
55	03135000	243	–	–	–	–
56	03136000	910	345	211	447	1100
57	03136500	222	70.1	49.0	106	235
58	03137000	481	148	95.1	205	500
59	03138500	1530	575	355	774	1850

Appendix 1. Mean annual streamflow, harmonic mean streamflow, and the 25th-, 50th-, and 75th- percentile streamflows for selected streamflow-gaging stations in Ohio—Continued

[–, no value computed because of significant regulation with respect to indicated statistic; ft^3/s, cubic feet per second]

Site number	Station ID	Mean annual streamflow (ft^3/s)	Harmonic mean streamflow (ft^3/s)	Percentile streamflow (in ft^3/s) for indicated percentage		
				25	50	75
60	03139000	427	134	93.6	209	506
61	03140000	27.9	2.14	2.79	10.8	30.9
62	03140500	5030	–	–	–	–
63	03141500	133	–	–	–	–
64	03142000	445	–	–	–	–
65	03142200	53.1	42.5	2.16	13.9	49.1
66	03142500	780	–	–	–	–
67	03143500	935	–	–	–	–
68	03144000	155	29.3	23.7	64.7	166
69	03144500	6390	2500	1590	3590	8500
70	03145000	160	–	–	–	–
71	03146000	138	15.9	13.3	41.9	115
72	03146500	622	168	114	261	663
73	03147000	672	184	116	262	684
74	03147500	837	241	151	366	920
75	03149500	89.2	4.81	7.43	31.1	85.9
76	03150000	7640	2930	1940	4340	10100
77	03156000	10.5	–	–	–	–
78	03156400	41.4	–	–	–	–
79	03157000	90.5	34.1	23.5	45.5	94.4
80	03157500	473	140	96.6	216	514
81	03159000	108	–	–	–	–
82	03159500	1010	232	151	415	1070
83	03159510	1110	–	–	–	–
84	03159540	173	8.22	15.5	59.3	161
85	03201600	1.11	0.16	0.35	0.70	1.13
86	03201700	1.15	0.12	0.34	0.69	1.1
87	03201800	5.73	–	–	–	–
88	03202000	652	54.5	66.8	251	747
89	03217500	214	19.5	14.6	48.6	178

Appendix 1. Mean annual streamflow, harmonic mean streamflow, and the 25th-, 50th-, and 75th- percentile streamflows for selected streamflow-gaging stations in Ohio—Continued

[–, no value computed because of significant regulation with respect to indicated statistic; ft^3/s, cubic feet per second]

Site number	Station ID	Mean annual streamflow (ft^3/s)	Harmonic mean streamflow (ft^3/s)	Percentile streamflow (in ft^3/s) for indicated percentage		
				25	50	75
90	03218000	50.2	1.36	1.14	10.7	45
91	03218500	75	–	–	–	–
92	03219500	469	54.1	36.6	131	427
93	03219590	73.1	0.59	2.38	18.1	56.6
94	03219600	0.09	0.02	0.25	0.51	0.76
95	03220000	160	8.53	8.78	28.6	101
96	03221000	824	–	–	–	–
97	03223000	158	8.55	11.9	43.9	134
98	03224500	97.9	7.87	8.85	28.5	81.5
99	03225500	362	43.3	27.1	86.5	310
100	03226500	365	–	26.5	82.9	290
101	03226800	456	–	–	–	–
102	03227500	1440	–	–	–	–
103	03228000	10.7	0.49	0.53	1.22	7.37
104	03228500	197	25.7	67.3	112	159
105	03228805	114	12.2	8.60	20.6	92.3
106	03229000	176	36.4	18.6	50.6	149
107	03229500	481	134	65.0	159	436
108	03230000	2110	–	–	–	–
109	03230500	471	61.3	50.7	159	459
110	03230800	249	52.6	42.3	102	250
111	03230900	267	–	–	–	–
112	03231000	305	57.9	29.1	105	313
113	03231500	3570	–	–	–	–
114	03232000	243	7.13	18.6	81.4	245
115	03232300	245	–	31.9	97.1	259
116	03232470	584	–	–	–	–
117	03232500	153	22.3	21.7	59	160
118	03234000	833	172	97.7	307	897
119	03234300	1340	–	–	–	–

Appendix 1. Mean annual streamflow, harmonic mean streamflow, and the 25th-, 50th-, and 75th- percentile streamflows for selected streamflow-gaging stations in Ohio—Continued

[–, no value computed because of significant regulation with respect to indicated statistic; ft^3/s, cubic feet per second]

Site number	Station ID	Mean annual streamflow (ft^3/s)	Harmonic mean streamflow (ft^3/s)	Percentile streamflow (in ft^3/s) for indicated percentage		
				25	50	75
120	03234500	4750	–	–	–	–
121	03235000	10.4	0.57	0.70	2.29	8.17
122	03235500	1.24	0.10	0.35	0.70	1.19
123	03236000	299	39.8	27.9	85.4	294
124	03237280	13.8	0.30	0.73	3.19	14.1
125	03237500	459	8.53	24.1	110	353
126	03238500	264	3.71	10.8	44.1	145
127	03240000	121	40.2	30	63.8	135
128	03240500	26.1	2.76	3.21	9.42	27.7
129	03241000	18.1	0.90	1.18	5.10	15.9
130	03241500	64.5	11.6	10.7	28.8	68.6
131	03242000	370	–	–	–	–
132	03242050	425	209	149	266	487
133	03242150	79.3	–	–	–	–
134	03242200	84.3	5.21	9.10	30.9	79.7
135	03242300	210	–	15.2	63.6	194
136	03242500	698	–	115	269	680
137	03244000	224	–	–	–	–
138	03245500	1270	420	215	504	1270
139	03246200	244	12.5	18.5	59.5	190
140	03246500	277	2.81	10.8	46.6	169
141	03247050	421	67.4	36.5	103	376
142	03247500	566	99.7	38.4	113	421
143	03255500	71.9	–	–	–	–
144	03257500	34.1	–	–	–	–
145	03258000	32.4	–	–	–	–
146	03259000	119	–	–	–	–
147	03260700	34	13.8	9.69	19.4	38.2
148	03260800	53.2	22.1	16.1	29.3	56.4
149	03261500	491	–	–	–	–

Appendix 1. Mean annual streamflow, harmonic mean streamflow, and the 25th-, 50th-, and 75th- percentile streamflows for selected streamflow-gaging stations in Ohio—Continued

[–, no value computed because of significant regulation with respect to indicated statistic; ft^3/s, cubic feet per second]

Site number	Station ID	Mean annual streamflow (ft^3/s)	Harmonic mean streamflow (ft^3/s)	Percentile streamflow (in ft^3/s) for indicated percentage		
				25	50	75
150	03261950	140	–	–	–	–
151	03262000	216	–	–	–	–
152	03262700	853	–	–	–	–
153	03263000	1020	–	–	–	–
154	03264000	181	–	35.7	76.5	174
155	03265000	454	–	60.4	146	380
156	03266000	592	–	–	–	–
157	03266500	7.72	2.69	1.86	3.59	8.44
158	03267000	151	95.2	72.5	111	177
159	03267500	256	–	–	–	–
160	03268000	65.6	40.1	29.9	45.2	71.5
161	03268500	39.5	–	10.4	19.1	39.9
162	03269000	123	–	–	–	–
163	03269500	499	–	–	–	–
164	03270000	639	–	–	–	–
165	03270500	2290	–	–	–	–
166	03270800	23.2	1.83	2.11	6.89	19.4
167	03271000	65.2	12.1	10.1	22.0	52.9
168	03271800	200	26.4	20.7	63.4	167
169	03272000	270	35.2	27.8	84.4	236
170	03272700	73.3	11.1	8.70	27.2	68.8
171	03272800	103	11.7	9.34	30.6	87.8
172	03273500	301	–	19.5	87.8	257
173	03274000	3370	–	–	–	–
174	03274500	3960	–	–	–	–
175	04177000	127	–	15.8	40.7	112
176	04183500	1690	–	–	–	–
177	04184500	167	–	28.0	65.5	181
178	04185000	336	–	–	–	–
179	04185440	4.5	0.15	0.44	0.88	2.67

Appendix 1. Mean annual streamflow, harmonic mean streamflow, and the 25th-, 50th-, and 75th- percentile streamflows for selected streamflow-gaging stations in Ohio—Continued

[–, no value computed because of significant regulation with respect to indicated statistic; ft³/s, cubic feet per second]

Site number	Station ID	Mean annual streamflow (ft^3/s)	Harmonic mean streamflow (ft^3/s)	Percentile streamflow (in ft^3/s) for indicated percentage		
				25	50	75
180	04186500	288	–	–	–	–
181	04187100	115	–	–	–	–
182	04187500	126	–	–	–	–
183	04189000	261	23.1	21.8	61.0	196
184	04189500	595	–	43.4	149	508
185	04191500	1790	–	–	–	–
186	04192500	4420	–	–	–	–
187	04193500	4980	–	–	–	–
188	04195500	337	–	18.6	70.5	263
189	04196000	89.2	8.32	7.08	22.5	69.4
190	04196500	246	–	18.6	62.4	212
191	04196800	188	–	–	–	–
192	04197000	594	62.5	47.4	144	492
193	04197020	16	–	1.05	4.29	13.7
194	04197100	135	4.81	8.04	32.7	111
195	04197170	31.9	3.64	2.71	6.61	17.2
196	04198000	1030	106	79.8	279	880
197	04198500	62.8	7.56	6.45	15.4	43.8
198	04199000	315	40.0	31.4	86.1	262
199	04199155	20.8	–	0.94	5.10	16.8
200	04199500	259	6.67	13.5	54.9	191
201	04200000	182	2.40	5.57	26.1	116
202	04200500	339	–	–	–	–
203	04201500	283	–	–	–	–
204	04202000	214	–	–	–	–
205	04204000	14.6	–	–	–	–
206	04204500	27.6	–	–	–	–
207	04205000	4.85	–	–	–	–
208	04206000	440	–	–	–	–
209	04207200	134	43.4	33.5	64.1	143

Appendix 1. Mean annual streamflow, harmonic mean streamflow, and the 25th-, 50th-, and 75th- percentile streamflows for selected streamflow-gaging stations in Ohio—Continued

[–, no value computed because of significant regulation with respect to indicated statistic; ft^3/s, cubic feet per second]

Site number	Station ID	Mean annual streamflow (ft^3/s)	Harmonic mean streamflow (ft^3/s)	Percentile streamflow (in ft^3/s) for indicated percentage		
				25	50	75
210	04208000	860	–	–	–	–
211	04208502	54.7	–	–	–	–
212	04209000	342	89.2	70.2	154	347
213	04210000	35.6	2.10	1.60	6.04	25.7
214	04211000	75.6	1.29	1.05	12.0	59.8
215	04211500	107	–	–	–	–
216	04212000	663	24.2	29.4	168	722
217	04212100	1050	111	113	429	1240
218	04212500	155	–	4.80	40.5	142
219	04213000	275	–	28.3	101	277

Appendix 2. Mean monthly streamflow statistics for selected streamflow-gaging stations in Ohio

[Gaps in the site-number sequence are due to omission of stations that are substantially regulated with respect to mean monthly streamflow; ft^3/s, cubic feet per second]

Site number	Station ID	Mean monthly streamflow (ft^3/s) for indicated month											
		October	November	December	January	February	March	April	May	June	July	August	September
2	03088000	7.21	13.1	30.4	53.1	65.8	69.9	47.1	45.9	29.2	9.48	9.28	5.53
3	03089500	4.19	6.15	15.7	27.1	35.4	41.5	29.3	22.9	8.40	6.62	3.07	1.35
6	03092000	5.99	15.4	30.2	33.1	44.5	55.2	37.1	27.5	13.2	8.97	4.03	5.65
7	03092090	11.2	28.7	45.1	33.6	47.4	55.1	40.3	28.0	17.3	13.0	7.49	13.4
9	03092500	35.1	49.8	96.6	162	169	226	175	107	55.8	35.7	25.3	16.8
10	03093000	46.4	86.8	140	164	201	239	197	121	71.8	49.2	30.6	35.0
14	03096000	11.1	42.2	110	225	198	299	245	105	57.6	26.2	22.6	11.7
20	03102950	63.4	149	208	156	231	254	178	114	76.1	46.1	33.3	48.6
21	03109000	1.83	1.79	4.76	9.63	11.7	11.5	11.6	7.29	5.14	2.68	1.70	0.84
22	03109500	178	327	544	718	862	1130	917	658	395	255	174	144
23	03110000	47.2	96.3	171	221	279	353	302	217	120	64.1	47.5	36.7
24	03110500	72.0	138	219	294	305	407	296	253	158	89.0	85.0	76.8
25	03111500	53.0	76.4	117	158	204	248	224	173	117	79.2	62.9	51.5
26	03111548	45.7	98.2	116	143	159	186	162	152	120	79.8	50.5	44.7
27	03114000	47.8	110	203	238	289	340	267	196	113	72.0	64.5	50.8
28	03115400	74.5	158	321	406	489	578	459	324	245	95.0	87.8	84.1
29	03115500	159	251	441	522	605	724	471	355	213	108	208	83.8
33	03117500	97.1	172	288	353	462	564	467	342	219	139	95.7	82.1
36	03119000	201	309	484	738	770	1010	743	570	428	298	259	204
39	03122500	524	862	1530	2180	2210	2640	1910	1380	897	765	764	602
43	03125000	0.33	0.61	1.33	1.96	2.31	2.96	2.38	1.38	0.88	0.64	0.34	0.36
46	03127500	113	321	538	718	699	890	613	419	223	168	175	140

Appendix 2. Mean monthly streamflow statistics for selected streamflow-gaging stations in Ohio—Continued

[Gaps in the site-number sequence are due to omission of stations that are substantially regulated with respect to mean monthly streamflow; ft^3/s, cubic feet per second]

Site number	Station ID	Mean monthly streamflow (ft^3/s) for indicated month											
		October	November	December	January	February	March	April	May	June	July	August	September
48	03129000	811	1670	2750	3730	3520	4750	3650	2530	1440	1170	1190	929
50	03130500	1.28	3.23	5.39	8.22	8.10	10.6	935	5.90	3.10	2.49	1.97	1.95
54	03134000	26.2	52.6	98.7	169	171	224	175	111	85.3	49.6	27.9	18.6
56	03136000	298	589	1010	1390	1300	1790	1310	1020	558	485	365	291
57	03136500	63.6	144	241	277	348	426	384	273	207	156	83.6	67.3
58	03137000	117	264	471	760	770	1020	847	575	413	256	167	133
59	03138500	458	954	1680	2370	2150	2890	2130	1660	949	760	595	473
60	03139000	136	227	383	549	669	869	744	521	404	289	201	145
61	03140000	6.76	14.8	29.5	39	49.7	58.9	53.4	32.8	22.5	14.7	7.56	6.47
65	03142200	5.71	16.1	45.6	70.8	110	157	110	60.0	23.0	25.8	9.68	8.14
68	03144000	37.2	86.2	156	221	256	310	298	197	127	81.9	58.5	37.5
69	03144500	1850	3850	6940	9260	8630	12100	9540	6600	3720	2860	3070	2220
71	03146000	36.4	100	153	181	238	289	248	122	128	64.8	65.5	41.6
72	03146500	168	433	682	855	1040	1170	1040	715	565	384	263	172
73	03147000	180	344	687	1170	1170	1310	1120	713	589	363	266	163
74	03147500	144	280	649	1290	1440	1580	1400	894	694	497	227	136
75	03149500	17.6	51.4	66.7	124	159	196	166	109	92.5	45.3	30.2	16.7
76	03150000	2130	4460	8230	10900	9710	13500	10900	7910	4600	3380	3730	2530
79	03157000	29.1	53.6	88.3	117	145	173	156	124	74.4	54.4	44.6	29.6
80	03157500	124	252	426	644	784	951	854	624	373	279	230	154
82	03159500	215	556	1070	1760	1760	2140	1710	1220	783	477	385	310
84	03159540	54.5	108	207	249	315	358	278	246	101	70.3	65.2	36.6

Appendix 2. Mean monthly streamflow statistics for selected streamflow-gaging stations in Ohio—Continued

[Gaps in the site-number sequence are due to omission of stations that are substantially regulated with respect to mean monthly streamflow; ft^3/s, cubic feet per second]

Site number	Station ID	Mean monthly streamflow (ft^3/s) for indicated month											
		October	November	December	January	February	March	April	May	June	July	August	September
85	03201600	0.31	0.69	1.48	1.51	2.02	2.05	1.97	1.39	0.78	0.50	0.36	0.38
86	03201700	0.32	0.68	1.50	1.50	2.21	2.14	1.84	1.47	0.89	0.52	0.39	0.40
88	03202000	123	312	661	959	1190	1490	1200	897	426	243	204	129
89	03217500	82.8	91.9	215	436	350	440	353	220	212	80.8	57.5	33.5
90	03218000	3.26	15.8	41.3	84.0	95.3	124	103	60.6	51.1	16.7	6.35	4.23
92	03219500	117	262	491	714	783	1020	875	494	409	272	125	95.9
93	03219590	16.4	59.4	105	82.2	111	101	110	108	73.0	95.5	9.58	8.49
94	03219600	0.01	0.02	0.07	0.20	0.18	0.19	0.17	0.09	0.08	0.02	0.04	0.01
95	03220000	26.3	98.4	173	257	285	332	290	178	147	79.6	39.5	24.2
97	03223000	29.5	106	178	256	281	314	263	165	145	94.0	44.9	28.9
98	03224500	16.2	65.6	97.3	142	151	228	177	120	74.5	54.9	28.2	23.0
99	03225500	118	209	382	541	591	742	539	353	321	126	80.3	108
100	03226500	31.3	117	293	685	782	901	772	384	524	120	69.1	49.4
103	03228000	0.35	3.52	10.9	26.1	22.8	16.7	20.3	10.1	7.84	5.36	3.30	1.38
104	03228500	11.8	76.2	206	383	400	407	332	169	213	101	44.5	18.1
105	03228805	30.5	86.7	138	140	161	264	274	207	85.6	57.9	39.8	17.9
106	03229000	34.6	84.7	176	274	280	353	301	195	145	72.6	47.5	32.6
107	03229500	108	272	597	938	884	1010	804	529	450	236	151	107
109	03230500	106	262	475	714	788	940	833	584	459	259	158	94.1
110	03230800	57.5	167	291	316	367	447	393	356	295	123	113	75.1
112	03231000	54.4	107	234	477	520	706	524	323	201	98.9	69.7	61.7
114	03232000	47.2	111	247	379	422	496	401	329	225	102	74.9	57.5

Appendix 2. Mean monthly streamflow statistics for selected streamflow-gaging stations in Ohio—Continued

[Gaps in the site-number sequence are due to omission of stations that are substantially regulated with respect to mean monthly streamflow; ft^3/s, cubic feet per second]

Site number	Station ID	Mean monthly streamflow (ft^3/s) for indicated month											
		October	November	December	January	February	March	April	May	June	July	August	September
115	03232300	100	204	365	325	373	434	366	222	230	104	105	116
117	03232500	23.4	66.8	133	282	321	351	283	144	138	64.5	48.1	41.4
118	03234000	163	356	800	1730	1480	1770	1380	826	542	352	357	206
121	03235000	0.75	3.38	11.4	23.0	22.7	18.8	19.0	10.0	4.93	5.73	3.34	1.97
122	03235500	0.07	0.38	1.07	1.82	2.21	3.2	3.27	1.92	0.52	0.25	0.14	0.15
123	03236000	26.5	85.9	193	395	567	728	712	378	282	94.5	78.9	64.9
124	03237280	2.70	6.73	17.8	16.2	23.8	29.8	29.7	18.6	6.70	4.13	3.30	3.50
125	03237500	91.6	262	541	747	823	1030	740	553	255	186	150	130
126	03238500	62.1	162	295	438	488	561	442	295	169	97.5	87.3	80.8
127	03240000	35.3	70.7	111	142	181	214	200	175	134	88.5	64.8	38.1
128	03240500	4.28	11.5	20.2	31	44.6	65.9	46.5	37.1	20.0	14.1	13.7	5.68
129	03241000	1.72	6.63	13.3	21.2	32.0	45.8	32.0	29.2	15.6	9.10	8.95	2.06
130	03241500	15.4	41.6	65.3	79.2	102	121	109	94.3	65.2	40.8	28.3	15.1
132	03242050	171	286	454	505	618	626	653	505	473	328	281	213
134	03242200	23.9	60.6	110	123	150	146	135	91	65.1	49.5	28.9	32.4
135	03242300	26.8	141	209	244	313	508	436	356	144	72.9	43.5	40.1
136	03242500	143	295	556	1220	1360	1410	1270	781	674	304	211	192
138	03245500	290	689	1160	1980	2100	2480	2160	1440	969	646	431	329
139	03246200	81.9	195	366	362	403	413	374	244	172	106	104	116
140	03246500	44.7	182	308	509	468	655	498	302	118	73.6	69.4	113
141	03247050	98	411	608	670	727	757	732	492	238	135	174	166
142	03247500	118	303	582	1130	958	1210	876	502	339	292	182	105

Appendix 2. Mean monthly streamflow statistics for selected streamflow-gaging stations in Ohio—Continued

[Gaps in the site-number sequence are due to omission of stations that are substantially regulated with respect to mean monthly streamflow; ft^3/s, cubic feet per second]

Site number	Station ID	Mean monthly streamflow (ft^3/s) for indicated month											
		October	November	December	January	February	March	April	May	June	July	August	September
147	03260700	12.8	22.5	37.6	37.9	50.2	63.1	59.6	44.9	32.3	22.4	15.1	11.1
148	03260800	18.0	34.2	51.8	69.4	76.0	98.0	92.3	65.0	48.7	39.2	27.8	19.3
154	03264000	56.2	112	179	251	279	333	323	221	190	111	69.8	48.5
155	03265000	132	292	451	619	718	928	842	480	472	274	149	117
157	03266500	2.17	4.24	7.17	10.9	11.3	15.5	15.9	10.8	5.96	4.01	2.76	2.18
158	03267000	84.8	101	131	174	201	224	222	189	165	135	103	86.0
160	03268000	29.5	39.6	52.7	87.0	95.7	94.6	96.0	82.1	82.0	55.8	41.2	33.6
161	03268500	11.0	19.7	38.8	69.1	71.8	67.1	64.7	41.2	46.4	25.2	17.7	11.7
166	03270800	3.81	20.8	31.2	26.5	36.4	51.5	40.4	30.6	19.3	8.92	7.89	2.53
167	03271000	17.0	32.3	55.8	94.8	103	112	129	95.3	69.3	37.3	23.1	16.7
168	03271800	49.6	144	261	234	296	398	361	294	176	105	59.2	22.4
169	03272000	58.1	159	292	453	458	529	477	345	241	140	78.2	47.0
170	03272700	18.6	57.3	91.0	90.0	107	142	134	114	63.5	35.6	19.3	9.45
171	03272800	11.5	40.8	103	113	152	258	231	202	61.1	31.4	25.4	11.1
172	03273500	40.7	107	226	607	613	684	586	257	267	111	51.7	58.4
175	04177000	61.5	101	137	121	176	297	247	129	134	54.0	31.5	43.8
177	04184500	42.8	86.9	165	186	279	393	338	221	128	90.9	41.0	42.5
179	04185440	2.88	5.02	6.85	5.64	7.44	7.69	7.34	3.48	2.80	1.87	2.23	0.92
183	04189000	63.0	157	290	374	427	562	461	276	233	135	64.3	88.2
184	04189500	193	315	696	1080	1150	1230	1020	701	491	120	85.3	279
188	04195500	84.2	200	356	461	522	765	640	409	288	154	84.3	88.9
189	04196000	23.6	57.5	112	144	145	189	147	93.7	77.4	36.3	25.0	21.8

Appendix 2. Mean monthly streamflow statistics for selected streamflow-gaging stations in Ohio—Continued

[Gaps in the site-number sequence are due to omission of stations that are substantially regulated with respect to mean monthly streamflow; ft^3/s, cubic feet per second]

Site number	Station ID	Mean monthly streamflow (ft^3/s) for indicated month											
		October	November	December	January	February	March	April	May	June	July	August	September
190	04196500	53.0	127	263	400	441	573	444	254	191	96.3	56.2	62.8
192	04197000	118	275	601	948	1110	1470	1070	588	459	226	129	154
193	04197020	8.40	19.5	20.6	11.0	29.2	30.8	25.7	17.3	13.8	11.0	1.55	4.60
194	04197100	30.2	108	169	157	232	285	247	122	123	76.2	42.3	35.5
195	04197170	12.3	38.7	40.9	34.1	56.9	49.1	55.1	22.4	13.5	15.2	6.27	13.6
196	04198000	223	587	1100	1580	1940	2340	1830	1070	820	464	232	255
197	04198500	39.8	38.3	66.3	128	122	137	100	48.9	19.5	18.6	11.1	27.4
198	04199000	55.2	173	352	474	550	703	571	320	238	182	101	76.9
199	04199155	4.51	14.3	25.3	36.3	35.3	35.6	43.5	19.5	16.6	6.49	6.21	7.01
200	04199500	29.9	118	321	378	474	751	455	247	119	140	42.6	40.1
201	04200000	58.3	91.1	230	361	337	401	263	142	83.8	70.1	49.5	71.3
209	04207200	70.0	139	178	156	203	239	194	126	90.7	80.5	65.2	75.1
212	04209000	212	468	488	615	559	603	614	383	277	143	216	202
213	04210000	12.0	18.0	43.0	58.1	77.3	83.2	61.0	37.5	16.8	6.87	10.9	4.90
214	04211000	21.7	42.0	83.2	132	149	196	141	81.3	35.6	12.0	12.7	5.16
216	04212000	221	472	840	1070	1250	1630	1160	670	268	148	107	143
217	04212100	509	1250	1610	1470	1800	2020	1480	834	686	274	251	429
218	04212500	67.7	150	246	230	263	348	244	140	62.4	32.4	25.6	42.8
219	04213000	138	321	422	423	460	539	392	234	135	77.4	66.3	106

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	A	Lat_s	$Long_s$	P_c	F	W	Physio-graphic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
1	03086500	89.2	40.93	81.09	36.4	24.7	2.8	4	0	40.88	80.90	0.61
2	03088000	33.2	40.98	81.16	35.7	26.3	9.8	4	0	41.00	81.08	0.59
3	03089500	19.1	41.00	80.97	35.5	30.9	3.8	4	0	40.96	80.83	0.69
4	03090500	248	41.05	81.00	35.9	29.2	7.5	4	0	40.94	80.95	0.67
5	03091500	273	41.13	80.97	35.7	30.7	8.3	4	0	40.95	80.94	0.74
6	03092000	21.9	41.14	81.00	35.1	44.3	7.1	4	0	41.09	80.93	0.78
7	03092090	21.8	41.16	81.20	38.0	39.8	10.2	4	1	41.21	81.08	0.51
8	03092460	81.7	41.16	81.07	36.0	45.4	11.9	4	0	41.15	81.05	0.59
9	03092500	96.3	41.17	81.02	35.9	46.0	11.3	4	0	41.15	81.04	0.54
10	03093000	97.6	41.26	80.95	38.1	49.4	10.5	4	1	41.27	80.96	0.46
11	03094000	575	41.24	80.88	35.1	38.7	10.0	4	0	41.08	80.94	0.54
12	03094500	594	41.24	80.83	35.2	38.5	10.0	4	0	41.09	80.93	0.58
13	03095500	97.5	41.30	80.76	38.2	31.5	23.9	4	1	41.43	80.62	0.62
14	03096000	138	41.18	80.76	37.5	33.7	20.4	4	1	41.38	80.62	0.62
15	03097550	854	41.17	80.76	35.2	37.9	11.5	4	0	41.14	80.85	0.62
16	03098000	898	41.11	80.67	35.1	38.1	11.4	4	0	41.14	80.84	0.61
17	03098500	66.3	41.07	80.69	35.2	30.1	5.4	4	0	40.99	80.59	0.62
18	03098600	978	41.11	80.66	35.0	37.2	10.9	4	0	41.13	80.82	0.61
19	03099500	1073	41.04	80.54	35.0	36.9	10.8	4	0	41.12	80.79	0.60
20	03102950	96.7	41.44	80.59	39.0	31.9	12.9	4	1	41.50	80.53	0.63

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	*A*	Lat_s	$Long_s$	P_c	*F*	*W*	Physiographic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
21	03109000	6.19	40.78	80.76	36.5	23.9	0.4	5	0	40.82	80.66	0.62
22	03109500	496	40.68	80.54	36.0	–	–	5	0	40.80	80.53	0.56
23	03110000	147	40.54	80.73	37.8	69.7	1.1	5	0	40.51	80.77	0.56
24	03110500	164	40.55	80.71	37.7	70.2	1.1	5	0	40.52	80.76	0.58
25	03111500	123	40.19	80.73	39.3	52.3	2.3	5	0	40.25	80.77	0.38
26	03111548	97.7	40.07	80.81	39.6	43.5	1.2	5	0	40.13	80.84	0.33
27	03114000	134	39.91	80.92	41.0	51.2	0.8	5	0	39.93	80.96	0.68
28	03115400	210	39.56	81.20	40.5	81.2	0.3	5	0	39.67	81.03	0.75
29	03115500	258	39.48	81.29	40.4	82.6	0.4	5	0	39.64	81.04	0.78
30	03116000	174	40.93	81.63	36.6	26.0	7.2	4	0	41.03	81.47	0.53
31	03116200	146	40.95	81.74	36.8	17.7	2.4	4	0	41.00	81.72	0.52
32	03117000	518	40.77	81.52	36.3	21.7	4.8	4	0	40.96	81.55	0.47
33	03117500	253	40.67	81.26	37.3	37.2	2.6	5	0	40.72	80.98	0.44
34	03118000	43.1	40.84	81.35	36.0	12.0	4.3	4	0	40.91	81.18	0.50
35	03118500	175	40.73	81.35	36.3	14.6	2.6	4	0	40.85	81.22	0.44
36	03119000	481	40.63	81.37	37.0	30.1	2.9	5	0	40.76	81.09	0.37
37	03120500	48.3	40.47	81.20	38.0	61.4	4.0	5	0	40.50	81.00	0.55
38	03121500	70	40.53	81.29	37.8	52.9	4.4	5	0	40.58	81.05	0.48
39	03122500	1405	40.53	81.43	36.7	33.3	3.7	5	0	40.78	81.27	0.40
40	03123000	160	40.66	81.58	36.4	15.6	1.4	5	0	40.74	81.61	0.46

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	*A*	Lat_s	$Long_s$	P_c	*F*	*W*	Physiographic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
41	03124000	300	40.64	81.55	37.0	21.1	1.7	5	0	40.64	81.59	0.45
42	03124500	311	40.59	81.52	37.0	21.7	1.7	5	0	40.64	81.58	0.44
43	03125000	1.64	40.47	81.40	38.3	36.8	0.3	5	0	40.48	81.28	0.48
44	03126000	122	40.20	81.22	40.4	55.9	5.0	5	0	40.12	81.03	0.64
45	03127000	282	40.27	81.29	40.1	61.2	3.8	5	0	40.17	81.08	0.64
46	03127500	367	40.39	81.35	40.0	63.1	3.2	5	0	40.20	81.12	0.72
47	03128500	71.1	40.36	81.23	39.3	67.4	6.1	5	0	40.34	80.99	0.63
48	03129000	2443	40.26	81.61	37.4	39.8	3.2	5	0	40.62	81.29	0.41
49	03130000	217	40.74	82.36	36.6	23.3	3.4	2	0	40.87	82.42	0.52
50	03130500	5.44	40.76	82.55	36.9	25.5	2.5	5	0	40.76	82.46	0.51
51	03131500	349	40.64	82.24	36.3	29.0	2.8	2	0	40.82	82.37	0.48
52	03132000	136	40.59	82.42	37.0	37.7	2.3	5	0	40.66	82.49	0.49
53	03133500	198	40.62	82.32	36.8	43.8	2.5	5	0	40.65	82.43	0.48
54	03134000	120	40.80	82.20	36.0	24.9	1.2	4	0	40.90	82.17	0.57
55	03135000	271	40.72	82.16	36.0	24.4	2.2	4	0	40.87	82.10	0.53
56	03136000	948	40.51	82.20	36.0	33.1	2.3	4	0	40.77	82.27	0.43
57	03136500	202	40.41	82.50	37.9	26.6	1.3	2	0	40.50	82.51	0.43
58	03137000	455	40.40	82.29	38.4	31.0	1.1	2	0	40.45	82.39	0.44
59	03138500	1505	40.34	82.07	37.0	34.5	2.0	5	0	40.65	82.29	0.44
60	03139000	464	40.49	81.99	36.2	29.3	2.5	5	0	40.73	81.85	0.45

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	*A*	Lat_s	$Long_s$	P_c	*F*	*W*	Physiographic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
61	03140000	27.2	40.36	81.86	36.4	38.6	0.2	5	0	40.41	81.71	0.64
62	03140500	4859	40.25	81.87	37.2	38.0	2.6	5	0	40.62	81.69	0.53
63	03141500	118	39.92	81.44	40.7	62.6	5.5	5	0	39.87	81.19	0.78
64	03142000	406	40.01	81.59	40.1	58.9	2.6	5	0	39.91	81.34	0.78
65	03142200	55.6	40.08	81.46	40.4	64.5	2.0	5	0	40.05	81.22	1.05
66	03142500	730	40.17	81.65	39.9	60.5	2.6	5	0	39.99	81.37	0.55
67	03143500	842	40.16	81.85	39.6	59.8	2.9	5	0	40.02	81.41	0.52
68	03144000	140	40.13	82.15	40.0	50.2	0.3	5	0	40.23	82.09	0.52
69	03144500	5993	40.12	82.00	38.0	41.7	2.6	5	0	40.51	81.67	0.45
70	03145000	133	39.99	82.48	38.6	20.0	4.4	2	0	39.97	82.47	0.51
71	03146000	116	40.23	82.45	38.0	18.2	0.9	2	0	40.28	82.47	0.60
72	03146500	537	40.06	82.34	38.4	26.6	1.7	2	0	40.11	82.44	0.47
73	03147000	672	40.06	82.22	38.7	31.7	1.5	2	0	40.11	82.39	0.46
74	03147500	742	39.99	82.08	39.0	33.5	1.7	2	0	40.11	82.36	0.47
75	03149500	75.7	39.91	81.86	39.0	42.1	0.3	5	0	39.99	81.74	0.65
76	03150000	7422	39.65	81.85	36.6	41.8	2.4	5	0	40.42	81.76	0.45
77	03156000	10	39.71	82.62	38.5	23.2	0.4	2	0	39.70	82.57	0.55
78	03156400	48.2	39.71	82.60	38.4	15.2	0.5	2	0	39.74	82.56	0.54
79	03157000	89	39.59	82.58	38.9	36.1	0.3	2	0	39.64	82.59	0.38
80	03157500	459	39.56	82.47	39.0	37.8	0.8	5	0	39.70	82.39	0.45

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	A	Lat_s	$Long_s$	P_c	F	W	Physiographic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
81	03159000	104	39.50	82.09	40.0	84.9	1.4	5	0	39.59	81.97	0.54
82	03159500	943	39.33	82.09	40.0	56.6	1.0	5	0	39.60	82.25	0.52
83	03159510	957	39.33	80.01	40.0	56.9	1.0	5	0	39.59	82.24	0.54
84	03159540	156	39.06	81.88	40.8	58.8	0.3	5	0	39.16	81.90	0.69
85	03201600	0.98	39.36	82.31	40.0	94.8	0.0	5	0	39.37	82.20	0.60
86	03201700	1.01	39.36	82.31	40.0	93.9	0.0	5	0	39.38	82.21	0.60
87	03201800	4.99	39.33	82.33	40.0	97.0	0.0	5	0	39.36	82.21	0.60
88	03202000	585	38.87	82.36	41.0	70.5	0.8	5	0	39.18	82.29	0.66
89	03217500	257	40.57	83.39	35.0	7.3	0.5	2	0	40.61	83.57	0.66
90	03218000	72.4	40.63	83.17	35.7	4.9	0.4	2	0	40.70	82.95	1.00
91	03218500	85.8	40.59	83.18	35.6	4.9	0.6	2	0	40.68	82.96	0.92
92	03219500	567	40.42	83.20	35.0	7.2	0.8	2	0	40.58	83.34	0.64
93	03219590	83.2	40.32	83.18	35.6	6.5	0.5	2	0	40.40	83.33	0.69
94	03219600	0.12	40.33	83.15	36.3	0.0	5.1	2	0	40.33	83.04	0.70
95	03220000	178	40.25	83.17	36.1	14.7	0.8	2	0	40.30	83.28	0.69
96	03221000	980	40.14	83.12	35.2	8.8	0.9	2	0	40.48	83.29	0.71
97	03223000	157	40.58	82.99	36.2	12.9	0.7	2	0	40.69	82.77	0.68
98	03224500	98.7	40.45	82.96	36.8	19.5	0.7	2	0	40.56	82.74	0.62
99	03225500	393	40.35	83.07	36.3	14.6	1.3	2	0	40.59	82.82	0.72
100	03226500	445	40.26	83.06	36.4	14.4	1.3	2	0	40.56	82.83	0.71

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	*A*	Lat_s	$Long_s$	P_c	*F*	*W*	Physio-graphic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
101	03226800	497	40.11	83.03	36.6	15.9	1.3	2	0	40.52	82.84	0.73
102	03227500	1629	39.91	83.01	35.5	11.3	1.1	2	0	40.45	83.13	0.79
103	03228000	11	39.92	83.07	37.7	15.3	0.7	2	0	39.93	83.01	1.03
104	03228500	190	40.10	82.88	37.4	23.8	3.1	2	0	40.28	82.70	0.80
105	03228805	122	40.18	82.96	37.2	24.5	4.3	2	0	40.36	82.80	0.70
106	03229000	189	39.94	82.94	37.0	23.6	3.3	2	0	40.28	82.85	0.64
107	03229500	544	39.86	82.96	37.1	23.1	2.8	2	0	40.19	82.75	0.60
108	03230000	2638	39.63	82.96	36.7	13.6	1.5	2	0	40.29	82.98	0.63
109	03230500	534	39.70	83.11	38.0	9.5	0.8	2	0	40.06	83.26	0.58
110	03230800	228	39.72	83.26	38.5	5.0	0.7	2	0	39.86	83.29	0.50
111	03230900	277	39.62	83.21	38.7	5.6	1.3	2	0	39.82	83.27	0.60
112	03231000	333	39.59	83.12	38.8	5.6	1.2	2	0	39.80	83.23	0.62
113	03231500	3849	39.34	82.97	37.0	12.0	1.3	2	0	40.14	83.03	0.61
114	03232000	249	39.38	83.38	39.2	3.4	0.2	2	0	39.62	83.38	0.74
115	03232300	209	39.33	83.48	40.9	4.7	0.2	2	0	39.50	83.50	0.65
116	03232470	570	39.25	83.35	39.7	6.7	0.6	2	0	39.51	83.42	0.56
117	03232500	140	39.22	83.39	43.0	26.1	2.8	2	0	39.20	83.44	0.53
118	03234000	807	39.26	83.17	40.3	14.5	1.0	2	0	39.43	83.39	0.61
119	03234300	1136	39.32	82.98	39.7	17.7	0.8	2	0	39.44	83.31	0.61
120	03234500	5131	39.21	82.86	37.7	14.6	1.2	2	0	39.96	83.09	0.60

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	A	Lat_s	$Long_s$	P_c	F	W	Physiographic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
121	03235000	11.5	39.56	82.78	39.0	18.2	0.0	2	0	39.60	82.68	0.79
122	03235500	1.35	39.39	82.75	39.0	98.4	0.0	5	0	39.40	82.64	0.61
123	03236000	286	39.26	82.77	39.4	68.7	0.4	5	0	39.44	82.57	0.60
124	03237280	12.2	38.64	83.22	43.2	99.1	0.0	5	0	38.68	83.13	0.92
125	03237500	387	38.80	83.42	43.0	39.3	0.4	3	0	38.99	83.40	0.79
126	03238500	218	38.86	83.93	42.0	17.0	0.3	2	0	39.05	83.71	0.82
127	03240000	129	39.75	83.93	38.0	9.2	0.6	2	0	39.84	83.63	0.42
128	03240500	28.9	39.76	83.79	38.4	0.0	0.2	2	0	39.78	83.59	0.60
129	03241000	17.1	39.74	83.76	38.8	0.0	0.2	2	0	39.74	83.58	0.69
130	03241500	63.2	39.72	83.88	38.5	5.1	0.2	2	0	39.76	83.62	0.51
131	03242000	361	39.61	84.01	38.5	10.9	0.5	2	0	39.76	83.76	0.37
132	03242050	366	39.58	84.03	38.5	11.2	0.5	2	0	39.76	83.76	0.33
133	03242150	71.4	39.62	83.90	39.7	5.8	0.5	2	0	39.67	83.67	0.55
134	03242200	77.8	39.57	83.90	42.4	5.2	0.3	2	0	39.54	83.65	0.66
135	03242300	209	39.51	84.01	41.2	8.4	1.5	2	0	39.59	83.71	0.47
136	03242500	680	39.38	84.09	39.8	12.1	1.1	2	0	39.67	83.77	0.59
137	03244000	219	39.33	84.09	43.0	16.0	0.9	2	0	39.41	83.76	0.62
138	03245500	1203	39.17	84.30	41.8	16.8	1.1	2	0	39.53	83.85	0.52
139	03246200	195	39.11	84.03	43.0	12.0	0.5	2	0	39.24	83.73	0.68
140	03246500	237	39.05	84.05	42.6	13.0	0.5	2	0	39.22	83.75	0.87

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; A, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; F, percentage of contributing basin area covered by forest; W, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	A	Lat_s	$Long_s$	P_c	F	W	Physiographic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
141	03247050	352	39.06	84.18	41.8	20.4	1.4	2	0	39.14	83.82	0.78
142	03247500	476	39.14	84.24	41.5	24.5	1.2	2	0	39.15	83.87	0.77
143	03255500	73	39.22	84.45	40.6	16.9	0.4	2	0	39.31	84.32	0.65
144	03257500	32.2	39.25	84.47	40.0	23.6	1.2	2	0	39.25	84.43	0.65
145	03258000	35.6	39.23	84.46	40.0	24.1	1.1	2	0	39.25	84.43	0.65
146	03259000	115	39.20	84.47	40.1	19.4	0.6	2	0	39.28	84.36	0.66
147	03260700	36.3	40.35	83.89	35.9	13.5	0.8	2	0	40.37	83.68	0.37
148	03260800	59.1	40.29	83.91	36.4	12.2	0.8	2	0	40.29	83.74	0.36
149	03261500	541	40.29	84.15	35.9	9.8	2.1	2	0	40.40	83.82	0.40
150	03261950	152	40.31	84.38	34.9	6.3	1.1	2	0	40.38	84.24	0.44
151	03262000	257	40.21	84.24	35.2	8.3	0.8	2	0	40.34	84.22	0.42
152	03262700	926	40.04	84.20	36.0	9.2	1.6	2	0	40.35	83.97	0.47
153	03263000	1149	39.87	84.16	36.0	9.1	1.4	2	0	40.29	83.97	0.52
154	03264000	193	40.10	84.43	37.2	–	–	2	0	40.09	84.59	0.49
155	03265000	503	40.06	84.36	37.0	–	–	2	0	40.14	84.49	0.49
156	03266000	650	39.87	84.28	37.0	–	–	2	0	40.10	84.43	0.57
157	03266500	7.31	40.35	83.67	35.8	41.6	1.0	2	0	40.38	83.58	0.40
158	03267000	162	40.11	83.80	36.7	16.7	0.4	2	0	40.24	83.63	0.26
159	03267500	264	40.01	83.82	37.0	15.0	0.5	2	0	40.19	83.66	0.32
160	03268000	65.3	39.99	83.71	37.8	9.7	0.6	2	0	40.05	83.54	0.25

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	A	Lat_s	$Long_s$	P_c	F	W	Physiographic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
161	03268500	39.2	39.94	83.75	38.1	8.9	1.4	2	0	39.94	83.53	0.34
162	03269000	139	39.93	83.82	37.9	9.6	3.0	2	0	40.00	83.56	0.38
163	03269500	490	39.92	83.87	37.4	13.3	1.3	2	0	40.10	83.65	0.42
164	03270000	635	39.80	84.09	37.4	12.7	1.3	2	0	40.05	83.70	0.50
165	03270500	2511	39.77	84.20	36.0	–	–	2	0	40.17	84.03	0.51
166	03270800	22.7	39.79	84.31	38.1	9.6	0.2	2	0	39.83	84.28	0.64
167	03271000	68.7	39.77	84.24	38.0	9.8	0.3	2	0	39.83	84.23	0.50
168	03271800	197	39.71	84.53	38.7	7.2	0.3	2	0	39.86	84.47	0.57
169	03272000	275	39.64	84.40	38.9	9.0	0.3	2	0	39.81	84.44	0.58
170	03272700	69	39.63	84.64	39.0	11.1	0.2	2	0	39.74	84.55	0.56
171	03272800	120	39.52	84.61	38.8	15.1	0.6	2	0	39.69	84.55	0.58
172	03273500	307	39.46	84.55	38.4	15.8	0.7	2	0	39.63	84.59	0.57
173	03274000	3630	39.39	84.57	36.0	–	–	2	0	40.01	84.14	0.57
174	03274500	3789	39.30	84.64	36.4	11.3	1.1	2	0	39.98	84.16	0.63
175	04177000	150	41.66	83.62	32.0	–	–	1	1	41.71	83.67	0.50
176	04183500	2129	41.20	84.74	–	–	–	1	0	41.19	84.71	0.62
177	04184500	206	41.68	84.23	–	–	–	1	1	41.86	84.22	0.46
178	04185000	410	41.50	84.43	–	–	–	1	1	41.75	84.23	0.59
179	04185440	4.23	41.36	84.69	34.0	0.0	1.6	1	1	41.37	84.60	0.82
180	04186500	332	40.95	84.27	35.0	8.1	0.6	2	0	40.68	84.09	0.57

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	A	Lat_s	$Long_s$	P_c	F	W	Physiographic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
181	04187100	128	40.73	84.13	35.0	9.6	1.5	2	0	40.76	83.76	0.52
182	04187500	160	40.75	84.19	35.0	11.4	1.5	2	0	40.75	83.82	0.54
183	04189000	346	41.06	83.69	35.5	27.3	1.2	2	0	40.84	83.18	0.63
184	04189500	644	41.06	84.15	35.0	–	–	2	0	40.93	83.57	0.61
185	04191500	2318	41.24	84.40	35.0	–	–	2	0	40.90	84.07	0.62
186	04192500	5545	41.29	84.28	34.3	–	–	1	0	41.13	84.36	0.59
187	04193500	6330	41.50	83.71	33.9	–	–	1	0	41.16	84.31	0.56
188	04195500	428	41.45	83.36	33.1	–	–	1	1	41.21	83.54	0.62
189	04196000	88.8	40.80	83.01	36.4	13.1	1.4	2	0	40.81	82.69	0.63
190	04196500	298	40.85	83.26	35.7	–	–	2	0	40.78	82.98	0.70
191	04196800	229	40.92	83.35	35.0	8.3	0.9	2	0	40.73	83.28	0.68
192	04197000	774	41.04	83.19	35.7	9.5	1.1	2	0	40.82	83.07	0.64
193	04197020	17	40.96	82.79	36.7	9.0	0.4	2	0	40.92	82.68	0.64
194	04197100	149	41.02	83.11	36.3	9.9	1.0	2	0	41.01	82.78	0.76
195	04197170	34.6	41.11	83.17	35.7	12.9	0.4	2	0	41.10	82.92	0.56
196	04198000	1251	41.31	83.16	36.0	9.3	1.1	2	0	40.93	83.03	0.64
197	04198500	85.5	41.25	82.65	35.8	16.8	1.0	2	0	41.17	82.47	0.57
198	04199000	371	41.30	82.61	36.0	15.2	1.0	1	0	41.14	82.57	0.58
199	04199155	22.1	41.38	82.51	34.5	22.0	2.9	2	1	41.31	82.38	0.63
200	04199500	262	41.38	82.32	35.3	24.4	1.7	2	0	41.13	82.29	0.77

Appendix 3. Basin characteristics for selected streamflow-gaging stations in Ohio—Continued

[–, no data; *A*, drainage area, in square miles; Lat_s, decimal latitude of the streamflow-gaging station; $Long_s$, decimal longitude of the streamflow-gaging station; P_c, mean annual precipitation at the basin centroid, in inches; *F*, percentage of contributing basin area covered by forest; *W*, percentage of contributing basin area covered by water and wetlands; $N_{41.2}$, code for location of basin centroid relative to 41.2 degrees latitude (0=south, 1=north); Lat_c, decimal latitude of the basin centroid; $Long_c$, decimal longitude of the basin centroid; V_g, streamflow-variability index at streamflow-gaging station as determined from geographic coverage]

Site number	Station ID	*A*	Lat_s	$Long_s$	P_c	*F*	*W*	Physiographic province code	$N_{41.2}$	Lat_c	$Long_c$	V_g
201	04200000	217	41.35	82.09	35.4	29.2	2.1	2	0	41.15	81.96	0.90
202	04200500	396	41.38	82.10	35.1	27.4	2.3	2	0	41.17	82.03	0.89
203	04201500	267	41.41	81.89	35.5	37.9	2.9	4	1	41.24	81.72	0.70
204	04202000	151	41.34	81.17	41.8	48.7	13.6	4	1	41.46	81.05	0.58
205	04204000	17.3	41.06	81.39	36.0	32.2	17.1	4	0	41.06	81.24	0.53
206	04204500	31.6	41.06	81.46	36.0	27.9	14.2	4	0	41.06	81.26	0.54
207	04205000	9.72	41.06	81.46	36.0	17.9	10.7	4	0	41.03	81.31	0.53
208	04206000	404	41.14	81.55	39.4	35.9	12.1	4	1	41.25	81.16	0.54
209	04207200	83.9	41.38	81.53	40.6	42.3	9.0	4	1	41.32	81.31	0.42
210	04208000	707	41.40	81.63	39.9	41.8	9.4	4	1	41.26	81.27	0.48
211	04208502	35.3	41.45	81.72	36.1	10.6	1.2	4	1	41.41	81.64	0.56
212	04209000	246	41.63	81.40	42.1	60.4	5.5	4	1	41.49	81.23	0.43
213	04210000	25.6	41.52	80.94	41.9	44.4	13.3	4	1	41.53	80.91	0.74
214	04211000	69.2	41.65	80.84	40.7	33.9	19.0	4	1	41.56	80.68	1.13
215	04211500	82	41.75	80.80	40.7	32.0	18.7	4	1	41.71	80.58	0.91
216	04212000	581	41.74	81.05	42.0	40.9	16.6	4	1	41.57	80.76	0.80
217	04212100	685	41.72	81.23	42.0	44.5	14.8	4	1	41.59	80.81	0.63
218	04212500	121	41.86	80.76	39.5	–	–	4	1	41.79	80.49	0.78
219	04213000	175	41.93	80.60	–	–	–	4	1	41.82	80.32	0.71