CALENDAR FOR WATER YEAR 2003

2002

OCTOBER

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
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NOVEMBER

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DECEMBER

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2003

JANUARY

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JUNE

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AUGUST

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31						

SEPTEMBER

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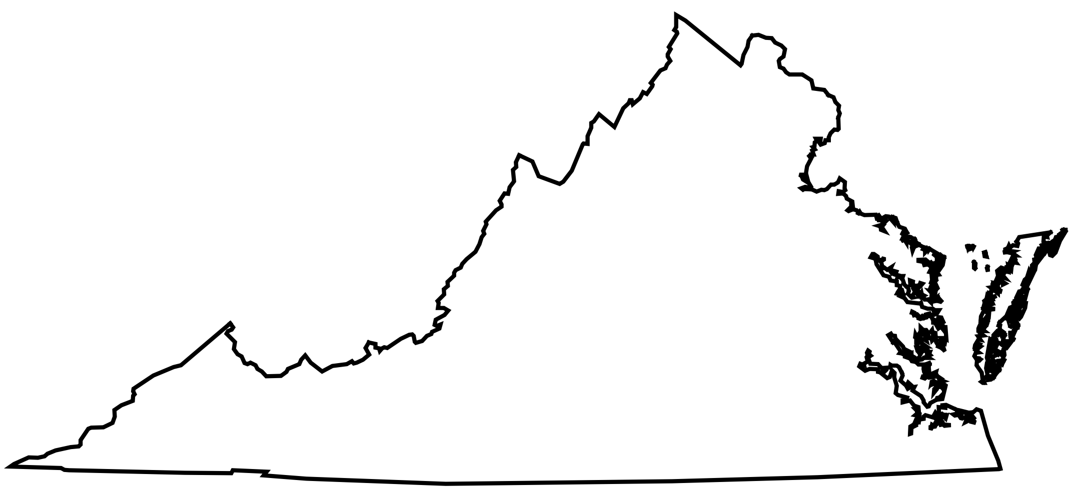
U.S. Department of the Interior
U.S. Geological Survey

Water Resources Data Virginia Water Year 2003

Volume 1. Surface-Water Discharge and Surface-Water Quality Records

By Roger K. White, Donald C. Hayes, Joel R. Guyer, and Eugene D. Powell

Water-Data Report VA-03-1



Prepared in cooperation with the
Virginia Department of Environmental Quality and with other agencies

U.S. DEPARTMENT OF THE INTERIOR

GALE A. NORTON, Secretary

U.S. GEOLOGICAL SURVEY

Charles G. Groat, Director

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Charlottesville, Virginia 22903

2004

PREFACE

This volume of the annual hydrologic data report of Virginia is one of a series of annual reports that document hydrologic data gathered from the U.S. Geological Survey's and cooperating agencies' surface- and ground-water data-collection networks in each State, Puerto Rico, and the Trust Territories. These records of streamflow, ground-water levels, and water quality provide the hydrologic information needed by State, local, and Federal agencies, and the private sector for developing and managing our Nation's land and water resources. Hydrologic data for Virginia are contained in two volumes:

Volume 1. Surface-Water-Discharge and Surface-Water-Quality Records

Volume 2. Ground-Water-Level and Ground-Water-Quality Records

This report (Volume 1) is the culmination of a concerted effort by dedicated personnel of the U.S. Geological Survey and the Virginia Department of Environmental Quality who collected, compiled, analyzed, verified, and organized the data, and who typed, edited, and assembled the report. In addition to the authors, who had primary responsibility for assuring that the information contained herein is accurate, complete, and adheres to Geological Survey policy and established guidelines, the following personnel contributed significantly to the collection, computation, processing, and completion of this information:

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13. ABSTRACT *(Maximum 200 words)*

Water-resources data for the 2003 water year for Virginia includes records of stage, discharge, and water quality of streams and stage, contents, and water quality of lakes and reservoirs. This volume contains records for water discharge at 178 gaging stations; stage only at 2 gaging stations; stage and contents at 11 lakes and reservoirs; and water quality at 16 gaging stations. Also included are data for 49 crest-stage partial-record stations. Locations of these sites are shown on figures 4 and 5. Miscellaneous hydrologic data were collected at 149 measuring sites and 6 water-quality sampling sites not involved in the systematic data-collection program. The data in this report represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Virginia.

14. SUBJECT TERMS
*Virginia, *Hydrologic data, *Surface water, *Water quality
Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses.

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CONTENTS

ILLUSTRATIONS

SURFACE-WATER STATIONS, IN DOWNSTREAM ORDER, FOR WHICH RECORDS ARE PUBLISHED IN THIS VOLUME

NOTE.--Data for partial-record stations and miscellaneous sites for both surface-water discharge and quality are published in separate sections of the data report. See references at the end of this list for page numbers for these sections.

[Letters after station name designate type of data collected: (d) discharge, (c) chemical, (b) biological, (m) microbiological, (t) water temperature, (s) sediment, (e) elevation, gage heights, or contents]

SURFACE-WATER STATIONS, IN DOWNSTREAM ORDER, FOR WHICH RECORDS ARE PUBLISHED IN THIS VOLUME

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DISCONTINUED SURFACE-WATER-DISCHARGE OR STAGE-ONLY STATIONS

The following continuous-record surface-water-discharge or stage-only stations (gaging stations) in Virginia have been discontinued. Daily streamflow or stage records were collected and published for the period of record, expressed in water years, shown for each station. Those stations with an asterisk (*) after the station number are currently operated as crest-stage partial-record stations. Discontinued project stations with less than 3 years of record have not been included. Information regarding these stations may be obtained from the District Office at the address given on the back side of the title page of this report.

[Letters after station name designate type of data collected: (d) discharge, (e) elevation]

Station name	Station number	Drainage area (mi2)	Period of record (water years)
NASSAWADOX CREEK BASIN			
Guy Creek (head of Holly Grove Cove) near Nassawadox, Va. (d)	01484800	1.72	1963-96
POTOMAC RIVER BASIN			
Abrams Creek at Winchester, Va. (d)	01615500	5.6	1946-49
Abrams Creek near Winchester, Va. (d)	01616000	16.5	1949-60, 1979-94
Dry River at Rawley Springs, Va. (d)	01621000	72.6	1946-48
Blacks Run at Rt 726 at Harrisonburg (d)	01621410	11.2	2000-02
Blacks Run at Rt 704 near Mt. Crawford (d)	01621470	19.4	1999-01
Cooks Creek at Mt. Crawford, Va. (d)	01621500	42	1905-06
Castle Spring near Churchville, Va. (d)	01622500	-	1949-56
Bell Creek at St. Pauls Chapel, near Staunton, Va. (d)	01623000	.61	1948-55
Bell Creek near Staunton, Va. (d)	01623500	3.8	1948-55
Bell Creek at Franks Mill, near Staunton, Va. (d)	01624000	9.6	1948-56
Middle River near Verona, Va. (d)	01624300	178	1967-86
Lewis Creek near Staunton, Va. (d)	01624500	18	1905-06
Christians Creek near Fishersville, Va. (d)	01624800	70.1	1967-97
North River at Port Republic, Va. (d)	01625500	804	1895-99
Back Creek near Lyndhurst, Va. (d)	01625900	41.2	1974-77
South River at Waynesboro, Va. (d)	01626500	133	1905-06, 1928-52
South River near Dooms, Va. (d)	01626850	149	1974-95
South River at Port Republic, Va. (d)	01628000	248	1895-99
White Oak Run near Grottoes, Va. (d)	01628060	1.94	1979-96
Elk Run at Elkton, Va. (d)	01629000	17	1901-06
Yagers Spring near Luray, Va. (d)	01629990	-	1949-56
Hawksbill Creek near Luray, Va. (d)	01630000	52	1905-06
Plains Mill Spring near New Market, Va. (d)	01632500	-	1949-56
Stony Creek at Columbia Furnace, Va. (d)	01633500	79.4	1947-56
Marlboro Spring at Marlboro, Va. (d)	01635000	-	1949-56
North Fork Shenandoah River near Riverton, Va. (d)	01636000	1,040	1899-1906
Happy Creek at Front Royal, Va. (d)	01636210	14.0	1948-77
Big Spring near Leesburg, Va. (d)	01643610	.03	1968-69, 1980-81
Stave Run at Reston, Va. (d)	01644290	.05	1966-71, 1973
Stave Run near Reston, Va. (d)	01644291	.08	1971-82
Smilax Branch at Reston, Va. (d)	01644295	.32	1967-78
Snakeden Branch at Reston, Va. (d)	01645784	.79	1973-78
Long Branch near Annandale, Va. (d)	01654500	3.71	1947-57
Accotink Creek near Accotink Station, Va. (d)	01655000	37.0	1949-57
Cedar Run near Warrenton, Va. (d)	01655500	12.3	1950-87

DISCONTINUED SURFACE-WATER-DISCHARGE OR STAGE-ONLY STATIONS--Continued

Station name	Station number	Drainage area (mi2)	Period of record (water years)
POTOMAC RIVER BASIN--Continued			
Cedar Run near Aden (d)	01656100	155	1973-87, 1996-99
Cedar Run at Route 646 near Aden	01656120	-	1996-2000
Broad Run at Buckland, Va. (d)	01656500	50.5	1950-79, 1981-87
Broad Run near Bristow, Va. (d)	01656650	89.6	1975-87
Occoquan River near Manassas, Va. (d)	01656700	343	1968-81
Bull Run near Catharpin, Va. (d)	01656725	25.8	1969-87
Cub Run near Bull Run, Va. (d)	01656960	49.9	1973-87
Bull Run near Manassas, Va. (d)	01657000	147	1950-81
Bull Run near Manassas Park, Va. (d)	01657020	148	1984-87
Bull Run near Clifton, Va. (d)	01657415	185	1972-84
Occoquan River (Creek) near Occoquan, Va. (d)	01657500	570	1913-16, 1921-23, 1937-56
Hooes Run near Occoquan, Va. (d)	01657655	3.97	1975-82
Neabsco Creek at Dale City, Va. (d)	01657850	6.11	1994-96
Neabsco Creek Tributary at Telegraph Road near Dale City, Va. (d)	01657885	.91	1995-96
Powells Creek near Dale City, Va. (d)	01657895	7.93	1994-96
Quantico Creek near Dumfries, Va. (d)	01658480	6.90	1983-85
South Fork Quantico Creek near Joplin, Va. (d)	01658550	9.62	1983-85
South Fork Quantico Creek near Dumfries, Va. (d)	01658650	16.6	1983-85
Little Creek at Mockingbird Road at Triangle (d)	01658698	-	1999-2001
Little Creek at Geiger Road at Quantico (d)	01658705	-	1999-2001
Chopawamsic Creek at Russell Road near Joplin (d)	01660100	-	1996-2002
Cannon Creek near Garrisonville, Va. (d)	01660380	10.2	1994-96
Upper Machodoc Creek at Dahlgren, Va. (e)	01660810	-	1992-98
GREAT WICOMICO RIVER BASIN			
Bush Mill Stream near Heathsville, Va. (d)	01661800*	6.82	1964-87
RAPPAHANNOCK RIVER BASIN			
Carter Run near Marshall, Va. (d)	01661900	19.5	1977-82
Rappahannock River near Warrenton, Va. (d)	01662000	195	1943-86
Rush River at Washington, Va. (d)	01662500	14.7	1953-77
Thornton River near Laurel Mills, Va. (d)	01663000	142	1943-56
Rappahannock River at Kellys Ford, Va. (d)	01664500	641	1925-52
Mountain Run near Culpeper, Va. (d)	01665000	15.9	1949-97
Robinson River at Locust Dale, Va. (d)	01666000	148	1942
Rapidan River at Rapidan, Va. (d)	01667000	446	1924-31
Mountain Run near Burr Hill, Va. (d)	01667870	28.8	1990-92
Cat Point Creek near Montross (d)	01668500	45.6	1944-99
Hoskins Creek near Tappahannock, Va. (d)	01668800	15.5	1965-86
PIANKATANK RIVER BASIN			
Dragon Swamp near Church View, Va. (d)	01669500	84.9	1943-81

* Currently operated as a crest-stage partial-record station.

DISCONTINUED SURFACE-WATER-DISCHARGE OR STAGE-ONLY STATIONS--Continued

Station name	Station number	Drainage area (mi2)	Period of record (water years)
YORK RIVER BASIN			
Beaverdam Swamp near Ark, Va. (d)	01670000	6.63	1950-89
Pamunkey Creek at Lahore, Va. (d)	01670180*	40.5	1989-92
Contrary Creek near Mineral, Va. (d)	01670300*	5.53	1976-86
North Anna River near Partlow, Va. (d)	01670400	344	1978-95
North Anna River near Hewlett, Va. (d)	01670500	424	1926-28
North Anna River near Doswell, Va. (d)	01671000	441	1926-86
Bunch Creek near Boswells Tavern, Va. (d)	01671500	4.37	1949-79
South Anna River at Vontay, Va. (d)	01672000	332	1927-30
Totopotomoy Creek near Atlee, Va. (d)	01673500	5.89	1949-77
Ware Creek near Toano, Va. (d)	01677000	6.29	1979-95
JAMES RIVER BASIN			
Bolar Spring at Bolar, Va. (d)	02010000	-	1950-56
Muddy Run Spring near Warm Springs, Va. (d)	02010500	-	1946-56
Warm Spring at Warm Springs, Va. (d)	02011000	-	1928-44
Back Creek on Rt. 600, near Mountain Grove, Va. (d)	02011480	85.8	1974-84
Falling Spring Creek near Falling Spring, Va. (d)	02012000	11.5	1948-52
Jackson River at Falling Spring, Va. (d)	02012500*	411	1925-84
Jackson River at Covington, Va. (d)	02012900	440	1907-08
Smith Creek above old dam, near Clifton Forge, Va. (d)	02014500	12.4	1947-56
Smith Creek near Clifton Forge, Va. (d)	02015000	12.5	1944-47
Stuart Spring near McDowell, Va. (d)	02015500	-	1950-56
Meadow Creek at New Castle, Va. (d)	02017000	13.8	1929-52
Catawba Creek near Fincastle, Va. (d)	02019000	104	1928-37
Karnes Spring near Buchanan, Va. (d)	02020000	-	1950-56
Calfpasture River at Goshen, Va. (d)	02021000	190	1925-39
Big Spring at Kerrs Creek, Va. (d)	02022000	-	1950-56
Maury River near Lexington, Va. (d)	02023000	487	1925-60
South River near Riverside, Va. (d)	02023500	111	1950-62
Buffalo Creek near Glasgow, Va. (d)	02024300	123	1963-64
Maury River at Glasgow, Va. (d)	02024500	831	1895-1906
Pedlar River near Pedlar Mills, Va. (d)	02025000	91	1942-56
Tye River at Roseland, Va. (d)	02026500	68	1927-38
Buffalo river near Tye River, Va. (d)	02027800	147	1960-95
Tye (Buffalo) River near Norwood, Va. (d)	02028000	360	1940-60
Hardware River near Scottsville, Va. (d)	02029500	104	1925-39
Slate River near Arvonia (d)	02030500	226	1926-95
Mechums River near White Hall (Ivy), Va. (d)	02031000	95.4	1942-51
North Fork Moormans River near White Hall, Va. (d)	02031500	11.4	1952-63, 1982-84
Moormans River near White Hall, Va. (d)	02032000	18	1943-46
Moormans River near Free Union, Va. (d)	02032250	74.6	1979-97
Buck Mountain Creek near Free Union, Va. (d)	02032400	37	1979-97
South Fork Rivanna River near Earlysville, Va. (d)	02032500	216	1951-66
South Fork Rivanna River near Charlottesville, Va. (d)	02032515	260	1979-97
North Fork Rivanna River near Proffit, Va. (d)	02032680	176	1970-92
Rivanna River near Charlottesville, Va. (d)	02033000	473	1925
Rivanna River below Moores Creek, near Charlottesville, Va. (d)	02033500	507	1925-34
Willis River at Lakeside Village (Flanagan Mills), Va. (d)	02034500	262	1927-86
(Big) Lickinghole Creek near Goochland, Va. (d)	02035500	70	1944-46
Beaverdam Creek at State Farm, Va. (d)	02036000	42	1944-47, 1957-64,

* Currently operated as a crest-stage partial-record station.

DISCONTINUED SURFACE-WATER-DISCHARGE OR STAGE-ONLY STATIONS--Continued

Station name	Station number	Drainage area (mi2)	Period of record (water years)
JAMES RIVER BASIN--Continued			
Falling Creek near Chesterfield, Va.. (d)	02038000*	32.8	1955-94
Falling Creek near Drewrys Bluff, Va. (d)	02038500	54	1942-56, 1957-64
Vaughans Creek near Hixburg, Va. (d)	02038880	23.2	1980-81
Fishpond Creek near Hixburg, Va. (d)	02038830	14	1980-81
Flat Creek near Amelia, Va. (d)	02040500*	73	1946-48
Appomattox River near Petersburg, Va. (d)	02041500	1,335	1927-66
Swift Creek near Chester, Va. (d)	02042000	143	1943-49
Chickahominy River near Atlee, Va. (d)	02042287	62.2	1990-97
Upham Brook near Richmond, Va. (d)	02042426	37.6	1989-94
GREAT DISMAL SWAMP BASIN			
Cypress Swamp at Cypress Chapel, Va. (d)	02043500	23.8	1953-71 1978-96
Washington Ditch near Cypress Chapel, Va. (d)	02043550	41	1979-81
Lake Drummond in Great Dismal Swamp (e)	02043600	-	1926-2002
CHOWAN RIVER BASIN			
Nottoway River near Burkeville, Va. (d)	02044000	38.7	1946-86
Nottoway River near McKenney, Va. (d)	02045000	362	1946-50
Waqua Creek near Alberta, Va. (d)	02045200	15.0	1966-67
Anderson Branch at Sussex, Va. (d)	02046500	5.35	1949-56
Assamoosick Swamp near Sebrell, Va. (d)	02047100	86.4	1982-88
Blackwater River at Zuni, Va. (d)	02048000	456	1943-88
Seacock Creek at Unity, Va. (d)	02048500	102	1943-49
Blackwater River near Burdette, Va. (d)	02049000	576	1942-44
North Meherrin River near Keysville, Va. (d)	02050500	9.2	1949-61
Great Creek near Cochran, Va. (d)	02051600	30.7	1958-86
Fountains Creek near Brink, Va. (d)	02052500	65.2	1953-95
Fontaine (Fountains) Creek near Emporia, Va. (d)	02053000	96	1944-53
ROANOKE RIVER BASIN			
Big Springs at Elliston, Va. (d)	02054000	-	1948-56
Roanoke River near Wabun	02054510	273	1994-99
Tinker Creek at Roanoke, Va. (d)	02055500	70	1907-08
Back Creek near Roanoke, Va. (d)	02056500	43	1907-08
Blackwater River near Union Hall, Va. (d)	02057000	208	1925-64
Roanoke River near Toshes, Va. (d)	02057500	1,020	1925-63
Snow Creek at Sago, Va. (d)	02058000	60	1935-44
Pigg River near Toshes, Va. (d)	02058500	394	1930-63
Roanoke River near Gretna, Va. (d)	02059000	1,430	1925-30
Goose Creek at Huddleston, Va. (d)	02060000	218	1929-32
Big Otter River near Bedford, Va. (d)	02061000	116	1944-60
Big Otter River near Altavista, Va. (d)	02062000	372	1929-37
Caldwells Creek near Appomattox, Va. (d)	02063000	5.13	1954-60
Falling River at Spring Mills, Va. (d)	02063500	52.2	1954-60
Little Falling River at Hat Creek, Va. (d)	02064500	43	1929-36

* Currently operated as a crest-stage partial-record station.

DISCONTINUED SURFACE-WATER-DISCHARGE OR STAGE-ONLY STATIONS--Continued

Station name	Station number	Drainage area (mi2)	Period of record (water years)
ROANOKE RIVER BASIN--Continued			
Falling River near Brookneal, Va. (d)	02065000	228	1936-41
Roanoke River at Clarkton, Va. (d)	02065200	2,691	1963-76
Roanoke Creek at Saxe, Va. (d)	02066500	135	1946-72
Roanoke River near Clover, Va. (d)	02067000	3,230	1929-52
Roanoke River above Dan River, at Clarksville, Va. (d)	02067500	-	1895-98
Leatherwood Creek near Martinsville (Old Liberty), Va. (d)	02073500	68	1926-34
Dan River at Danville, Va. (d)	02075000	2,050	1934-95
Georges Creek near Gretna, Va. (d)	02076500	9.24	1949-97
Hyco River near Omega, Va. (d)	02078000	413	1934-50
Dan River at Clarksville, Va. (d)	02078500	-	1896-98
Roanoke River at Clarksville, Va. (d)	02079000	7,320	1935-52
KANAWHA RIVER BASIN			
New River near Baywood, Va. (d)	03163000	1,000	1928-30
New River near Grayson, Va. (d)	03164500	1,160	1908-12
New River at Ivanhoe, Va. (d)	03165500	1,340	1927, 1930-78
Cripple Creek near Ivanhoe, Va. (d)	03166000	148	1930-34
Neff-Litz Spring near Rural Retreat, Va. (d)	03166500	-	1947-56
Glade Creek at Grahams Forge, Va. (d)	03166800	7.15	1976-93
Big Reed Island Creek near Allisonia, Va. (d)	03167500	278	1908-16, 1939-95
Peak Creek at Pulaski, Va. (d)	03168500	58.3 60.9	1927-33, 1951-57
Little River near Copper Va.lley, Va. (d)	03169500	239	1908-16
New River at Eggleston, Va. (d)	03171500	2,941	1915-76
Wabash Spring near Poplar Hill, Va. (d)	03172000	-	1950-51
Walker Creek at Staffordsville, Va. (d)	03172500	277	1908-16
Francis Spring near Bane, Va. (d)	03173500	-	1952-56
Wolf Creek near Shawver Mill (Burkes Garden), Va. (d)	03174500	36	1927-28
West Fork Cove Creek near Bluefield, Va. (d)	03175000	5.5	1929-32
Cox Branch above Tazewell Reservoir, near Gratton, Va. (d)	03175100	2.06	1988-92
Bluestone River at Bluefield, Va. (d)	03177700	39.8	1965-80
Bluestone River at Falls Mills, Va. (d)	03177710	44.2	1980-97
BIG SANDY RIVER BASIN			
Levisa Fork near Grundy, Va. (d)	03207500	235	1942-74, 1986-87
Grissom Creek near Council, Va. (d)	03208034	2.82	1981-83
Barton Fork near Council, Va. (d)	03208036	1.23	1981-83
Russell Fork at Council, Va. (d)	03208040*	10.2	1981-83
Russell Fork near Birchleaf, Va. (d)	03208100	87.4	1981-83
North Fork Pound River at Pound, Va. (d)	03208700*	18.5	1962-87
Pound River above Indian Creek, at Pound, Va. (d)	03208800*	36.7	1966-78
Pound River below Bold Camp Creek, at Pound, Va. (d)	03208850*	61.2	1966-78
Pound River near Georges Fork, Va. (d)	03208900*	82.5	1964-82
Russell Fork at Bartlick, Va. (d)	03209200*	526	1963-82
Kersaw Branch near Hurley, Va. (d)	03213577	.60	1981-82
Knox Creek at Kelsa, Va. (d)	03213590*	84.3	1980-81
Steve Keesling Spring at Sugar Grove, Va. (d)	03471000	-	1928, 1948-56
South Fork Holston River near Chilhowie, Va. (d)	03472000	89.5	1907-10
Beaverdam Creek at Damascus, Va. (d)	03472500	56.0	1947-59
Middle Fork Holston River at Groseclose, Va. (d)	03473500*	7.39	1948-57, 1988-89

* Currently operated as a crest-stage partial-record station.

DISCONTINUED SURFACE-WATER-DISCHARGE OR STAGE-ONLY STATIONS--Continued

Station name	Station number	Drainage area (mi2)	Period of record (water years)
TENNESSEE RIVER BASIN			
Middle Fork Holston River at Chilhowie, Va. (d)	03474500	155	1907-10, 1921-32
Cedarville Spring at Cedarville, Va. (d)	03475500	-	1950-53
Beaver Creek near Wallace, Va. (d)	03477500	13.7	1946-57
Percy Preston Spring near Wallace, Va. (d)	03478000	-	1950-56
Lick Creek near Chatham Hill, Va. (d)	03487800*	25.5	1966-68
North Fork Holston River near Plasterco, Va. (d)	03488100	259	1963-66
Brumley Creek near Hansonville, Va. (d)	03488445	4.29	1979-82
Brumley Creek at Brumley Gap, Va. (d)	03488450*	21.1	1979-82
North Fork Holston River at Holston, Va. (d)	03488500	402	1951-59
North Fork Holston River near Mendota, Va. (d)	03489500	493	1921-32
Cove Creek near Hilton, Va. (d)	03489850	17.6	1966-68
Big Moccasin Creek at Collinwood, near Hansonville, Va. (d)	03489870	41.9	1966-68
Big Moccasin Creek near Gate City, Va. (d)	03489900	79.6	1953-59, 1966-68
North Fork Holston River near Gate City, Va. (d)	03490000*	672	1932-82
Taylor Springs at Cedar Bluff, Va. (d)	03520500	-	1953
Clinch River at Cedar Bluff, Va. (d)	03521000	125	1944-46
Clinch River at Richlands, Va. (d)	03521500*	137	1946-89
Little River at Wardell, Va. (d)	03522000	103	1949-52
Will Brooks Spring at Wardell, Va. (d)	03522500	-	1950-52
(Big) Cedar Creek near Lebanon, Va. (d)	03523000*	51.5	1953-59
Thompson Creek near Coulwood, Va. (d)	03523500	14.0	1942-49
Guest River at Coeburn, Va. (d)	03524500*	87.3	1949-59, 1979-81
Guest River at Miller Yard, Va. (d)	03524550	100	1997-98
Stony Creek at Ka, Va. (d)	03524900*	30.9	1980-81
Stony Creek at Fort Blackmore, Va. (d)	03525000	41.4	1949-52
Clinch River at Clinchport, Va. (d)	03525500	986	1907-10
Copper Creek near Gate City, Va. (d)	03526000	106	1948-72 1996-98
Quillen Springs near Gate City, Va. (d)	03526500	-	1954-56
North Fork Clinch River at Duffield, Va. (d)	03527500	23.1	1953-59
South Fork Powell River at Big Stone Gap, Va. (d)	03530000	40	1945-47, 1951-77
North Fork Powell River at Pennington Gap, Va. (d)	03530500*	71.4	1944-51, 1978-81, 1993-95
Powell River near Pennington Gap, Va. (d)	03531000	290	1921-32

* Currently operated as a crest-stage partial-record station.

DISCONTINUED SURFACE-WATER-QUALITY STATIONS

The following surface-water-quality stations in Virginia have been discontinued. Water-quality data (daily or periodic samples with collection frequency not less than quarterly) were collected and published for the period of record, expressed in water years, shown for each station. For each station entry, a period of record is provided for each type of record listed.

[Type of record: C (chemical), T (water temperature), SC (specific conductance), SED (sediment)]

Station name	Station number	Drainage area (mi^2)	Type of record	Period of record (water years)
POTOMAC RIVER BASIN				
Blacks Run at Rt 704 near Mt. Crawford	01621470	19.4	C,T,SC	1999-01
North River near Burketown, Va.	01622000	379	C,T,SC	1994
Middle River near Grottoes, Va.	01625000	375	C,T,SC	1994
South River at Harriston, Va.	01627500	212	SC	1949
			C,T,SC	1994
South Fork Shenandoah River near Luray, Va.	01629500	1,377	SC	1949
			C,T,SC	1994
South Fork Shenandoah River at Front Royal	01631000	1,642	C,SED	1996-02
North Fork Shenandoah River near Strasburg	01634000	768	C,SED	1996-02
Catoctin Creek at Taylorstown, Va.	01638480	89.6	C	1993-95
Stave Run near Reston, Va.	01644291	.08	SED	1971-74
Smilax Branch at Reston, Va.	01644295	.32	SED	1971-75
Snakeden Branch at Reston, Va.	01645784	.79	SED	1973-78
Cedar Run near Aden, Va.	01656100	155	SED	1996-99
Bull Run near Catharpin, Va.	01656725	25.8	SED	1974
Cub Run near Bull Run, Va.	01656960	49.9	SED	1972-74
Bull Run near Clifton, Va.	01657415	185	SED	1973-74
Neabsco Creek Tributary at Telegraph Road near Dale City, Va.	01657885	.91	C,T,SC,SED	1995-96
Quantico Creek near Dumfries, Va.	01658480	6.90	C	1983-85
South Fork Quantico Creek at Camp 5, near Joplin, Va.	01658550	9.62	C	1983-85
South Fork Quantico Creek near Dumfries, Va.	01658650	16.6	C	1983-85
South Fork Quantico Creek near Triangle, Va.	01658620	15.7	T,SC	1973
Little Creek at Mockingbird Road at Triangle	01658698	-	C	1999-01
Little Creek at Geiger Road at Quantico	01658705	-	C	1999-01
Chopawamsic Creek at I-95 near Joplin	01660100		C	1996-02
Beaverdam Run near Garrisonville, Va.	01660500	12.7	C,M,SED	1997-01
RAPPAHANNOCK RIVER BASIN				
Carter Run near Marshall, Va.	01661900	19.5	SED	1977-78
Hazel River at Rixeyville, Va.	01663500	287	T	1951-55
			SC	1953-55
			SED	1952-55
Rappahannock River at Remington, Va.	01664000	620	SC,T	1951-56, 1965-86
			SED	1951-93
Rapidan River near Culpeper, Va.	01667500	472	T	1946,1951-56
			SC	1953-56
			SED	1951-56
Mountain Run near Burr Hill, Va.	01667870	28.8	C,T,SC	1990-92
Rappahannock River at VEPCO Dam, at Fredericksburg, Va.	01668020	-	T,SC	1971-72

DISCONTINUED SURFACE-WATER-QUALITY STATIONS--Continued

Station name	Station number	Drainage area (mi^2)	Type of record	Period of record (water years)
YORK RIVER BASIN				
North Anna River below Lake Anna, near Hewlett, Va.	01670600	-	T,SC	1972-73
Pamunkey Creek at Lahore, Va.	01670180	40.5	C,T,SC	1989-92
Bunch Creek near Boswells Tavern, Va.	01671500	4.37	T	1954-56
Mattaponi River near Bowling Green, Va.	01674000	257	T	1946
Ware Creek near Toano, Va.	01677000	6.29	C	1979-81, 1985-95
JAMES RIVER BASIN				
Back Creek near Sunrise, Va.	02011460	60.1	T	1984-95
Back Creek at Sunrise, Va.	02011470	76.1	T	1984-92, 1993-95
Little Back Creek near Sunrise, Va.	02011490	4.91	T	1984-92, 1993-95
Jackson River at Falling Spring, Va.	02012500	411	T,SC	1969-86
			C	1930,1948, 1968-86
James River at Buchanan, Va.	02019500	2,075	T	1948,1951-56, 1968-86
			SC	1953-56, 1968-86
			SED	1951-56
			C	1930,1948, 1951-56, 1968-86
James River at Bent Creek, Va.	02026000	3,683	T	1948
James River at Scottsville, Va.	02029000	4,584	T,SC	1951-56,1987
			SED	1951-56
James River and Kanawha Canal, near Richmond, Va.	02037000	-	C,T,SC	1972-73
James River near Richmond, Va.	02037500	6,758	T,SC	1948-51, 1953-56
Fishpond Creek near Hixsburg, Va.	02038830	14.0	SC	1981
Holiday Creek near Andersonville, Va.	02038850	8.53	C,T,SC,SED	1968-96
Vaughans Creek near Hixsburg, Va.	02038880	23.2	SC	1981
Chickahominy River tributary at Atlee Exit, near Greenwood, Va.	0204228301	-	C,T,SC,	1994
Chickahominy River near Atlee, Va.	02042287	62.2	C,SED	1989-91
Upham Brook near Richmond, Va.	02042428	38.6	C,SED	1989-91
Chickahominy River at Rt. 156, near Seven Pines, Va.	02042440	149.3	C	1984,1987-91
			SED	1988-91
Chickahominy River near Providence Forge, Va.	02042500	248	C,T,SC	1969-70, 1972-91 1995-98
			SED	1990-91
Chickahominy River above Walkers Dam, at Walkers, Va.	02042720	301	C,T,SC	1983-91
			SED	1990-91

TYPE OF RECORD: C (chemical), T (water temperature), SC (specific conductance), SED (sediment)

DISCONTINUED SURFACE-WATER-QUALITY STATIONS--Continued

Station name	Station number	Drainage area (mi^2)	Type of record	Period of record (water years)
JAMES RIVER BASIN--Continued				
Diascund Creek at Rt. 628, near New Kent, Va.	02042726	9.25	C,T,SC	1986-91
			SED	1991
Diascund Creek Reservoir off Timber Swamp, near Walkers, Va.	02042734	-	C,T,SC	1983-91
Beaverdam Creek at Rt. 632, near Barhamsville, Va.	02042736	4.82	C,T,SC	1986-91
			SED	1991
Wahrani Swamp at Rt. 632, near Barhamsville, Va.	02042742	4.02	C,T,SC	1986-91
Diascund Creek Reservoir off pump station, near Walkers, Va.	02042746	-	C,T,SC	1983-91
Little Creek Reservoir Infall near Norge, Va.	0204275415	-	C,T,SC	1983-85
Little Creek Reservoir (North) near Norge, Va.	0204275420	-	C,T,SC	1983-85
Little Creek Reservoir (North Central) near Norge, Va.	0204275430	-	C,T,SC	1983-91
Little Creek Reservoir (Northeast) near Norge, Va.	0204275440	-	C,T,SC	1983-85
Little Creek Reservoir (South Central) near Norge, Va.	0204275470	-	C,T,SC	1983-91
Little Creek Reservoir (West) near Norge, Va.	0204275490	-	C,T,SC	1983-91
CHOWAN RIVER BASIN				
Nottoway River near Burkeville, Va.	02044000	38.7	T	1947
Nottoway River near Sebrell, Va.	02047000	1,421	T	1947
			C,T,SC,SED	1978-96
Blackwater River at Zuni, Va.	02048000	456	T	1947
Blackwater River near Franklin, Va.	02049500	617	C,T,SC,SED	1947, 1952, 1975-96
North Meherrin River near Lunenburg, Va.	02051000	55.6	T	1947
Meherrin River at Emporia, Va.	02052000	747	T,SC	1968-80
			C	1968-93
ROANOKE RIVER BASIN				
Roanoke River at Lafayette, Va.	02054500	257	T,SC	1951
Roanoke River at Altavista, Va.	02060500	1,789	T	1951,1953-56, 1968-86
			SC	1953-56, 1968-86
			SED	1953-56
			C	1951,1953-56, 1968-86
Roanoke River at Randolph, Va.	02066000	2,977	T,SC	1951-56, 1968-62
			SED	1954-81
			C	1930,1951-86
Smith River above Route 615, near Woolwine, Va.	02071510	-	C,T,SC	1994-95
Smith River at Rt 8 near Woolwine, Va.	02071520	-	C,T,SC	1994
Smith River near Philpott, Va.	02072000	216	C,T,SC	1994-95
Smith River near Irisburg, Va.	02073600	-	C,T,SC	1994-95

TYPE OF RECORD: C (chemical), T (water temperature), SC (specific conductance), SED (sediment)

DISCONTINUED SURFACE-WATER-QUALITY STATIONS--Continued

Station name	Station number	Drainage area (mi^2)	Type of record	Period of record (water years)
ROANOKE RIVER BASIN--Continued				
Dan River at Sewage Treatment Plant, near Danville, Va.	02075045	2,105	C,T,SC	1993-94
Dan River at Sewage Treatment Plant effluent, near Danville, Va.	02075046	-	C,T,SC	1993-94
Dan River at Paces, Va.	02075500	2,550	T,SC	1954-56
			SED	1954-81
			C	1954-93
Dan River at South Boston, Va.	02076000	2,730	T	1952
			SC	1951-52
Roanoke River at Clarksville, Va.	02079000	7,320	C	1987-91
Lake Gaston near Elams, N.C.	02079785	-	T,SC	1988
			SED	1988
Lake Gaston (Little River Channel) near Henrico, Va.	0207987950	-	C,T,SC	1987-92
Pea Hill Creek at Route 665, near Gasburg, Va.	02079880	-	C,T,SC	1987-92
Pea Hill Creek above Rt. 667, near Gasburg, Va.	0207988050	-	C,T,SC	1989-90
Pea Hill Creek tributary No. 1, near Gasburg, Va.	02079881	-	C,T,SC	1989-90
Pea Hill Creek tributary No. 2, near Valentines, Va.	0207988130	-	C,T,SC	1989-90
Pea Hill Creek tributary No. 3, near Valentines, Va.	0207988160	-	C,T,SC	1989-90
Pea Hill Creek tributary No. 4, near Valentines, Va.	02079883	-	C,T,SC	1989-90
Pea Hill Creek tributary No. 4 tributary, near Valentines, Va.	0207988430	-	C,T,SC	1989-90
Cold Spring Branch near Gasburg, Va.	0207988440	-	C,T,SC	1989-90
Pea Hill Creek above North Carolina State line, near Gasburg, Va.	0207988450	-	C,T,SC	1987-92
Lake Gaston (Pea Hill Creek) near Henrico, N.C.	0207988490	-	C,T,SC	1989-90
Lake Gaston tributary near Tillans Chapel, near Elams, N.C.	0207988510	-	C,T,SC	1989-90
Pea Hill Creek tributary No. 5, near Henrico, N.C.	02079888550	-	C,T,SC	1989-90
Pea Hill Creek near Bowens Corner, near Valentines, Va.	02079882	-	C,T,SC	1988
KANAWHA RIVER BASIN				
New River near Galax, Va.	03164000	1,131	T,SC	1950,1968-83
			C	1931,1950, 1952,1968-86
New River at Radford, Va.	03171000	2,748	T,SC	1950,1956
New River at Eggleston, Va.	03171500	2,941	T,SC	1953-55
New River at Glen Lyn, Va.	03176500	3,768	SC	1968-88
			T	1964-88
			C,T,SC,SED	1931,1950, 1952,1955-56, 1965-95

TYPE OF RECORD: C (chemical), T (water temperature), SC (specific conductance), SED (sediment)

DISCONTINUED SURFACE-WATER-QUALITY STATIONS--Continued

Station name	Station number	Drainage area (mi^2)	Type of record	Period of record (water years)
BIG SANDY RIVER BASIN				
Levisa Fork near Grundy, Va.	03207500	235	T,SC	1950
			SED	1986
Levisa Fork at Big Rock, Va.	03207800	297	T,SC	1970-81
			SED	1970-81
Grissom Creek near Council, Va.	03208034	2.82	C,T,SC,SED	1982-83
Barton Fork near Council, Va.	03208036	10.2	C,T,SC,SED	1981-83
Russell Fork at Council, Va.	03208040	1.23	T,SC	1981-83
			C	1982-83
Russell Fork near Birchleaf, Va.	03208100	87.4	T,SC,C	1982-83
TENNESSEE RIVER BASIN				
South Fork Holston River near Damascus, Va.	03473000	301	T	1950,1968-73
			SC	1950
			C	1950,1952, 1968-86
Middle Fork Holston River at Seven Mile Ford,Va.	03474000	132	C,T,SC,SED	1997-98
Middle Fork Holston River at Chilhowie, Va.	03474500	155	T	1962
Brumley Creek near Hansonville, Va.	03488445	4.29	T	1980-81
Brumley Creek at Brumley Gap, Va.	03488450	21.1	T	1979-81
North Fork Holston River at Holston, Va.	03488500	402	T,SC	1952-56
North Fork Holston River near Gate City, Va.	03490000	672	T	1950-51, 1968-78
			SC	1950-51
			SED	1935-38, 1963-65
Guest River near Miller Yard,Va.	03524550	100	C,T,SC,SED	1997-98
Copper Creek near Gate City, Va.	03526000	106	C,T,SC,SED	1997-98
Clinch River at Speers Ferry, Va.	03527000	1,126	T	1950,1965-67
			SC	1950
			SED	1935-38, 1963-65
Powell River at Big Stone Gap, Va.	03529500	112	T,SC	1950
Powell River near Jonesville, Va.	03531500	319	T	1964-67

TYPE OF RECORD: C (chemical), T (water temperature), SC (specific conductance), SED (sediment)

VOLUME 1. SURFACE-WATER-DISCHARGE AND SURFACE-WATER-QUALITY RECORDS

INTRODUCTION

The Water Resources Division of the U.S. Geological Survey (USGS), in cooperation with State agencies, obtains a large amount of data pertaining to the water resources of Virginia each water year. These data, accumulated during many water years, constitute a valuable data base for developing an improved understanding of the water resources of the State. To make these data readily available to interested parties outside the Geological Survey, the data are published annually in this report series entitled "Water Resources Data - Virginia."

This report series includes records of stage, discharge, and water quality of streams and stage, contents, and water quality of lakes and reservoirs. This volume contains records for water discharge at 178 gaging stations; stage only at 2 gaging stations; stage and contents at 10 lakes and reservoirs; and water quality at 16 gaging stations. Also included are data for 49 crest-stage partial-record stations. Locations of these sites are shown on figures 4 and 5. Miscellaneous hydrologic data were collected at 149 measuring sites and 5 water-quality sampling sites not involved in the systematic data-collection program. The data in this report represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Virginia.

This series of annual reports for Virginia began with the 1961 water year with a report that contained only data relating to the quantities of surface water. For the 1964 water year, a similar report was introduced that contained only data relating to water quality. Beginning with the l975 water year, the report format was changed to present, in one volume, data on quantities of surface water, quality of surface and ground water, and ground-water levels. Beginning with the 1990 water year, the report format was changed to two volumes. Volume 1 contains surface-water-discharge and surface-water-quality data and Volume 2 contains ground-water-level and ground-water-quality data.

Prior to the introduction of this series and for several water years concurrent with it, water-resources data for Virginia were published in U.S. Geological Survey Water-Supply Papers. Data on stream discharge and stage and on lake or reservoir contents and stage, through September 1960, were published annually under the title "Surface-Water Supply of the United States, Parts 6A and 6B." For the 1961 through 1970 water years, the data were published in two 5-year reports. Data on chemical quality, temperature, and suspended sediment for the 1941 through 1970 water years were published annually under the title "Quality of Surface Waters of the United States." The above mentioned Water-Supply Papers may be consulted in the libraries of the principal cities of the United States and may be purchased from the U.S. Geological Survey, Branch of Information Services, Federal Center, Bldg. 41, Box 25286, Denver, Colorado 80225.

Publications similar to this report are published annually by the Geological Survey for all States. These official Survey reports have an identification number consisting of the two-letter State abbreviation, the last two digits of the water year, and the volume number. For example, this volume is identified as "U.S. Geological Survey Water-Data Report VA-01-1." For archiving and general distribution, the reports for l971-74 water years also are identified as water-data reports. These water-data reports are for sale in paper copy or in microfiche by the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161.

Additional information, including current prices, for ordering specific reports may be obtained from the District Office at the address given on the back of the title page or by telephone (804) 261-2600.

Water resources data, including those provided in water data reports, are available through the World Wide Web on the Internet. The Universal Resource Location (URL) to the Virginia District's home page is:

http://va.water.usgs.gov

COOPERATION

The U.S. Geological Survey and agencies of the State of Virginia have had joint-funding agreements for the collection of water-resource records since 1930. Organizations that assisted in collecting the data in this report through joint-funding agreements with the Survey are:

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY, Robert G. Burnley, Executive Director.

VIRGINIA DEPARTMENT OF TRANSPORTATION, Charles D. Nottingham, Commissioner.

CITY OF ALEXANDRIA, Vola Lawson, City Manager.

CITY OF DANVILLE, Barry Dunkley, Director, Water and Wastewater.

CITY OF NEWPORT NEWS, Brian Ramaley, Director, Department of Public Utilities.

CITY OF ROANOKE, Kit B. Kiser, Director, Utilities and Operations.

NORTHERN VIRGINIA REGIONAL COMMISSION, G. Mark Gibb, Executive Director.

WEST PIEDMONT PLANNING DISTRICT COMMISSION, Robert W. Dowd, Executive Director.

CITY OF NORFOLK, Regina V. K. Williams, City Manager.

HAMPTON ROADS PLANNING DISTRICT COMMISSION, Arthur L. Collins, Executive Director.

WASHINGTON COUNTY SERVICE AUTHORITY, David S. Dawson, General Manager.

Assistance with funds or services was given by the U.S. Army Corps of Engineers in collecting records for gaging stations and water-quality stations throughout the State.

Under a cooperative agreement covering the Tennessee River Basin, the Tennessee Valley Authority provided financial assistance for the operation of gaging stations, the records for which are published herein. Similar financial assistance for water-quality studies was provided by the U.S. Marine Corps Base, Quantico, VA, for the Quantico, Cannon, and Aquia Creek Basins. Other cooperators that provided funds for the collection of records are the American Electric Power, Virginia Power, City of Danville, City of Radford, City of Bedford, Multitrade of Pittsylvania County, LG & E, Synergics Incorporated, and Georgia Pacific Corporation.

Organizations that provided data are acknowledged in station descriptions.

RECORDS COLLECTED BY THE STATE OF VIRGINIA

In addition to data collected by the U.S. Geological Survey, there are included herein records for 67 gaging stations operated by the Virginia Department of Environmental Quality. These records are published as provided and are acknowledged in the "COOPERATION" paragraph of each individual station. The Virginia Department of Environmental Quality is under the direction of Robert G. Burnley, director. Published material for the gaging-station records is supplied through the Division of Water Resource Management, Larry G. Lawson, P.E., director.

SUMMARY OF HYDROLOGIC CONDITIONS

Surface-Water Discharge

Statewide, annual mean discharges for the 2003 water year were above the normal range of flow (above the 75th percentile of annual mean flows) based on streamflow data at the farthest downstream gaged locations in the Shenandoah, Potomac, Rappahannock, York, James, Roanoke, Kanawha, Big Sandy, and Tennessee River Basins. Annual mean discharges were at record high levels at 105 of 153 streamflow gages with more than 5 years of record. These levels of streamflow also are unusual in that 68 of the 153 streamflow gages set record low levels for annual mean discharge in the 2002 water year. Figure 1 shows annual mean discharges with the long-term mean discharges at four selected streamflow gages throughout the State.

Monthly average precipitation was well below average through August 2002, but increased in September 2002 and remained above average for the 2003 water year, except for January and February 2003, when precipitation was below average. Statewide, monthly mean discharges (based on monthly mean streamflow statistics) followed a similar pattern. Monthly mean discharges were above the normal range of flow for much of the water year. About a third of the streamflow gages were below the normal range of flow (below the 25th percentile of monthly mean flows) in October 2002, as soil moisture was replenished and ponds and reservoirs filled. Streamflows increased into the normal range (above the 25th percentile and below the 75th percentile of monthly mean flows) or above-normal range of flow in November and December 2002. In January and February 2003, streamflows declined to the below-normal to normal range of flow, but increased to the above-normal range of flows by the March-April time frame. From April through September, streamflow remained in the above-normal range of flows at almost all streamflow gages throughout the State. Figure 2 shows the distribution of monthly and annual mean discharges for four selected streamflow gages throughout the State.

Very few floods occurred during the 2003 water year. Of 153 streamflow gages with more than 5 years of record, new maximum instantaneous flows were recorded at only 4 gages. Table 1 lists the gaging stations and their peak flows for the 2003 water year, associated recurrence intervals, and period of records. Three of the four streamflow gages have period of records less than 12 years.

Precipitation on February 22-23, 2003, combined with accumulated sleet and snow, caused heavy localized flooding in the mountain regions of Virginia and minor to moderate flooding elsewhere. Recurrence intervals of flood discharges at streamgages ranged from less than 2 years across most of the State to 25 years in the upper James River Basin.

Precipitation on March 20-21, 2003, caused heavy localized flooding in the south-central portions of Virginia and minor flooding elsewhere. Recurrence intervals of flood discharges at streamgages ranged from less than 2 years across most of the State, to 5 years in the Potomac River Basin (Fairfax County), and greater than 10 years in the Roanoke River Basin. The greatest flooding in Virginia was in the Dan River, Banister River, and Hyco River.

On September 18, 2003, at approximately noon, Hurricane Isabel made landfall on the outer banks of North Carolina. The 600-mile-wide storm, previously a class 5 hurricane with 160-mile-per-hour winds, made landfall as a class 2 hurricane and 110-mile-per-hour winds. The leading edge of the storm crossed into southeast Virginia with 100 mile-per-hour winds before being downgraded to a tropical storm. The storm tracked from the outer banks of North Carolina to Richmond, Va., across the Blue Ridge into eastern West Virginia and western Maryland. The storm brought heavy rains and winds to already saturated soils. The Virginia Beach area received approximately 4 inches of rain, while most of central Virginia received 5 to 8 inches. Peak rainfall amounts were in the Blue Ridge Mountains south and west of Charlottesville with as much as 20 inches of rain (Upper Sherando rain gage). The worst flooding occurred in central Virginia where the discharge in the South River near Harriston, Va., approached a 50-year recurrence interval, and the discharge in the South River near Buena Vista, Va., had a recurrence interval in excess of 100 years.

Table 1: Maximum, period of record, instantaneous peak discharges recorded during 2003 water year [--; not computed]

Gaging Station	Maximum instantaneous discharge, in cubic feet per second	Recurrence interval, in years	Length of record, in years
North Branch Chopawamsic Creek near Independent Hill, Va.	415	--	11
Middle Branch Chopawamsic Creek near Garisonville, Va.	512	--	8
Smith River near Woolwine, Va.	1,480	--	8
Allen Creek near Boydton, Va.	7,380	70	39

–

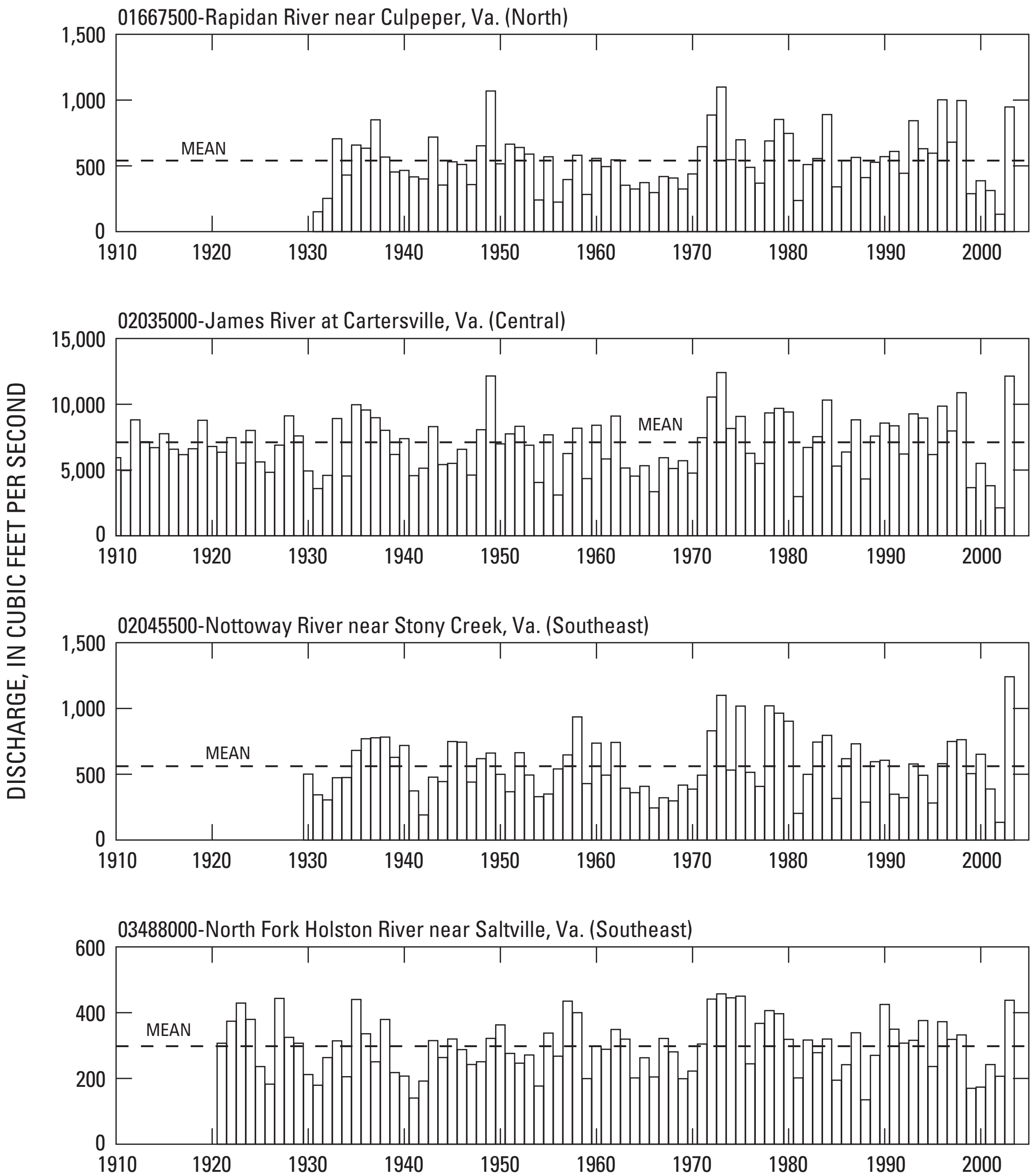

Figure1. Annual mean discharge at four selected stream-gaging stations

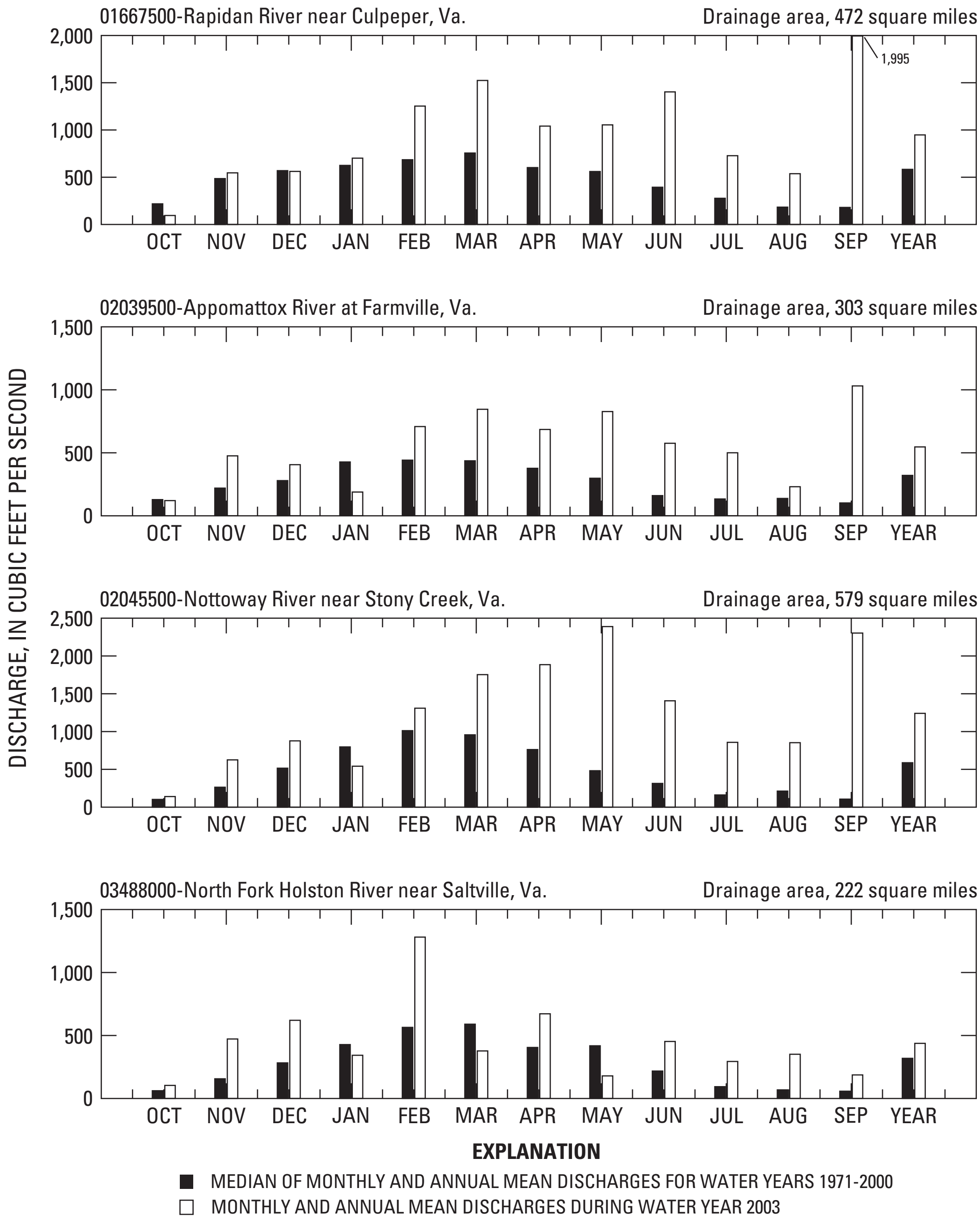

Figure 2. Monthly and annual mean discharges during 2003 water year and median of monthly and annual mean discharges for 1971-2000 water years at four representative stream-gaging stations.

DOWNSTREAM ORDER AND STATION NUMBER

Since October 1, 1950, hydrologic-station records in USGS reports have been listed in order of downstream direction along the main stream. All stations on a tributary entering upstream from a main-stream station are listed before that station. A station on a tributary entering between two main-stream stations is listed between those stations. A similar order is followed in listing stations on first rank, second rank, and other ranks of tributaries. The rank of any tributary on which a station is located with respect to the stream to which it is immediately tributary is indicated by an indention in that list of stations in the front of this report. Each indentation represents one rank. This downstream order and system of indentation indicates which stations are on tributaries between any two stations and the rank of the tributary on which each station is located.

As an added means of identification, each hydrologic station and partial-record station has been assigned a station number. These station numbers are in the same downstream order used in this report. In assigning a station number, no distinction is made between partial-record stations and other stations; therefore, the station number for a partial-record station indicates downstream-order position in a list composed of both types of stations. Gaps are consecutive. The complete 8-digit (or 10-digit) number for each station such as 09004100, which appears just to the left of the station name, includes a 2-digit part number “09” plus the 6-digit (or 8-digit) downstream order number “004100.” In areas of high station density, an additional two digits may be added to the station identification number to yield a 10-digit number. The stations are numbered in downstream order as described above between stations of consecutive 8-digit numbers.

NUMBERING SYSTEM FOR WELLS AND MISCELLANEOUS SITES

The USGS well and miscellaneous site-numbering system is based on the grid system of latitude and longitude. The system provides the geographic location of the well or miscellaneous site and a unique number for each site. The number consists of 15 digits. The first 6 digits denote the degrees, minutes, and seconds of latitude, and the next 7 digits denote degrees, minutes, and seconds of longitude; the last 2 digits are a sequential number for wells within a 1-second grid. In the event that the latitude-longitude coordinates for a well and miscellaneous site are the same, a sequential number such as “01,” “02,” and so forth, would be assigned as one would for wells (see fig. 3). The 8-digit, downstream order station numbers are not assigned to wells and miscellaneous sites where only random water-quality samples or discharge measurements are taken.

Downstream Order System

Since October 1, 1950, the order of listing hydrologic-station records in Survey reports is in a downstream direction along the main stream. All stations on a tributary entering upstream from a mainstream station are listed before that station. A station on a tributary that enters between two mainstream stations is listed between them. A similar order is followed in listing stations on first rank, second rank, and other ranks of tributaries. The rank of any tributary with respect to the stream to which it is immediately tributary is indicated by an indention in the "List of Stations" in the front of this report. Each indention represents one rank. This downstream order and system of indention shows which stations are on tributaries between any two stations and the rank of the tributary on which each station is situated.

The station-identification number is assigned according to downstream order. In assigning station numbers, no distinction is made between partial-record stations and other stations; therefore, the station number for a partial-record station indicates downstream-order position in a list made up of both types of stations. Gaps are left in the series of numbers to allow for new stations that may be established; hence, the numbers are not consecutive. The complete eight-digit number for each station, such as 02027500, which appears just to the left of the station name, includes the two-digit Part number "02" plus the six-digit downstream-order number "027500." The Part number designates the major river basin; for example, Part "02" is the James River Basin.

Latitude-Longitude System

The identification numbers for some miscellaneous surface-water and water-quality sites are assigned according to the grid system of latitude and longitude. The number consists of 15 digits. The first six digits denote the degrees, minutes, and seconds of latitude, the next seven digits denote degrees, minutes, and seconds of longitude, and the last two digits (assigned sequentially) identify the sites within a 1-second grid. This site-identfication number, once assigned, is a pure number and has no locational significance. In the rare instance where the initial determination of latitude and longitude are found to be in error, the station will retain its initial identification number; however, its true latitude and longitude will be listed in the LOCATION paragraph of the station description.

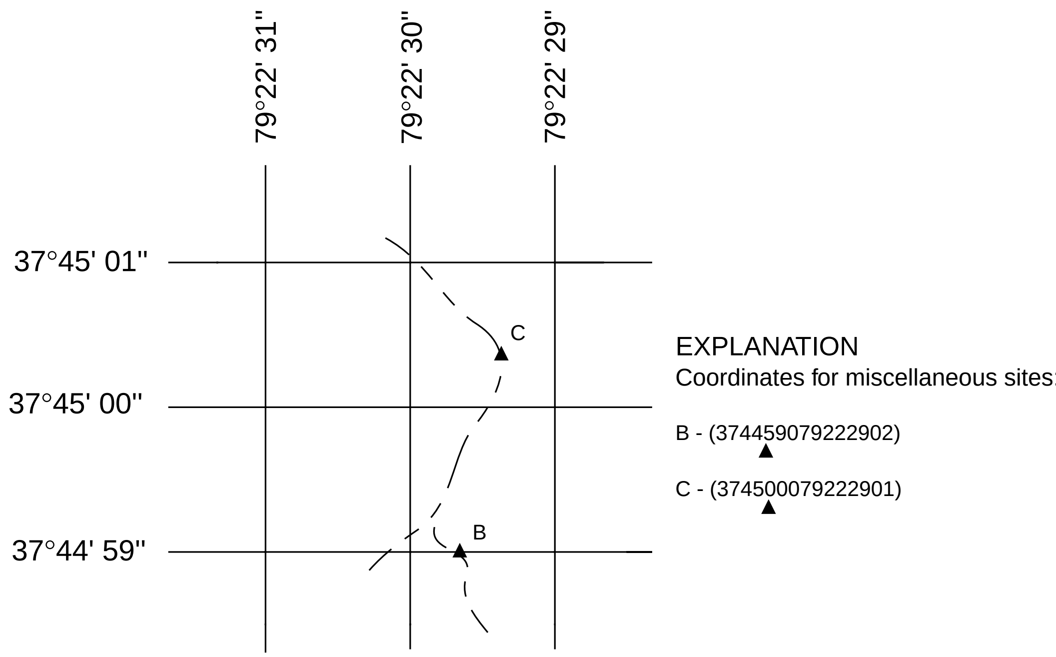

Figure 3. System for numbering selected miscellaneous sites.

SPECIAL NETWORKS AND PROGRAMS

Hydrologic Benchmark Network is a network of 61 sites in small drainage basins in 39 States that was established in 1963 to provide consistent streamflow data representative of undeveloped watersheds nationwide, and from which data could be analyzed on a continuing basis for use in comparison and contrast with conditions observed in basins more obviously affected by human activities. At selected sites, water-quality information is being gathered on major ions and nutrients, primarily to assess the effects of acid deposition on stream chemistry. Additional information on the Hydrologic Benchmark Program may be accessed from *http://water.usgs.gov/hbn/*.

National Stream-Quality Accounting Network (NASQAN) is a network of sites used to monitor the water quality of large rivers within the Nation's largest river basins. From 1995 through 1999, a network of approximately 40 stations was operated in the Mississippi, Columbia, Colorado, and Rio Grande River basins. For the period 2000 through 2004, sampling was reduced to a few index stations on the Colorado and Columbia Rivers so that a network of 5 stations could be implemented on the Yukon River. Samples are collected with sufficient frequency that the flux of a wide range of constituents can be estimated. The objective of NASQAN is to characterize the water quality of these large rivers by measuring concentration and mass transport of a wide range of dissolved and suspended constituents, including nutrients, major ions, dissolved and sediment-bound heavy metals, common pesticides, and inorganic and organic forms of carbon. This information will be used (1) to describe the long-term trends and changes in concentration and transport of these constituents; (2) to test findings of the National Water-Quality Assessment (NAWQA) Program; (3) to characterize processes unique to large-river systems such as storage and re-mobilization of sediments and associated contaminants; and (4) to refine existing estimates of off-continent transport of water, sediment, and chemicals for assessing human effects on the world's oceans and for determining global cycles of carbon, nutrients, and other chemicals. Additional information about the NASQAN Program may be accessed from *http://water.usgs.gov/nasqan/*.

The National Atmospheric Deposition Program/National Trends Network (NADP/NTN) is a network of monitoring sites that provide continuous measurement and assessment of the chemical constituents in precipitation throughout the United States. As the lead Federal agency, the USGS works together with over 100 organizations to provide a long-term, spatial and temporal record of atmospheric deposition generated from this network of 250 precipitation-chemistry monitoring sites. The USGS supports 74 of these 250 sites. This long-term, nationally consistent monitoring program, coupled with ecosystem research, provides critical information toward a national scorecard to evaluate the effectiveness of ongoing and future regulations intended to reduce atmospheric emissions and subsequent impacts to the Nation's land and water resources. Reports and other information on the NADP/NTN Program, as well as data from the individual sites, may be accessed from *http://bqs.usgs.gov/acidrain/*.

The USGS National Water-Quality Assessment (NAWQA) Program is a long-term program with goals to describe the status and trends of water-quality conditions for a large, representative part of the Nation's ground- and surface-water resources; to provide an improved understanding of the primary natural and human factors affecting these observed conditions and trends; and to provide information that supports development and evaluation of management, regulatory, and monitoring decisions by other agencies.

Assessment activities are being conducted in 42 study units (major watersheds and aquifer systems) that represent a wide range of environmental settings nationwide and that account for a large percentage of the Nation's water use. A wide array of chemical constituents is measured in ground water, surface water, streambed sediments, and fish tissues. The coordinated application of comparative hydrologic studies at a wide range of spatial and temporal scales will provide information for water-resources managers to use in making decisions and a foundation for aggregation and comparison of findings to address water-quality issues of regional and national interest.

Communication and coordination between USGS personnel and other local, State, and Federal interests are critical components of the NAWQA Program. Each study unit has a local liaison committee consisting of representatives from key Federal, State, and local water-resources agencies, Indian nations, and universities in the study unit. Liaison committees typically meet semiannually to discuss their information needs, monitoring plans and progress, desired information products, and opportunities to collaborate efforts among the agencies. Additional information about the NAWQA Program may be accessed from *http://water.usgs.gov/nawqa/*.

The USGS National Streamflow Information Program (NSIP) is a long-term program with goals to provide framework streamflow data across the Nation. Included in the program are creation of a permanent Federally funded streamflow network, research on the nature of streamflow, regional assessments of streamflow data and databases, and upgrades in the streamflow information delivery systems. Additional information about NSIP may be accessed from *http://water.usgs.gov/nsip/*.

EXPLANATION OF STAGE AND WATER-DISCHARGE RECORDS

Data Collection and Computation

The base data collected at gaging stations (fig. 4) consist of records of stage and measurements of discharge of streams or canals, and stage, surface area, and volume of lakes or reservoirs. In addition, observations of factors affecting the stage-discharge relation or the stage-capacity relation, weather records, and other information are used to supplement base data in determining the daily flow or volume of water in storage. Records of stage are obtained from a water-stage recorder that is either downloaded electronically in the field to a laptop computer or similar device or is transmitted using telemetry such as GOES satellite, land-line or cellular-phone modems, or by radio transmission. Measurements of discharge are made with a current meter or acoustic Doppler current profiler, using the general methods adopted by the USGS. These methods are described in standard textbooks, USGS Water-Supply Paper 2175, and the Techniques of Water-Resources Investigations of the United States Geological Survey (TWRIs), Book 3, Chapters A1 through A19 and Book 8, Chapters A2 and B2. The methods are consistent with the American Society for Testing and Materials (ASTM) standards and generally follow the standards of the International Organization for Standards (ISO).

For stream-gaging stations, discharge-rating tables for any stage are prepared from stage-discharge curves. If extensions to the rating curves are necessary to express discharge greater than measured, the extensions are made on the basis of indirect measurements of peak discharge (such as slope-area or contracted-opening measurements, or computation of flow over dams and weirs), step-backwater techniques, velocity-area studies, and logarithmic plotting. The daily mean discharge is computed from gage heights and rating tables, then the monthly and yearly mean discharges are computed from the daily values. If the stage-discharge relation is subject to change because of frequent or continual change in the physical features of the stream channel, the daily mean discharge is computed by the shifting-control method in which correction factors based on individual discharge measurements and notes by engineers and observers are used when applying the gage heights to the rating tables. If the stage-discharge relation for a station is temporarily changed by the presence of aquatic growth or debris on the controlling section, the daily mean discharge is computed by the shifting-control method.

The stage-discharge relation at some stream-gaging stations is affected by backwater from reservoirs, tributary streams, or other sources. Such an occurrence necessitates the use of the slope method in which the slope or fall in a reach of the stream is a factor in computing discharge. The slope or fall is obtained by means of an auxiliary gage at some distance from the base gage.

An index velocity is measured using ultrasonic or acoustic instruments at some stream-gaging stations and this index velocity is used to calculate an average velocity for the flow in the stream. This average velocity along with a stage-area relation is then used to calculate average discharge.

At some stations, stage-discharge relation is affected by changing stage. At these stations, the rate of change in stage is used as a factor in computing discharge.

At some stream-gaging stations in the northern United States, the stage-discharge relation is affected by ice in the winter; therefore, computation of the discharge in the usual manner is impossible. Discharge for periods of ice effect is computed on the basis of gage-height record and occasional winter-discharge measurements. Consideration is given to the available information on temperature and precipitation, notes by gage observers and hydrologists, and comparable records of discharge from other stations in the same or nearby basins.

For a lake or reservoir station, capacity tables giving the volume or contents for any stage are prepared from stage-area relation curves defined by surveys. The application of the stage to the capacity table gives the contents, from which the daily, monthly, or yearly changes are computed.

If the stage-capacity curve is subject to changes because of deposition of sediment in the reservoir, periodic resurveys of the reservoir are necessary to define new stage-capacity curves. During the period between reservoir surveys, the computed contents may be increasingly in error due to the gradual accumulation of sediment.

For some stream-gaging stations, periods of time occur when no gage-height record is obtained or the recorded gage height is faulty and cannot be used to compute daily discharge or contents. Such a situation can happen when the recorder stops or otherwise fails to operate properly, the intakes are plugged, the float is frozen in the well, or for various other reasons. For such periods, the daily discharges are estimated on the basis of recorded range in stage, prior and subsequent records, discharge measurements, weather records, and comparison with records from other stations in the same or nearby basins. Likewise, lake or reservoir volumes may be estimated on the basis of operator’s log, prior and subsequent records, inflow-outflow studies, and other information.

Data Presentation

The records published for each continuous-record surface-water discharge station (stream-gaging station) consist of five parts: (1) the station manuscript or description; (2) the data table of daily mean values of discharge for the current water year with summary data; (3) a tabular statistical summary of monthly mean flow data for a designated period, by water year; (4) a summary statistics table that includes statistical data of annual, daily, and instantaneous flows as well as data pertaining to annual runoff, 7-day low-flow minimums, and flow duration; and (5) a hydrograph of discharge.

Station Manuscript

The manuscript provides, under various headings, descriptive information, such as station location; period of record; historical extremes outside the period of record; record accuracy; and other remarks pertinent to station operation and regulation. The following information, as appropriate, is provided with each continuous record of discharge or lake content. Comments follow that clarify information presented under the various headings of the station description.

LOCATION.—Location information is obtained from the most accurate maps available. The location of the gaging station with respect to the cultural and physical features in the vicinity and with respect to the reference place mentioned in the station name is given. River mileages, given for only a few stations, were determined by methods given in “River Mileage Measurement,” Bulletin 14, Revision of October 1968, prepared by the Water Resources Council or were provided by the U.S. Army Corps of Engineers.

DRAINAGE AREA.—Drainage areas are measured using the most accurate maps available. Because the type of maps available varies from one drainage basin to another, the accuracy of drainage areas likewise varies. Drainage areas are updated as better maps become available.

PERIOD OF RECORD.—This term indicates the time period for which records have been published for the station or for an equivalent station. An equivalent station is one that was in operation at a time that the present station was not and whose location was such that its flow reasonably can be considered equivalent to flow at the present station.

REVISED RECORDS.—If a critical error in published records is discovered, a revision is included in the first report published following discovery of the error.

GAGE.—The type of gage in current use, the datum of the current gage referred to a standard datum, and a condensed history of the types, locations, and datums of previous gages are given under this heading.

REMARKS.—All periods of estimated daily discharge either will be identified by date in this paragraph of the station description for water-discharge stations or flagged in the daily discharge table. (See section titled Identifying Estimated Daily Discharge.) Information is presented relative to the accuracy of the records, to special methods of computation, and to conditions that affect natural flow at the station. In addition, information may be presented pertaining to average discharge data for the period of record; to extremes data for the period of record and the current year; and, possibly, to other pertinent items. For reservoir stations, information is given on the dam forming the reservoir, the capacity, the outlet works and spillway, and the purpose and use of the reservoir.

COOPERATION.—Records provided by a cooperating organization or obtained for the USGS by a cooperating organization are identified here.

EXTREMES OUTSIDE PERIOD OF RECORD.—Information here documents major floods or unusually low flows that occurred outside the stated period of record. The information may or may not have been obtained by the USGS.

REVISIONS.—Records are revised if errors in published records are discovered. Appropriate updates are made in the USGS distributed data system, NWIS, and subsequently to its Web-based National data system, NWISWeb (*http://water.usgs.gov/nwis/nwis*). Users are encouraged to obtain all required data from NWIS or NWISWeb to ensure that they have the most recent data updates. Updates to NWISWeb are made on an annual basis.

Although rare, occasionally the records of a discontinued gaging station may need revision. Because no current or, possibly, future station manuscript would be published for these stations to document the revision in a REVISED RECORDS entry, users of data for these stations who obtained the record from previously published data reports may wish to contact the District Office (address given on the back of the title page of this report) to determine if the published records were revised after the station was discontinued. If, however, the data for a discontinued station were obtained by computer retrieval, the data would be current. Any published revision of data is always accompanied by revision of the corresponding data in computer storage.

Manuscript information for lake or reservoir stations differs from that for stream stations in the nature of the REMARKS and in the inclusion of a stage-capacity table when daily volumes are given.

Peak Discharge Greater than Base Discharge

Tables of peak discharge above base discharge are included for some stations where secondary instantaneous peak discharge data are used in flood-frequency studies of highway and bridge design, flood-control structures, and other flood-related projects. The base discharge value is selected so an average of three peaks a year will be reported. This base discharge value has a recurrence interval of approximately 1.1 years or a 91-percent chance of exceedence in any 1 year.

Data Table of Daily Mean Values

The daily table of discharge records for stream-gaging stations gives mean discharge for each day of the water year. In the monthly summary for the table, the line headed TOTAL gives the sum of the daily figures for each month; the line headed MEAN gives the arithmetic average flow in cubic feet per second for the month; and the lines headed MAX and MIN give the maximum and minimum daily mean discharges, respectively, for each month. Discharge for the month is expressed in cubic feet per second per square mile (line headed CFSM); or in inches (line headed IN); or in acre-feet (line headed AC-FT). Values for cubic feet per second per square mile and runoff in inches or in acre-feet may be omitted if extensive regulation or diversion is in effect or if the drainage area includes large noncontributing areas. At some stations, monthly and (or) yearly observed discharges are adjusted for reservoir storage or diversion, or diversion data or reservoir volumes are given. These values are identified by a symbol and a corresponding footnote.

Statistics of Monthly Mean Data

A tabular summary of the mean (line headed MEAN), maximum (MAX), and minimum (MIN) of monthly mean flows for each month for a designated period is provided below the mean values table. The water years of the first occurrence of the maximum and minimum monthly flows are provided immediately below those values. The designated period will be expressed as FOR WATER YEARS __-__, BY WATER YEAR (WY), and will list the first and last water years of the range of years selected from the PERIOD OF RECORD paragraph in the station manuscript. The designated period will consist of all of the station record within the specified water years, including complete months of record for partial water years, and may coincide with the period of record for the station. The water years for which the statistics are computed are consecutive, unless a break in the station record is indicated in the manuscript.

Summary Statistics

A table titled SUMMARY STATISTICS follows the statistics of monthly mean data tabulation. This table consists of four columns with the first column containing the line headings of the statistics being reported. The table provides a statistical summary of yearly, daily, and instantaneous flows, not only for the current water year but also for the previous calendar year and for a designated period, as appropriate. The designated period selected, WATER YEARS __-__, will consist of all of the station records within the specified water years, including complete months of record for partial water years, and may coincide with the period of record for the station. The water years for which the statistics are computed are consecutive, unless a break in the station record is indicated in the manuscript. All of the calculations for the statistical characteristics designated ANNUAL (see line headings below), except for the ANNUAL 7-DAY MINIMUM statistic, are calculated for the designated period using complete water years. The other statistical characteristics may be calculated using partial water years.

The date or water year, as appropriate, of the first occurrence of each statistic reporting extreme values of discharge is provided adjacent to the statistic. Repeated occurrences may be noted in the REMARKS paragraph of the manuscript or in footnotes. Because the designated period may not be the same as the station period of record published in the manuscript, occasionally the dates of occurrence listed for the daily and instantaneous extremes in the designated-period column may not be within the selected water years listed in the heading. When the dates of occurrence do not fall within the selected water years listed in the heading, it will be noted in the REMARKS paragraph or in footnotes. Selected streamflow duration-curve statistics and runoff data also are given. Runoff data may be omitted if extensive regulation or diversion of flow is in effect in the drainage basin.

The following summary statistics data are provided with each continuous record of discharge. Comments that follow clarify information presented under the various line headings of the SUMMARY STATISTICS table.

ANNUAL TOTAL.—The sum of the daily mean values of discharge for the year.

ANNUAL MEAN.—The arithmetic mean for the individual daily mean discharges for the year noted or for the designated period.

HIGHEST ANNUAL MEAN.—The maximum annual mean discharge occurring for the designated period.

LOWEST ANNUAL MEAN.—The minimum annual mean discharge occurring for the designated period.

HIGHEST DAILY MEAN.—The maximum daily mean discharge for the year or for the designated period.

LOWEST DAILY MEAN.—The minimum daily mean discharge for the year or for the designated period.

ANNUAL 7-DAY MINIMUM.—The lowest mean discharge for 7 consecutive days for a calendar year or a water year. Note that most low-flow frequency analyses of annual 7-day minimum flows use a climatic year (April 1-March 31). The date shown in the summary statistics table is the initial date of the 7-day period. This value should not be confused with the 7-day 10-year low-flow statistic.

MAXIMUM PEAK FLOW.—The maximum instantaneous peak discharge occurring for the water year or designated period. Occasionally the maximum flow for a year may occur at midnight at the beginning or end of the year, on a recession from or rise toward a higher peak in the adjoining year. In this case, the maximum peak flow is given in the table and the maximum flow may be reported in a footnote or in the REMARKS paragraph in the manuscript.

MAXIMUM PEAK STAGE.—The maximum instantaneous peak stage occurring for the water year or designated period. Occasionally the maximum stage for a year may occur at midnight at the beginning or end of the year, on a recession from or rise toward a higher peak in the adjoining year. In this case, the maximum peak stage is given in the table and the maximum stage may be reported in the REMARKS paragraph in the manuscript or in a footnote. If the dates of occurrence of the maximum peak stage and maximum peak flow are different, the REMARKS paragraph in the manuscript or a footnote may be used to provide further information.

INSTANTANEOUS LOW FLOW.—The minimum instantaneous discharge occurring for the water year or for the designated period.

ANNUAL RUNOFF.—Indicates the total quantity of water in runoff for a drainage area for the year. Data reports may use any of the following units of measurement in presenting annual runoff data:

> Acre-foot (AC-FT) is the quantity of water required to cover 1 acre to a depth of 1 foot and is equivalent to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.
>
> Cubic feet per square mile (CFSM) is the average number of cubic feet of water flowing per second from each square mile of area drained, assuming the runoff is distributed uniformly in time and area.
>
> Inches (INCHES) indicate the depth to which the drainage area would be covered if all of the runoff for a given time period were uniformly distributed on it.

10 PERCENT EXCEEDS.—The discharge that has been exceeded 10 percent of the time for the designated period.

50 PERCENT EXCEEDS.—The discharge that has been exceeded 50 percent of the time for the designated period.

90 PERCENT EXCEEDS.—The discharge that has been exceeded 90 percent of the time for the designated period.

Data collected at partial-record stations follow the information for continuous-record sites. Data for partial-record discharge stations are presented in two tables. The first table lists annual maximum stage and discharge at crest-stage stations, and the second table lists discharge measurements at low-flow partial-record stations. The tables of partial-record stations are followed by a listing of discharge measurements made at sites other than continuous-record or partial-record stations. These measurements are often made in times of drought or flood to give better areal coverage to those events. Those measurements and others collected for a special reason are called measurements at miscellaneous sites.

Identifying Estimated Daily Discharge

Estimated daily-discharge values published in the water-discharge tables of annual State data reports are identified. This identification is shown either by flagging individual daily values with the letter “e” and noting in a table footnote, “e–Estimated,” or by listing the dates of the estimated record in the REMARKS paragraph of the station description.

Accuracy of Field Data and Computed Results

The accuracy of streamflow data depends primarily on (1) the stability of the stage-discharge relation or, if the control is unstable, the frequency of discharge measurements, and (2) the accuracy of observations of stage, measurements of discharge, and interpretations of records.

The degree of accuracy of the records is stated in the REMARKS in the station description. “Excellent” indicates that about 95 percent of the daily discharges are within 5 percent of the true value; “good” within 10 percent; and “fair,” within 15 percent. “Poor” indicates that daily discharges have less than “fair” accuracy. Different accuracies may be attributed to different parts of a given record.

Values of daily mean discharge in this report are shown to the nearest hundredth of a cubic foot per second for discharges of less than 1 ft^3/s; to the nearest tenths between 1.0 and 10 ft^3/s; to whole numbers between 10 and 1,000 ft^3/s; and to 3 significant figures above 1,000 ft^3/s. The number of significant figures used is based solely on the magnitude of the discharge value. The same rounding rules apply to discharge values listed for partial-record stations.

Discharge at many stations, as indicated by the monthly mean, may not reflect natural runoff due to the effects of diversion, consumption, regulation by storage, increase or decrease in evaporation due to artificial causes, or to other factors. For such stations, values of cubic feet per second per square mile and of runoff in inches are not published unless satisfactory adjustments can be made for diversions, for changes in contents of reservoirs, or for other changes incident to use and control. Evaporation from a reservoir is not included in the adjustments for changes in reservoir contents, unless it is so stated. Even at those stations where adjustments are made, large errors in computed runoff may occur if adjustments or losses are large in comparison with the observed discharge.

Other Data Records Available

Information of a more detailed nature than that published for most of the stream-gaging stations such as discharge measurements, gage-height records, and rating tables is available from the District office. Also, most stream-gaging station records are available in computer-usable form and many statistical analyses have been made.

Information on the availability of unpublished data or statistical analyses may be obtained from the District office (see address that is shown on the back of the title page of this report).

The following information is provided with each precipitation station. Comments that follow clarify information presented under the various headings of the station description.

LOCATION.—See Data Presentation in the EXPLANATION OF STAGE- AND WATER-DISCHARGE RECORDS section of this report (same comments apply).

PERIOD OF RECORD.—See Data Presentation in the EXPLANATION OF STAGE- AND WATER-DISCHARGE RECORDS section of this report (same comments apply).

INSTRUMENTATION.—Information on the type of rainfall collection system is given.

REMARKS.—Remarks provide added information pertinent to the collection, analysis, or computation of records.

EXPLANATION OF WATER-QUALITY RECORDS

Collection and Examination of Data

Surface-water samples for analysis usually are collected at or near stream-gaging stations. The quality-of-water records are given immediately following the discharge records at these stations.

The descriptive heading for water-quality records gives the period of record for all water-quality data; the period of daily record for parameters that are measured on a daily basis (specific conductance, water temperature, sediment discharge, and so forth); extremes for the current year; and general remarks.

For ground-water records, no descriptive statements are given; however, the well number, depth of well, sampling date, or other pertinent data are given in the table containing the chemical analyses of the ground water.

Water Analysis

Most of the methods used for collecting and analyzing water samples are described in the TWRIs. A list of TWRIs is provided in this report.

One sample can define adequately the water quality at a given time if the mixture of solutes throughout the stream cross-section is homogeneous. However, the concentration of solutes at different locations in the cross section may vary widely with different rates of water discharge, depending on the source of material and the turbulence and mixing of the stream. Some streams must be sampled at several verticals to obtain a representative sample needed for an accurate mean concentration and for use in calculating load.

Chemical-quality data published in this report are considered to be the most representative values available for the stations listed. The values reported represent water-quality conditions at the time of sampling as much as possible, consistent with available sampling techniques and methods of analysis. In the rare case where an apparent inconsistency exists between a reported pH value and the relative abundance of carbon dioxide species (carbonate and bicarbonate), the inconsistency is the result of a slight uptake of carbon dioxide from the air by the sample between measurement of pH in the field and determination of carbonate and bicarbonate in the laboratory.

For chemical-quality stations equipped with digital monitors, the records consist of daily maximum and minimum values (and sometimes mean or median values) for each constituent measured, and are based on 15-minute or 1-hour intervals of recorded data beginning at 0000 hours and ending at 2400 hours for the day of record.

SURFACE-WATER-QUALITY RECORDS

Records of surface-water quality ordinarily are obtained at or near stream-gaging stations because discharge data is useful in the interpretation of surface-water quality. Records of surface-water quality in this report involve a variety of types of data and measurement frequencies.

Classification of Records

Water-quality data for surface-water sites are grouped into one of three classifications. A *continuous-record station* is a site where data are collected on a regularly scheduled basis. Frequency may be one or more times daily, weekly, monthly, or quarterly. A *partial-record station* is a site where limited water-quality data are collected systematically over a period of years. Frequency of sampling is usually less than quarterly. A *miscellaneous sampling site* is a location other than a continuous- or partial-record station, where samples are collected to give better areal coverage to define water-quality conditions in the river basin.

A careful distinction needs to be made between *continuous records* as used in this report and *continuous recordings* that refer to a continuous graph or a series of discrete values recorded at short intervals. Some records of water quality, such as temperature and specific conductance, may be obtained through continuous recordings; however, because of costs, most data are obtained only monthly or less frequently. Locations of stations for which records on the quality of surface water appear in this report are shown in figure 4.

Accuracy of the Records

One of four accuracy classifications is applied for measured physical properties at continuous-record stations on a scale ranging from poor to excellent. The accuracy rating is based on data values recorded before any shifts or corrections are made. Additional consideration also is given to the amount of publishable record and to the amount of data that have been corrected or shifted.

Rating classifications for continuous water-quality records

[≤, less than or equal to; ±, plus or minus value shown; °C, degree Celsius; >, greater than; %, percent; mg/L, milligram per liter; pH unit, standard pH unit]

Measured physical property	Rating			
	Excellent	Good	Fair	Poor
Water temperature	≤ ±0.2 °C	> ±0.2 to 0.5 °C	> ±0.5 to 0.8 °C	> ±0.8 °C
Specific conductance	≤ ±3%	> ±3 to 10%	> ±10 to 15%	> ±15%
Dissolved oxygen	≤ ±0.3 mg/L	> ±0.3 to 0.5 mg/L	> ±0.5 to 0.8 mg/L	> ±0.8 mg/L
pH	≤ ±0.2 unit	> ±0.2 to 0.5 unit	> ±0.5 to 0.8 unit	> ±0.8 unit
Turbidity	≤ ±5%	> ±5 to 10%	> ±10 to 15%	> ±15%

Arrangement of Records

Water-quality records collected at a surface-water daily record station are published immediately following that record, regardless of the frequency of sample collection. Station number and name are the same for both records. Where a surface-water daily record station is not available or where the water quality differs significantly from that at the nearby surface-water station, the continuing water-quality record is published with its own station number and name in the regular downstream-order sequence. Water-quality data for partial-record stations and for miscellaneous sampling sites appear in separate tables following the table of discharge measurements at miscellaneous sites.

On-Site Measurements and Sample Collection

In obtaining water-quality data, a major concern is assuring that the data obtained represent the naturally occurring quality of the water. To ensure this, certain measurements, such as water temperature, pH, and dissolved oxygen, must be made on site when the samples are taken. To assure that measurements made in the laboratory also represent the naturally occurring water, carefully prescribed procedures must be followed in collecting the samples, in treating the samples to prevent changes in quality pending analysis, and in shipping the samples to the laboratory. Procedures for on-site measurements and for collecting, treating, and shipping samples are given in TWRIs Book 1, Chapter D2; Book 3, Chapters A1, A3, and A4; and Book 9, Chapters A1-A9. These TWRIs are listed in this report. Also, detailed information on collecting, treating, and shipping samples can be obtained from the USGS District office (see address that is shown on the back of title page in this report).

Water Temperature

Water temperatures are measured at most of the water-quality stations. In addition, water temperatures are taken at the time of discharge measurements for water-discharge stations. For stations where water temperatures are taken manually once or twice daily, the water temperatures are taken at about the same time each day. Large streams have a small diurnal temperature change; shallow streams may have a daily range of several degrees and may follow closely the changes in air temperature. Some streams may be affected by waste-heat discharges.

At stations where recording instruments are used, either mean temperatures or maximum and minimum temperatures for each day are published. Water temperatures measured at the time of water-discharge measurements are on file in the District office.

Sediment

Suspended-sediment concentrations are determined from samples collected by using depth-integrating samplers. Samples usually are obtained at several verticals in the cross section, or a single sample may be obtained at a fixed point and a coefficient applied to determine the mean concentration in the cross section.

During periods of rapidly changing flow or rapidly changing concentration, samples may be collected more frequently (twice daily or, in some instances, hourly). The published sediment discharges for days of rapidly changing flow or concentration were computed by the subdivided-day method (time-discharge weighted average). Therefore, for those days when the published sediment discharge value differs from the value computed as the product of discharge times mean concentration times 0.0027, the reader can assume that the sediment discharge for that day was computed by the subdivided-day method. For periods when no samples were collected, daily discharges of suspended sediment were estimated on the basis of water discharge, sediment concentrations observed immediately before and after the periods, and suspended-sediment loads for other periods of similar discharge.

At other stations, suspended-sediment samples are collected periodically at many verticals in the stream cross section. Although data collected periodically may represent conditions only at the time of observation, such data are useful in establishing seasonal relations between quality and streamflow and in predicting long-term sediment-discharge characteristics of the stream.

In addition to the records of suspended-sediment discharge, records of the periodic measurements of the particle-size distribution of the suspended sediment and bed material are included for some stations.

Laboratory Measurements

Samples for biochemical oxygen demand (BOD) and indicator bacteria are analyzed locally. All other samples are analyzed in the USGS laboratory in Lakewood, Colorado, unless otherwise noted. Methods used in analyzing sediment samples and computing sediment records are given in TWRI, Book 5, Chapter C1. Methods used by the USGS laboratories are given in the TWRIs, Book 1, Chapter D2; Book 3, Chapter C2; and Book 5, Chapters A1, A3, and A4. These methods are consistent with ASTM standards and generally follow ISO standards.

Data Presentation

For continuing-record stations, information pertinent to the history of station operation is provided in descriptive headings preceding the tabular data. These descriptive headings give details regarding location, drainage area, period of record, type of data available, instrumentation, general remarks, cooperation, and extremes for parameters currently measured daily. Tables of chemical, physical, biological, radiochemical data, and so forth, obtained at a frequency less than daily are presented first. Tables of “daily values” of specific conductance, pH, water temperature, dissolved oxygen, and suspended sediment then follow in sequence.

In the descriptive headings, if the location is identical to that of the discharge gaging station, neither the LOCATION nor the DRAINAGE AREA statements are repeated. The following information is provided with each continuous-record station. Comments that follow clarify information presented under the various headings of the station description.

LOCATION.—See Data Presentation information in the EXPLANATION OF STAGE- AND WATER-DISCHARGE RECORDS section of this report (same comments apply).

DRAINAGE AREA.—See Data Presentation information in the EXPLANATION OF STAGE- AND WATER-DISCHARGE RECORDS section of this report (same comments apply).

PERIOD OF RECORD.—This indicates the time periods for which published water-quality records for the station are available. The periods are shown separately for records of parameters measured daily or continuously and those measured less than daily. For those measured daily or continuously, periods of record are given for the parameters individually.

INSTRUMENTATION.—Information on instrumentation is given only if a water-quality monitor temperature record, sediment pumping sampler, or other sampling device is in operation at a station.

REMARKS.—Remarks provide added information pertinent to the collection, analysis, or computation of the records.

COOPERATION.—Records provided by a cooperating organization or obtained for the USGS by a cooperating organization are identified here.

EXTREMES.—Maximums and minimums are given only for parameters measured daily or more frequently. For parameters measured weekly or less frequently, true maximums or minimums may not have been obtained. Extremes, when given, are provided for both the period of record and for the current water year.

REVISIONS.—Records are revised if errors in published water-quality records are discovered. Appropriate updates are made in the USGS distributed data system, NWIS, and subsequently to its Web-based National data system, NWISWeb (*http://waterdata.usgs.gov/nwis*). Users of USGS water-quality data are encouraged to obtain all required data from NWIS or NWISWeb to ensure that they have the most recent updates. Updates to the NWISWeb are made on an annual basis.

The surface-water-quality records for partial-record stations and miscellaneous sampling sites are published in separate tables following the table of discharge measurements at miscellaneous sites. No descriptive statements are given for these records. Each station is published with its own station number and name in the regular downstream-order sequence.

Remark Codes

The following remark codes may appear with the water-quality data in this section:

Printed Output	Remark
E or e	Estimated value.
>	Actual value is known to be greater than the value shown.
<	Actual value is known to be less than the value shown.
K	Results based on colony count outside the acceptance range (non-ideal colony count).
L	Biological organism count less than 0.5 percent (organism may be observed rather than counted).
D	Biological organism count equal to or greater than 15 percent (dominant).
V	Analyte was detected in both the environmental sample and the associated blanks.
&	Biological organism estimated as dominant.

Water-Quality Control Data

The USGS National Water Quality Laboratory collects quality-control data on a continuing basis to evaluate selected analytical methods to determine long-term method detection levels (LT-MDLs) and laboratory reporting levels (LRLs). These values are re-evaluated each year on the basis of the most recent quality-control data and, consequently, may change from year to year.

This reporting procedure limits the occurrence of false positive error. Falsely reporting a concentration greater than the LT-MDL for a sample in which the analyte is not present is 1 percent or less. Application of the LRL limits the occurrence of false negative error. The chance of falsely reporting a non-detection for a sample in which the analyte is present at a concentration equal to or greater than the LRL is 1 percent or less.

Accordingly, concentrations are reported as less than LRL for samples in which the analyte was either not detected or did not pass identification. Analytes detected at concentrations between the LT-MDL and the LRL and that pass identification criteria are estimated. Estimated concentrations will be noted with a remark code of “E.” These data should be used with the understanding that their uncertainty is greater than that of data reported without the E remark code.

Data generated from quality-control (QC) samples are a requisite for evaluating the quality of the sampling and processing techniques as well as data from the actual samples themselves. Without QC data, environmental sample data cannot be adequately interpreted because the errors associated with the sample data are unknown. The various types of QC samples collected by this District office are described in the following section. Procedures have been established for the storage of water-quality-control data within the USGS. These procedures allow for storage of all derived QC data and are identified so that they can be related to corresponding environmental samples. These data are not presented in this report but are available from the District office.

Blank Samples

Blank samples are collected and analyzed to ensure that environmental samples have not been contaminated in the overall data-collection process. The blank solution used to develop specific types of blank samples is a solution that is free of the analytes of interest. Any measured value signal in a blank sample for an analyte (a specific component measured in a chemical analysis) that was absent in the blank solution is believed to be due to contamination. Many types of blank samples are possible; each is designed to segregate a different part of the overall data-collection process. The types of blank samples collected in this district are:

Field blank—A blank solution that is subjected to all aspects of sample collection, field processing preservation, transportation, and laboratory handling as an environmental sample.

Trip blank—A blank solution that is put in the same type of bottle used for an environmental sample and kept with the set of sample bottles before and after sample collection.

Equipment blank—A blank solution that is processed through all equipment used for collecting and processing an environmental sample (similar to a field blank but normally done in the more controlled conditions of the office).

Sampler blank—A blank solution that is poured or pumped through the same field sampler used for collecting an environmental sample.

Filter blank—A blank solution that is filtered in the same manner and through the same filter apparatus used for an environmental sample.

Splitter blank—A blank solution that is mixed and separated using a field splitter in the same manner and through the same apparatus used for an environmental sample.

Preservation blank—A blank solution that is treated with the sampler preservatives used for an environmental sample.

Reference Samples

Reference material is a solution or material prepared by a laboratory. The reference material composition is certified for one or more properties so that it can be used to assess a measurement method. Samples of reference material are submitted for analysis to ensure that an analytical method is accurate for the known properties of the reference material. Generally, the selected reference material properties are similar to the environmental sample properties.

Replicate Samples

Replicate samples are a set of environmental samples collected in a manner such that the samples are thought to be essentially identical in composition. Replicate is the general case for which a duplicate is the special case consisting of two samples. Replicate samples are collected and analyzed to establish the amount of variability in the data contributed by some part of the collection and analytical process. Many types of replicate samples are possible, each of which may yield slightly different results in a dynamic hydrologic setting, such as a flowing stream. The types of replicate samples collected in this district are:

Concurrent samples—A type of replicate sample in which the samples are collected simultaneously with two or more samplers or by using one sampler and alternating the collection of samples into two or more compositing containers.

Sequential samples—A type of replicate sample in which the samples are collected one after the other, typically over a short time.

Split sample—A type of replicate sample in which a sample is split into subsamples, each subsample contemporaneous in time and space.

Spike Samples

Spike samples are samples to which known quantities of a solution with one or more well-established analyte concentrations have been added. These samples are analyzed to determine the extent of matrix interference or degradation on the analyte concentration during sample processing and analysis.

ACCESS TO USGS WATER DATA

The USGS provides near real-time stage and discharge data for many of the gaging stations equipped with the necessary telemetry and historic daily-mean and peak-flow discharge data for most current or discontinued gaging stations through the World Wide Web (WWW). These data may be accessed from http://water.usgs.gov.

Water-quality data and ground-water data also are available through the WWW. In addition, data can be provided in various machine-readable formats on various media. Information about the availability of specific types of data or products, and user charges, can be obtained locally from each Water Discipline District Office (See address that is shown on the back of the title page of this report.)