

contamination, the U.S. Geological Survey began using new trace-element protocols in water year 1994. Full implementation of the protocols took place during the 1995 water year.

### CURRENT WATER RESOURCES PROJECTS IN NEW JERSEY

The Geological Survey is currently involved in a number of hydrologic investigations in the State of New Jersey. The following is a list of these investigations. Results are published at the conclusion of short-term projects or periodically in the case of long-term projects. Hydrologic data from these projects are entered into the NWIS data base.

- Aquifer Flow and Chemistry in Salem County
- Assessment of Current Ground-Water and Surface-Water Conditions within the NJ-NY Highlands Area
- Delaware River Basin National Water Quality Assessment
- Development of Database, Models, and Determination of Vulnerability of Public Supply Wells and Surface-Water Intakes in New Jersey for Chemicals of Concern to Support Source Water Assessment Program
- Distribution of MTBE and Related Volatile Organic Compounds in Lakes in Northern NJ and Investigation of Lake-Well Interactions
- Distribution of Radium and Related Radionuclides in Coastal-Plain Aquifers
- Effects of Land Use, Septic Systems, and Sewering on the Distribution of Nitrate in Shallow Ground Water
- EPA Technical Assistance Program
- Estimation of the Relative Importance of Nonpoint Source Loads in the Raritan River Basin
- Flood Characteristics of New Jersey Streams
- Flow Characteristics and Basis for Development of Ecological Goals for New Jersey Streams
- Geohydrology of the Naval Air Warfare Center, West Trenton, New Jersey
- Ground-Water Data Collection Network
- Ground-Water Levels and Chloride Concentrations in Major Aquifers of the Coastal Plain
- Ground-Water Supply Availability in Southern Ocean County
- Head of Tide Sampling Program for the New Jersey Harbour Toxic Contaminant Assessment Reduction Program
- High-Flow Water Quality Management Objectives
- Hydrogeologic Investigation to Ensure Sustainable Water Supply for Cape May County
- Hydrogeologic Support to McGuire Air Force Base, Burlington County, New Jersey
- Investigation of Ground-Water/Surface-Water Interaction in the Northern Passaic River Valley, New Jersey
- Investigation of Hydrogeology and Volatile Organic Compound Contamination in Fair Lawn, New Jersey
- Investigation of Hydrogeology and Volatile Organic Compound Contamination in the Pohatcong Valley, New Jersey
- Investigation of Potential Threats to Water Supply from the Potomac-Raritan-Magothy Aquifer in Salem and Western Gloucester Counties, New Jersey
- Lower Delaware Non-Point Source
- Low Flow Characteristics of New Jersey Streams
- Modeling and Experimental Investigation of Hydrocarbon Transport and Biodegradation in the Unsaturated Zone
- Movement of Chromium in the Ground Water of Pennsauken Township, Camden County
- Natural Radionuclide Occurrence in Principal New Jersey Aquifers
- New Jersey Drought Monitoring System
- New Jersey-Long Island National Water Quality Assessment
- New Jersey Tide Telemetry System
- Pascack Brook Flood Warning System
- Passaic Flood Warning System
- Passaic River Basin Flow Model
- Program to Maintain and Update Ground-Water Models to Evaluate Continued Water-Supply Development
- Quality of Water Data Collection Network
- Quantification of Radium Mass Loading and Radioactivity in the Shallow Aquifer from the Water-Softening-Treatment Backwash Waste Stream that is Discharged to Septic Systems
- Rahway Flood Warning System
- Refinement of a Data Model for Watershed Water Transfer Analysis
- Small Watershed Flood Data Collection
- Somerset County Flood-Information System
- Surface Water Data Collection Network
- Vulnerability Assessment of the Kirkwood-Cohansey Aquifer System to Radium, Mercury, and Trace Metals
- Water-Quality Characteristics of Upper-Delaware Watershed

### WATER-RELATED REPORTS FOR NEW JERSEY COMPLETED BY THE GEOLOGICAL SURVEY IN RECENT YEARS

- Ayers, M.A., Kennen, J.G., and Stackelberg, P.E., 2000, Water quality in the Long Island-New Jersey Coastal drainages, New York and New Jersey, 1996-98: U.S. Geological Survey Water Resources Circular 1201, 40 p.
- Baehr, A.L., and Reilly, T.J., 2001, Water quality and occurrence of Methyl tert-butyl ether (MTBE) and other fuel-related compounds in lakes and ground water at lakeside communities in Sussex and Morris Counties, New Jersey, 1998-1999: U.S. Geological Survey Water-Resources Investigations Report 01-4149, 86 p.
- Barringer, J.L., Barringer, T.H., Lacombe, P.J., and Holmes, C.W., 2001, Arsenic in soils and sediments adjacent to Birch Swamp Brook in the vicinity of Texas Road (downstream from the Imperial Oil Company Superfund site), Monmouth County, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 00-4185, 111 p.
- Barringer, J.L., and MacLeod, C.L., 2001, Relation of mercury to other chemical constituents in ground water in the Kirkwood-Cohansey aquifer system, New Jersey Coastal Plain, and mechanisms for mobilization of mercury from sediments to ground water: U.S. Geological Survey: Water-Resources Investigations Report 00-4230, 162 p.
- Barringer, T.H., Reiser, R.G., and Price, C.V., 2000, Use of low-flow trend and transfer-function models to determine relation of low flows to regional urbanization and precipitation, Rahway River Basin, New Jersey, 1940-91: U.S. Geological Survey Open-File Report 99-257, 24 p.
- Buxton, D.E., Hunchak-Kariouk, K., and Hickman, R.E., 1999, Relations of surface-water quality to stream flow in the Walkkill and upper Delaware River Basins, New Jersey and vicinity, water years 1976-93: U.S. Geological Survey Water-Resources Investigations Report 99-4016, 98 p.
- Carleton, G.B., Welty, C., and Buxton, H.T., 1999, Design and analysis of tracer tests to determine effective porosity and dispersivity in fractured sedimentary rocks, Newark Basin, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 98-4126A, 80 p.
- Cauler, S.J., Carleton, G.B., and Storck, M.J., 1999, Hydrogeology of water withdrawal from, and water levels and chloride concentrations in the major Coastal Plain aquifers of Gloucester and Salem Counties, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 98-4136, 123 p., 6 pl.
- Chang, M., Tasker, G., and Nieswand, S., 2001, Model simulation of the Manasquan water-supply system in Monmouth County, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 01-4172, 51 p.
- Charles, E.G., Storck, D.A., and Clawges, R.M., 2001, Hydrology of the unconfined aquifer system, Maurice River area: Maurice and Cohansey River basins, New Jersey, 1994-95: U.S. Geological Survey Water-Resources Investigations Report 01-4229, 5 sheets.
- DeLuca, M.J., Hoppe, H.L., Doyle, H.A., and Gray, B.J., 2002 Water resources data for New Jersey - water year 2001, Volume 3. Water-quality data: U.S. Geological Survey Water-Data Report NJ-01-3, 580 p.
- DeLuca, M.J., Mattes, G.L., Burns, H.L., Thomas, A.M., Gray, B.J., and Doyle, H.A., 2001, Water-resources data for New Jersey - water year 2000, Volume 3, Water-quality data: U.S. Geological Survey Water-Data Report NJ-00-3, 618 p. (year of publication erroneously listed as 2000 in the previous edition of this report)
- DeLuca, M.J., Romanok, K.M., Riskin, M.L., Mattes, G.L., Thomas, A.M., and Gray, B.J., 2000, Water-resources data for New Jersey - water year 1999, Volume 3, Water-quality data: U.S. Geological Survey Water-Data Report NJ-99-3, 517 p.
- Focazio, J.J., Szabo, Z., Kraemer, T.F., Mullin, A.H., Barringer, T.H., and dePaul, V.T., 2001, Occurrence of selected radionuclides in ground water used for drinking water in the United States: A reconnaissance survey, 1998: U.S. Geological Survey Water-Resources Investigations Report 00-4273, 39 p.
- Gibs, J., Gray, B.J., Rice, D.E., Tessler, S., and Barringer, T.H., 2001, Water quality of the Delaware and Raritan Canal, New Jersey, 1998-99: U.S. Geological Survey Water Resources Investigations Report 01-4072, 67 p.
- Gordon, A.D., 2002, Simulation of transient ground-water flow in the valleyfill aquifers of the upper Rockaway River Basin, Morris County, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 01-4174, 41 p.
- Hickman, R.E., and Barringer, T.H., 1999, Trends in water quality of New Jersey streams, water years 1986-95: U.S. Geological Survey Water-Resources Investigations Report 98-4204, 174 p.
- Hunchak-Kariouk, K., 2000, Comparisons of water quality during various streamflow conditions in five streams in northern New Jersey, 1982-97: U.S. Geological Survey Water-Resources Investigations Report 01-4249, 50 p.

**WATER-RELATED REPORTS FOR NEW JERSEY COMPLETED BY THE GEOLOGICAL SURVEY IN RECENT YEARS--Continued**

- Hunchak-Kariouk, K., 1999, Relation of water quality to land use in the drainage basins of four tributaries to the Toms River, New Jersey, 1994-95: U.S. Geological Survey Water-Resources Investigations Report 99-4001, 120 p.
- Hunchak-Kariouk, K., Buxton, D.E., and Hickman, R.E., 1999, Relations of surface-water quality to stream flow in the Atlantic Coastal, lower Delaware River, and Delaware Bay Basins, New Jersey, water years 1976-93: U.S. Geological Survey Water-Resources Investigations Report 98-4244, 158 p.
- Jacobsen, E., 2000, Ground-water quality, water levels, and precipitation at the biosolids study site, Lakehurst Naval Air Engineering Station, New Jersey, 1995-97: U.S. Geological Survey Open-File Report 00-197, 61 p.
- Jones, W.D., and Edwards, R.W., 2002, Water resources data for New Jersey - water year 2001, volume 2, Ground-water data: U.S. Geological Survey Water-Data Report NJ-01-2, 232 p.
- Jones, W.D., 2001, Water resources data for New Jersey - water year 2000, volume 2, Ground-water data: U.S. Geological Survey Water-Data Report NJ-00-2, 233 p.
- Jones, W.D., 2000, Water-resources data for New Jersey - water year 1999, Volume 2. Ground-water data: U.S. Geological Survey Water-Data Report NJ-99-2, 233 p.
- Kauffman, L.J., Baehr, A.L., Ayers, M.A., and Stackelberg, P.E., 2001, Effects of land use and travel time on the distribution of nitrate in the Kirkwood-Cohansey aquifer system in southern New Jersey: U.S. Geological Survey Water-Resources Investigations Report 01-4117, 58 p.
- Kennen, J.G., and Ayers, M.A., 2002, Relation of environmental characteristics to the composition of aquatic assemblages along a gradient of urban land use in New Jersey, 1996-98: U.S. Geological Survey Water-Resources Investigations Report 02-4069, 77 p.
- Lacombe, P.J., 2002, Ground-water levels and potentiometric surfaces, Naval Warfare Center, West Trenton, New Jersey, 2000: U.S. Geological Survey Water-Resources Investigations Report 01-4197, 48 p.
- Lacombe, P.J., and Carleton, G.B., 2002, Hydrogeologic framework, availability of water supplies, and saltwater intrusion, Cape May County, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 01-4246, 165 p.
- Lacombe, P.J. and Rosman, R., 2001, Water levels in, extent of freshwater in, and water withdrawals from ten confined aquifers, New Jersey and Delaware Coastal Plain, 1998: U.S. Geological Survey Water-Resources Investigations Report 00-4143, 10 sheets.
- Lacombe, P.J., 2000, Hydrogeologic framework, water levels, and trichloroethylene contamination, Naval Air Warfare Center, West Trenton, New Jersey, 1993-97: U.S. Geological Survey Water-Resources Investigations Report 98-4167, 139 p.
- Lewis-Brown, J.C., and Rice, D.E., 2002, Simulated ground-water flow, Naval Air Warfare Center, West Trenton, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 02-4019, 44 p.
- Lewis-Brown, J.C., dePaul, V., 2000, Ground-water flow and distribution of volatile organic compounds, Rutgers University Busch Campus and vicinity, Piscataway Township, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 99-4256, 72 p.
- Long, G.R., Chang, M., Kennen, J.G., 2000, Trace elements and organochlorine compounds in bed sediment and fish tissue at selected sites in New Jersey streams--Sources and effects: U.S. Geological Survey Water-Resources Investigations Report 99-4235, 29 p.
- McAuley, S.D., Barringer, J.L., Paulachok, G.N., Clark, J.S., Zapecza, O.S., 2001, Ground-water flow and quality in the Atlantic City 800-foot sand, New Jersey: New Jersey Department of Environmental Protection Geological Survey Report GSR 41, 86 p.
- Nicholson, R.S., and Watt, M.K., 1998, Simulation of ground-water-flow patterns and areas contributing recharge to streams and water-supply wells in a valley-fill and carbonate-rock aquifer system, southwestern Morris County, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 97-4216, 40 p.
- Pope, D.A., and Gordon, A.D., 1999, Simulation of ground-water flow and movement of the freshwater-saltwater interface in the New Jersey Coastal Plain: U.S. Geological Survey Water-Resources Investigations Report 98-4216, 159 p.
- Reed, T.J., White, B.T., Centinaro, G.L., Dudek, J.F., Corcino, V., Spehar, A.B., and Protz, A.R., 2002, Water resources data for New Jersey - water year 2000, Volume 1. Surface-water data: U.S. Geological Survey Water-Data Report NJ-01-1, 297 p.
- Reed, T.J., Centinaro, G.L., Dudek, J.F., Corcino, V., and Steckroat, G.C., 2001, Water resources data for New Jersey - water year 2000, Volume 1. Surface-water data: U.S. Geological Survey Water-Data Report NJ-00-1, 233 p.

**WATER-RELATED REPORTS FOR NEW JERSEY COMPLETED BY THE GEOLOGICAL SURVEY IN RECENT YEARS--CONTINUED**

- Reed, T.J., Centinaro, G.L., Dudek, J.F., Corcino, V., and Steckroat, G.C., 2000, Water-resources data for New Jersey - water year 1999, Volume 1. Surface-water data: U.S. Geological Survey Water-Data Report NJ-99-1, 293 p.
- Reiser, R.G., and Schopp, R.D., 2002, Sparta, New Jersey, flood of August 11-14, 2000: U.S. Geological Survey Investigations Report 02-4099, 95 p.
- Reiser, R.G., and O'Brien, A.K., 1999, Pesticides in streams in New Jersey and Long Island, New York, and relation to land use: U.S. Geological Survey Water-Resources Investigations Report 98-4261, unpaginated.
- Spitz, F.J., 2001, Method and computer programs to improve pathline resolution near weak sinks representing wells in MODFLOW and MODPATH ground-water-flow simulations: U.S. Geological Survey Open-File Report 00-392, 51 p.
- Spitz, F.J., Nicholson, R.S., and Pope, D.A., 2001, A nested rediscritization method to improve pathline resolution by eliminating weak sinks representing wells: *Ground Water* vol. 39, no. 5, p. 778-785. Geological Survey Open-File Report 01-406, 74 p.
- Spitz, F.J., and Nicholson, R.S., 2001, Simulated effects of alternative pumping strategies on ground-water-flow patterns and areas contributing recharge to selected wells near Kenvil, Morris County, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 01-4180, 32 p.
- Stackelberg, P.E., Kauffman, L.J., Baehr, A.L., and Ayers, M.A., 2000, Comparison of nitrate, pesticides, and volatile organic compounds in samples from monitoring and public-supply wells, Kirkwood-Cohansey aquifer system, southern New Jersey: U.S. Geological Survey Water-Resources Investigations Report 00-4123, 78 p.
- Storck, D.A., and Nawyn, J.P., 2001, Reconstruction of streamflow records in the Passaic and Hackensack River Basins, New Jersey and New York, water years 1993-96: U.S. Geological Survey Water-Resources Investigations Report 01-4078, 95 p.
- Walker, R.L., 2001, Effects of pumping on ground-water flow near water-supply wells in Lower Potomac-Raritan-Magothy aquifer, Pennsauken Township, Camden County, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 00-4012, 12 p.
- Watt, M.K., 2001, A hydrologic primer for New Jersey watershed management: U.S. Geological Survey Water-Resources Investigations Report 00-4140, 116 p.

**WATER-RELATED ARTICLES FOR NEW JERSEY COMPLETED BY THE GEOLOGICAL SURVEY IN RECENT YEARS**

- Baehr, A.L., 1999, Evaluation of the atmosphere as a source of volatile organic compounds in shallow groundwater: *Water Resources Research*, v. 35, no. 1, p. 127-136.
- Gibs, J., Szabo, Z., Ivahnenko, T., and Wilde, F.D., 2000, Change in field turbidity and trace element concentrations during well purging: *Ground Water*, v. 38, no.4, p.577-588.
- Ivahnenko, T., Szabo, Z., and Gibs, J., 2001, Changes in sample collection and analytical techniques and effects on retrospective comparability of low-level concentrations of trace elements in ground water: *Water Resources*, v. 35, no. 15, p. 3611-3624.
- Mast, M.A., and Turk, J.T., 1999, Environmental characteristics and water quality of hydrologic benchmark network stations--McDonalds Branch in Lebanon State Forest, New Jersey, *in* Environmental characteristics and water quality of hydrologic benchmark network stations in the eastern United States, 1963-95: U.S. Geological Survey Circular 1173-A, p. 63-71.
- Spitz, F.J., Nicholson, R.S., and Pope, D.A., 2001, A nested rediscritization method to improve pathline resolution by eliminating weak sinks representing wells: *Ground Water* vol. 39, no. 5, p. 778-785
- Szabo, Z., Oden, J.H., Gibs, J., Rice, D.E., and Ding Yuan, 2002, Variation in aluminum, iron, and particle concentrations in oxic ground-water samples by use of tangetial-flow ultrafiltration with low-flow sampling, in Jensen, J.L., and Burggraf, L.W., eds., Chemical and biological early warning monitoring for water, food, and ground: Proceedings of SPIE, November 1-2, 2001, v. 4575, 42-61
- Szabo, Z., Focazio, M.J., Landmeyer, J.E., Senior, L.A., Ayotte, J.D., dePaul, V.T., Oden, T.D., and Kozar, M.D., 2001, Naturally occurring radionuclides in ground water in the Appalachian Physiographic Province
- WATER-RELATED FACT SHEETS FOR NEW JERSEY COMPLETED BY THE GEOLOGICAL SURVEY IN RECENT YEARS**
- Fischer, J.M., 1999, National Water-Quality Assessment Program, Delaware River Basin: U.S. Geological Survey Fact Sheet FS-056-99.
- Jones, W.D., Navoy, A.S., Pope, D.A., 2002, Real-time ground-water-level monitoring in New Jersey, 2001: U.S. Geological Survey Fact Sheet FS-011-02, unpaginated.
- Modica, E., 1999, Source and age of ground-water seepage to streams: U.S. Geological Survey Fact Sheet FS-063-99, unpaginated.

## WATER-RELATED FACT SHEETS FOR NEW JERSEY COMPLETED BY THE GEOLOGICAL SURVEY IN RECENT YEARS--CONTINUED

Reiser, R.G., and Schopp, R.D., 2001, Sparta, New Jersey, flood of August 11-14, 2000: U.S. Geological Survey Fact Sheet FS-104-01, unpaginated.

### ACCESS TO USGS WATER DATA

The U.S. Geological Survey 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 at

<http://water.usgs.gov>

Some water-quality and ground-water data also are available through the WWW. In addition, data can be provided in various machine-readable formats on magnetic tape or 3-1/2 inch floppy disk. Information about the availability of specific types of data or products, and user charges, can be obtained locally from each of the Water Resources Division District Offices (see address on the back of the title page).

### DEFINITION OF TERMS

Specialized technical terms related to streamflow, water-quality, and other hydrologic data, as used in this report, are defined below. Definitions of common terms such as algae, water level, and precipitation are given in standard dictionaries. Not all terms defined in this alphabetical list apply to every State. See also table for converting inch/pound units to International System (SI) units on the inside of the back cover.

**Acid neutralizing capacity (ANC)** is the equivalent sum of all bases or base-producing materials, solutes plus particulates, in an aqueous system that can be titrated with acid to an equivalence point. This term designates titration of an "unfiltered" sample (formerly reported as alkalinity).

**Acre-foot (AC-FT, acre-ft)** is a unit of volume, commonly used to measure quantities of water used or stored, equivalent to the volume of water required to cover 1 acre to a depth of 1 foot and equivalent to 43,560 cubic feet, 325,851 gallons, or 1,233 cubic meters. (See also "Annual runoff")

**Adenosine triphosphate (ATP)** is an organic, phosphate-rich compound important in the transfer of energy in organisms. Its central role in living cells makes ATP an excellent indicator of the presence of living material in water. A measurement of ATP therefore provides a sensitive and rapid estimate of biomass. ATP is reported in micrograms per liter.

**Algal growth potential (AGP)** is the maximum algal dry weight biomass that can be produced in a natural water sample under standardized laboratory

conditions. The growth potential is the algal biomass present at stationary phase and is expressed as milligrams dry weight of algae produced per liter of sample. (See also "Biomass" and "Dry weight")

**Alkalinity** is the capacity of solutes in an aqueous system to neutralize acid. This term designates titration of a "filtered" sample.

**Annual runoff** is the total quantity of water that is discharged ("runs off") from a drainage basin in a year. Data reports may present annual runoff data as volumes in acre-feet, as discharges per unit of drainage area in cubic feet per second per square mile, or as depths of water on the drainage basin in inches.

**Annual 7-day minimum** is the lowest mean value for any 7-consecutive-day period in a year. Annual 7-day minimum values are reported herein for the calendar year and the water year (October 1 through September 30). Most low-flow frequency analyses use a climatic year (April 1-March 31), which tends to prevent the low-flow period from being artificially split between adjacent years. 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.)

**Aroclor** is the registered trademark for a group of polychlorinated biphenyls that were manufactured by the Monsanto Company prior to 1976. Aroclors are assigned specific 4-digit reference numbers dependent upon molecular type and degree of substitution of the biphenyl ring hydrogen atoms by chlorine atoms. The first two digits of a numbered aroclor represent the molecular type, and the last two digits represent the percentage weight of the hydrogen-substituted chlorine.

**Artificial substrate** is a device that is purposely placed in a stream or lake for colonization of organisms. The artificial substrate simplifies the community structure by standardizing the substrate from which each sample is collected. Examples of artificial substrates are basket samplers (made of wire cages filled with clean streamside rocks) and multi-plate samplers (made of hardboard) for benthic organism collection, and plexiglass strips for periphyton collection. (See also "Substrate")

**Ash mass** is the mass or amount of residue present after the residue from the dry mass determination has been ashed in a muffle furnace at a temperature of 500 xC for 1 hour. Ash mass of zooplankton and phytoplankton is expressed in grams per cubic meter (g/m<sup>3</sup>), and periphyton and benthic organisms in grams per square meter (g/m<sup>2</sup>). (See also "Biomass" and "Dry mass")

**Aspect** is the direction toward which a slope faces with respect to the compass.

**Bacteria** are microscopic unicellular organisms, typi-

cally spherical, rodlike, or spiral and threadlike in shape, often clumped into colonies. Some bacteria cause disease, whereas others perform an essential role in nature in the recycling of materials; for example, by decomposing organic matter into a form available for reuse by plants.

**Bankfull stage**, as used in this report, is the stage at which a stream first overflows its natural banks formed by floods with 1- to 3-year recurrence intervals.

**Base discharge** (for peak discharge) is a discharge value, determined for selected stations, above which peak discharge data are published. The base discharge at each station is selected so that an average of about three peak flows per year will be published. (See also "Peak flow")

**Base flow** is sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced streamflows. Natural base flow is sustained largely by ground-water discharge.

**Bedload** is material in transport that is supported primarily by the streambed. In this report, bedload is considered to consist of particles in transit from the bed to an elevation equal to the top of the bedload sampler nozzle (ranging from 0.25 to 0.5 foot) that are retained in the bedload sampler. A sample collected with a pressure-differential bedload sampler also may contain a component of the suspended load.

**Bedload discharge** (tons per day) is the rate of sediment moving as bedload, reported as dry weight, that passes through a cross section in a given time. NOTE: Bedload discharge values in this report may include a component of the suspended-sediment discharge. A correction may be necessary when computing the total sediment discharge by summing the bedload discharge and the suspended-sediment discharge. (See also "Bedload," "Dry weight," "Sediment," and "Suspended-sediment discharge")

**Bed material** is the sediment mixture of which a stream-bed, lake, pond, reservoir, or estuary bottom is composed. (See also "Bedload" and "Sediment")

**Benthic organisms** are the group of organisms inhabiting the bottom of an aquatic environment. They include a number of types of organisms, such as bacteria, fungi, insect larvae and nymphs, snails, clams, and crayfish. They are useful as indicators of water quality.

**Biochemical oxygen demand (BOD)** is a measure of the quantity of dissolved oxygen, in milligrams per liter, necessary for the decomposition of organic matter by microorganisms, such as bacteria.

**Biomass** is the amount of living matter present at any

given time, expressed as mass per unit area or volume of habitat.

**Biomass pigment ratio** is an indicator of the total proportion of periphyton that are autotrophic (plants). This is also called the Autotrophic Index.

**Blue-green algae** (*Cyanophyta*) are a group of phytoplankton organisms having a blue pigment, in addition to the green pigment called chlorophyll. Blue-green algae often cause nuisance conditions in water. Concentrations are expressed as a number of cells per milliliter (cells/mL) of sample. (See also "Phytoplankton")

**Bottom material** (See "Bed material")

**Bulk electrical conductivity** is the combined electrical conductivity of all material within a doughnut-shaped volume surrounding an induction probe. Bulk conductivity is affected by different physical and chemical properties of the material including the dissolved solids content of the pore water and lithology and porosity of the rock.

**Cells/volume** refers to the number of cells of any organism that is counted by using a microscope and grid or counting cell. Many planktonic organisms are multicelled and are counted according to the number of contained cells per sample volume, and are generally reported as cells or units per milliliter (mL) or liter (L).

**Cells volume** (biovolume) determination is one of several common methods used to estimate biomass of algae in aquatic systems. Cell members of algae are frequently used in aquatic surveys as an indicator of algal production. However, cell numbers alone cannot represent true biomass because of considerable cell-size variation among the algal species. Cell volume ( $\text{mm}^3$ ) is determined by obtaining critical cell measurements or cell dimensions (for example, length, width, height, or radius) for 20 to 50 cells of each important species to obtain an average biovolume per cell. Cells are categorized according to the correspondence of their cellular shape to the nearest geometric solid or combinations of simple solids (for example, spheres, cones, or cylinders). Representative formulae used to compute biovolume are as follows:

sphere  $\frac{4}{3} \pi r^3$  cone  $\frac{1}{3} \pi r^2 h$  cylinder  $\pi r^2 h$ .

$\pi$  (p) is the ratio of the circumference to the diameter of a circle;  $\pi = 3.14159\dots$

From cell volume, total algal biomass expressed as biovolume ( $\text{mm}^3/\text{mL}$ ) is thus determined by multiplying the number of cells of a given species by its average cell volume and then summing these volumes for all species.

**Cfs-day** (See "Cubic foot per second-day")

**Channel bars**, as used in this report, are the lowest prominent geomorphic features higher than the channel bed.

**Chemical oxygen demand (COD)** is a measure of the chemically oxidizable material in the water and furnishes an approximation of the amount of organic and reducing material present. The determined value may correlate with BOD or with carbonaceous organic pollution from sewage or industrial wastes. [See also "Biochemical oxygen demand (BOD)"]

***Clostridium perfringens* (*C. perfringens*)** is a spore-forming bacterium that is common in the feces of human and other warmblooded animals. Clostridial spores are being used experimentally as an indicator of past fecal contamination and presence of microorganisms that are resistant to disinfection and environmental stresses. (See also "Bacteria")

**Coliphages** are viruses that infect and replicate in coliform bacteria. They are indicative of sewage contamination of water and of the survival and transport of viruses in the environment.

**Color unit** is produced by 1 milligram per liter of platinum in the form of the chloroplatinate ion. Color is expressed in units of the platinum-cobalt scale.

**Confined aquifer** is a term used to describe an aquifer containing water between two relatively impermeable boundaries. The water level in a well tapping a confined aquifer stands above the top of the confined aquifer and can be higher or lower than the water table that may be present in the material above it. In some cases, the water level can rise above the ground surface, yielding a flowing well.

**Contents** is the volume of water in a reservoir or lake. Unless otherwise indicated, volume is computed on the basis of a level pool and does not include bank storage.

**Continuous-record station** is a site where data are collected with sufficient frequency to define daily mean values and variations within a day.

**Control** designates a feature in the channel that physically affects the water-surface elevation and thereby determines the stage-discharge relation at the gage. This feature may be a constriction of the channel, a bedrock outcrop, a gravel bar, an artificial structure, or a uniform cross section over a long reach of the channel.

**Control structure**, as used in this report, is a structure on a stream or canal that is used to regulate the flow or stage of the stream or to prevent the intrusion of saltwater.

**Cubic foot per second (CFS, ft<sup>3</sup>/s)** is the rate of discharge representing a volume of 1 cubic foot passing a given point in 1 second. It is equivalent to

approximately 7.48 gallons per second or approximately 449 gallons per minute, or 0.02832 cubic meters per second. The term "second-foot" sometimes is used synonymously with "cubic foot per second" but is now obsolete.

**Cubic foot per second-day (CFS-DAY, Cfs-day, [(ft<sup>3</sup>/s)/d])** is the volume of water represented by a flow of 1 cubic foot per second for 24 hours. It is equivalent to 86,400 cubic feet, 1.98347 acre-feet, 646,317 gallons, or 2,446.6 cubic meters. The daily mean discharges reported in the daily value data tables are numerically equal to the daily volumes in cfs-days, and the totals also represent volumes in cfs-days.

**Cubic foot per second per square mile [CFSM, (ft<sup>3</sup>/s)/mi<sup>2</sup>]** 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. (See also "Annual runoff")

**Daily mean suspended-sediment concentration** is the time-weighted concentration of suspended sediment passing a stream cross section during a 24-hour day. (See also "Sediment" and "Suspended-sediment concentration")

**Daily-record station** is a site where data are collected with sufficient frequency to develop a record of one or more data values per day. The frequency of data collection can range from continuous recording to periodic sample or data collection on a daily or near-daily basis.

**Data collection platform (DCP)** is an electronic instrument that collects, processes, and stores data from various sensors, and transmits the data by satellite data relay, line-of-sight radio, and/or landline telemetry.

**Data logger** is a microprocessor-based data acquisition system designed specifically to acquire, process, and store data. Data are usually downloaded from onsite data loggers for entry into office data systems.

**Datum** is a surface or point relative to which measurements of height and/or horizontal position are reported. A vertical datum is a horizontal surface used as the zero point for measurements of gage height, stage, or elevation; a horizontal datum is a reference for positions given in terms of latitude-longitude, State Plane coordinates, or UTM coordinates. (See also "Gage datum," "Land-surface datum," "National Geodetic Vertical Datum of 1929," and "North American Vertical Datum of 1988")

**Diatoms** are the unicellular or colonial algae having a siliceous shell. Their concentrations are expressed as number of cells per milliliter (cells/mL) of sample. (See also "Phytoplankton")

**Diel** is of or pertaining to a 24-hour period of time; a regular daily cycle.

**Discharge**, or **flow**, is the rate that matter passes through a cross section of a stream channel or other water body per unit of time. The term commonly refers to the volume of water (including, unless otherwise stated, any sediment or other constituents suspended or dissolved in the water) that passes a cross section in a stream channel, canal, pipeline, etc., within a given period of time (cubic feet per second). Discharge also can apply to the rate at which constituents, such as suspended sediment, bedload, and dissolved or suspended chemicals, pass through a cross section, in which cases the quantity is expressed as the mass of constituent that passes the cross section in a given period of time (tons per day).

**Dissolved** refers to that material in a representative water sample that passes through a 0.45-micrometer membrane filter. This is a convenient operational definition used by Federal and State agencies that collect water-quality data. Determinations of "dissolved" constituent concentrations are made on sample water that has been filtered.

**Dissolved oxygen (DO)** is the molecular oxygen (oxygen gas) dissolved in water. The concentration in water is a function of atmospheric pressure, temperature, and dissolved-solids concentration of the water. The ability of water to retain oxygen decreases with increasing temperature or dissolved-solids concentration. Photosynthesis and respiration by plants commonly cause diurnal variations in dissolved-oxygen concentration in water from some streams.

**Dissolved-solids concentration** in water is the quantity of dissolved material in a sample of water. It is determined either analytically by the "residue-on-evaporation" method, or mathematically by totaling the concentrations of individual constituents reported in a comprehensive chemical analysis. During the analytical determination, the bicarbonate (generally a major dissolved component of water) is converted to carbonate. In the mathematical calculation, the bicarbonate value, in milligrams per liter, is multiplied by 0.4926 to convert it to carbonate. Alternatively, alkalinity concentration (as mg/L CaCO<sub>3</sub>) can be converted to carbonate concentration by multiplying by 0.60.

**Diversity index (H)** (Shannon index) is a numerical expression of evenness of distribution of aquatic organisms. The formula for diversity index is:

$$\bar{d} = -\sum_{i=1}^s \frac{n_i}{n} \log_2 \frac{n_i}{n}$$

where  $n_i$  is the number of individuals per taxon,  $n$  is the total number of individuals, and  $s$  is the total number of taxa in the sample of the community. Index values range from zero, when all the organisms in the sample are the same, to some positive number, when some or all of the organisms in the

sample are different.

**Drainage area** of a stream at a specific location is that area upstream from the location, measured in a horizontal plane, that has a common outlet at the site for its surface runoff from precipitation that normally drains by gravity into a stream. Drainage areas given herein include all closed basins, or noncontributing areas, within the area unless otherwise specified.

**Drainage basin** is a part of the Earth's surface that contains a drainage system with a common outlet for its surface runoff. (See "Drainage area")

**Dry mass** refers to the mass of residue present after drying in an oven at 105°C, until the mass remains unchanged. This mass represents the total organic matter, ash and sediment, in the sample. Dry-mass values are expressed in the same units as ash mass. (See also "Ash mass," "Biomass," and "Wet mass")

**Dry weight** refers to the weight of animal tissue after it has been dried in an oven at 65°C until a constant weight is achieved. Dry weight represents total organic and inorganic matter in the tissue. (See also "Wet weight")

**Embeddedness** is the degree to which gravel-sized and larger particles are surrounded or enclosed by finer-sized particles. (See also "Substrate embeddedness class")

**Enterococcus bacteria** are commonly found in the feces of humans and other warmblooded animals. Although some strains are ubiquitous and not related to fecal pollution, the presence of enterococci in water is an indication of fecal pollution and the possible presence of enteric pathogens. Enterococcus bacteria are those bacteria that produce pink to red colonies with black or reddish-brown precipitate after incubation at 41°C on mE agar (nutrient medium for bacterial growth) and subsequent transfer to EIA medium. Enterococci include *Streptococcus feacalis*, *Streptococcus feacium*, *Streptococcus avium*, and their variants. (See also "Bacteria")

**EPT Index** is the total number of distinct taxa within the insect orders Ephemeroptera, Plecoptera, and Trichoptera. This index summarizes the taxa richness within the aquatic insects that are generally considered pollution sensitive; the index usually decreases with pollution.

**Escherichia coli (E. coli)** are bacteria present in the intestine and feces of warmblooded animals. *E. coli* are a member species of the fecal coliform group of indicator bacteria. In the laboratory, they are defined as those bacteria that produce yellow or yellow-brown colonies on a filter pad saturated with urea substrate broth after primary culturing for 22 to 24 hours at 44.5°C on mTEC medium (nutrient medium for bacterial growth). Their concentrations

are expressed as number of colonies per 100 mL of sample. (See also "Bacteria")

**Estimated (E) concentration value** is reported when an analyte is detected and all criteria for a positive result are met. If the concentration is less than the method detection limit (MDL), an 'E' code will be reported with the value. If the analyte is qualitatively identified as present, but the quantitative determination is substantially more uncertain, the National Water Quality Laboratory will identify the result with an 'E' code even though the measured value is greater than the MDL. A value reported with an 'E' code should be used with caution. When no analyte is detected in a sample, the default reporting value is the MDL preceded by a less than sign (<).

**Euglenoids** (*Euglenophyta*) are a group of algae that are usually free-swimming and rarely creeping. They have the ability to grow either photosynthetically in the light or heterotrophically in the dark. (See also "Phytoplankton")

**Extractable organic halides** (EOX) are organic compounds that contain halogen atoms such as chlorine. These organic compounds are semivolatiles and extractable by ethyl acetate from air-dried streambed sediment. The ethyl acetate extract is combusted, and the concentration is determined by microcoulometric determination of the halides formed. The concentration is reported as micrograms of chlorine per gram of the dry weight of the streambed sediment.

**Fecal coliform bacteria** are present in the intestines or feces of warmblooded animals. They often are used as indicators of the sanitary quality of the water. In the laboratory, they are defined as all organisms that produce blue colonies within 24 hours when incubated at 44.5°C plus or minus 0.2°C on M-FC medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 mL of sample. (See also "Bacteria")

**Fecal streptococcal bacteria** are present in the intestines of warmblooded animals and are ubiquitous in the environment. They are characterized as gram-positive, cocci bacteria that are capable of growth in brain-heart infusion broth. In the laboratory, they are defined as all the organisms that produce red or pink colonies within 48 hours at 35°C plus or minus 1.0°C on KF-streptococcus medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 mL of sample. (See also "Bacteria")

**Fire algae** (*Pyrrhophyta*) are free-swimming unicells characterized by a red pigment spot. (See also "Phytoplankton")

**Flow-duration percentiles** are values on a scale of 100 that indicate the percentage of time for which a flow is not exceeded. For example, the 90th per-

centile of river flow is greater than or equal to 90 percent of all recorded flow rates.

**Gage datum** is a horizontal surface used as a zero point for measurement of stage or gage height. This surface usually is located slightly below the lowest point of the stream bottom such that the gage height is usually slightly greater than the maximum depth of water. Because the gage datum itself is not an actual physical object, the datum usually is defined by specifying the elevations of permanent reference marks such as bridge abutments and survey monuments, and the gage is set to agree with the reference marks. Gage datum is a local datum that is maintained independently of any national geodetic datum. However, if the elevation of the gage datum relative to the national datum (North American Vertical Datum of 1988 or National Geodetic Vertical Datum of 1929) has been determined, then the gage readings can be converted to elevations above the national datum by adding the elevation of the gage datum to the gage reading.

**Gage height** (G.H.) is the water-surface elevation, in feet above the gage datum. If the water surface is below the gage datum, the gage height is negative. Gage height often is used interchangeably with the more general term "stage," although gage height is more appropriate when used in reference to a reading on a gage.

**Gage values** are values that are recorded, transmitted, and/or computed from a gaging station. Gage values typically are collected at 5-, 15-, or 30-minute intervals.

**Gaging station** is a site on a stream, canal, lake, or reservoir where systematic observations of stage, discharge, or other hydrologic data are obtained.

**Gas chromatography/flame ionization detector** (GC/FID) is a laboratory analytical method used as a screening technique for semivolatiles organic compounds that are extractable from water in methylene chloride.

**Geomorphic channel units**, as used in this report, are fluvial geomorphic descriptors of channel shape and stream velocity. Pools, riffles, and runs are types of geomorphic channel units considered for National Water-Quality Assessment (NAWQA) Program habitat sampling.

**Green algae** have chlorophyll pigments similar in color to those of higher green plants. Some forms produce algae mats or floating "moss" in lakes. Their concentrations are expressed as number of cells per milliliter (cells/mL) of sample. (See also "Phytoplankton")

**Habitat**, as used in this report, includes all nonliving (physical) aspects of the aquatic ecosystem, although living components like aquatic macrophytes and riparian vegetation also are usually

included. Measurements of habitat are typically made over a wider geographic scale than are measurements of species distribution.

**Habitat quality index** is the qualitative description (level 1) of instream habitat and riparian conditions surrounding the reach sampled. Scores range from 0 to 100 percent with higher scores indicative of desirable habitat conditions for aquatic life. Index only applicable to wadable streams.

**Hardness** of water is a physical-chemical characteristic that commonly is recognized by the increased quantity of soap required to produce lather. It is computed as the sum of equivalents of polyvalent cations (primarily calcium and magnesium) and is expressed as the equivalent concentration of calcium carbonate ( $\text{CaCO}_3$ ).

**High tide** is the maximum height reached by each rising tide. The high-high and low-high tides are the higher and lower of the two high tides, respectively, of each tidal day. See NOAA web site: <http://www.co-ops.nos.noaa.gov/tideglos.html>

**Hilsenhoff's Biotic Index (HBI)** is an indicator of organic pollution that uses tolerance values to weight taxa abundances; usually increases with pollution. It is calculated as follows:

$$HBI = \text{sum} \frac{(n)(a)}{N}$$

where  $n$  is the number of individuals of each taxon,  $a$  is the tolerance value of each taxon, and  $N$  is the total number of organisms in the sample.

**Horizontal datum** (See "Datum")

**Hydrologic index stations** referred to in this report are continuous-record gaging stations that have been selected as representative of streamflow patterns for their respective regions. Station locations are shown on index maps.

**Hydrologic unit** is a geographic area representing part or all of a surface drainage basin or distinct hydrologic feature as defined by the former Office of Water Data Coordination and delineated on the State Hydrologic Unit Maps by the USGS. Each hydrologic unit is identified by an 8-digit number.

**Inch (IN., in.)**, as used in this report, refers to the depth to which the drainage area would be covered with water if all of the runoff for a given time period were uniformly distributed on it. (See also "Annual runoff")

**Instantaneous discharge** is the discharge at a particular instant of time. (See also "Discharge")

**Island**, as used in this report, is a mid-channel bar that has permanent woody vegetation, is flooded once a year on average, and remains stable except during large flood events.

**Laboratory reporting level (LRL)** is generally equal to twice the yearly determined long-term method detection level (LT-MDL). The LRL controls false negative error. The probability of falsely reporting a nondetection for a sample that contained an analyte at a concentration equal to or greater than the LRL is predicted to be less than or equal to 1 percent. The value of the LRL will be reported with a "less than" (<) remark code for samples in which the analyte was not detected. The National Water Quality Laboratory (NWQL) collects quality-control data from selected analytical methods on a continuing basis to determine LT-MDLs and to establish LRLs. These values are reevaluated annually on the basis of the most current quality-control data and, therefore, may change. [Note: In several previous NWQL documents (NWQL Technical Memorandum 98.07, 1998), the LRL was called the nondetection value or NDV—a term that is no longer used.]

**Land-surface datum (lsd)** is a datum plane that is approximately at land surface at each groundwater observation well.

**Latent heat flux** (often used interchangeably with latent heat-flux density) is the amount of heat energy that converts water from liquid to vapor (evaporation) or from vapor to liquid (condensation) across a specified cross-sectional area per unit time. Usually expressed in watts per square meter.

**Light-attenuation coefficient**, also known as the extinction coefficient, is a measure of water clarity. Light is attenuated according to the Lambert-Beer equation:

$$I = I_o e^{-\lambda L}$$

where  $I_o$  is the source light intensity,  $I$  is the light intensity at length  $L$  (in meters) from the source,  $\lambda$  is the light-attenuation coefficient, and  $e$  is the base of the natural logarithm. The light-attenuation coefficient is defined as

$$\lambda = -\frac{1}{L} \log_e \frac{I}{I_o}$$

**Lipid** is any one of a family of compounds that are insoluble in water and that make up one of the principal components of living cells. Lipids include fats, oils, waxes, and steroids. Many environmental contaminants such as organochlorine pesticides are lipophilic.

**Long-term method detection level (LT-MDL)** is a detection level derived by determining the standard deviation of a minimum of 24 method detection limit (MDL) spike sample measurements over an extended period of time. LT-MDL data are collected on a continuous basis to assess year-to-year variations in the LT-MDL. The LT-MDL controls false positive error. The chance of falsely reporting a concentration at or greater than the LT-MDL for a sample that did not contain the analyte is predicted to be less than or equal to 1 percent.

**Low tide** is the minimum height reached by each falling tide. The high-low and low-low tides are the higher and lower of the two low tides, respectively, of each tidal day. See NOAA web site: <http://www.co-ops.nos.noaa.gov/tideglos.html>

**Macrophytes** are the macroscopic plants in the aquatic environment. The most common macrophytes are the rooted vascular plants that usually are arranged in zones in aquatic ecosystems and restricted in the area by the extent of illumination through the water and sediment deposition along the shoreline.

**Mean concentration of suspended sediment** (Daily mean suspended-sediment concentration) is the time-weighted concentration of suspended sediment passing a stream cross section during a given time period. (See also "Daily mean suspended-sediment concentration" and "Suspended-sediment concentration")

**Mean discharge** (MEAN) is the arithmetic mean of individual daily mean discharges during a specific period. (See also "Discharge")

**Mean high or low tide** is the average of all high or low tides, respectively, over a specific period.

**Mean sea level** is a local tidal datum. It is the arithmetic mean of hourly heights observed over the National Tidal Datum Epoch. Shorter series are specified in the name; for example, monthly mean sea level and yearly mean sea level. In order that they may be recovered when needed, such datums are referenced to fixed points known as benchmarks. (See also "Datum")

**Measuring point** (MP) is an arbitrary permanent reference point from which the distance to water surface in a well is measured to obtain water level.

**Membrane filter** is a thin microporous material of specific pore size used to filter bacteria, algae, and other very small particles from water.

**Metamorphic stage** refers to the stage of development that an organism exhibits during its transformation from an immature form to an adult form. This developmental process exists for most insects, and the degree of difference from the immature stage to the adult form varies from relatively slight to pronounced, with many intermediates. Examples of metamorphic stages of insects are egg-larva-adult or egg-nymph-adult.

**Method detection limit** (MDL) is the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the analyte concentration is greater than zero. It is determined from the analysis of a sample in a given matrix containing the analyte. At the MDL concentration, the risk of a false positive is predicted to be less than or equal to 1 percent.

**Methylene blue active substances** (MBAS) are apparent detergents. The determination depends on the formation of a blue color when methylene blue dye reacts with synthetic anionic detergent compounds.

**Micrograms per gram** (UG/G, mg/g) is a unit expressing the concentration of a chemical constituent as the mass (micrograms) of the element per unit mass (gram) of material analyzed.

**Micrograms per kilogram** (UG/KG, mg/kg) is a unit expressing the concentration of a chemical constituent as the mass (micrograms) of the constituent per unit mass (kilogram) of the material analyzed. One microgram per kilogram is equivalent to 1 part per billion.

**Micrograms per liter** (UG/L, mg/L) is a unit expressing the concentration of chemical constituents in water as mass (micrograms) of constituent per unit volume (liter) of water. One thousand micrograms per liter is equivalent to 1 milligram per liter. One microgram per liter is equivalent to 1 part per billion.

**Microsiemens per centimeter** (US/CM, mS/cm) is a unit expressing the amount of electrical conductivity of a solution as measured between opposite faces of a centimeter cube of solution at a specified temperature. Siemens is the International System of Units nomenclature. It is synonymous with mhos and is the reciprocal of resistance in ohms.

**Milligrams per liter** (MG/L, mg/L) is a unit for expressing the concentration of chemical constituents in water as the mass (milligrams) of constituent per unit volume (liter) of water. Concentration of suspended sediment also is expressed in milligrams per liter and is based on the mass of dry sediment per liter of water-sediment mixture.

**Minimum reporting level** (MRL) is the smallest measured concentration of a constituent that may be reliably reported by using a given analytical method.

**Miscellaneous site**, miscellaneous station, or miscellaneous sampling site is a site where streamflow, sediment, and/or water-quality data or water-quality or sediment samples are collected once, or more often on a random or discontinuous basis to provide better areal coverage for defining hydrologic and water-quality conditions over a broad area in a river basin.

**Most probable number** (MPN) is an index of the number of coliform bacteria that, more probably than any other number, would give the results shown by the laboratory examination; it is not an actual enumeration. MPN is determined from the distribution of gas-positive cultures among multiple inoculated tubes.

**Multiple-plate samplers** are artificial substrates of

known surface area used for obtaining benthic invertebrate samples. They consist of a series of spaced, hardboard plates on an eyebolt.

**Nanograms per liter (NG/L, ng/L)** is a unit expressing the concentration of chemical constituents in solution as mass (nanograms) of solute per unit volume (liter) of water. One million nanograms per liter is equivalent to 1 milligram per liter.

**National Geodetic Vertical Datum of 1929 (NGVD of 1929)** is a fixed reference adopted as a standard geodetic datum for elevations determined by leveling. It was formerly called "Sea Level Datum of 1929" or "mean sea level." Although the datum was derived from the mean sea level at 26 tide stations, it does not necessarily represent local mean sea level at any particular place. See NOAA web site: <http://www.ngs.noaa.gov/faqs.html#WhatVD29VD88> (See "North American Vertical Datum of 1988")

**Natural substrate** refers to any naturally occurring immersed or submersed solid surface, such as a rock or tree, upon which an organism lives. (See also "Substrate")

**Nekton** are the consumers in the aquatic environment and consist of large free-swimming organisms that are capable of sustained, directed mobility.

**Nephelometric turbidity unit (NTU)** is the measurement for reporting turbidity that is based on use of a standard suspension of formazin. Turbidity measured in NTU uses nephelometric methods that depend on passing specific light of a specific wavelength through the sample.

**North American Vertical Datum of 1988 (NAVD 1988)** is a fixed reference adopted as the official civilian vertical datum for elevations determined by Federal surveying and mapping activities in the United States. This datum was established in 1991 by minimum-constraint adjustment of the Canadian, Mexican, and United States first-order terrestrial leveling networks.

**Open or screened interval** is the length of unscreened opening or of well screen through which water enters a well, in feet below land surface.

**Organic carbon (OC)** is a measure of organic matter present in aqueous solution, suspension, or bottom sediment. May be reported as dissolved organic carbon (DOC), particulate organic carbon (POC), or total organic carbon (TOC).

**Organic mass or volatile mass** of a living substance is the difference between the dry mass and ash mass and represents the actual mass of the living matter. Organic mass is expressed in the same units as for ash mass and dry mass. (See also "Ash mass," "Biomass," and "Dry mass")

**Organism count/area** refers to the number of organisms collected and enumerated in a sample and adjusted to the number per area habitat, usually square meter (m<sup>2</sup>), acre, or hectare. Periphyton, benthic organisms, and macrophytes are expressed in these terms.

**Organism count/volume** refers to the number of organisms collected and enumerated in a sample and adjusted to the number per sample volume, usually milliliter (mL) or liter (L). Numbers of planktonic organisms can be expressed in these terms.

**Organochlorine compounds** are any chemicals that contain carbon and chlorine. Organochlorine compounds that are important in investigations of water, sediment, and biological quality include certain pesticides and industrial compounds.

**Parameter code** is a 5-digit number used in the USGS computerized data system, National Water Information System (NWIS), to uniquely identify a specific constituent or property.

**Partial-record station** is a site where discrete measurements of one or more hydrologic parameters are obtained over a period of time without continuous data being recorded or computed. A common example is a crest-stage gage partial-record station at which only peak stages and flows are recorded.

**Particle size** is the diameter, in millimeters (mm), of a particle determined by sieve or sedimentation methods. The sedimentation method utilizes the principle of Stokes law to calculate sediment particle sizes. Sedimentation methods (pipet, bottom-withdrawal tube, visual-accumulation tube, sedi-graph) determine fall diameter of particles in either distilled water (chemically dispersed) or in native water (the river water at the time and point of sampling).

**Particle-size classification**, as used in this report, agrees with the recommendation made by the American Geophysical Union Subcommittee on Sediment Terminology. The classification is as follows

Classification	Size (mm)	Method of Analysis
Clay	0.00024 - 0.004	Sedimentation
Silt	0.004 - 0.062	Sedimentation
Sand	0.062 - 2.0	Sedimentation/sieve
Gravel	2.0 - 64.0	Sieve
Cobble	64 - 256	Manual measurement
Boulder	>256	Manual measurement

The particle-size distributions given in this report are not necessarily representative of all particles in transport in the stream. For the sedimentation method, most of the organic matter is removed, and the sample is subjected to mechanical and

chemical dispersion before analysis in distilled water. Chemical dispersion is not used for native water analysis.

**Peak flow (peak stage)** is an instantaneous local maximum value in the continuous time series of streamflows or stages, preceded by a period of increasing values and followed by a period of decreasing values. Several peak values ordinarily occur in a year. The maximum peak value in a year is called the annual peak; peaks lower than the annual peak are called secondary peaks. Occasionally, the annual peak may not be the maximum value for the year; in such cases, the maximum value occurs at midnight at the beginning or end of the year, on the recession from or rise toward a higher peak in the adjoining year. If values are recorded at a discrete series of times, the peak recorded value may be taken as an approximation of the true peak, which may occur between the recording instants. If the values are recorded with finite precision, a sequence of equal recorded values may occur at the peak; in this case, the first value is taken as the peak.

**Percent composition or percent of total** is a unit for expressing the ratio of a particular part of a sample or population to the total sample or population, in terms of types, numbers, weight, mass, or volume.

**Percent shading** is a measure of the amount of sunlight potentially reaching the stream. A clinometer is used to measure left and right bank canopy angles. These values are added together, divided by 180, and multiplied by 100 to compute percentage of shade.

**Periodic-record station** is a site where stage, discharge, sediment, chemical, physical, or other hydrologic measurements are made one or more times during a year but at a frequency insufficient to develop a daily record.

**Periphyton** is the assemblage of microorganisms attached to and living upon submerged solid surfaces. Although primarily consisting of algae, they also include bacteria, fungi, protozoa, rotifers, and other small organisms. Periphyton are useful indicators of water quality.

**Pesticides** are chemical compounds used to control undesirable organisms. Major categories of pesticides include insecticides, miticides, fungicides, herbicides, and rodenticides.

**pH** of water is the negative logarithm of the hydrogen-ion activity. Solutions with pH less than 7.0 standard units are termed "acidic," and solutions with a pH greater than 7.0 are termed "basic." Solutions with a pH of 7.0 are neutral. The presence and concentration of many dissolved chemical constituents found in water are affected, in part, by the hydrogen-ion activity of water. Biological processes including growth, distribution of organisms, and toxicity of the water to organisms also are affected,

in part, by the hydrogen-ion activity of water.

**Phytoplankton** is the plant part of the plankton. They are usually microscopic, and their movement is subject to the water currents. Phytoplankton growth is dependent upon solar radiation and nutrient substances. Because they are able to incorporate as well as release materials to the surrounding water, the phytoplankton have a profound effect upon the quality of the water. They are the primary food producers in the aquatic environment and commonly are known as algae. (See also "Plankton")

**Picocurie (PC, pCi)** is one trillionth ( $1 \times 10^{-12}$ ) of the amount of radioactive nuclide represented by a curie (Ci). A curie is the quantity of radioactive nuclide that yields  $3.7 \times 10^{10}$  radioactive disintegrations per second (dps). A picocurie yields 0.037 dps, or 2.22 dpm (disintegrations per minute).

**Plankton** is the community of suspended, floating, or weakly swimming organisms that live in the open water of lakes and rivers. Concentrations are expressed as a number of cells per milliliter (cells/mL) of sample.

**Polychlorinated biphenyls (PCBs)** are industrial chemicals that are mixtures of chlorinated biphenyl compounds having various percentages of chlorine. They are similar in structure to organochlorine insecticides.

**Polychlorinated naphthalenes (PCNs)** are industrial chemicals that are mixtures of chlorinated naphthalene compounds. They have properties and applications similar to polychlorinated biphenyls (PCBs) and have been identified in commercial PCB preparations.

**Pool**, as used in this report, is a small part of a stream reach with little velocity, commonly with water deeper than surrounding areas.

**Primary productivity** is a measure of the rate at which new organic matter is formed and accumulated through photo-synthetic and chemosynthetic activity of producer organisms (chiefly, green plants). The rate of primary production is estimated by measuring the amount of oxygen released (oxygen method) or the amount of carbon assimilated (carbon method) by the plants.

**Primary productivity (carbon method)** is expressed as milligrams of carbon per area per unit time [ $\text{mg C}/(\text{m}^2/\text{time})$ ] for periphyton and macrophytes or per volume [ $\text{mg C}/(\text{m}^3/\text{time})$ ] for phytoplankton. The carbon method defines the amount of carbon dioxide consumed as measured by radioactive carbon (carbon-14). The carbon-14 method is of greater sensitivity than the oxygen light and dark bottle method and is preferred for use with unenriched water samples. Unit time may be either the hour or day, depending on the incubation period. (See also "Primary productivity")

**Primary productivity (oxygen method)** is expressed as milligrams of oxygen per area per unit time [ $\text{mg O}/(\text{m}^2/\text{time})$ ] for periphyton and macrophytes or per volume [ $\text{mg O}/(\text{m}^3/\text{time})$ ] for phytoplankton. The oxygen method defines production and respiration rates as estimated from changes in the measured dissolved-oxygen concentration. The oxygen light and dark bottle method is preferred if the rate of primary production is sufficient for accurate measurements to be made within 24 hours. Unit time may be either the hour or day, depending on the incubation period. (See also "Primary productivity")

**Radioisotopes** are isotopic forms of elements that exhibit radioactivity. Isotopes are varieties of a chemical element that differ in atomic weight but are very nearly alike in chemical properties. The difference arises because the atoms of the isotopic forms of an element differ in the number of neutrons in the nucleus; for example, ordinary chlorine is a mixture of isotopes having atomic weights of 35 and 37, and the natural mixture has an atomic weight of about 35.453. Many of the elements similarly exist as mixtures of isotopes, and a great many new isotopes have been produced in the operation of nuclear devices such as the cyclotron. There are 275 isotopes of the 81 stable elements, in addition to more than 800 radioactive isotopes.

**Reach**, as used in this report, is a length of stream that is chosen to represent a uniform set of physical, chemical, and biological conditions within a segment. It is the principal sampling unit for collecting physical, chemical, and biological data.

**Recoverable from bed (bottom) material** is the amount of a given constituent that is in solution after a representative sample of bottom material has been digested by a method (usually using an acid or mixture of acids) that results in dissolution of readily soluble substances. Complete dissolution of all bottom material is not achieved by the digestion treatment and thus the determination represents less than the total amount (that is, less than 95 percent) of the constituent in the sample. To achieve comparability of analytical data, equivalent digestion procedures would be required of all laboratories performing such analyses because different digestion procedures are likely to produce different analytical results. (See also "Bed material")

**Recurrence interval**, also referred to as return period, is the average time, usually expressed in years, between occurrences of hydrologic events of a specified type (such as exceedances of a specified high flow or nonexceedance of a specified low flow). The terms "return period" and "recurrence interval" do not imply regular cyclic occurrence. The actual times between occurrences vary randomly, with most of the times being less than the average and a few being substantially greater than the average. For example, the 100-year flood is the flow rate that is exceeded by the annual maximum

peak flow at intervals whose average length is 100 years (that is, once in 100 years, on average); almost two-thirds of all exceedances of the 100-year flood occur less than 100 years after the previous exceedance, half occur less than 70 years after the previous exceedance, and about one-eighth occur more than 200 years after the previous exceedance. Similarly, the 7-day, 10-year low flow ( $7Q_{10}$ ) is the flow rate below which the annual minimum 7-day-mean flow dips at intervals whose average length is 10 years (that is, once in 10 years, on average); almost two-thirds of the non-exceedances of the  $7Q_{10}$  occur less than 10 years after the previous nonexceedance, half occur less than 7 years after, and about one-eighth occur more than 20 years after the previous nonexceedance. The recurrence interval for annual events is the reciprocal of the annual probability of occurrence. Thus, the 100-year flood has a 1-percent chance of being exceeded by the maximum peak flow in any year, and there is a 10-percent chance in any year that the annual minimum 7-day-mean flow will be less than the  $7Q_{10}$ .

**Replicate samples** are a group of samples collected in a manner such that the samples are thought to be essentially identical in composition.

**Return period** (See "Recurrence interval")

**Riffle**, as used in this report, is a shallow part of the stream where water flows swiftly over completely or partially submerged obstructions to produce surface agitation.

**River mileage** is the curvilinear distance, in miles, measured upstream from the mouth along the meandering path of a stream channel in accordance with Bulletin No. 14 (October 1968) of the Water Resources Council and typically is used to denote location along a river.

**Run**, as used in this report, is a relatively shallow part of a stream with moderate velocity and little or no surface turbulence.

**Runoff** is the quantity of water that is discharged ("runs off") from a drainage basin during a given time period. Runoff data may be presented as volumes in acre-feet, as mean discharges per unit of drainage area in cubic feet per second per square mile, or as depths of water on the drainage basin in inches. (See also "Annual runoff")

**Sea level**, as used in this report, refers to one of the two commonly used national vertical datums (NGVD 1929 or NAVD 1988). See separate entries for definitions of these datums.

**Sediment** is solid material that originates mostly from disintegrated rocks; when transported by, suspended in, or deposited from water, it is referred to as "fluvial sediment." Sediment includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity,

characteristics, and cause of the occurrence of sediment in streams are affected by environmental and land-use factors. Some major factors are topography, soil characteristics, land cover, and depth and intensity of pre-cipitation.

**Sensible heat flux** (often used interchangeably with latent sensible heat-flux density) is the amount of heat energy that moves by turbulent transport through the air across a specified cross-sectional area per unit time and goes to heating (cooling) the air. Usually expressed in watts per square meter.

**Seven-day, 10-year low flow** ( $7Q_{10}$ ) is the discharge below which the annual 7-day minimum flow falls in 1 year out of 10 on the long-term average. The recurrence interval of the  $7Q_{10}$  is 10 years; the chance that the annual 7-day minimum flow will be less than the  $7Q_{10}$  is 10 percent in any given year. (See also "Annual 7-day minimum" and "Recurrence interval")

**Shelves**, as used in this report, are streambank features extending nearly horizontally from the flood plain to the lower limit of persistent woody vegetation.

**Sodium adsorption ratio (SAR)** is the expression of relative activity of sodium ions in exchange reactions within soil and is an index of sodium or alkali hazard to the soil. Sodium hazard in water is an index that can be used to evaluate the suitability of water for irrigating crops.

**Soil heat flux** (often used interchangeably with soil heat-flux density) is the amount of heat energy that moves by conduction across a specified cross-sectional area of soil per unit time and goes to heating (or cooling) the soil. Usually expressed in watts per square meter.

**Soil-water content** is the water lost from the soil upon drying to constant mass at  $105 \times C$ ; expressed either as mass of water per unit mass of dry soil or as the volume of water per unit bulk volume of soil.

**Specific electrical conductance (conductivity)** is a measure of the capacity of water (or other media) to conduct an electrical current. It is expressed in microsiemens per centimeter at  $25^{\circ}C$ . Specific electrical conductance is a function of the types and quantity of dissolved substances in water and can be used for approximating the dissolved-solids content of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is from 55 to 75 percent of the specific conductance (in microsiemens). This relation is not constant from stream to stream, and it may vary in the same source with changes in the composition of the water.

**Stable isotope ratio** (per MIL) is a unit expressing the ratio of the abundance of two radioactive isotopes. Isotope ratios are used in hydrologic studies to determine the age or source of specific water, to

evaluate mixing of different water, as an aid in determining reaction rates, and other chemical or hydrologic processes.

**Stage** (See "Gage height")

**Stage-discharge relation** is the relation between the water-surface elevation, termed stage (gage height), and the volume of water flowing in a channel per unit time.

**Streamflow** is the discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff" as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

**Substrate** is the physical surface upon which an organism lives.

**Substrate embeddedness class** is a visual estimate of riffle streambed substrate larger than gravel that is surrounded or covered by fine sediment (<2mm, sand or finer). Below are the class categories expressed as the percentage covered by fine sediment:

- 0 no gravel or larger substrate
- 1 > 75 percent
- 2 51-75 percent
- 3 26-50 percent
- 4 5-25 percent
- 5 < 5 percent

**Surface area of a lake** is that area (acres) encompassed by the boundary of the lake as shown on USGS topographic maps, or other available maps or photographs. Because surface area changes with lake stage, surface areas listed in this report represent those determined for the stage at the time the maps or photographs were obtained.

**Surficial bed material** is the upper surface (0.1 to 0.2 foot) of the bed material that is sampled using U.S. Series Bed-Material Samplers.

**Suspended** (as used in tables of chemical analyses) refers to the amount (concentration) of undissolved material in a water-sediment mixture. It is defined operationally as the material retained on a 0.45-micrometer filter.

**Suspended, recoverable** is the amount of a given constituent that is in solution after the part of a representative suspended water-sediment sample that is retained on a 0.45-micrometer membrane filter has been digested by a method (usually using a dilute acid solution) that results in dissolution of only readily soluble substances. Complete dissolu-

tion of all the particulate matter is not achieved by the digestion treatment, and thus the determination represents something less than the "total" amount (that is, less than 95 percent) of the constituent present in the sample. To achieve comparability of analytical data, equivalent digestion procedures are required of all laboratories performing such analyses because different digestion procedures are likely to produce different analytical results. Determinations of "suspended, recoverable" constituents are made either by directly analyzing the suspended material collected on the filter or, more commonly, by difference, on the basis of determinations of (1) dissolved and (2) total recoverable concentrations of the constituent. (See also "Suspended")

**Suspended sediment** is the sediment maintained in suspension by the upward components of turbulent currents or that exists in suspension as a colloid. (See also "Sediment")

**Suspended-sediment concentration** is the velocity-weighted concentration of suspended sediment in the sampled zone (from the water surface to a point approximately 0.3 foot above the bed) expressed as milligrams of dry sediment per liter of water-sediment mixture (mg/L). The analytical technique uses the mass of all of the sediment and the net weight of the water-sediment mixture in a sample to compute the suspended-sediment concentration. (See also "Sediment" and "Suspended sediment")

**Suspended-sediment discharge** (tons/d) is the rate of sediment transport, as measured by dry mass or volume, that passes a cross section in a given time. It is calculated in units of tons per day as follows: concentration (mg/L) x discharge (ft<sup>3</sup>/s) x 0.0027. (See also "Sediment," "Suspended sediment," and "Suspended-sediment concentration")

**Suspended-sediment load** is a general term that refers to a given characteristic of the material in suspension that passes a point during a specified period of time. The term needs to be qualified, such as "annual suspended-sediment load" or "sand-size suspended-sediment load," and so on. It is not synonymous with either suspended-sediment discharge or concentration. (See also "Sediment")

**Suspended, total** is the total amount of a given constituent in the part of a water-sediment sample that is retained on a 0.45-micrometer membrane filter. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent determined. Knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to determine when the results should be reported as "suspended, total." Determinations of "suspended, total" constituents are made either by directly analyzing portions of the suspended material collected on the filter or, more commonly, by dif-

ference, on the basis of determinations of (1) dissolved and (2) total concentrations of the constituent. (See also "Suspended")

**Suspended solids, total residue at 105°C concentration** is the concentration of inorganic and organic material retained on a filter, expressed as milligrams of dry material per liter of water (mg/L). An aliquot of the sample is used for this analysis.

**Synoptic studies** are short-term investigations of specific water-quality conditions during selected seasonal or hydro-logic periods to provide improved spatial resolution for critical water-quality conditions. For the period and conditions sampled, they assess the spatial distribution of selected water-quality conditions in relation to causative factors, such as land use and contaminant sources.

**Taxa (Species) richness** is the number of species (taxa) present in a defined area or sampling unit.

**Taxonomy** is the division of biology concerned with the classification and naming of organisms. The classification of organisms is based upon a hierarchical scheme beginning with Kingdom and ending with Species at the base. The higher the classification level, the fewer features the organisms have in common. For example, the taxonomy of a particular mayfly, *Hexagenia limbata*, is the following:

Kingdom:	Animal
Phylum:	Arthropoda
Class:	Insecta
Order:	Ephemeroptera
Family:	Ephemeridae
Genus:	<i>Hexagenia</i>
Species:	<i>Hexagenia limbata</i>

**Thalweg** is the line formed by connecting points of minimum streambed elevation (deepest part of the channel).

**Thermograph** is an instrument that continuously records variations of temperature on a chart. The more general term "temperature recorder" is used in the table descriptions and refers to any instrument that records temperature whether on a chart, a tape, or any other medium.

**Time-weighted average** is computed by multiplying the number of days in the sampling period by the concentrations of individual constituents for the corresponding period and dividing the sum of the products by the total number of days. A time-weighted average represents the composition of water resulting from the mixing of flow proportionally to the duration of the concentration.

**Tons per acre-foot** (T/acre-ft) is the dry mass (tons) of a constituent per unit volume (acre-foot) of water. It is computed by multiplying the concentration of the constituent, in milligrams per liter, by 0.00136.

**Tons per day** (T/DAY, tons/d) is a common chemical or sediment discharge unit. It is the quantity of a substance in solution, in suspension, or as bedload that passes a stream section during a 24-hour period. It is equivalent to 2,000 pounds per day, or 0.9072 metric tons per day.

**Total** is the amount of a given constituent in a representative whole-water (unfiltered) sample, regardless of the constituent's physical or chemical form. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent present in both the dissolved and suspended phases of the sample. A knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to judge when the results should be reported as "total." (Note that the word "total" does double duty here, indicating both that the sample consists of a water-suspended sediment mixture and that the analytical method determined at least 95 percent of the constituent in the sample.)

**Total coliform bacteria** are a particular group of bacteria that are used as indicators of possible sewage pollution. This group includes coliforms that inhabit the intestine of warmblooded animals and those that inhabit soils. They are characterized as aerobic or facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria that ferment lactose with gas formation within 48 hours at 35°C. In the laboratory, these bacteria are defined as all the organisms that produce colonies with a golden-green metallic sheen within 24 hours when incubated at 35°C plus or minus 1.0°C on M-Endo medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 milliliters of sample. (See also "Bacteria")

**Total discharge** is the quantity of a given constituent, measured as dry mass or volume, that passes a stream cross section per unit of time. When referring to constituents other than water, this term needs to be qualified, such as "total sediment discharge," "total chloride discharge," and so on.

**Total in bottom material** is the amount of a given constituent in a representative sample of bottom material. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent determined. A knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to judge when the results should be reported as "total in bottom material."

**Total length** (fish) is the straight-line distance from the anterior point of a fish specimen's snout, with the mouth closed, to the posterior end of the caudal (tail) fin, with the lobes of the caudal fin squeezed together.

**Total load** refers to all of a constituent in transport. When referring to sediment, it includes suspended

load plus bed load.

**Total organism count** is the number of organisms collected and enumerated in any particular sample. (See also "Organism count/volume")

**Total recoverable** is the amount of a given constituent in a whole-water sample after a sample has been digested by a method (usually using a dilute acid solution) that results in dissolution of only readily soluble substances. Complete dissolution of all particulate matter is not achieved by the digestion treatment, and thus the determination represents something less than the "total" amount (that is, less than 95 percent) of the constituent present in the dissolved and suspended phases of the sample. To achieve comparability of analytical data for whole-water samples, equivalent digestion procedures are required of all laboratories performing such analyses because different digestion procedures may produce different analytical results.

**Total sediment discharge** is the mass of suspended-sediment plus bed-load transport, measured as dry weight, that passes a cross section in a given time. It is a rate and is reported as tons per day. (See also "Bedload," "Bedload discharge," "Sediment," "Suspended sediment," and "Suspended-sediment concentration")

**Total sediment load or total load** is the sediment in transport as bedload and suspended-sediment load. The term may be qualified, such as "annual suspended-sediment load" or "sand-size suspended-sediment load," and so on. It differs from total sediment discharge in that load refers to the material, whereas discharge refers to the quantity of material, expressed in units of mass per unit time. (See also "Sediment," "Suspended-sediment load," and "Total load")

**Transect**, as used in this report, is a line across a stream perpendicular to the flow and along which measurements are taken, so that morphological and flow characteristics along the line are described from bank to bank. Unlike a cross section, no attempt is made to determine known elevation points along the line.

**Turbidity** is the reduction in the transparency of a solution due to the presence of suspended and some dissolved substances. The measurement technique records the collective optical properties of the solution that cause light to be scattered and attenuated rather than transmitted in straight lines; the higher the intensity of scattered or attenuated light, the higher the value of the turbidity. Turbidity is expressed in nephelometric turbidity units (NTU). Depending on the method used, the turbidity units as NTU can be defined as the intensity of light of a specified wavelength scattered or attenuated by suspended particles or absorbed at a method specified angle, usually 90 degrees, from the path of the incident light. Currently approved methods for the measurement of turbidity in the USGS

include those that conform to U.S. EPA Method 180.1, ASTM D1889-00, and ISO 7027. Measurements of turbidity by these different methods and different instruments are unlikely to yield equivalent values.

**Ultraviolet (UV) absorbance (absorption)** at 254 or 280 nanometers is a measure of the aggregate concentration of the mixture of UV absorbing organic materials dissolved in the analyzed water, such as lignin, tannin, humic substances, and various aromatic compounds. UV absorbance (absorption) at 254 or 280 nanometers is measured in UV absorption units per centimeter of pathlength of UV light through a sample.

**Unconfined aquifer** is an aquifer whose upper surface is a water table free to fluctuate under atmospheric pressure. (See "Water-table aquifer")

**Vertical datum** (See "Datum")

**Volatile organic compounds (VOCs)** are organic compounds that can be isolated from the water phase of a sample by purging the water sample with inert gas, such as helium, and subsequently analyzed by gas chromatography. Many VOCs are human-made chemicals that are used and produced in the manufacture of paints, adhesives, petroleum products, pharmaceuticals, and refrigerants. They are often components of fuels, solvents, hydraulic fluids, paint thinners, and dry cleaning agents commonly used in urban settings. VOC contamination of drinking-water supplies is a human health concern because many are toxic and are known or suspected human carcinogens.

**Water table** is that surface in a ground-water body at which the water pressure is equal to the atmospheric pressure.

**Water-table aquifer** is an unconfined aquifer within which the water table is found.

**Water year** in USGS reports dealing with surface-water supply is the 12-month period October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 2002, is called the "2002 water year."

**WDR** is used as an abbreviation for "Water-Data Report" in the REVISED RECORDS paragraph to refer to State annual hydrologic-data reports. (WRD was used as an abbreviation for "Water-Resources Data" in reports published prior to 1976.)

**Weighted average** is used in this report to indicate discharge-weighted average. It is computed by multiplying the discharge for a sampling period by the concentrations of individual constituents for the corresponding period and dividing the sum of the

products by the sum of the discharges. A discharge-weighted average approximates the composition of water that would be found in a reservoir containing all the water passing a given location during the water year after thorough mixing in the reservoir.

**Wet mass** is the mass of living matter plus contained water. (See also "Biomass" and "Dry mass")

**Wet weight** refers to the weight of animal tissue or other substance including its contained water. (See also "Dry weight")

**WSP** is used as an acronym for "Water-Supply Paper" in reference to previously published reports.

**Zooplankton** is the animal part of the plankton. Zooplankton are capable of extensive movements within the water column and often are large enough to be seen with the unaided eye. Zooplankton are secondary consumers feeding upon bacteria, phytoplankton, and detritus. Because they are the grazers in the aquatic environment, the zooplankton are a vital part of the aquatic food web. The zooplankton community is dominated by small crustaceans and rotifers. (See also "Plankton")

## SELECTED REFERENCES

- Anderson, P.W., and George, J.R., 1966, Water-quality characteristics of New Jersey streams: U.S. Geological Survey Water-Supply Paper 1819-G, 48 p.
- Ayers, M.A., and Pustay, E.A., 1988, New Jersey ground-water quality: in National Water Summary 1986, U.S. Geological Survey Water Supply Paper 2325, p. 369-376.
- Fusillo, T.V., Hochreiter, J.J., Jr., and Lord, D.G., 1984, Water-quality data for the Potomac-Raritan-Magothy aquifer system in southwestern New Jersey, 1923-83: U.S. Geological Survey Open-File Report 84-737, 127 p, 1 plate.
- Hem, J.D., 1985, Study and interpretation of the chemical characteristics of natural water, 3d ed.: U.S. Geological Survey Water-Supply Paper 2254, 263 p.
- Langbein, W.B., and Iseri, K.T., 1960, General introduction of hydrologic definitions: U.S. Geological Survey Water-Supply Paper 1541-A, 29 p.
- New Jersey Department of Environmental Protection, 1996, New Jersey geographic information system: Trenton, N.J., CD-ROM series 1, v.2.
- Rantz, S.E., and others, 1982, Measurement and computation of streamflow; Volume 1. Measurement of stage and discharge, Volume 2. Computation of Discharge: U.S. Geological Survey Water-Supply Paper 2175, 631 p.

- Rooney, J.G., 1971, Ground-water resources, Cumberland County, New Jersey: New Jersey Department of Environmental Protection Special Report 34, 83 p.
- Schaefer, F.L., 1983, Distribution of chloride concentrations in the principal aquifers of the New Jersey Coastal Plain, 1977-81: U.S. Geological Survey Water-Resources Investigations Report 83-4061, 56 p.
- Schaefer, F.L., 1987, Selected literature on the water resources of New Jersey by the U.S. Geological Survey, through 1986: U.S. Geological Survey Open-File Report 87-767, 45 p.
- Schopp, R.D., and Bauersfeld, W.R., 1986, New Jersey surface-water resources: in National Water Summary 1985 - Hydrologic events and surface-water resources, U.S. Geological Survey Water-Supply Paper 2300, p. 335-340.
- Seaber, P.R., 1963, Chloride concentrations of water from wells in the Atlantic Coastal Plain of New Jersey, 1923-61: New Jersey Division of Water Policy and Supply, Special Report 22, 250 p.
- Shelton, T.B., Interpreting drinking water quality analysis, Rutgers Cooperative Extension booklet, 63 p.
- U.S. Environmental Protection Agency, 1996, Drinking water regulations and health advisories: Office of Water, Washington, D.C., EPA 822-R-96-001, 16 p.

### TECHNIQUES OF WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY

The USGS publishes a series of manuals, the Techniques of Water-Resources Investigations, describing procedures for planning and conducting specialized work in water-resources investigations. The material is grouped under major subject headings called books and is further divided into sections and chapters. For example, section A of book 3 (Applications of Hydraulics) pertains to surface water. The chapter, the unit of publication, is limited to a narrow field of subject matter. This format permits flexibility in revision and publication as the need arises.

Reports in the Techniques of Water-Resources Investigations series, which are listed below, are online at <http://water.usgs.gov/pubs/twri/>. Printed copies are for sale by the USGS, Information Services, Box 25286, Federal Center, Denver, Colorado 80225 (authorized agent of the Superintendent of Documents, Government Printing Office), telephone 1-888-ASK-USGS. Please telephone 1-888-ASK-USGS for current prices, and refer to the title, book number, chapter number, and mention the "U.S. Geological Survey Techniques of Water-Resources Investigations." Products can then be ordered by telephone, or online at <http://www.usgs.gov/sales.html>, or by FAX to (303)236-469 of an order form available online at <http://>

[mac.usgs.gov/isb/pubs/forms/](http://mac.usgs.gov/isb/pubs/forms/). Prepayment by major credit card or by a check or money order payable to the "U.S. Geological Survey" is required.

#### Book 1. Collection of Water Data by Direct Measurement

##### Section D. Water Quality

- 1-D1. *Water temperature—Influential factors, field measurement, and data presentation*, by H. H. Stevens, Jr., J.F. Ficke, and G. F. Smoot: USGS–TWRI book 1, chap. D1. 1975. 65 p.
- 1-D2. *Guidelines for collection and field analysis of ground-water samples for selected unstable constituents*, by W.W. Wood: USGS–TWRI book 1, chap. D2. 1976. 24 p.

#### Book 2. Collection of Environmental Data

##### Section D. Surface Geophysical Methods

- 2-D1. *Application of surface geophysics to ground-water investigations*, by A.A. R. Zohdy, G.P. Eaton, and D.R. Mabey: USGS–TWRI book 2, chap. D1. 1974. 116 p.
- 2-D2. *Application of seismic-refraction techniques to hydrologic studies*, by F.P. Haeni: USGS–TWRI book 2, chap. D2. 1988. 86 p.

##### Section E. Subsurface Geophysical Methods

- 2-E1. *Application of borehole geophysics to water-resources investigations*, by W.S. Keys and L.M. MacCary: USGS–TWRI book 2, chap. E1. 1971. 126 p.
- 2-E2. *Borehole geophysics applied to ground-water investigations*, by W.S. Keys: USGS–TWRI book 2, chap. E2. 1990. 150 p.

##### Section F. Drilling and Sampling Methods

- 2-F1. *Application of drilling, coring, and sampling techniques to test holes and wells*, by Eugene Shuter and W.E. Teasdale: USGS–TWRI book 2, chap. F1. 1989. 97 p.

#### Book 3. Applications of Hydraulics

##### Section A. Surface-Water Techniques

- 3-A1. *General field and office procedures for indirect discharge measurements*, by M.A. Benson and Tate Dalrymple: USGS–TWRI book 3, chap. A1. 1967. 30 p.
- 3-A2. *Measurement of peak discharge by the slope-area method*, by Tate Dalrymple and M.A. Benson: USGS–TWRI book 3, chap. A2. 1967. 12 p.

- 3-A3. *Measurement of peak discharge at culverts by indirect methods*, by G.L. Bodhaine: USGS–TWRI book 3, chap. A3. 1968. 60 p.
- 3-A4. *Measurement of peak discharge at width contractions by indirect methods*, by H.F. Matthai: USGS–TWRI book 3, chap. A4. 1967. 44 p.
- 3-A5. *Measurement of peak discharge at dams by indirect methods*, by Harry Hulsing: USGS–TWRI book 3, chap. A5. 1967. 29 p.
- 3-A6. *General procedure for gaging streams*, by R.W. Carter and Jacob Davidian: USGS–TWRI book 3, chap. A6. 1968. 13 p.
- 3-A7. *Stage measurement at gaging stations*, by T.J. Buchanan and W.P. Somers: USGS–TWRI book 3, chap. A7. 1968. 28 p.
- 3-A8. *Discharge measurements at gaging stations*, by T.J. Buchanan and W.P. Somers: USGS–TWRI book 3, chap. A8. 1969. 65 p.
- 3-A9. *Measurement of time of travel in streams by dye tracing*, by F.A. Kilpatrick and J.F. Wilson, Jr.: USGS–TWRI book 3, chap. A9. 1989. 27 p.
- 3-A10. *Discharge ratings at gaging stations*, by E.J. Kennedy: USGS–TWRI book 3, chap. A10. 1984. 59 p.
- 3-A11. *Measurement of discharge by the moving-boat method*, by G.F. Smoot and C.E. Novak: USGS–TWRI book 3, chap. A11. 1969. 22 p.
- 3-A12. *Fluorometric procedures for dye tracing*, Revised, by J.F. Wilson, Jr., E.D. Cobb, and F.A. Kilpatrick: USGS–TWRI book 3, chap. A12. 1986. 34 p.
- 3-A13. *Computation of continuous records of streamflow*, by E.J. Kennedy: USGS–TWRI book 3, chap. A13. 1983. 53 p.
- 3-A14. *Use of flumes in measuring discharge*, by F.A. Kilpatrick and V.R. Schneider: USGS–TWRI book 3, chap. A14. 1983. 46 p.
- 3-A15. *Computation of water-surface profiles in open channels*, by Jacob Davidian: USGS–TWRI book 3, chap. A15. 1984. 48 p.
- 3-A16. *Measurement of discharge using tracers*, by F.A. Kilpatrick and E.D. Cobb: USGS–TWRI book 3, chap. A16. 1985. 52 p.
- 3-A17. *Acoustic velocity meter systems*, by Antonius Laenen: USGS–TWRI book 3, chap. A17. 1985. 38 p.
- 3-A18. *Determination of stream reaeration coefficients by use of tracers*, by F.A. Kilpatrick, R.E. Rathbun, Nobuhiro Yotsukura, G.W. Parker, and L.L. DeLong: USGS–TWRI book 3, chap. A18. 1989. 52 p.
- 3-A19. *Levels at streamflow gaging stations*, by E.J. Kennedy: USGS–TWRI book 3, chap. A19. 1990. 31 p.
- 3-A20. *Simulation of soluble waste transport and buildup in surface waters using tracers*, by F.A. Kilpatrick: USGS–TWRI book 3, chap. A20. 1993. 38 p.
- 3-A21. *Stream-gaging cableways*, by C. Russell Wagner: USGS–TWRI book 3, chap. A21. 1995. 56 p.

### Section B. Ground-Water Techniques

- 3-B1. *Aquifer-test design, observation, and data analysis*, by R.W. Stallman: USGS–TWRI book 3, chap. B1. 1971. 26 p.
- 3-B2. *Introduction to ground-water hydraulics, a programed text for self-instruction*, by G.D. Bennett: USGS–TWRI book 3, chap. B2. 1976. 172 p.
- 3-B3. *Type curves for selected problems of flow to wells in confined aquifers*, by J.E. Reed: USGS–TWRI book 3, chap. B3. 1980. 106 p.
- 3-B4. *Regression modeling of ground-water flow*, by R.L. Cooley and R.L. Naff: USGS–TWRI book 3, chap. B4. 1990. 232 p.
- 3-B4. *Supplement 1. Regression modeling of ground-water flow -- Modifications to the computer code for nonlinear regression solution of steady-state ground-water flow problems*, by R.L. Cooley: USGS–TWRI book 3, chap. B4. 1993. 8 p.
- 3-B5. *Definition of boundary and initial conditions in the analysis of saturated ground-water flow systems—An introduction*, by O.L. Franke, T.E. Reilly, and G.D. Bennett: USGS–TWRI book 3, chap. B5. 1987. 15 p.
- 3-B6. *The principle of superposition and its application in ground-water hydraulics*, by T.E. Reilly, O.L. Franke, and G.D. Bennett: USGS–TWRI book 3, chap. B6. 1987. 28 p.
- 3-B7. *Analytical solutions for one-, two-, and three-dimensional solute transport in ground-water systems with uniform flow*, by E.J. Wexler: USGS–TWRI book 3, chap. B7. 1992. 190 p.
- 3-B8. *System and boundary conceptualization in ground-water flow simulation*, by T.E. Reilly: USGS–TWRI book 3, chap. B8. 2001. 29 p.

**Section C. Sedimentation and Erosion Techniques**

- 3-C1. *Fluvial sediment concepts*, by H.P. Guy: USGS–TWRI book 3, chap. C1. 1970. 55 p.
- 3-C2. *Field methods for measurement of fluvial sediment*, by T.K. Edwards and G.D. Glysson: USGS–TWRI book 3, chap. C2. 1999. 89 p.
- 3-C3. *Computation of fluvial-sediment discharge*, by George Porterfield: USGS–TWRI book 3, chap. C3. 1972. 66 p.

**Book 4. Hydrologic Analysis and Interpretation****Section A. Statistical Analysis**

- 4-A1. *Some statistical tools in hydrology*, by H.C. Riggs: USGS–TWRI book 4, chap. A1. 1968. 39 p.
- 4-A2. *Frequency curves*, by H.C. Riggs: USGS–TWRI book 4, chap. A2. 1968. 15 p.
- 4-A3. *Statistical methods in water resources*, by D.R. Helsel and R.M. Hirsch: USGS–TWRI book 4, chap. A3. 1991. Available only online at <http://water.usgs.gov/pubs/twri/twri4a3/>. (Accessed August 30, 2002.)

**Section B. Surface Water**

- 4-B1. *Low-flow investigations*, by H.C. Riggs: USGS–TWRI book 4, chap. B1. 1972. 18 p.
- 4-B2. *Storage analyses for water supply*, by H.C. Riggs and C.H. Hardison: USGS–TWRI book 4, chap. B2. 1973. 20 p.
- 4-B3. *Regional analyses of streamflow characteristics*, by H.C. Riggs: USGS–TWRI book 4, chap. B3. 1973. 15 p.

**Section D. Interrelated Phases of the Hydrologic Cycle**

- 4-D1. *Computation of rate and volume of stream depletion by wells*, by C.T. Jenkins: USGS–TWRI book 4, chap. D1. 1970. 17 p.

**Book 5. Laboratory Analysis****Section A. Water Analysis**

- 5-A1. *Methods for determination of inorganic substances in water and fluvial sediments*, by M.J. Fishman and L.C. Friedman, editors: USGS–TWRI book 5, chap. A1. 1989. 545 p.
- 5-A2. *Determination of minor elements in water by emission spectroscopy*, by P.R. Barnett and E.C. Mallory, Jr.: USGS–TWRI book 5, chap. A2. 1971. 31 p.
- 5-A3. *Methods for the determination of organic substances in water and fluvial sediments*,

edited by R.L. Wershaw, M.J. Fishman, R.R. Grabbe, and L.E. Lowe: USGS–TWRI book 5, chap. A3. 1987. 80 p.

- 5-A4. *Methods for collection and analysis of aquatic biological and microbiological samples*, by L.J. Britton and P.E. Greeson, editors: USGS–TWRI book 5, chap. A4. 1989. 363 p.
- 5-A5. *Methods for determination of radioactive substances in water and fluvial sediments*, by L.L. Thatcher, V.J. Janzer, and K.W. Edwards: USGS–TWRI book 5, chap. A5. 1977. 95 p.
- 5-A6. *Quality assurance practices for the chemical and biological analyses of water and fluvial sediments*, by L.C. Friedman and D.E. Erdmann: USGS–TWRI book 5, chap. A6. 1982. 181 p.

**Section C. Sediment Analysis**

- 5-C1. *Laboratory theory and methods for sediment analysis*, by H.P. Guy: USGS–TWRI book 5, chap. C1. 1969. 58 p.

**Book 6. Modeling Techniques****Section A. Ground Water**

- 6-A1. *A modular three-dimensional finite-difference ground-water flow model*, by M.G. McDonald and A.W. Harbaugh: USGS–TWRI book 6, chap. A1. 1988. 586 p.
- 6-A2. *Documentation of a computer program to simulate aquifer-system compaction using the modular finite-difference ground-water flow model*, by S.A. Leake and D.E. Prudic: USGS–TWRI book 6, chap. A2. 1991. 68 p.
- 6-A3. *A modular finite-element model (MODFE) for areal and axisymmetric ground-water-flow problems, Part 1: Model Description and User's Manual*, by L.J. Torak: USGS–TWRI book 6, chap. A3. 1993. 136 p.
- 6-A4. *A modular finite-element model (MODFE) for areal and axisymmetric ground-water-flow problems, Part 2: Derivation of finite-element equations and comparisons with analytical solutions*, by R.L. Cooley: USGS–TWRI book 6, chap. A4. 1992. 108 p.
- 6-A5. *A modular finite-element model (MODFE) for areal and axisymmetric ground-water-flow problems, Part 3: Design philosophy and programming details*, by L.J. Torak: USGS–TWRI book 6, chap. A5, 1993. 243 p.
- 6-A6. *A coupled surface-water and ground-water flow model (MODBRANCH) for simulation of stream-aquifer interaction*, by Eric D. Swain

and Eliezer J. Wexler: USGS–TWRI book 6, chap. A5, 1996. 125 p.

- 6-A7. User's guide to *SEAWAT: A computer program for simulation of three-dimensional variable-density ground-water flow*, by Weixing Guo and Christian D. Langevin: USGS–TWRI book 6, chap. A7. 2002. 77p.

## **Book 7. Automated Data Processing and Computations**

### **Section C. Computer Programs**

- 7-C1. *Finite difference model for aquifer simulation in two dimensions with results of numerical experiments*, by P.C. Trescott, G.F. Pinder, and S.P. Larson: USGS–TWRI book 7, chap. C1. 1976. 116 p.
- 7-C2. *Computer model of two-dimensional solute transport and dispersion in ground water*, by L.F. Konikow and J.D. Bredehoeft: USGS–TWRI book 7, chap. C2. 1978. 90 p.
- 7-C3. *A model for simulation of flow in singular and interconnected channels*, by R.W. Schaffranek, R.A. Baltzer, and D.E. Goldberg: USGS–TWRI book 7, chap. C3. 1981. 110 p.

## **Book 8. Instrumentation**

### **Section A. Instruments for Measurement of Water Level**

- 8-A1. *Methods of measuring water levels in deep wells*, by M.S. Garber and F.C. Koopman: USGS–TWRI book 8, chap. A1. 1968. 23 p.
- 8-A2. *Installation and service manual for U.S. Geological Survey manometers*, by J.D. Craig: USGS–TWRI book 8, chap. A2. 1983. 57 p.

### **Section B. Instruments for Measurement of Discharge**

- 8-B2. *Calibration and maintenance of vertical-axis type current meters*, by G.F. Smoot and C.E. Novak: USGS–TWRI book 8, chap. B2. 1968. 15 p.

## **Book 9. Handbooks for Water-Resources Investigations**

### **Section A. National Field Manual for the Collection of Water-Quality Data**

- 9-A1. *National Field Manual for the Collection of Water-Quality Data: Preparations for Water Sampling*, by F.D. Wilde, D.B. Radtke, Jacob Gibs, and R.T. Iwatsubo: USGS–TWRI book 9, chap. A1. 1998. 47 p.
- 9-A2. *National Field Manual for the Collection of Water-Quality Data: Selection of Equipment for*

*Water Sampling*, edited by F.D. Wilde, D.B. Radtke, Jacob Gibs, and R.T. Iwatsubo: USGS–TWRI book 9, chap. A2. 1998. 94 p.

- 9-A3. *National Field Manual for the Collection of Water-Quality Data: Cleaning of Equipment for Water Sampling*, edited by F.D. Wilde, D.B. Radtke, Jacob Gibs, and R.T. Iwatsubo: USGS–TWRI book 9, chap. A3. 1998. 75 p.
- 9-A4. *National Field Manual for the Collection of Water-Quality Data: Collection of Water Samples*, edited by F.D. Wilde, D.B. Radtke, Jacob Gibs, and R.T. Iwatsubo: USGS–TWRI book 9, chap. A4. 1999. 156 p.
- 9-A5. *National Field Manual for the Collection of Water-Quality Data: Processing of Water Samples*, edited by F.D. Wilde, D.B. Radtke, Jacob Gibs, and R.T. Iwatsubo: USGS–TWRI book 9, chap. A5. 1999, 149 p.
- 9-A6. *National Field Manual for the Collection of Water-Quality Data: Field Measurements*, edited by F.D. Wilde and D.B. Radtke: USGS–TWRI book 9, chap. A6. 1998. Various paginated.
- 9-A7. *National Field Manual for the Collection of Water-Quality Data: Biological Indicators*, edited by D.N. Myers and F.D. Wilde: USGS–TWRI book 9, chap. A7. 1997 and 1999. Various paginated.
- 9-A8. *National Field Manual for the Collection of Water-Quality Data: Bottom-material samples*, by D.B. Radtke: USGS–TWRI book 9, chap. A8. 1998. 48 p.
- 9-A9. *National Field Manual for the Collection of Water-Quality Data: Safety in Field Activities*, by S.L. Lane and R.G. Fay: USGS–TWRI book 9, chap. A9. 1998. 60 p.