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The Water Dictionary

Second Edition

A Comprehensive Reference of Water Terminology

Nancy E. McTigue, *Editor*
James M. Symons, *Editor Emeritus*

American Water Works Association

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The Water Dictionary: A Comprehensive Reference of Water Terminology, Second Edition

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Preface

The Water Dictionary, here in its second edition, was written in response to a need identified by leading water sector professionals almost 20 years ago.

AWWA management approved an ambitious project to be led by Dr. James M. Symons of the University of Houston to develop a compendium of terms as they are used in the water field. As with most successful AWWA publications, the project included the recruitment and participation of many volunteers. A Technical Advisory Committee (TAC) of 22 people was put together made up of various professionals representing many facets of the water community. Two TAC members, Lee C. Bradley Jr. and Theodore C. Cleveland, also agreed to be associate editors.

With the TAC formed, work began in earnest on the first edition in early 1994. AWWA's 1981 edition of the *Glossary: Water and Wastewater Control Engineering* was used as a starting point. The glossary was reviewed, and terms not directly related to drinking water were deleted. Outdated definitions were updated, and arcane definitions were simplified.

Next, new entries were added from terms suggested by the TAC members, from glossaries in references provided by AWWA, and from terminology encountered in technical articles and at professional conferences and meetings. Finally, in mid-1998, new entries were added to reflect the latest terminology. Dr. Symons and the associate editors reviewed and edited the entries and definitions, working to ensure that consistency and accuracy were maintained in all entries. Units of measure—in both US customary and Système International (SI) units—were gathered in a single list for ready reference. The development team also incorporated words and definitions from the Water Quality Association's *WQA Glossary of Terms* to standardize some of the commonly used terms. Joseph F. Harrison and the WQA graciously permitted AWWA to reprint that material in the first edition and in all future editions.

Work on the second edition of *The Water Dictionary* began almost as soon as the first edition, *The Drinking Water Dictionary*, was published in 2000. The water field is constantly changing, with new technologies, new regulations, and new science applications being used nearly every day. New words and terminologies are continually being added to the lexicon of water, even as this edition goes to print.

Early in the process of creating this second edition, Dr. Symons, primary editor and supervisor of the first edition, together with developmental editor Maripat Murphy, spent many hours gathering and vetting new material with a crew of steadfast volunteers. Dr. Symons recalls: "My way of generating new words was to review all of the journal articles and the technical conference programs since the publication of the first edition, looking for words that were not in the first edition. I broke these lists up into categories and sent them to a new Technical Advisory Committee I had recruited for definitions. This time the words were not self-generated, but assigned to the TAC members by me."

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Dr. Symons retired from the project, and I was asked to take on his role of senior technical editor. Together with a team of many talented professionals working countless hours—in particular, AWWA Publications Manager Gay Porter De Nileon, AWWA Technical Editor Martha Ripley Gray, and key AWWA contractors, including Project Manager Deborah Lynes of D&D Editorial Services—I have had the pleasure of seeing the second edition of this seminal work through to completion.

Those of us active in the water field know that our profession encompasses aspects of a variety of disciplines. Although this diverse knowledge base helps us do our job, it also means that the terms we use come from many sources. Sorting out which of these terms to include and which to omit from the dictionary was a painstaking process. For every new entry added, an original yet accurate definition had to be developed, vetted, and edited. As for deleting entries or determining what not to include from the hundreds of suggestions, a decision had to be made as to what this book is and what it couldn't be: it isn't a math or calculations book, it isn't a computer technology book, and it isn't an engineering design book. It's more of a glossary than a dictionary in that we have not included the etymology, pronunciation, or grammatical information about the words. We have focused on providing the useful scientific information needed by water professionals.

As was the case in the development of the first edition, volunteers played a vital role in helping complete the task of reviewing the material from the first edition and from the subsequent submissions. A careful reading of the material was required to be certain that regulatory and technological changes were accurately reflected. In addition to the TAC assembled for this project by Dr. Symons, I relied heavily on my friends and colleagues to review terms and definitions. I gratefully acknowledge the help and patience of David A. Cornwell of EE&T; Stuart W. Krasner, Metropolitan Water District of Southern California; Mark LeChevallier, American Water; Paal Engebrigsten, EE&T; and James Day, EE&T.

The Water Dictionary is a unique reference book, pulling together information from numerous sources, covering the many broad areas that make up the water field. As a book of words and phrases defined in terms of their relevance and usefulness to the professional community, *The Water Dictionary* presents the common language of water.

—Nancy E. McTigue
November 2009

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A

A *See* ampere *in the Units of Measure section.*

Å *See* angstrom *in the Units of Measure section.*

AA *See* activated alumina.

AADF *See* annual average daily flow.

AAEE *See* American Academy of Environmental Engineers.

AAES *See* American Association of Engineering Societies.

AAS method *See* atomic absorption spectrophotometric method.

AA spectrophotometric method *See* atomic absorption spectrophotometric method.

abandoned call rate The number of instances during a certain time period that consumers hang up after waiting for a representative to answer their phone calls. The calls are usually abandoned because the length of time "on hold" is too long or because the automated voice mail system is ineffective. This rate is a measure of the efficiency of a consumer call center and can provide a benchmark for improvement.

abandonment In legal terminology, the giving up, with the definite intent to do so, of (1) the right to use water for any purpose or (2) the method of using such water. A temporary cessation of such use or temporary giving up of such right does not constitute abandonment. Intent to abandon may be implied from acts of the one using the water, such as nonuse for a considerable period or diversion without beneficial use.

ABC *See* Association of Boards of Certification.

abiological Pertaining to (1) processes, actions, or chemical reactions that occur in the absence of biological activity or (2) events that are not biologically mediated.

abiotic Pertaining to the nonliving parts of a system.

abiotic removal Removal of a constituent or contaminant by nonbiological treatment methods.

above mean sea level (AMSL) A vertical distance above the mean sea level, where the mean sea level is the zero elevation for a given area. *See also* mean sea level.

abrasion number A number associated with granular activated carbon and used to define the resistance of the particles to degradation on handling. It is calculated by contacting an activated carbon sample with steel balls on a sieve column vibrator and determining the percentage ratio of the final mean particle diameter to the original mean particle diameter.

abrupt wave A translatory wave or increase in water depth in an open channel caused by a sudden change in flow conditions. *See also* hydraulic jump; sloping wave.

ABS *See* alkylbenzene sulfonate.

absolute Measured only by the fundamental units of mass, length, or time.

absolute filter rating Filter rating indicating that 99.9 percent (or essentially all) of the particles larger than a specified micrometer rating will be trapped on or within the filter.

absolute humidity A measure of the amount of water vapor held in a volume of air (in grams per cubic meter), frequently in the atmosphere. *See also* relative humidity.

absolute ownership In the context of water rights, complete ownership of water by one person or entity.

absolute pore size For microporous low-pressure membrane processes and other filtration mechanisms, the maximum size (diameter) of pores in the membrane. *See also* pore size.

absolute pressure The total pressure in a system, including both the pressure of the water and the pressure of the atmosphere. *Contrast with* gauge pressure.

absolute right In the context of water rights, a water-user right that cannot be lessened.

absolute temperature A temperature measurement relative to
(–273° Celsius, –459° Fahrenheit, 0 kelvin, or 0° Rankine). *See also* absolute zero.

absolute value The numerical value of a number without reference to the sign (i.e., plus or minus) associated with it.

absolute viscosity (μ) A numerical factor that represents a measure of a fluid's internal resistance to flow. The greater the resistance, the stickier the fluid and the greater the absolute viscosity. The viscosity of a fluid is an important property in the analysis of liquid behavior and so must be considered when designing water conveyance methods such as pumps. The absolute viscosity is also known as the coefficient of viscosity and the dynamic viscosity. It is calculated by dividing the shear stress (τ) by the sheer rate. In other words, $\mu = \tau/(dv/dy)$ in any consistent set of units. In US customary units, the absolute viscosity is expressed in terms of pounds-force seconds per square foot. In Système International units, it is expressed in terms of newton seconds per square meter, or kilograms per meter second, or pascal seconds. Water at 68° Fahrenheit (20° Celsius) has a viscosity of 0.0208 pound force seconds per foot squared

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(1.002 × 10^{-3} pascal seconds, or 1.002 centipoise). *See also* Newtonian flow; non-Newtonian flow.

absolute zero The temperature at which the molecules of an ideal gas are at rest, i.e., motionless. Common values for this temperature are –273° Celsius, –459° Fahrenheit, 0 kelvin, or 0° Rankine.

absorbance The amount of light attenuated by a sample. It is defined as $\log(P_0 / P)$, where P_0 is the initial power of the light beam and P is the power after passing through the sample. It is also known as the negative logarithm of the transmittance. *See also* transmittance.

absorbed dose The amount of a chemical that enters the body of an exposed organism.

absorbing well A shaft or well driven through an impermeable stratum to allow water to drain through to a permeable stratum; also called a drain well, negative well, or dead well.

absorption (1) The penetration of one substance into the structure of another substance. (2) The penetration of a chemical through the skin, wall of the gastrointestinal tract, or the lung into the systemic circulation (i.e., the blood). (3) The transformation of ultraviolet light to other forms of energy as it passes through a substance. *Contrast with* adsorption.

absorption analysis A technique in which measurement of an analyte is based on a decrease in signal from a radiation source. The type of absorption analysis is based on the wavelength of the electromagnetic radiation source (e.g., ultraviolet, visible, infrared).

absorption capacity The quantity of a soluble substance that can be absorbed by a given quantity of a solid substance.

absorption factor The fraction of a chemical making contact with an organism that is absorbed by the organism.

absorption field Typically, an area with soil and vegetation and subsurface piping that is designed for treated liquid disposal or reclaimed water reuse. Absorption fields commonly are designed so that portions of the fields can be isolated to allow alternate loading and resting periods to allow continuous discharge of reclaimed water.

absorption spectroscopy A class of techniques in which the properties of molecules or atoms are studied by measuring the characteristics of electromagnetic spectra. Absorption is the selective removal of energy resulting from interaction with atoms. The absorbed energy promotes the transfer of an electron to a higher orbital.

Abyssinian well A tube with perforations above the pointed end, driven into strata of moderate hardness to obtain a supply of water. It is also called a well point.

AC *See* alternating current.

Acanthamoeba A genus of free-living amoebae that are ubiquitous in the environment, particularly in soil and water habitats including drinking water; that can infect a variety of mammals, including humans; and that can produce severe, even fatal disease. In humans, *Acanthamoeba* can cause keratitis infection of cornea, most often in contact lens wearers. The primary source in those cases is believed to be tap water used for cleaning the contact lenses. Infections in humans can also be acquired through cuts and wounds and through the nasal passages. Infection with specific species such as *Naegleria fowleri* can be fatal. *Acanthamoeba* cysts are large (15–28 micrometers) and should easily be removed by filtration; cysts are chlorine resistant to residuals found in adequately treated distribution water, but trophozites are inactivated in such water.

accelerated depreciation An approach for depreciating an asset by amortizing its cost at a faster rate than would occur under the straight-line method. The three principal methods of accelerated depreciation are known as (1) sum of the years' digits, (2) double declining balance, and (3) units of production.

acceleration units *See in the Units of Measure section.*

acceptable daily intake (ADI) An amount of a chemical that can be taken into the body without producing harm. It is generally calculated by dividing an experimentally determined no-adverse-effect level of a chemical in humans or experimental animals by a series of safety or uncertainty factors. ADI is also known as the reference dose.

acceptable risk The level of risk associated with minimal adverse effects. Acceptable health and environmental risks are usually determined by risk analysis. Cost may be an important consideration for establishing regulations and public policy. In situations where benefits may accrue, an acceptable risk may be the risk for which potential benefits outweigh adverse effects.

acceptance limits criteria Contaminant-specific analytical performance limits established by the US Environmental Protection Agency to judge the performance of laboratories analyzing contaminants under Safe Drinking Water Act requirements. Laboratories seeking certification to conduct analyses used to judge compliance under the Safe Drinking Water Act must demonstrate that they can quantify a contaminant within the contaminant's specified acceptance limits. These limits are usually expressed as a percentage range greater or less than the practical quantitation limit (e.g., ±40 percent at 0.005 milligrams per liter).

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accessible equipment Water treatment equipment that, when installed and operating, is exposable and available for proper and thorough cleaning and inspection using only simple tools such as a screwdriver, pliers, or an open-end wrench. *See also* readily accessible equipment.

access time The cycle time required for a memory device to produce an output after receiving a request from the central processing unit.

accidental fecal release (AFR) Uncontrolled or accidental release of fecal material usually associated with the passing of intestinal gas in a swimming pool.

accidental release prevention program A program intended to prevent and minimize the impact of accidental releases of hazardous substances to the environment. Organizations such as water and wastewater utilities, manufacturing facilities, and energy installations may have such programs. *See also* risk management plan.

accidental spill The unplanned release of substances, either directly or indirectly, in such quantities that substantial effects on receiving systems will be noted. Such a release is the result of accidents, acts of nature, or operational malfunctions.

acclimation Adjustment to a change in a system.

acclimation period The time that passes before a process is ready to perform at its best; sometimes called lag time.

accounts Records of the financial transactions of a certain property, person, or business.

accounts receivable Moneys not yet received by a business or person for goods delivered or services rendered.

accreditation The process of certifying that an individual or a process has met all requirements and standards established by an authorized board, committee, or agency.

accrual basis accounting A method of accounting in which revenues are recorded when they are earned and expenditures become liabilities for benefits received, even though payment for the expenditures or receipt of the revenue may take place in another accounting period.

accrued depreciation The monetary difference between the original cost of an article and its remaining value. *See also* depreciation.

accumulated deficiency The total amount of water less than the normal level of runoff in units of million gallons, acre-feet, or cubic meters from any stated time (such as the beginning of a drought, month, or calendar year) to date, as used in the design of impounding reservoirs. *See also* accumulated excess.

accumulated excess The total amount of water in excess of the normal level of runoff from any stated time (such as the beginning of the month or calendar year) to date. An accumulated excess is indicated by a plus sign. *See also* accumulated deficiency.

accumulation tank A vessel or tank that receives and stores product water for use on demand.

accuracy (1) The closeness of a result to the true value. (2) In the context of maps, the closeness of results of observations, computations, or estimates of graphic map features to their true values or positions. Relative accuracy is a measure of the accuracy of individual features on a map to other features; absolute accuracy is a measure of the accuracy of features compared to their true positions on the face of the earth. Mapping accuracy standards are generally stated in terms of an acceptable error that must be achieved and the proportion of measured features that must meet the criterion. In the case of some plotting and display devices, accuracy refers to tolerance in the display of graphic features relative to the original coordinate file. (3) In the context of a geographic information database, accuracy also takes into consideration the correctness of content (e.g., errors of commission and omission of features), the correctness in identification of features, the currency or temporal characteristics of the data, and the topologic integrity of graphic and nongraphic information. *See also* bias; precision.

acetaldehyde (CH_3CHO) An organic chemical formed during the disinfection of water. It is most commonly associated with the use of ozone (O_3) as a disinfectant.

acetanilide ($C_6H_5NH(COCH_3)$) A chemical with many derivatives that are common herbicides, commonly referred to as acetanilide herbicides or pesticides. Their degradation products are unregulated contaminants and are listed on the Drinking Water Contaminant Candidate List. *See also* Drinking Water Contaminant Candidate List; herbicide; pesticide; unregulated contaminant.

acetochlor An herbicide that was registered by the US Environmental Protection Agency's Office of Pesticide Programs in 1994. *See also* herbicide.

ACFTD *See* air cleaner fine test dust.

ACH *See* aluminum chlorohydrate.

acid (1) A chemical substance that can donate a hydrogen ion, H^+, or a proton as it is commonly called. (2) Any chemical species that can accept an electron pair.

acid extractable concentration The concentration of a substance in solution after treatment of an unfiltered sample with hot, cold, or dilute mineral acid.

acid-fast bacteria Bacteria belonging to the genus *Mycobacterium.* When stained by a procedure called the acid-fast stain, these organisms retain the dye carbol fuchsin when washed with 95 percent ethanol

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(C_2H_5OH) containing 3 percent hydrochloric acid (HCl).

acid-fast stain A bacterial staining technique, also called the Ziehl–Neelsen stain (used primarily for bacteria of the genus *Mycobacterium*). In this technique, a solution of 95 percent ethanol (C_2H_5OH) with 3 percent hydrochloric acid (HCl) will remove the carbol fuchsin stain from all bacteria other than the mycobacteria and some closely related organisms.

acid-forming bacteria Microorganisms that can metabolize complex organic compounds under anaerobic conditions. This metabolic activity is the first step in the two-step anaerobic fermentation process leading to the production of methane (CH_4). It may occur in the bottom muds of reservoirs.

acidic *See* acidic solution.

acidic methanol methylation A method that uses acidic methanol (CH_3OH) to convert haloacetic acids, ketoacids, and other organic acids to their methyl esters for subsequent gas chromatography analysis. *See also* gas chromatography; haloacetic acid; ketoacid.

acidic rain *See* acid precipitation.

acidic solution Water or soil that contains a sufficient amount of acid substances (hydrogen [H^+] ions) to lower the pH to less than 7.0.

acidification *See* acidified.

acidified Pertaining to water in which acid has been added to lower the pH. In many analytic procedures, a sample will be acidified to a pH of less than 2 for preservation until actual analysis.

acidity A measure of the capacity of a water to neutralize strong base. In natural waters this capacity is usually attributable to acids such as H_2CO_3* and sometimes hydrogen ion (H^+). (H_2CO_3* is a hypothetical species that represents the molar concentration of carbonic acid (H_2CO_3) plus aqueous carbon dioxide; because very little H_2CO_3 is actually in solution, H_2CO_3* is roughly equivalent to aqueous carbon dioxide.) Acidity is usually expressed in terms of milligrams of calcium carbonate per liter (mg $CaCO_3$/L).

acidized Pertaining to a solution or material to which acid has been added.

acid mine drainage Drainage of water from areas that have been mined for coal or other mineral ores; the water has low pH, sometimes less than 2.0 (acidic), because of its contact with sulfur-bearing material; acid drainage is harmful because it often kills aquatic organisms.

acid precipitation Precipitation having a pH lower than the pH range commonly found in natural waters, caused by absorption from the atmosphere of sulfur dioxide gas (SO_2), which then forms sulfuric acid (H_2SO_4) in solution. It is sometimes called acid rain.

acid rain *See* acid precipitation.

acid sensitive Pertaining to a mixture that has a low capacity to neutralize hydrogen ions (buffering capacity) and can therefore be affected by acidic material, such as acid rain.

acid shock *See* pH shock.

acid solubility The susceptibility of filtering material, or of substances precipitated onto filtering material, to being dissolved in acid.

acid solubility test A filter media test used to determine the percentage by weight of filter media that can be dissolved in acid. Described in ANSI/AWWA B100, Granular Filter Material, this test can be used to determine the proportion of calcareous material in filtering materials or in support gravel before they are placed in a filter. The test also can be used to evaluate the extent of weight gain caused by the precipitation of calcium carbonate ($CaCO_3$) on filtering material at a lime softening plant.

acid-washed activated carbon Activated carbon that has been washed with an acid solution for the purpose of dissolving any ash in the activated carbon.

acoustic emission technology (AET) A technique for locating an underground leak that does not result in water on the surface. To detect the leak, AET uses the sound emitted by water exiting a water main.

acoustic sensing A method of detecting leaks and broken fibers in a low-pressure membrane system using a headphone hearing device, such as a stethoscope. It is also called sonic sensing.

acoustic shock A potential water treatment technology that uses acoustic shock or electro-hydraulic cavitation to cause physical damage to cells.

A–C pipe *See* asbestos–cement pipe.

acquired immune deficiency syndrome (AIDS) A disease caused by the human immunodeficiency virus (HIV) that leads to loss of the immune functions and makes individuals susceptible to a variety of diseases. HIV may be found in blood and other human excretions but is not found in drinking water.

acquired immunity Resistance to a pathogen or foreign substance acquired as a result of previous exposure.

acquisition The process of attaining ownership and operation of a small water system by a larger water utility or regulatory agency.

acre *See in the Units of Measure section.*

acre-foot *See in the Units of Measure section.*

acre-ft *See* acre-foot *in the Units of Measure section.*

acridine orange direct count (AODC) A widely used procedure employing the fluorochrome 3,6-bis (dimethylamino) acridinium chloride (acridine orange) to stain bacteria that are then counted visually using epifluorescence microscopy. Acridine orange enables vital staining by differentiating orange

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fluorescent vital microorganisms from green fluorescent nonviable cells.

acrylamide ($CH_2CHCONH_2$) An organic monomer used as a starting material for polymers that are used as coagulants or filter aids. Its concentration in finished drinking water is controlled by limiting the allowable dose of polymer that can be added to water.

acrylic resin A plastic material, tradename Lucite®.

ACS *See* American Chemical Society.

actinometer A tool (i.e., instrument or chemical) for measuring the power of radiant energy, especially in the visible or ultraviolet spectral regions. *See also* chemical actinometer.

actinometry The determination of irradiation intensity through the use of a chemical actinometer such as potassium ferric oxalate ($K_3Fe(C_2O_4)_3 \cdot 3H_2O$). *See also* chemical actinometer.

Actinomycetales An order of filamentous prokaryotic organisms (bacteria) that have mold-like characteristics and are considered transitional forms. This order includes eight families and a number of lesser known genera in addition to better known genera such as *Actinomyces, Nocardia, Streptomyces, Micromonospora,* and *Mycobacterium.*

actinomycetes A group of bacteria that occupies an uncertain position between the bacteria and the true fungi. This group includes both anaerobic and aerobic forms, and morphologies range from filamentous forms that show true branching to club-shaped rods to others that demonstrate a large amount of pleomorphism during different life stages. This group includes many organisms that produce antibiotic substances. Actinomycetes can be present in soil, lake, and river muds. Certain actinomycetes produce geosmin, 2-methylisoborneol, or both (compounds that produce earthy–musty odors at very low levels). *See also* geosmin; 2-methylisoborneol.

action level (AL) A specified concentration of a contaminant in water that determines treatment requirements or actions that a water system is required to complete to control the contaminant (such as further treatment or further monitoring, or both) to comply with a drinking water regulation.

action spectrum The relative efficiency of ultraviolet energy at different wavelengths in inactivating microorganisms. Each microorganism has a unique action spectrum.

activated alumina (AA) A charged form of aluminum, used in combination with a synthetic, porous media in an ion exchange process for removing charged contaminants from water. It is typically used for fluoride removal but can also remove arsenic and selenium. *See also* ion exchange.

activated carbon A form of particulate carbon (a crude form of graphite) with increased surface area to enhance adsorption of soluble contaminants. The primary source of activated carbon is bituminous coal, which is activated through a combustion process. Activated carbon is sometimes mistakenly called charcoal or just carbon. *See also* granular activated carbon; powdered activated carbon.

activated carbon adsorption treatment A treatment process using either powdered activated carbon or a granulated form of activated carbon—granular activated carbon—to remove soluble contaminants from water by adsorption. Powdered activated carbon is added as a chemical slurry and is removed along with chemical sludges after sedimentation; granular activated carbon is contained in separate contactors or as filter media. *See also* activated carbon; granular activated carbon; powdered activated carbon.

activated carbon block filter A point-of-use filtration device consisting of activated carbon particles fused into a uniform block.

activated carbon canister *See* chemical cartridge.

activated carbon cloth A contiguous, flexible form or cloth made of activated carbon.

activated carbon reactivation *See* activated carbon regeneration.

activated carbon regeneration The process of restoring the adsorption capacity of granular activated carbon or (rarely) powdered activated carbon by thermal means. Used, or spent, activated carbon is removed from the process, dewatered, and combusted in furnaces in the absence of oxygen to remove adsorbed contaminants and restore the microporous structure (i.e., to increase surface area) for adsorption. *See also* granular activated carbon; powdered activated carbon.

activated carbon usage rate (CUR) A measure of the capacity of granular activated carbon or powdered activated carbon to remove a contaminant to a specified level. Usage rates are often expressed in terms of weight of activated carbon used per unit volume treated. *See also* activated carbon adsorption treatment; granular activated carbon; powdered activated carbon.

activated silica A negatively charged colloid used primarily as an aid to coagulation. Activated silica is formed from a reaction between sodium silicate ($Na_2Si_4O_9$) and acid to form a supersaturated gel, which is then diluted. *See also* coagulation.

activation (1) The process of producing a highly porous structure in carbon by exposing the carbon to high temperatures in the presence of steam. (2) The process of making a solid material more capable of a desirable selective action. *See also* activated carbon.

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activation polarization A corrosion phenomenon in which the electric potential or net current, and therefore the rate of corrosion, is controlled by the activation energy of the elements participating in the reaction (e.g., iron). An activation polarization diagram is often used to determine the electron transfer step that controls the reaction. *See also* corrosion.

active humoral immunity Immunity attained either naturally by infection, with or without clinical symptoms, or artificially by inoculation of the agent, fractions of the agent, or products of the agent. Such immunity usually lasts for years.

active leakage control A proactive policy and program that a water utility implements to control hidden, unreported leaks in water distribution networks. Active leakage control includes, in most basic form, regular soundings of the network to detect leak noise sounds. Permanent monitoring can also be established by creating district metered areas (DMA) and gathering data to reveal diurnal flow patterns. *See also* district metered area.

active power (*P*) The time average over one period of power, measured in watts (W). For a single-phase circuit,

$$P = V \times I \times \mathrm{PF}$$

Where:

V = root mean square (rms) voltage, in volts
I = rms current, in amperes
PF = power factor

For a sinusoidal three-phase symmetrical and balanced circuit, the total active power for all three phases is given by

$$P = \sqrt{3} \times V \times I \times \mathrm{PF}$$

Where:

V = line-to-line rms voltage, in volts
I = rms current, in amperes
PF = power factor

active transport An energy-expending mechanism by which a cell moves a chemical across the cell membrane from a point of lower concentration to a point of higher concentration against the diffusion gradient.

active water *See* aggressive water.

activity coefficient A fractional number that, when multiplied by the molar concentration of a substance in solution, yields the chemical activity. This value gives an idea of how much interaction occurs between molecules at higher concentrations. The value of chemical (thermodynamic) activity replaces the actual molar concentration in mathematical expressions for the equilibrium constant, thereby eliminating the effect of concentration on the equilibrium constant. *See also* chemical activity.

activity network diagram A diagram used for planning the most appropriate schedule for completion of any complex task and all of its related subtasks.

actual cross-connection Any arrangement of pipes, fittings, or devices that connects a potable water supply directly to a nonpotable source or allows a nonpotable water supply to come directly into contact with a potable water supply. It is also known as a direct cross-connection.

actual evaporation The amount of water loss that can be attributed to evaporation based on measured values of precipitation, runoff, and estimated or calculated soil moisture. It represents the volume of water that evaporates over a given time period based on a water budget calculation using the following formula:

$$\mathrm{AE} = P_i - R_o + S_m$$

Where:

AE = actual evaporation
P_i = the cumulative precipitation for the time period (typically expressed as a length)
R_o = the cumulative runoff for the same time period (expressed as a length)
S_m = the cumulative soil moisture (also expressed as a length)

Actual evaporation is different from evaporation measured using an evaporation pan.

actual evapotranspiration The evapotranspiration that actually *occurs* under particular climatic and soil moisture conditions.

actual groundwater velocity The effective or field velocity of groundwater percolating through water-bearing material. It is measured by the volume of groundwater passing through a unit cross-sectional area in unit time divided by the effective porosity. It is also called average linear velocity, true groundwater velocity, field groundwater velocity, and seepage velocity.

actuator A device, usually electrically or pneumatically powered, that is used to operate valves.

acute Pertaining to an intense effect of a chemical or infectious agent. Acute effects are generally closely associated with high doses of the causative agent. They are not necessarily confined to brief exposure to the agent.

acute digestive condition A digestive condition that may include cramping, diarrhea, or vomiting following the ingestion of food or water contaminated with certain bacteria or other microorganisms. It also known as sudden digestive condition.

acute exposure A single exposure to a toxic substance that results in severe biological harm or death. An

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acute exposure is usually characterized as lasting no longer than a day.

acute gastroenteritis illness (AGI) (1) Acute *viral* gastroenteritis presents as a sporadic or epidemic illness. Several enteropathogenic viruses (e.g., rotaviruses) affect primarily infants and young children, resulting in a diarrheal illness that may be severe enough to produce dehydration; other enteric viruses (e.g., Norwalk-like viruses) affect primarily older children and adults and cause self-limiting (recovery without treatment) sporadic illness or outbreaks. (2) Acute *bacterial* gastroenteritis is characterized by diarrhea and sometimes vomiting and may be mild or severe, resulting in dehydration and occasionally septicemia if high levels of the causative agent or its toxins occur in the circulating blood. *See also* acute gastroenteritis illness of undetermined etiology; diarrhea.

acute gastroenteritis illness (AGI) of undetermined etiology A designation used to describe cases of illness in outbreaks where no specific etiologic (causative) agent has been identified. In some instances no etiologic agent is identified even after exhaustive laboratory analysis, but in most cases a lack of identification is a result of limited laboratory analysis or lack of collection of appropriate or timely clinical specimens during the epidemiologic investigation. Although in many waterborne outbreaks, the symptoms of acute gastroenteritis illness (AGI) of undetermined etiology may suggest a viral etiology, the illness may also be of bacterial or protozoan etiology.

acute health effect An immediate (i.e., within hours or days) effect that may result from exposure to certain drinking water contaminants (e.g., pathogens).

acute poisoning Poisoning that yields a rapid and intense response. It is generally associated with a single dose.

acute respiratory diseases Immediate responses of the respiratory system to infectious agents, allergens, or irritant chemicals. These responses generally restrict the passage of air through the upper airways of the lung or reduce the area for exchange of oxygen (O_2) and carbon dioxide (CO_2) between inhaled air and blood. Examples include bronchitis, chloramine-induced upper respiratory tract irritation, hay fever, and the common cold.

acute toxicity (1) The ability of a substance to cause poisonous effects resulting in severe biological harm or death soon after a single exposure or dose. (2) Any severe poisonous effect resulting from a single short-term exposure to a toxic substance.

acute violation Failure of a water system to meet a Safe Drinking Water Act requirement, resulting in an immediate public health risk. The US Environmental Protection Agency specifies which violations are acute when it sets drinking water regulations, and it requires extensive public notification when they occur. *See also* public notification.

ACWA *See* Association of California Water Agencies.

adaptation (1) The condition of showing fitness for a particular environment, as applied to characteristics of a structure, function, or entire organism. (2) A modification of a species that makes it more fit for reproduction, existence, or both under the conditions of its environment.

adaptive organization An organization that adopts innovative ways that enable it to achieve its mission through use of changing technologies and business methods.

additional bonds test A statement in a bond indenture that stipulates requirements to be met before additional bonds can be issued with a parity claim on revenues already pledged. It ensures that additional bonds are not issued unless historical and projected revenues indicate sufficient revenue exists to avoid dilution of coverage on outstanding bonds.

additive A chemical agent added to meet treatment goals (e.g., coagulants, chemicals to adjust pH, and corrosion inhibitors).

additive effect The toxicological effect of two chemicals given in combination, equivalent to the sum of their independent effects. Additivity can be defined in terms of either the intensity of the effects or the frequency in which a stochastic response is observed within a population of individuals at risk.

address matching The process of relating street addresses to point locations or areas such as census blocks, tracts, administrative units, buildings where permits are pending, or points of emergency response incidents.

adduct A covalent product of a reaction between a chemical or one or more of its metabolites and biological constituents. This term is most often applied to the product of reactions between reactive chemicals and cellular macromolecules such as nucleic acids or proteins.

ADE *See* average daily exposure.

adenoma A benign tumor that has originated from epithelial cells. It is produced in a variety of organs such as the pituitary gland, alveoli of the lung, liver, and kidney. Adenomas are recognizable because they maintain the normal structures of the cells from which they are derived.

adenosine triphosphate (ATP) ($C_{10}H_{16}N_5O_{13}P_3$) A compound found in all living cells in which energy is stored in high-energy phosphate bonds. Its components are the purine adenine, ribose, and three phosphoric acid groups.

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A

adenosine triphosphate (ATP) bioluminescence assay A rapid detection method, completed in less than 1 hour, that measures the total density of viable bacteria in a sample. It is also known as the firefly luciferase test for ATP, a test based on the reactions among the enzyme luciferase, luciferin, magnesium ions, and ATP. During the reaction, the light that is produced is quantitatively measured and subsequently correlated with a quantity of ATP extracted from a known concentration of bacteria. The level of light that is emitted from the sample is proportional to the ATP concentration, and an estimate of the bacterial density in the test sample can be determined.

adenovirus A large icosahedral deoxyribonucleic acid (DNA) virus, approximately 70 nanometers across. At least 41 different types are known, many of them associated with respiratory effects. Subtypes 40 and 41 are intestinal, associated with gastrointestinal disease, and waterborne. They are difficult to cultivate in cell culture.

ADF *See* average daily flow.

adhesion (1) Attachment or binding of unlike materials to one another. (2) Attachment of microorganisms to solid surfaces during biofilm formation. Adhesion may be reversible or irreversible in either case.

ad hoc query An operator-initiated request for information to be extracted from a database.

ADI *See* acceptable daily intake.

adiabatic expansion The expansion (increase) in volume of an air mass that occurs when the mass rises and expands without exchanging heat with its surroundings.

ADID *See* advance identification.

adipate A class of synthetic organic chemicals with various industrial uses, including use as a plasticizer. Di(2-ethylhexyl) adipate—$(CH_2\ CH_2COOCH_2CH(C_2H_5)C_4H_9)_2$ — is an adipate the presence of which in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.4 milligrams per liter. *See also* di(2-ethylhexyl) adipate; plasticizer; synthetic organic chemical.

adjacent wetlands Wetlands separated from other waters of the United States by constructed dikes or barriers, natural river berms, beach dunes, and the like.

adjusted r^2 A statistical term describing the goodness of fit of an equation to a given data set while considering the number of parameters included in the equation.

adjusted water budget A quantity of water used to maintain a landscape based on evapotranspiration and area, adjusted to reflect an efficiency standard.

adjustment factor In the context of water-efficient landscapes, a decimal fraction used to modify reference evapotranspiration to reflect an efficiency standard.

administration The collective management of governmental, business, or institutional affairs.

administrative consent order *See* administrative order on consent.

administrative order A legally binding compliance document signed by the US Environmental Protection Agency directing an individual, business, or other entity to take corrective action or refrain from an activity. It describes the violations and actions to be taken, and it can be enforced in court under the Safe Drinking Water Act. Such orders may be issued, for example, as a result of an administrative complaint whereby the respondent is ordered to pay a penalty for violations of a statute.

administrative order on consent A legal agreement signed by the US Environmental Protection Agency and an individual, business, or other entity through which the violator agrees to pay for correction of violations, take the required corrective or cleanup actions, or refrain from an activity. It describes the actions to be taken, may be subject to a comment period, applies to civil actions, and can be enforced in court.

administrative penalty authority The legal authority that state primacy agencies must have under the Safe Drinking Water Act to issue administrative penalties to water systems not in compliance with US Environmental Protection Agency regulations.

Administrative Procedure Act (APA) A body of law defining legal procedures and requirements related to the promulgation of federal regulations, codified generally as 5 US Code Sections 551–59, 701–06, 1305, 3105, 3344, 5372, and 7521.

administrative water law A subcategory of administrative law that focuses on water rights.

adsorbable organic halogen (AOX) *See under* total organic halogen.

adsorbate A solid, liquid, or gas substance that is adsorbed as molecules, atoms, or ions.

adsorbent Any material that can be used to adsorb substances on its surface (e.g., activated carbon).

adsorber A vessel designed to hold any adsorbent.

adsorption (1) The attraction and adhesion of molecules of a gas, liquid, or dissolved substance to a surface. Adsorption is generally a passive and reversible process. Granular or powdered activated carbon is often used as an adsorption medium. (2) The interaction of an analyte with the surface of a matrix. This interaction can form the basis for the extraction of analytes from water or the chromatographic separation of compounds. *Contrast with* absorption. *See also* activated carbon adsorption treatment.

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adsorption–destabilization A mechanism for the coagulation of particles in which counterions are adsorbed on the surface of nonsettling (stable) particles; thus, the particles can approach one another close enough to stick together and lose their stability (i.e., become settleable). *See also* bridging; double-layer compression; sweep-floc coagulation.

adsorption isotherm The plotted output of a test to evaluate the extent of adsorption determined at a constant temperature by varying the amount of activated carbon used or the concentration of the impurity in contact with the activated carbon. This test produces data that, when graphed, yield a line called the adsorption isotherm.

adsorption pores (1) The finest pores in an adsorbent's structure. (2) Pores that have adsorption capabilities.

adsorption water Water held on the surface of solid particles by molecular forces, with emission of heat (heat of wetting) taking place.

adsorptive oxide particles Metal oxide particles that have active surfaces to adsorb various chemicals. For example, iron oxide particles can be used in conjunction with rapid sand or membrane filtration for natural organic matter removal. *See also* membrane filtration; rapid sand filter.

ad valorem tax A state or local tax based on the assessed value of real or personal property.

advanced chemical cleaning *See* chemical cleaning.

advanced early warning system See early warning system.

Advanced Notice of Proposed Rulemaking (ANPR) A notice issued by a federal agency and published in the *Federal Register* announcing the intent of the agency to develop a proposed rule.

advanced oxidation process (AOP) A process in which the oxidative capacity of a parent compound is modified to make oxidation–reduction reactions more rapid or complete. For example, hydrogen peroxide (H_2O_2) may be added to ozone (O_3), or hydrogen peroxide may be photolyzed by ultraviolet light, to generate hydroxyl radicals, which are strong, nonspecific oxidizing agents. Other AOPs include the ozone-biodegradation process (O_3/bio), ozone–ultraviolet light process (O_3/UV), pulsed ultraviolet light–hydrogen peroxide process (pulsed UV/H_2O_2), and sonolyis. *See also* hydrogen peroxide; hydroxyl radical; ozone; ozone–biodegradation process; ozone–hydrogen peroxide process; ozone–ultraviolet light process; pulsed ultraviolet light–hydrogen peroxide process; ultraviolet light; ultraviolet light–hydrogen peroxide process.

advanced treatment plant (ATP) A treatment facility using treatment processes that provide treatment to a higher level than that considered conventional. For example, a conventional surface water treatment process includes coagulation, flocculation, sedimentation, and filtration. An advanced treatment plant may include processes such as ozonation, granular activated carbon adsorption treatment, or both.

advanced wastewater treatment Any physical, chemical, or biological treatment process used to provide a degree of treatment beyond secondary treatment. It is also known as tertiary treatment. *See also* tertiary treatment.

advance for construction An advance payment made by or on behalf of customers or others for the purpose of construction, to be refunded either wholly or in part. When applicants are refunded the entire amount to which they are entitled according to the agreement or rule under which the advance was made, the balance, if any, remaining in this account shall be credited to contribution in aid of construction.

advance identification (ADID) A planning process under which the US Environmental Protection Agency, in cooperation with the US Army Corps of Engineers and after consultation with the state, identifies wetlands and other waters of the United States that are either generally suitable or unsuitable for the discharge of dredged and fill material prior to the receipt of the Clean Water Act Section 404 permit application.

advance refunding bonds Bonds issued to replace an outstanding bond issue prior to the date on which the outstanding bond becomes due or callable. Proceeds of the advance refunding bonds are deposited in escrow with a fiduciary, invested in US Treasury bonds or other authorized securities, and used to redeem the underlying bonds at maturity or the call date and to pay interest on the bonds being refunded or the advance refunding bonds.

advection The transport of dissolved or suspended mass by motion of the host fluid. The motion is typically caused by pressure, density, or thermal gradients. The analogous term, *convection*, is often reserved to describe advection that results from density or thermal gradients.

advection dispersion equation A mathematical relationship to estimate the concentration of a given solute based on the flow (advection) and mixing (dispersion) in the aquifer. The estimate of dispersion includes effects of both molecular diffusion and mechanical mixing caused by shear forces at boundary layers. This equation is given as

$$\frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2} - V\frac{\partial C}{\partial x}$$

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Where:

C = concentration of species in water phase, in grams per cubic meter

D = dispersion coefficient, in square meters per second

V = average linear velocity, in meters per second

x = distance, in meters

adversary A person performing malevolent acts in pursuit of interests harmful to the facility; an adversary may be an insider or an outsider.

adversary path An ordered collection of actions against a target that, if completed, results in successful theft or sabotage.

adverse effect An effect that is judged to compromise the normal physiology of an organism. In the context of regulatory decisions, the term is used to differentiate between effects that clearly affect health and responses unlinked to health effects or of unknown significance.

adverse pressure gradient A backflow condition that may cause the introduction of contaminated water or a specific contaminant into a distribution system.

adverse reaction An effect of a chemical other than the intended effect, posing some threat to health or life. The term is usually applied in the context of drug use.

advisory group A group of people representing various interests, points of view, and fields of expertise. The group's purpose is to provide advice, credibility (sometimes), input, structured feedback, and support to an agency's projects or policies. The group may be standing or ad hoc, as well as handpicked or chosen from interested applicants.

advocacy The act of speaking or writing in support of an individual or thing.

ADWF *See* average dry weather flow.

AEESP *See* Association of Environmental Engineering and Science Professors.

aeolian deposit Soil deposited by wind, also called a wind deposit.

aeration A gas transfer unit process that allows for the absorption of gas (frequently oxygen or disinfectant) by water, the air stripping of volatile compounds, and the precipitation of inorganic contaminants.

aeration softening A physicochemical reaction using diffused aeration that, under very specific water quality conditions (high carbon dioxide and high alkalinity or calcium), can result in partially softening water. No lime or soda ash is added.

aeration zone The zone between the land surface and the water table. It includes the root zone, intermediate zone, and capillary fringe. The pore spaces contain water, as well as air and other gases. Saturated bodies, such as perched groundwater, may exist in the aeration zone, which is also called the vadose zone or the unsaturated zone.

aerator A treatment device that brings air into contact with water for the purposes of transferring gases (e.g., oxygen) from the air into the liquid phase. When this type of device is used for transferring contaminants from the liquid to the gaseous phase, it is sometimes called a stripper. *See also* air-stripping; diffused aeration; tray aerator.

aerial photography A method of obtaining photographic images taken from an airborne platform, commonly an airplane or satellite. Information derived from these photographs can be used to determine watershed characteristics, land use, topographic contours, geologic features, and artificial features in a given area.

aerification *See* coring.

Aerobacter aerogenes *See Enterobacter aerogenes.*

aerobe Any organism requiring free oxygen (O_2) or air to maintain its life processes.

aerobic (1) In reference to microorganisms, pertaining to the requirement for oxygen for growth. (2) In reference to environmental conditions, pertaining to the presence of oxygen.

aerobic bacteria *See* aerobe.

aerobic bacterial spore A highly resistant endospore, formed when conditions are unfavorable for continued growth of specific aerobic bacteria (i.e., *Bacillus*). It is a complex multilayered structure containing peptidoglycan within the spore coat and calcium dipicolinate within the core. Aerobic bacterial spores are capable of generating viable vegetative cells when conditions are favorable.

aerobic condition An environmental condition in which oxygen is available. In water, this means that dissolved oxygen is present.

aerobic treatment A biologic treatment technique used to oxidize and remove from water soluble or fine materials, usually organic in nature.

aerohydrous Pertaining to both air and water. This term applies to minerals containing water in pores or cavities.

Aeromonas Oxidase- and catalase-positive, glucose-fermenting, motile, facultative gram-negative bacilli found primarily in fresh or brackish water. These pathogens are usually found in fish, reptiles, and amphibians.

Aeromonas hydrophila (A. hydrophila) One species of aerobic, straight-rod or coccobacillus-shaped, gram-negative, motile (single polar flagellum) bacterium found in aquatic habitats. This bacterium grows well at 72° to 82° Fahrenheit (22° to 28° Celsius) and at 98.6° Fahrenheit (37.0° Celsius). It

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grows on a wide range of culture media and can be isolated on membrane filters of the type used for detection of coliform bacteria in water. *A. hydrophila* can cause wound infections and septicemia and has been associated with diarrheal illness worldwide. Other species of *Aeromonas* are pathogenic for fish and amphibians. *A. hydrophila* may regrow in treated distribution water that contains organic carbon and a low disinfectant residual and that has a long residence time in the system or in a storage reservoir or tank.

aerosolation The process of dispersing colloidal particles in a gas, smoke, or fog. As related to drinking water, aerosolation of particles through open boiling of contaminated water or showering with contaminated water may be a concern if the particles pose a greater threat to human health when they are inhaled than when ingested. Thermally resistant spores, such as anthrax, are a type of colloidal particle that poses a greater threat when inhaled than when ingested.

aerosolization The process by which a fine suspension of particles or liquid droplets is sprayed into the air.

AES *See* atomic emission spectroscopy.

aesthetic Pertaining to a quality of water that is determined by the senses, e.g., color, taste, or odor.

aesthetic contaminants *See* aesthetic.

AET *See* acoustic emission technology.

affinity constant A measure of the strength of association between two chemicals. In formal terms, it is the inverse of the dissociation constant. In toxicology it applies to chemicals that act through association with a biological molecule by noncovalent linkages; the biological molecule is referred to as the receptor. *See also* dissociation constant.

affinity diagram A method of gathering large amounts of data (ideas, opinions, issues) and visually organizing it into groupings based on natural relationships between each item.

affirmative action A program or plan designed to increase the number of women and minorities in the workplace.

affluent stream A stream or river flowing into a larger river or into a lake; a tributary.

aflatoxin A family of mycotoxins found in certain strains of *Aspergillus flavus*. Aflatoxin B1 is the most potent of these toxins. It is a hepatotoxin and among the most potent carcinogens known. Other aflatoxins are designated B2, G1, and G2, primarily on the basis of their fluorescent properties, either blue (B) or green (G). Metabolites of aflatoxin B1 are frequently designated M1, M2, and so on. The molecular formulas for various aflatoxins are as follows:

aflatoxin	$C_xH_yO_z$, where x is typically 16 or 17; y is typically 10, 12, or 14; and z is typically 6, 7, or 8
aflatoxin B1	$C_{17}H_{12}O_6$
aflatoxin B2	$C_{17}H_{14}O_6$
aflatoxin B2a	$C_{17}H_{14}O_7$
aflatoxin G1	$C_{17}H_{12}O_7$
aflatoxin G2	$C_{17}H_{14}O_7$
aflatoxin G2a	$C_{17}H_{14}O_8$
aflatoxin M1	$C_{17}H_{12}O_7$
aflatoxin M2	$C_{17}H_{14}O_7$
aflatoxin P1	$C_{16}H_{10}O_6$
aflatoxin Q1	$C_{17}H_{12}O_7$

AFM *See* atomic force microscopy.

AFR *See* accidental fecal release.

AFT *See* alternative filtration techniques; Alternative Filtration Technology.

afterburner A device that oxidizes compounds in the gaseous phase under conditions of high temperature. An afterburner can be used following an incinerator to convert undesirable gaseous by-products of the incineration process, such as carbon monoxide (CO) and hydrocarbons (C_xH_y), to carbon dioxide (CO_2) and water.

aftergrowth An increase in bacterial density in treated distribution water caused by growth of bacteria released from the pipewall biofilm and sediments, generally more apparent in areas where the disinfectant residual has been depleted. Aftergrowth is also called regrowth. *See also* regrowth.

after-precipitation The continued precipitation of a chemical compound after leaving the sedimentation basin or solids contact basin. This process can cause scale formation on the filter media and in the distribution system.

after-the-fact (ATF) permit A permit issued under Section 404 of the Clean Water Act to allow dredged or fill material that accrued prior to permit application to be discharged into a wetlands or other waters of the United States.

AGA *See* American Gas Association.

agar A gelatinous material recovered from seaweed that is used to solidify media for microbiological assays.

agar layer method A technique for enhancing the recovery of affected microorganisms by the use of a microorganism-nonspecific agar layer on top of a microorganism-specific agar layer. Microorganism recovery can be improved because weak (e.g., heat-shocked) microorganisms that are barely surviving the bottom specific layer will be able to proliferate in the top layer and thus be more detectable.

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age tank A tank used to store a chemical solution of known concentration for feed to a chemical feeder. It is also called a day tank.

agglomeration The collecting or coalescence of dispersed suspended matter into larger masses or flocs that can settle and be filtered from water.

agglutination The microscopic or macroscopic clumping of microorganisms. This process allows researchers to identify organisms by the formation of organism–antibody complexes that create a lattice or network.

aggradation The geological process of building up a surface by the accumulation of deposits.

aggrading river A river that is building up its valley bottom by deposition of material.

aggregate A collection of soil grains or particles gathered into a mass and behaving mechanically as a unit.

aggregate volume index (AVI) A ratio of total aggregate unit volume to the fraction of that volume occupied by dry sludge solids. This ratio is determined by performing sludge-thickening studies using batch cylindrical columns. The densities of sludge particles and aggregates, also measured during the test, are necessary to calculate the aggregate volume index. The AVI is an indication of the dewaterability of the sludge; higher aggregate volume indexes indicate poorer dewaterability.

aggregation A general term describing the tendency of large molecules or colloidal particles to combine in clusters or clumps, especially in solutions.

aggregative risk analysis A total review of water quality in a distribution system considering the major ways water can be compromised, including inadequate water treatment, corrosion, regrowth, permeation, and intrusion.

aggregator/consolidator model Model for electronic billing services referring to outside service providers that furnish billing and payment services to customers. Aggregators allow a customer access to bills from multiple sources. Consolidators provide services to billers from initial enrollment through collection processes, including managing the process of delivering bills to the clients.

aggressive Pertaining to a corrosive water that will deteriorate material such as distribution piping.

aggressive water Water having corrosive qualities. *See also* aggressive.

aggressivity index (AI) A general indicator of the tendency for corrosion to occur in a specific water. It is sometimes used in place of the Langelier saturation index (LSI), but it is less accurate than the LSI. It is calculated as:

$$AI = pH_{actual} + C + D$$

Where:

pH = the measured pH of the water
C = the logarithm (base 10) of the calcium hardness expressed in milligrams per liter
D = the logarithm (base 10) of the total alkalinity expressed in milligrams per liter

An AI of 12 or above indicates nonaggressive (not corrosive) water. AI values below 10 indicate extremely aggressive (corrosive) conditions. *See also* Langelier saturation index.

AGI *See* acute gastroenteritis illness.

agitator A mechanical apparatus for mixing, aerating, or both; a device for creating turbulence.

agricultural chemicals Chemicals used during various stages of agriculture to (1) control pests and weeds and (2) promote desired plant growth. *See also* fertilizer; fumigant; herbicide; pesticide.

agricultural drainage The runoff of water from farmed areas that travels through surface waterways and ditches or via subsurface tile drains and conduits.

agricultural reuse The use of treated wastewater for agricultural purposes, usually irrigation, to preserve drinking water supplies for human consumption.

agrochemicals Synthetic chemicals (pesticides and fertilizers) used in agricultural production.

A·h *See* ampere-hour *in the Units of Measure section.*

Ah locus A location on deoxyribonucleic acid where the dioxin-activated receptor binds to activate synthesis of a variety of proteins. Prominent among these proteins are specific members of the cytochrome P 450 family of enzymes that are involved in the metabolism of chemicals that are foreign to the body.

Ah receptor A protein complex that binds to certain chemicals to induce a specific constellation of responses in the cell. It includes the induction of cytochromes in the 1A family and some changes in the rates of cell replication for a variety of tissues. Activation of the receptor seems clearly associated with the toxicological properties of chemicals in the dibenzodioxin and dibenzofuran groups, and, to a lesser degree, in the polychlorinated biphenyl groups. Most effects of these chemicals seem to involve catalyzing the binding of the receptor to a variety of nuclear proteins, which in turn acts to stimulate or inhibit transcription of genes. Which of these responses is responsible for the carcinogenic and development effects of this class of compounds is not clear.

A. hydrophila *See Aeromonas hydrophila.*

AI *See* aggressivity index; artificial intelligence.

AIChE *See* American Institute of Chemical Engineers.

aid A chemical used to enhance and improve the performance of a physical–chemical process. For example, a coagulant aid is a chemical used in addition to

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the primary coagulant to improve performance; a filter aid is a chemical added to the filtration process to improve particle capture. *See also* coagulant.

AIDIS *See* Inter-American Association of Sanitary and Environmental Engineering.

AIDS *See* acquired immune deficiency syndrome.

AIHA *See* American Industrial Hygiene Association.

air-and-vacuum relief valve A dual-function air valve that (1) permits entrance of air into a pipe being emptied, thus preventing a vacuum and (2) allows air to escape in a pipe while the pipe is being filled or under pressure.

air-and-vacuum valve An air valve that permits air to enter an empty pipe to counteract a vacuum and prevent accumulated air from escaping. This type of valve is also called a vacuum valve.

air backwash A process for cleaning filtration media in which air is introduced into a liquid backwash flow to assist in dislodging particles entrapped in the media. Air backwash is typically used for backwashing either pressure filters or gravity media filters. *See also* backwash.

air binding (1) The clogging of a filter, pipe, or pump as a result of the presence of air released from water. Air can prevent the passage of water during the filtration process and can cause the loss of filter media during the backwash process. (2) An increase in the pressure of air trapped in soil interstices, which decreases the rate of water infiltration into the soil.

air-bound Pertaining to a pipe or pump obstructed because of air entrapped at a high point.

air bubble volume The volume of air bubbles present in a dissolved air flotation clarifier in proportion to the total volume of air and water in the clarifier. As air bubble volume is increased in a dissolved air flotation clarifier, the solids separation capability of the clarifier increases.

air chamber A closed pipe chamber installed on the discharge line of a reciprocating pump to take up irregularities in hydraulic conditions and relieve the pump of shocks caused by the pulsating flow.

air check A device that allows water, but not air, to pass through it.

air cleaner fine test dust (ACFTD) A test dust that has been used for primary calibration of automatic particle counters, for filter testing, and for component contamination sensitivity testing.

air diffuser Devices of varied design that transfer (dissolve) air into a liquid, frequently water.

air diffusion The process of transferring (dissolving) air into a liquid, frequently water. *See also* air diffuser.

air-displacement pump A displacement pump in which compressed air, rather than pistons or plungers, is used to force liquid through a cylinder. Such a pump is also called an air-chamber pump.

air dryer A device used to dry out (desiccate) air by removing the water vapor. An air dryer is used during the generation of ozone (O_3) from air to produce higher concentrations of ozone and lessen the production of corrosive nitrous oxides.

air-fed ozonator A device for producing ozone (O_3) that uses dry air, rather than dry oxygen (O_2), as the feed material. An electrical discharge through the dry air produces the ozone.

air gap A dedicated air space between a pressurized water supply and a source of contamination, used to ensure that an incompatible liquid or contamination source is physically disconnected from the piping system and therefore cannot be siphoned into the system. *See also* backflow prevention; siphon.

air-gap device Any mechanism that uses the principle of separation or an air gap to prevent a cross-connection or physical connection where potable water could be contaminated. *See also* air gap.

air-gap fitting A physical device engineered to produce an air gap. *See also* air gap; air-gap device.

airlift pump A pump based on the airlift principle in which fine pressurized air bubbles are released in water. These fine bubbles lower the density of the air–water mixture, allowing the weight of the more dense surrounding water to push the air–water mixture up the pipe.

air-line correction In wire sounding, a correction applied to that part of the line above the water surface when large vertical angles are induced by high velocities, great depth, insufficient sounding weight, or any combination thereof. *See also* wet-line correction.

air lock A condition in which accumulated air in a high point of a piping system is sufficient to reduce or block the flow of water.

air padding The process of pumping dry air (dew point –40° Fahrenheit or –40° Celsius) into a container to force a liquefied gas such as chlorine out of a container or to assist with the withdrawal of a liquid.

air pocket A location within a pipeline or filtering medium in which air has collected. Air pockets interfere with the flow of a liquid and result in the loss of a siphon in pipelines. In filters, air pockets interfere with filter performance. They develop when pressure loss within a filter results in a localized pressure that is less than atmospheric pressure. Dissolved gases are released from the solution to form air pockets within the media. *See also* air binding.

air pressure–decay test *See* air pressure–hold test.

air pressure–hold test For microfiltration and ultrafiltration hollow-fiber membrane processes, a direct integrity test method that applies air at a specific

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pressure (less than the bubble point pressure of the membrane; typically up to 15 pounds per square inch [103.4 kilopascals]) to the drained filtrate/permeate side of the membrane and monitors the pressure loss over a given time period. If the pressure decline is greater than a fixed value for the membrane, the membrane system is considered compromised, possibly from a broken membrane fiber (for a hollow-fiber membrane). *See also* bubble point.

air purging A procedure to clean water mains in which air from a compressor is mixed with the water and flushed through the main. This procedure is used to clean mains that are less than 4 inches (100 millimeters) in diameter.

air-purifying respirator A respirator that uses disposable chemically active cartridges or high-efficiency particulate filters that remove harmful contaminants from the air.

air release valve *See* air relief valve.

air relief valve An air valve placed at the summit of a pipeline (1) to release air automatically and prevent air binding and pressure buildup or (2) to allow air to enter a line if the internal pressure becomes less than that of the atmosphere.

air scour (1) The practice of admitting air through the underdrain system of a filter to help complete cleaning of media during filter backwash. (2) A technique using high-volume, high-velocity, low-pressure air in water to remove tuberculation and other internal corrosion particles, improving water quality and restoring the flow-carrying capacity of a water pipeline, with minimal disruption to service. *See also* air backwash.

air scrubbing A process that uses a liquid spray to oxidize and subsequently remove undesirable contaminants (e.g., particulates and acid gases such as carbon dioxide [CO_2]) from the gaseous phase. Scrubbants can include either water or an agent such as sodium hydroxide (NaOH).

air-stripping A process that removes volatile compounds from a liquid phase by passing air through the liquid. The process uses the principles of Henry's law to transfer volatile pollutants from a solution of high concentration into an airstream of lower concentration. Air can be diffused into a bulk liquid stream or can be introduced into packed towers by compressors, countercurrent to the water flow. *See also* packed tower aeration; stripping.

air-surging A well development technique that uses compressed air to remove fines (clay, sand, silt) that can clog the screen and filter pack of a well.

air-to-water (A/W) ratio A design criterion used in air-stripping to indicate the volume of air required per volume of water to effectively remove volatile contaminants.

air vent An opening in a penstock or other pipeline, covered tank, or well that allows inflow of air.

air wash *See* air backwash.

air–water backwash *See* air–water wash.

air–water wash A method of backwashing granular filter media in which both air and water are used. The air is entrained under pressure into the backwash water in the underlying media support structure and is released as the water flows upwardly through the granular media. The purpose of the air is to provide additional energy and some buoyancy that increases the scouring action and enhances the release of particles attached to the granular media. *See also* backwash.

AL *See* action level.

ALA *See* aminolevulinic acid.

alachlor (2-chloro-2'-6'-diethyl-*N*-(methoxymethyl)-acetanilide) ($C_{14}H_{20}ClNO_2$) An herbicide used primarily on corn and soybeans. It is slightly soluble in water, and its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.002 milligrams per liter.

alachlor ethane sulfonic acid (ESA) A sulfonic acid ($–SO_2OH$) degradate of alachlor ($C_{14}H_{20}ClNO_2$). *See also* alachlor.

ALAD *See* aminolevulinic acid dehydrase.

alarm A mechanism used to alert operators when monitoring data have reached a preset limit. For example, alarms may be used in conjunction with online turbidimeters or particle counters to alert operators to a rise in turbidity or particle counts to an unacceptable level or to a level that requires action to prevent a further rise in the parameter being monitored.

alarm contact A switch that operates when some preset low, high, or abnormal condition exists.

albedo Reflective power, specifically, the fraction of incident light or electromagnetic radiation that is reflected by a surface or body (such as the moon or a cloud).

alcian A common histological cationic dye used for the demonstration of glycosaminoglycans or mucopolysaccharides.

alcohol A class of organic compounds that have a hydroxyl (–OH) functional group attached to one of the carbon atoms in the structure.

AL.COL model (also AL COL model) A model applied in the Parisian suburbs' distribution system that is used to predict the level of risk of coliform occurrence at specific sampling sites 1 week in advance, based on exceeding threshold values for four water quality parameters. The model's inputs are mean values of temperature, disinfectant residual, suspended

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bacteria counts, and biodegradable dissolved organic carbon consumption. *AL.COL* is the acronym for the French name of the model (*Alerte Coliformes*), which translates to "Coliform Alert."

aldehyde A class of organic compounds that have a carbonyl (C=O) functional group on the first or last carbon atom in the chemical structure. Some aldehydes are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. *See also* disinfection by-product.

aldicarb ($CH_3SC(CH_3)_2HC{:}NOCONHCH_3$) The common name for 2-methyl-2-(methylthio) propionaldehyde O-(methylcarbamoyl) oxime, a synthetic organic chemical used as an insecticide or nematocide in soil. The US Environmental Protection Agency has set a maximum contaminant level of 0.003 milligrams per liter, but the effective date for its regulation has not been set. *See also* insecticide; nematocide.

aldicarb sulfone ($CH_3SO_2C(CH_3)_2HC{:}NOCONHCH_3$) Another name for aldoxycarb, which is the common name for 2-methyl-2-(methylsulfonyl)propanal *O*{(methylamino)carbonyl} oxime, a synthetic organic chemical used as a nematocide or insecticide. In addition, aldicarb sulfone is the final oxidation by-product of aldicarb. The US Environmental Protection Agency has set a maximum contaminant level of 0.002 milligrams per liter, but the effective date for its regulation has not been set. *See also* aldicarb; insecticide; nematocide.

aldicarb sulfoxide ($CH_3SOC(CH_3)_2HC{:}NOCONHCH_3$) The intermediate oxidation by-product of aldicarb. Aldicarb sulfoxide can be further oxidized to aldicarb sulfone. The US Environmental Protection Agency has set a maximum contaminant level of 0.004 milligrams per liter, but the effective date for its regulation has not been set. *See also* aldicarb; aldicarb sulfone.

aldoacid A class of organic compounds that have both an aldehyde (HC=O) and carboxylic acid (COOH) functional group in the chemical structure. Some aldoacids are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. An aldoacid is also referred to as an aldehyde-acid or ketoacid. *See also* disinfection by-product.

aldoketone A class of organic compounds that have both an aldehyde (HC=O) and carbonyl (C=O) functional group in the chemical structure. Some aldoketones are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. *See also* disinfection by-product.

aldrin ($C_{12}H_8Cl_6$) The assigned common name for an insecticidal product containing 95 percent or more of 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-*exo*-1,4-*endo*-5,8-dimeth-anonaphthalene. *See also* insecticide.

***Alerte Coliformes* (AL.COL)** *See* AL.COL.

alga *See* algae.

algae (alga) The simplest plants that contain chlorophyll and require sunlight. Algae vary from microscopic forms to giant seaweed. In drinking water sources, blooms of microscopic forms (phytoplankton) cause taste-and-odor problems.

algal assay An analytic procedure that employs specified nutrients and algal inoculums to identify which algal nutrient is limiting in water bodies.

algal bloom A sudden, dramatic growth of microscopic and macroscopic plant life, such as blue-green algae (cyanobacteria) or green algae, that develops in lakes and reservoirs.

algal harvesting A process for recovering algal cell mass from suspension.

algal inhibition The process of slowing down or stopping algal growth.

algal mat A surface layer of dead algae.

algal polysaccharide Within algal cells, a carbohydrate formed by a few hundred to a few thousand monosaccharides (i.e., starch and cellulose) linked together. Some polysaccharides are storage material, hydrolyzed as needed to provide sugar to the cell. Others serve as building material for cell structures.

algal toxin Toxic chemicals produced by single-celled algae, dinoflagellates, diatoms, and cyanobacteria. These toxins can affect fish and marine mammals, birds, and humans. Humans are exposed by eating contaminated seafood. The toxins affect the nervous system and liver in humans. Cyanobacteria can be found in drinking water. *See also* cyanobacterial toxin.

algicide Any substance or chemical specially formulated to kill or control algae.

algogenic organic matter Natural organic matter derived from algae. Algogenic organic matter can contribute to both the bacterial regrowth potential and the disinfection by-product formation potential of a water. *See also* algae; bacterial regrowth; disinfection by-product; disinfection by-product formation potential; natural organic matter.

ALGOL *See* algorithmic language.

algorithm An arrangement of logical steps to perform a certain operation within a computer program.

algorithmic language (ALGOL) A high-level programming language used to code mathematical problems.

aliphatic *See* aliphatic compound.

aliphatic aldehyde An organic compound in which the aldehyde group (HC=O) is connected to a

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branched or unbranched open chain of carbon atoms rather than a ring. Some aldehydes are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. *See also* disinfection by-product.

aliphatic compound An organic compound with carbon atoms arranged in a branched or unbranched open chain rather than a ring. If an aliphatic compound contains double bonds, it is said to be unsaturated; if not, it is saturated.

aliphatic hydroxy acid (R-COOH) An organic acid with carbon atoms arranged in open chains, branched or unbranched, rather than rings.

aliphatic-type polyamide membrane A type of synthetic organic membrane with amide-linked open chains of carbon atoms, usually manufactured as a thin film membrane composite flat sheet. The thin film composite type often has a polyamide barrier layer supported by a microporous substrate (e.g., polysulfone). Variations of the membrane types are commonly used for spiral-wound reverse osmosis. Typically these membranes exhibit good pH range tolerance but are intolerant to strong oxidants.

aliquot A representative portion of a sample, often an equally divided portion.

alizarin-visual test A laboratory procedure for determining the fluoride concentration in water.

alkali metals A class of soft metals in Group 1A of the periodic table with closely related outermost electron configurations that react rapidly with water, evolving hydrogen gas and forming an alkaline (basic) solution containing a hydroxide of the formula MOH, where M represents the metal lithium, sodium, potassium, rubidium, francium, or cesium.

alkaline *See* alkaline solution.

alkaline-earth metals Elements in Group 2A of the periodic table, including beryllium, magnesium, calcium, strontium, barium, and radium. Because the oxides of these elements form alkaline solutions when added to water, they are called alkaline-earth metals. Alchemists used *earth* to refer to all metal oxides. *See also* barium; beryllium; calcium; magnesium; periodic table; radium.

alkaline scale Scale composed of a carbonate or a hydroxide of an alkali metal, such as calcium carbonate and magnesium hydroxide. Scales dissolve under acidic conditions. *See also* scale.

alkaline soil Soil having a pH greater than 7.0.

alkaline solution A solution that contains significant numbers of hydroxide (OH^-) ions such that the pH is greater than 7.0. Such a solution is also called basic water.

alkaline water *See* alkaline solution.

alkalinity A measure of the capacity of a water to neutralize strong acid. In natural waters this capacity is usually attributable to bases such as bicarbonate (HCO_3^-), carbonate (CO_3^{2-}), and hydroxide (OH^-), and to a lesser extent silicates, borates, ammonia (NH_3), phosphates, and organic bases. It is expressed in milligrams of equivalent calcium carbonate per liter (mg $CaCO_3$/L).

alkalinity test One of several analytic methods used to determine the acid-neutralizing capacity of a sample. Typically, a water sample is titrated with a standard solution of acid to a specific end point. End points can be detected by titrating potentiometrically or to a color change with an indicator dye.

alkaloid A group of naturally occurring amines derived from plant sources. Because of their basic chemical properties, they are referred to as alkaloids. Nicotine, cocaine, and morphine are well-known alkaloids because of their poisonous or medicinal attributes. Many alkaloids are used as insecticides or pesticides. Studies have revealed the production of alkaloids by algae (cyanobacteria) blooms in water supply. Cyanobacterial toxins are listed on the Drinking Water Contaminant Candidate List. *See also* cyanobacteria; Drinking Water Contaminant Candidate List; pesticide.

alkane (C_iH_{2i+2}, where $i \geq 1$) An organic chemical in which the basic building group is ($–CH_2–$). It does not contain double bond (saturated) compounds.

alkene Hydrocarbons containing a carbon-carbon double bond. Because they have fewer hydrogens per carbon than related alkanes, they are also referred to as unsaturated hydrocarbons. *See also* alkane; hydrocarbon; unsaturated.

alkylbenzene sulfonate (ABS) ($R–C_6H_4SO_3^-$) A class of branched-chain sulfonate type of synthetic detergents. Usually the detergent is a dodecylbenzene ($C_{12}H_{25}C_6H_4SO_3–$) or tridecylbenzene sulfonate. In actuality, tridecylbenzenesulfonate is not a true compound but rather a mixture of C_{12} and C_{15} alkyl benzene sulfonates that approximates C_{13}. Since these detergents are difficult to break down by microorganisms, they have been replaced by linear alkyl sulfonates (LAS) detergents, which are biodegradable.

allele One of two copies of a genetic locus in a diploid organism. One copy exists on one chromosome of a pair, the other on the other chromosome. These are not necessarily identical because one is inherited from each parent. This is a property common to all chromosomes except the sex chromosomes. One allele, if expressed, is all that is required to express a particular characteristic if it is a dominant trait. Therefore, if damage is induced in one allele of a genetic locus, it

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does not necessarily produce a harmful effect (although it does increase the probability of certain types of health effects, such as cancer). However, mutation at both loci can result in serious health effects if the cell survives (i.e., if the effects are not lethal).

allergy A response to a chemical that is mediated through the immune system. A prior exposure is required to sensitize the individual. Such effects are generally produced in a relatively small number of individuals within a population. They can range from mild skin reactions or hay fever to severe and unpredictable, even life-threatening, reactions. These reactions are difficult to predict from animal studies.

alliance contracting A contract managed jointly by an owner and a preselected contractor who form a board to jointly manage a project with goals of eliminating change orders, integrating expertise of both parties, and avoiding duplication of resources.

alligator teeth V-notched weirs in a short (3–6 feet [1–2 meters]) U-shaped effluent structure for a sedimentation basin. Frequently these structures cover the entire end of the basin.

allochthonous Pertaining to turbidity-causing material that originates from a location different from its present location and is carried into a lake or other surface water. Such material includes humus, silt, organic detritus, colloidal matter, and plants and animals.

allochthonous bacteria Bacteria that are not indigenous to their present location but have migrated or been transported from their original habitat.

allochthonous natural organic matter Natural organic matter (e.g., humic acid, fulvic acid) that has been formed somewhere other than its present location and transported to its present location. *Compare with* autochthonous natural organic matter.

allowable depletion The amount of total water available to a plant that can be depleted from the soil in the active plant root zone before irrigation is required. It is measured as a percent of water.

alluvia *See* alluvial deposit.

alluvial Pertaining to soil materials deposited by running water.

alluvial aquifer A water-bearing geologic unit composed of material deposited by flowing rivers. An alluvial aquifer is usually a good source of easily exploited groundwater when the aquifer is adjacent to a flowing stream.

alluvial deposit Mud, sand, or gravel deposited by water flowing over land that is not usually submerged. Alluvial deposits may occur after a heavy rainstorm.

alluvial fan A landform created in relatively dry climates when large quantities of sediments are deposited to the dry valley floors by seasonal rivers draining nearby mountains. These landforms are often the only water-bearing unconsolidated deposits in these climates.

alluvial plain A plain formed by alluvial material eroded from areas of higher elevation.

alluvial river A river that has formed its channel by the process of aggradation. The sediment that it carries is similar to that in its bed and banks.

alluvial-slope spring A spring occurring on the lower slope of an alluvial cone at the point where the water table slope and surface gradient are equal. Such a spring is also called a border spring. *See also* boundary spring.

alluvial terrace A terrace, usually adjacent to a river valley, that was originally deposited by stream action and, in later geologic periods, was cut through by the stream and thus left at some distance above the streambed.

alluvium Sediments deposited by streams or running water. *See also* alluvial deposit.

alpha (α) particle A positively charged particle emitted by certain radioactive materials. It consists of two neutrons and two protons and is identical to the nucleus of a helium atom. It is the least penetrating of the three common forms of radiation—alpha (α), beta (β), and gamma (γ)—and is stopped by a sheet of paper. *See also* radiation; radionuclide.

alpha decay A radioactive process in which an alpha particle is emitted from the nucleus of an atom, decreasing the atomic number of that atom by two.

alphanumeric variable A variable, as found within a computer program, that includes alphabetical as well as numeric characters.

alpha value A commonly used variable name to indicate the level of statistical significance for a test of a hypothesis.

alphavirus A virus transmitted by arthropods such as mosquitoes that infect horses causing fever and swelling of the brain.

alternate method Any method of sampling and testing for an air or water pollutant that is not a reference or equivalent method but that has been demonstrated in specific cases—to the US Environmental Protection Agency's satisfaction—to produce results adequate for compliance monitoring.

alternate test procedure (ATP) *See* alternate method.

alternating copolymer A copolymer consisting of macromolecules comprising two types of monomers (building blocks) in alternating sequence. *See also* copolymer.

alternating current (AC) A periodic current for which the average value over a period is zero. AC is measured in amperes.

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A

alternating system A multiple-unit system that functions with one or more units in service and one or more on standby.

alternative disinfectant A disinfectant used in place of chlorine, typically to minimize the formation of chlorination disinfection by-products. Common alternative disinfectants include chloramines (NH_xCl_y, where x = 0–2, y = 1–3), chlorine dioxide (ClO_2), and ozone (O_3). *See also* chloramines; chlorine dioxide; ozone.

alternative dispute resolution A class of techniques designed to result in "win–win" resolutions to disputes. Techniques include facilitated discussion, interest-based bargaining, interest-based negotiation, mediation, conflict resolution, and arbitration.

alternative filtration techniques (AFT) Techniques or technologies for filtration that do not use granular media. Examples of alternative filtration techniques include cartridge filters, bag filters, and membrane filters.

Alternative Filtration Technology (AFT) Filtration technology that requires site-specific pilot testing and third-party verification of the removal capabilities of *Giardia*, *Cryptosporidium*, or both as preconditions for use in achieving compliance with the surface water treatment requirements.

alternative funding mechanism A method for funding a state or federal drinking water program with funds other than general tax revenue, such as operating fees, plan and specification reviews, and inspection fees.

alternative maximum contaminant level (AMCL) A limit proposed by US Environmental Protection Agency (USEPA) for radon in drinking water of 4,000 picocuries per liter. Under USEPA's proposed radon regulation (64 FR 59246), a water system may be allowed by its primacy agency to meet the AMCL, rather than the proposed radon maximum contaminant level of 300 picocuries per liter, if the primacy agency implements a multimedia mitigation program for controlling radon in indoor air.

alternative monitoring guidelines Authority granted under Section 1418 of the Safe Drinking Water Act to state primacy agencies that have a US Environmental Protection Agency–approved source water assessment program to adopt tailored alternative monitoring requirements for public water systems in the state as an alternative to monitoring requirements for chemical contaminants set in the applicable National Primary Drinking Water Regulations. Prior to the 1996 Amendment to the Safe Drinking Water Act, the guidelines were known as permanent monitoring relief.

alternative public–private partnership Various methods of contracting between the owner and contractor for a project with joint responsibilities and shared cost-saving efficiencies.

altitude valve A valve that automatically shuts off the flow into an elevated tank when the water level in the tank reaches a predetermined level. The valve automatically opens when the pressure in the distribution system drops to less than the pressure in the tank. An altitude valve is sometimes called an altitude-control valve.

ALU *See* arithmetic and logic unit.

alum ($Al_2(SO_4)_3 \cdot 14H_2O$) The common name for aluminum sulfate, a chemical used in the coagulation process to remove particles from water. *See also* aluminum sulfate; coagulation.

aluminosilicate An anion containing aluminum, silicon, and oxygen. It is commonly referred to as gel zeolite. *See also* gel zeolite; zeolite.

aluminum (Al) A metallic element. Aluminum is the most abundant metal in the earth's crust; it does not occur free in nature. Its presence in drinking water is regulated by the US Environmental Protection Agency as a secondary standard at a recommended level of 0.05 to 0.2 milligrams per liter.

aluminum chlorohydrate (ACH) A highly concentrated solution of polyaluminum hydroxychloride. It can be used as a primary coagulant for drinking water treatment and industrial water treatment. *See also* coagulant; polyaluminum hydroxychloride.

aluminum silicate *See* pumicite.

aluminum sulfate ($Al_2(SO_4)_3$) An inorganic compound commonly used as a coagulant in water treatment. It contains waters of hydration, $Al_2(SO_4)_3 \cdot XH_2O$ (where X is a variable number). Aluminum sulfate is often called alum.

alum sludge The material produced as a result of adding an alum-based coagulant to a raw water and by the subsequent coagulation and sedimentation processes. Alum sludge contains the hydrolyzed floc formed by alum's reaction with the raw water and the particulate matter removed by the process. *See also* alum; backwash.

alveolar (1) A small cavity or pit, such as a honey comb cell. (2) Pertaining to the tiny air sacs of the lungs.

Alzheimer's disease A brain disease of unknown origin that results in memory loss, among other symptoms.

AM *See* asset management.

amaranth Sulfonic acid-based purplish-red (blackcurrant) naphthylazo dye used as a chemical indicator, for example, in the experimental observation of chlorine decay.

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ambient Surrounding. For example, a test performed at ambient temperature would be performed at the temperature surrounding the apparatus, i.e., laboratory temperature if the equipment is in a laboratory.

ambient spore A spore found in nature; an indigenous endospore.

ambient temperature Temperature of the surrounding air (or other medium); for example, the temperature of a room where chemical-feeding equipment is installed.

ambient water quality standards Provisions of state or federal law set under the authority of the Clean Water Act that consist of a designated use or uses for the waters within the state or within the United States and water quality criteria for these waters based on the designated use. Ambient water quality standards protect public health and welfare, enhance the quality of surface waters, and serve the purposes of the Clean Water Act.

AMCL *See* alternative maximum contaminant level.

amebiasis *See* waterborne disease.

ameboflagellate Amoeba that has a flagellate stage in addition to the trophozoite and cyst stages.

ameboid Shapeless or shape-changing.

American Academy of Environmental Engineers (AAEE) A professional association that encourages excellence in engineering and provides certification for qualified environmental engineers.

American Association of Engineering Societies (AAES) A professional organization founded in 1980 as the successor to the Engineers Joint Council to foster cooperation among engineering societies. It is composed of a number of member societies.

American Chemical Society (ACS) A professional society for chemists and chemical engineers.

American Gas Association (AGA) A professional organization of natural gas producers.

American Industrial Hygiene Association (AIHA) An association the purpose of which is to promote the field of industrial hygiene, to provide education and training, and to represent the interests of industrial hygienists and those they serve.

American Institute of Chemical Engineers (AIChE) A professional organization of chemical engineers.

American Membrane Technology Association (AMTA) A nonprofit organization the stated mission of which is to promote, advocate, and advance the understanding and application of membrane technology to create safe, affordable, and reliable water supplies and to treat municipal, industrial, agricultural, and waste waters for beneficial use. Formerly it was named the National Water Supply Improvement Association (NWSIA) and the Water Supply Improvement Association (WSIA). It is an affiliate of the International Desalination Association. *See also* International Desalination Association.

American National Standards Institute (ANSI) A nonprofit organization involved in voluntary consensus standards development for products, services, processes, systems, and personnel in the United States. The organization also coordinates US standards with international standards so that American products can be used worldwide. ANSI uses a process of accrediting the procedures of standards-developing organizations. ANSI accreditation signifies that the procedures used by standards-setting organizations meet the institute's requirements for openness, balance, consensus, and due process.

American Public Health Association (APHA) An association representing the variety of disciplines in the public health profession.

American Public Works Association (APWA) A professional organization the members of which are interested in public works, drinking water, wastewater, electricity, gas, storm flow, and the like.

American Rule A groundwater ownership doctrine that states that the landowner has the right to use only a reasonable amount of groundwater.

American Society for Testing and Materials (ASTM) An organization founded in 1898, now known as ASTM International. *See also* ASTM International.

American Society of Civil Engineers (ASCE) A professional organization of engineers interested in the practice of civil and environmental engineering.

American Society of Mechanical Engineers (ASME) A professional association representing mechanical engineers.

American Society of Safety Engineers (ASSE) A group of safety professionals dedicated to advancing the interests of safety professionals and fostering the well-being and professional development of its members.

American Standard Code for Information Interchange (ASCII) A code established by the American National Standards Institute that assigns codes to all standard keyboard characters to provide compatibility for data communications.

American Standard fittings The standardized types and dimensions of the various malleable iron, cast-iron, steel, or other metal pipe fittings as set forth in standards published by the American National Standards Institute.

American Water Resources Association (AWRA) An organization dedicated to the advancement of interdisciplinary water resources research, planning, management, development, and education.

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A

American Water Works Association (AWWA) An international nonprofit scientific, technical, and educational organization, founded in 1881. The American Water Works Association is the largest organization of water professionals in the world. The association provides knowledge, information, and advocacy to improve the quality and supply of water in North America and beyond. AWWA advances public health, safety, and welfare by uniting the efforts of the full spectrum of the water community. AWWA is the American National Standards Institute–accredited standard-setting organization for the water industry. Its Web site is www.awwa.org. *See also* AWWA standard.

American Water Works Association Research Foundation (AwwaRF) Former name for the Water Research Foundation. *See also* Water Research Foundation.

Ames test A test for mutagenic activity using a series of genetically engineered strains of *Salmonella*. It is frequently used in combination with drug-metabolizing enzymes isolated from rodent livers, usually in the form of a supernatant liquor from a $9{,}000 \times g$ centrifugation of liver homogenates (the so-called S9 fraction). This test is most frequently employed as a prescreen for potential carcinogenic activity. It is also utilized to determine whether a chemical that has been shown to induce cancer may be acting through a genotoxic mechanism. *See also* carcinogenesis bioassay.

AM/FM/GIS *See* automated mapping/facilities management/geographic information system.

AM/FM system *See* automated mapping/facilities management system.

amicus curiae A person who is not a party to a lawsuit but who petitions the court or is requested by the court to file a brief in the action because that person has a strong interest in the subject matter.

amine ($R_{3-x}NH_x$, where x = 0, 1, or 2) Any of a class of organic compounds of nitrogen that may be considered as derived from ammonia (NH_3) by replacing one or more of the hydrogen atoms with alkyl (C_nH_{2n+1}) groups. The amine is primary ($R\text{-}NH_2$), secondary ($R_1\text{-}NH\text{-}R_2$), or tertiary ($R_1\text{-}N(R_2)\text{-}R_3$) depending on whether one, two, or three of the hydrogen atoms are replaced, respectively. *See also* alkane; organic compound.

amine-based polyectrolyte A polymer each monomer of which contains a positively charged quaternary amine. The cationic polymers could be used as primary coagulants or flocculants. *See also* coagulant; polymer.

amine-based polymers Treatment chemicals in the polymer family manufactured using and containing chemicals from the nitrogen-based amine family. *See also* polymer.

amino acid An important class of organic compounds that form building blocks of proteins. The 20 standard (alpha) amino acids have the general formula $R\text{-}NH_2$.

aminolevulinic acid (ALA) ($NH_2\text{-}CH_2\text{-}CO\text{-}CH_2\text{-}CH_2\text{-}COOH$) An amino acid precursor of heme proteins with the chemical name 5-amino-4-oxopentanoic acid. Heme is the part of certain proteins that interacts with oxygen (e.g., hemoglobin and cytochromes). It is used as a biomarker, most often for lead exposure.

aminolevulinic acid dehydrase (ALAD) The enzyme that catalyzes the conversion of aminolevulinic acid to porphobilinogen, an intermediate in the synthesis of heme. It is inhibited by lead. It is also called a dehydratase.

ammeter An instrument for measuring amperes (electrical current).

ammonia (NH_3) An inorganic gas commonly detected in wastewater. Ammonia may be present in drinking water that has been chloraminated, as well as in source waters.

ammonia nitrogen (NH_3-N) A common way to report a concentration of ammonia (expressed as nitrogen). The concentration of ammonia multiplied by $^{17}/_{14}$ yields the concentration of ammonia nitrogen. Ammonia nitrogen is sometimes called ammonia as nitrogen.

ammonia-oxidizing bacteria (AOB) The bacteria responsible for the oxidation of ammonia (NH_3) to nitrite and then to nitrate. The genus *Nitrosomonas* is an example of AOB. These organisms are important in situations in which combined chlorine (chloramines) is used as a residual disinfectant in a distribution system. The bacteria can produce disinfectant-demanding end products that lower the concentration of the chloramine residual. *See also* nitrifying bacteria; *Nitrobacter; Nitrosomonas.*

ammoniator An apparatus used for applying ammonia (NH_3) or ammonium (NH_4^+) compounds to water.

ammonium (NH_4^+) One form of nitrogen usable by plants.

ammonium hydroxide (NH_4OH) A strongly basic inorganic solution formed when ammonia (NH_3) dissolves in water. It is often used as a source of ammonia in the formation of chloramines.

amoeba A single-celled protozoan that is widely found in fresh water and salt water. Some types of amoeba cause diseases such as amoebic dysentery. *See also* protozoa.

amoebal pathogen Any amoebal protozoan that can cause infection and illness in a host species or an accidental host. Such pathogens may be parasitic (require a host species to complete their life cycle) or

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free-living (do not require a host species to complete their life cycle).

amoebic (1) Caused by an amoeba, as in ameobic dysentery. (2) Pathogens pertaining to or resembling amoebae.

amorphous Noncrystalline; having no ordered molecular structure.

amortization (1) The gradual reduction, redemption, or liquidation of the balance of an account according to a specified schedule of times and amounts. (2) A provision for the extinguishment of a debt by means of a sinking fund.

amperage The strength of an electric current, measured in amperes (coulombs per second); the amount of electric current flow, analogous to the flow of water in gallons per minute or liters per second.

ampere (A) *See in the Units of Measure section.*

ampere-hour (A·h) *See in the Units of Measure section.*

amperometric Relating to or being a chemical titration in which the measurement of the electric current flowing under an applied potential difference between two electrodes in a solution is used for detecting the end point.

amperometric methods Any of the analytical methods based on an electrochemical neutralization reaction of species in solution. Electric current is measured as it passes through a polarography cell. The most common example in water analysis is the determination of chlorine residual by amperometric titration. In this case, chlorine is an oxidizing species that is neutralized with a reducing agent, such as phenylarsene oxide (C_6H_5AsO).

amperometric titration Volumetric analysis in which the end point is based on the potential–current behavior of an electrode in solution. A common example is the determination of chlorine residual.

amperometric titrator A laboratory analytic device that is used for the determination of anions in water including chlorine, chloramine, chlorine dioxide, and iodine.

amphoteric Pertaining to a compound that has the ability to act as either an acid or a base. Amino acids are examples of such compounds.

ampicillin-dextrin agar A medium specified in US Environmental Protection Agency Method 1605 to isolate *Aeromonas* spp. in finished water. The agar is supplemented with the antibiotic vancomycin.

amplification The production of an output of greater magnitude than the input.

AMR *See* automated meter reading.

AMSL *See* above mean sea level.

AM system *See* automated mapping system.

AMTA *See* American Membrane Technology Association.

amu *See* atomic mass unit *in the Units of Measure section.*

AMW *See* apparent molecular weight.

AMWA *See* Association of Metropolitan Water Agencies.

Anabaena A genus of filamentous cyanobacteria (formerly blue-green algae) characterized as resembling a string of beads. Various species in this genus are common to lakes and ponds. Dense blooms of these organisms may occur during the spring-to-fall period, contributing to taste-and-odor problems in lakes and reservoirs used for water supply.

Anabaenopsis A type of cyanobacteria responsible for algae blooms associated with algal toxins that may cause hepatotoxicity.

anadromous Pertaining to migrating fish growing in the sea and returning to freshwater streams to spawn.

anaerobe *See* anaerobic.

anaerobic (1) In reference to microorganisms, pertaining to organisms that can grow in the absence of oxygen (anaerobes). (2) In reference to the environment, pertaining to the condition in which oxygen is absent or greatly reduced in concentration.

anaerobic bacterial spore Highly resistant endospore formed when conditions are unfavorable for continued growth of specific anaerobic bacteria (i.e., *Clostridium*). It is a complex multilayered structure containing peptidoglycan within the spore coat and calcium dipicolinate within the core. Anaerobic bacterial spores are capable of generating viable vegetative cells when conditions are favorable.

anaerobic condition An environmental condition in which oxygen is not available as a terminal electron acceptor. Under such a condition, compounds such as iron, manganese, and sulfur are reduced to dissolved constituents that must be removed in the treatment process.

anaerobic organism *See* anaerobic.

analog (analogue) (1) Pertaining to a medium or mode in which data are represented by continuously variable quantities such as amplitude, frequency, shape, or position. Hard copy or screen displays of maps, drawings, records, and photographs are analog images. In analog phone communications, voices are transmitted as an electrical signal that continuously varies in frequency and amplitude. (2) Pertaining to the readout of an instrument by a pointer (or other indicating means) against a dial or scale. *Contrast with* digital. (3) In chemistry, a structural derivative of a compound where one atom is replaced with another atom or with a functional group.

analog controller A device used for proportion–integral–derivative deviation control. The device operates on analog values (voltages, currents, or air pressures).

anal–oral route of exposure *See* fecal–oral transmission.

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A

analysis (1) An examination of a sample for its microbiological or chemical constituents. (2) An examination of data, fundamental principles, or operations in whole or in parts to determine their nature, proportion, functions, and interrelationships.

analysis of variance (ANOVA) A commonly used statistical procedure to compare the means of several normally distributed data sets to test the hypothesis that the data sets are statistically similar.

analyte The substance for which an analysis is performed. For example, if an analysis for the concentration of calcium in water was performed, calcium would be the analyte.

analytical method An analysis for which the description is sufficiently detailed to be set up in a laboratory. This type of method is less detailed than a standard operating procedure. *Standard Methods for the Examination of Water and Wastewater* is commonly used as a reference for analytical methods in drinking water applications.

analytical profile index (API) A commonly used kit containing multicompartmentalized chambers, with each performing a separate biochemical test. It is used for the identification of bacterial species.

analytic balance A sensitive balance (device for weighing substances) used to make precise weight measurements.

analytic epidemiologic study An epidemiologic study that investigates the possible causal association between the disease or health status of individuals within a group. In contrast to ecologic studies, analytic studies obtain information about each individual's disease status, his or her exposures to possible risk factors and confounding variables, and other individual demographic characteristics. *See also* case-control epidemiologic study; cohort epidemiologic study; ecologic epidemiologic study.

analytic grade A characteristic of a chemical indicating a level of purity high enough to permit its use in chemical analysis. *See also* reagent grade water.

analytic standard A substance of known purity and concentration used to calibrate an analytic method.

analytic triangulation A process used in photogrammetric mapping that establishes the mathematical relationships among control points and adjusts them as a network of location values. Analytical triangulation involves a computer-aided extension of the control points in order to mathematically densify the control network and provide a positionally accurate structure for the photographs. *See also* control point.

analyzer A device that conducts periodic or continuous measurements of some factor such as chlorine or fluoride concentration or turbidity. Analyzers operate by one of several methods, including photocells, conductivity, or complex instrumentation.

anaphylaxis An acute allergic response; also referred to as immediate hypersensitivity. If severe enough, such a reaction can be life-threatening.

anatase titanium dioxide (TiO_2) The brown, dark-blue, or black tetragonal crystalline form of titanium dioxide. It is commonly used in paint, crayons, plastics, paper, and synthetic fibers. Many studies have reported the use of titanium dioxide as a photocatalyst for the decomposition of organic compounds, especially natural organic matter in water. *See also* heterogeneous advanced oxidation process.

anatoxin-a A neurotoxin synthesized by several blue-green algae including algae from the genuses *Anabaena* and *Oscillatoria*, which are common constituents of pond scum. Although this toxin has a limited persistence in reservoir waters, levels can be high following algal blooms when toxin is released from large numbers of senescent cells. Domestic and livestock animals drinking water heavily contaminated by these organisms have died as a result of ingesting the toxin. Onset of symptoms is swift (within 5 minutes) and include limp paralysis leading to dyspnea, cyanosis, and cardiac arrhythmia leading to death. Rapid and sensitive assays are available for use in water monitoring.

anchorage A large and heavy block of material installed along a pipe for the purpose of resisting forces caused by the weight of the pipeline, the change in direction of the fluid flowing therein, or expansion or contraction in the pipeline caused by changes in temperature. Anchorage is also called an anchor or anchor block. When resisting forces are caused by change of direction, anchorage is usually called a thrust block.

anchor ice Ice formed below the surface of a stream or other body of water, on the bed, or on a submerged body or structure.

ancillary charge A separate charge for ancillary services that is not included in costs for general water service. Often in providing water service, the utility must perform these ancillary services, which often benefit only the individual customer using the services and have no systemwide benefit.

anemia A condition in which the red blood cell concentrations in blood are reduced. Anemias can arise from a variety of causes including nutritional deficiencies (e.g., lack of iron) or the effects of toxic chemicals. The most serious type of chemically induced anemia is referred to as aplastic anemia, in which the bone marrow's ability to synthesize red blood cells is obliterated. Hemolytic anemia arises

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from increased destruction of existing red blood cells by a process referred to as hemolysis.

anemometer An instrument for measuring the force or velocity of wind; a wind gauge.

aneuploidy Loss of a chromosome following cell division.

angiosarcoma A malignant tumor formed from cells of blood vessels. It is frequently referred to by the organ in which it occurs (e.g., hepatic or liver angiosarcoma). However, an angiosarcoma is a tumor of the blood vessels, not of the tissue in which it is found.

angle gate valve *See* angle valve.

angle of repose The maximum angle or slope from the horizontal that a given loose or granular material, such as sand, can maintain without caving in or sliding. The angle of repose can vary considerably with changes in moisture content.

angle valve A 90° service fitting with a valve incorporated, used in setting water meters to allow a cutoff and direction change from vertical to horizontal.

Angstrom (Å) *See in the Units of Measure section.*

angular acceleration The rate of change in angular velocity, in degrees (or radians) per second squared.

angular frequency (ω) For a periodic function, the total angle per unit time.

$$\omega = 2\pi f$$

Where:

f = the function's frequency, in hertz

Angular frequency is measured in units of degrees (or radians) per second. For example, if a periodic function had a frequency of 10 hertz, its angular frequency would be 3,600 degrees/second (62.83 radians/second).

angular velocity The rate of circular movement, in degrees (or radians per second).

animal bioassay *See* carcinogenesis bioassay.

animal infectivity The exposure of animals, generally mice, to a particular biological insult (bacterial, viral, protozoan) in an effort to produce a recognizable disease (i.e., histological changes, morbidity, mortality).

animal study An investigation using animals as surrogates for humans, on the expectation that results in animals are pertinent to humans.

anion (X^{-c}, where $c \geq 1$) A negatively charged atom or molecule that forms when an atom acquires one or more extra electrons. Anions may be present in solids and in solution in water or other solvents.

anion exchange A process in which anions are removed from a liquid phase by contacting a synthetic, porous medium or resin that is coated with other anions. The anions on the medium are exchanged for the anions in solution. When the medium is depleted of the exchanging anions, it is backwashed with a concentrated solution to restore the bed with the exchange anions and to flush the removed anions. For removal, the chemical formula follows (where R represents the resin):

$$\overline{R_4N^+OH^-} + NaNO_3 \rightarrow \overline{R_4N^+NO_3} + NaOH$$

For regeneration, the chemical formula is as follows:

$$\overline{R_4N^+NO_3} + NaOH \text{ (high concentration)} \rightarrow \overline{R_4N^+OH^-} + NaNO_3$$

See also anion; ion exchange.

anionic Having a negative ionic charge.

anionic polyelectrolyte *See* anionic polymer.

anionic polymer A negatively charged polymeric compound used to assist in removing particles from water. Anionic polymers are most typically used as flocculant aids or for sludge conditioning; they bridge floc particles and thereby generate larger particles that can be removed by sedimentation, filtration, or both. *See also* flocculation; polymer.

anion membrane An electrodialysis membrane that allows the passage of cations (but not anions) and is practically impermeable to water under typical electrolysis system working conditions. An anion membrane is also called an anion transfer membrane.

anion suppressor device *See* suppressor device.

anisole A name for methoxybenzene, which is a colorless liquid with aromatic odor. Anisole is also a methyl ester of phenol. *See also* methyl ester.

anisotropic Pertaining to crystals for which the index of refraction varies with the direction of the incident light. This is true of most crystals, e.g., it is true of calcite (Iceland spar). It is not true of isometric (cubic) crystals, which are isotropic. *See also* isotropic.

anisotropic hydraulic conductivity Within a permeable medium, such as an aquifer, hydraulic conductivity that is dependent on the direction of measurement. For example, in many soils with high percentages of clay, the horizontal hydraulic conductivities are significantly greater than vertical hydraulic conductivities, and flow velocities are greater horizontally than vertically.

anisotropic membrane A membrane with nonuniform structure in cross section. Typically, the support substructure has pores much larger than the barrier layer.

anisotropy A condition in which one or more of the hydraulic properties of a porous medium vary according to the direction of measurement. *See also* anisotropic; hydraulic conductivity.

ANN (artificial neural network) *See under* neural network model.

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anneal To reassociate or join together deoxyribonucleic acid or ribonucleic acid by base-pairing two single-stranded sequences.

annexation The process of extending the service area of a water district or municipality to adjacent property owner(s) or a small water utility in order to provide service.

annotation The alphanumeric text or labels plotted graphically on a map, such as street names, place names, identification numbers, and dimensions.

annual average daily flow (AADF) The average of daily flows for a 12-month period. This value may also be determined by dividing the total volume of flow for the year by 365, the number of days in a year (AADF = annual flow/365).

annual flood The maximum 24-hour average rate of flow occurring in a stream or river during any period of 12 consecutive months. Commonly, the 12-month period is considered to run from October 1 of one year through September 30 of the following year.

annual load factor The load factor taken over an entire year. *See also* load factor.

annual operating revenue requirement The total receipts from water system operations required on an annual basis adequate to meet all expenses, capital needs, debt service, and reserve requirements of the utility. It is typically used to determine adequacy of current rates to meet the needs of the utility.

annual planning cycle The development by a utility of a capital and operating budget, projection of favorable and unfavorable variables that may affect its performance, allocation of resources including employees, and so on, on a yearly basis.

annual variation The general pattern of a particular parameter throughout the year, obtained by plotting the normal values of the parameter for each month and connecting the points by a smooth curve.

annular reactor A small treatability reactor used to simulate the impact of biological treatment on biological regrowth in the distribution system. Treated water flows through cylindrical reactors with a volume of approximately 1 liter (0.25 gallons) that are stirred, creating internal liquid circulation through four draft tubes in the reactor. Hydraulic conditions in the draft tubes can be varied by changing the rotor speed, thereby simulating various conditions in this simulated distribution system.

annular space The space between the outside of a well casing and the drilled hole.

annulus (1) The space between two concentric circles on a plane. (2) The space between two cylinders of different diameters centered on the same axis.

anode (1) In electrochemical or metal corrosion reactions, the site at which electrons are removed (flowing to the cathode) and dissolution of the metal occurs (releasing metal ions) as a result of the oxidation half-reaction of ions or molecules at the site. The anode is positively charged because of the movement of electrons away from it. (2) A positively charged electrode of an electrolysis cell, attracting negatively charged ions. Electrons flow away from the anode and negatively charged ions are oxidized. *See also* cathode.

anodic Pertaining to a site on a metal surface where the oxidation half-reaction occurs, in which metal ions tend to be released and dissolve and electrons tend to flow away to the cathode.

anodic stripping voltammetry (ASV) An electrochemical technique used in the analysis of metals. Metals are plated onto an electrode and then oxidized back into solution at a characteristic voltage. The current generated is a function of the concentration. This technique can also be used to speciate metals.

anolyte liquor The portion of an aqueous electrolyte in the vicinity of the anode. In a divided cell, the portion of the electrolyte that is on the anode side of the diaphragm.

anomaly A deviation from a norm for which an explanation is not apparent on the basis of available data.

anomorphic zone The zone of rock flowage, especially characterized by silicatization involving decarbonation, dehydration, and deoxidation. *See also* aeration zone; katamorphic zone; weathering zone.

ANOVA *See* analysis of variance.

anoxia A condition in which the blood oxygen level within the body is less than normal. It may be caused by lowered oxygen content of the air, obstruction of the respiratory tract, depressed breathing rate, chemically induced interference with oxygen (O_2) transport (e.g., carbon monoxide, CO), chemically induced interference with oxygen utilization (e.g., cyanide, CN^-), or interference with blood flow to a particular part of the body.

anoxic Lacking in oxygen. This term is synonymous with anaerobic.

anoxic condition A state in which free dissolved oxygen is absent but in which oxygen is available as a terminal electron acceptor through compounds such as nitrate (NO_3^-) or sulfate (SO_4^{2-}).

ANPR *See* Advanced Notice of Proposed Rulemaking.

ANSI *See* American National Standards Institute.

ANSI/NSF 61 Certification The process of evaluating and testing an indirect additive to determine if it meets the requirements of ANSI/NSF standard 61 of the American National Standards Institute/NSF International (the standard generally considered to be the guideline for drinking water purity in the United States). ANSI/NSF 61, Drinking Water System Components—Health Effects, was established in 1988 to

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set safety standards for drinking water system components. The standard measures contaminants that may leach or migrate from drinking water system components, requiring contaminants to be at safe levels that will not cause adverse health effects.

antagonism In toxicology, a circumstance where exposure to one chemical blocks the effects of another chemical. This term is generally not useful unless the basis of the interaction is known. Antagonism is produced in several ways. A chemical can influence the distribution of a second chemical by interfering with transport processes. An effect can be elicited by one chemical that is the physiological opposite of the effect produced by a second chemical. A chemical can directly interfere with the binding of a second chemical to a receptor site on a protein that is responsible for producing the effect.

antecedent moisture The soil moisture present before a particular precipitation event. It is also called the antecedent-precipitation index.

anthracite *See* anthracite coal.

anthracite coal A particulate form of coal that is used in granular media filters to remove particles from water. Anthracite coal is typically used in dual-media filters in combination with sand. *See also* anthracite coal–sand filter; dual-media filter.

anthracite coal–sand filter A granular filter in which a layer of crushed anthracite coal of a specified size is placed over a layer of sand of a specified size. Such a filter is sometimes called a dual-media filter. These filters can often perform satisfactorily when operated at higher filtration rates than all-sand filters. *See also* dual-media filter.

anthrax A very infectious disease of animals, such as sheep or cattle, that is caused by the bacterium *Bacillus anthracis.*It may be transmitted to humans from animals but not from human to human and is a possible bioterrorism agent. *See also Bacillus anthracis.*

anthropogenic Pertaining to or involving the impact of humans. *See also* xenobiotic.

anthropogenic virus A virus of human origin.

antibacksliding provision A provision of Safe Drinking Water Act, Sec. 1412(b)(9), requiring that any revision of the National Primary Drinking Water Regulations (NPDWRs) must maintain or provide for greater protection of the health of persons.

antibiosis An antagonistic action of one or more microorganisms to other organisms.

antibiotic A chemotherapeutic chemical compound that is produced by the metabolism of a living organism. Fungi, actinomycetes, and molds have been prolific sources of antibiotics.

antibiotic resistance A characteristic of a microorganism that allows it to neutralize the effect of an antibiotic compound. Antibiotic resistance in bacteria is mediated by (1) genes present in the bacterial genome or (2) extrachromosomal genetic elements (R plasmids) in the cytoplasm that are replicable and transferable (through a process called resistance gene transfer) to other bacteria. When an organism is resistant to two or more antibiotics, it is said to be multiple antibiotic resistant.

antibody A protein in mammals induced by the presence of a foreign substance called an antigen. The specificity of the antigen–antibody binding mechanism makes antibodies useful for identification of microorganisms.

antichlors Reagents, such as sulfur dioxide (SO_2), sodium bisulfite ($NaHSO_3$), and sodium thiosulfate ($NaS_2O_3 \cdot 5H_2O$), which can be used to remove excess chlorine residuals from water by conversion to an inert salt.

anticholinergic A drug or toxin that blocks the effects of acetylcholine, a chemical that is responsible for communication between nerve cells and between nerve cells and other cells within the body.

anticholinesterase A drug or chemical (usually either an organophosphorus or carbamate pesticide) that acts by inhibiting the enzyme that destroys acetylcholine. Acetylcholine serves as a chemical signal between nerves and muscles. This signal cannot be terminated rapidly enough without the activity of this enzyme. A high degree of inhibition is fatal.

anticipated yield The predicted yield of a production well based on an aquifer pumping test but neglecting inefficiencies that will arise after construction and operation.

anticlinal spring A contact spring occurring along the surface outcrop of an anticline (a folded geologic structure where the layer of interest is hill shaped) from a pervious stratum overlying a less pervious stratum.

anticorrosion chemical A chemical added to water that has the ability to reduce the release of metal ions such as lead and copper from distribution system materials, either by preventing or mitigating electrochemical corrosion or by reducing the solubility of the metals of interest.

anticorrosion treatment Treatment to reduce or eliminate the corrosion-producing or aggressive qualities of a water.

anti-*Cryptosporidium* antibodies Antibodies that react with *Cryptosporidium* antigens.

antigen A chemical, usually either a protein or a small molecule in combination with a protein, that stimulates the development of antibodies. Chemicals that covalently bind with proteins can often serve as antigens. An antigen can set up a sensitization reaction

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on subsequent exposures to the chemicals that can result in toxicity that is mediated through the immune system.

antigen capture A system using support-bound antibodies to specifically bind and capture microorganisms, such as hepatitis A virus, from an environmental sample. The system is able to recover small numbers of microorganisms.

antigenic determinant A specific site on an antigen where an antibody binds. *See also* antibody; antigen.

antihelminthic Acting to expel or destroy intestinal worms.

antimetabolite A chemical or drug that closely resembles a normal metabolite structurally. These chemicals exert an effect by blocking reactions that the normal metabolite will participate in, or they may be metabolized to a product that cannot be effectively utilized by the organism.

antimicrobial Capable of destroying or suppressing the growth of microorganisms.

antimony A naturally occurring trivalent or pentavalent metalloid element used as a constituent of metal in the manufacture of flame retardants, ceramics, glass, pesticides, and tin–antimony solder, as well as in medicine. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.006 milligrams per liter.

antioxidant A chemical that is more easily oxidized than the material being protected. Classic examples in the biology of nutrition are vitamin E and ascorbic acid. These vitamins, by oxidizing easily, prevent oxidative damage within the body, although in certain combinations with metals ascorbic acid can act to generate oxygen radicals. Also, a variety of synthetic antioxidants are used as food additives, such as butylated hydroxytoluene (commonly known as BHT).

antiscalant A chemical that inhibits or delays precipitation and subsequent scale formation of sparingly soluble inorganic salts and silica.

antisense technology New technology for developing drugs to specifically treat any disease or disorder related to abnormal gene expression, such as cancer.

antisiphon device *See* vacuum breaker.

antitelescoping device A plastic cover, resembling a wheel with spokes, attached to the ends of a spiral-wound cartridge or element used to prevent movement of the membrane leaves in the feed flow direction because of high feed flow rates. *See also* membrane element; telescoping.

antithyroid Pertaining to a chemical effect that decreases the normal function of the thyroid gland. A wide variety of mechanisms can result, ranging from interference with the normal utilization of iodine to the synthesis and release of thyroid hormones.

AOB *See* ammonia-oxidizing bacteria.

AOC *See* assimilable organic carbon.

AODC *See* acridine orange direct count.

AOP *See* advanced oxidation process.

AOX *See under* carbon absorbable organic halogen.

APA *See* Administrative Procedure Act.

APD *See* apparent particle diameter.

aperiodic Not occurring regularly, but rather taking place at unequal intervals of time.

APHA *See* American Public Health Association.

Aphanizomenon A genus of cyanobacteria associated with algal blooms. It is capable of producing neurotoxins.

aphotic Lacking light, as in the deeper part of a reservoir.

API *See* analytical profile index.

Apicomplexa Large phylum of parasitic protozoans with more than 4,000 species. They are unicellular and spore-forming, and may be relatively benign or cause serious illnesses, including cryptosporidiosis, malaria, and toxoplasmosis. Most apicomplexans have complex life cycles that include both asexual and sexual reproduction. The basic life cycle begins when an infective stage, or sporozoite, enters a host cell, and divides repeatedly to form numerous merozoites that can infect additional organisms. Some of the merozoites can eventually transform into sexually reproductive cells, or gamonts. Gamonts can then give rise to new cysts. Formerly, most of these protozoan protists were classified as Sporozoa, but the Sporozoa class is no longer used by taxonomists.

aplastic anemia *See* anemia.

aplysiatoxin A marine algal toxin found in *Aplysia,* a marine mollusk. This toxin is produced in *Alpysia* that have eaten the seaweed, *Lyngbya.* The toxin causes dermal irritation.

apoptosis An active process of inducing cell death. It is also referred to as programmed cell death. Most organs (except the brain) have a continual process for replacing damaged cells. Death arises not from the aging of the cell per se but rather through the recognition of specific types of damage and the generation of specific cellular signals that cause the cell to die. A similar process occurs during development of tissues when excess cells have been generated and need to be disposed of in the normal maturation process. Some chemicals that induce certain adverse effects (cancer and developmental effects, in particular) may act by suppressing apoptosis, allowing a damaged cell to remain alive and divide. Such cells could probably contain mutations that lead to malignancy. *See also* necrosis.

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apparent cohesion Cohesion of moist soils caused by surface tension in capillary interstices. It disappears on immersion of the soil.

apparent color The color caused by substances in solution as well as that caused by suspended matter. Apparent color is determined in an original sample without filtration or centrifugation. In some waters, colloidal or suspended material may contribute to color. In such cases both true color and apparent color should be determined. *See also* true color.

apparent density (1) In soil mechanics, the mass per unit volume of oven-dried soil, pore space included. (2) The mass per unit volume of activated carbon.

apparent elastic limit *See* proportional limit.

apparent groundwater velocity The apparent distance covered by groundwater per unit time, computed by dividing the volume of flowing water per unit time by the cross-sectional area taken perpendicular to the streamlines. It is also called the discharge velocity.

apparent losses Losses attributed to inaccuracies associated with customer metering, data handling error, plus unauthorized consumption (theft or illegal use of water). Apparent losses represent "paper" losses that result in uncaptured revenue for the water utility and distortion of customer consumption data. Reducing apparent losses will not reduce real (physical) water losses but will recover lost revenue and improve consumption data integrity. *See also* water audit; water balance.

apparent molecular weight (AMW) A measure of molecular weight based on the size of the molecule. Filters with pores of different sizes are calibrated with proteins of known molecular weight. Test molecules that pass through the same filter are assumed to have the same molecular weight as the calibration protein. The unit of this measure is the dalton.

apparent particle diameter (APD) The opening in a screen mesh used for sizing granular particles. The units of measure are millimeters.

apparent power ($|S|$) The magnitude of the complex power:

$$|S| = \sqrt{(P^2 + Q^2)}$$

Where:

P = the active power
Q = the reactive power

For a sinusoidal single-phase circuit, the apparent power is given by

$$|S| = V \times I$$

Where:

V = root mean square (rms) voltage, in volts
I = rms current, in amperes

For a sinusoidal three-phase circuit that is symmetrical and balanced, the apparent power is given by

$$|S| = \sqrt{3} \times V \times I$$

Where:

V = the line-to-line rms voltage, in volts
I = the rms current, in amperes

Apparent power is a scalar quantity and is customarily measured in units of volt-amperes.

apparent specific gravity The ratio of the mass of a unit volume of oven-dried soil to the mass of an equal volume of water under standard conditions. The term may be applied to either oven-dried undisturbed field samples or to samples manipulated in the laboratory. Referring to treatment by granular activated carbon (GAC) adsorption, the apparent specific gravity of the GAC is used to indicate the success of the regeneration process. *See also* apparent density.

apparent volume of distribution (V) The dose or concentration in a particular body fluid (usually blood) extrapolated to the time a drug was administered. In pharmacokinetics (or toxicokinetics), this quantity is used to describe the distribution of a drug within the body in abstract terms. A highly lipid-soluble chemical will have a very large volume of distribution (one that can actually be much greater than the total body volume) because the chemical will be concentrated in the fat, leaving a low concentration in the blood. This relationship is used in medicine primarily to calculate the dose needed to achieve a certain blood level in the therapeutic range. This concept is inherent in all the simple compartmental models used in pharmacokinetics.

application rate The rate of delivery by an irrigation circuit, in inches or centimeters for sprinkler irrigation and in gallons or liters for drip irrigation.

application software Software developed for a specific, practical application. Examples are word processing and database management.

applications program *See* application software.

applied climatology The study of weather and its effects on human activities. *See also* climatology.

applied pressure The feedwater hydraulic pressure applied to a process. In pressure-driven membrane separation, applied pressure is equal to the hydraulic feedwater pressure minus the permeate pressure.

applied water Water applied by irrigation, usually expressed as a depth of water in inches or feet (centimeters or meters).

appraisal The value placed on a firm's assets by an estimator or assessor considering age, wear, condition, obsolescence, and marketability, usually to establish

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a value for the purpose of sale or taxation; the act of appraising the value of assets.

appraisal inventory A detailed list of the individual items constituting an assembled property, with or without unit costs or prices applied.

appreciation The increase in monetary value that is attributed to assets (especially land) from one period to the next, resulting from increased demand or marketability.

approach velocity Filtration rate expressed as a velocity in unit length per time. A rate of filtration in gallons per minute per square foot can be converted to an approach velocity, i.e., the rate of flow of the water as it flows down through the filter box. One gallon per minute per square foot = 8.02 $ft^3/ft^2/h$ (8.02 ft/h) or 2.44 m/h. Further, approach velocity is the rate at which a particle would pass through the treatment process. It is also called filtration rate or superficial velocity. *See also* filtration rate.

appropriate To take the legal actions necessary to establish the right to take water from a natural stream or aquifer for beneficial use.

appropriation (1) Federal funding limits, set under the jurisdiction of the House and Senate Committees on Appropriations, up to which, if approved by the US Congress, federal agencies can legally incur obligations and make payments out of the US Treasury for specified purposes. (2) The setting aside moneys for a specific use.

appropriation doctrine A legal concept developed in the western United States whereby a right to surface water is obtained simply by taking water and applying it to a beneficial use, with no limitations on the place of use or origin of the water. In times of shortage, the appropriation most junior in time must cease using water, if necessary, in order to satisfy more senior appropriations—hence the expression "first in time, first in right."

appropriation system A means of regulating water use by issuing permits so that overdrafts cannot occur. This approach is also called a permit system.

appropriative right Water rights to or ownership of a water supply that is acquired by diverting and putting the water to beneficial use following procedures established by state statutes or courts.

appropriator of water rights One who diverts and puts to beneficial use the water of a stream or other body of water under a water right obtained through appropriation.

appurtenances Machinery, appliances, structures, and other parts of a main structure that are necessary to allow it to operate as intended but that are not considered part of the main structure.

apron A floor or lining of concrete, timber, or other resistant material placed at the toe of a dam, bottom of a spillway, chute, and so on to protect the surface from erosion from falling water or turbulent flow.

APWA *See* American Public Works Association.

aquaculture The cultivation of aquatic organisms. It can be used as a process for removing contaminants from water through the use of aquatic plants (e.g., water hyacinths) in contaminated ponds. The contaminants are either synthesized by, or bioaccumulated in, the aquatic plants, which ultimately are harvested for disposal. Aquaculture facilities are significantly more land-intensive than mechanical treatment methods but are simpler to operate.

aquagenic organic matter Natural organic matter originating from aquatic media. *See also* natural organic matter.

aquatic Associated with water.

aquatic animal A member of the animal kingdom that lives in water, e.g., fish, zebra mussels, nematodes.

aquatic biomonitor An apparatus that is used to measure the responses of biological systems, such as cells, tissues, or entire organisms, to changes in the chemical, biological, or physical characteristics of the water to which the biological system is exposed.

aquatic ecosystem (1) A basic ecological unit composed of living and nonliving elements interacting in an aqueous mixture. (2) Waters, including wetlands, that serve as habitat for interrelated and interacting communities and populations of plants and animals.

aquatic environment *See* aquatic ecosystem.

aquatic fulvic acid A complex organic compound of unknown specific structure that leaches from decaying vegetation. Aquatic fulvic acids are the cause of most of the visible brownish color in some waters. Although nontoxic, they are major precursors of disinfection by-products. They make up most of the natural organic matter in water and are lower in molecular weight than aquatic humic acids. *See also* aquatic humic acid; disinfection by-product precursor; fulvic acid; humic acid; natural organic matter.

aquatic growth The aggregate of floating and attached organisms in a body of water; plankton.

aquatic habitat *See* aquatic ecosystem.

aquatic humic acid A complex organic compound of unknown specific structure that leaches from decaying vegetation. Aquatic humic acids contribute to the visible brownish color in some waters. Although nontoxic, they are major precursors of disinfection by-products. They make up about 10 percent of the natural organic matter in water and are higher in molecular weight than aquatic fulvic acids. *See also* aquatic fulvic acid; disinfection by-product precursor; natural organic matter.

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aquatic humic substance A complex organic compound of unknown specific structure that can leach from decaying vegetation. Aquatic humic acids and aquatic fulvic acids fall in this category. Aquatic humic substances make up a significant fraction of the natural organic matter in water and are major precursors of disinfection by-products. *See also* aquatic fulvic acid; aquatic humic acid; disinfection by-product precursor; natural organic matter.

aquatic insect An insect that lives in water.

aquatic life All forms of animal and plant life that live in water.

aquatic nuisance species Organisms living in water that can cause problems with water treatment plant operations and complaints from water consumers because of undesirable and often offensive tastes, odors, and color. The most common nuisance organisms are algal cells, iron bacteria, actinomycetes, sulfur bacteria, and certain types of larvae. Typical control measures include increased chlorine, ozone, activated carbon, copper sulfate, flushing, and control of nutrient input, as well as other disinfection, acidification, and cleaning practices.

aquatic plant A member of the plant kingdom that lives in water, e.g., algae, phytoplankton.

aqueduct A conduit at or above ground level, usually of considerable size and open to the air, used to convey water by gravity flow.

aqueous Made up of, similar to, or containing water; watery.

aqueous silica The total concentration of dissolved silica species (e.g., H_4SiO_4, $H_3SiO_4^-$) in water, typically expressed as milligrams of silicon dioxide (SiO_2) per liter.

aqueous solubility A chemical term to describe the maximum amount of a chemical that dissolves in water. Water temperature and pH generally affect the solubility of a chemical.

aqueous vapor The gaseous form of water. *See also* water vapor.

aquiclude A low-permeability geologic unit that forms either the upper or lower boundary of a groundwater flow system.

aquifer A geologic formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.

aquifer management model A hydrogeologic model based on three-dimensional finite element methods. These models are specific to a given locality and are utilized to manage groundwater recharge and withdrawal.

aquifer recharge area That land above an aquifer that contributes water to it.

aquifer safe yield The quantity of naturally occurring groundwater that can be economically and legally withdrawn from an aquifer on a sustained basis without impairing the native groundwater quality or creating an undesirable effect. It cannot exceed the increased recharge or leakage from adjacent formations plus the decreased natural discharge resulting from decline in head caused by pumping. *See also* groundwater safe yield.

aquifer storage and recovery (ASR) A management strategy in which excess surface water is treated and artificially recharged to an aquifer system for later withdrawal when surface water is in short supply.

aquifer storage recovery (ASR) well A well designed to inject treated water into an aquifer during periods of surplus water and to extract the treated water during periods of great water demand. The aquifer is used as a storage facility in this situation.

aquifer test A test made by pumping a well over a period of time and observing changes in hydraulic head in the aquifer. The test is used to determine the capacity of the well and the hydraulic characteristics of the aquifer.

aquifer transmissivity A measure of the ability of an aquifer to transmit water per unit width of the aquifer.

aquitard A low-permeability geologic unit that can store groundwater and also transmit it slowly from one aquifer to another.

aramid A synthetic aromatic polyamide material that can be manufactured into hollow-fiber reverse osmosis membranes. *See also* membrane; reverse osmosis.

arbitrage A buying of bills of exchange, stocks, bonds, and so on in one market and selling them at a profit in another. Note that, except for certain temporary periods defined in the federal tax code, governments normally are not permitted to reinvest the proceeds of tax-exempt debt in higher-yielding taxable securities. Even during these temporary periods, interest earnings in excess of interest expense must be rebated to the federal government.

arbitrage bond Any bond issue for which any portion of the proceeds is reasonably expected (at time of issuance) to be used directly or indirectly to acquire higher-yielding investments or to replace funds that were used directly or indirectly to acquire higher-yielding investments (per *Internal Revenue Code*, Sec. 148).

arbitration The settlement of a dispute by one or more persons chosen to reach a decision after hearing both sides.

arbitration, binding *See* binding arbitration.

arbitration, nonbinding *See* nonbinding arbitration.

arbor press A special tool used to force a press-fitted impeller and bearings off of a pump shaft without damaging the parts.

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A

arch A curved structure supporting weight, for example, an arch dam or the curved top of a conduit.

archaea An ancient group of microbes that diverged from bacteria billions of years ago.

arch dam A curved masonry dam that depends principally on arch action for stability. Such a dam is also called an arched dam or single-arch dam.

arch gravity dam A curved solid-masonry dam that depends on both arch action and gravity action for stability.

Archimedes' principle The principle of buoyancy, stating that the resultant force on a wholly or partly submerged body is equal to the weight of the fluid displaced and acts vertically upward through the center of gravity of the displaced fluid.

Archimedes' screw A screw pump consisting of an inclined shaft carrying one or more helices (screw flights) that are rotated, with little clearance, in a circular or semicircular conduit, thus lifting water.

arching A condition that occurs when dry chemicals bridge the opening from the hopper to the dry feeder, preventing the discharge of chemicals from the feeder.

archive A place where public documents and records, private documents and records, or both, are kept to preserve and safeguard them.

area A bounded, continuous two-dimensional object (the boundary may or may not be included). Numerical units of area are expressed in terms of length squared (square feet or square meters). For example, the amount of land a parking lot occupies is an area.

area–capacity curve A graph showing the relationship between the surface area in a reservoir, lake, or impoundment and the corresponding volume.

areal cover A measure of dominance that defines the degree to which aboveground portions of plants cover the ground surface. The total areal cover for all strata combined in a community or a single stratum can exceed 100 percent because (1) most plant communities consist of two or more vegetative strata, (2) areal cover is estimated for each vegetative layer, and (3) foliage within a single layer may overlap.

areal standard unit (asu) count *See* areal standard unit count *in the Units of Measure section.*

area of diversion That portion of an adjacent area beyond the normal groundwater or watershed divide that contributes water to the groundwater basin or watershed under discussion.

area of influence The land area that has the same horizontal extent as the part of the water table or other piezometric surface that is perceptibly lowered by the withdrawal of the water through a well at a given rate. The area of influence for a given rate of discharge may vary with the period of withdrawal and the rate of recharge.

area takeoff A calculation of area based on measurements from plans drawn to scale.

Area-Wide Optimization Program (AWOP) A water treatment optimization program that applies performance status trending, proven training methods, and a continuous improvement philosophy to a group of water systems with the goal of achieving optimum performance.

Arenavirus A single genus that makes up the entire family Arenaviridae. Two serotypes are recognized in the genus *Arenavirus:* Old World arenaviruses and New World arenaviruses. The natural hosts of these viruses are generally rats, bats, and mice. All known arenaviruses pathogenic to humans are rodent viruses, causing chronic, harmless infections in rodents indigenous to Europe, Africa, and the Americas. When these viruses are transmitted to humans, a broad spectrum of disease with symptoms ranging from mild to severe (e.g., hemorrhagic fever) can occur. The epidemiology of *Arenavirus* is governed by patterns of infection in reservoir hosts and dependent on factors that bring humans into proximity with rodents or the saliva and urine of rodents. For example, humans are primarily infected with Lassa virus by eating infected rats or by ingesting food or water contaminated with rat excretions. Person-to-person transmission of Lassa only can occur via direct contact, such as contamination of skin breaks with infected blood, or via aerosol spray.

ARI *See* average rainfall intensity.

arid Pertaining to climatic conditions or a soil that lacks humidity.

arid climate A climate characterized by less than 10 inches (25 centimeters) of annual rainfall.

ARIMA forecasting method *See* autoregressive integrated moving average forecasting method.

arithmetic and logic unit (ALU) A central part of the computer within the central processing unit that performs numerical operations fundamental to the execution of programs and other functions.

arithmetic average *See* arithmetic mean.

arithmetic mean An average value of a data set calculated by determining the sum of all the numbers in the data set and dividing by the number of data values within the set.

arithmetic operators Symbols representing various arithmetic operations, such as "+" for addition.

arithmetic scale A series of equally spaced intervals (marks or lines), usually marked along the side and bottom of a graph, that represent the range of values of the data being presented.

armature *See* rotor.

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aromatic heterocycle A molecule having an aromatic ring composed of both carbon and heteroatoms, chiefly oxygen, sulfur, and nitrogen. *See also* aromatic hydrocarbon.

aromatic hydrocarbon A six-carbon ring with alternating single and double bonds. *See also* polynuclear aromatic hydrocarbon.

aromaticity The condition in which a stable electron shell configuration in organic molecules, especially those related to benzene, renders aromatic rings very stable. Aromaticity is also known as resonance stabilization or delocalization. In nuclear magnetic resonance spectroscopy, aromatic rings produce a clear and dramatic shielding effect that assists the spectroscopist in assessing the aromaticity of a sample. *See also* aromatic hydrocarbon; benzene; nuclear magnetic resonance; resonance.

aromatic polyamide membrane A type of synthetic organic membrane with amide-linked closed rings of carbon atoms, each having one free valence bond site, usually manufactured as either an asymmetric hollow fiber or a thin film composite flat sheet. The hollow fiber type is typically asymmetric, with the supporting and "rejecting" layers made of aromatic polyamide. The thin film composite type often has a cross-linked polyamide barrier layer supported by a microporous substrate (e.g., polysulfone). Variations of the membrane types are commonly used for reverse osmosis and nanofiltration. Typically these membranes exhibit good pH range tolerance but are susceptible to attack by strong oxidants.

aromatic sulfonate ($Ar\text{-}(SO_3^-)_x$ A type of synthetic organic chemical produced and applied in the chemical industry [where Ar is an aromatic hydrocarbon—e.g., benzene, C_6H_6; naphthalene, $C_{10}H_8$; or anthraquinone, $C_6H_4(CO)_2C_6H_4$—that may be substituted, e.g., with an amino (NH_2), nitro (NO_2), or hydroxy (OH) group, and where x typically equals 1 to 3] Aromatic sulfonates are employed in the manufacture of azo dyestuffs ($R\text{-}(N{=}N)_y$, where y = 1–4), optical brighteners, ion exchange resins, plasticizers, pharmaceuticals, and fluorescent whitening agents for laundry products. Aromatic sulfonates have been found as contaminants in river water.

array In a pressure-driven membrane separation system, an arrangement of membrane elements or pressure vessels by stage. For example, a 4:2:1 pressure vessel array contains four pressure vessels in the first stage, two in the second stage, and one in the third stage. In a multiple-staged array, the concentrate from the first stage is the feed to the second stage, the concentrate from the second stage is the feed to the third stage, and so on.

arrhythmia An irregular beat of any of the heart chambers. Some arrhythmias are relatively benign (e.g., atrial flutter); others can be fatal (e.g., ventricular fibrillation). Arrhythmia is a concern for those who drink water containing barium (Ba^{2+}).

arroyo A stream channel or gully, usually rather small, walled with steep banks and dry much of the time.

arsenate (As (V)) A salt of arsenic acid. It generally refers to a group of arsenic species that has a positive valence 5 or (V). This type of arsenic is easier to remove by adsorption than arsenic (III). *See also* arsenic; valence.

arsenic (As) An inorganic contaminant element that is found in water supplies primarily as a result of natural geologic formations and has been associated with adverse health effects. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.010 milligrams per liter.

arsenic (III) hydride (AsH_3) A chemical name for arsine. *See also* arsine.

arsenite (As (III)) The arsenic ion with a positive valence of 3 or (III). This type of arsenic is more difficult to remove by adsorption than arsenic (V). To better remove arsenite (As (III)) in water, it needs to be oxidized into arsenic (V) prior to the adsorption process.

arsine A gaseous arsenic species that is also known as arsenic hydride (AsH_3). Arsine gas is one of the most toxic chemicals. In most field test kits, arsenic is reduced to arsine gas that reacts with active reagents to produce a red color to determine arsenic concentrations. *See also* arsenic; arsenic (III) hydride.

arterial-loop system A distribution system layout involving a complete loop of arterial water mains (sometimes called trunk mains or feeders) around an area being served, which provides two directions of flow and helps eliminate dead-end mains or systems.

arterial main *See* trunk main.

arterial map A comprehensive map showing primary distribution mains 12 inches (305 millimeters) or larger. It is also called a skeletal map. Smaller systems may map mains of 6 inches (152 millimeters) and larger. Generally, arterial map refers to a supplemental mapped record that is used in system analysis.

artesian Pertaining to groundwater, a well, or an underground basin in which the water is under greater-than-atmospheric pressure and will rise higher than the level of its upper confining surface if given an opportunity to do so.

artesian aquifer An aquifer confined between less permeable materials from which water will rise above the bottom of the overlying confining bed if

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afforded an opportunity to do so. Such an aquifer is also called a confined aquifer.

artesian discharge The rate of discharge of water from a flowing well.

artesian head The distance, whether above or below the land surface, to which the water in an artesian aquifer or groundwater basin would rise if free to do so.

artesian pressure The pressure exerted by groundwater against an overlying impermeable or less permeable formation when the free water surface of the groundwater stands at a higher level than the bottom of the overlying formation.

artesian spring A spring from which water issues under pressure through some fissure or other opening in the confining formation above the aquifer.

artesian well A well that flows freely, without pumping, as a result of the piezometric surface of the aquifer area being at a higher elevation than the well discharge. Artesian wells are found in mountainous areas in which the aquifer supply is confined between two impervious layers, permitting a pressurized system to exist at a higher elevation than the well discharge.

artesian well water *See* bottled artesian water.

artifact A data point that does not fit into an experimental result properly. For example, if something went wrong during a portion of a test and was then corrected, the data point collected during the problem portion of the test would be called an artifact.

artificial destratification The mixing of lakes and reservoirs by mechanical equipment to overcome thermal or density stratification, e.g., by pumping diffused air into bottom layer of water. This frequently results in improved water quality. *See also* destratification; overturn; thermal stratification.

artificial intelligence (AI) The feature or property of a machine that allows it to process information based on reason and to learn new information (or update existing reasoning logic) based on additional new information processed by the machine. Expert systems are based on artificial intelligence in which available knowledge about a process is entered into the model and reasoning logics are assigned; on the basis of these logics, the machine can arrive at conclusions when new or different scenarios are presented to it. *See also* expert system.

artificially created beta particle and photon emitter All radionuclides emitting beta particles, photons, or both that are listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure," *National Bureau of Standards Handbook 69* as amended August 1963 (Washington, D.C.: US Department of Commerce), except the daughter products of thorium-232, uranium-235, and uranium-238. These radionuclides are regulated under the Beta Particle and Photon Radioactivity standard set by the 2000 Radionuclides Rule.

artificial neural network (ANN) model *See* neural network model.

artificial recharge The process of intentionally adding water to an aquifer by injection or infiltration. Dug basins, injection wells, or the simple spreading of water across the land surface are all means of artificial recharge.

artificial watercourse A surface watercourse constructed by human agencies.

artificial wetland A wetland created by the activities of humans, either accidentally or purposefully.

As (III) *See* arsenite.

As (V) *See* arsenate.

ASA *See* average speed of answer.

asbestos–cement (A–C) pipe A water main material made from a mixture of cement and asbestos fibers.

asbestos fiber A fibrous silicate mineral generally ranging from 0.03 to 0.10 micrometers in diameter and less than 10 micrometers in length. Asbestos fibers, from both natural and human-made sources, have been associated with adverse health effects. Asbestos fibers in drinking water are regulated by the US Environmental Protection Agency at maximum contaminant level of 7 million fibers per liter > 10 micrometers.

as-built drawings Records of a treatment plant, conduit, or pipeline that reflect changes made from original drawings during construction and installation.

as $CaCO_3$ *See* as calcium carbonate.

as calcium carbonate (as $CaCO_3$) A phrase used in expressing particular concentrations for one or more chemicals in terms of an equivalent concentration of calcium carbonate ($CaCO_3$). The particular concentrations typically include the following: (1) hardness; (2) acidity; or (3) carbon dioxide (CO_2), carbonate (CO_3^{2-}), bicarbonate (HCO_3^-), hydroxide (OH^-), total alkalinity, or lime. The resulting concentration is expressed in milligrams per liter as calcium carbonate equivalent. Expressing these values in terms of calcium carbonate facilitates comparisons of values. For example, to convert a hardness concentration caused by calcium (Ca^{2+}) to an equivalent calcium carbonate concentration, one can multiply the calcium concentration by 2.50, based on the following equation:

$$\frac{50 \text{ milligrams } CaCO_3 \text{ per milliequivalent} \times 2 \text{ milliequivalents per millimole}}{40 \text{ milligrams } Ca^{2+} \text{ per millimole}} = 2.50$$

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Hence, for example, 50 milligrams per liter of calcium ions can be expressed as 125 milligrams per liter as calcium carbonate.

ascariasis Infestation with nematode worms of the species *Ascaris lumbricoides.*

ASCE *See* American Society of Civil Engineers.

ASCII *See* American Standard Code for Information Interchange.

ascorbic acid ($C_6H_8O_6$) The chemical name for vitamin C. It can be used for dechlorination in water and wastewater and also to quench chlorine residual in water sample preservation.

ASDWA *See* Association of State Drinking Water Administrators.

aseptic Free from living pathogens or organisms causing fermentation or putrefaction; sterile.

aseptic meningitis The most common form of meningitis. Also known as viral meningitis, aseptic meningitis involves swelling of brain or spinal tissue. Symptoms include fever, stiffness of the neck, blurred vision, nausea, and vomiting.

ash The mineral oxide constituents of activated carbon. Ash is normally measured on a weight percent basis after a given amount of sample is oxidized.

Asiatic clam A freshwater clam, *Corbicula fluminea,* that was introduced into US waters from southeast Asia in 1938. It is now present in almost all surface waters south of 40° latitude and causes problems by clogging intakes and mechanical systems.

ASME *See* American Society of Mechanical Engineers.

aspartic acid ($COOHCH_2CH(NH_2)COOH$) An organic compound (amino acid) containing two –COOH groups and one $–NH_2$ group. It is a precursor of a class of disinfection by-products called haloacetonitriles. Free chlorine reacts with aspartic acid to form some members of the haloacetonitrile group. *See also* amino acid; disinfection by-product; haloacetonitrile.

asphyxia A lack of oxygen, causing unconsciousness or death.

aspirate To remove a fluid from a container by suction.

aspirator A feeder using a hydraulic device that creates suction. The suction draws the material to be fed into the flow of the water.

aspirator feeder *See* aspirator.

ASR *See* aquifer storage and recovery.

assay A test for a particular chemical or effect.

ASSE *See* American Society of Safety Engineers.

assembler *See* assembly language.

assembly An assemblance composed of one or more approved body components and including approved shutoff valves.

assembly language A low-level programming language that is unique to specific computers. It utilizes mnemonic instructions rather than binary numbers to represent machine language instructions.

assessment district A specific area of land and property that, under the Municipal Improvement Act of 1913 and Improvement Bond Act of 1915, will be assessed a pro rata share of the cost of improved water service to that area. The debt incurred to make this improvement is secured by direct lien against the assessed property that receives the benefit. The assessment can be apportioned on any basis that reasonably defines the benefits: area served, units of water use, and so forth. In the context of development, an assessment district is sometimes referred to as a community facilities district.

assessment district bond A bond issued to finance required improvements to an assessment district under procedures specified by the Municipal Improvement Act of 1913 and Improvement Bond Act of 1915. The debt is secured by direct lien against a piece of property that will receive the special benefit and upon which an assessment is made. Assessments can be apportioned on any basis that reasonably defines the benefits: area, units of use, and so forth. Assessments are most often collected by means of an ad valorem tax, usually a percentage of true or market value. *See also* assessment district.

assessment monitoring contaminant A contaminant that is listed on US Environmental Protection Agency's Unregulated Contaminant Monitoring Rule List 1. Contaminants on List 1 were monitored by approximately 2,800 large community water systems (CWSs) and nontransient noncommunity water systems (NTNCWSs) and by a statistically representative sample of 800 small water systems to assess national occurrence.

asset management (AM) The systematic care, disposal, maintenance, or replacement of the total resources of a business, including cash, notes, accounts receivable, inventories, securities, machinery, fixtures, real estate, or any source of wealth having economic value to the business. AM allows the organization to make rational, prioritized decisions on whether to repair, rehabilitate, or replace an asset based on economic and risk-based factors.

assets The entire resources of a government entity or person, or private business, both tangible and intangible.

assimilable organic carbon (AOC) The fraction of organic carbon that can be used by specific microorganisms and converted to cell weight. AOC also represents a potential for biological regrowth in distribution systems. Ozone (O_3) can convert organic matter in water to assimilable organic carbon, whereas biological filtration can reduce the AOC level. *See also* biological filtration.

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A

assimilation The transformation and incorporation of absorbed materials into components of the organism.

assimilative capacity of an aquifer The ability of an aquifer to receive an unacceptable-quality water at one point while being able to supply an acceptable quality of water further downgradient. This term is important when an aquifer system is used to treat water by exploiting both the filtration effect and dilution effect in porous media.

association The dependence between two or more events, characteristics, or variables (e.g., exposure and disease). Variables are associated if one is more (or less) common in the presence of the other. Events or variables are also associated when they occur more frequently together than expected by chance. The terms *association* and *relationship* are often used interchangeably for describing epidemiologic associations. *Association* does not necessarily imply a causal relationship between the events or variables. *See also* statistically significant.

Association of Boards of Certification (ABC) A group that promotes water and wastewater operator certification through model state legislation and national testing services.

Association of California Water Agencies (ACWA) An organization headquartered in Sacramento, Calif., that represents municipal and agricultural water agencies in that state on both a national and statewide basis.

Association of Environmental Engineering and Science Professors (AEESP) A group of college and university faculty who teach environmental engineering and environmental science.

Association of Metropolitan Water Agencies (AMWA) An association representing the largest publicly owned drinking water systems in the United States. The association was formed in 1981 by a group of general managers of metropolitan water systems who wanted to ensure that the interests of large publicly owned water suppliers would be represented in Washington, D.C. Member representatives to AMWA are the general managers and chief executive officers of these large water systems. The association represents the interests of these water systems by working with Congress and the federal agencies to ensure safe and cost-effective federal drinking water laws and regulations that protect public health.

Association of State Drinking Water Administrators (ASDWA) An association representing state drinking water regulatory agencies.

ASTM (American Society for Testing and Materials) *See* ASTM International.

ASTM grade water *See* reagent grade water.

ASTM International Founded in 1898 and originally known as the American Society for Testing and Materials, an organization that establishes standards for materials, products, systems, and services through technical committees. More than 9,000 standard test methods, specifications, classifications, definitions, and recommended practices are now in use.

astrovirus An enteric virus (30 nanometers across) associated with waterborne diarrhea. It is identified by its characteristic star-like appearance in electron photomicrographs.

asu count *See* areal standard unit count *in the Units of Measure section*.

ASV *See* anodic stripping voltammetry.

asymmetric Not similar in form, shape, or size arrangement, of parts on opposite sides of a line, point, or plane.

asymmetric membrane A type of membrane with a structure in which separation takes place in a thin microporous or dense permselective barrier layer supported by a less dense, more porous substrate of the same chemical composition. *See also* anisotropic membrane.

asymptomatic Pertaining to the presence of infection in a host without recognizable clinical signs or symptoms. An asymptomatic infection is also referred to as an inapparent infection or a subclinical illness or disease.

asymptotic Pertaining to the outcome of a process that gradually approaches but never reaches a goal or some absolute value.

asynchronous Pertaining to a transmission of data at irregular intervals to a computer. The data are preceded by a start bit and followed by a stop bit with no regard to timing.

asynchronous communication The transmission of data via serial lines without a specific timing pattern.

atacamite ($Cu_2(OH)_3Cl$) A substance yellow to black green in color that forms in dry climates where copper is exposed to oxygen. Atacamite has been reported on pipe walls in drinking water distribution system pipes.

ATF permit *See* after-the-fact permit.

atherosclerosis A chronic disease that is typified by the formation of lesions in the blood vessels. It usually involves damage to the endothelial cells that make up the blood vessel. As the lesion develops, plaques of fat deposits develop that can occlude the vessel.

atm *See* atmosphere *in the Units of Measure section.*

atmometer An instrument for measuring evaporation. An atmometer is also called an atmidometer or evaporimeter.

atmosphere The gaseous envelope (air) surrounding the earth. It consists of oxygen (O_2), nitrogen (N_2),

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and other gases, extends to a height of about 22,000 miles (35,400 kilometers), and rotates with the earth. *See also* atmosphere *in the Units of Measure section.*

atmospheric hazard A risk posed by constituents in the air at a particular location. For example, low oxygen (O_2) concentrations or the presence of toxic or flammable gases, mist, and dust can pose risks ranging from disorientation to death for individuals exposed.

atmospheric moisture Water as it occurs in various forms in the atmosphere.

atmospheric pressure The pressure exerted by the atmosphere at any point. It decreases as the elevation above sea level increases.

atmospheric vacuum breaker (AVB) A device consisting of a float check, a check seat, an air inlet port, and possibly a shutoff valve immediately upstream. It is designed to allow air to enter the downstream water line to prevent backsiphonage. An AVB must never be subjected to a backpressure condition or have a downstream shutoff valve. Backpressure from, say, an irrigation system into the plumbing line will defeat the purpose of the AVB. A downstream valve, if closed, can create a vacuum, allowing water between the AVB and the closed valve to be pulled back into the supply system when the system is shut off.

atmospheric water Water in the atmosphere in gaseous, liquid, or solid state.

atom The smallest particle of an element that still retains the character of that element. In the classical model, an atom is composed of a nucleus (made up of one or more protons and two or more neutrons—except for hydrogen, which may have no neutrons) and one or more electrons that revolve around the nucleus. Atoms come together to form molecules.

atomic absorption spectrometric method *See* atomic absorption spectrophotometric method.

atomic absorption spectrometry *See* atomic absorption spectrophotometric method.

atomic absorption spectrophotometer A spectrophotometer used to determine the concentrations of metals in water and other types of samples.

atomic absorption spectrophotometric method (AAS method or AA) An analytic technique used to identify the constituents of a sample by detecting which frequencies of light the sample absorbs. This technique is used to measure the concentrations of metals in water. *See also* spectrophotometry.

atomic absorption spectrophotometry *See* atomic absorption spectrophotometric method.

atomic absorption spectrophotometry, flame *See* flame atomic absorption spectrophotometry.

atomic absorption spectrophotometry, graphite furnace *See* graphite furnace atomic absorption spectrophotometry.

atomic absorption spectroscopy A common name for the atomic absorption spectrophotometric method. *See also* atomic absorption spectrophotometric method.

atomic emission The emission of photons when compounds are energized into excited atoms in a hot gas. The photons are emitted as the electrons return to the ground state and can be detected by a spectrophotometer, thus identifying the element.

atomic emission spectroscopy (AES) A general name for an instrumental technique for measuring elements based on the intensity of radiation formed from atoms in an excited state. An example is inductively coupled plasma spectroscopy, a technique that requires little sample preparation and can be very sensitive for certain elements.

atomic force microscopy (AFM) A type of nonoptical microscopy, also known as atomic resolution microscopy. Atomic force microscopy is a means of measuring differences in electrical potentials at the atomic forces level using a specially coated probe tip that rides across the surface of a specimen. The electrical potentials are converted to digitized signals that are used to generate a computer picture of the specimen surface.

atomic mass unit (AMU, amu) *See in the Units of Measure section.*

atomic number The number of protons in the nucleus of an atom.

atomic resolution microscopy *See* atomic force microscopy.

atomic weight (at wt) Approximately the number of protons and neutrons in the nucleus of an element.

ATP *See* adenosine triphosphate; advanced treatment plant.

ATP (alternate test procedure) *See under* alternate method.

atrazine (2-chloro-4-ethylamino-6-isopropyl amino-1,3,5-triazine) ($C_8H_{14}N_5Cl$) An herbicide and plant growth regulator used primarily on corn and soybeans. It is slightly soluble in water, and its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.003 milligrams per liter.

atrazine-desethyl A degradation product of atrazine ($C_8H_{14}N_5Cl$). *See also* atrazine; degradation.

atrazine immunoassay A method for quantifying analytes by their action as antigens, or stimulants, on an enzyme-bound antibody. Upon reaction with the antibody, a color change is produced that can be measured using ultraviolet-visible (UV/Vis) spectrophotometry. This assay is commonly used for quantifying analytes such as polychlorinated biphenyls because of the quick turnaround time.

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A

ATR–FTIR analysis *See* attenuated total reflectance–Fourier transform infrared analysis.

attack rate A rate, often expressed as a percentage (cases per 100), that describes the cumulative incidence of disease or illness in a particular group observed for a limited time and under special circumstances (i.e., during an epidemic or outbreak). The period of time used for observation of cases varies, but it begins at the time of exposure and continues over an interval that allows for the occurrence of all possible cases of illness attributable to the exposure. A secondary attack rate in communicable disease outbreaks refers to cases among familial, institutional, or other contacts following exposure to a primary case; secondary cases may be restricted to susceptible contacts.

attenuated total reflectance–Fourier transform infrared (ATR–FTIR) analysis A method for improving FTIR by using crystals coated with submicron thick layers of polymeric or sol-gel materials that enhance the sensitivity by concentrating an analyte in the region probed by the evanescent wave (i.e., in the coating). *See also* Fourier transform infrared analysis.

attenuation The production of an output of lower magnitude than the input.

Atterberg limits Laboratory classification criteria developed to classify fine-grade soils. It is now also used to classify coagulant and lime sludges. A clay or similar fine-grained soil or sludge, when dry or nearly dry, will have a semisolid consistency. As moisture content increases, the material reaches a point at which it achieves a plastic or putty-like consistency. This point is called the plastic limit. As moisture content continues to increase, the material remains plastic over a certain range and then the consistency of the material ultimately changes to semiliquid at a point called the liquid limit. The upper and lower limits of the plastic range (i.e., the liquid and plastic limits) are referred to as the Atterberg limits.

atto *See in the Units of Measure section.*

attractive forces Forces that are created by dipoles on the surfaces of particles, called van der Waal forces. Their magnitude decreases markedly as the separation distance of the particles increases. They are important in the coagulation of particles in that they hold the particles together once they are close enough to each other.

attributable risk The rate of a disease or other outcome in exposed individuals that may be attributed to the exposure in question. This term is often used to denote several other risk measures, including rate difference, population excess rate, attributable fraction in the population, and attributable fraction among the exposed. To avoid confusion with similar and other measures of risk when evaluating epidemiologic studies, readers should carefully search for the investigator's definition of this term when it is used.

attribute A type of nongraphic data that describes the entities represented by graphic elements. The term is frequently used to cover all types of nongraphic, usually alphanumeric, data that are linked to a map element. For example, a map depicting parcels, each identified by a parcel number, may be linked to an attribute data file containing information about ownership, land use, and appraised value. In the context of engineered facilities, attribute data describe the facilities themselves, recording the characteristics of individual devices such as the type, size, material, and manufacturer.

attribute data A set of data that describes the characteristics of real-world objects and is usually represented alphanumerically.

attrition The gradual lessening of the capacity or effectiveness of media. This phenomenon may occur because of sacrificial properties of the media, friction, or chemical attack of the media.

at wt *See* atomic weight.

atypical bacteria (1) Bacteria that are not typical of normal flora. (2) Three groups of pathogenic or potentially pathogenic bacteria that are unusual: the mycoplasmas, the rickettsias, and the chlamydiae. *See also* chlamydia; mycoplasmas; *Rickettsia*.

audit A formal process in which an outside party examines the financial records and accounts of a business or public agency to verify the correctness of the records.

auger hole test An aquifer test made in shallow auger holes to determine hydraulic properties of the aquifer or overlying soils.

augmentation plan A court-approved plan that allows a lower-priority water user to divert water out of priority if certain conditions are met: (1) adequate replacement is made to the stream system and to the water right that is affected and (2) in some cases, injury to the water rights of other users is avoided.

augmentation source The supply of water that is used to replace any depletions in an augmentation plan. *See also* augmentation plan.

Australian Water Association (AWA) Nonprofit association that represents the Australian water profession. AWA promotes water-sustainable water management through collaboration, advocacy, and professional development.

autecology The study of the relationships between a species or an individual and its environment.

authority The power to give a command, enforce obedience, make final decisions, and take action.

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authority bond A bond payable from the revenues of a specific authority. Because authorities usually have no revenues other than charges for services, their bonds are ordinarily revenue bonds.

authorization *See* authorizing legislation.

authorized consumption The volume of water taken by registered customers, the water supplier, and others who are implicitly or explicitly authorized to do so by the water supplier, for residential, commercial, industrial, or agricultural purposes. It also includes water exported across operational boundaries. Authorized consumption may include items such as firefighting and training, flushing of mains and sewers, street cleaning, watering of municipal gardens, public fountains, frost protection, and building water. These may be billed or unbilled; metered or unmetered. *See also* water audit; water balance.

authorizing legislation Federal legislation that establishes or continues the operation of a federal program or agency, either indefinitely or for a specified period of time, or that sanctions a particular type of federal monetary obligation or expenditure within a program.

autochthonous Pertaining to turbidity-causing material produced within a lake or other surface waters.

autochthonous bacteria Bacteria indigenous to a given ecosystem.

autochthonous natural organic matter Natural organic matter (e.g., humic acid, fulvic acid) formed in its present location. That is, it is indigenous to the location. *Compare with* allochthonous natural organic matter.

autoclave A device that sterilizes laboratory and microbial media by using pressurized steam.

autoclaved Sterilized with steam at elevated temperatures.

autocorrelation The autocorrelation function is used in regression analysis of time-series data (e.g., monthly water consumption) to measure the strength of the relationship of differences in the variable's terms separated by a specific number (n) of time periods. The strength of the measurement is given by the autocorrelation coefficient, r, which can take on positive or negative values from –1.0 to 1.0. The higher the positive or negative values, the stronger the correlation. If $n = 1$, the paired terms (C_t, C_{t-1}) are one period apart and the autocorrelation is a first-order autocorrelation. Correlating pairs two periods apart, $n = 2$, yields a second-order autocorrelation, and so forth.When pairs 12 monthly periods apart ($n = 12$)—1 year apart—are being correlated, if the correlation of paired differences is high ($r \geq 0.75$), strong evidence exists of a seasonal pattern causing the differences because the pattern of data is recurring at 12-month intervals. Once the time-dependent pattern has been identified, it can be filtered out of the data series to achieve a stationary state in which no further significant autocorrelation exists. The filtering-out process is done by taking second differences (for seasonality, taking the differences of the first differences, 12 periods apart) or by using autoregressive analysis to quantify the relationships. *See also* autoregressive term; Durbin–Watson test; seasonal analysis; serial correlation.

autocrine A mechanism of cellular control that is internal to a particular cell (i.e., the cell regulates itself).

autohydrogenotrophic denitrification A denitrification process in which hydrogen is the electron donor that drives nitrate reduction. A biological, hydrogen-based denitrification system may be effective at reducing levels of perchlorate (a carcinogenic contaminant traced to the chemical industry and rocket fuel) in drinking water. Using hydrogen rather than an organic compound as the electron donor offers several advantages, e.g., prevention of microbial growth in the distribution system, cost savings of 3 to15 times over organic compounds to remove the same amount of nitrate, and reduction in reactor fouling. Drawbacks associated with sparging hydrogen (i.e., explosive potential) have led to use of this biological process in the form of membrane–biofilm reactors.

autoimmunity An allergic response directed toward the self. Autoimmunity is the apparent basis for many chronic diseases. These activities can be triggered by chronic exposure to toxic chemicals, as well as other causes.

automated laboratory instrument An instrument that may perform one or more tests on input samples without operator attention other than the initial setup. The instrument may provide scaling, linearization, and other necessary calculations as well as data storage and limited reporting.

automated mapping (AM) system A computer system used to draw and produce maps that can be viewed on a terminal screen or on paper. Automated mapping systems (also known as computer mapping) are designed for efficient graphic data processing and display; they have little or no geographic analysis capability and a limited ability to store and manipulate any data other than graphic images.

automated mapping/facilities management (AM/FM) system A computer system that integrates automated mapping tools with facilities management capabilities, principally distinguished from automated mapping by the addition of database management capabilities and a linkage of attribute data to graphic entities. AM/FM systems can also be categorized as geographic information systems that emphasize applications related to managing utility networks or infrastructure. Typical AM/FM applications include

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managing geographically distributed facilities, maintaining facilities inventories, managing operations, overlaying combinations of features and recording resulting conditions, analyzing flows or other characteristics of networks, and defining districts to satisfy specified criteria.

automated mapping/facilities management/geographic information system (AM/FM/GIS) A specialized software system for collecting, storing, and analyzing water system components for which geographic location is an important characteristic. The combination of the terms *automated mapping/facilities management (AM/FM)* and *geographic information systems (GIS)* is often used to describe a multipurpose geographic information system that serves several agencies or departments and satisfies application requirements in several areas, such as infrastructure management, property, appraisal, planning functions, and development tracking. *See also* automated mapping/facilities management system; geographic information system.

automated meter reading (AMR) The electronic reading of customers' meters from a remote central location. Data from meters are transmitted via telephone or cable television lines or radio frequency to a central computer for billing purposes.

automated surveillance The use of electronic protection systems, e.g., intrusion detection, closed circuit television, and so on, to monitor and alert for intrusions at a facility without the need for a physical presence.

automatic adjustment charge Mechanism by which adopted rates and charges are changed without further actions by the governing body in response to specified changes in the cost of providing water, such as increased energy costs or costs of purchased water.

automatic backwash filter A filter that backwashes automatically upon reaching maximum head loss, using filtered water being produced by other filters as the source of backwash water. Often these are fabricated in clusters of four filters, with three filters providing wash water for the one filter being washed.

automatic control A mode of process control in which changes to operating conditions are made automatically through the use of control logic, based on information from online monitors.

automatic flushing A solution, method, or apparatus that periodically discharges water through a system to enhance the water quality in a distribution system.

automatic gate A gate that operates without human assistance when prescribed conditions are met.

automatic recording gauge An automatic instrument for continuously measuring and recording graphically; also called a register.

automatic sampling The process of collecting samples of prescribed volume over a defined time period by an apparatus designed to operate remotely without direct manual control. *See also* composite sampling.

automatic valve A valve that opens or closes without human assistance when prescribed conditions are met.

automatic water softener A water softener that is equipped with a clock timer that automatically initiates the backwash process, regeneration process, or both at certain preset intervals of time. All operations, including bypass of treated or untreated water (depending on design), backwashing, brining, rinsing, and returning the unit to service are performed automatically.

automation The use of electronic devices to control or perform a process or task. With respect to management of water utilities, areas of automation typically include process control, design and engineering, facilities mapping and analyses, hydraulic flow and hydraulic modeling, handling of customer complaints, and work order management, meter management, and customer billing. *See also* automated mapping/facilities management/geographic information system; computer-aided design and drafting; supervisory control and data acquisition.

autoregressive integrated moving average (ARIMA) forecasting method An extension of the autoregressive method that includes three tools for capturing the statistical relationship among differences. The first tool addresses the autocorrelation of first differences in the original time-series data. The second tool specifies the order of the autocorrelation. The third tool applies a moving average to the forecast errors to improve the current forecast. The moving average can be first-order, using the most recent forecast error, or second-order, using the forecast error from the two most recent periods, and so on. The ARIMA model is referred to as a univariate model because it requires no data other than the single variable that is being forecast; however, various parameters for differencing and order are required. The model extracts from the dependent variable any patterns of seasonality, trend, and recurring cycle that can be identified and uses these patterns to make forecasts. *See also* autocorrelation; autoregressive term; serial correlation; weighted average.

autoregressive term A coefficient derived in regression analysis of time-series data (e.g., monthly water consumption) that quantifies the time dependency of random errors. The assumption in this type of analysis is that the effects of changes in the variables are not instantaneous, that they carry forward to future periods. By using autoregressive analysis, the errors of prior observations are included as variables in the

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regression analysis to identify the relationship between the errors or residuals in one period and the variable values in future periods. Because each coefficient that is identified will generate different residuals throughout the time series, an iterative process is used to find the coefficient with the most stable or stationary results. The most popular form of this analysis is the first-order autoregressive process, which measures the effect of residuals one period apart, but higher-order autoregressive models can also be used. The key value of this type of analysis is that, by identification of the autocorrelation, the coefficients of other variables take on more accurate values. *See also* autocorrelation; Durbin–Watson test; serial correlation.

autosampler A device that allows automated introduction of a sample or sample extract into an instrument.

autotroph An organism that obtains energy by the oxidation of inorganic compounds.

autotrophic Pertaining to organisms capable of synthesizing organic nutrients directly from simple inorganic substances such as carbon dioxide (CO_2), nitrogen (N), and nitrate ion (NO_3^-). *See also* autotroph.

autotrophic bacteria Bacteria that derive energy for growth and metabolism from oxidation–reduction reactions in which inorganic substances are used as hydrogen donors and carbon dioxide (CO_2) is the carbon source for biosynthesis. Such bacteria are also called chemoautotrophs.

autoxidation A spontaneous process in which a compound loses electrons (i.e., is oxidized)—usually in the presence of oxygen. However, other compounds can act as the electron acceptors. This term is usually associated with compounds that are chemically unstable in the presence of air or oxygen.

auxiliary scour *See* filter agitation.

auxiliary source A source of water supply that (1) is not normally used but has been approved for use by agencies having the jurisdiction or primacy and (2) has been or may be developed for use when the normal sources are inadequate.

auxiliary storage device A device used to maintain large volumes of digital data and software that are directly accessible through high-speed connections to a processing unit. Examples include disk and tape drives. Such devices are sometimes called mass storage devices.

auxiliary supply Any water source or system, other than a potable water supply, that may be available in a building or on a premises.

auxiliary tank valve In a chlorination system, a union or yoke-type valve connected to the chlorine container or cylinder. It acts as a shutoff valve in case the container valve is defective.

auxiliary water supply Any water supply on or available to the premises other than the purveyor's approved public water supply. These auxiliary waters may include (1) water from another purveyor's public potable water supply or any natural source(s), such as a well, lake, spring, river, stream, harbor, and so forth or (2) used waters or industrial fluids. These waters may be contaminated or polluted, or they may be objectionable and constitute an unacceptable water source over which the water purveyor does not have sanitary control.

availability charge A limited-use charge made by a water utility to a property owner between the time when water service is made available to the property and the time when the property connects to the utility's facilities and starts using the service.

available chlorine A measure of the amount of chlorine in chlorinated lime, hypochlorite compounds, chloramines, and other materials that are used for disinfection as compared to the amount in elemental (liquid or gaseous) chlorine. For example, the molecular weight of monochloramine (NH_2Cl) is 51.5 and each mole is equivalent to 71 grams of available chlorine (Cl^{1+} undergoes two-electron addition [reduction] to Cl^{1-}–$2 \times 35.5 = 71$). Thus, monochloramine is equivalent to 1.38 (71/51.5) grams of available chlorine per gram.

available expansion The vertical distance from the media surface to the underside of a trough in a granular filter. This distance is also called freeboard.

available freshwater The quantity of renewable water available for human use. It is sometimes called the renewable water supply.

available head The head, or pressure, available to drive water through a granular media filter. Available head depends on the design of the plant and the filter. When the available head is provided in large measure by using a deep filter box with 6 to 8 feet (1.8 to 2.4 meters) of water over the filter media, this reduces the tendency for air binding to occur in the filter bed. On the other hand, when a major portion of the available head is provided below the filter media, pressure within the filter bed may decrease to less than 1 atmosphere (101.3 kilopascals), which can cause air binding.

available supply The maximum amount of reliable water supply, including surface and groundwater sources and purchases under secure contracts.

AVB *See* atmospheric vacuum breaker.

avdp *See* avoirdupois *in the Units of Measure section.*

average *See* arithmetic mean.

average annual flood A flood discharge equal to the mean of the discharges of all of the maximum annual floods during the period of record.

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A

average annual runoff The amount of runoff calculated for a selected period of record of one year for a specific area that represents average hydrologic conditions.

average cost The total cost divided by the total number of units associated with the total cost.

average daily demand The average amount of water necessary in a 24-hour time frame to meet all needs of all customers. It is determined by dividing annual usage by the total number of days in the year.

average daily exposure (ADE) An estimate of exposure averaged over the number of days in a given period of time of exposure to a contaminant; used in assessments of risk of noncancerous chronic health effects.

average daily flow (ADF) A measurement of the total amount of flow past a point over a day or over a period of several or more days divided by the number of days in that period. Mathematically, it is the sum of all daily flows divided by the total number of daily flows used.

average-day demand Annual water consumption divided by 365 days in a year; the average water demand a given water distribution system experiences over a 1-day period. The average-day demand applies to a specific time period over which the average is calculated.

average dry weather flow (ADWF) In rivers and streams, the normal flow of water made up primarily of water that seeps into the ground.

average efficiency The efficiency values of a machine or mechanical device averaged out over the range of loads through which the machine operates.

average feed concentration The arithmetic average feedwater composition of a substance. In pressure-driven membrane separation,

$$\text{average feed concentration} = \frac{(C_f + C_c)}{2}$$

Where:

C_f = feed concentration, in milligrams per liter
C_c = concentrate concentration, in milligrams per liter

For reverse osmosis, a log-mean feed concentration is sometimes considered instead of the arithmetic average feed concentration to better simulate conditions in a concentrate-staged system. *See also* log-mean feed concentration.

average flow The arithmetic average of flows measured at a given point. *See also* mean flow; normal flow.

average flow rate The average of the instantaneous flow rates over a given period of time, such as a day.

average groundwater velocity The average distance traveled per unit of time by a body of groundwater. It is equal to the total volume of groundwater passing through a unit cross-sectional area in unit time divided by the porosity of the water-transmitting material.

average linear velocity *See* actual groundwater velocity.

average rainfall intensity (ARI) A measurement of rainfall, expressed in inches or centimeters of rain per unit of time.

average speed of answer (ASA) The amount of time a caller waits on hold before speaking to an agent.

average streamflow The average rate of discharge during a specified period. *See also* mean flow.

average velocity The average velocity of a stream flowing in a channel or conduit at a given cross section or in a given reach. It is equal to the discharge divided by the cross-sectional area of the section or the average cross-sectional area of the reach. Average velocity is also called mean velocity.

average water consumption The amount of water (in gallons per day) that a consumer typically uses for indoor purposes. This amount usually does not include outdoor uses such as irrigation.

average year A year for which the observed quantities of hydrologic phenomena, such as precipitation, evaporation, temperature, and streamflow, approximate the mathematical mean of such observed quantities for a considerably longer period. *Normal year* is a better term.

average-year demand Water demand under average hydrologic conditions for a 365-day period.

average-year water supply The average amount of water available annually through a water system.

averaging Pitot flowmeter A flowmeter that consists of a rod extending across a pipe with several interconnected upstream holes, which simulate an array of Pitot tubes across the pipe, and a downstream hole for the static pressure reference. *See also* Pitot tube.

AVI *See* aggregate volume index.

avidity A characteristic of antibodies that tends to enhance their rate or firmness of combination with antigen.

Avogadro number The number of molecules in a mole of any molecular substance, or the number of atoms in a mole of any substance in atomic form, its value being 6.023×10^{23}. For example, 1 mole (16 grams) of oxygen atoms contains 6.023×10^{23} oxygen atoms.

avoided cost The incremental savings associated with not having to produce additional units of water or water service. Avoided cost can be used to compare demand management and supply management options and to encourage utilities to seek out least-cost alternatives for meeting future water needs.

avoirdupois (avdp) *See in the Units of Measure section.*

AWA *See* Australian Water Association.

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AWOP *See* Area-Wide Optimization Program.

AWRA *See* American Water Resources Association.

A/W ratio *See* air-to-water ratio.

AWWA *See* American Water Works Association.

Awwa Research Foundation (American Water Works Association Research Foundation) Former name for the Water Research Foundation. *See also* Water Research Foundation.

AwwaRF *See* Water Research Foundation.

AWWA standard The minimum requirements for water supply products or procedures established by the American Water Works Association (AWWA) through a consensus process that involves representatives from different interest groups, including manufacturers, water utilities, consultants, governmental agencies, and others. AWWA standards are not legally binding and are not specifications, but they may be referenced in specifications of water utilities or others who are acquiring a particular type of product or procedure. *See also* American Water Works Association.

axenic culture A culture free of all living organisms except those of a single species. The concept of axenic culture gave rise to the development of pure culture techniques in bacteriology.

axial flow *See* longitudinal flow.

axial-flow pump A type of centrifugal pump that develops most of its head by the propelling or lifting action of the vanes on the liquid. Such a pump is also called a propeller pump.

axial to impeller The direction of the discharge of the flow—parallel to the impeller shaft—with propeller pumps, as opposed to the discharge being perpendicular to the impeller shaft with centrifugal pumps.

axis of impeller An imaginary line running along the center of an impeller shaft.

axoneme Basal portions of flagella within cytoplasm.

azeotrophic mixture A term describing a liquid mixture of two or more substances that behaves like a single substance. The vapor produced by partial evaporization of the liquid has the same composition as the liquid.

azurite ($2CuCO_3Cu(OH)_2$) Azure-blue to dark blue in color, a commonly reported copper corrosion byproduct found on drinking water distribution system pipes.

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B

B2B site *See* business-to-business site.

B2C site *See* business-to-customer site.

B2E site *See* business-to-employee site.

B6C3F1 mouse The standard mouse used by the National Toxicology Program in the United States. It is a hybrid derived from crossing male C3H mice with female C57BL mice. These mice inherit the very high background incidence of liver tumors (hepatocellular adenomas and carcinomas) from the tumor-prone C3H parent. The tendency for liver tumors is particularly evident in the males.

BAA *See* bromoacetic acid.

Babington nebulizer One of several devices that can be used for aspirating samples for analysis by inductively coupled plasma–mass spectrometry. It is suitable for samples with high matrix and high total dissolved solids levels because of its structure containing a large sample orifice. The material is based on polyetheretherketone formulation and is therefore resistant to many sample types, including hydrofluoric acid. *See also* inductively coupled plasma–mass spectrometry; nebulizer.

BAC *See* biologically enhanced activated carbon.

Bacillus anthracis (B. anthracis) A nonmotile, aerobic spore-forming gram-positive bacillus belonging to the family Bacillaceae. These ubiquitous soil bacteria are responsible for an infection in humans known as anthrax.

***Bacillus* spore** A highly resistant endospore produced by *Bacillus* spp. *See also* aerobic bacterial spore; *Bacillus anthracis*; *Bacillus subtilis.*

Bacillus stearothermophilus
See Geobacillus stearothermophilus.

Bacillus subtilis (B. subtilis) An aerobic spore-forming gram-positive bacillus that is ubiquitous in soil and decomposing matter. *Bacillus subtilis* is nonpathogenic. This microbe's genome is well studied in microbiology and genetic engineering and is often used as a host in recombinant deoxyribonucleic acid experiments because of its ability to secrete proteins. *See also* aerobic bacterial spore.

backblowing A reversal of the flow of water under pressure in a conduit or well to remove clogging material. *See also* backwash.

backfill The material placed in an excavation after construction or repair of water facilities.

backflow A hydraulic condition, caused by a difference in pressures, that causes nonpotable water or other fluid to flow into a potable water system.

backflow connection In plumbing, any arrangement whereby backflow can occur. It is also called an interconnection or cross-connection. *See also* backflow; cross-connection.

backflow preventer A device for a water supply pipe to prevent the backflow of water into the water supply system from the connections on its outlet end. *See also* check valve; vacuum breaker.

backflow prevention The use of a system or a device such as a double gate, double check assembly, or air gap to separate a potable water system from a system of water of unknown quality or source. The device or system prevents water from flowing back into a protected system when the pressure in the protected system drops lower than in the system of unknown quality. *See also* backflow-prevention device.

backflow-prevention device Any effective device, method, or construction used to prevent backflow into a potable water system. *See also* air gap; backflow prevention; check valve.

backflow-tester certification A program usually administered by the state to train and provide experience for people to be certified to test backflow devices. *See also* backflow.

backflushing The reversing of flow direction through a filter, ion-exchange column, or membrane to remove particles for cleaning purposes. The backflush source can be feedwater, treated water, some other fluid, or air. *See also* backwash.

background concentration The quantity of gaseous liquid or solid material in relation to a weight or a volume of other substances in which the material is mixed, suspended, or dissolved as a result of natural processes.

background correction, deuterium
See deuterium background correction.

background correction, Smith–Hieftje
See Smith–Hieftje background correction.

background correction, Zeeman *See* Zeeman background correction.

background level In toxic substance monitoring, the average presence of a substance in the environment, formerly referred to as naturally occurring phenomena.

background losses Individual water loss events (small leaks and weeps at pipe joints) that continue to flow, with flow rates too low to be detected by an active leakage control program, unless detected by chance or when they gradually worsen to the point that they are disruptive and are detected. *See also* system leakage.

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background organic matter (BOM) Natural organic matter in a mixture with one or more specific organic chemicals but at a much higher concentration than those chemicals. Background organic matter frequently interferes with the adsorption of the specific organic compound on solid adsorbents. *See also* fouling; natural organic matter; preloading.

background radiation Radiation extraneous to an experiment.

backhoe A track-mounted or wheeled machine hydraulically controlled and operated to excavate for water facilities construction or repair.

backmixing The creation of eddy-like velocities in a water stream by changes in pipe size or direction that allow chemicals added by pulsating pumps to mix evenly with the receiving stream.

backpressure A pressure that can cause water to backflow into the water supply when a user's water system is at a higher pressure than the public water system.

backpressure valve A valve provided with a disk hinged on the edge so that it opens in the direction of normal flow and closes with reversal of flow. Such a valve is frequently called a check valve.

back-pullout An end-suction pump design that allows a portion of the pump casing to be removed without disturbing the suction or discharge pipes.

backpulse A type of membrane backwash or reverse filtration procedure. For some types of low-pressure microporous hollow-fiber membranes, backpulse is a backwashing technique in which filtered water is introduced into the filtered-water side of a membrane for a short duration and then flows through the membrane barrier to the feed side as a method for dislodging particles from the membrane.

backsiphonage A form of backflow caused by a negative or subatmospheric pressure within a water system. *See also* backflow; vacuum breaker.

backup system Any part of a water system that is used as an auxiliary or alternate, e.g., a diesel engine backing up an electric motor.

backward elimination A method used for statistical regression analyses in which all variables are initially included and the least important ones are eliminated in sequence.

backwash (1) The process of cleansing filter media of particles that have been removed during the filtration or adsorption process. Backwashing involves reversing the flow through a filter to dislodge the particles. Backwash water is either treated and returned to the plant influent or is disposed. (2) The passing of a fluid (feedwater, treated water, or other fluid) or air through an ion-exchange column or some types of microporous membranes for cleaning purposes to remove particles.

backwashable depth filter A filter consisting of layers of fibers of varying thickness that are entwined with each other in a random pattern, resulting in a porous structure. The filter retains particles and contaminants throughout its entire cross section, and it can be cleaned by reversing the flow through it to dislodge the particles.

backwashing *See* backwash.

backwash rate The velocity of water used in the backwash process. The unit of measure is a flow rate per unit area. *See also* backwash.

backwash recycle The practice of reusing spent or dirty backwash water by returning the water to the treatment plant. Generally, backwash recycle is returned to the influent raw water. The US Environmental Protection Agency requires that backwash recycle be returned to a point in the treatment plant that allows it to be treated through all processes of existing treatment.

backwash stage A specific action in the sequence of actions that form the backwash process. Examples of backwash stages include filter drawdown, initial media fluidization, backwashing at one or more rates, and filter-to-waste. *See also* backwash; filter drawdown; filter-to-waste; fluidization.

backwash volume The volume of water used to backwash a filter during the filter cycle. As this volume increases, the net productivity of the filter will decrease unless the total volume of water filtered during the run has increased in proportion to the increase in the backwash volume.

backwater (1) The increased depth of water upstream from a dam or obstruction in a stream channel caused by the existence of such obstruction. (2) The body of relatively still water in coves or covering low-lying areas and having access to the main body of water. (3) A water reserve obtained at high tide and discharged at low tide. *See also* backwater curve.

backwater curve The longitudinal shape of the water surface in a stream or open conduit where such water surface is raised or lowered from its normal level by a natural or artificial constriction. In uniform channels, the curve is concave upward, the velocities decrease in a downstream direction, and the flow is nonuniform.

bacteria (bacterium) Microscopic unicellular organisms having a rigid cell wall. Bacteria lack a nuclear membrane, a mitotic system, and mitochondria; possess only a single piece of chromosomal deoxyribonucleic acid; and divide by binary fission. Most are nonphotosynthetic.

bacterial aftergrowth The growth of bacteria in treated water after that water reaches the distribution system. *See also* bacterial regrowth.

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bacterial conjugation A process by which bacteria exchange extrachromosomal genetic material. Conjugation is one of the mechanisms by which bacteria can acquire new genetic material and, as a result, new traits like antibiotic resistance.

bacterial examination An analysis of water for bacteria, conducted qualitatively, quantitatively, or both. Drinking water is examined to determine the presence, number, and identity of bacteria. This process is also called a bacterial analysis. *See also* bacteriological count.

bacterial gastroenteritis *See* waterborne disease.

bacterial mutagenesis Mutagenic activity in bacteria (e.g., *Salmonella* in the Ames test) that are being used to prescreen chemicals for such activity. Positive results in this type of test heighten concern that a carcinogenic chemical may have the capability of acting as a genotoxic agent. A positive response in these assays suggests that an untested chemical may be carcinogenic. These data cannot substitute for carcinogenesis tests in either a qualitative or a quantitative way.

bacterial nutrient An organic or inorganic compound used by bacteria to meet their nutritional requirements for survival, growth, and multiplication. *See also* assimilable organic carbon; biodegradable organic carbon.

bacterial phage *See* bacteriophage.

bacterial regrowth The presence of a persistent population of bacteria in a water distribution system. Such regrowth may lead to problems in the compliance monitoring of total coliform bacteria.

bacterial regrowth potential An assessment of the potential for bacteria present in treated drinking water to increase in density in the absence of a disinfectant residual.

bacterial viability test A method to determine the viability of the test organism under controlled conditions.

bactericide Any substance or agent that kills bacteria.

bacteriological analysis The examination of an environmental, water, or food sample for the presence of bacteria. The analysis may be to detect or enumerate either specific types of bacteria, the general heterotroph population density, or both. It may involve a variety of methods, including microscopic examination, culture techniques, and genetic, immunologic, or enzyme probes.

bacteriological corrosion Corrosion that results from the by-products of bacteria including sulfate-reducing bacteria in media of very low or no oxygen content.

bacteriological count A quantification of the number of bacteria per unit volume in a water sample. *See also* heterotrophic plate count; indicated number; most probable number; plate count.

bacteriologically mediated Influenced or controlled by bacteria, such as with a process or reaction.

bacteriology A subset of microbiology focusing on the study of small, single-celled prokaryotic organisms.

bacteriophage A group of viruses that infect and grow in bacteria, such as coliphages that grow in *Escherichia coli.* Following replication in the host bacterium, new bacteriophages are released by lysis of the host cell. Bacteriophages can be used as surrogates or models in place of human enteric viruses during water treatment testing and can be potential indicators of pathogens. Examples of common bacteriophages are MS2 coliphages and F-specific phages. A bacteriophage is also called a phage. *See also* F-specific coliphage; MS2 coliphage.

bacteriophage MS2 A single-stranded ribonucleic acid phage that belongs to the family Leviviridae and infects various strains of the bacterium *Escherichia coli*. MS2 measures 24–26 nanometers in diameter and is symmetrically icosahedral. This phage is commonly used in device testing and inactivation studies. *See also* MS2 coliphage.

bacteriostatic Having the ability to inhibit the growth of bacteria without destroying the bacteria.

bacteriostatic agent Substance that stops or inhibits growth or multiplication of bacteria.

***Bacteroides* species phage** A phage specific to the bacterium *Bacteroides* that is common in human feces and grows under anaerobic conditions. Detection of this phage is an indicator of polluted water.

BAF *See* biologically active filtration.

baffle A metal, wooden, or plastic plate installed in a flow of water to slow the water velocity and provide a uniform distribution of flow.

baffled-channel system A system that includes baffles to minimize short-circuiting or to provide flocculation as a result of head loss through the baffled system. *See also* baffling; flocculation.

baffle wall A physical barrier designed to modify the flow characteristics into a treatment basin, alter the distribution of the flow stream, and minimize short-circuiting. For example, a sequence of solid baffle walls may be used to approximate plug flow conditions, or a perforated baffle wall may be used to improve the flow distribution into a basin. *See also* dispersion; perforated baffle wall; plug flow; sedimentation basin.

baffling The process of adding physical barriers to modify the distribution of flow and alter the distribution of the flow stream. *See also* baffle wall.

bag filter A filtration device made with a woven fabric bag that is inserted into a rigid housing. The fabric bags are manufactured with materials and filtration properties (i.e., specific size openings in the fabric

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media) for the application. Commonly, the bags are replaced with new ones when they are clogged; in some cases, however, bags may be cleaned and reused.

bail-down test A type of slug (aquifer) test performed by using a bailer to remove a measured volume of water from a small-diameter well.

bailer A device used to withdraw a water sample from a small-diameter well. Typically a piece of pipe attached to a wire with a check valve in the bottom is used as a bailer.

Baird–Parker agar Growth medium that permits the detection, enumeration, and isolation of coagulase-positive bacteria of the genus *Staphylococcus* after 24 hours of incubation.

BaIReMt *See* batch internal recycle membrane test.

balance An instrument used to measure weight.

balanced Pertaining to a chemical equation such that, for each element in the equation, the same number of atoms shown on the right side of the equation are shown on the left side.

balanced flow A flow pattern that is controlled to achieve the flow specified for that water treatment system.

balanced gate A gate in a reservoir outlet, conduit, or similar structure that operates automatically to release water and that usually is controlled by the head of water behind the gate.

balanced mechanical seal A spring-loaded or rubberized seal designed to reduce the leakage between a pump casing and the rotating shaft, used rather than a packing gland and pump packing material.

balance sheet A financial statement summarizing the assets, liabilities, and net worth of a business or an individual at a given time. A balance sheet is so called because the sum of the assets equals the total of the liabilities plus the net worth.

balancing reservoir A holding basin in which variations in flow and composition of a liquid are averaged. Such a basin is used to provide a flow of reasonably uniform volume and composition to a treatment plant. It is also called an equalizing basin or a balancing tank.

balancing tank *See* balancing reservoir.

Balantidium coli (B. coli) Large ciliated protozoa known to parasitize humans. Fecally contaminated water is a major source of transmission to humans. Infection of the human colon typically results in fever and diarrhea.

ballast *See* electrical ballast.

ballasted floc clarifier A clarifier used for removal of suspended solids in which particle removal is assisted by weighted or ballasted flocs. *See also* sand ballasted flocculation–sedimentation.

ballasted flocculation
See sand ballasted flocculation–sedimentation.

ballasted sand flocculation
See sand ballasted flocculation–sedimentation.

ball joint A flexible pipe joint made in the shape of a ball or sphere.

ball valve A valve with the closing and opening mechanism formed in the shape of a ball with a hole. The valve is opened by rotating the ball so the hole is parallel to the flow, allowing it to pass. The valve is closed when the hole is perpendicular to the flow.

BAM *See* biofilm accumulation model.

BAN *See* bromoacetonitrile.

band A thin circular metal strip with a gasket inside used to repair a leaking pipe by applying compression around the pipe by bolts attached to each end of the metal strip. It is also called a repair clamp, full circle repair clamp, full circle repair band, or a stainless-steel band.

banded steel pipe A steel pipe for which the strength has been increased by the use of bands shrunk around the shell. Such pipe is used under extremely high heads for which the shell thickness ordinarily required would be greater than about 1 ¼ inches (3 centimeters).

bandwidth A measure of data transmission speed. For example, a bandwidth of 10 megabytes means the line can transfer data at the rate of 10 million binary digits per second.

bank (1) The continuous margin along a river or stream where all upland vegetation ceases. (2) The elevation of land that confines waters of a stream to their natural channel in their normal course of flow. (3) The rising land bordering a river, lake, or sea. (4) In a pressure-driven membrane treatment system, a grouping of membrane modules or pressure vessels in a common control unit or stage. (5) An institution for receiving, lending, exchanging, and safeguarding money, issuing notes, and transacting other financial business.

bank instrument Any of a variety of legal documents, such as a memorandum of agreement, check, or money order, that sets up the specifics of a bank.

bank protection Riprap, paving, brush, concrete, or other material placed to prevent erosion on a stream, reservoir, or lake shore. It usually extends to and beyond the thalweg of the channel.

bank sponsor A person or entity that financially supports or funds the mitigation bank. *See also* mitigation bank sponsor; mitigation banker; mitigation banking.

bank storage Groundwater temporarily stored in sediments adjacent to a stream channel caused by a rise in stream elevation during flooding. It is a significant

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storage component in controlled streams and in arid climates.

B. anthracis *See Bacillus anthracis.*

bar (1) An alluvial deposit or bank of sand, gravel, or other material at the mouth of a stream or at any point in the stream itself that obstructs flow or navigation; in the case of a bay or inlet, a spit that extends completely across the waterway. (2) *See* bar *in the Units of Measure section.*

bar code An identification code made up of lines of varying thickness that are optically read and most commonly used for inventory and work time tracking.

BaReMT *See* batch recycle membrane test.

barium (Ba) An alkaline-earth metal. In nature, barium is found in the ores of barite and witherite. Its atomic number is 56, and it is bivalent. Barium has various industrial uses, and its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 2 milligrams per liter. *See also* alkaline-earth metals.

barometric efficiency (of an aquifer) The ratio of groundwater elevation change in a confined aquifer to change in atmospheric pressure. Barometric efficiency is significant in estimating water reserves and hydraulic performance of wells in confined aquifers.

barometric loop A backflow prevention system consisting of a looped piping arrangement 35 feet (11 meters) in height, in which water flow goes over the loop at the top. This method of backflow prevention is capable of protecting only against backsiphonage, because backpressure could drive water backward over the loop.

barometric pressure The force per unit area exerted by air. The measuring device is a barometer. The numerical value of the barometric pressure is a function of the air temperature, relative humidity, and the elevation above sea level of the instrument. Typical units are inches of mercury, pounds per square inch, millibars, atmospheres, and kilopascals.

barothermograph An instrument that records simultaneous barometric pressure and temperature on the same chart.

barrel (bbl) *See in the Units of Measure section.*

barrier boundary (1) A groundwater flow boundary caused by an abrupt change in hydraulic conductivity of the aquifer. (2) An engineered low-hydraulic-conductivity unit used to isolate a contaminated part of an aquifer. Examples include slurry walls, sheet pile walls, and grout curtains.

barrier spring (1) A spring formed above a fault between a raised bedrock block and a depressed block covered by a thick deposit of alluvium. (2) A spring that occurs when a raising of the confining bed forces the groundwater to rise to the ground surface.

bar screen A series of straight steel bars welded at their ends to horizontal steel beams, forming a grid. Bar screens are placed on intakes or in waterways to remove large debris.

base In practical terms, a chemical that, when dissolved in water, yields a pH greater than 7. The Bronsted–Lowry concept defines a base by its function as a proton acceptor. The Lewis theory describes a base as a species that can donate its lone pair of electrons.

base-catalyzed hydrolysis A chemical reaction that is catalyzed by hydroxide ions (OH^-) in which water reacts with another substance to form two or more new substances. A number of disinfection by-products can undergo base-catalyzed hydrolysis (e.g., 1,1,1-trichloropropanone can be converted to chloroform by this process). *See also* catalysis.

base costs Costs that tend to vary with the total quantity of water used and operation under average load conditions. Costs include operation and maintenance expenses of supply, treatment, pumping, and transmission and distribution facilities; and capital costs related to plant investment associated with serving customers at a constant, or average, annual rate of use (100 percent load factor), often used as a component for allocating costs to customer classes. *See also* base–extra-capacity approach to rate structure design.

base exchange *See* cation exchange.

base exchange process A process permitting an exchange of positive ions on a prepared medium. *See also* cation exchange.

base–extra capacity *See* base–extra-capacity approach to rate structure design.

base–extra-capacity approach to rate structure design A rate structure design method in which the costs of service are assigned to four cost components: (1) base costs that include operations and maintenance (O&M) and capital costs that tend to vary with the total quantity of water used and costs that relate to average load conditions; (2) extra-capacity costs that include O&M and capital costs associated with meeting rate-of-use requirements in excess of average use, usually expressed in terms of meeting maximum-day and maximum-hour demand; (3) customer costs that relate to serving customers irrespective of the amount or rate of water use; and (4) direct costs incurred solely for the purpose of fire protection.

base flow (BF) That part of the stream discharge that is not attributable to direct runoff from precipitation or melting snow. It is usually sustained by water draining from natural storage in groundwater bodies, lakes, or swamps.

base flow recession The declining rate of discharge observed for an extended period in a stream fed only

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by base flow. Typically the recession can be described by an exponential function.

base flow-recession hydrograph A hydrograph depicting the base flow-recession curve. It is interpreted using an exponential model to determine the annual recharge to a groundwater basin.

baseline The condition of a natural community or environment at the starting point (e.g., prior to restoration activities) that will be used to track future changes.

baseline data The historical water usage of the water provider's customers, either in total or for the selected customer sample.

baseline survey A detailed assessment of the environmentally significant ambient chemical, physical, and biological conditions existing in a specific geographical area before superimposing additional human activity.

baseline test The process of taking a measurement that represents a starting or initial level of ability. Such a measurement is typically used for health tests.

base load The minimum use of something (water, electricity, and so on) over a given period of time.

base map A map of locations of basic mapped data that remain constant.

base metal A metal (such as iron) that reacts with dilute hydrochloric acid (HCl) to form hydrogen. *See also* noble metal.

base-pair substitution An alteration in a deoxyribonucleic acid (DNA) sequence that results from the substitution of one normal base (i.e., adenine, guanine, thymine, or cytosine) for another in DNA. When this DNA is replicated during cell division, a new complementary base will be inserted into the new strand; thus, the substitution comes as a pair. Such an alteration will be passed on as a mutation to subsequent generations of the affected cell. If this mutation results in changing the amino acid sequence in the protein coded for in this stretch of DNA, it may alter the protein's function or the regulation of its activity by the cell. Such mutations may be lethal or may result in abnormal development or function of a cell. A series of such mutations can give rise to a cancer cell.

base peak The most abundant mass/charge ratio peak in a mass spectrum being used for organic analysis. In most cases, the peaks in a mass spectrum are normalized to the size of the base peak; therefore, the base peak will be the largest peak in the mass spectrum.

base plate A flat steel section to which an electric motor and pump are bolted, used to provide a rigid and level platform for installing the pump–motor unit on a foundation.

base runoff Sustained or dry weather flow. In most streams, base runoff is composed largely of groundwater runoff.

basic In practical terms, pertaining to a solution with a pH greater than 7.

BASIC (Beginner's All-Purpose Symbolic Instruction Code) A computer programming language in which statements are translated and executed rather than being compiled prior to execution.

basic data Records of observations and measurements of physical facts, occurrences, and conditions as they have occurred, excluding any material or information developed by means of computation or estimate. In the strictest sense, basic data include only the recorded notes of observations and measurements, although in general use it is taken to include computations or estimates necessary to present a clear statement of facts, occurrences, and conditions.

***Basic Financial Statements—and Management's Discussion and Analysis—for State and Local Governments* (GASB Statement No. 34 [GASB 34])** A Governmental Accounting Standards Board (GASB) policy statement that establishes reporting requirements for preparing annual financial reports for state and local governments. GASB 34 requires inclusion of management discussion and analysis, which consist of a basic narrative at the beginning of financial statements providing an analytical overview of the government's financial activities and performance during that year. It is also referred to as Governmental Accounting Standards Board Issued Statement 34.

basic hydrologic data Records of (1) measurements and observations of the quantity per unit of time of precipitation, including snowfall; streamflow; evaporation from water; the elevation of natural water planes, both surface and underground, and the change thereof from time to time; and (2) any related phenomena and natural conditions necessary to allow estimates to be made of the past, present, and probable future occurrence of water. The unit of time involved in recording the quantities may vary from seconds to years, depending on custom, convenience, and method of compilation and publication of the data.

basicity The state of being basic (alkaline) as opposed to being acidic. On the pH scale it measures above 7.

basic polyaluminum chloride (BPACl) A preformed inorganic polymeric coagulant, used in place of or in conjunction with a metal coagulant like alum. *See also* polyaluminum chloride.

basic solution A solution that contains significant numbers of OH^- ions and has a pH greater than 7.

basic stage flood An arbitrarily selected rate of flow of a stream used as the lower limit in selecting floods

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to be analyzed, usually taken as the minimum annual flood.

basic water *See* basic solution.

basin (1) A natural or artificially created space or structure, on the surface or underground, that has a shape and character of confining material that enable it to hold water. This term is sometimes used to describe a receptacle midway in size between a reservoir and a tank. (2) The surface area within a given drainage system. (3) An area upstream from a subsurface or surface obstruction to the flow of water. (4) A shallow tank or depression through which liquids may be passed or in which they are detained for treatment or storage. *See also* tank.

BASINS *See* Better Assessment Science Integrating Point and Nonpoint Sources.

basin storage capacity Either the total or usable volume of water that can be stored in a watershed. This may consist of the water in surface reservoirs, in the aquifers that underlie the watershed, or both.

BAT *See* best available technology.

batch electrokinetic-charge analyzer A batch single-sample instrument used for determining the electrokinetic characteristics of particles in a water sample. Depending on the design of the instrument, particle charge characteristics can be quantified by charge titration, streaming potential, streaming current, or electrophoretic mobility. *See also* charge titration; electrophoretic mobility; streaming current; streaming potential.

batch internal recycle membrane test (BaIReMT) Test of a membrane unit in a batch mode with recycled process output flow(s) where the recycle flow(s) are returned to the feed of the membrane system internally rather than by use of an external device such as a tank. *See also* batch recycle membrane test.

batch mode A type of process operation in which the feed input and process output flows are not continuous. *Contrast with* continuous mode.

batch process A process for treatment in which a reactor or tank is filled, the water is treated or a chemical solution is prepared, and the tank is emptied. The tank may then be refilled, and the process may then be repeated. *See also* batch treatment.

batch processing A mode of computer processing in which the user is not in direct communication with the processing unit while a program is being executed. In batch, or off-line, processing, the user submits a job request to the processing unit for execution when time is available. The job is placed in a batch queue in a temporary storage area. The job contains information necessary to execute the program, the destination of products to be generated, and identification of the user.

batch recycle membrane test (BaReMT) Test of a membrane unit in a batch mode, where source water input and process output flow(s) are not continuous and where process output flow(s) (such as concentrate, or permeate flow streams, or both) are returned (recycled) to the membrane source water and blended to produce the membrane feed stream (such as concentrate return in a reverse osmosis or nanofiltration test system to produce increased feed-concentrate concentrations to simulate higher recovery). *See also* batch internal recycle membrane test.

batch treatment A method in which a fixed quantity of water is processed through a single treatment device in a single vessel. *See also* batch process.

bathing As interpreted by the US Environmental Protection Agency, the use of water for personal hygiene purposes in a home, business setting, school, and so forth. The term *bathing* does not refer to swimming in an open canal or to incidental, casual contact with water from an open canal in connection with outdoor activities (such as agricultural work, canal maintenance, or lawn and garden care). *See also* human consumption.

battery A device for producing direct current electric current from a chemical reaction. In a storage battery, the process may be reversed, with current flowing into the battery, thus reversing the chemical reaction and recharging the battery.

battery backup Power supplied by battery to components requiring power to retain stored information. For example, clocks and calendars used in system setup are supplied with battery backup.

battery of wells A group of wells from which water is drawn by a single pump or other lifting device. It is also called a gang of wells.

baud *See in the Units of Measure section.*

Baumé (Bé) degree A unit of measure used in two scales of density that are related to the specific gravity of a solution. In the heavy Baumé scale, 0°Bé corresponds to a specific gravity of 1.000 (water at 4° Celsius). In the light Baumé scale, 0°Bé is equivalent to a solution of 10 percent sodium chloride (NaCl). Aqueous solutions of ammonium hydroxide (NH_4OH) used in water treatment (aqua ammonia) are often specified in terms of degrees Baumé.

Bayesian analysis A statistical principle used to select the strategy with the greatest payoff from among several available ones. The procedure, also known as the Bayesian principle, involves calculating the probability of occurrences for each strategy.

bay region epoxide A reactive intermediate that forms in a chemical structure made up of (1) ring substitutions that are ortho (adjacent) to one another on a third ring or (2) analogous substitutions on two aliphatic carbons. The diol-epoxides of certain polyaromatic

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hydrocarbons (e.g., benzo(a)pyrene) are the metabolites that are responsible for the carcinogenic effects of those hydrocarbons, as opposed to other epoxide intermediates (e.g., K-region epoxides). It is the active form of the carcinogenic polyaromatic hydrocarbons.

bay salt A relatively coarse salt made from seawater.

Bazin roughness coefficient The roughness coefficient, *m*, in Bazin's discharge coefficient formula:

$$C = \frac{157.6}{1 + m/\sqrt{R}}$$

Where:

C = open-channel discharge coefficient
m = a coefficient of channel roughness, the value of which varies from 0.100 to 3.20
R = hydraulic radius of the channel, in feet

The value of C is then used as the discharge coefficient in the Chezy open-channel formula:

$$V = C\sqrt{RS}$$

Where:

V = velocity of flow, in feet per second
R = hydraulic radius of the channel, in feet
S = channel slope (for uniform flow) or energy slope (for nonuniform flow), dimensionless

BBDR modeling *See* biologically based dose–response modeling.

bbl *See* barrel *in the Units of Measure section.*

BC *See* body contact.

BCA *See* bromochloroacetaldehyde.

BCAA *See* bromochloroacetic acid.

BCAN *See* bromochloroacetonitrile.

BCD *See* binary coded decimal.

B cell A lymphocyte (white blood cell) responsible for synthesizing circulating antibodies.

BCF *See* brine consumption factor.

BCIM *See* bromochloroiodomethane.

BCNM *See* bromochloronitromethane.

B. coli *See Balantidium coli.*

BCSP *See* Board of Certified Safety Professionals.

BDCA *See* bromodichloroacetaldehyde.

BDCAA *See* bromodichloroacetic acid.

BDCAN *See* bromodichloroacetonitrile.

BDCM *See* bromodichloromethane.

BDCNM *See* bromodichloronitromethane.

1,1,1-BDCP *See* 1-bromo-1,1-dichloropropanone.

BDIM *See* bromodiiodomethane.

BDOC *See* biodegradable organic carbon.

BDOM *See* biodegradable organic matter.

Bé *See* Baumé degree.

bead count A method of evaluating the physical condition (quality) of the resin in a bed by determining the percentages of whole, cracked, or broken beads in a wet sample of the resin.

beaker A container with an open top, vertical sides, and a pouring lip, used for mixing chemicals.

bearer bond A security that has no identification as to owner. It is presumed to be owned by the holder of the bond. Such bonds are no longer issued since Congress in 1983 required full registration of all new issues. Notes are still bearer designated.

bearing Usually stainless-steel balls set in grooved rings over one or both ends of a pump shaft to reduce friction. Pump bearings are usually regreasable; smaller motor bearings may be sealed bearings.

beaver fever *See Giardia lamblia.*

BECC *See* Border Environment Cooperation Commission.

becquerel (Bq) *See in the Units of Measure section.*

bed (1) The bottom of a watercourse or any body of water. (2) The weight of ion-exchange resin or other media through which the water passes in the process of water treatment.

bed depth The height of the medium (excluding support material) in a bed, usually expressed in inches or centimeters.

bedding The earth or other materials on which a pipe or conduit is supported.

bedding compaction The consolidation of bedding material to allow the bedding to withstand loads. Pipe bedding may be compacted to prevent pipe movement.

bed expansion The effect produced during backwashing when the filter medium becomes separated and rises in the tank or column. It is usually expressed as a percentage increase of bed depth, such as 25 percent, 50 percent, or 75 percent.

bed life The time it takes for a bed of adsorbent to lose its adsorptive capacity. When this loss occurs, the bed must be replaced with fresh adsorbent or be regenerated.

bed load Sediment that moves by sliding, rolling, or skipping on or very near the stream bed; sediment that is moved by tractive forces, gravitational forces, or both, but at velocities less than that of adjacent flow.

bed-load discharge The quantity of bed load passing a given point in a unit of time.

bed-load sampler A device for sampling the bed load.

bed material In a stream system, the geologic formations and the alluvial deposits through which the stream channel is cut.

bed material sampler A device for sampling bed material.

bedrock Solid rock underlying unconsolidated surficial cover such as soil.

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bed volume (BV) The volume occupied by a bed of porous media or resin used for filtration, adsorption, or ion exchange. The number of bed volumes is a unitless measure that indicates the capacity of a system to remove contaminants. The product of the number of bed volumes and the empty bed contact time is the operation time. *See also* breakthrough; empty bed contact time; ion exchange.

beef extract A by-product of beef processing available as a powder, made up of proteins, used in 1 percent to 10 percent solutions to recover and desorb viruses from filters, sludges, or soils.

Beer–Lambert law A law that describes the linear relationship between the light absorption and the concentration of the absorbing material (absorber). This law is the theoretical foundation of colorimetric analysis. *See also* colorimetric analysis.

Beer's law *See* Beer–Lambert law.

Beginner's All-Purpose Symbolic Instruction Code *See* BASIC.

behead To cut off and capture by erosion, as sometimes occurs when the upper portion of one stream is captured by another. *See also* beheaded stream; river piracy.

beheaded stream A stream that has been separated from its original headwater drainage area by a second stream, which had greater erosive power, allowing it to drain the headwater area.

Belanger's critical velocity The flow velocity in a channel when critical flow occurs; usually called critical velocity. In equation form, for rectangular channels,

$$V_c = \sqrt{gY_c}$$

Where (in any consistent set of units):

V_c = Belanger's critical velocity
g = the gravitational constant
Y_c = the critical water depth.

See also critical flow condition*; see also* critical depth*;* critical velocity.

bell (1) In a pipe fitting, the recessed, overenlarged end of a pipe into which the end fits; also called a hub. (2) In plumbing, the expanded spigot end of a wiped joint.

bell-and-spigot joint A form of joint used on pipes that has an enlarged diameter or bell at one end and a spigot at the other that fits into and is laid in the bell. The joint is then made tight by lead, cement, a rubber O-ring, or other jointing compounds or materials.

bell joint clamp A repair clamp that can be installed over a water line joint that compresses a gasket against the bell and spigot to seal a leaking joint or gasket.

bellmouth An expanding rounded entrance to a pipe or orifice.

bellmouthed orifice An orifice with a short tube on the outside that flares or increases in diameter, away from the opening in the orifice plate.

bellmouth inlet A converging, funnel-shaped (that is, bellmouthed) entrance to a pipe or conduit, used to facilitate entry of water. It is also called flaring.

bellows gauge A device for measuring pressure in which the pressure on a bellows, with the end plate attached to a spring, causes a measurable movement of the plate.

belt filter *See* belt filter press.

belt filter press A piece of mechanical equipment designed to dewater sludge by applying pressure between two continuously rotating horizontal belts. The belts are supported by rollers that rotate at a fixed speed. Sludge is fed onto a lower belt, and water is squeezed from the sludge as it is pressed between the lower and upper belt. The filtrate is often either discharged to a sanitary collection system or treated and recycled to the plant influent. The dewatered sludge is typically applied to land or sent to a landfill. *See also* dewatering of sludge; filtrate; land application; landfill.

belt-line layout *See* gridiron system.

BEMX-1 *See* (E)-2-chloro-3-(bromochloromethyl)-4-oxobutenoic acid.

BEMX-2 *See* (E)-2-chloro-3-(dibromomethyl)-4-oxobutenoic acid.

BEMX-3 *See* (E)-2-bromo-3-(dibromomethyl)-4-oxobutenoic acid.

benchmark (1) A reference point from which measurements can be made. (2) A standard or point of reference in judging or measuring quality or value.

benchmark dose The dose that has been derived based on actual dose-response data from a mathematical model and that serves as a common point of departure for calculating a "safe" dose. The most common method of arriving at a benchmark dose is to apply the multistage model to a stochastic data set to derive the upper 95 percent confidence limit on a dose that would be predicted to give a 1 percent or 10 percent response rate (i.e., a response relatively close to the experimental data rather than one extrapolated over orders of magnitude). Then appropriate uncertainty factors are applied in much the same way that they are applied to no-observed-adverse-effect levels (NOAELs) or lowest-observed-adverse-effect levels (LOAELs). The advantage of this methodology is that it uses all the data in a data set and escapes the dilemma posed by the NOAEL and LOAEL, which are determined, in part, by the spacing between the doses used in the study and the study's

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statistical power (i.e., the numbers of animals used). *See also* multistage model; uncertainty factor.

bench-scale study An experimental study to evaluate the performance of unit processes performed in laboratory surroundings. For example, a jar test to evaluate the coagulation, flocculation, and sedimentation processes is performed on a batch of water, and the apparatus is of a size that will fit on a laboratory "bench." *See also* jar test.

bend A directional-change length of pipe, normally at a designated angle of 90°, 45°, 22½°, or 11¼°—known respectively as a 1/4 bend, 1/8 bend, 1/16 bend, or 1/32 bend—but able to be manufactured in a specific angle in some types of materials.

beneficial rainfall *See* effective precipitation.

beneficial use The lawful and prudent use of water that has been diverted from a stream or aquifer for human and natural benefit. A water user may be legally required to meet the criteria for beneficial use or risk losing the right to that water.

benefit–cost analysis A type of analysis often used in making decisions among alternatives, such as different sources of water, different types of equipment, different water treatment processes, and so forth. Benefit–cost analysis is most frequently applied to capital-spending decisions, although the process can be applied to cash flows of any type. The process is to calculate the net present values of alternative cash flows for the benefits (cost reduction, avoided capital, and so on) and compare them with the costs (new capital, processes, and so on). When the benefit–cost ratio is 1.0 or more, the benefits have a greater value than costs, and the project has at least passed this hurdle on the way to being undertaken. *See also* net present value; return on investment.

benefit–cost ratio *See* benefit–cost analysis.

benefits The advantages, tangible or intangible, gained by installing or constructing a system or works for one or more given purposes. Benefits may also be used as a measure for justifying projects proposed for construction at public expense.

benthic Relating to the bottom or bottom environment of a body of water.

benthos Organisms living on the bottom of bodies of water.

bentonite A form of clay that has been studied extensively with respect to the coagulation process. Bentonite can be added in waters of low turbidity to improve coagulation and flocculation and thereby improve particle removal in the source water. *See also* coagulation.

benzene (C_6H_6) An aromatic hydrocarbon used as a solvent. It is a volatile organic chemical whose presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.005 milligrams per liter. *See also* aromatic hydrocarbon; solvent; volatile organic compound.

benzene–toluene–ethylbenzene–xylene (BTEX) A group of volatile organic compounds commonly found in petroleum products and detected together in contaminated water or soil. They are regulated under the National Primary Drinking Water Regulations. *See also* National Primary Drinking Water Regulation; volatile organic compound.

benzene–toluene–xylene (BTX) (C_6H_6, benzene; $C_6H_5CH_3$, toluene; $C_6H_4(CH_3)_2$, xylene) The volatile organic compounds measured in gasoline.

benzenoid (Bz) A compound with fused benzene rings that has similar aromatic properties to benzene. Naphthalene, a benzenoid compound, is used as an insecticide**,** especially in mothballs. Benzenoid compounds are also polycyclic aromatic hydrocarbons. *See also* polynuclear aromatic hydrocarbon.

benzo(a)pyrene ($C_{20}H_{12}$) (PAH) A polynuclear (five-ring) aromatic hydrocarbon found in coal tar, in cigarette smoke, and in the atmosphere as a product of incomplete combustion. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.0002 milligrams per liter. *See also* coal tar; polynuclear aromatic hydrocarbon.

berm ditch A ditch constructed along a berm of ground to convey runoff of surface water.

Bernoulli law A physical law of hydraulics that states that under conditions of uniform steady flow of water in a conduit or stream channel, the sum of the velocity head, pressure head, and head resulting from elevation at any given point along the conduit or channel is equal to the sum of these three heads at any other point along the conduit or channel, taking into account the losses in head between the two points due to friction. In equation form, Bernoulli law may be expressed as follows for upstream point 1 and downstream point 2:

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2 + h_{f1-2}$$

Where (in any consistent set of units):

P_1 = pressure at point 1
P_2 = pressure at point 2
V_1 = velocity at point 1
V_2 = velocity at point 2
Z_1 = elevation at point 1
Z_2 = elevation at point 2
γ = specific weight of the fluid

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g = the gravitational constant
h_{f1-2} = amount of head loss caused by friction between points 1 and 2

beryllium (Be) An alkaline-earth metal element. In nature, beryllium is found in the ores of beryl. Beryllium has various industrial uses. Its atomic number is 4. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.004 milligrams per liter. *See also* alkaline-earth metals.

best available technology (BAT) (1) Under Section 1412(b)(4)(D) of the Safe Drinking Water Act, the best technology, treatment techniques, or other means that the US Environmental Protection Agency administrator finds available to water systems—after examination for efficacy under field conditions, not solely under laboratory conditions, and taking cost into consideration—for meeting National Primary Drinking Water Standards. For the purposes of setting maximum contaminant levels for synthetic organic chemicals, any best available technology must be at least as effective as granular activated carbon. Water systems are not required to use the best available technology set under Section 1412 to meet a regulation; they may use any technology acceptable to the state primacy agency. (2) Under Section 1415(9)(1)(A) of the Safe Drinking Water Act, the best technology, treatment techniques, or other means that the US Environmental Protection Agency administrator finds available (taking costs into consideration). To be eligible for a variance, a water system must agree to apply the best available technology designated under Section 1415 prior to applying for a variance.

Best available technology designations by the US Environmental Protection Agency under Sections 1412 and 1415 are separate and may or may not be the same. *See also* variance.

best management practice (BMP) A single *recommended* measure but is usually expressed as a *collection* of recommended measures (BMPs). A basic definition of a water conservation (or efficiency) "measure" is a technology or practice that reduces water use. What constitutes a BMP or BMPs is a subjective decision, usually made by a professional and/or regulatory group, based on the specific water-using activities and water conservation needs of a category of customers or end users (i.e., residential, landscape, industrial, and agricultural) under its jurisdiction.

beta (β) particle A directly ionizing product of radioactive decay that can be positively or negatively charged. Commonly used radioisotopes, such as ^{14}C, ^{3}H, and ^{32}P, emit only a single type of ionizing particle, the beta particle. Negatively charged beta particles are equivalent to high-speed electrons. Beta particles with photon emitters are limited to 4 millirems per year in drinking water by the US Environmental Protection Agency.

β-D-galactosidase *See under* galactosidase.

β-D-galactoside *See under* galactoside.

β-D-glucuronidase *See under* glucuronidase.

β-D-glucuronide *See under* glucuronide.

β-glucuronidase *See under* glucuronidase.

beta-Poisson model A mathematical model used to assess microbial risk and to develop dose–response relationship for various types of infection. Other models used for this purpose include exponential models and Weibull–Gamma models. A beta-Poisson model is typically described in the following form:

$$P = 1 - [1 + (Dose/\beta)]^{-\alpha}$$

where P is the probability of infection (i.e., response to the dose); dose can be in any typical unit such as number of oocysts per milliliter; and α and β are values defined by the dose–response curve specific to individual organisms.

beta ratio The ratio of the diameter of the constriction (or orifice) to the pipe diameter in a differential pressure-type flowmeter.

beta-ray spectrometer An instrument for the detection of the energy distribution of beta particles and secondary electrons. A beta particle is an electron or positron ejected after a collision of two particles or as a result of radioactive decay. A secondary electron is an electron ejected when a substance is bombarded with electrons (the primary electrons).

beta site The location for the testing of a new program or hardware.

beta value A commonly used statistical term to indicate the significance of a coefficient of regression.

beta version The first version of a product, usually in a test mode prior to commercial use.

BET method *See under* Brunauer–Emmett–Teller method.

Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) A multipurpose computer modeling system developed and maintained by the US Environmental Protection Agency for use in performing watershed-based and water quality–based studies.

betterment An addition or change made to a fixed asset that is expected to prolong the asset's life or increase its efficiency to an extent greater than normal maintenance would accomplish. The cost of the betterment is added to the book value of the asset.

BeV *See* billion electron volts *in the Units of Measure section.*

BF *See* base flow.

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bgd *See* billion gallons per day *in the Units of Measure section.*

BGM cells *See* Buffalo green monkey cells.

bhp *See* brake horsepower.

bias (1) A systematic error in an analytical method. Bias can be positive or negative. (2) A fixed amount that is always added or subtracted to a measurement. For example, if a tank level is measured as water depth by a level sensor but water surface elevation is needed for operations, then a bias equal to the elevation of the bottom of the tank can be added to the measurement of depth. This would result in the readout indicating the elevation of the water surface. (3) In epidemiology, an error or effect that may produce associations or measures of risk that depart systematically from the true value; to be distinguished from random error. Bias must be avoided during the study or controlled in the data analysis to ensure the internal validity of an epidemiologic study. Most common types of bias in epidemiologic studies are selection, observation, confounding, and misclassification bias.

bib valve A valve closed by screwing down a leather- or fiber-washered disk onto a seat in the valve body.

bicarbonate (HCO_3^-) An inorganic monovalent anion usually found in natural water. *See also* bicarbonate alkalinity.

bicarbonate alkalinity The acid-neutralizing capability caused by bicarbonate ions (HCO_3^-). At a normal pH of drinking water (pH < 9), the anions of calcium carbonate ($CaCO_3$) and magnesium carbonate ($MgCO_3$) are present primarily as bicarbonate ions, therefore, the concentration of alkalinity and bicarbonate ion are equal. *See also* alkalinity.

bicarbonate hardness The hardness of a water caused by the presence of calcium bicarbonate ($Ca(HCO_3)_2$) and magnesium bicarbonate ($Mg(HCO_3)_2$). It is usually the major component of carbonate hardness or total hardness. Bicarbonate hardness is often referred to simply as carbonate hardness. *See also* carbonate hardness; total hardness.

bifurcate To divide into two branches.

bifurcation gate A gate located at the point where a conduit is divided into two branches to divert the flow into either branch or allow flow into both branches.

bile A fluid that aids in the absorption of dietary fat. It is formed in canniculi passing between hepatocytes (liver parenchymal cells) by active transport of various solutes in blood, including bilirubin, bile acids, and their conjugates. Bile is stored in the gallbladder and secreted into the intestine in response to dietary fat. The bile is a common excretory mechanism for conjugated chemicals, particularly amphipathic chemicals (i.e., chemicals that have both polar and nonpolar character). Processing of conjugates in the intestine by endogenous bacteria can, however, free the parent chemical or one of its metabolites for reabsorption into the systemic circulation. A metabolite of trichloroethylene, trichloroethanol glucuronide, is secreted into the bile.

bile acid Acidic metabolites of cholesterol, generally found in bile as conjugates. *See also* bile.

bile salt The salts of bile acids. *See also* bile acid.

biliary atresia Closure of bile ducts.

bilirubin A bile pigment that is a breakdown product of heme. It is usually excreted into the bile as a glucuronide conjugate, but it is extensively processed by intestinal flora, reabsorbed, reconjugated, and secreted. *See also* bile; heme.

biliverdin A green bile pigment that is the initial breakdown product of hemoglobin. It is converted to bilirubin by reduction of a methine bridge. *See also* bile; bilirubin; hemoglobin.

biller direct model An electronic billing model in which the customer accesses billing information and handles payments directly from the biller's system or Web site.

bill frequency analysis An analysis of water bills, usually by customer class, to develop a distribution of how many customers use increasing amounts of water. These amounts are specified in terms of consumption blocks. Initially consumption blocks represent one unit (usually 1,000 gallons or 1,000 liters), but they are frequently summarized in 5- or 10-unit increments or according to water rate blocks. The purpose of the bill frequency analysis is usually to select break points for increasing block rates or to analyze historical consumption within existing rate blocks. *See also* inclining block rate.

billing The act of issuing a statement of charges for goods and services delivered. The statement is usually itemized.

billing allocation formula A regulated billing method in which an owner may pass the cost of water to the units within a multifamily complex or commercial property.

billing system The system that takes data from customers' meters to produce bills and track payments.

billion electron volts (BeV) *See in the Units of Measure section.*

billion gallons per day (bgd) *See in the Units of Measure section.*

bill of lading A contract issued to a shipper by a transportation agency. It lists the goods shipped, acknowledges their receipt, and promises delivery to the person named.

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bimetal couple A type of corrosion in which two different metals or alloys are in contact with each other in a common medium.

bimetallic Made of two different types of metals.

bimonthly user charges The charges made once every two months to the users of water service through the general water rate structures of the utility for the utility's share of the cost of servicing the water service requirements.

bin Classification of surface water treatment plants under the Long Term 2 Enhanced Surface Water Treatment Rule according to the average source water *Cryptosporidium* concentration:

Bin 1 < 0.075 oocyst/liter
Bin 2 ≥ 0.075 to 1 oocyst/liter
Bin 3 ≥ 1 to <3 oocysts/liter
Bin 4 ≥ 3 oocysts/liter

binary Having two possible states or values (e.g., on and off). Computer instructions and data are represented as sequences of binary digits.

binary coded decimal (BCD) A positional value code for which each decimal digit is binary coded into 4-bit segments.

binary digit (bit) The basic element of a binary code. A bit is a unit of computer information represented by an electrical pulse (binary value 1) or no pulse (binary value 0) or a similar code equivalent to the result of a choice between two alternatives (e.g., yes or no).

binary digits (bits) per second (bps) *See in the Units of Measure section.*

binary synchronous communication (BSC or Bisync) A protocol used for synchronous communication, often referred to as Bisync or bisynchronous protocol. This protocol, originally developed by IBM, was adopted by many mainframe and minicomputer vendors in the 1970s and early 1980s. Binary synchronous control is classified as a character-oriented protocol because a data transmission consists of frames of characters (8-bit strings), each of which represents a control signal or a portion of the message. Significant disadvantages of this protocol for interactive processing in complex networks led to the development of bit-oriented protocols in the late 1970s. IBM abandoned the use of BSC with its introduction of System Network Architecture. However, instruments are still in use (e.g., ATM machines) that use this protocol. *See also* synchronous communication.

binding arbitration A quasijudicial process in which the parties agree to submit an unresolved dispute for binding agreement to a neutral third party. The arbitrator makes a decision after both parties submit their positions.

binding region The site on which a natural ligand, drug, or other chemical binds to a macromolecule. These binding sites can be specific or nonspecific. Specific sites are those in which a biological response can be expected as a result of binding. This term can also refer to sites on deoxyribonucleic acid where protein effectors (e.g., transcription factors) control the expression of particular genes.

binomial distribution A type of nonparametric data distribution.

binuclear surface complex Complexes formed on the surface of solid phase surface groups. Ligands such as phosphate are known to form binuclear surface complexes and, as a result, inhibit dissolution of the solid.

bioaccumulation (1) A process by which a chemical becomes concentrated within organisms within a food chain. With organic chemicals, the extent of bioaccumulation is related to the chemical's lipid solubility (i.e., its oil–water partition coefficient) and its resistance to physical, chemical, and metabolic degradation. Inorganic chemicals can also be bioaccumulated, particularly some metals that are incorporated into bone (e.g., lead) or are complexed by proteins in particular organs (e.g., cadmium). Ambient water quality standards explicitly consider bioaccumulation in the human food chain; this is one reason why these standards vary from drinking water standards. (2) The uptake and retention of substances by an organism from its environment. *See also* ambient water quality standards.

bioassay (1) A technique that uses a change in biological activity (stimulatory, inhibitory, or toxic) of a test organism to qualitatively or quantitatively assess the effects of exposure to a defined chemical compound; a defined mixture of compounds; or a complex, undefined mixture. (2) A procedure used to determine the response of a specific microorganism after exposure to ultraviolet light. In the ultraviolet literature, bioassay is used in the same context as biodosimetry. *See also* biodosimetry.

bioassessment A comprehensive evaluation of the biological condition of a water body. Bioassessments consist of surveys and other direct measurements of aquatic life, including algae, fish, vegetation, and other resident living organisms.

bioavailability A measure of the extent to which a chemical is available for systemic absorption by an organism. Bioavailability varies by chemical form (e.g., depending on the oxidation states of metals or metalloids), the matrix in which the chemical occurs, and the route of exposure (i.e., skin, gastrointestinal tract, or lung).

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biocenosis A group of plants and animals living under the same conditions in the same space. It is also called a biotic community.

biochemical Pertaining to chemical change resulting from biological action.

biochemical action A chemical change resulting from the metabolism of living organisms.

biochemical fingerprinting The process of identifying microorganisms based on a matrix system of biochemical reactions by bacteria, e.g., glucose fermentation.

biochemical oxygen demand (BOD) A measure of the quantity of oxygen used in the biochemical oxidation of organic matter in a specified time and at a specific temperature. It is not related to the oxygen requirements in chemical combustion; it is determined entirely by the availability of the organic matter as a biological food and by the amount of oxygen the microorganisms use during oxidation. BOD serves as a surrogate for the biodegradable organic content (BDOC) in water because it is proportional to the BDOC.

biochemistry The branch of chemistry that deals with the chemical reactions involved in the life processes of plants and animals.

biocide A chemical that can kill or inhibit the growth of living organisms, such as bacteria, fungi, molds, and slimes.

biocide-to-food ratio *See* total-chlorine-to-free-ammonia ratio.

bioconcentration The physical, chemical, and biological processes that act to increase the concentrations of a chemical in an organism relative to its environment. Bioconcentration can occur by passive or active processes. Passive processes are governed primarily by the oil–water partition coefficient or specific complexation within a compartment such as the bone matrix. Active processes require the expenditure of metabolic energy.

biocorrosion An increase in corrosion of a metal or a corrosion by-product release as a result of the metabolic activity of microorganisms.

biodegradability The susceptibility of a substance to decomposition by microorganisms.

biodegradable Subject to degradation (breakdown) into simpler substances by biological action.

biodegradable organic carbon (BDOC or BOC) That portion of the organic carbon in water that can be mineralized by heterotrophic microorganisms. Ozone (O_3) can convert organic matter in water to biodegradable organic carbon, whereas biological filtration can reduce the biodegradable organic carbon level. *See also* biological filtration.

biodegradable organic matter (BDOM or BOM) That portion of the organic matter in water that can be degraded by microorganisms. Biodegradable organic carbon is a subset of biodegradable organic matter. *See also* biodegradable organic carbon.

biodegradation The breakdown of organic matter by microorganisms.

biodosimeter The challenge microorganism used to measure inactivation by ultraviolet irradiation and ultimately calculate the reduction equivalent dose (ultraviolet dose) in an ultraviolet reactor. *See also* ultraviolet dose–response.

biodosimetry Procedure used to determine the reduction equivalent dose of a given ultraviolet (UV) reactor. The procedure involves measuring the inactivation of a challenge microorganism after treatment in an ultraviolet reactor and then comparing UV reactor results to the known UV dose–response curve of the challenge microorganism established by collimated beam testing. *See also* bioassay; challenge microorganism; ultraviolet dose–response.

biofilm A layer of microorganisms held together by a matrix of organic polymers and found at the interface between water and a solid substrate in an aquatic environment. Biofilms in natural environments are heterogeneous and contain a range of microenvironments conducive to development of a diverse bacterial population. A biofilm can be detrimental to a process (say, by fouling a water treatment membrane) or beneficial (as in a biological treatment system). Biofilms are common in pipes used to distribute finished water to consumers and can adversely impact the quality of the water. *Contrast with* suspended growth.

biofilm accumulation model (BAM) Collective term for mathematical models that describe biofilm dynamics in terms of predicting diffusion of substrate, its consumption, and the correlated biomass growth in the biofilm process. Several phenomena occur in the biofilm systems, including transport of dissolved and particulate components in the biofilm and detachment and attachment of solids at the biofilm surface. Although detailed accurate mechanistic models are not often available to simulate these activities, many of the experimental or industrial biofilm systems can be well reproduced by mathematical functions portraying the gross observations in the biofilms.

biofilm formation potential The study of the effect of various parameters that influence the formation, promotion, and stability of biofilms and the subsequent impact on water quality in the distribution system.

biofilter *See* biologically active filter.

biofiltered Removed by means of a biologically active filter. *See also* biological filtration; biologically active filter.

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biofouling A phenomenon in which the performance of a unit process is compromised by biological growth. For example, biofouling can occur in a membrane process when microorganisms grow on the membrane surface and result in a premature and excessive loss of flow rate, or flux, through the membrane.

biogeochemical cycling The continuous and regularly occurring circulation of chemicals among atmosphere, biosphere, hydrosphere, and lithosphere.

biohazard An infectious agent presenting a risk or potential risk to human health, either directly through infection or indirectly through disruption of the environment. *See also* bloodborne pathogens; hazardous material.

bioindicator An organism that produces an observable response on exposure to a given substance.

bioinvasion The introduction by human activity of nonnative species into ecosystems in which such species have not been previously found and in which they tend to spread and become established, often at the expense of the distribution of some of the existing species.

biological activated carbon *See* biologically enhanced activated carbon.

biological analysis The examination of an environmental sample for the presence of biological agents, including macroscopic forms such as nematodes, worms, insects, and plants, as well as microscopic forms such as bacteria, fungi, algae, protozoa, and viruses.

biological denitrification The transformation of nitrate nitrogen (NO_3^-–N) to nitrogen gas (N_2) by microorganisms in an oxygen-free (anoxic) environment and in the presence of an electron donor (usually organic carbon) to drive this reaction:

$$2\ NO_3^- \rightarrow N_2 + 3\ O_2 + 2\ e^-$$

biological deposits Deposits of organisms or the products of their life processes.

biological filtration The process of filtering water through a filter medium that has been allowed to develop a microbial biofilm that assists in the removal of fine particulate and dissolved organic materials.

biological fluidized-bed treatment A reactor with upward flow through a bed of support media with attached biomass, such that the media are fluidized by the upward flow of water. Fluidized beds provide a high surface area that promotes rapid mass transfer and increased biomass attachment.

biological fouling The clogging of a filtration medium as a result of microbiological growth. It is typically associated with (1) a loss of flux and potential filtrate quality degradation in membrane filters or (2) growth on a groundwater well casing. It is also called biofouling. *See also* flux; membrane filter.

biological growth The activity and growth of any and all living organisms.

biological indicator *See* bioindicator; indicator organism.

biological iron Iron involved in biological processes. Iron is involved in numerous oxidation–reduction reactions that are important in biological processes. For example, consider iron in the ferredoxins involved in the reduction of hydrogen and its incorporation into carbohydrates during photosynthesis; the role of iron in functional groups of most enzymes of the Krebs cycle and as an electron carrier in the cytochromes; and the central role of iron in the heme molecule that permits oxygen and electron transport essential to respiration in all vertebrates.

biologically active carbon *See* biologically enhanced activated carbon.

biologically active filter Granular media (e.g., activated carbon, anthracite coal, or sand) that has developed a biofilm capable of degrading organic matter, ammonia (NH_3), or both. *See also* biologically enhanced activated carbon.

biologically active filtration (BAF) The removal of biodegradable organic matter by passing water over a fixed medium covered with a biofilm.

biologically available The physical or chemical form of a substance that can be directly used by an organism.

biologically based dose–response (BBDR) modeling Modeling of toxicological risks from a chemical by individually considering the contributions of biological variables to the response of interest. For example, in modeling the effects of a putative chemical carcinogen in humans based on animal data, the relative rates of activation and deactivation of the chemical by metabolism, as well as the kinetics of the chemical and any active metabolites, would be formally incorporated into a comparative pharmacokinetic model. This would normalize dosimetry between species. Then those biological responses, such as the chemical's genotoxic activity versus cytotoxic effects, which are induced by either the parent compound or its metabolites, would be individually factored into the model. In addition, any inherent differences in the responses of different species to these variables might be included, if known. Such models will inherently include more information about biological variability both within and across species and when the appropriate information is available, place the risks from exposure to a chemical in a much better context. The data demands from such an approach are much greater than for current risk assessment methods. Therefore, the use of such models will probably be reserved for those cases where competing risks (for example, health risks from competing processes or high economic impacts) compel a more accurate understanding of the risks than

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provided by standard methodologies. *See also* linearized multistage model; logit model; log-probit model; multihit model; multistage model; one-hit model; probit model; Weibull model.

biologically enhanced activated carbon (BAC) Granular activated carbon (GAC) used as a treatment medium in which a microbial population is permitted to grow on the GAC surface. The GAC removes contaminants through adsorption, whereas the microbial population removes biodegradable components. The process is often coupled with ozone (O_3) pretreatment, which creates more biodegradable compounds and increases the biological activity on the GAC but frequently decreases organic adsorbability. *See also* adsorption; granular activated carbon; ozone.

biologically refractory Difficult to biodegrade. *See also* biodegradability.

biologically significant Having the ability to affect an organism measurably.

biologically stable water Treated water that does not promote (or support to a significant extent) the growth of microorganisms during its distribution.

biological metrics A type of data analysis method that reduces raw data into workable indicators of biological condition.

biological oxidation The process by which living organisms in the presence of oxygen convert organic matter into a more stable or a mineral form.

biological pest control The process of controlling nuisance insects and plants through the use of parasitic or predatory organisms.

biological plausibility Explanation of cause and effect relationships based on our current understanding of the biology of people and disease agents.

biological reactor A vessel or chamber with a controlled volume in which biological reactions proceed. *See also* biological treatment processes.

biological regrowth The phenomenon of biological growth in treated water, typically in the distribution system. *See also* bacterial regrowth.

biological slime The gelatinous film formed by microbial growths covering the medium or spanning the interstices of a biological bed. Biological slime is also called microbial film.

biological stability A condition in which the nutrient status of treated drinking water is such that the water will not support (or will support only minimally) the growth of bacteria. *See also* biostability.

biological treatment processes Treatment processes that achieve contaminant removal through biological means. Conventional physicochemical processes, such as filtration, can remove biodegradable compounds if permitted to become biologically active by allowing microbial growth on the filtering medium. Biological treatment processes can also be designed to remove specific contaminants, such as nitrate (NO_3^-), in either fixed-film or suspended-growth biological reactors. *See also* fixed film; suspended growth.

biologic variation The totality of differences in response to a toxic or infectious insult that can be observed within representatives of a single species. Some of these differences are caused by differences in the genetics of an individual. Other differences can result from differences in the environment. For example, exposure to other agents or foods can alter the metabolism of a chemical, or preexisting diseases can alter the susceptibility of an individual to chemical, physical, or microbial agents.

biology The science of living things and processes. It is subdivided into specialties such as zoology, botany, ecology, and microbiology.

bioluminescence (1) A chemical reaction within a living organism, e.g., various fish, fungi, and bacteria, that causes the organism to glow. (2) The light produced by this chemical reaction.

biomagnification A process by which a compound increases in concentration in an organism's tissue as the food level increases. Organisms at the top of the food chain have an unusually high concentration of the compound. Compounds that tend to biomagnify have a high affinity for the lipids (fats) of organisms. *See also* bioaccumulation; bioconcentration.

biomarker A measurable and quantifiable biological parameter that serves as an index for health and physiology-related assessments, such as disease risk or environmental exposure and its effects.

biomass (1) The total weight of biological matter, including any attached extracellular polymeric materials. (2) A material that is or was a living organism or was excreted from a microorganism.

biome A region or group of regions with specific climatic and other environmental conditions supporting similar flora and fauna.

biometry The study of numerical data concerning biological observations and phenomena via the application of statistical methods.

biomonitor An analytical instrument (monitor) that (1) detects the presence of biological species of concern (e.g., algae or microorganisms), or (2) uses the response of a biological species to indicate the presence of contaminants (e.g., toxic chemicals).

bioproductivity The quantity of organic material produced by the organisms in an ecosystem during a given period of time.

bioreactor A vessel in which a biological process (e.g., radiation, disinfection) takes place.

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bioregeneration A process in which sites previously covered in an adsorbing medium are regenerated or made available to perform future adsorption through biological means. In bioregeneration, microorganisms residing on the external surface of the medium biodegrade contaminants that have been previously adsorbed, thereby regenerating the site for further adsorption. Bioregeneration is often associated with granular activated carbon adsorption treatment. It is also called bioreactivation.

bioremediation A process of adding nutrients to speed up processes in which microorganisms break down organic contaminants into harmless compounds.

biosensor An organism or organisms used to determine toxicity of raw or treated water.

biosorbent Biodegradable absorbent material for the removal of heavy metals from the water environment.

biostability A condition and quality of water in a distribution system in which the growth potential of bacteria is at or near an equilibrium. *See also* biological stability.

biostat A substance that inhibits biological growth without destruction of the biomass.

biostatistics The application of statistics to biomedical issues. It is also called medical statistics.

biosurfactant A surface active chemical agent produced by a microorganism.

biota Living organisms, including bacteria, plants, and animals, in a given ecosystem.

bioterrorism Intentional or threatened use of viruses, bacteria, fungi, or toxins from living organisms to produce death or disease in humans, plants, or animals.

Bioterrorism Act *See* Public Health Security and Bioterrorism Preparedness and Response Act of 2002.

biotic community *See* biocenosis.

biotic influence Biological influence on life, in contrast to climatic influence.

biotic removal Removal of a constituent or contaminant by biological treatment methods. *See also* biological treatment processes.

biotope A limited space characterized by certain ecological conditions and inhabited by one or more plant or animal species.

biotransformation The metabolism of a chemical. Metabolism can either detoxify or actually mediate the toxicity of a chemical. Metabolic reactions in mammalian systems are frequently placed into two categories, referred to as phase I and II reactions. Phase I reactions generally result in the production of reactive intermediates that are often the mediators of toxic responses. Phase II reactions generally involve conjugation reactions with moieties (chemical groups) that increase the water solubility of the chemical and thus make it easier to eliminate from the body. These latter reactions most frequently lead to reductions in toxicity, but definite exceptions to this rule exist.

biotreatment A treatment process using biological methods to remove contaminants. *See also* biological treatment processes; biologically active filtration; biologically enhanced activated carbon; bioremediation.

biphasic kinetic model A model that describes the nonlinear behavior of two modes of decays with the rate constants differing with several orders of magnitude. The model represents both the rapid and slow decays in capturing this behavior.

birefringence The resolution or splitting of a light wave into two waves with mutually perpendicular vibration directions by an optically anisotropic medium, such as calcite or quartz.

Birge–Ekman dredge A sampler designed for collecting grab samples from the top inch or so (2–3 centimeters) of the bottom sediment of a lake or river.

birth defect A structural or functional abnormality that is induced in the womb and is apparent at birth or expressed later in life as a clear pattern of symptomology.

Bisync *See* binary synchronous communication.

bit *See* binary digit.

bits (binary digits) per second (BPS) *See* binary digits per second *in the Units of Measure section.*

bittern *See* mother liquor.

bituminous-based activated carbon A form of granular activated carbon or powdered activated carbon that is produced using bituminous coal as the raw material. *See also* granular activated carbon; powdered activated carbon.

bituminous coal-based activated carbon *See* bituminous-based activated carbon.

bivalent ion An ion that has a valence charge of two. The charge can be positive or negative.

BK *See* bromoketone.

black alum Alum used as a coagulant that contains a small percentage of activated carbon.

black-body radiation An object or system, such as the vapor mixture inside a lamp, that absorbs all radiation incident upon it and reradiates energy that is characteristic of this radiating system only and is not dependent upon the type of radiation that is incident upon it. The radiated energy can be considered to be produced by standing wave or resonant modes of the cavity that is radiating. In drinking water treatment, pulsed ultraviolet disinfection devices depend on black-body radiation. It is also known as cavity radiation. *See also* pulsed ultraviolet light.

blackfoot disease A circulatory disease that has been associated with arsenic exposures in Taiwan and India.

black water An off-color condition that develops in drinking water from the presence of excess manganese that has been oxidized. Normally, less than

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0.005 milligrams per liter of manganese will not cause black water; however, as levels approach 0.10 milligrams per liter, black water is more likely to occur. The color of the water can range from yellow to black.

bladder pump A device for lifting water in a well by alternately filling a submerged bladder and then squeezing the bladder to force the water toward the surface. This type of pump is frequently used for contaminant characterization because of its ability to precisely pump small volumes of sample water.

blank A sample or result representing a matrix with all constituents except the analyte. A blank is analyzed in the same manner as standards and samples are analyzed.

Blastocystis An intestinal protozoan parasite transmitted through the fecal–oral route by contaminated food or water.

bleach A strong oxidizing agent and disinfectant formulated to break down organic matter and destroy biological organisms. The term *bleach* commonly refers to a 5.25 percent nominal solution of sodium hypochlorite (NaOCl, household bleach) that is equivalent to 3 percent to 5 percent available free chlorine (strength varies by shelf life). Sodium hypochlorite is also available commercially in concentrations of between 5 percent and 15 percent available chlorine. Dry bleach is a dry calcium hypochlorite ($Ca(OCl)_2$) with 99.2 weight percent available chlorine.

bleaching powder A combination of slaked lime and chlorine.

bleed (1) To drain a liquid or gas, as in bleeding accumulated air from a water line or draining a trap or a container of accumulated water. (2) The exuding, percolation, or seeping of a liquid through a surface.

bleed-off The release of built-up solids and contaminants in a cooling tower or boiler by removing a portion of the recirculating water that carries dissolved solids.

blended media call center A customer relationship management system adopted by call centers for handling all types of contacts, including voice, e-mail, Web, and faxes. A blended media call center manages thousands of agents and organizes them into groups and queues.

blending The process of mixing flow from more than one source into a single flow stream. Blending can be used to lessen the concentrations of compounds to desired levels by mixing a treated flow stream with one that is untreated or partially treated.

blind flange A pipe flange used to close the end of a pipe. It produces a blind end that is also called a dead end.

blinding The reduction or shutting off of flow caused by filter medium or membrane fouling. *See also* fouling.

blind spots Places in the filter medium or membrane where no filtration takes place.

blind study In epidemiology, an experimental study in which either the investigators, study participants, or both (a double-blind study) do not know to which group—control or study—a participant has been assigned. This information can also be withheld from laboratory analysts (a triple-blind study). The intent is to eliminate biases or prejudices of the investigators and study participants. *See also* double-blind study.

block In a pressure-driven membrane treatment system, a grouping of membranes and pressure vessels in a single unit having common control.

block copolymer A polymer comprised of two homopolymers joined together at the ends. It can be used to create thin film composite membranes with specialized behavior and properties.

blocking A volume of concrete poured behind and around a bend, tee, or directional change that resists the forces created by the liquid moving inside the pipe. A vertical bend may require blocking under and around the pipe, with straps or reinforcement around the bend to hold down the bend and resist the upward forces when the depth above the bend is small. An instance of blocking is also called a thrust block.

block rate (1) Inverted block rate: A rate structure of increasing price per unit of water delivered after the first unit. (2) Declining block rate: A rate structure of reducing price per unit of water delivered after the first unit.

bloodborne pathogens Potentially infectious bloodborne materials, including non-A hepatitis, non-B hepatitis, hepatitis B, and delta hepatitis viruses, as well as human immunodeficiency virus (HIV). The two most significant bloodborne pathogens are hepatitis B and HIV. The skin (particularly damaged skin), eye, or mucous membranes may become entry points.

blood–brain barrier Tight junctions that exist between the endothelial cells of vessels that supply the brain. Similar tight junctions are found between the ependymal cells lining the choroid plexus, a structure involved in the formation of cerebrospinal fluid. These two barriers make it necessary for chemicals to pass through cells before they can gain access to the brain. Therefore, the brain is more protected than other organs against polar chemicals that are present in the blood. Lipid-soluble chemicals pass through the blood–brain barrier very easily.

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blood–testis barrier A poorly defined diffusional barrier that limits access of polar chemicals to the germ cells. The permeability of this barrier differs significantly among species. As a consequence, the prediction of a chemical's access to germ cells based on simple consideration of physical and chemical properties is problematic at best.

blood–urea nitrogen (BUN) A convenient measure of chemically induced renal damage in toxicological studies. Urea is a by-product of protein catabolism and provides a means of eliminating metabolic ammonia (NH_3) from the body. Urea is eliminated by the kidney, so compromised renal function leads to increased concentrations of urea in blood.

bloom A large, undesirable growth of algae, cynobacteria, or diatoms in a water supply.

blowby (1) The technique sometimes used for recycling concentrate (e.g., membrane reject) back to the feed. (2) Contaminant leakage through or by the water treatment device.

blowdown (1) The continuous or intermittent removal of a portion of any process flow to maintain the constituents of the flow within desired levels. (2) The water discharged from a boiler, cooling tower, or membrane water treatment system to dispose accumulated dissolved solids.

blowoff (1) A connection at the low point on a pipeline used to drain or flush the pipe. (2) A device on an enclosed tank such as a water heater that opens at a specific pressure to prevent excessive pressure from occurring inside the tank.

blowoff valve A valve installed in a low point or depression on a pipeline to allow drainage of the line. It is also called a washout valve.

blowout A condition of bursting under hydrostatic pressure, e.g., a conduit, dam, or canal blowout.

blue-baby syndrome A condition in which infants have markedly elevated concentrations of methemoglobin. Methemoglobin is a form of hemoglobin in which the iron has been oxidized to the ferric state. In this form, it is incapable of acting as a carrier of oxygen in the blood. If not corrected, blue-baby syndrome can result in asphyxiation. Having small amounts of methemoglobin in the blood is normal. The level can be markedly elevated, however, when an individual is exposed to chemicals that directly oxidize hemoglobin or participate in reactions that produce such an oxidant; nitrite (NO_2^-) and chlorite (ClO_2^-) are examples of chemicals that can produce this effect.

blue copperas ($CuSO_4$) Copper sulfate.

bluegrass A variety of cool-season turf grass of the genus *Poa.* Commercial turf grass mixes are usually a blend of varieties.

blue-green algae Term formerly used for the group of living organisms called cyanobacteria. Cyanobacteria are aquatic prokaryotic organisms that contain chlorophyll a, and which can undertake photosynthesis. Previously, it was thought that only plants could photosynthesize, and so these organisms were mistakenly categorized as primitive plants, or algae, but cyanobacteria are a phylum of bacteria. Some of the organisms release odorous chemicals that are associated with tastes and odors in drinking water supplies. *See also* cyanobacteria.

blue stone ($CuSO_4$) A common name for copper sulfate.

blue vitriol ($CuSO_4$) A water supply term for copper sulfate.

blue water (1) Water that is associated with corrosion of copper water pipe. (2) A thick layer of clear water that appears blue in color.

bluff body The name given to the obstruction (body) in a vortex-shedding meter to enhance the generation of vortices in the flow around the body and downstream in the meter.

B. mallei *See Burkholderia mallei.*

B. melitensis *See Brucella melitensis.*

BMP(s) *See* best management practice(s).

BMX-1 *See* 3-chloro-4-(bromochloromethyl)-5-hydroxy-2(5H)-furanone.

BMX-2 *See* 3-chloro-4-(dibromomethyl)-5-hydroxy-2(5H)-furanone.

BMX-3 *See* 3-bromo-4-(dibromomethyl)-5-hydroxy-2(5H)-furanone.

BNM *See* bromonitromethane.

board feet/board foot *See under* feet board measure *in the Units of Measure section.*

Board of Certified Safety Professionals (BCSP) A peer certification organization founded in 1969. The board's energies are directed toward evaluating academic and professional experience qualifications of safety professionals, administering examinations, and issuing certificates of qualification to those meeting its criteria.

BOC *See* biodegradable organic carbon.

BOD *See* biochemical oxygen demand.

body The major part or casing of a valve that houses the remainder of the valve assembly.

body burden The total amount of a chemical that is in the body. This concept is most useful when one is referring to metals or very poorly metabolized nonpolar chemicals that accumulate in the body with repeated exposure. In these cases, chronic toxicity parallels the body burden because the compounds are not metabolized. Frequently, a reservoir may be established in a particular body compartment that acts to buffer and maintain concentrations of the chemical

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in blood (examples are lead in bone and dioxin in fat). The term is not particularly useful when one is referring to chemicals that produce cumulative damage without accumulating in the body. The best examples of this latter group of chemicals are organic chemicals that interact with deoxyribonucleic acid to produce point mutations.

body contact (BC) Physical contact of the human body with water or total immersion of the human body in water; generally refers to source water. *See also* body contact recreation.

body contact (BC) recreation Activities such as swimming, sailing, surfing, and canoeing that involve physical contact with water. *See also* body contact.

body feed In diatomaceous earth filters, the continuous addition of diatomaceous earth during the filtering cycle to provide a fresh filtering surface as the suspended material clogs the precoat.

body water The portion of the body that is water, generally about 80 percent of the total body weight (the percentage decreases with increasing body fat). Water is, however, compartmentalized in the body into extracellular and intracellular compartments. The extracellular water is divided into vascular water (i.e., within blood vessels) and interstitial water (between cells). Interstitial water in some organs (e.g., the brain) is very isolated from vascular water, whereas in other areas (e.g., the peritoneal cavity) relatively rapid mixing of vascular and interstitial water occurs. Chemicals in the body have varying access to these different water compartments. Nonpolar, or uncharged, molecules move between these compartments with ease, whereas polar, or charged, molecules move with difficulty unless they have very small molecular weights (lower than 100) or are transported by a carrier mechanism.

body weight (Bw) The weight of an animal or a person. It is used in the calculation of safe doses of chemicals, expressed in terms of milligrams of the chemical per kilogram of body weight.

bog Permanently wet terrain characterized by an acidic soil that produces peat and dominated by sphagnum and shrubs of the Ericaceae family.

boil (1) A rise in the water surface caused by the turbulent upward movement of water. (2) A painful localized pus-filled swelling of the skin and subcutaneous tissue caused by bacterial infection.

boil water advisory (BWA) A public notice issued by a federal, state, or local health department via broadcast media that informs users of a public water system that their drinking water is, or potentially is, unsafe microbiologically and that the drinking water should be boiled before use. To kill waterborne pathogens, water at sea level should be brought to a rolling boil, held in that condition for 1 minute, and then allowed to cool (protected from further contamination) before consumption. It is also known as a boil water alert or boil water order.

boil water alert *See* boil water advisory.

boil water order *See* boil water advisory.

Boltzmann's constant A mathematical constant used in Ludwig Boltzmann's kinetic theory of gases and the rules governing their viscosity and diffusion. The Boltzmann constant equals the gas constant (8.314×10^7 ergs per mole degree) divided by Avogadro number (6.02×10^{23} molecules per mole), which equals 1.3804×10^{-16} ergs per degree molecule.

bolus dose A dose of a substance such as a drug or a chemical given to an animal or human in a single volume, instead of over an extended period as would be the case if the substance were ingested in drinking water over time.

BOM *See* background organic matter; biodegradable organic matter.

bond (1) A long-term debt instrument (covering usually 20 to 30 years) that includes a promise to pay a specified sum of money (the principal) at a specified time in the future. Periodic interest payments (usually tax-free for municipal or governmental entities) on the face value of the bonds are made at a specified rate and at specified dates (usually semiannually). A number of basic bond types exist: general obligation bonds are secured by the full faith and credit of an issuing entity and are backed by the taxing authority of that entity; revenue bonds are secured by the revenue-producing ability of the entity; special assessment bonds (under the Improvement Acts of 1911, 1913, and 1915) are secured by a direct lien against a piece of property in the assessment district for specific public improvements. Many other variations of long-term bond debt instruments exist: certificates of participation (lease revenue bonds), zero coupon bonds, limited obligation bonds, variable rate bonds, adjustable rate bonds, and moral obligation bonds. (2) *See* chemical bond.

bond anticipation note A short-term interest-bearing note issued by a governmental agency in anticipation of bonds to be issued at a later date. The note is retired from proceeds of the bond issue to which it is related.

bond council A council typically made up of one or more attorneys who ensure that all of the legal aspects of a bond issued as a means of borrowing money for capital programs are properly conducted and stated in the debt agreement.

bond covenant A binding agreement to perform actions or meet conditions. Bond issues include various covenants in addition to the promise to make periodic interest payments and retire the debt according to a prescribed schedule. Maintaining a minimum

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ratio of net revenues to debt service payments (a debt service coverage ratio) is a common covenant.

bond discount The excess of the face value of a bond over the price for which it is acquired or sold.

bonded debt That portion of the indebtedness of an enterprise represented by outstanding bonds.

bond fund The proceeds realized or received from a bond issue after payment of the costs of issuing and underwriting. Bond funds are typically designated to be used for one or more specific projects over a prescribed period of time.

bond indenture The legal instrument, as adopted by the issuer, that concerns a bond issue. Typically, such instruments contain pledges to bondholders regarding the circumstances of payment of principal and interest, operation, flow of funds, and further debt issuance.

bond ordinance *See* bond indenture.

bond premium The excess of the price at which a bond is acquired or sold over its face value.

bond resolution *See* bond indenture.

bonds payable The face value of bonds issued and unpaid.

bone char A black pigment substance, with a carbon content of about 10 percent, made by carbonizing animal bones. Bone char is used for decolorizing sugar and in water treatment. In water treatment, it has been used as a selective anion exchanger for fluoride and arsenic control.

bone marrow The soft organic material that fills the cavities of bones. In adults this is the site in which blood cells are formed. It is the target of certain toxic chemicals, most notably benzene. Benzene can completely suppress blood cell production, leading to aplastic anemia, a fatal disease. It can also cause loss of control over the production of white blood cells, leading to leukemia.

bonnet The cover on a gate valve or fire hydrant.

BOO *See* build–own–operate.

Boolean logic A system of adaptation of algebra that reduces all values to either true or false. Boolean logic is a basic building block for electronic computing.

boom A floating structure, usually made of timber or logs, used (1) to protect the face of a dam or other structure built in or on water from damage by wave action or by floating material being dashed against it by the waves or (2) to deflect floating material away from the dam or other structure. A boom is also used to contain floating materials, as in the case of oil spills.

booster chlorination The use of chlorination facilities in a distribution system to increase (boost) the chlorine residual after an initial decay downstream of the treatment plant. Booster chlorination is used to lower initial dosages at the treatment plant while maintaining residuals at the far ends of the distribution system.

booster pump A pump used (1) to increase the pressure of the fluid on the discharge side of a pump that provides pressure in a closed distribution system and (2) to lift or boost water from a lower pressure plane to a higher pressure plane.

booster station (1) A pumping station in a water distribution system that is used to increase the pressure in the mains on the discharge side of the pumps. (2) A station that pumps water from low-level or ground storage to a distribution system.

borate A salt or ester of a boric acid (H_3BO_3). The salts of boric acid are quite complicated and, at least in aqueous solution, never contain the simple anion BO_3^{3-}. For example, the anion that occurs in borax (a sodium borate) is $(B_4O_5(OH)_4)^{2-}$.

borate buffer A solution of boric acid (H_3BO_3) and sodium hydroxide (NaOH) used to maintain a constant pH of 8 during simulated distribution system (or other) testing. *See also* simulated distribution system test.

Border Environment Cooperation Commission (BECC) Texas-based binational commission that identifies, supports, evaluates, and certifies affordable environmental infrastructure projects to improve the quality of life of people in the US–Mexico border region in an open public process. Its priority action areas include drinking water, sanitation, and sewerage.

bore (1) A wave of water, such as a tidal wave, having a nearly vertical front and advancing upstream as a result of high tides in certain estuaries; a similar wave advancing downstream as the result of a cloudburst or the sudden release of a large volume of water from a reservoir. A bore is analogous to a hydraulic jump in that it represents the limiting condition of the surface curve in which the curve tends to become perpendicular to the bed of the stream. (2) A standing wave that advances upstream in an open conduit from a point where the flow has suddenly been stopped. (3) A tunnel, especially during its construction. *See also* hydraulic bore; suction wave.

bored well A well that is excavated by means of an auger (hand or power), as distinguished from one that is dug, drilled, or driven.

borehole *See* boring (definition 2); open-ended well.

borehole geochemical probe A water quality monitoring device that is lowered into a well on a cable and that can make direct measurements of physical parameters such as pH, E_H, temperature, and specific conductivity. Ion-sensitive electrodes can be added to allow for direct measurement of certain chemical parameters for which oxidation–reduction (redox) couples exist, e.g., ferrous iron.

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borehole geophysics A subdiscipline of geophysics developed around the lowering of various probes into wells. The probes are used to infer hydraulic, chemical, and physical properties from various physical, electrical, radioactive, and chemical measurements made in the borehole.

boring (1) Subsurface investigations performed by drilling down to the desired depth, removing samples of the material penetrated so that it can be examined at the surface, recording the elevation at which changes in material are found, obtaining samples in a disturbed or undisturbed condition from the various strata, and preparing a log or chart of the boring data. Borings may be classified as follows: soil auger boring, churn drilling, rotary drilling, and core boring. (2) Holes made by boring. (3) Material removed by boring.

boring sample Material recovered from a boring and used to indicate the character of the formation penetrated by the boring.

boron (B) A trivalent metallic element (atomic number 5) found in nature only in combination with other elements.

borosilicate glass A type of heat-resistant glass used for labware.

borosilicate glass filter The most commonly used filter type for ultraviolet and dissolved organic carbon measurements. It may contain a binder to provide smaller pore sizes.

borrow pit A bank or pit from which earth is taken for use in filling or embanking.

bottled artesian water Bottled water that comes from a well drilled into a confined aquifer in which the water level stands at some height above the top of the aquifer, according to Food and Drug Administration rules for the labeling of bottled water. Bottled artesian water is also referred to as artesian well water.

bottled groundwater Bottled water from a subsurface saturated zone that is under a pressure greater than or equal to atmospheric pressure, according to Food and Drug Administration rules for the labeling of bottled water. The groundwater must not be under the direct influence of surface water.

bottled mineral water According to Food and Drug Administration rules for the labeling of bottled water, water that meets the following criteria: contains no less than 250 milligrams per liter of total dissolved solids (determined by evaporating to dryness and weighing the residue); comes from a source tapped at one or more boreholes or springs; and originates from a geologically and physically protected underground water source. *See also* total dissolved solids.

bottled purified water Bottled water that has been produced by distillation, deionization, reverse osmosis, or other suitable process that meets the definition of purified water in the *United States Pharmacopeia,* 23rd revision, Jan. 1, 1995, according to Food and Drug Administration rules for the labeling of bottled water. Bottled purified water is also called demineralized water. Alternatively, bottled water may be called deionized water if it has been processed by deionization; distilled water if it has been processed by distillation; reverse osmosis water if it has been processed by reverse osmosis; and so forth.

bottled sparkling water Bottled water that, after treatment and possible replacement of carbon dioxide (CO_2), contains the same amount of carbon dioxide that it had when it was taken from the source, according to Food and Drug Administration rules for the labeling of bottled water.

bottled spring water Bottled water that is collected from an underground formation from which water flows naturally to the surface of the earth, according to Food and Drug Administration rules for the labeling of bottled water. The water must be collected at the spring or through a borehole tapping the underground formation feeding the spring. A natural force must cause the water to flow to the surface, and the location of the spring must be identified.

bottled sterile water Bottled water that meets the requirements of the sterility tests in the *United States Pharmacopeia*, 23rd revision, Jan. 1, 1995, according to Food and Drug Administration rules for the labeling of bottled water. Such water is also called sterilized water.

bottled water Water intended for human consumption that is sealed in bottles or other containers with no added ingredients except a disinfectant, if necessary, to ensure microbial quality. Bottled water is regulated as a food in the United States by the Food and Drug Administration.

bottled well water Bottled water from a hole—bored, drilled, or otherwise constructed in the ground—that taps the water of an aquifer, according to Food and Drug Administration rules for the labeling of bottled water.

bottle-point isotherm A bench-scale test used to determine the amount of a contaminant that can be removed from solution by adsorption. The procedure consists of adding a known mass of adsorbent (such as granular activated carbon) to a bottle containing a water sample with a known amount of contaminant. Samples are shaken until equilibrium is achieved and then analyzed for residual contaminant in the liquid phase. The mass of contaminant adsorbed per mass of adsorbent is then calculated. This procedure is frequently used to determine the feasibility of treatment

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with adsorbent media such as granular activated carbon and ion-exchange resins.

bottom contraction The reduction in the area of overflowing water caused by the crest of a weir contracting the nappe.

bottom sediment Those sediments making up the bed of a body of still or running water.

bottom-up transition In Utility Communications Architecture (UCA), this strategy enables a utility to transition to UCA after completing a utilitywide system integration project.

bottom water level (BWL) (1) The lower level in a tank or reservoir used to set a level at which to turn on a pump or open an altitude valve. (2) The level beneath an oil or gas production formation where water is found.

botulinum toxin The toxic substance produced by the bacterium *Clostridium botulinum* growing without any oxygen, such as in canned goods. The toxin is destroyed by thorough cooking.

botulism The often fatal illness most often caused by eating canned foods that have been contaminated by the bacterium *Clostridium botulinum.* Botulism can also be caused by the bacteria entering the body through a wound.

boundary layer (1) The region near a solid surface where fluid motion and transport are negatively affected by that surface. (2) For membrane water treatment, a thin layer at the membrane surface where water velocities are significantly lower than in the bulk stream flow.

boundary layer resistance For membrane technologies, the resistance to flow by the accumulation of substances at the membrane surface.

boundary spring A spring occurring on the lower slope of an alluvial cone at the point where the water table slope and surface gradient are equal. Such springs are usually located on the boundary between two formations, the upstream one being the more pervious and having a flatter slope to its water table. A boundary spring is also called an alluvial-slope spring.

bound water (1) Water held strongly on the surface or in the interior of colloidal particles. (2) Water associated with the hydration of crystalline compounds. *See also* deliquescence; hydrophilic; hydroscopic.

Bourdon tube A semicircular tube of elliptical cross section, used to detect pressure changes.

bovine serum albumin (BSA) A blood protein preparation obtained from the serum of cattle. A dilute (usually 5 percent) filter-sterilized solution of bovine serum albumin is used as an enrichment in media for culturing a variety of microorganisms and tissue cells.

bowl, pump *See* pump bowl.

box The inside-threaded end of a pipe, fitting, or connection. *See also* trench box; valve box.

box-and-whisker plot A graphic presentation of the statistical analysis of a data set in which the bottom and top of the box equal the twenty-fifth and seventy-fifth percentile values, respectively; an additional line within the box corresponds to the median level; lines perpendicular to and above or below the box indicate the maximum or minimum values excluding statistical outliers; and outliers are shown as separate points. Other variations are possible on this representation in which (1) a dotted line within the box corresponds to the mean level, or (2) the sides of the box can be notched to indicate the 95 percent confidence interval for the median.

Box–Jenkins method *See* autoregressive integrated moving average forecasting method.

box plot A graphical representation of statistical parameters of a data set. Various indicators in a box plot correspond to various quartiles and the mean of the data distribution. *See also* box-and-whisker plot.

BPACl *See* basic polyaluminum chloride.

bps *See* binary digits (bits) per second *in the Units of Measure section.*

B. pseudomallei *See Burkholderia pseudomallei.*

Bq *See* becquerel *in the Units of Measure section.*

brace *See* trench brace.

brackish water Water having a mineral content in the range between freshwater and seawater. In water-desalting practice, brackish water is generally considered to be water containing 1,000 to 10,000 milligrams per liter of total dissolved solids.

bradyzoites Slowly multiplying forms of parasites.

brake horsepower (bhp) The power supplied to a pump by a motor, expressed in units of horsepower (watts). *See also* motor horsepower; water horsepower.

branch A special form of cast-iron pipe used for making connections to water mains. The various types are called T, Y, T–Y, double Y, and V branches, according to their respective shapes.

brass A metal alloy of copper, zinc, and usually some lead. Brass is harder and stronger than copper because of its zinc content; lead contributes malleability and ductility.

brazing The process of joining metal parts with an alloy that melts at a temperature higher than 800° Fahrenheit (427° Celsius) but lower than the melting temperature of the metal parts to be joined.

BrdU *See* bromodeoxyuridine.

breach size For low-pressure membrane technologies, the size of an opening that would allow particles to pass from the feed to the filtrate or permeate of a membrane system.

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break A significant leakage event in a pressurized pipeline that typically results in damage and disruption to service. It is also referred to as a burst. *See also* leakage management.

breakage rate The number of water main breaks repaired during a time period, usually per year.

breakaway hydrant A two-part, dry-barrel post hydrant with a coupling or other device joining the upper and lower sections. The coupling and barrel are designed to break cleanly when the hydrant is struck by a vehicle, preventing water loss and allowing easy repair.

breakaway point The rate of flow at which a water meter begins to register or the lowest rate of flow at which a definite movement of the register occurs.

breakeven analysis A method of analyzing costs and revenues over a range of products, such as treated water volumes, to determine the volume point at which revenues and total costs are equal. The method assumes that a portion of costs is fixed (does not vary with volume) and that revenue and a portion of costs vary directly with volume. The basic equation is

$$\text{breakeven volume} = \frac{\text{fixed costs}}{\text{unit price} - \text{variable cost per unit}}$$

breakpoint The point at which the chlorine dosage has satisfied the chlorine demand exerted by ammonia (NH_3).

breakpoint chlorination A process by which ammonia (NH_3) is removed from water through the continuous addition of chlorine (Cl_2 or HOCl). As chlorine is added, monochloramine (NH_2Cl) is initially formed, followed by dichloramine ($NHCl_2$) and trichloramine (nitrogen trichloride—NCl_3). At the breakpoint, the nitrogen has been completely released and any additional chlorine added is measured as a free, rather than combined, chlorine residual. *See also* chloramines; combined chlorine; dichloramine; trichloramine.

breakpoint curve A graphical representation of chemical relationships that exist as varying amounts of chlorine are added to water containing small amounts of ammonia-nitrogen (NH_3-N). Prior to the breakpoint, chlorine is present in the form of chloramines; subsequently, free chlorine is available. *See also* breakpoint; breakpoint chlorination.

breaks and background estimates (BABE) model A model used to assess leakage management practices. Developed as part of the United Kingdom National Leakage Initiative, the model segregates leakage events into separate awareness, location, and repair time periods and evaluates utility policies and response in each of the three leakage components: background losses, reported leaks, and unreported leaks.

break tank A storage device that is used for hydraulic isolation and surge protection from a pressurized system for which the water surface is at atmospheric pressure. For example, a tank receiving pumped well water for which the contents are either repumped or flow by gravity to a subsequent process is a break tank.

breakthrough (1) The point in a filtering cycle at which turbidity-causing material starts to pass through the filter. (2) The time in the cycle of a treatment bed when an increase, sometimes defined as an unacceptable increase, in the effluent concentration occurs for the contaminant being controlled.

breakthrough capacity The capacity of an ion-exchange column at a fixed regeneration level. It is usually expressed in terms of kilograms per cubic foot or kilograms per cubic meter of ion-exchange resin.

brick In abstract modeling, an individual equipment component. *See also* Utility Communications Architecture.

bridge A device for interconnecting two local area networks. The bridge can be used for extending the range of a local area network and to filter the messages that are passed from one portion of a local area network to another.

bridging (1) In water softening, the caking in a dry-salt brine tank that causes the liquid or brine beneath the dry salt to fail to become saturated. The result of bridging is insufficient salt in the regenerant solution to properly regenerate the cation resin. (2) The ability of particles to form a crust-like film over void spaces within a filter medium or membrane. (3) A condition in which dry chemicals adhere in an arch-like shape and do not fall out of a storage tank as intended. (4) A coagulation mechanism in which long chains of organic polymers added as coagulants bridge the distance between small particles, holding them together to create larger particles that will settle readily. *See also* adsorption–destabilization; arching; double-layer compression; sweep-floc coagulation.

brightfield microscope Another term for a light microscope. Because the object being viewed is illuminated by the light source, the field of view is bright, hence the term *brightfield.*

brightfield microscopy The most common form of light microscopy, in which the light source is emitted upward from beneath the specimen to the lens and the oculars. With brightfield illumination, specimen images appear dark against a bright background.

brine (1) A concentrated salt solution, generally containing sodium, chloride, and other ions typically having a concentration of 3 weight percent or more. (2) A concentrated salt solution remaining after desalting brackish or seawaters. For a brackish water membrane

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desalting system, the use of the word *concentrate* or *reject* is commonly preferred over *brine*. (3) A concentrated potassium chloride (KCl) or sodium chloride (NaCl) solution used in the regeneration stage of either cation- or anion-exchange water treatment devices. Sodium chloride brine saturation in an ion-exchange softening brine tank is about 26 percent NaCl by weight at 60° Fahrenheit (15.5° Celsius). *See also* salt water.

brine collector A device used to gather and retrieve brine from a brine tank or ion-exchange bed. *See also* collector.

brine consumption factor (BCF) In ion exchange, the equivalents of regenerant required divided by the equivalents of target ion removed. In nitrate (NO_3^-) removal, the BCF is sometimes called the brine use factor. *See also* ion exchange.

brine disposal The process of ultimately discharging a reject stream, most often associated with desalination or membrane processes, to the environment. Brine disposal often involves ocean discharge, deep well injection, or discharge to another receiving medium for which the mineral concentration is at least as high as the brine's concentration. *See also* deep-well injection.

brine draw The process of drawing a brine solution into a cation- or anion-exchange water treatment device during regeneration.

brine ejector (eductor) A device used to draw (or educt) brine from a brine tank and force (or eject) it into either a cation or an anion water treatment device. It is usually a component of the brine tank's control valve.

brinelling Tiny indentations (dents) high on the shoulder of the bearing race or bearing. Brinelling is a type of bearing failure.

brine seal A rubber lip seal outside of the feed end of a spiral-wound membrane element that seals against the inside of the pressure vessel and prevents feed bypass through the annular opening between the outside of the element and the inside pressure vessel wall. With the brine seal, essentially all feed flow passes into the feed-concentrate flow channel. *See also* membrane element.

brine use factor (BUF) *See* brine consumption factor.

brining In ion-exchange softening, the passing of a concentrated salt (sodium chloride, NaCl) solution through the resin bed for regeneration.

British thermal unit (Btu) *See in the Units of Measure section.*

broadbanding Utilizing a communication network that has the capability to transmit multiple channels simultaneously for a variety of purposes. *See also* broadband network.

broadband network A communications facility that operates with uniform efficiency over a wide band of frequencies and has the capability to transmit multiple channels simultaneously over the same physical connector.

broadband ultraviolet (UV) lamp An ultraviolet lamp that emits radiation across a polychromatic spectrum or range of wavelengths, typically between 185 and 300+ nanometers. Medium-pressure UV lamps and pulsed UV systems emit radiation in a polychromatic spectrum. *See also* medium-pressure ultraviolet lamp; pulsed ultraviolet light.

broad-base terrace A long ridge of earth, usually 1 to 3 feet (0.3 to 1 meter) high and 15 to 30 feet (4.5 to 9 meters) wide, with gently sloping sides, a rounded crown, and a broad, shallow channel along the upper side, constructed to control erosion by diverting runoff along the contour at low velocity instead of permitting it to rush down the slope.

broad-crested weir A weir having a substantial width of crest in the direction parallel to the direction of flow of water over it. This type of weir supports the nappe for an appreciable length and produces no bottom contraction of the nappe. It is also called a wide-crested weir.

broad-screen analysis A chemical analysis in which unknown compounds are being sought.

Broad Street pump A pump associated with John Snow's discovery in 1854 that cholera is conveyed by water. The well and pump were located near the corner of what is now Broadwick and Lexington Streets in Soho, London. In late August and early September 1854, Snow noted that within 250 yards (230 meters) "there were upwards of five hundred fatal attacks of cholera in ten days" and "there were no other outbreaks of or increase in cholera in that part of London except amongst those who habitually used the pump." He drew a map of the district showing the distribution of the deaths and tabulated the rise and fall of the epidemic. Snow presented his evidence the evening of Sept. 7, 1854, to the Board of Guardians, and the pump handle was removed the following day.

brochantite ($Cu_4(SO_4)(OH)_6$) A basic hydrated copper sulfate. Brochantite is a corrosion product associated with waters of a high sulfate activity and is often associated with copper pitting corrosion by-products.

bromamines Chemicals formed during the mixing of chlorine (Cl_2 or HOCl), ammonia (NH_3), and the bromide ion. They can be produced during the chloramination of bromide-containing waters. *See also* chloramines.

bromate *See* bromate ion.

bromate ion (BrO_3^-) The highest oxidation state of the bromide ion (Br^-). The bromate ion can be

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formed during the ozonation of bromide-containing waters. For water plants that use ozone, bromate's presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.010 milligrams per liter.

bromide (Br^-) An inorganic ion found in surface water and groundwater and caused by (1) seawater intrusion, (2) the impact of connate water, or (3) industrial and oil-field brine discharges. When oxidized by chlorine (Cl_2 or HOCl) or ozone (O_3), it can result in the formation of bromide-substituted disinfection by-products. *See also* connate water; disinfection by-product; seawater intrusion.

bromide-to-DOC (dissolved organic carbon) ratio *See* bromide-to-TOC ratio.

bromide-to-FAC ratio (Br^-Cl^+) The molar ratio of the water bromide level to the average free available chlorine (FAC) is equal to $[(FAC_0)+(FAC_t)]/2$, where FAC_0 and FAC_t are the FAC values at the beginning and end of the contact period, respectively—concentration during the chlorine contact period. This ratio gives an indication of the relative amounts of hypobromous acid (HOBr) and hypochlorous acid (HOCl) available for trihalomethane formation, which in turn influences the degree of bromine substitution. *See also* trihalomethane.

bromide-to-TOC ratio (Br^-TOC) The weight ratio of the water bromide level to the total organic carbon (TOC) concentration at the point of chlorination. Because coagulation and granular activated carbon filtration can remove organic carbon but not bromide, this ratio increases during treatment and can result in a shift to more bromine-substituted disinfection by-products upon chlorination. *See also* disinfection by-product.

bromide utilization A measure of the degree of bromine substitution in trihalomethanes, where the molar sum of bromine in the individual trihalomethanes is divided by the molar amount of the water bromide. This value provides an indication of the percentage of bromide that is substituted into trihalomethanes. *See also* trihalomethane.

brominated alcohol *See* bromohydrin.

brominated organic *See* bromine-substituted organic.

bromine (Br_2) The oxidized form of the bromide ion (Br^-). In water, bromine is present as hypobromous acid (HOBr) and the hypobromite ion (OBr^-). *See also* bromide; hypobromite ion; hypobromous acid.

bromine atom (Br) A halogen atom that can be substituted into organic molecules during chlorination or ozonation of bromide-containing waters, thus forming disinfection by-products. Bromine atoms are also present in a number of synthetic organic chemicals. *See also* bromide; disinfection by-product; halogen; synthetic organic chemical.

bromine incorporation factor *See* bromine incorporation factor for haloacetic acids; bromine incorporation factor for trihalomethanes.

bromine incorporation factor for haloacetic acids [$n'(xy)$] A measure of the degree of bromine substitution in haloacetic acids (HAAs), where the molar sum of bromine in all the individual HAAs is divided by the molar amount of the total HAAs. Because typically not all nine HAAs are measured, the bromine incorporation factor $n'(xy)$ is calculated for the molar sum of bromine in the measured bromine-containing HAAs (x measured species) divided by the molar amount of the total measured HAAs (y total measured species). For example, when the five HAA species (two of which contain bromine) that make up HAA5 have been measured, $x = 2$ and $y = 5$. *See also* bromine incorporation factor for trihalomethanes; haloacetic acid.

bromine incorporation factor for trihalomethanes (n) A measure of the degree of bromine substitution in trihalomethanes, where the molar sum of bromine in all the individual trihalomethanes is divided by the molar amount of the total trihalomethanes. This value can vary from 0 (corresponding to all chloroform) to 3 (corresponding to all bromoform). *See also* trihalomethane.

bromine-substituted Pertaining to a molecule into which a bromine atom has been introduced.

bromine-substituted by-product A disinfection by-product containing bromine atom(s). *See also* disinfection by-product.

bromine-substituted organic An organic molecule into which a bromine atom has been introduced.

bromine-substituted trihalomethanes, total (TTHM-Br) *See* total trihalomethane bromine.

bromism A syndrome produced by chronic intakes of bromide. This poisoning is marked by signs of central nervous system depression. It was observed when bromides were commonly used as sedatives and hypnotics. Suspension of use corrects the problem. Bromism is unlikely to be associated with the milligram quantities of bromide that are frequently found in drinking water. The syndrome is also called brominism.

bromoacetic acid (BAA) A haloacetic acid (CX_3COOH, where one to three of the X atoms are bromine atoms and the remaining are chlorine and/or hydrogen) containing bromine atom(s). *See also* haloacetic acid.

bromoacetonitrile (BAN) A haloacetonitrile ($CX_3C{\equiv}N$, in which one to three of the X atoms are bromine atoms and the remaining are chlorine and/or hydrogen) containing bromine atom(s). *See also* haloacetonitrile.

bromobenzene (C_6H_5Br) A synthetic organic chemical used as a solvent. *See also* solvent; synthetic organic chemical.

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bromochloroacetaldehyde (BCA) (CHBrClCHO) A halogenated acetaldehyde in which two hydrogen atoms of acetaldehyde have been replaced by one chlorine atom and one bromine atom. It is a disinfection by-product formed in chlorinated water containing bromide. *See also* disinfection by-product; haloacetaldehydes.

bromochloroacetic acid (BCAA) (CHBrClCOOH) A haloacetic acid containing one bromine atom and one chlorine atom. *See also* haloacetic acid.

bromochloroacetonitrile (BCAN) (CHBrClCN) A haloacetonitrile containing one bromine atom and one chlorine atom. *See also* haloacetonitrile.

bromochloroiodomethane (BCIM) (CHBrClI) An iodinated trihalomethane formed in chlorinated water high in iodide. It may cause medicinal odors in drinking water. *See also* disinfection by-product; trihalomethane.

bromochloronitromethane (BCNM) ($CHBrClNO_2$) A halogenated nitromethane in which two hydrogen atoms of nitromethane have been replaced by one bromine and one chlorine atom. It is formed in chlorinated water containing bromide. *See also* disinfection by-product; halonitromethanes.

bromodeoxyuridine (BrdU) A pyrimidine analog that is used in toxicology and related sciences to detect cells that divide. It is used in place of tritiated thymidine. It is injected into animals or administered over an extended period via miniature pumps. It is also frequently employed in cell cultures. BrdU is incorporated in the deoxyribonucleic acid (DNA) when cells replicate. BrdU so incorporated can be detected in histological sections by using an antibody and immunohistochemical techniques. This detection provides a very important parameter for use in nonlinear low-dose extrapolation models for carcinogenesis.

3-bromo-4-(dibromomethyl)-5-hydroxy-2(5H)-furanone (BMX-3) A brominated analog of MX. It is a disinfection by-product formed in chlorinated water high in bromide. MX and its analogs are major contributors to the mutagenic activity of a number of chlorinated drinking water samples. *See also* 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX); disinfection by-product; mutagenesis.

(E)-2-bromo-3-(dibromomethyl)-4-oxobutenoic acid (BEMX-3) A brominated analog of EMX that is a geometric isomer of MX. It is a disinfection by-product formed in chlorinated water high in bromide. MX and its analogs are major contributors to the mutagenic activity of a number of chlorinated drinking water samples. *See also* 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX); (E)-2-chloro-3-(dichloromethyl)-4-oxobutenoic acid (EMX); disinfection by-product; mutagenesis.

bromodichloroacetaldehyde (BDCA) ($CBrCl_2CHO$) A halogenated acetaldehyde in which three hydrogen atoms of acetonitrile have been replaced by two chlorine atoms and one bromine atom. It is formed in chlorinated water containing bromide. It is not stable in drinking water and can undergo hydrolysis reactions to form bromodichloromethane. *See also* disinfection by-product; haloacetaldehydes; trichloroacetaldehyde.

bromodichloroacetic acid (BDCAA) ($CBrCl_2COOH$) A haloacetic acid containing one bromine atom and two chlorine atoms. *See also* haloacetic acid.

bromodichloroacetonitrile (BDCAN) ($CBrCl_2CN$) A brominated analog of trichloroacetonitrile. It is formed in chlorinated water containing bromide. *See also* disinfection by-product; haloacetonitrile; trichloroacetonitrile.

bromodichloromethane (BDCM) ($CHCl_2Br$) A trihalomethane containing one bromine atom and two chlorine atoms. It is a commonly formed trihalomethane, even in waters with low bromide levels. *See also* trihalomethane.

bromodichloronitromethane (BDCNM) ($CBrCl_2NO_2$) A brominated analog of chloropicrin in which three hydrogen atoms of acetonitrile have been replaced by one bromine atom and two chlorine atoms. It is a disinfection by-product and formed in chlorinated water containing bromide. *See also* disinfection by-product; halonitromethanes; trichloronitromethane (chloropicrin).

1-bromo-1,1-dichloropropanone (1,1,1-BDCP) ($CBrCl_2COCH_3$) A halogenated propanone in which three of the six hydrogen atoms of propanone have been replaced by one bromine and two chlorine atoms. It is a disinfection by-product in chlorinated water high in bromide. It is not stable in drinking water and undergoes hydrolysis reactions to form bromodichloromethane. *See also* disinfection by-product; halopropanones.

bromodiiodomethane (BDIM) ($CHBr_2I$) An iodinated trihalomethane formed in chlorinated water high in iodide. It may cause medicinal odors in drinking water. *See also* disinfection by-product; trihalomethane.

bromoform (tribromomethane) (TBM) ($CHBr_3$) A common name for tribromomethane, a trihalomethane containing only bromine atoms. It is typically formed to a significant extent only in waters containing moderate amounts of bromide. *See also* trihalomethane.

bromohydrin A class of organic compounds that are bromine-containing alcohols. Specifically, 3-bromo-2-methyl-2-butanol has been identified as a possible by-product from the ozonation of bromide-containing waters.

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bromoketone (BK) A haloketone containing bromine atoms (R_1-CO-R_2, where one or both R groups contain one or more bromine atoms). *See also* haloketone.

bromonitromethane (BNM) (CH_2BrNO_2) A brominated halonitromethane in which one hydrogen atom of nitromethane has been replaced by one bromine atom. It is a disinfection by-product and formed in chlorinated water containing bromide. *See also* disinfection by-product; halonitromethanes.

bromopicrin (tribromonitromethane) (TBNM) (CBr_3NO_2) A common name for tribromonitromethane, a disinfection by-product formed during the chlorination or ozonation of bromide-containing waters. *See also* disinfection by-product.

bronze Any of various copper-base metal alloys that may or may not include tin, lead, or other metals in small amounts. Bronze is a commonly used material in water utility products such as water meters and valves.

bronze seat ring A machined ring made of bronze mounted in the body of a hydrant or valve, against which the moving disk of the valve closes.

Brownian motion The random movement of particles suspended in a fluid medium resulting from molecular bombardment. Brownian motion accounts for the diffusion mechanism in particle removal by filtration and in perikinetic flocculation. *See also* diffusion; perikinetic flocculation.

browser A software application that enables a user to access and display information located on the World Wide Web.

Brucella melitensis (B. melitensis) Extremely small gram-negative coccobacillus that is a bacterial pathogen of sheep and goats. *Brucella melitensis* is a facultative intracellular pathogen surviving in macrophages of the reticuloendothelial system. It is transmitted to humans by ingestion of contaminated milk or cheese or by direct contact with infected animals or animal products.

brucellosis An infectious disease caused by the bacteria of the genus *Brucella.* Various *Brucella* species affect sheep, goats, cattle, deer, elk, pigs, dogs, and several other animals. Humans become infected by coming in contact with animals or animal products that are contaminated with these bacteria. In humans, brucellosis can cause a range of symptoms that are similar to the flu and may include fever, sweats, headaches, back pain, and physical weakness. Severe infection of the central nervous system or lining of the heart may occur. Brucellosis can also cause long-lasting or chronic symptoms that include recurrent fevers, joint pain, and fatigue.

Brunauer-Emmett-Teller (BET) method A laboratory procedure used to determine the surface area of granular activated carbon (GAC). The method is based on the adsorption of nitrogen to the surface of the GAC. Based on the vapor pressure and equilibrium pressure of nitrogen, the amount of nitrogen adsorbed, and a linearized form of the BET, the GAC surface area available to form a monolayer of nitrogen can be calculated based on an assumption of the area of an adsorbed nitrogen molecule. The BET equation is

$$\frac{q}{Q} = \frac{BC}{\left[(C_s - C)(1 + B - 1)\left(\frac{C}{C_s}\right)\right]}$$

Where (in any consistent set of units):

q = number of moles of adsorbate per mass of adsorbent at equilibrium

Q = maximum number of moles adsorbed per mass of adsorbent when the surface sites are saturated with adsorbate

B = dimensionless constant related to the difference in free energy between adsorbate on the first and successive layers

C = concentration of adsorbate in solution in milligrams per liter

C_s = saturation concentration of the adsorbate in solution in milligrams per liter

brush borders Cells of the lining of the intestine. *See also* neonatal mouse infectivity assay.

brushes Graphite connectors that rub against the spinning commutator in an electric motor or generator, connecting the rotor windings to the external circuit.

BSA *See* bovine serum albumin.

BSC *See* binary synchronous communication.

B. subtilis *See Bacillus subtilis.*

BTEX *See* benzene–toluene–ethylbenzene–xylene.

Btu *See* British thermal unit *in the Units of Measure section.*

BTX *See* benzene–toluene–xylene.

bu *See* bushel *in the Units of Measure section.*

bubble memory Magnetic regions in thin film crystal that maintain data when electric power is shut off.

bubble point The required gas pressure point to fully displace liquid from the pores of a wetted filtration material, such as from a microfiltration membrane. The bubble point is also called the bubbling pressure or gas entry pressure.

bubble-point test A membrane integrity test in which air is applied to one side of a wetted porous membrane at a pressure that would not cause air to pass through the largest pores of an intact membrane. The test can identify compromised membranes or broken

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membrane fibers by the passage of air and a resulting decline in air pressure. *See also* bubble point.

bubbler A type of sprinkler head that delivers a relatively large volume of water to a level area where standing water gradually infiltrates into the soil. The flow rate is large relative to the area to which the water is delivered. Bubblers are used to irrigate trees and shrubs.

bubbler-tube level indicator A gauge to monitor the water level by using a continuous air supply bubbled through the water at a set elevation to supply a pressure that can be recorded.

bubbler-tube level-sensing transmitter A electronic device that sends a signal from a water-level monitoring gauge to a remote receiver through a communications network for water-level recording.

bubble size The average diameter of the gas (e.g., ozone [O_3] or air) bubbles discharged from a diffuser at the bottom of the contactor in an ozone or aeration system. Generally, the finer the bubble size and the longer the bubble resides (contacts) within the water, the greater the transfer of air or ozone to the water.

Buchner funnel A laboratory filter consisting of a funnel with a perforated bottom. A disposable filter is placed atop the perforated bottom before liquid is filtered. A Buchner funnel is used to evaluate sludge dewaterability.

buckling The bending of a pipe caused by loads applied along the axis of the pipe in both directions such as with temperature changes that cause expansion. *See also* collapse.

budget A plan adjusting expenses for a given time period to the estimated income for that same period.

budget and resource planning Tactical manifestations of the annual strategic planning process involving budgeting and staff analyses of strategic investment resource requirements.

budgeting The process of (1) identifying detailed operating and capital expenditures of all types required for efficient operations at a defined level of volume and service, and (2) matching revenues to the level of expenditures through adjustments of rates and charges, allowing for necessary levels of dedicated and available cash reserves.

BUF *See under* brine consumption factor.

buffalo box *See* valve box.

Buffalo green monkey (BGM) cells A type of cell used for cell cultures that can be cultured in the laboratory continuously and is excellent for growing some of the human enteric viruses.

buffer A chemical substance that stabilizes the pH value of solutions. *See also* buffer solution.

buffer action The action of certain ions in solution in opposing a change in hydrogen ion concentration.

buffer capacity The concentration of a strong base (in moles per liter) that causes a unit change in pH when added to a solution. Buffer capacity is also known as buffer intensity.

buffered Able to resist changes in pH.

buffer intensity *See* buffer capacity.

buffer solution A solution containing one or more substances that, in combination, resist any marked change in pH following addition of moderate amounts of either strong acid or strong base.

buffer strip A small area of land in permanent vegetation, designed to intercept pollutants and manage other environmental concerns. Strategically placed buffer strips in the agricultural landscape can effectively mitigate the movement of sediment, nutrients, and pesticides within farm fields and from farm fields. Buffer strips are also referred to as filter strips, vegetated filter strips, and grassed buffers.

bug An error in either a software program or the hardware.

building footprint The dimensions and area of a building foundation as represented in a two-dimensional plan.

building service The water pipe from the public main to a building. Building services are owned and maintained by the building owner or the distribution or collection agency, depending on local regulations.

build–own–operate (BOO) A process enabling privately owned companies to finance, design, construct, and operate water or wastewater facilities over a long term for a municipality or other governmental agency. Build–own–operate negates the need for government agencies to obtain capital funds for construction and privatizes the utility operation.

buildup An increase of groundwater elevation around a recharge well or spreading basin. Buildup is the opposite of drawdown.

bulk density The mass per standard volume (usually kilograms per cubic meter or pounds per cubic foot) of material as it would be shipped from the supplier to the treatment plant.

bulkhead (1) A structure of wood, stone, or concrete erected along the shore of a water body to arrest wave action or along a steep embankment to control erosion. (2) A permanent or movable wall closely fitting into and across a waterway and intended to hold back earth or water. *See also* groin.

bulk modulus of elasticity of water (E_v) The pressure required to produce a small change in water volume. In equation form,

$$E_v = -(dP)/(dV/V)$$

Where (in any consistent set of units):

E_v = the bulk modulus of elasticity of water
dP = the change in pressure

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dV = the change in volume
V = the initial volume

bump joint A type of joint used to connect riveted or welded steel pipes of large diameter, usually 24 inches (0.6 meters) or more. One end of the length of pipe is flared out, and the end of the adjoining pipe is shaped so that it fits snugly into the flared end. Bends up to 5° per length of pipe can be made readily with such a joint.

BUN *See* blood–urea nitrogen.

buoyancy The upward force exerted by the fluid in which a body is immersed.

burden The amount of indirect costs that are incurred and applied (burdened) to direct cost. Direct cost is usually direct labor (labor hours applied directly to the production of a product), but sometimes machine hours or other measures of direct cost are used if they are more closely related to the product produced. Typical burden costs are, for example, clerical support, material handling, maintenance, and rent. Burden rates (indirect cost divided by direct cost) are often developed by department, cost center, plant, function, or entity and applied to direct cost to estimate the total cost of producing a product through that cost center. Burden is sometimes called overhead.

burette A graduated glass tube fitted with a stopcock. It is used to dispense solutions during titration.

buried channel A former stream channel that has been filled with alluvial or glacial deposits and later covered by other material so that little surface indication of its existence or location exists.

buried gate valve A valve installed directly in the ground with a valve box extending from the valve to the ground or street surface to provide operating access.

Burkholderia mallei (B. mallei) A bacterium associated with infections in laboratory workers because so very few organisms are required to cause disease. The organism has been considered as a potential agent for biological warfare and of biological terrorism. The United States has not seen any naturally occurring cases since the 1940s. However, it is still commonly seen among domestic animals in Africa, Asia, the Middle East, and Central and South America. This organism also causes a disease known as glanders that primarily affects horses, donkeys, and mules, and can be contracted by goats, dogs, and cats.

Burkholderia pseudomallei (B. pseudomallei) An organism that has been considered as a potential agent for biological warfare and biological terrorism. This organism causes a condition known as melioidosis, also called Whitmore's disease. Melioidosis is predominantly a disease of tropical climates such as India, Africa, Australia, and Southeast Asia, where it is endemic. The bacteria causing melioidosis are found in contaminated water, soil, and vegetation and are spread to humans and animals through direct contact with the contaminated source, whether by inhalation of dust, ingestion of contaminated water, or contact with contaminated soil, especially through skin abrasions, and for military troops, by contamination of war wounds. Person-to-person transmission can occur. The bacteria are recognized as the cause of melioidosis during Vietnam War when soil suspended in air by helicopter blades was inhaled by military personnel. Melioidosis occurs as: (1) acute suppurative infection, (2) chronic pulmonary disease, or (3) localized suppurative cutaneous infection with lymphadenitis, fever, and malaise.

burn, first to third degree Damage to the skin caused by various sources of heat, resulting in skin damage of increasing severity measured in degrees. A first-degree burn shows redness in unbroken skin. Indications of a second-degree burn are blistering and some breaks in the skin. Third-degree burns range from blistered, missing skin to damage to underlying tissues.

burner A high-temperature heating device that uses natural or bottled gas. It is also called a Bunsen burner.

burnt lime *See* lime.

burst pressure The ultimate interior pressure a pipe can resist for a short term before failing. *See also* weeping.

burst strength The circumferential stress at burst pressure. It is also known as hoop stress.

bury length The depth from the surface of the ground to the bottom of the pipe to which a hydrant is connected.

bus A parallel data path that carries data at high speed between certain components of a computer system. The information-carrying capacity of a bus depends on its width, or the number of bits that can be transferred simultaneously.

bushel (bu) *See in the Units of Measure section.*

bushing A short tube threaded inside and outside that screws into a pipe fitting to reduce its size.

business risk exclusion *See* policy exclusion.

business-to-business (B2B) site A Web site that accommodates both buyers and sellers, facilitating, for example, the electronic exchange of purchase and qualification requests, proposals from buyers and responses from sellers, and procurements.

business-to-customer (B2C) site A Web site used by businesses to meet customer needs via service companies and other Internet applications.

business-to-employee (B2E) site A multifunctional Web-based tool that brings together information employees need to perform their jobs.

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butane number The volume of butane ($CH_3CH_2CH_2CH_3$) adsorbed per unit weight of activated carbon after air saturated with butane is passed through an activated carbon bed at a given temperature and pressure.

butterfly gate A gate that opens like a damper turning on a shaft inside the pipe. *See also* butterfly valve.

butterfly valve A valve that operates by the disk rotating on a shaft or stem through the center section of the valve body, closed when the disk is perpendicular to the flow and pressed against the seat around the outer edge, and fully open when unseated to a position such that the disk is parallel to the flow.

BV *See* bed volume.

Bw *See* body weight.

BWA *See* boil water advisory.

BWL *See* bottom water level.

bypass (1) An arrangement of pipes, conduits, gates, or valves by which the flow may be passed around an appurtenance or treatment process. (2) In cross-connection control, any pipe arrangement that passes water around a protective device, causing the device to be ineffective.

bypass channel A channel, such as a diversion cut or spillway, formed around the side of a reservoir past the end of the dam to convey flood discharge from the stream above the reservoir into the stream below the dam.

bypass flow Water that is allowed to move past a storage facility or diversion structure.

bypassing The diversion of a flow of water around processes or structures through which the flow normally passes.

bypass valve A small valve installed in parallel with a larger valve to equalize the pressure on both sides of the disk of the larger valve before the larger valve is opened.

by-product A compound that is not the compound of interest but is also formed during a chemical reaction. Many by-products are formed during water treatment, but not all have yet been identified.

by-product, disinfection *See* disinfection by-product.

by-product, oxidation *See* oxidation by-product.

by-product, ozonation *See* ozonation by-product.

by-product synergy A long-term view of production that identifies cost-effective ways in which by-products and waste from one process stream can be used or recycled to another.

byssus A tuft of long, tough filaments that are formed in a groove of the foot between the valves of certain bivalve mollusks by which they attach themselves to rocks, pipes, and other protuberances.

byte A group of adjacent binary digits that a computer stores and retrieves as a unit. A byte is commonly eight bits of data.

BZ *See* 3-quinuclidinyl benzilate.

Bz *See* benzenoid.

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C

C *See C* factor; Chezy resistance factor; friction factor; residual disinfectant concentration.

C *See* coulomb *in the Units of Measure section.*

c The speed of light, 9.81×10^{10} feet per second (2.99×10^8 meters per second) in a vacuum.

c *See* centi *in the Units of Measure section.*

^{13}**C** *See* carbon-13 nuclear magnetic resonance.

CA *See* conventional aeration.

C_a *See* Cauchy number.

CAA *See* Clean Air Act.

CAB (cellulose acetate blend) membrane *See* cellulose acetate membrane.

cable-tool drilling A method of drilling wells by the use of cable tools. The hole is drilled by a heavy bit, which is alternately raised by a cable and allowed to drop, breaking and crushing the material that it strikes. Such material is removed from the hole by bailing or sand pumping.

CAB membrane *See* cellulose acetate blend membrane.

cache memory Temporary storage for frequently accessed computer data and programs. When a program is executed by the central processing unit, the cache is first examined for the required data or instructions; auxiliary storage devices are accessed only if the information is not found in the cache. Cache memory is also referred to as random access memory (RAM).

Caco-2 cell Cell line derived from cells of a human colon carcinoma. It is widely used to predict the adsorption rate of compounds across the intestinal cell barrier. This cell line can be utilized in assays for the detection of infectious *Cryptosporidium* oocysts in water.

CAD *See* computer-aided dispatch; computer-aided drafting.

cadastral features Map elements created from legal descriptions that depict boundaries of property ownership and other rights to land.

cadastral map A map composed of cadastral features.

cadastre A public register or survey of a geodetic framework that defines or reestablishes boundaries of public land, private land, or both for purposes of ownership, taxation, or both.

CAD/CAM *See* computer-aided design/computer-aided manufacturing.

CADD *See* computer-aided design and drafting.

cadmium (Cd) A malleable, ductile, bivalent metallic element (atomic number 48). In nature, cadmium is found in the ores of greenockite. It has various industrial uses, especially in protective platings and bearing metals. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.005 milligrams per liter.

caecum A cavity with only one opening; the large blind pouch forming the beginning of the large intestine.

CAG *See* Carcinogen Assessment Group.

cage screen A cage-shaped screen built of bars, rods, or mesh to catch debris. A cage screen is arranged for lowering into water and for raising when the screen is to be cleaned.

CAH *See* chlorinated aliphatic hydrocarbon.

caisson A large-diameter, watertight chamber in which work can be done below the surface of the earth or water.

cake *See* sludge cake.

cake filtration Particle removal by straining. It is most often associated with slow sand filters, in which a layer—or cake—of particles forms at the surface of the filter media. Once this cake is formed, it assumes the dominant role in filtration. In slow sand filtration, this cake is called a schmutzdecke. *See also* surface filtration.

cake space The volumetric space available in a filter to support the formation of a sludge cake.

calcareous Pertaining to material containing calcium carbonate ($CaCO_3$) in sufficient concentrations to effervesce visibly with cold dilute (0.1 molar) hydrochloric acid (HCl).

calcareous spring A spring in which the water contains a considerable quantity of calcium carbonate ($CaCO_3$) in solution.

calcite ($CaCO_3$) The most common form of natural calcium carbonate ($CaCO_3$). Calcite is an essential ingredient in limestone, marble, and chalk. Calcium carbonate (limestone, calcite, whiting, chalk) is sometimes termed *unburned lime.* It is widely used as an agricultural lime and is also used in neutralization, stabilization, or prevention of corrosion in water treatment. *See also* calcium carbonate; lime; limestone.

calcite contactor A layer or bed of crushed limestone through which water passes. The pH, alkalinity, and calcium content of the water are normally increased by the dissolving calcium carbonate ($CaCO_3$).

calcite indices Measurements used to indicate the saturation state of a water with respect to calcium carbonate ($CaCO_3$) precipitation (e.g., Langelier saturation index, calcium carbonate precipitation potential).

calcite saturation index (CSI) The saturation index for calcium carbonate ($CaCO_3$). For any solid, a general saturation index can be defined as

$$SI = \log_{10} (Q/K_{sp})$$

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Where:

SI = the saturation index
Q = the product of the ion activities
K_{sp} = the solubility constant for the given temperature

Interpreting this SI value is analogous to interpreting the Langelier saturation index: SI = 0 indicates saturation equilibrium; SI < 0 indicates undersaturation; and SI > 0 indicates supersaturation. In the preceding equation, ion concentrations can be substituted for ion activities in expressing Q, and the solubility constant can be corrected for the ionic strength (yielding K'_{sp}). The activities (and concentrations) represent those of the free ions, not the total analyzed concentrations. Thus, for calcium carbonate, the preceding equation translates into

$$CSI = \log_{10}([Ca^{2+}][CO_3^{2-}]/K'_{sp})$$

Where:

$[Ca^{2+}]$ = concentration of calcium ions, in moles per liter
$[CO_3^{2-}]$ = concentration of carbonate ions, in moles per liter

calcium (Ca) One of the principal elements making up the earth's crust. The presence of calcium in water is a factor contributing to the formation of scale and insoluble soap curds that are a means of clearly identifying hard water. *See also* hard water.

calcium bicarbonate ($Ca(HCO_3)_2$) *See* soda ash.

calcium carbonate ($CaCO_3$) A colorless or white crystalline compound that occurs naturally as chalk, limestone, marble, and other forms. Pure calcium carbonate exists in two distinct crystalline forms: the trigonal solid, calcite; and the orthorhombic solid, aragonite. $CaCO_3$ is a sparingly soluble salt, the solubility of which decreases with increasing temperature. It has the potential to cause scaling if it is concentrated to supersaturation.

calcium carbonate equivalent An expression of the concentration of specified constituents in water in terms of the equivalent value to calcium carbonate ($CaCO_3$). For example, the hardness in water that is caused by calcium, magnesium, and other ions is usually described in terms of the calcium carbonate equivalent. For example, the concentration of calcium ions (i.e., $[Ca^{2+}]$) can be multiplied by 100/40 (the ratio of $CaCO_3$'s molecular weight to Ca^{2+}'s atomic weight) to give $[Ca^{2+}]$ as equivalent $CaCO_3$.

calcium carbonate precipitation potential (CCPP) The amount of solid calcium carbonate ($CaCO_3$) that will precipitate or dissolve as water equilibrates. *See also* calcium carbonate precipitation potential index.

calcium carbonate precipitation potential (CCPP) index An index that predicts the milligrams per liter of calcium carbonate ($CaCO_3$) that should dissolve or precipitate with a particular water. The equation used to determine this index is:

$$CCPP = 50{,}045([Alk]_i - [Alk]_{eq})$$

Where:

CCPP = calcium carbonate precipitation potential, in milligrams per liter as $CaCO_3$
50,045 = a unit conversion factor
$[Alk]_i$ = measured total alkalinity of a given water, in milligrams per liter as $CaCO_3$
$[Alk]_{eq}$ = total alkalinity that the water would have in equilibrium, measured as milligrams per liter as $CaCO_3$

calcium carbonate saturation index *See* Langelier saturation index.

calcium chloride ($CaCl_2$) A soluble salt some uses of which are similar to those of sodium chloride (NaCl). Because its most striking property is its ability to draw moisture from the air and thereby dissolve itself, it is often used as an air dryer and a deicing salt.

calcium hardness The portion of total hardness caused by calcium compounds such as calcium carbonate ($CaCO_3$) and calcium sulfate ($CaSO_4$).

calcium hydrate *See* hydrated lime.

calcium hydroxide ($CaOH_2$) *See* hydrated lime.

calcium hypochlorite ($Ca(OCl)_2$) A chemical compound used as a bleach or disinfecting agent and a source of chlorine in water treatment. Commercial grades contain 70 percent available chlorine (99.2 percent available chlorine for the pure chemical). Calcium hypochlorite is specifically useful because it is stable as a dry powder and can be formed into pellets. *See also* disinfection.

calcium oxide (CaO) *See* lime.

calcium sulfate ($CaSO_4$) A sparingly soluble salt, the solubility of which decreases with increasing temperature. It is called gypsum in its hydrated form. It is a potential source of scaling in desalting systems if it is concentrated to supersaturation.

Caldwell–Lawrence diagram A diagram illustrating a series of relationships associated with the chemical equilibrium of calcium carbonate ($CaCO_3$) as a function of pH, alkalinity, and calcium hardness for a solution of given temperature and ionic strength. *See also* alkalinity; calcium carbonate; calcium hardness.

caliber *See in the Units of Measure section.*

calibrate To adjust a measuring instrument so that it gives the correct result with a known concentration or sample.

calibration A procedure that adjusts or checks the accuracy of an instrument by comparison with a standard or reference.

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and chloride in water. Analytic methods using this technique are characterized by little sample preparation and rapid analysis. Organic anions have also been analyzed with this technique. *See also* capillary zone electrophoresis.

capillary lift The height to which water or other liquid rises in a capillary tube.

capillary migration The movement of water through a rock or soil, as produced by molecular attraction of the rock or soil material for the water.

capillary moisture Available soil moisture easily abstracted by roots of plants.

capillary movement *See* film flow.

capillary opening An opening small enough in cross-sectional area to create a condition in which capillary flow can occur.

capillary percolation Percolation through capillary interstices. *See also* percolation.

capillary suction test A test in which a water treatment sludge is placed on a special blotting paper. The time for the wetted area to move a set distance, often 1 centimeter, is an indication of the dewatering characteristics of the sludge. *See also* capillary suction time.

capillary suction time (CST) The time required, in seconds, for the wetted area in a special blotting paper to travel a set distance (normally 1 centimeter) as a result of capillary action after a water treatment sludge is placed in the sample holder. The time measurement is accomplished by an automatic timer that starts recording when the wetted surface reaches the first probe and stops recording when the wetted surface reaches the second probe. Capillary suction time is an indication of the dewatering characteristics of water treatment sludge. Larger capillary suction time values are an indication of poorer dewaterability. Capillary suction time values decrease with chemical conditioning of the sludge.

capillary tube A tube with an interior area of such small size that water within it is raised or moved by capillary force.

capillary water Water retained in the soil by capillary forces.

capillary zone The zone in which soil water is held by capillary forces. *See also* capillary migration.

capillary zone electrophoresis (CZE) A technique in which charged particles are separated because of differential migration in an electric field. Although electrophoresis has traditionally been used in the separation of large biomolecules, capillary zone electrophoresis has emerged as a powerful tool in a wider range of applications, e.g., the separation of proteins, peptides, amino acids, and carboxylic acids.

capital The net worth of a business; the amount by which the liabilities are exceeded by the assets.

capital asset An asset of a relatively permanent nature. *See also* fixed asset.

capital budget A plan, usually adopted on an annual or biannual basis, that establishes the spending requirements or limits for additions to and retirements from the existing utility plant.

capital cost A cost (usually associated with long-term debt) of financing construction and equipment. Capital cost is usually a fixed, onetime expense that is independent of the amount of water produced. It is also called capital expenditure or capital outlay.

capital expenditure *See* capital cost.

capital grant A grant that is restricted by the grantor for the acquisition and/or construction of fixed assets.

capital improvement plan (CIP) A plan, updated or compiled annually by most utilities, that identifies facility requirements over an extended period, often 20 years or more. The capital improvement plan is often a part of or stems from a water system master plan that combines water demand projections with supply alternatives and facility requirements. It is different from an asset replacement program concentrating on smaller assets that are generally funded from current revenues or from funds established for replacement. The capital improvement plan, by contrast, is focused on larger expenditures that are often debt funded but are sometimes funded from capacity charges or current revenues.

capitalized interest cost The interest cost incurred when a utility, during the construction of major debt funded facilities, opts to capitalize the interest on debt for 1 or 2 years. By so doing, the utility can use bond proceeds rather than current revenues to pay the interest costs during the period before the facilities begin to produce product and possibly generate revenue.

capital program A set of planned major improvements to be accomplished by a business or government within a set period of time.

capital recovery charge *See* capacity charge.

cap nut A metal fastener that connects a standard compression hydrant valve assembly to the hydrant main rod.

capsid A regular, shell-like structure, composed of aggregated protein subunits, that encloses the nucleic acid component of viruses.

capsule A mucopolysaccharide layer enveloping certain bacteria.

capsule filter Type of filtration device used to collect protozoan pathogens from large-volume water samples.

capture zone The up-gradient and down-gradient areas of an aquifer that drain into a particular well. The

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delineation of capture zones is used extensively in wellhead protection planning and in contaminant recovery.

carbofuran The common name for 2,3-dihydro-2,2-dimethyl-7-benzofuranylmethylcarbamate, a pesticide designed to combat corn rootworm and rice water weevil. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.04 milligrams per liter. *See also* pesticide.

carbon (C) (1) A chemical element essential for growth. (2) A solid material that, when activated, may be used to adsorb contaminants.

carbon-13 (^{13}C) nuclear magnetic resonance A spectrometric technique that can provide structural information about organic compounds. The adsorption of electromagnetic radiation depends on the nuclei present in a compound. A nuclear magnetic resonance spectrum plots the frequencies of absorption versus the peak intensity. The technique is similar to proton nuclear magnetic resonance (i.e., ^{1}H nuclear magnetic resonance), yet it became popular only after Fourier transform instruments became widely available. When used in conjunction with other electromagnetic techniques, carbon-13 nuclear magnetic resonance can be a powerful tool in the elucidation of molecular structure. *See also* proton nuclear magnetic resonance.

carbon absorbable organic halogen (CAOX) The fraction of organic halogens that can be absorbed on carbon. It is also commonly referred to as absorbable organic halogen. Because total organic halogen is generally analyzed through carbon adsorption, the total organic halogen measured is also carbon absorbable organic halogen. *See also* total organic halogen.

carbonaceous Containing carbon and derived from organic substances such as coal, coconut shells, and wood.

carbonaceous biochemical oxygen demand (CBOD) A measure of the quantity of oxygen used in the biochemical oxidation of carbonaceous organic matter not including ammonia. The nitrification reaction is inhibited during the analysis by adding 2-chloro-6-trichloromethyl pyridine to water samples. *See also* biochemical oxygen demand.

carbonate (CO_3^{2-}) A divalent negatively charged anion.

carbonate alkalinity Alkalinity caused by carbonate ions (CO_3^{2-}) and expressed in terms of milligrams of equivalent calcium carbonate ($CaCO_3$) per liter. *See also* calcium carbonate equivalent.

carbonated spring A spring of water containing carbon dioxide (CO_2) gas. Such springs are very common, especially in volcanic regions.

carbonate hardness Hardness caused by the presence of carbonates and bicarbonates of calcium and magnesium in water. Such hardness may be removed to the limit of solubility by boiling the water. When the hardness is numerically greater than the sum of the carbonate alkalinity and the bicarbonate alkalinity, that amount of hardness that is equivalent to the total alkalinity is called carbonate hardness and is expressed in milligrams of equivalent calcium carbonate ($CaCO_3$) per liter. Carbonate hardness was previously called temporary hardness. *See also* calcium carbonate equivalent; hard water; hardness.

carbonate system A system of chemical relationships in natural waters that performs important functions related to acid–base chemistry, buffering capacity, metal complexation, solids formation, and biological metabolism. Species comprising the carbonate system include carbon dioxide (CO_2), carbonic acid (H_2CO_3), bicarbonate (HCO_3^-), carbonate (CO_3^{2-}), hydroxide (OH^-), hydrogen ion (H^+), and calcium carbonate ($CaCO_3$). *See also* alkalinity; carbonate alkalinity; carbonate hardness.

carbonation The diffusion of carbon dioxide (CO_2) gas through a liquid to render the liquid stable with respect to precipitation or dissolution of alkaline constituents. *See also* recarbonation.

carbonator A device for the carbonation or recarbonation of water.

carbon chloroform extract (CCE) The residue from a carbon chloroform extraction test. *See also* carbon chloroform extraction.

carbon chloroform extraction An outdated method for assessing organic pollutants in water. It consists of adsorbing organic material onto activated carbon, then extracting the activated carbon with chloroform ($CHCl_3$). The chloroform is then evaporated and the residue weighed. The residue is called the carbon chloroform extract (CCE).

carbon dioxide (CO_2) A colorless, odorless, incombustible gas that is a normal component of natural waters. It may enter surface water and groundwater by absorption from the atmosphere or biological oxidation of organic matter.

carbonic acid (H_2CO_3) A weak acid formed by dissolving carbon dioxide in water. Carbonic acid and its salts, carbonate and bicarbonate, play an important role in water alkalinity and acidity. Carbonate and bicarbonate ions also affect ozone decomposition in water. *See also* carbon dioxide.

carbon reactivation *See* activated carbon regeneration.

carbon regeneration *See* activated carbon regeneration.

carbon tetrachloride (CCl_4) A common name for tetrachloromethane, a volatile organic compound with various industrial uses (e.g., as a solvent). It is not a

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disinfection by-product. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.005 milligrams per liter. *See also* volatile organic compound.

carbon tetrachloride activity The maximum percentage increase in weight of an activated carbon bed after air saturated with carbon tetrachloride (CCl_4) is passed through it at a given temperature.

carbon usage rate (CUR) *See* activated carbon usage rate.

carbonyl (C=O) An organic functional group composed of a carbon and oxygen atom double bonded together. It is present in aldehydes, ketones, organic acids, and sugars. *See also* aldehyde; ketone; organic acid.

carbonyl-containing disinfection by-products Disinfection by-products that contain the carbonyl functional group, including aldehydes, ketones, ketoacids, and carboxylic acids. These disinfection by-products are commonly present in ozonated water. *See also* disinfection by-product.

carboxyhemoglobin The complex between carbon monoxide (CO) and hemoglobin. Carbon monoxide competes effectively with oxygen at its binding site on hemoglobin. Consequently, carbon monoxide poisons individuals by sharply reducing the oxygen-carrying capacity of the blood.

carboxylic acid (R-COOH) Any of a broad array of organic acids composed chiefly of hydrocarbon groups, usually in a straight chain, terminating in a carboxyl group (COOH). They contribute cation-exchange ability to some resins. Carboxylic acids are sometimes called weak acid cation exchangers. *See also* organic acid.

carbuncle A painful, localized, pus-producing infection of the skin and subcutaneous tissue.

carcinogen A chemical, physical, or microbial agent that is capable of inducing cancer. The mechanisms by which these agents act can vary widely. These differences seriously affect the extrapolation of risks to low exposure levels. Some carcinogens can alter a deoxyribonucleic acid (DNA) sequence by causing errors in its replication or by incorporating new material into the genome that is inappropriately replicated in the infected cell. These types of events are essentially irreversible and are assumed to accumulate during a lifetime. Therefore, a linear relationship between dose and response is assumed for estimating risks at low doses. Such agents are called genotoxic carcinogens. Agents can also produce cancer by altering the control of gene function without being directly involved in producing a permanent error in the DNA sequence. The effects of these agents would be considered largely, if not entirely, reversible once the exposure is removed. These are referred to as epigenetic or nongenotoxic carcinogens because their effects are reversible. Usually these agents affect the relative rates at which normal and transformed cells divide within a particular tissue. Chemicals that induce death of normal cells can also produce cancer by increasing the rate at which cells within the organ divide. A higher degree of cell turnover increases the probability of mistakes being made in DNA replication. Moreover, the killing of normal cells provides a selective growth advantage to abnormal cells that may not be sensitive to the cytotoxic effects of the chemical. Generally, chemicals that produce cancer in this way should be treated as toxins rather than as carcinogens. *See also* tumor initiator; tumor promoter.

Carcinogen Assessment Group (CAG) A group that was administratively housed in the Office of Health and Environmental Assessment within the Office of Research and Development of the US Environmental Protection Agency that developed and promulgated the accepted methods of identifying hazards and assessing risks associated with putative carcinogens found in various environmental media. The principles laid out in their documents formed the basis of the US Environmental Protection Agency's policy for developing standards, guidelines, regulations, and maximum contaminant levels for these chemicals. In 1995, the CAG was disbanded and its functions were incorporated into the US Environmental Protection Agency's National Center for Environmental Assessment.

carcinogenesis bioassay A test of the cancer-causing capabilities of chemical, physical, or microbial agents. The term has been applied loosely to a wide variety of in vivo and in vitro assay systems. The term is correctly applied only to assays that actually measure cancer as an end point. The assay as conducted by the National Toxicology Program (NTP), for example, represents the standard for cancer bioassays. The experimental design for NTP 2-year bioassay is standardized and involves administration of the test substance for a major portion of the test animals' lifetimes. The rodent species used in these assays are the Wistar HAN rat and the B6C3F1 mouse, although exceptions are incorporated based on the needs for a particular chemical or other agent. The NTP bioassay is a frequent source of data used for establishing regulatory limits on chemicals. The main reason for this is the comprehensive nature and high quality of these assays and the broad historical background data available. There are limitations related to the high dose levels that have to be used in order to detect increases in tumor frequency above the background

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levels for the species and strains used, and the fact that the tumors observed to be increased in the treated groups are frequently the type that is characteristic for a particular species and strain. There are continuing efforts to enhance the predictive value of the 2-year bioassay. However, the application of data to estimating cancer risk across species and to low doses is controversial. The lay public does not always recognize that such extrapolations are not really justifiable on strictly scientific grounds because it is very rare that these extrapolations are confirmed, particularly the low-dose extrapolations. This extrapolation usually means taking data from an experiment conducted in a limited number of animals (typically 50 animals from each sex of each species) to estimate doses that would produce cancer at a rate as low as one extra cancer death in a population of one million people per lifetime. However, the sensitivity of the actual NTP bioassay is usually about one extra cancer death per population of 10 people per lifetime. The high doses and small numbers of animals are practical limitations of the bioassay both from a cost standpoint and because of the almost impossible logistical difficulties that arise from attempting studies with the appropriate sensitivity. Because the technical community generally regards the cancer bioassay in animals as a qualitative test, the standard practice has been to use doses that approximate the maximally tolerated dose for the animals. At such doses, almost by definition, a variety of effects can occur that are unique to high doses, almost certainly affecting the outcome of the bioassay. Therefore, as already noted, the extension of these data to low doses is highly questionable. The extrapolation does provide a standard means of ranking carcinogens, but this must be recognized as largely a governmental policy approach based on some hypothetical and general conception of chemical carcinogenesis. Once implemented, the policy does have the logical benefit of establishing a way of essentially dismissing those chemicals that occur at concentrations much less than some hypothetical risk considered to be of regulatory importance. Implicit in this philosophy is the concept that sufficient economic interest exists to drive the development of data that are more appropriate for assessing the risks of chemicals in instances where human exposures approach some predetermined level of concern. Unfortunately, such data are not commonly developed, partly because of the expense of these more elaborate studies, particularly if the agent involved is generally ubiquitous in the community as opposed to being the responsibility of a small commercial sector. A second major problem is that such research almost invariably requires a chemical-by-chemical approach rather than a standardized methodology. The type of experimental data that would be needed to demonstrate that an alternative mechanism is actually operative has yet to be defined, however. *See also* B6C3F1 mouse; linearized multistage model; multihit model; multistage model; one-hit model; probit model; Weibull model.

carcinogenic Able to produce carcinoma or a cancer arising from epithelial cells. The term is also commonly used to describe any process or agent that produces cancer, regardless of the cell of origin.

carcinogenicity The power or ability of an agent to produce cancer. The agent can be a virus, a chemical, or a physical agent. The hepatitis B virus is an example of a viral carcinogen, benzo(a)pyrene is a chemical carcinogen, and radiation is a physical agent.

carcinoma A malignant growth arising from epithelial cells.

cardiomyopathy A general diagnostic term applied to primary disease of the muscles of the heart. Frequently, the term is applied to heart muscle disease for which the cause is obscure or unknown.

cardiopulmonary resuscitation (CPR) A first-aid procedure used to maintain breathing and blood circulation for an injured person.

cardiovascular disease A group of diseases that affect either the heart or vasculature. The diseases range from the highly specific (e.g., myocardial infarct) to descriptions of symptoms (e.g., angina, hypertension). The diseases can arise from physical damage to critical organs such as the heart, lungs, or kidneys, or they may arise from changed regulation of the function of the heart or vasculature. Cardiovascular disease includes blocked (infarcted) blood flow to a variety of organs, most notably the brain (e.g., cerebrovascular accidents or strokes, thrombophlebitis). As can be imagined, these diseases have a wide variety of causes. Some studies have suggested that a relationship may exist between the mineral content (or lack thereof) in drinking water and cardiovascular disease, but results are contradictory and a definitive casual relationship has not been established.

cardiovascular system The heart and blood vessels. *See also* vascular system.

card record A card, typically 5 inches × 8 inches, with a preprinted, standardized format for recording descriptive, historical, and maintenance information. Card records are generally maintained for valves, hydrants, and services because recording information of such detail on mapped records is difficult.

carrier (1) A person or animal that harbors a specific infectious agent and serves as a potential source of infection. Clinical disease is absent in the carrier, and the carrier state may be of a long or short duration.

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(2) An organization supplying insurance coverage, such as an insurance company, self-insurance group, or state fund.

carrying capacity The maximum rate of flow that a conduit, channel, or other hydraulic structure is capable of passing.

carryover (1) The entrainment of liquid or solid particles in the vapor evolved by a boiling liquid. (2) The entrained particles in a boiling liquid's vapor.

Cartesian coordinate system A coordinate system in which the location of a point on a plane is expressed by (1) two coordinates (x, y) that measure the point's distance from two intersecting, often perpendicular, straight-line axes along a line parallel to the other axis or (2) three coordinates (x, y, z) that locate a point in space by its distance from three fixed planes that intersect one another at right angles.

cartography The art and science of making maps.

cartridge A removable cylindrical water treatment separations device installed, alone or with others, in a pressure vessel (housing); such as (1) a micrometer-pore-size filter element installed in a cartridge filter pressure vessel or (2) a spiral-wound membrane element housed in a pressure vessel of a membrane treatment system.

cartridge filter A filtration device that has a pressure vessel containing one or more cartridges of a specified nominal (or sometimes absolute) pore size rating used to remove particles from a process stream. *See also* cartridge.

cascade (1) A stretch of a stream, intermediate between a rapids and a waterfall, where the drop in elevation of the stream bed is considerable but not sufficient to cause the water to fall vertically. (2) A sudden drop installed in a waterway to produce agitation and aeration of the liquid flowing over it.

cascade aerator An aerating device built in the form of either steps or an inclined plane, on which are placed staggered projections arranged to break up the water and bring it into contact with air.

case (1) In epidemiology, a person identified as having a particular disease or health condition under investigation. A variety of criteria may be used to identify a case, and the case definition for an epidemiologic investigation may not necessarily be the same as a clinical definition. (2) In a database, a complete set of information in the database, such as a row of data.

case-control epidemiologic study A study in which individuals enter on the basis of their disease status without knowledge of their exposure status. A single disease or health outcome (e.g., giardiasis, lung cancer, bladder cancer, blood lipid levels) is selected for study, and two groups are assembled: those with the disease or condition and those without. Information about any number of individual exposures or other characteristics (e.g., smoking, use of chlorinated or unchlorinated water, radon exposures) can be obtained and studied to determine possible associations (an odds ratio) with the disease. Such a study is also called a case-comparison epidemiology study or a case-referent epidemiology study. *See also* odds ratio.

case fatality rate The percentage of individuals diagnosed with a specific disease who die as the result of that disease. This rate is different from mortality rate, which considers the entire population with and without disease.

casein A well-defined group of proteins found in milk. When treated with formaldehyde, the curd forms casein plastic. Casein is commonly used in a general-purpose medium for microbiological analysis.

case-referent epidemiology study *See* case-control epidemiologic study.

cash basis The basis of accounting under which revenues are recorded when cash is received and expenditures are recorded when cash is disbursed.

cash-needs approach The method of determining annual operating revenue requirements based on all cash needs, including but not limited to operations-and-maintenance expense, debt service, capital expenditures from current revenues, and reserve requirements.

cash requirements method A method of accounting used for ratemaking analysis by an estimated 90 percent of all not-for-profit water utilities. The major characteristic of this method is that the net revenue requirement that must be funded by water rates is based on actual (or estimated) cash expenditures and actual cash receipts only, which by definition exclude depreciation, accrued expenses, and accrued revenues. This method, which can be contrasted with the utility method, also excludes return on investment as a cost to be recovered by rates. *See also* net revenue requirement; rate of return; return on investment; utility method.

cash reserve Cash set aside in a bank account by businesses to pay operating expenses in winter months when expenses often exceed revenues, to pay claims not reimbursed from insurance, or to cover any other emergency or unplanned need for cash. Reported cash reserves should exclude cash that is restricted for specific purposes, such as cash that has accumulated in a sinking fund for asset replacement or that has been collected from capacity charges to pay for new facilities. Cash reserves are generally targeted to cover 3 to 6 months of operating expenses.

Casil index (CI) A measure of the corrosiveness of water based on a cation–anion balance. As the number of cations decreases, the index decreases,

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indicating more corrosive conditions. As the number of anions increases, the index decreases, again indicating more corrosive conditions. A decrease in pH through the addition of acid will increase the number of anions, which will lower the index, thus indicating increasing corrosiveness. The formula for determining the Casil index is

$$CI = \frac{\text{calcium ions + magnesium ions + silica ions} - \text{anions}}{2}$$

All ions are expressed in terms of milliequivalents per liter.

casing A solid piece of pipe used to keep a well open in unstable materials.

casing head In well boring, a heavy weight of iron screwed into the top of a string of casing to take the blows produced by driving the pipe.

casing shoe A rigid annular fitting placed at the lower end of a metal well casing, commonly with a cutting edge on the bottom.

CASM *See* common application services model.

CAS number *See* Chemical Abstracts Service Registry number.

casting The shaping of an object such as a tee or valve body by pouring melted cast iron or ductile iron into a mold, usually a sand mold, and letting it harden.

cast iron (CI) A heavy brittle alloy of iron, carbon, and silicon that is normally cast in specific shapes and has the ability to withstand shocks. It is used for such construction materials as piping, valves, and fittings. It is also known as gray iron.

cast-iron pipe A pipe made from pig iron cast in a revolving, water-cooled mold, or in a stationary, cylindrical sand mold with a round, central core.

Cast Iron Pipe Research Association (CIPRA) *See* Ductile Iron Pipe Research Association.

catalase An enzyme that catalyzes the degradation of hydrogen peroxide (H_2O_2).

catalysis The speeding up (in most cases) of a chemical reaction by the addition of a specific substance, the catalyst. Although the catalyst causes the reaction to speed up, the catalyst is not changed chemically in any way.

catalyst Any substance of which a fractional percentage notably affects the rate of a chemical reaction, without the substance itself being consumed or undergoing a chemical change. Most catalysts accelerate reactions, but a few retard them (the latter substances are called negative catalysts or inhibitors).

catalyst filter A class of media bed filters that contain manganese-treated greensand, zeolites, or pumicites. Such filters are sometimes called oxidizing filters.

catalyst media Those filter media that can cause certain reactions to occur in water treatment, e.g., activated carbon, calcite, manganese greensand, magnesium oxides, and dissimilar metal alloys.

catalytically aided platinum combustion technique A technique using platinum to catalyze sample oxidation. In total organic carbon analysis, this technique is used to oxidize organic compounds to carbon dioxide and is commonly referred to as combustion or high-temperature oxidation. *See also* total organic carbon.

catalytically destroy To break down a substance through catalysis. *See also* catalysis.

catalytic filtration A method of filtration in which a contaminant is removed through the catalytic effect of a coating on the filtering media. For example, iron and manganese can be removed through greensand filters in which the natural zeolite medium catalyzes the oxidation and removal of iron and manganese.

catalytic granular activated carbon Activated carbon that has the ability to facilitate or promote the reaction between chemical species. This reaction would not occur, or would occur at a lower rate, in the absence of the activated carbon.

catalytic ozone destructor A type of ozone (O_3) destruction unit that uses a catalyst to enhance the performance of the off-gas treatment system.

catalytic photochemical oxidation A method of accelerating and increasing the oxidation of compounds by using a catalyst together with a strong oxidant. For example, ultraviolet absorbance can be used together with ozone to rapidly degrade specific compounds.

catalyze To act as a catalyst; to speed up a chemical reaction.

catalyzed oxidation The enhancement of chemical or biological oxidation by the addition of agents called catalysts, which promote higher rates of reaction.

cataract An opacity of the crystalline lens of the eye.

cataract action The digging back action of rapid current on a river bed.

catch basin A chamber or well, usually built at the curbline of a street, that admits surface water for discharge into a stormwater drain. *See also* curb inlet.

catch-can test A measurement of precipitation from a sprinkler system, taken by placing graduated containers at evenly spaced intervals throughout an irrigated area.

catchment The area tributary to a lake or stream. *See also* catchment area; drainage area; river basin; watershed.

catchment area (1) The intake area of an aquifer, as well as all areas that contribute surface water to the intake area. (2) In tropical island zones, a hard-surfaced area on which rain is collected and then conducted to a reservoir. (3) The area tributary to a lake

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or stream. A catchment area is also called a catchment basin. *See also* drainage area; intake area; watershed.

catchment basin *See* catchment area.

caterpillar gate A roller-bearing crest gate equipped on each side with a continuous chain of caterpillar rollers that run in a vertical groove and travel around the gate as it is raised or lowered.

cathode (1) The pole of an electrolytic cell that attracts positively charged particles or ions (cations). It is the electrode where reduction (and practically no corrosion) occurs. It is the opposite of the anode. (2) The negatively charged electrode of an electrodialysis cell.

cathode protection *See* cathodic protection.

cathodic corrosion An unusual condition (especially in the case of aluminum, zinc, and lead) in which corrosion is accelerated at the cathode because the cathodic reaction—in which cations are attracted to the negatively charged electrode—creates an alkaline condition that is corrosive to certain metals.

cathodic protection (CP) Reduction or elimination of corrosion by making the metal a cathode by means of an impressed direct current or attachment to a sacrificial anode (usually magnesium, aluminum, or zinc).

cation A positively charged ion (e.g., H^+ or Zn^{2+}) or radical (as NH_4^+) that migrates toward the cathode.

cation exchange A process in which cation contaminants such as calcium, magnesium, or radium are removed from a liquid phase by contacting a synthetic, porous medium or resin that is coated with different cation species. The cations on the medium are exchanged for the cation contaminants. When the medium is depleted of the exchanging cations, it is regenerated with a concentrated solution to restore the bed with the exchanging cations and flush the contaminant cations for subsequent disposal. *See also* cation; ion exchange.

cation-exchange capacity A measure of the ability of soil to absorb cations.

cation-exchange material A material that releases nontroublesome ions into water in exchange for hardness-causing or other ions.

cation exchanger *See* cation-exchange resin.

cation-exchange resin A synthetic material possessing reversible ion-exchange ability for cations. Sulfonated polystyrene copolymer divinylbenzene exchange resin is the most commonly used cation resin. It is characterized as a strong acid cation (CAT) resin and is typically used to remove both carbonate and noncarbonate hardness. Weak acid cation (WAC) resins contain carboxylate functional groups in place of the sulfonate groups. WAC will only remove carbonate hardness, but it is more readily regenerated than CAT resins. There are also special purpose cation resins that are specifically formulated to remove target contaminants such as copper and lead. *See also* ion exchanger.

cation-exchange water softener An equipment unit capable of reducing water hardness by the cation-exchange process.

cationic Having a positive ionic charge.

cationic flocculant A polyelectrolyte with a net positive electrical change.

cationic polyelectrolyte A polyelectrolyte that forms positively charged ions when dissolved in water.

cationic polymer A polymeric substance with a net positive charge, used in coagulation, flocculation, flotation, or filtration processes to improve the removal of negatively charged particles from natural waters. Cationic polymers can be used to destabilize negatively charged particles or to form a bridge between destabilized floc. *See also* charge neutralization; floc.

cation membrane An electrodialysis membrane that allows the passage of anions (but not cations) and is practically impermeable to water under typical electrodialysis system working pressure.

cation transfer membrane *See* cation membrane.

Cauchy number (C_a) A numerical quantity used as an index to characterize the type of flow in a hydraulic structure in which compression forces, in conjunction with the resisting force of inertia, influence the motion of the liquid. Cauchy number is the ratio of inertia forces to compression forces (in any consistent set of units):

$$C_a = rV^2/E$$

Where:

V = the characteristic velocity of the fluid
E = the bulk modulus of elasticity of the liquid
r = the density

The number is useful in the study of water hammer.

caulking (1) The process of driving, pouring, or forcing lead, oakum, plastic, or other material into a joint to make it leakproof. (2) The materials used in the caulking process. It is sometimes spelled "calking."

caulking tool A blunt offset chisel-like tool that is used to drive or press the lead ring poured in a bell-and-spigot-joint water pipe. The tool is placed against the lead and hit with a hammer. The tool has been adapted to be used with a pneumatic caulking gun or hammer and is made in various widths to correspond to the width of the lead ring in the joint. *See also* bell-and-spigot joint.

causal association An association, as observed in epidemiological studies, indicating that sufficient evidence is available to make a causal inference (i.e., that the exposure is a cause of the disease rather than the disease merely being associated with exposure). Guidelines used to evaluate causality include consideration of the

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association's biological plausibility, coherence, and specificity of effect; the consistency of results of studies in different geographic areas; whether a dose–response relationship was observed; and magnitude and temporal nature strength of the association. *See also* association; causality.

causality In epidemiology, the relation of causes to their effects; causes may be necessary, sufficient, or both. Criteria are available to help determine whether epidemiological associations may be causal. Establishing whether an epidemiological association is causal usually requires evidence outside the field of epidemiology; such a process is not performed without considerable debate among epidemiologists.

cause-and-effect diagram A graphic showing the relationship between cause and effect. It is an investigative tool that organizes randomly connected causes.

causeway A raised road across wet or marshy ground or across water.

caustic (1) Caustic soda (NaOH) or any compound chemically similar to caustic soda. (2) Any substance capable of burning or destroying animal flesh or tissue. The term is usually applied to strong bases. *See also* caustic soda.

caustic alkalinity The alkalinity caused by hydroxide ions (OH^-). *See also* hydroxide alkalinity.

caustic corrosion Deterioration of a material caused by exposure to caustic soda (sodium hydroxide, NaOH). Caustic soda will rapidly attack zinc, tin, aluminum, bronze, and brass, so exposure of these materials to caustic soda is not advised.

caustic lime *See* hydrated lime.

caustic soda (NaOH) Sodium hydroxide, a strongly alkaline chemical used for pH adjustment, water softening, anion-exchange demineralizer regeneration, and other purposes. It is sometimes called caustic.

caustic soda softening A process to remove hardness from waters by using caustic soda (NaOH). Caustic soda softening is effective when the source water contains insufficient carbonate hardness to react with lime. *See also* carbonate hardness.

cave-in An occurrence in an excavation where the sidewalls slough off into a trench or hole.

cavern flow The movement of water through large openings in rocks, such as caves, or through coarse sorted granular materials.

cavitation The formation and sudden collapse of vapor bubbles in a liquid, usually resulting from local low pressures, as on the trailing edge of a propeller. This phenomenon develops a momentary high local pressure that can mechanically destroy a portion of a surface on which the bubbles collapse. Cavitation can occur in pumps when the suction side has insufficient head for the current operating conditions.

cavitation erosion A process that occurs when a fluid's operational pressure drops below its vapor pressure, causing gas pockets and bubbles to form and collapse. Additionally, this condition can form an airlock that prevents any incoming fluid from offering cooling effects.

cavitation microbubbles *See* critical resonance frequency size.

cavity radiation *See* black-body radiation.

CBFP *See* continuous belt filter press.

CBO *See* Congressional Budget Office.

CBOD *See* carbonaceous biochemical oxygen demand.

C. botulinum *See Clostridium botulinum.*

C. burnetii *See Coxiella burnetii.*

C. cayetanensis *See Cyclospora cayetanensis.*

CCE *See* carbon chloroform extract.

ccf *See* 100 cubic feet *in the Units of Measure section.*

CCL (Contaminant Candidate List) *See* Drinking Water Contaminant Candidate List.

CCML method *See* Cohen censored maximum likelihood method.

CCP *See* Composite Correction Program.

CCPP index *See* calcium carbonate precipitation potential index.

CCR *See* consumer confidence report.

CCTV *See* closed-circuit television system.

CD *See* compact disc.

C_D *See* drag coefficient.

cd *See* candela *in the Units of Measure section.*

CD-1 neonatal mouse infectivity assay *See* neonatal mouse infectivity assay.

CDA membrane *See* cellulose diacetate membrane.

CDBG program *See* Community Development Block Grant program.

CDC *See* Centers for Disease Control and Prevention.

c-deoxyribonucleic acid (c-DNA) probe hybridization The use of complementary deoxyribonucleic acid clones made from ribonucleic acid to detect target gene sequences.

CDI *See* capacitive deionization.

CDIM *See* chlorodiiodomethane.

c-DNA probe hybridization *See* c-deoxyribonucleic acid probe hybridization.

CD-ROM *See* compact disc, read-only memory.

CEBW *See* chemically enhanced backwash.

CEFI *See* Civil Engineering Forum for Innovation.

celerity The velocity of propagation of a wave through a fluid medium relative to the undisturbed velocity of the fluid through which the disturbance is moving. *See also* wave velocity.

cell-associated hepatitis A virus (HAV) Hepatitis A virus not causing cytopathic effects in cell cultures.

cell culture In vitro growth and replication of cells in suspension or on surfaces.

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cerussite ($PbCO_3$) A commonly found corrosion byproduct, colorless to white to green in color, associated with lead materials in drinking water distribution systems.

cesium chloride (CsCl) A chloride salt of cesium that has a radioactive man-made isotope, cesium-137. Cesium-137 decays by emitting beta particles and gamma rays, which are regulated under the Radionuclides Rule at a level of 4 millirems per year. *See also* radioisotope; Radionuclides Rule.

cestode A flatworm of the class Cestoda, which includes tapeworms.

C-F (or C/F) *See under* modified coagulation/filtration.

C

***C* factor (*C*)** (1) A coefficient representing the relative roughness of a pipe in the Hazen–Williams formula for water flow in a pipe. Pipes with low Hazen–Williams *C* factors have greater resistance to flow than pipes with large Hazen–Williams *C* factors. (2) The coefficient in the Chezy open-channel flow equation that represents the frictional effects of the channel on the flow. (3) A coefficient of proportionality in weir flow equations and orifice flow equations. (4) The coefficient of proportionality in the rational formula for peak flow prediction from the rainfall–runoff process. Usually the term is modified by the particular formula, as in "the Hazen–Williams *C* factor," "Chezy's *C*," or "the rational *C* coefficient." *See also* Chezy open-channel formula; Chezy resistance factor; Hazen–Williams formula; Manning formula.

CFD *See* computational fluid dynamics.

CFE *See* combined filter effluent.

CFM (also cfm) *See* cubic feet per minute *in the Units of Measure section.*

CFR *See Code of Federal Regulations.*

C. freundii *See Citrobacter freundii.*

CFS (also cfs) *See* cubic feet per second *in the Units of Measure section.*

CFSTR *See* continuous-flow stirred-tank reactor.

cfu *See* colony-forming unit *in the Units of Measure section.*

CGR *See* coliform growth response.

CGS system *See* centimeter–gram–second system *in the Units of Measure section.*

CH *See* chloral hydrate (trichloroacetaldehyde hydrate).

chain-and-flight sludge collector A device for removing sludge from a rectangular basin by a scraping mechanism. Collected sludge is scraped into a hopper, from which it typically is discharged to solids processing by means of a screw conveyer. The scrapers, or flights, are attached to chains that are driven along the length of the basin by rotating cogs located at the ends of the basin. The chains move longitudinally along the basin bottom and across the top of the basin in a circular fashion. *See also* screw conveyer.

chain bucket A continuous chain equipped with buckets and mounted on a scow. It is also called a ladder dredge.

chain gauge A gauge consisting of a tagged or indexed chain, tape, or other line attached to a weight that is lowered from a boat or platform to touch the water surface, whereupon the gauge height is determined based on the tag or index indicator on the boat deck or platform. *See also* tape gauge.

chain of custody (1) The sequence of persons handling a sample, as specified in a document accompanying a sample when certifying sampling information and the person with control of the sample at any given time is important. A chain-of-custody document is an important part of a quality assurance program when rigorous data validation is required. (2) The document that specifies this sequence of persons having custody.

challenge microorganism A microorganism selected for use in experimental tests to measure the treatment effectiveness of a given process. For ultraviolet (UV) reactors, the challenge microorganism is used in biodosimetry tests of the UV reactor. *See also* biodosimetry.

challenge water Water specifically prepared for testing the performance of water treatment equipment products. Challenge water for each type of equipment is specifically defined in individual equipment testing standards, such as those established by the Water Quality Association and NSF International.

chalybeate spring A spring in which the water contains a considerable amount of iron compounds, especially the sulfate, $Fe_2(SO_4)_3$, in solution.

change of state The process by which a substance passes from one phase to another among the solid, liquid, and gaseous states and in which marked changes in the substance's physical properties and molecular structure occur.

channel (1) A perceptible natural or artificial waterway that periodically or continuously contains moving water or that forms a connecting link between two bodies of water. It has a definite bed and banks that confine the water. (2) The deep portion of a river or waterway where the main current flows. (3) The part of a body of water deep enough to be used for navigation through an area otherwise too shallow for navigation. (4) Informally, a more or less linear conduit of substantial size in cavernous limestones or lava racks. *See also* buried channel; bypass channel; open channel.

channel inflow Water that, at any instant, is flowing into a channel system from surface flow, subsurface flow, base flow, or rainfall directly on the channel.

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channeling The flow of water or regenerant through a limited number of passages in a filter or ion-exchanger bed, as opposed to the usual distributed flow through all passages in the bed. Channeling may be caused by fouling of the bed and the resulting plugging of many passages, poor distributor design, low flow rates, faulty operations procedures, insufficient backwash, or other causes.

channel line The route of strongest flow of a river. It usually coincides, or nearly coincides, with the thalweg.

channel loss The loss of water from a channel by capillary action and percolation.

channel of approach That reach of a channel immediately upstream from a control structure such as a dam, weir, sill, or bridge.

channel-phase runoff That phase of runoff that takes place in the channel and is governed by the laws of channel hydraulics.

channel roughness Variation from smooth texture in a channel, including the extra roughness caused by local expansion or contraction and obstacles, as well as the roughness of the streambed proper. This roughness is expressed in terms of a roughness coefficient in the velocity formulas.

channel spring A spring occurring on the banks of a stream that has cut a channel below the water table.

channel storage The in-channel storage volume, which depends on the stage of the water surface in the channel.

chapelet (1) A machine for raising water, or for dredging, that uses buckets on a continuous chain passing between two rotating sprocket wheels. (2) A chain pump having buttons or disks at intervals along its chain.

characteristic speed A speed or velocity of revolution, expressed in revolutions per minute, at which the runner of a given type of turbine would operate if it were so reduced in size and proportion that it would develop 1 horsepower under a 1-foot head (1.341 kilowatts under a 0.305-meter head). It is sometimes referred to as characteristic type. *See also* specific speed.

charcoal An adsorbent carbon product that has about one third the surface area of activated carbon. It is often confused with activated carbon. *See also* granular activated carbon.

Charcot–Leyden crystal Substance formed from the breakdown of eosinophils (a type of white blood cells) that may occur in the stool or sputum of patients with parasitic diseases. The crystals are slender and pointed and stain purplish-red in the trichrome stain. They can appear in a variety of sizes and only indicate an immune response; the cause may or may not be a parasitic infection.

charge (1) An excess or deficiency of electrons in a body. (2) The cost for goods or services rendered.

charge neutralization A process under which a positively charged material (coagulant) is added to a negatively charged particle suspension to neutralize, or destabilize, particles. After charge neutralization, particles can agglomerate and settle. *See also* adsorption–destabilization; bridging; double-layer compression; sweep-floc coagulation; zone of coagulation.

charge neutralization zone *See* zone of coagulation.

charge titration A method of titrating the charge of a substance that can be used to determine the proper coagulant dosage that efficiently reduces or neutralizes the charge on particles in water. Neutralizing particle charges destabilizes the particle and reduces the turbidity in water. *See also* coagulation.

Chartered Institution of Water and Environmental Management (CIWEM) The organization of professionals in water and environmental management in Great Britain.

check dam A low, uncontrolled dam used for a variety of purposes including (1) the spreading of water in shallow basins for artificial recharge to underlying aquifers, (2) dissipation of energy in flood channels, and (3) as a weir for maintaining a water depth suitable for navigation.

checklist approach A method of establishing water efficiency standards by prescribing specific criteria for landscape design, installation, and management.

check sample A sample taken to verify the results of a previous sample. Under the Total Coliform Rule, water utilities are required to take check samples after a routine positive coliform sample is detected.

check valve A valve that allows flow in one direction and that closes when the flow tries to reverse, used on pump discharge lines for pump protection and on building services to prevent draining of plumbing lines back into the distribution system. A single check valve is not a backflow prevention device; that requires a double check assembly that can be tested for positive closing.

chelating agent A chemical or complex that interacts with an ion, usually a metal, causing the ion to join that chemical or complex by both ordinary and coordinate valence forces. Such linkages result in the formation of one or more heterocyclic rings in which the metal atom is part of the ring. Commercially available chelating agents may be used to remove traces of metal ions. *See also* sequestering agent.

chelating filter A device for removing trace metal ion contaminants from water in a closed-loop industrial water supply system.

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chelating ion exchanger A special selective resin that will adsorb one metal ion to the exclusion of any other ion present in a stream of water. *See also* chelation.

chelation A process in which metal ions are reacted with a ligand to form a cyclic compound. Such complexes are used to bind certain ions for specific purposes in analytical methods. An example is the use of ethylenediaminetetraacetic acid as a chelating agent in determining the hardness in water.

chelation concentration–atomic absorption spectrometry A method that contains an initial step similar to the first step of chelation ion chromatography for preconcentrating trace metal ions. The concentrated ions are transferred to an atomic absorption spectrometer for detection. *See* atomic absorption spectrophotometric method; chelation ion chromatography.

chelation extraction–atomic absorption spectrometry *See* chelation concentration–atomic absorption spectrometry.

chelation ion chromatography A method of preconcentrating trace-level metal ions followed by ion chromatographic determination. The use of a high-capacity cation-exchange column maximizes the amount of metal ions in a small volume for better sensitivity with a detector. The method of detector is usually derivatization with a reagent to generate colorimetric complexes for detection by ultraviolet–visible spectrophotometry. *See* ion chromatography; ultraviolet–visible spectrophotometry.

chemical (1) A specific association of atoms into a single entity or molecule that has characteristic properties of form and structure under a given set of environmental conditions. (2) A substance used or produced in a reaction.

Chemical Abstracts Service Registry number (CAS number) A number assigned by the Chemical Abstracts Service to a chemical substance that is manufactured or processed in the United States. The US Environmental Protection Agency compiles and keeps these numbers current under the Toxic Substances Control Act.

chemical actinometer An actinometer utilizing a chemical reaction that has been accurately investigated in terms of its photochemical behavior. For example, the decomposition of oxalic acid ($H_2C_2O_4$) in the presence of uranyl sulfate (UO_2SO_4) is a common actinometric reaction. Potassium ferric oxalate ($K_3Fe(C_2O_4)_3{\cdot}3H_2O$) is another common chemical actinometer. *See also* actinometer.

chemical activity The molar concentration of a chemical species multiplied by its activity coefficient. For electrolytes in very dilute aqueous solution, activity is very nearly equal to molal or molar concentration. *See also* molality; molarity.

chemical analysis An examination of a sample for its constituents. The examination may be quantitative, qualitative, or both. In a chemical analysis of water, chemical constituents other than water are typically present in concentrations ranging from milligrams per liter to micrograms per liter.

chemical and physical analysis A series of examinations incorporating chemical and physical parameters. Physical analyses include parameters such as color, turbidity, and conductivity that result from a combination of chemical constituents. In a chemical analysis of water, chemical constituents other than water are typically present in concentrations ranging from milligrams per liter to micrograms per liter.

chemical antagonism Neutralization of the effects of one compound as a result of a chemical reaction involving that compound. For example, large cations and large anions tend to react with one another at neutral pH to form an insoluble precipitate. Such reactions can interfere with the absorption of the chemicals from the gastrointestinal tract. Relatively few examples of such reactions exist within tissues. Mercury and selenium form insoluble complexes in tissues, and this limits the toxicity of both elements. *See also* antagonism.

chemical bond The force that holds atoms together within molecules. A chemical bond is formed when a chemical reaction takes place. Two types of chemical bonds are ionic bonds and covalent bonds.

chemical carcinogen A chemical that is capable of inducing cancer in humans or animals. *See also* carcinogen.

chemical cartridge The filtering element of a respirator. It contains a compound-specific medium that absorbs or filters out hazardous fumes or dust.

chemical cleaning (1) Adjustment of the water treatment process in order to remove scale or chemical deposits from the interior of water mains. (2) Placement of a chemical or chemical solution into water mains to remove chemical deposits, followed by flushing to remove the chemical and other foreign material from the water main being cleaned.

chemical cleaning in place *See* chemical cleaning.

chemical coagulation The destabilization and initial aggregation of colloidal and finely divided suspended matter by the addition of an inorganic coagulant. *See also* coagulation; flocculation.

chemical dissolving box A box or small tank for dissolving chemicals before their introduction into the liquid to be treated. *See also* chemical solution tank.

chemical dose A specific quantity of chemical applied to a specific quantity of fluid for a specific purpose. *See also* dose.

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chemical equation A shorthand way, using chemical formulas, of writing the reaction that takes place when chemicals are brought together. The left side of the equation indicates the chemicals brought together (the reactants); the arrow indicates which direction the reaction occurs (a bidirectional arrow indicating a reversible reaction); and the right side of the equation indicates the results (the products) of the chemical reaction.

chemical equilibrium The condition that exists when no net transfer of weight, energy, or both exists between the components of a system. This is the condition in a reversible chemical reaction when the rate of the forward reaction equals the rate of the reverse reaction.

chemical equivalent The weight, in grams, of a substance that combines with or displaces 1 gram of hydrogen. It is found by dividing the substance's formula weight by its valence. For example, calcium has a molecular weight of 40 and a valence of +2; thus, its chemical equivalent is 20 grams per mole.

chemical feeder A device for dispensing a chemical at a predetermined rate for the treatment of water. A change in rate of feed may be effected manually or automatically by flow-rate changes. Feeders are designed for solids, liquids, or gases.

chemical feed pump A pump used to apply chemicals to water. Pumps are used to apply chemicals into conduits under pressure and to control the chemical feed rate relatively precisely.

chemical formula *See* formula.

chemical gas feeder A feeder for dispensing a chemical in the gaseous state. The rate is usually graduated in gravimetric terms. Such devices may have proprietary names.

chemical gauging A method of measuring the flow or discharge of water in which a solution containing certain chemicals in known concentration is added at a given rate to a stream of water. Opportunity is afforded for complete mixing, and samples of the water are then taken and analyzed to determine the quantity of chemical in the resulting mixed flow. By computation, using the figures for the quantity and rate at which the chemical is added and the concentration of the chemical in the resulting mixture, one can determine the dilution and thus the discharge. This method is used most frequently when direct measurement of the velocity of flow is difficult or impossible. *See also* salt-velocity method.

chemical grout A material used to seal cracks or joints that uses a catalyst to cause the material to develop specific desired properties.

chemical handling and feeding A system designed to load, store, and apply chemicals for drinking water treatment. Components include storage tanks, day tanks, dilution water, feed pumps, flowmeters, and valves. *See also* day tank.

chemical ionization (CI) A mode of operation in mass spectrometry in which analyte molecules are bombarded with a reagent gas such as methane (CH_4). Molecules can be selectively ionized and often produce little fragmentation relative to mass spectra produced in the electron impact mode. The determination of molecular weight is often possible when chemical ionization mass spectra are being generated. *See also* electron impact ionization; mass spectrometry.

chemically enhanced backwash (CEBW) In membrane treatment, the process of adding chemicals to the permeate during backwash to enhance the effectiveness of the backwash for inactivating biological growth and removing foulants. *See also* fouling.

Chemical Monitoring Reform An effort undertaken by the Office of Ground Water and Drinking Water of the US Environmental Protection Agency (USEPA) from 1992 to 1996 to revise the standardized monitoring framework to reduce unnecessary monitoring requirements and use chemical-monitoring resources more efficiently. While USEPA was working with state primacy agencies on Chemical Monitoring Reform, Congress enacted the 1996 amendments to the Safe Drinking Water Act (SDWA), which reflected a number of the issues being addressed. (See 63 *Federal Register* 40709 for additional background.) USEPA incorporated its Chemical Monitoring Reform effort into a broader effort under the 1996 SDWA amendments; this broader effort falls under the heading of Chemical Monitoring Revisions. *See also* Chemical Monitoring Revisions; standardized monitoring framework.

Chemical Monitoring Revisions An ongoing effort by the US Environmental Protection Agency's Office of Ground Water and Drinking Water to revise chemical-monitoring requirements to reduce unnecessary monitoring requirements, use chemical-monitoring resources more efficiently, and satisfy provisions of the 1996 Safe Drinking Water Act amendments to revise and update chemical-monitoring requirements.

chemical oxidation The process of using an oxidizing chemical to remove or change some contaminant in water by removing electrons.

chemical oxygen demand (COD) An operationally defined surrogate parameter in water analysis that is a measure of the constituents susceptible to oxidation by strong chemical oxidants.

chemical precipitation The process of generating solids from the soluble phase by changing the equilibrium conditions of a solution. By adding chemicals

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that react with the soluble material to be removed, or by changing pH, one can alter the solubility of constituents, resulting in the formation of solids that subsequently can be removed by physical processes (e.g., sedimentation, filtration).

chemical precipitation softening *See* lime softening; lime–soda ash softening.

chemical proportioner A device for dispensing a chemical into water in proportion to the flow. *See also* chemical feeder.

chemical reaction A process that occurs when atoms of certain elements are brought together and combine to form molecules, or when molecules are broken down into individual atoms.

chemical reagent A chemical added to a system to induce a chemical reaction.

chemical rejuvenation For membrane separation processes, any of several in-place chemical cleaning methods to remove foulant materials and scales or to recondition membranes to recover lost performance.

chemical sensor array A group of several sensors or analytical instruments for monitoring chemical parameters that is located in one area or that samples a single water stream.

chemical solution tank A tank in which chemicals are added in solution before they are used in a water treatment process.

chemical stability Resistance to attack by chemical action. This term is often applied to the resistance of ion-exchange resins to breakdown caused by contact with aggressive solutions.

chemical suppression A general technique for improving the sensitivity of ion chromatographic determinations by reducing the conductivity of the eluent with respect to the analytes. *See also* suppressor device.

chemical tank A tank in which chemicals are stored before use in a water treatment process.

Chemical Transportation Emergency Center (CHEMTREC) A 24-hour-a-day emergency telephone service that provides information on hazardous chemical spills in transport. CHEMTREC is an emergency service operation, free of charge to fire, police, and other emergency agencies. The phone number is (800) 262-8200.

chemical treatment Any water treatment process involving the addition of chemicals to obtain a desired result, such as precipitation, coagulation, flocculation, sludge conditioning, or disinfection.

chemigation The injection of agricultural chemicals or fertilizer into irrigation water for distribution to the field.

chemihydrometry A form of chemical gauging to determine the flow or discharge of water. *See also* chemical gauging; salt-velocity method.

chemisorption A process related to adsorption in which atoms or molecules of reacting substances are held to the surface atoms of a catalyst by electrostatic forces having about the same strength as chemical bonds. Chemisorption differs from physical adsorption chiefly in the strength of bonding, which is much greater in chemisorption. *See also* adsorption.

chemistry A science concerned with the composition, properties, and reactions of matter.

chemocline A zone of a lake, reservoir, or impoundment in which the concentration of dissolved substances changes rapidly with depth.

chemolithotroph A type of bacterial organism that obtains its energy by chemical oxidation of inorganic substances and that has the ability to fix carbon dioxide (CO_2) as its sole source of carbon. *See also* autotroph.

chemoorganotroph A type of bacterial organism that obtains energy and carbon through the oxidation of organic compounds.

chemoorganotrophic Describes heterotrophic bacteria that oxidize chemical bonds for energy but require organic carbon compounds to grow.

chemosynthetic bacteria Bacteria that synthesize organic compounds by using energy derived from the oxidation of organic and inorganic materials without the aid of light.

CHEMTREC *See* Chemical Transportation Emergency Center.

chevron tube settler A type of tube settler with a design in which the cross-sectional area approximates a V shape. *See also* tube settler.

Chezy open-channel formula A basic hydraulic formula developed by Antoine Chézy in 1775 for determining the flow of water in open channels:

$$V = C\sqrt{RS}$$

Where:

V = flow velocity, in feet per second (meters per second)
C = Chezy resistance factor, in $\sqrt{\text{feet}}$ per second ($\sqrt{\text{meters}}$ per second)
R = hydraulic radius of the channel, in feet (meters)
S = channel slope (for uniform flow) or energy slope (for nonuniform flow), dimensionless

See also Chezy resistance factor; Kutter roughness coefficient; Manning formula; Manning roughness coefficient.

Chezy resistance factor (*C*) A coefficient used in the Chezy open-channel formula. Two formulas can be used to determine its value. The first is the Kutter formula:

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$$C = \frac{41.65 + \frac{0.00281}{S} + \frac{1.811}{n}}{1 + \left(41.65 + \frac{0.00281}{S}\right)\frac{n}{\sqrt{R}}}$$

US customary units

$$C = \frac{23 + \frac{0.00155}{S} + \frac{1}{n}}{1 + \left(23 + \frac{0.00155}{S}\right)\frac{n}{\sqrt{R}}}$$

Système International units

Where:

C = Chezy resistance factor, in $\sqrt{\text{feet}}$ per second ($\sqrt{\text{meters}}$ per second)
S = channel slope (for uniform flow) or energy slope (for nonuniform flow), dimensionless
n = Kutter roughness coefficient, dimensionless
R = hydraulic radius, in feet (meters)

The second formula is

$$C = \frac{1.486}{n}R^{1/6} \qquad C = \frac{1}{n}R^{1/6}$$

US customary units Système International units

Where:

n = Manning roughness coefficient (generally very close numerically to the value of the Kutter roughness coefficient), dimensionless
R = hydraulic radius, in feet (meters)

See also Chezy open-channel formula; Kutter formula; Kutter roughness coefficient.

Chick–Watson model A model of chemical inactivation of microorganisms with the reaction rate of inactivation dependent on the relative concentrations of microorganisms and changes in disinfectant concentration during a specific time interval. It is expressed as follows:

$$\ln(N/N_0) = -kC^n t$$

Where:

N = the number of organisms per unit volume recovered at time t
N_0 = the number of organisms per unit volume at time 0
k = the pseudo first-order reaction rate constant
C = the concentration of disinfectant, in milligrams per liter
n = the coefficient of dilution, an empirical factor, usually assumed to be 1.0

See also Hom model; modified Hom model.

chiller A component (generally a heat exchanger) designed to remove heat from a gas or liquid stream.

chisel plowing Cropland preparation by a special implement (chisel) that avoids complete inversion of the soil (as occurs with conventional moldboard plowing). Chisel plowing can leave a protective cover of crop residues on the soil surface that helps prevent erosion and improve infiltration.

chi-square distribution The distribution of sample variance in a normally distributed data set. Sample variances are calculated from the following equation:

$$S^2 = \sum \frac{\chi_i - \bar{\chi}}{n-1}$$

Where:

S = sample variance
χ_i = ith observation from a normally distributed data set containing n observations
$\bar{\chi}$ = average of the observed data set

See also normal distribution.

chi-square test A statistical procedure to determine the level of significance of the difference between two nonnormally distributed data sets.

chitinized spore coat A hard, white, horny polysaccharide that is the principal constituent of the spore coating.

chlamydia Unusual bacterium that is small (0.2–0.7 micrometers in size) and lacks peptidoglycan in its cell wall. Chlamydiae are obligate intracellular parasites and have a unique intracellular pattern of replication. *See also* atypical bacteria; obligate pathogen.

Chlamydophila psittaci (C. psittaci) Intestinal parasite that causes parrot fever. While more commonly found in birds, the parasite can also be transmitted to livestock and, rarely, humans, causing fever and chills.

chloracne A form of skin eruption (i.e., acne) that is induced by some, but not all, chlorinated compounds. The effect is most commonly associated with 2,3,7,8-tetrachlorodibenzodioxin (commonly called dioxin) and compounds with similar toxicological effects. *See also* dioxin.

chloral *See* trichloroacetaldehyde.

chloral hydrate (trichloroacetaldehyde hydrate) (CH) ($CCl_3CH(OH)_2$) The common name for hydrated trichloroacetaldehyde, a disinfection by-product produced at low levels during chlorination. It is medically used as a sedative. It is also known as chloral. *See also* disinfection by-product.

chloramination The process of disinfecting water with chloramines. *See also* chloramines.

chloramines Disinfectants produced from the mixing of chlorine (Cl_2) and ammonia (NH_3). The general formula is NH_xCl_y, where x can be 0, 1, or 2; y can be

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1, 2, or 3. Typically, monochloramine (NH_2Cl) and a small percentage of dichloramine ($NHCl_2$) are formed, depending on the pH and the chlorine-to-ammonia ratio that reacts. Under certain circumstances, nitrogen trichloride (trichloramine, $NHCl_3$) can be formed. In the presence of the bromide ion, bromamines can be produced. In the presence of organic nitrogen, organic chloramines can also form; however, organic chloramines are not considered to be disinfectants. *See also* bromamines; dichloramine; monochloramine; organic chloramines.

chlorate ion (ClO_3^-) A disinfection by-product formed during the treatment of water with chlorine dioxide (ClO_2). The chlorate ion is also produced during the decomposition of bleach (NaOCl) in stock solutions. Furthermore, ozonation of water with a chlorine residual can yield chlorate ions. *See also* bleach; chlorine dioxide; chlorite ion; hypochlorite ion; liquid chlorine.

chlordane ($C_{10}H_6Cl_8$) The common name for 1,2,4,5,6,7,8,8-octachloro-4,7-methano 3a,4,7,7a-tetrahydroindane or 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro 4,7-methanoindane. Chlordane is an insecticide and fumigant whose presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.002 milligrams per liter. *See also* fumigant; insecticide.

chloride (Cl^-) One of the major anions commonly found in water and wastewater. Its presence is often determined by ion chromatographic or volumetric analysis. Consumers who drink water with concentrations of chloride exceeding a secondary maximum contaminant level of 250 milligrams per liter may notice a salty taste.

chlorinated (1) Pertaining to a water to which chlorine was added as a disinfectant or oxidant. (2) Pertaining to a chlorine-containing organic compound that may be present in water. For example, chlorinated organic solvents are among the most commonly detected groundwater contaminants. The preferred term is *chlorine-substituted. See also* chlorine-substituted.

chlorinated aliphatic hydrocarbon (CAH) A chlorine-substituted hydrocarbon with carbon atoms in straight- or branched-chain arrangement. Many of them are volatile organic compounds and are regulated by the Safe Drinking Water Act in drinking water. Two typical examples are trichloroethylene and tetrachloroethylene. *See also* tetrachloroethylene; trichloroethylene.

chlorinated copperas ($FeSO_4$ + $FeCl_3$) A solution of ferrous sulfate ($FeSO_4$) and ferric chloride ($FeCl_3$) produced by chlorinating a solution of ferrous sulfate.

chlorinated lime (approximately $CaCl(ClO)•4H_2O$) A water treatment chemical that is used primarily for disinfection, mostly in swimming pools, and also has buffering capacity. Chlorinated lime is prepared by chlorinating slaked lime ($Ca(OH)_2$); it decomposes in water and releases 39 percent available chlorine for disinfecting action. *See also* available chlorine; buffer; hydrated lime.

chlorinated organic *See* chlorine-substituted organic.

chlorinated polyvinyl chloride (CPVC) A modified form of polyvinyl chloride, a synthetic resin that is composed of polymerized vinyl chloride and that, when plasticized or softened with other chemicals, has some rubber-like properties. Vinyl chloride (CH_2:CHCl) is derived from acetylene (CH≡CH) and anhydrous hydrochloric acid (HCl). A chlorinated polyvinyl chloride molecule has more chlorine atoms per repeating monomer unit than does the polyvinyl chloride molecule. This extra chlorine is responsible for CPVC's strength at high temperatures as well as other properties useful in industrial piping applications.

chlorination An oxidation process that is initiated through the addition of chlorine. In chlorination, chlorine oxidizes microbiological material, organic compounds, and inorganic compounds. Chlorination is the principal form of disinfection in US water supplies. *See also* chlorine; disinfection.

chlorination chamber A detention basin provided primarily to secure the diffusion of chlorine through the liquid. It is also called a chlorine contact chamber.

chlorination of wells The addition of chlorine and mixing energy to routinely disinfect production wells.

chlorinator Any device that is used to add chlorine to water.

chlorine A chemical used as a disinfectant and oxidizing agent. Gaseous molecular chlorine (Cl_2), when introduced into water, is converted into hypochlorous acid (HOCl) and the hypochlorite ion (OCl^-); the ratio of the two substances is dependent on the pH of the solution ($HOCl \leftrightarrow OCl^- + H^+$). Chlorine is also commercially available in liquid form as a hypochlorite ion solution. Individual chlorine atoms are halogen atoms that can be substituted into organic molecules during chlorination, thus forming disinfection by-products. Chlorine atoms are also present in a number of pesticides and other synthetic organic chemicals. *See also* disinfection by-product; halogen; hypochlorite ion; hypochlorous acid; liquid chlorine; pesticide; synthetic organic chemical.

chlorine, combined *See* combined chlorine.

chlorine, free *See* free available chlorine.

chlorine–ammonia process The application of chlorine (Cl_2) and ammonia (NH_3) to water, or of

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without interference from chloride. *See also* ion chromatography.

cholera An infectious gastroenteritis, typically transmitted by contaminated water or food, caused by the bacterium *Vibrio cholerae*. *See also* waterborne disease.

cholestasis Stoppage of the flow of bile. It can be caused by inhibition of the transport of bile salts by chemicals or some disease processes. It may also be caused by obstruction of the bile ducts (e.g., by formation of stones). In either of these cases it leads to jaundice (yellowing of the skin).

cholesterol ($C_{27}H_{45}OH$) A fat-like steroid alcohol that serves as an integral part of biological membranes and is a precursor for a variety of steroid hormones. Excessive amounts of cholesterol in blood have been associated with a variety of diseases, including atherosclerosis.

cholic acid ($C_{23}H_{49}O_3COOH$) An oxidized form of cholesterol conjugated to glycine (NH_2CH_2COOH) or taurine ($NH_2CH_2CH_2SO_3H$) to form one of the more important bile salts.

cholinesterase A hydrolytic enzyme that hydrolyzes esters of choline. The term applies to a wide variety of such enzymes. Toxicologically, the most important of these enzymes is acetylcholinesterase, the enzyme that inactivates acetylcholine in the synaptic clefts formed by nerves that secrete this neurotransmitter. Inhibition of this enzyme is responsible for the acute neurotoxic symptoms associated with poisoning by organophosphorus pesticides. *See also* organophosphorus pesticide.

cholinesterase inhibitors Toxic compounds that act by inhibiting cholinesterases. The most important inhibitors found in the environment are the organophosphorus pesticides. They produce acute neurotoxic effects by virtue of their inhibition of a particular cholinesterase, acetylcholinesterase. *See also* cholinesterase; organophosphorus pesticide.

chorioretinitis Inflammation of the choroid and retina, which may be associated with infection from *Toxoplasma* species.

chromatin A combination of proteins and deoxyribonucleic acid. The proteins are a complex group of basic proteins referred to as histones and are responsible for the staining properties of the chromosomes. Chromatin exists in two basic states, a tightly coiled form and an open form that is actively involved in the transcription of ribonucleic acid used in the synthesis of proteins.

chromatographic behavior Movement of chemical components through a sorption bed in a way that is similar to movement through a chromatograph during an analytic method using chromatographic principles. In granular activated carbon adsorption or in ion exchange, some components of a mixture will have more affinity for the sorbent than others. The more strongly sorbed component will push a less strongly sorbed component out of the sorption bed first, causing a "peak" of concentration of the less strongly sorbed component in the effluent at the time it exits the column. *See also* chromatography.

chromatography A group of separation techniques based on the distribution of analytes between two phases. Separation is based on the difference in an analyte's affinity for the stationary phase relative to that for the mobile phase. Many analyses of organic compounds in water involve such chromatographic techniques as gas chromatography or liquid chromatography.

chromium (Cr) A blue-white metallic element (atomic number 24) with various industrial uses, e.g., in alloys and electroplating. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.1 milligrams per liter. Chromium exists in the environment primarily in two forms: chromium(VI), or hexavalent, which is a human carcinogen, and chromium(III), or trivalent, the toxicity of which is much lower.

chromogenic (or fluorogenic) substrate technology Bacteriological testing technology that uses hydrolyzable substrates linked to a chromogen (or fluorogen) molecule. The test is based on the target bacteria having the specific enzyme(s) to hydrolyze the substrate-chromogen or substrate-fluorogen molecules, resulting in the release of a colored compound or a fluorogenic compound. When exposed to ultraviolet light of appropriate wavelength, colored compounds (chromogens) impart a characteristic color to the culture suspension, and fluorogenic compounds (fluorogens) impart a bright, colored fluorescence. Examples of these substrates are: *ortho*-nitrophenyl-β-D-galactopyranoside (ONPG), which, when hydrolyzed by the enzyme β-galactosidase, releases the yellow chromogen *ortho*-nitrophenol; and 4-methylumbelliferyl-β-D-glucuronide (MUG), which, when hydrolyzed by the enzyme β-glucuronidase, releases 4-methylumbelliferyl, which gives a bright bluish fluorescence when exposed to long-wavelength (366 nanometers) ultraviolet light. *See also* 4-methylumbelliferyl-β-D-glucuronide; *ortho*-nitrophenyl-β-D-galactopyranoside.

chromogenic colony Colony producing a pigment or coloring matter.

chromosomal abnormality Damage to chromosomes as indicated by breaks in the chromosome, altered banding patterns (indicating translocations or deletions of a portion of the chromosome), and increased or decreased numbers of chromosomes in a cell.

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chromosomal deoxyribonucleic acid (chromosomal DNA) Deoxyribonucleic acid that contains the necessary sequences for cell growth, maintenance, and reproduction. Chromosomal deoxyribonucleic acid must be present in a cell for it to survive.

chronic Pertaining to symptoms that continue for a long time as a result of a single exposure or repeated exposures over a long period of time.

chronic exposure Exposure to an agent for an extended period of time. Although frequently referred to in a nonspecific way, this term ordinarily refers to periods of time in excess of 1 year in most animal species.

chronic health effect The possible result of exposure over many years to a drinking water contaminant at levels above its maximum contaminant level. Examples of the chronic health effects drinking contaminated water could cause are cancer, kidney problems, or reproductive difficulties.

chronicity index An expression of the potential of a chemical to produce cumulative effects with repeated exposure. The index is calculated as the ratio of the daily dose necessary to produce a chronic toxicity relative to the dose that is required to produce acute toxicity.

chronic toxicity A condition in which an adverse effect persists for an extended period of time. The term is more loosely used to describe the effects of a chemical that is administered over a long period of time. However, chronic toxicity can arise from short-term exposures to chemicals if the effect is irreversible.

chronotropic action Alteration of the rate at which the heart beats as a result of chemical effects.

churn drill A type of drill used in cable-tool drilling.

chute (1) An inclined conduit or structure used for conveying water, other liquids, or granular material at high velocity to lower levels. (2) An inclined drop or fall. (3) The narrow, usually shorter channel around an island in a river. (4) A short, straight channel that bypasses a long bend in a river, formed by the river breaking through a narrow land area between two adjacent bends. *See also* drop.

CI *See* Casil index; cast iron; chemical ionization.

Ci *See* curie *in the Units of Measure section.*

CID *See Cryptosporidium* inactivation device.

ciénega An area where the water table is at or near the surface of the ground. Standing water occurs in depressions in the area, which is covered with grass or sometimes with heavy vegetation. The term is usually applied to areas ranging in size from several hundred square feet to several thousand square feet (several hundred square meters to several thousand square meters). Sometimes springs or small streams originate in the ciénega and flow from it for short distances.

CIP *See* capital improvement plan.

CIPAG *See* Critical Infrastructure Protection Advisory Group.

Cipolletti weir A contracted weir of trapezoidal shape, in which the sides of the notch are given a slope of one part horizontal to four parts vertical to compensate as much as possible for the effect of end contractions.

CIPRA (Cast Iron Pipe Research Association) *See under* Ductile Iron Pipe Research Association.

CIP system *See* clean-in-place system.

circle A closed plane curve consisting of all points at a given distance from the center.

circle of influence The circular outer edge of a depression produced in the water table by the pumping of water from a well. *See also* cone of depression; drawdown; well cone of influence; zone of influence.

circuit (1) The complete path of an electric current, including the generating apparatus or other source. (2) A specific segment or section of that complete path.

circuit breaker A device that functions both as a current overload protective device and as a switch.

circuit rider A person providing on-site technical assistance in the operation of a number of small water systems within a prescribed geographical area.

circular clarifier A unit process device used for removing particles from solution by settling. In a circular clarifier, the influent is most commonly fed to the unit from the center and the flow is directed radially to effluent weirs at the periphery of the clarifier. Collected particles, or sludge, are continuously removed from the bottom of the clarifier with a scraper mechanism.

circulation loop The portion of some types of membrane process systems where some or all of the concentrate stream is continuously being recycled and blended with incoming water to produce the membrane feedwater. This loop is used to increase the crossflow velocity across the membrane surface.

circumference The distance measured around the outside edge of a circle.

circumferential flow The flow of water or other liquid parallel to the circumference or periphery of a circular tank or other circular structure. It is also called peripheral flow.

cirrhosis A disease state in which the normal microscopic lobular structure of the liver is replaced by fibrosis and nodular regeneration within the liver.

CIS *See* customer information system.

cis Indicating a geometric isomer in which two groups attached to the two carbons in a double bond are at adjacent corners of the molecule. *See also* geometric isomers; *trans.*

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CISC *See* complex-instruction-set computer.

***cis*-1,2-dichloroethylene** *See under* dichloroethylene.

cistern A small, covered tank, usually placed underground, in which rainwater is stored for household purposes.

citizen's civil action *See* civil action.

citrate A salt or ester of citric acid.

citric acid ($C_3H_4(OH)(COOH)_3 \cdot H_2O$) An acidic chemical, commercially available as colorless crystals or powder, that is highly soluble and used in water treatment for pH adjustment, as a sequestering agent, as a cleaning agent, and for other purposes.

Citrobacter A genus of gram-negative bacteria in the family Enterobacteriaceae. Members of this genus are closely related to the coliform bacteria but either are unable to ferment lactose or do so only very slowly.

Citrobacter freundii (C. freundii) A species of *Citrobacter* occasionally found in coliform biofilm problems in drinking water distribution systems. *See also Citrobacter.*

Citrobacter youngae (C. youngae) Gram-negative bacillus that is oxidase-negative, *ortho*-nitrophenyl-β-D-galactopyranoside-positive, and Voges–Proskauer-negative; it is encountered in the environment and in the human and animal gastrointestinal tract. *C. youngae* is mainly responsible for nosocomial infections, particularly in immunosuppressed patients. *See also* nosocomial infection.

city council A municipality's elected legislative body.

civil action Legal action taken against a party that has violated an environmental law but has not committed a criminal offense.

Civil Engineering Forum for Innovation (CEFI) Formerly known as the Civil Engineering Research Foundation (CERF). The American Society of Civil Engineers (ASCE) established CEFI in January 2006 to strengthen the profession and industry through technical innovation and public policy. CEFI engages senior leaders from industry, academia, and government in strategic actions to advance ASCE's mission and facilitates, coordinates, and integrates research in the civil engineering field.

Civil Engineering Research Foundation (CERF) *See under* Civil Engineering Forum for Innovation.

C. jejuni *See under Campylobacter.*

clamp A thin, circular metal strip with a gasket inside used to repair a leaking pipe by applying compression around the pipe by bolts attached to the metal strip.

C language A third-generation source code programming language often used to develop application software for computers.

Clara cell A nonciliated cell in the small bronchioles of the lung. The function of these cells is not well understood, but they contain most of the lung's capacity for metabolizing foreign chemicals. As a result, they are frequently injured by chemicals that are metabolized to reactive intermediates.

clarification Any process or combination of processes that reduces the amount of suspended matter in water. At rapid-rate granular-media filtration plants, clarification often is accomplished by using gravity sedimentation. Other clarification processes that are used include dissolved air flotation and roughing filters.

clarifier *See* sedimentation basin.

clarifier sludge *See* sedimentation sludge.

clarity Clearness of liquid, as measured by a variety of methods.

class, pipe *See* pipe class.

classification *See* hydraulic classification; pipe class.

clastogenesis Chromosomal aberrations consisting of breaks in a chromosome or translocation of portions of one chromosome to another. These events are frequently associated with the cause of congenital abnormalities, birth defects, or cancer.

clathrate Derived from the Latin word for *cage*, a chemical substance consisting of a lattice of one type of molecule trapping and containing a second type of molecule. Methane hydrate, methane trapped in water, is an example. *See also* methane hydrate.

clay (1) Soil consisting of inorganic material for which the grains have diameters smaller than 0.002 millimeters. (2) A mixture of earthy matter formed by the decay of certain minerals.

claypan A stratum or horizon of accumulated stiff, compact, and relatively impervious clay. It is not cemented, but it may interfere with water movement.

clay pipe A pipe made of clay and baked in a kiln. Such a pipe is also called a tile. *See also* vitrified clay pipe.

clay soil A soil containing more than 40 percent clay but less than 45 percent sand and less than 40 percent silt.

Clean Air Act (CAA) The principal US law intended to protect human health and the environment by controlling ambient, or outdoor, air pollution through controlling pollutants at their source. It is codified generally as 42 US Code 7401–7626.

clean bed A bed of granular filter media that has been cleaned or backwashed. Immediately following a thorough backwash, the particles that formerly adhered to the surface of the media are removed and the interstitial spaces between media grains are clear and free of particulate matter.

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clean bed head loss The head loss that occurs after a filter has been backwashed and restored to a clean condition. Clean bed head loss is measured at the start of a filter run. It is also known as starting head loss.

clean bed volume The volume of water that occupies the interstitial spaces in a given volume of filter media. The clean bed volume can be calculated by multiplying the bulk volume of the filter media by the porosity of the filter media. *See also* porosity.

cleaning The flushing of an item such as a pipe or tank by spraying water or running water through the item with enough velocity to remove debris or contaminants. The initial flush may contain a chlorine solution for disinfection, and a chlorine solution may be held in the facility for a specific time prior to flushing.

cleaning-in-place A chemical cleaning process in which the membranes in a membrane water treatment system (1) are not removed from their housings (pressure vessels) or the system and (2) are cleaned by being exposed to cleaning solution(s), which are commonly recirculated through the cleaning system and membranes. *See also* cleaning system; membrane cleaning.

cleaning system Tank(s), pump(s), and other equipment used to prepare and recirculate membrane cleaning and, commonly, storage solutions through the membrane modules of a membrane water treatment system.

cleaning wye A wye fitting, usually with an oversized branch, installed on a water main to allow the insertion of a pig for cleaning water mains.

clean-in-place (CIP) system Facilities used for in situ cleaning. *See also* cleaning-in-place; membrane cleaning.

cleanout Any structure or device that is designed to provide access for the purpose of removing deposited or accumulated materials.

clean river A river that has no obvious evidence of pollution and from which wholesome drinking water can be obtained by practicable methods of water purification.

clean room A room for a precise operation that requires a contamination-free environment. The room is maintained at a high level of cleanliness by special means (e.g., activated carbon filtered air).

Clean Water Act (CWA) The US law, codified generally as 33 US Code 1251–1387, that establishes a regulatory and enforcement program administered by the US Environmental Protection Agency to control pollutant discharges into US waters.

clean water reservoir A holding basin where treated water is stored for delivery to customers.

clear acrylic The generic name for the trade name Plexiglas®.

clearance The rate at which a chemical is cleared from a body compartment, generally blood. This is a formal pharmacokinetic term. It is expressed in units of milliliters of plasma cleared completely of chemical (or drug) per unit time.

clear-water basin *See* clearwell.

clear water iron *See* ferrous iron.

clear-water reservoir *See* clearwell.

clearwell A tank or vessel used for storing treated water. Typical examples of storage needs include (1) finished water storage to prevent the need to vary the rate of filtration with variations in distribution system demand, and (2) backwash water for filters. Clearwells are located on-site at a water treatment plant. A clearwell is also called a filtered-water reservoir. *See also* backwash.

cleat A device to join together the crossbraces and wales in a timber-shoring setup.

cliff spring A spring occurring at the base of a cliff, where the water table is intersected by the face of the cliff. *See also* contact spring.

climate (1) The total of meteorological phenomena that combine to characterize the average and extreme conditions of the atmosphere at any specified place on the earth's surface. *See also* weather. (2) The collective state of the atmosphere at a given place or over a given area within a specified period of time; weather averaged on the daily, monthly, seasonal, and yearly basis.

climatic Pertaining to climate.

climatic cycle Actual or supposed recurrences of such weather phenomena as wet and dry years or hot and cold years at more or less regular intervals, in response to long-range terrestrial and solar influences.

climatic province An area characterized by a general similarity of climate throughout.

climatic variation The gradual change in the climate of a given locality occurring over an extended period of time, usually measured in centuries.

climatic year A continuous 12-month period during which a complete annual cycle occurs, arbitrarily selected from the presentation of data relative to hydrological or meteorological phenomena. The US Geological Survey uses the period October 1 to September 30 in the publication of its records of stream flow. A climatic year is also called a water year.

climatology The science dealing with the collective state of the atmosphere over a given area within a specified period of time. It is a subdivision of meteorology that deals with the average or normal state of the atmosphere. The distinction between meteorology and climatology is indefinite, and the two terms are often used interchangeably.

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cline A graded series of morphological or physiological characteristics exhibited by a natural group, such as a species, along a line of environmental transition (e.g., in terms of climate, soil) or geographic transition.

clinical trial Testing a drug's effectiveness in the treatment of a particular disease state. During this period the drug's side effects are monitored as its effectiveness as a therapeutic agent is monitored. This term has also been applied to studies of the potentially adverse effects of nondrug chemicals in humans. Generally, these types of studies are limited to circumstances that would not be anticipated to produce irreversible damage to the individuals participating in the study. For example, the ability of humans to metabolize a particular chemical might be examined at doses much lower than those that would produce toxicity. *See also* experimental epidemiologic study.

clinoptilolite A naturally occurring zeolite that exchanges ammonium (NH_4^+) ions in preference to sodium, magnesium, and calcium ions. It is sometimes used as an ion-exchange resin in water treatment.

CLLE *See* continuous liquid–liquid extraction.

clogging An impeding of flow, typically as a result of particle blockage. Clogging can occur in (1) filters as a result of excessive particle removal prior to backwash or mudball formation or (2) piping as a result of particles or highly viscous liquids. *See also* backwash; mudball.

clonal expansion An increase in the population of cells carrying the same genetic characteristics (i.e., genotype). The term is frequently applied to the division of a cell initiated for cancer into a population of cells containing the same mutation. The expansion of this population dramatically increases the probability that a group of these cells will undergo additional mutations to yield a malignant tumor. Clonal expansion of a group of initiated cells can be induced by a group of carcinogenic chemicals referred to as tumor promoters. *See also* tumor initiator; tumor promoter.

clone (1) A copy or lookalike computer. (2) A virus or cell descended from a single common ancestor.

cloning The entire process of isolating, identifying, and manipulating genes or cells in recombinant deoxyribonucleic acid research.

close-coupled pump A pump directly connected to its power unit without any reduction gearing or shafting. *See also* direct-connected pump.

closed basin (1) A basin draining to some depression or pond within its area, from which water is usually lost only by evaporation or percolation. (2) A basin without a surface outlet for precipitation. *See also* sink.

closed centrifugal pump A centrifugal pump having its impeller built with the vanes enclosed within circular disks.

closed-circuit television system (CCTV) Video surveillance equipment designed to observe and record activities at a facility in order to detect and deter malicious acts and to facilitate investigation after events occur.

closed conduit Any closed duct for conveying fluids.

closed fire line An unmetered connection to the distribution system to provide water for a fire protection or fire sprinkler system without hose connections or fire hydrants.

closed impeller An impeller having the sidewalls extended from the outer circumference of the suction opening to the vane tips.

closed-loop control A form of computerized control that automatically adjusts for changing conditions to produce the correct output, so that no operator intervention is needed.

closed-loop stripping analysis (CLSA) An extraction technique useful for the isolation of volatile and semivolatile organic compounds, typically in the range of nanograms per liter to micrograms per liter. An inert gas is bubbled into a water sample, and the headspace is continuously recycled through an adsorbent trap. Analytes are desorbed chemically or thermally and injected into a gas chromatographic system. The closed-loop stripping analysis technique is a very sensitive way of determining volatile compounds such as 2-methylisoborneol and geosmin, which are known to cause taste and odor problems in drinking water.

closed system A distribution system that has no elevated storage and uses continuously running pumps to provide pressure and meet water usage demands.

close nipple A nipple having no unthreaded length between the two threads. *See also* nipple.

closing dike A structure built across the branch channel of a river to stop or reduce the flow entering that channel.

Clostridium A genus of anaerobic, gram-positive, spore-forming bacteria. Many organisms in this genus produce powerful toxins involved in human diseases.

Clostridium botulinum (C. botulinum) An anaerobic, gram-positive, spore-forming rod that produces a potent neurotoxin. It is found in soils, marine sediments, and water. There are seven types of botulism toxin designated by the letters A through G; only types A, B, E, and F cause illness in humans. Types C and D cause most cases of botulism in animals, primarily wildfowl and poultry, cattle, horses, and some species of fish. Type G has been isolated from soil; however, no outbreaks involving it have been recognized. The

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bacterial spores are heat-resistant and can survive in foods that are incorrectly or minimally processed. Nearly all outbreaks reported annually in the United States are associated with inadequately processed, home-canned foods. Occasionally, commercially produced foods are involved in outbreaks. In foodborne botulism, symptoms generally begin 18 to 36 hours after eating a contaminated food, but they can occur as early as 6 hours or as late as 10 days. Symptoms of botulism include double vision, blurred vision, drooping eyelids, slurred speech, difficulty swallowing, dry mouth, and muscle weakness.

Clostridium perfringens (C. perfringens) An anaerobic, spore-forming bacillus that is a normal inhabitant of the human gastrointestinal tract. It has limited use as an indicator of fecal pollution of water. This organism is also important as a cause of gas gangrene in wound infections and food poisoning.

cloth A type of woven filter septum made from natural or synthetic yarns.

cloth media filtration A process of employing a cloth filter for the reduction of solids in a water stream. The cloth filter utilizes one of the following two types of cloth media: (1) polyester needle felt or nylon pile fabrics that are 3 to 13 millimeters thick and have a range of pore sizes from 10 to 30 micrometers or larger, or (2) a cloth microscreen utilizing a monofilament polyester filter fabric that is 60 micrometers thick with a nominal pore size of 11 micrometers. Even though the disk form of the cloth media filter is used most frequently, other configurations (e.g., a drum configuration and a diamond configuration) are commercially available and are being used.

cloth-membrane filter A filtration device using cloth membrane, manufactured with woven natural or synthetic fibers, to produce a filtration media with specific properties and removal characteristics.

cloudburst (1) A rainstorm of extraordinary intensity and relatively short duration that usually occurs over a rather small area. Such storms may result in severe floods. (2) Quantitatively, a rainstorm in which the rate of rainfall is at least 3.94 inches (100 millimeters) per hour (more than 10 times the rate used by the National Weather Service in defining a heavy rainfall). *See also* thermal-convection storm.

cloudiness The visible effect in water caused by material in suspension (e.g., turbidity). *See also* turbidity.

CLP *See* chlorpromazine.

CLSA *See* closed-loop stripping analysis.

CLSM *See* confocal laser scanning microscopy.

clumping The formation of media agglomerations or resin clumps within an operating filter or ion-exchange bed caused by organic fouling or electrostatic charges.

cluster Typically a group of closely interconnected computers that are configured so that they share the same operating system and peripheral devices.

cm *See* centimeter *in the Units of Measure section.*

CMC *See* critical micelle concentration.

CMF *See* completely mixed flow.

CMMS *See* computer maintenance management system.

CMOS *See* complementary metal oxide semiconductor.

CNBr *See* cyanogen bromide.

CNCl *See* cyanogen chloride.

CNM *See* chloronitromethane.

CNS *See* central nervous system.

^{13}C nuclear magnetic resonance
See carbon-13 nuclear magnetic resonance.

CNX *See* cyanogen halide.

coagulant A chemical added to water that has suspended and colloidal solids to destabilize particles, allowing subsequent floc formation and removal by sedimentation, filtration, or both (e.g., the use of alum or iron salts for removing turbidity in a water treatment process).

coagulant aid A chemical added during coagulation to improve the process by stimulating floc formation or by strengthening the floc so it holds together better. Such a chemical is also called a flocculant aid. *See also* coagulant; flocculant.

coagulant demand The amount of coagulant required to meet a given treatment goal. The characteristics of the water to be treated will affect the amount of coagulant required. Some of the water quality characteristics that may influence the optimum coagulant dose for meeting the treatment goal include turbidity, natural organic matter, temperature, and alkalinity.

coagulant sludge The material produced as a result of adding a coagulant such as alum, ferric, or polymer to a raw water, and subsequent coagulation and sedimentation. Coagulant sludge contains the hydrolyzed floc formed by the coagulant's reaction with the raw water and the particulate matter removed by the process. *See also* sludge.

coagulate To combine or aggregate small particles into larger masses or clumps by chemical or physical means.

coagulated–settled water Treated water, prior to filtration, to which one or more coagulant chemicals was added to form particles that subsequently settled. *See also* coagulation.

coagulation The process of destabilizing charges on particles in water by adding chemicals (coagulants). Natural particles in water have negative charges that repel other material and thereby keep it in suspension. In coagulation, positively charged chemicals are added to neutralize or destabilize these charges and allow the particles to accumulate and be removed by

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physical processes such as sedimentation or filtration. Commonly used coagulants include aluminum and iron salts and cationic polymers. *See also* aluminum sulfate; cationic polymer; ferric chloride; flocculation.

coagulation-assisted membrane filtration Membrane filtration following coagulant addition to improve constituent removal rates and improve membrane performance.

coagulation basin A basin used for the coagulation of suspended or colloidal matter. In this basin, the liquid is mixed gently to induce agglomeration, with a consequent increase in the settling velocity of particulates.

coagulation followed by direct microfiltration A treatment scheme in which coagulant is added to the water to be treated, the water then passes through a flocculation basin, and then the water is applied to a microfiltration unit without passing through a sedimentation basin.

coal A solid, carbon-based material formed naturally through heat and pressure. Coal is the raw material for anthracite filter media used in filtration and for some activated carbons. *See also* activated carbon; anthracite coal; filtration.

coalescence The union or growing together of colloidal particles into a group or larger unit as a result of molecular attraction on the surfaces of the particles.

coal tar A black, viscous liquid (or semisolid) obtained by destructive distillation of bituminous coal. Among its uses, coal tar can be applied for waterproofing and pipe coating.

coarse rack A rack with relatively wide spaces between bars, usually 1 inch (2.5 centimeters) or more.

coarse sand Sediment particles having diameters between 0.500 and 1.000 millimeter.

coarse screen A mesh or bar screen in which the openings are greater than 1 inch (2.5 centimeters) in least dimension. *See also* coarse rack.

Coastal Zone Management Act (CZMA) The US law, codified generally as 16 US Code 1451–1464, that requires all federal agencies and permittees who conduct activities that affect a state's coastal zone to comply with an approved state coastal zone management program.

coastline The line that separates the land surface and the water surface of the sea or ocean. Strictly speaking, it is a strip of land surface rather than a line and is considered somewhat wider than the shoreline. *See also* shoreline.

coating A material applied to the inside or outside of a pipe, valve, or other fixture to protect it, primarily against corrosion. Coatings may be formed of various materials.

COAU *See* central office access unit.

cobalt–platinum unit *See under* color unit in *the Units of Measure section.*

COBOL (common business-oriented language) A source-code programming language commonly used in business and financial system applications.

cocarcinogenesis The interaction of a chemical, physical, or biological process with other factors that cause cancer to increase the magnitude of a carcinogenic response induced by a second agent. A wide variety of mechanisms can fall into the category of cocarcinogens, ranging from chemicals that are true tumor promoters to chemicals that modify the metabolism of a carcinogen to increase its activity as a carcinogen.

cocci Sphere-shaped bacteria.

coccidian parasite A one-celled organism that alternates between asexual and sexual generation and requires only one host. It is a parasite of the intestinal epithelium. *See also* Apicomplexa; Sporozoa.

Coccidioides Genus of fungi. *Coccidioides immitis* causes an infection called coccidioidomycosis, also known as valley fever, desert rheumatism, and San Joaquin fever.

coccidioidomycosis An acute, self-limiting respiratory disease, or a progressive chronic infection that disseminates to produce lesions in any organ of the body, caused by the fungus *Coccidioides immitis.*

coccobacilli Visual description of rod-shaped bacteria that are considered to be more short and oval in shape.

cock A device for regulating or stopping the flow in a pipe, consisting of a plug that may be rotated in a body that has ports corresponding to those in the plug.

cocktail An organic solution used in the analysis of radioisotopes. For example, in the determination of radon in water, a scintillation cocktail is used to extract radon from the water sample. *See also* scintillation cocktail.

coconut-based activated carbon Activated carbon, used for adsorption, that is produced from coconut shells. Although coconuts are a relatively inexpensive raw material, the use of coconuts for activated carbon may be sensitive to available supply.

cocurrent In the same direction as the water flow.

cocurrent flow *See* downflow.

cocurrent operation The operation of two components of a unit process in a parallel fashion, e.g., when a feed gas is injected into a vessel in the same direction as the fluid flow.

cocurrent regeneration Regeneration of an ion-exchange resin such that the flow of the regenerant across the resin during regeneration is in the same direction as the flow of the process stream during exhaustion

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of (or treatment with) the resin. *Contrast with* countercurrent regeneration. *See also* regeneration.

COD *See* chemical oxygen demand.

***Code of Federal Regulations* (CFR)** The US government publication that codifies the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the federal government.

code of practice A set of ethical guidelines and conduct that a person undertaking a particular activity or profession must, or must not, do in order to practice within a particular discipline or to carry out a particular activity.

codescent debris cone A debris cone composed of two or more debris cones formed by debris contributed by large streams. The lower parts of the cones merge. The space between the apexes of the smaller cones is filled by debris from small intervening streams. The small stream may contribute enough debris to form the apex of a major debris cone.

codisposal of residuals The simultaneous disposal of residuals generated from two unique processes, resulting in a more efficient operation than disposing the residuals individually. For example, water treatment plant residuals can be codisposed with wastewater biosolids by discharging the water treatment plant residuals to the sanitary sewer for processing at the wastewater plant. As another example, drinking water treatment residuals, when combined with organically derived wastes such as lawn clippings and leaves, can be codisposed in a composting operation.

codon A single frame of three sequential bases in one polynucleotide chain of deoxyribonucleic acid or ribonucleic acid that specifies the insertion of a particular amino acid at a specific location during protein synthesis. The frame for the three bases in each codon is set by an initiation site for transcription and translation.

codon rearrangement Multiple transpositions of codons between two strands of deoxyribonucleic acid. This can result in a different sequence of amino acids being synthesized. If these changes occur in a catalytic or regulatory site in the protein, changes in the functional properties of the protein will occur.

COE *See* US Army Corps of Engineers.

coefficient A numerical quantity determined by experimental or analytical methods and used in a formula that expresses the relationship between two or more variables.

coefficient of determination (r^2) A commonly used statistical measure of the goodness of fit of a linear model. An r^2 value of 1 represents a perfect linear relationship between an independent variable, X, and a dependent variable, Y. An r^2 value of 0.9 means that the equation explains 90 percent of the variability in the dependent variable. An r^2 value of 0 indicates no linear relationship between X and Y. The equation for the coefficient of determination is

$$r^2 = \frac{\text{regression sum of squares}}{\text{total sum of squares}}$$

$$= \frac{\sum_{i=1}^{N}\left(\hat{Y}_i - \bar{Y}\right)^2}{\sum_{i=1}^{N}\left(Y_i - \bar{Y}\right)^2}$$

Where:

Y_i = measured value
$\hat{Y}_i$ = predicted value
$\bar{Y}$ = average of measured values
N = number of measured values

Suppose, for example, in water demand forecasting, that the value of r^2 is 0.90 for the regression of residential daily water volume use (the dependent variable) on the independent variables of lot size, normal precipitation, and deviation of temperature from normal temperature. In this case, these three variables explain 90 percent of the variation in residential daily water volume use; the remaining variation (10 percent) is said to be residual or unexplained variation. The objectives are (1) to explain most of the variation with as few logically sound independent variables as possible and (2) to have the unexplained variation be randomly distributed (i.e., without a pattern). The coefficient of determination should not be the only test of adequacy in regression analysis. At minimum, the standard error of the estimate, the mean absolute percentage error, a test for heteroskedasticity, and the standard errors of the coefficients should also be analyzed. *See also* heteroskedasticity; mean absolute percentage error; standard error of the coefficient; standard error of the estimate.

coefficient of fineness The ratio of suspended solids to turbidity. It is a measure of the size of particles causing turbidity; a higher particle size means a higher coefficient of fineness.

coefficient of regime The ratio of the maximum daily flow in 1 year to the minimum daily flow in the same year.

coefficient of viscosity *See* absolute viscosity.

cofferdam A temporary structure built around a construction site to allow the removal of water and to permit free access to the area within. It may take various forms, such as an earth embankment, a single row of steel or timber sheet piling, or a double row of

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sheet piling with the space between filled with impermeable material.

cogeneration The use of an energy source for multiple purposes. For example, when natural gas is used to produce steam to drive turbines and produce electricity, the waste heat from the process can be used in other energy applications.

COGO *See* coordinate geometry.

Cohen censored maximum likelihood (CCML) method A statistical procedure to determine the mean and variance of a normal distribution when the data set is either left or right censored, i.e., biased toward left or right.

cohesion The force of molecular attraction that exists between the particles of any substance and tends to hold them together.

cohesive soil Clay or soil with a high clay content, which provides cohesive strength. Cohesive soil does not crumble; it is plastic when moist, hard to break when dry.

cohort A designated group of persons who are assembled based on a common characteristic (e.g., age, period of birth, exposure) and followed or traced over a period of time. In epidemiology, the cohort is traced to determine a health-related outcome, morbidity, or death.

cohort epidemiologic study A type of epidemiologic study in which individual subjects are selected on the basis of their exposure status (e.g., chlorinated or unchlorinated water; high, moderate, low, or no levels of radon in the home) without knowledge of their disease status. These studies are also called follow-up studies. Any number of health-related outcomes or diseases can be ascertained in a cohort study. Morbidity or mortality rates are determined for each group in the cohort and compared (in terms of rate ratio, rate difference) among the various exposure categories. There are two types of cohort studies: prospective and retrospective. In a prospective cohort study, the disease has not occurred at the time the exposed and unexposed groups are defined by the investigator. In a retrospective cohort study, the disease has occurred at the time these groups are defined. *See also* morbidity rate; mortality rate.

co-ion An ion of similar charge to another.

coke-tray aerator An aerator in which the water is passed or sprayed through coke-filled trays.

cold spring (1) A nonthermal spring in which the water has a temperature appreciably lower than the mean annual temperature of the atmosphere in the vicinity of the spring. (2) In areas of thermal springs, any nonthermal spring.

cold sterilization The use of submicrometer-pore-diameter filtration to screen out bacteria from a water or fluid.

cold weather operation Modification of operating procedures to account for cold weather conditions. For example, chemical dosages and settling rates in conventional water treatment will be affected by colder weather. Higher coagulant dosages may be required because of slower reaction kinetics, and settling performance may decrease as a result of lower differential density between particles and water (because the density of water decreases with temperature above 39° Fahrenheit [4° Celsius] as does the viscosity). *See also* conventional water treatment.

coli-aerogenes bacteria A group of bacteria predominantly inhabiting the intestines of humans or warm-blooded animals but also occasionally found elsewhere. *See also* coliform group bacteria.

coliform bacteria Bacteria of the family Enterobacteriaceae, commonly found in the intestinal tracts of warm-blooded animals. In sanitary bacteriology, these organisms are defined as all aerobic and facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria that ferment lactose with gas and acid formation within 48 hours at 95° Fahrenheit (35° Celsius). *See also* coliform group bacteria; *Escherichia coli;* fecal coliform.

coliform group bacteria A group of related bacteria comprised of the genera *Escherichia, Enterobacter,* and *Klebsiella,* commonly associated with the intestinal tracts of warm-blooded animals and shed in their fecal material.

coliform growth response (CGR) A bioassay method developed to assess the potential for potable water to support the growth of coliform bacteria. The bioassay organism used is generally a strain of *Enterobacter cloacae.*

coliform regrowth potential *See* coliform growth response.

Coliform Rule *See* Total Coliform Rule.

coliphage A bacterial virus, also known as a bacteriophage, that uses *Escherichia coli* as its host cell.

collagen A proteinaceous material that makes up the basic structure of most tissues and organs. Basement membranes and various supportive tissue (e.g., tendons) are composed largely of collagen, which is characterized by a high proportion of its structure being made up of proline residues.

collapse Failure caused by application of a uniform force around the total circumference of a pipe. The force may be caused by an externally applied pressure or vacuum inside the pipe. The mode of failure is usually stability-related and occurs as flattening of

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the pipe but can be caused by compressive (shear) failure of the pipe wall.

collapse pulsing backwash A method of cleaning a filter by introducing air and subcritical fluidization backwash water, causing the formation and collapse of air pockets within the bed, a condition called collapse pulsing. This condition enhances the abrasion between the media grains for removing retained particles. *See also* subcritical fluidization backwash.

collar (1) A projection secured to the outer surface of a hydraulic structure to increase the resistance to seepage or flow of water along the outside of the structure. It also acts as a rigid anchor when it is embedded in concrete. (2) A weight of concrete around the joint between vitrified-tile pipes and cast-iron pipes, where the socket cannot be forced into the bell, to provide a watertight joint. (3) A short sleeve or cylinder of any material with diameter sufficiently large to permit two pipes of lesser diameter to be connected by sliding their ends into opposite ends of the collar and sealing with a watertight substance such as a rubber ring, cement mortar, or bituminous compounds.

collateral material (1) Multiple public relations tools developed for simultaneous or serial use to meet one or more particular objective(s). (2) Materials that deal with related issues.

collection lysimeter A device that collects water samples from the unsaturated zone using mild negative pressures. It is also known as a suction lysimeter. It should not be confused with a lysimeter cell that contains soil and vegetation and is used for measuring evapotranspiration.

collective bargaining Negotiation between organized (unionized) workers and their employers for coming to an agreement (contract) on benefits, wages, and working conditions.

collector A device or system designed to collect backwash water from a filter or ion-exchange bed. A collector may also be used as an upper distributor to spread the flow of water in downflow column operation. *See also* distributor.

collector well A well, usually located near a river, with a vertical vault that connects a series of horizontal shafts (the collectors) arranged in a radial fashion. The groundwater enters the shafts and flows to the vault, where it is collected. Collector wells can produce enormous quantities of water under ideal conditions when the adjacent river is running at high stages.

College of American Pathologists (CAP) grade water Water that meets standards established by the College of American Pathologists. The standards cover three types of laboratory grade water: clinical, cell or tissue, and cultural.

collimated beam test A controlled bench-scale test used to determine the ultraviolet dose–response of a microorganism. Both time and ultraviolet light intensity are accurately measured, resulting in a specific calculation of delivered ultraviolet dose for the microorganism being tested. *See also* ultraviolet dose–response.

collimated light Electromagnetic radiation for which the waves have been rendered parallel. In a spectrometer, a mirror may serve to collimate radiation prior to dispersion in a prism. *See also* spectrometer.

collimating tube Part of a collimated beam apparatus that covers the path from the ultraviolet lamp to the petri dish containing the test sample. A cover over the path protects the user from exposure to ultraviolet radiation.

collision efficiency factor A measure of the efficiency of the collision of destabilized particles in forming larger particles in the flocculation process. After particles become destabilized in the coagulation process, they can be brought together to agglomerate into larger particles via flocculation. *See also* flocculation.

colloid A small, discrete solid particle in water that is suspended (not dissolved) and will not settle by gravity because of molecular bombardment.

colloidal fouling For membrane processes, fouling of the membranes by colloid-sized particles. *See also* colloid; fouling; membrane fouling.

colloidal matter Finely divided solids that will not settle but may be removed by coagulation or membrane filtration. *See also* colloid.

colloidal natural organic matter (NOM) A fraction of natural organic matter made up of very small, insoluble, and nondiffusible particles that remain in suspension in water. Colloidal particles have a size range between 0.003 to 1 micrometer and will not settle even if allowed a long period of time in which to do so. *See also* natural organic matter.

colloidal solid A finely divided solid that will not settle out of water for very long periods of time unless the coagulation–flocculation process is used. *See also* colloid.

colluvial Consisting in part of alluvium and in part of angular fragments of the original rocks. Colluvial soil is formed in regions of precipitous topography and is made up of fragments of rocks detached from the slopes above. Talus slopes, cliff debris, and other heterogeneous rock detritus are examples of colluvial soil.

colluvial deposit A heterogeneous deposit of rock waste, such as talus, cliff, and avalanche accumulations, that results from the transporting action of gravity. *See also* colluvial.

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colluvial soil Soil formed when running water or wind transports sedentary soil from one location and deposits it in another, where it intermingles with other sedentary soil. Such soil forms a large portion of the soil found on rolling and hilly upland areas.

colluviarium An access opening in an aqueduct, used for maintenance and ventilation.

colmatage In a pressure-driven membrane treatment system, the portion of water flux decline that is reversible by chemical cleaning or hydrodynamic means.

colon bacilli Bacteria residing normally in the intestinal tract. These bacteria are not necessarily dangerous if present in drinking water, but they are indicators of other possible pathogens. *See also* coliform bacteria.

colony (1) A localized population of individuals, animals, or plants. (2) A cluster of microorganisms in or on a nutrient medium that was derived from a single microorganism.

colony counter An instrument used to count bacterial colonies for the standard plate count test.

colony-forming unit (cfu) *See in the Units of Measure section.*

color A physical characteristic describing the appearance of water (different from turbidity, which is the cloudiness of water). Color is frequently caused by fulvic and humic acids.

color body Those complex molecules that impart color (usually undesirable) to a solution.

color comparator A device used for tests such as chlorine residual or pH tests. Personnel can determine concentrations of constituents by visually comparing a permanent standard (usually sealed in glass or plastic) and a water sample.

colorimeter A device used for absorption analysis. In some cases the human eye can serve as the detector in visual methods, such as those in which Nessler tubes are used. Another technique involves a filter photometer, an instrument that uses filters to produce a wide band of wavelengths suitable to the particular determination. *See also* absorption analysis.

colorimetric analysis The process of forming a group of absorption analyses in which a fairly broad band of radiation, usually in the visible wavelengths, is used. These techniques find wide application in water analysis. For example, the determination of chlorine residual by the N,N-diethyl-p-phenylenediamine (DPD) method uses a visual comparison of samples and standards. Nessler tubes and photometers are also commonly used in colorimetric analyses. Colorimetric analysis is also called colorimetric measurement or the colorimetric method. *See also* absorption analysis.

colorimetry The measurement of color naturally present in samples or developed in them by the addition of reagents. The color is measured in terms of the absorption of a particular wavelength of light.

color removal The process of removing or reducing color in water. Color is undesirable aesthetically and is related to the abundance of natural organic matter in a water supply. Color removal can be achieved through physical–chemical processes such as coagulation, adsorption processes such as granular activated carbon or powdered activated carbon adsorption, or oxidation processes such as chlorination or ozonation. While color is removed, the natural organic matter causing the color is only transformed, not typically removed, by oxidation processes.

color throw The discharge of color into the effluent of an ion-exchange or filter media system by any component. This usually occurs after an extended standing period that allows slowly soluble colored matter to accumulate in the water. A color throw may result from the leaching of color bodies from an ion-exchange resin into the water.

color unit *See in the Units of Measure section.*

column A vessel, usually a cylindrical and vertical tank, with an inlet at one end and an outlet at the other end, with some means of holding the medium in place so that a stream of water passing through it is processed.

column operation A process in which a solution to be treated is passed through a column in either an upflow or downflow pattern.

combination bond A government-issued bond that is payable from the revenues of a governmental enterprise but is also backed by the full faith and credit of the government. It is also known as a double-barrel bond.

combination starter An electric motor controller with a manual disconnect, fuses, a circuit breaker, or an electromagnetic contactor. It may also include an overload relay, phase failure, and a lightning arrestor.

combination well A well system consisting of an open well and one or more wells or infiltration galleries that are connected to it.

combined air and water wash A filter backwashing technique that employs a gentle, nonfluidizing upflow of wash water simultaneously with air scour. For filters using media consisting of fine sand, dual media, mixed media, or coarse anthracite monomedia, combined air and water wash is used until the level of water in the filter approaches about 6 inches (15 centimeters) from the top of the wash water trough. Then air scour is ended, and water backwash completes the cleaning of the bed and restratification of media, if necessary. For filters consisting of coarse

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sand or anthracite monomedia with an effective size of 1.0 millimeters or larger, the combined air and water wash may be used for about 10 minutes, and some water will overflow the wash water trough. *See also* air–water wash; backwash.

combined available chlorine The total chlorine, present as chloramine or other derivatives, that is present in a water and still available for disinfection and for oxidation of organic matter. The combined chlorine compounds are more stable than free chlorine forms, but they are somewhat slower in action. *See also* chloramines.

combined available residual chlorine The concentration of residual chlorine that is combined with ammonia (NH_3), organic nitrogen, or both in water as a chloramine (or other chloro derivative) yet is still available to oxidize organic matter and help kill bacteria. *See also* chloramines.

combined chlorine The sum of the species composed of free chlorine and ammonia (NH_3), including monochloramine (NH_2Cl), dichloramine ($NHCl_2$), and trichloramine (nitrogen trichloride, $NHCl_3$). Dichloramine is the strongest disinfectant of these species, but it has less oxidative capacity than free chlorine. Di- and trichloramine can result in tastes and odors. *See also* chloramines.

combined distribution system The totality of the distribution system of all interconnected wholesale systems and consecutive systems.

combined filter effluent (CFE) The point in a treatment process at which all of the individual filter effluent flows are combined into a single flow.

combined filter effluent (CFE) turbidity A measurement of turbidity representing the quality of combined treated water from two or more granular media filters at a water treatment plant.

combined moisture Moisture in combination with organic or inorganic matter.

combined radium 226/228 The numerical sum of the concentrations of radium 226 and radium 228 in a water sample. The US Environmental Protection Agency's maximum contaminant level for combined radium 226/228 is 5 picocuries per liter.

combined residual A compound of an additive (such as chlorine) that has combined with something else and that remains in the water. Chloramines, where the chlorine has combined with ammonia, are combined residuals. *See also* chloramines.

combined residual chlorination The application of chlorine to water to produce combined available residual chlorine. This residual can be made up of monochloramine (NH_2Cl), dichloramine ($NHCl_2$), and nitrogen trichloride ($NHCl_3$). *See also* chloramines.

combined sewer A sewer that transports both surface runoff and human domestic wastes (wastewater), and sometimes industrial wastes. Wastewater and runoff in a combined sewer may occur in excess of the sewer capacity and cannot be treated immediately. The excess is frequently discharged directly to a receiving stream without treatment or to a holding basin for subsequent treatment and disposal.

combined water Soil water that is held in chemical combination and remains after hygroscopic water evaporates. It will not evaporate and is driven off only by heating.

combining weight The formula weight of a dissolved species divided by its electrical charge.

combustible Pertaining to materials that have the ability to catch fire and burn.

combustion oxidation A method of measuring total organic carbon by oxidizing the carbon at high temperature followed by detecting the evolved carbon dioxide.

co-metabolism Process by which microorganisms transform substrates into organic products but do not obtain energy, carbon, or nutrients from the conversion. This process offers a biological alternative for the removal of pollutants from contaminated aquifers because the microorganisms transform the pollutant substrate (e.g., trichloroethylene) into intermediate degradation products but fail to multiply.

command-and-control regulations Specific requirements prescribing how to comply with specific standards defining acceptable levels of pollution.

commensal Describing a relationship between two organisms in which one is unaffected and the other benefits. For example, commensal organisms can reside more or less harmlessly in the skin, eyes, nose, mouth, intestines, and genitals of the human ecosystem.

commensal organism One of two organisms in close association in which one or both may derive some benefit but neither harms or is parasitic on the other.

commercial landscape A landscape adjacent to a facility used for commercial purposes, such as a retail center, office building, or office park.

commercial landscape survey An on-site measurement and evaluation of water use and water-using features in a commercial landscape, including but not limited to grass, turf, ground covers, plants, shrubs, gardens, trees, irrigation systems and apparatus, hoses, fountains, and pools.

commercial water conservation Wise water use by business customers.

commercial water consumption Potable water delivered to business customers (as opposed to residential, industrial, or public customers) such as stores,

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motels, shopping centers, gas stations, laundries, offices, and services.

commodity charge The portion of a water bill that varies with water use; also known as a variable charge.

commodity cost Operations-and-maintenance costs that vary with the quantity of water produced, such as purchased water costs, chemicals, direct power costs, and storage or other costs that vary with average daily demand.

commodity demand approach to rate structure design A rate structure design method in which the costs of service are assigned to four cost components: commodity costs, demand costs, customer costs, and direct fire protection costs. Commodity costs include the operations-and-maintenance and capital costs that vary with the quantity of water produced, such as purchased water costs, chemicals, direct power costs, and storage or other costs that vary with average daily demand. Demand costs are associated with the facilities that meet peak rates of use, or demands, placed on the water system (e.g., maximum-day or maximum-hour demands). Customer costs are those that relate to serving customers irrespective of the amount or rate of water use. Direct fire protection costs are those incurred solely for the purpose of fire protection. This rate is also called the commodity demand rate. *See also* base–extra-capacity approach to rate structure design.

common application services model (CASM) In Utility Communications Architecture (UCA), a standard allowing UCA-compliant applications, such as data read, data write, equipment control, data logging, alarm, and event detection to be truly compatible. It also provides multi-cast transmission, time synchronization, and security services as well as services for transmitting large binary data objects.

common business-oriented language *See* COBOL.

common-ion effect The decrease in the solubility of a salt dissolved in water caused by the presence of ions of the salt already contained in the water.

common law That body of law developed in England prior to the establishment of the United States. It refers principally to rights and privileges and, though generally followed in the United States, has in some of its applications been abrogated or modified, as in the case of riparian rights to water in some jurisdictions in the United States.

common law doctrine A legal doctrine that arose out of the English system of law.

common logarithm The exponent in the representation of a number as a power of 10. For example, the common logarithm of 100 is 2, because 10 raised to the power of 2 equals 100.

common salt (NaCl) Sodium chloride, a white or colorless crystalline compound that occurs abundantly in nature (present as 2.6 percent of seawater) and in animal fluids. Sodium chloride is used in water treatment to regenerate cation-exchange water softeners and some dealkalizer systems. It is also called table salt or common table salt. *See also* salt.

common source epidemic An outbreak of illness in a group of persons that is caused by a common exposure. When the exposure is brief, cases develop within one incubation period of the disease.

communicable disease An illness caused by a specific infectious agent or its toxic products and transmitted from an infected person, animal, or the environment (e.g., through water, food, fomites) to a susceptible host. Transmission can be direct or indirect.

communications port (COM port) A computer communications channel that uses the serial transmission of data from one device or computer to another.

community Any naturally occurring group of organisms occupying a common environment.

Community Development Block Grant (CDBG) program A state grant program funded through the US Department of Housing and Urban Development to assist cities and counties with the development of needed infrastructure and housing.

Community Right to Know A provision of Title III of Superfund Amendments and Reauthorization, requiring companies that keep hazardous materials onsite in sufficient quantities to report to local officials, such as fire departments or local emergency planning agencies.

community system *See* community water system.

Community Water Supply Study (CWSS) A comprehensive survey of 969 US water supplies conducted by the US Public Health Service (USPHS) to determine whether the US consumer's drinking water met the 1962 USPHS standards. The study was initiated in 1969 and results were released in 1970 in two reports: (1) *Community Water Supply Study: Analysis of National Survey Findings*. 1970. NTIS PB214982. Springfield, Va.: USPHS; and (2) *Community Water Supply Study: Significance of National Findings*. 1970. NTIS PB215198/BE. Springfield, Va.: USPHS. The findings of CWSS led to the enactment of the Safe Drinking Water Act in 1974.

community water system (CWS) A public water system serving at least 15 service connections used by year-round residents or regularly serving at least 25 year-round residents. *See also* public water system.

commutator (l) A device that reverses half of the alternating current cycle to create a unidirectional current.

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(2) A device for grinding wastewater solids usually following grit removal in wastewater treatment.

compact A formal agreement between states relating to the use of water in a stream or river that flows across state boundaries.

compact call The requirement that an upstream state stop or reduce diversions of water from a river system that is the subject of the compact, in order to satisfy the downstream state's compact entitlements.

compact disc (CD) A computer peripheral device used to optically store large amounts of digitized text, data, images, and sound. One disc typically holds in excess of 700 megabytes of information.

compact disc, read-only memory (CD-ROM) A specialized computer peripheral device used to store large amounts of data in a read-only medium. CD-ROM disks store digitized text, data, images, and sound.

compaction For a pressure-driven membrane process, a physical reduction in membrane thickness, deformation of the membrane, or both. Compaction is dependent on pressure, temperature, and operating time and is caused by transmembrane pressure resulting in decreased membrane permeability. It is typically associated with some irreversible water flux decline.

comparative risk framework methodology (CRFM) model Model that evaluates data on public health consequences associated with various drinking water treatment alternatives. It provides the framework to link various technologies to health outcomes. Comparative risk assessment is a methodology to identify and address the areas of greatest environmental risk and provide a framework for prioritizing environmental problems. The results of a comparative risk analysis can be used to provide a technical basis for targeting activities, management priorities, and resources. *See also* risk analysis; risk assessment.

compartment A chamber or other enclosed or partially enclosed division of a structure, generally underground, that may or may not be windowless. The term is usually applied to a space that is a subdivision of another space and is used for a specialized purpose in connection with some other space or chamber. The term is usually applied to smaller spaces than is the term *chamber* and to larger spaces than *access hole* and *vault.*

compartmental model A type of pharmacokinetic model that treats the body as abstract compartments that are expressed as volumes. The sizes of compartments are estimated based on concentration measures in some body fluid (e.g., blood or urine). The sizes of various compartments are also estimated on the basis of the behavior of the chemical in the sampled fluid over time. The compartments do not actually correspond to specific body compartments.

compensated hardness A calculated value based on the total hardness, the magnesium-to-calcium ratio, and the sodium, iron, and manganese concentrations in a water. This value is used to correct for the reduction in hardness removal capacity of a cation-exchange water softener as caused by the presence of these substances. No single method of calculation has been uniformly accurate.

compensation ratio A value that establishes the types and levels of allowable trades of bank currency for permitted wetland impacts.

competent person An employee who possesses the following: (1) the ability to identify existing and predictable hazards in the surroundings, (2) the ability to identify working conditions that are unsanitary, hazardous, or dangerous to employees, and (3) authorization to take prompt corrective action to eliminate these problems.

competition (1) Rivalry in business for markets and customers in an effort to increase profits. Economists generally regard price competition as the only true form of competition. (2) The struggle among individual organisms for water, food, space, and so on when the available supply is limited.

competitive adsorption A phenomenon in which the adsorption of a target compound is hindered by the presence of another compound. These latter, or competing, compounds either are preferentially adsorbed on the medium or, in the case of granular activated carbon, may also occupy the pore space through which the target compound must pass to be adsorbed. These conditions prevent the target compound from being effectively removed from the liquid phase. *See also* fouling; granular activated carbon.

competitive index A listing of costs incurred by other organizations performing like functions to determine if those functions are being accomplished in-house at a comparable price.

competitive sale A form of bond sale in which the issuer publishes a notice of sale that specifies, among other things, when bids are due and how they will be evaluated, with brokerage houses bidding against each other for the right to purchase bonds. The winning bid is usually the one that provides the lowest overall cost of debt to the issuer.

compiler A computer program that translates a source code language into machine or object code, which is the binary representation of the program, for execution by a computer.

complaint investigation A professionally conducted investigation of a customer's water quality complaint.

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complement A complex set of proteins that interacts with the antigen–antibody complex, attaches to cells, and causes lysis.

complementary metal oxide semiconductor (CMOS) A semiconductor device that, by design, has a high noise and voltage tolerance and uses very little power. This advanced design is widely used in most microprocessors.

complete diversion The taking or removing of water from one location in a natural drainage area and the discharge of it into another drainage.

completed test The third major step of the multiple-tube fermentation test. It confirms that positive results from the presumptive test are caused by coliform bacteria. *See also* confirmed test; presumptive test.

completely mixed flow (CMF) A liquid stream in which a heterogeneous mixture of constituents exists throughout the stream.

complete treatment A method of treating water that consists of the addition of coagulant chemicals, flash mixing, coagulation–flocculation, sedimentation, filtration, and disinfection. This approach is also called conventional filtration or conventional water treatment.

complete uncertainty analysis The process of using ranges and distributions for the diverse inputs in a risk assessment analysis and incorporating these variations into the final result, either analytically or by using various computer methods, such as Monte Carlo simulation. In a risk assessment, a number of inputs exist, such as water consumption, contaminant concentration, potency of the contaminant, and risk mediators (e.g., smoking, alcohol, diet, age). As with a sensitivity analysis for a model, obtaining a measure of the degree to which different values of the inputs will impact the computed population or individual risk of an adverse event (illness, death, and so forth) is useful in risk assessment. This overall process is the essence of performing an uncertainty analysis. In recent applications, the various input variables have been placed into two categories: those possessing variability and those possessing uncertainty. Variability characterizes those input variables that are intrinsic properties of the population and for which no amount of effort will lessen the variability (e.g., water consumption, body weight, distribution of contaminant concentration). Uncertainty characterizes those input variables that, theoretically at least, can be obtained more precisely with greater effort (such as potency of the contaminant). Unfortunately, components of uncertainty exist within variability input variables (and probably vice versa). For example, in a given situation, because only a finite sample of persons are consuming water, only an estimate of the true water consumption distribution is available. *See also* health effects risk analysis; Monte Carlo analysis; sensitivity analysis.

complexation The inactivation of an ion by addition of a reagent that combines with it and, in effect, prevents it from participating in other reactions. Complexation is also called sequestration.

complexes Compounds formed by the union of two or more simple salts.

complex-instruction-set computer (CISC) A computer containing a processor designed to sequentially run many variable-length instructions, many of which require several clock cycles. Most personal computers use CISC architecture. *See also* reduced-instruction-set computer.

complex power (*S*) A complex quantity, customarily measured in volt-amperes, that has the active power as the real component and the reactive power as the imaginary component:

$$S = P + \sqrt{-1} \times Q$$

Where:

P = the active power, in volt-amperes

Q = the reactive power, in volt-amperes

compliance The act of meeting the requirements of a national primary drinking water regulation or other regulation.

compliance alternatives Options identified from which a water system could choose in order to achieve or maintain compliance with drinking water regulations.

compliance cycle The 9-year calendar year cycle during which public water systems must monitor as defined in the Safe Drinking Water Act. Each compliance cycle consists of three 3-year compliance periods. The first compliance cycle began Jan. 1, 1993, and ended Dec. 31, 2001; the second began Jan. 1, 2002, and ends Dec. 31, 2010; the third begins Jan. 1, 2011, and ends Dec. 31, 2019, and so on. *See also* compliance period.

compliance monitoring Monitoring required by the US Environmental Protection Agency for the purpose of demonstrating compliance with a regulation.

compliance period A 3-year calendar period within a compliance cycle. Each compliance cycle has three 3-year compliance periods. Within the first compliance cycle, the first compliance period began Jan. 1, 1993, and ended Dec. 31, 1995; the second began Jan. 1, 1996, and ended Dec. 31, 1998; the third began Jan. 1, 1999, and ended Dec. 31, 2001. *See also* compliance cycle.

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compliance planning Efforts focused on producing measurable results to protect public health and the environment.

compliance safety health officer (CSHO) A field representative of the Occupational Safety and Heath Administration who reviews the types of conditions in the workplace likely to be encountered by employees, including work processes, equipment, and machinery involved and the hazards associated with them.

compliance strategy A course of action identified by a water system that would result in achieving or maintaining compliance with drinking water regulations.

component analysis A means to analyze the occurrence of leakage in water distribution networks. *See also* breaks and background estimates (BABE) model.

COM port *See* communications port.

composite (1) The act of adding one sample to one or more samples for the purpose of obtaining a final sample that is representative of a certain period of time. (2) A type of sample to which more than one subsample has been added. The purpose of a composite is to obtain a sample that is representative of a period of time or series of subsamples.

Composite Correction Program (CCP) A two-stage program for evaluating the performance of a water treatment plant. The first stage is a comprehensive performance evaluation, which can be followed by comprehensive technical assistance. The Composite Correction Program was developed for the US Environmental Protection Agency to improve performance at wastewater treatment plants. It has been applied to drinking water treatment plants to determine whether treatment performance can be optimized without major capital improvement.

composite membrane A semipermeable membrane used in water treatment, consisting of a rejecting barrier layer of one chemical composition (usually a type of polymer) supported by one or more layers of porous materials with different composition(s).

composite rate of depreciation A single depreciation rate to be applied against the total depreciable assets to determine the depreciation for an accounting period. The use of a composite rate is based on the assumption that the depreciation expense is the same as would be obtained by applying proper individual rates of depreciation against the cost of each unit and totaling the individual amounts.

composite sample A type of sample to which more than one subsample has been added in order to obtain a sample that is representative of a period of time or series of subsamples.

composite sampling The taking of discrete individual samples, which are then combined to represent the integrated composition of the sample source. *See also* automatic sampling; depth-integrated sample.

composite unit hydrograph A unit hydrograph for a large area, constructed from unit hydrographs for the subareas that compose the large area. The composite unit hydrograph is the sum of the individual unit hydrograph discharge values at time values that have been shifted to reflect the time of travel from the outlets of the subareas to the outlet of the large area.

compositing The process of combining discrete individual water samples prior to performing a water quality analysis. *See also* composite sampling.

compost The product of thermophilic biological oxidation of organic materials.

composting The combining of biologically active sludge, such as wastewater biosolids, with "green" wastes, such as lawn clippings or leaves, to lessen volume by biological activity and generate a stable, reusable organic solid additive. *See also* windrow composting.

compound A substance composed of at least two elements in specific proportions.

compound hydrograph The hydrograph of an intermittent storm when the flow resulting from one substorm continues during the next substorm.

compound loop control The use of both feedforward and feedback control loops for the same final control element.

compound meter A water-measuring device that has both a small meter and a large meter and alternate flow paths. Such a meter is used where flow demands vary or fluctuate beyond the range of one type of meter, and the flow is diverted to the alternate meter when it varies outside the range of either meter.

compound microscope A microscope with two or more lenses.

compound pipe (1) A pipeline made up of two or more pipes of different diameters. (2) Two or more pipes of the same or different diameters connected in parallel pipelines to form a loop.

compound tube A tube made up of several shorter tubes of various diameters, of various longitudinal cross sections, or both.

comprehensive coliform monitoring plan A plan required by the Total Coliform Rule, developed by a public water system, and approved by the state primacy agency that specifies the sampling locations and monitoring protocol to be used to comply with the monitoring requirements of the Total Coliform Rule.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) The US law, codified generally as 42 US Code 9601–9675, that establishes a regulatory and enforcement program administered by the US Environmental

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Protection Agency to clean up abandoned hazardous waste sites. It is also known as Superfund. *See also* Superfund Amendments and Reauthorization Act (SARA).

comprehensive flushing The total flushing of all mains to remove dirt and settlement in the system prior to a change in water treatment processes. Polypigs or swabs may be used in the process to aid in the removal of silt and/or deposit in isolated areas. *See also* polypig; swab.

comprehensive map A map that provides a clear picture of an entire distribution system. It usually indicates the locations of water mains, fire hydrants, valves, reservoirs and tanks, pump stations, pressure zone limits, and closed valves at pressure zone limits.

comprehensive performance evaluation (CPE) A systematic review and analysis of a water treatment plant's performance without major capital improvements. It is the first part of a two-stage composite correction program, which was developed for the US Environmental Protection Agency to improve performance at wastewater treatment plants. It has been applied to drinking water treatment plants in conjunction with the Surface Water Treatment Rule.

comprehensive plan A method for formulating beforehand all relevant details—including schedule, methods of proceeding, finances, and so on—for creating or improving a system or physical plant to provide a specific service.

comprehensive planning A process that results in widespread community planning.

comprehensive technical assistance (CTA) The second step in what is known as the Composite Correction Program. CTA involves correcting the problems identified during the comprehensive performance evaluation that limit treatment plant performance. The major purpose of the CTA is to optimize the performance of existing facilities and to train plant staff and administrators to maintain long-term, optimal plant performance. *See also* comprehensive performance evaluation.

compressibility The degree of physical change in suspended solids or filter cake when subjected to pressure.

compression settling The settling of particles at very high concentrations, as would occur near the bottom of a settling basin. The particles actually touch each other, and settling can occur only by the compression of the compacting mass. *See also* type IV settling.

compression-type hydrant A hydrant that opens against the flow of water by the movement of the operating stem and in which the water pressure tends to keep the main valve closed.

compressive force The force that occurs when opposing loads act on a material, either crushing or threatening to crush it. In pipe, circumferential compressive forces may result from external pressure, or longitudinal compressive forces may result from heating of an end-restrained fiberglass pipe.

comptroller A person in charge of finances or expenditures in a business or institution.

computational fluid dynamics (CFD) The process of modeling fluid flow, heat transfer, and mass transfer using numerical solutions governed by partial differential equations. It is a powerful engineering tool for predicting heat and fluid flow in real applications.

computational fluid dynamics (CFD) model *See* computational fluid dynamics.

computer A machine that is capable of executing a set of instructions of data stored in digital form.

computer-aided design and drafting (CADD) Software that supports civil, mechanical, and other engineering design activities, including interactive graphics display, engineering calculation and analysis, and limited attribute processing. In addition, computer-aided design and drafting systems allow for 2-dimensional drafting and 3-dimensional solid and surface modeling.

computer-aided design/computer-aided manufacturing (CAD/CAM) The use of computers in the design and control of manufacturing processes.

computer-aided dispatch (CAD) A group of automated tools used by organizations to identify the physical location of a query for service or emergency assistance and to assist in identifying the most appropriate vehicle and route of response.

computer-aided drafting (CAD) The use of computers to automate drafting functions, storing drawing elements as graphic features with *x, y, z* coordinates in digital form. Computer-aided drafting allows data to be entered and modified through digitizing or manipulation of a screen cursor via a mouse. Some data or analytic capabilities are typically included.

computer-aided modeling system A complex system of simulation modeling that is enhanced by the application of pre- and postprocessors to aid the experienced or inexperienced user in setting up and running the model. The user must have great expertise in the topic for which the model is designed.

computer-assisted manufacturing (CAM) The use of computers in the control of manufacturing processes.

computer-assisted mapping (CAM) The use of computers in the creation and production of maps. Map features are stored in digital form as elements with coordinate values.

computer-assisted mass appraisal (CAMA) A computer-aided analysis of data describing property characteristics, used in establishing property values for tax assessment.

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computer-based modeling The simulation of an activity or condition through the use of equations developed from a collection of data.

computer maintenance management system (CMMS) A computer program designed for the management of infrastructure maintenance, which performs functions including but not limited to work-order generation, prioritization, and tracking by equipment/component. The program is usually integrated with the geographic information system mapping and attribute databases in support of management and of operations-and-maintenance activities. Advanced computer maintenance management systems are often linked to predictive maintenance and supervisory control and data acquisition databases that track run times, vibration, heat, and lubrication analysis. Costs, inventory control, maintenance scheduling, and training also are often included.

computer mapping *See* automated mapping system.

computer model A means of defining a system using computer programs.

computer program An arrangement of instructions for computational operation to achieve a set of desired results.

computer router A network interconnection and switching device that is capable of optimizing and selecting the least costly and most efficient available paths for data transmission.

concave stream bank A stream bank that has its center of curvature toward the channel.

concentrate The concentrated solution containing constituents removed or separated from the feedwater by a membrane water treatment system. It is commonly in the form of a continuous flow stream. Concentrate is also called reject, brine, retentate, or blowdown, depending on the specific membrane process.

concentrated fall The fall that is concentrated at one point on the stream in a hydroelectric power development, e.g., the fall a dam uses to generate power.

concentrate disposal The process, method, or facilities used to dispose of the concentrate generated by a membrane treatment system.

concentrated solution A solution that contains a relatively high quantity of the solute.

concentrate recycle A technique for increasing the amount of product water from reverse osmosis and electrodialysis systems by recycling a fraction of the concentrate stream back through the membrane or membrane stack.

concentrate staging For a pressure-driven membrane process, the membrane module arrangement such that the concentrate from one stage is further processed in a following stage, nearly always without an additional pumping step prior to the following stage. *See also* array; hydraulic staging.

concentrate stream (1) For pressure-driven membrane treatment systems, the stream into which rejected materials are concentrated, including ions in the case of reverse osmosis and nanofiltration. (2) For electrical-driven membrane treatment systems (e.g., electrodialysis), the stream in a membrane stack into which ions are transferred and concentrated.

concentration A means of expressing the strength of a solution. A common way to express results of water analyses is by weight of a solute per unit volume of the solution, e.g., milligrams per liter or micrograms per liter. Molarity (moles per liter) or normality (equivalent weights per liter) are other ways of expressing solute concentration.

concentration cell A corrosion cell involving two identical electrode materials, with corrosion resulting from mechanical, physical, or chemical differences of the environments adjacent to the two electrodes.

concentration cell corrosion A form of localized corrosion that can form deep pits and tubercles.

concentration factor (1) An expression of the enhancement in concentration that is possible (or has occurred) during sample preparation. It can refer to the enhancement of either the solute or solvent. In the case of solutes, the concentration factor is the ratio of concentration in the final extract to that in the original sample. (2) In a membrane treatment process, the concentrate solute concentration divided by the feed solute concentration.

concentration polarization (CP) (1) A corrosion phenomenon in which a transport step for movement of the dissolved species to or from the surface sites is limiting, thus controlling the rate of corrosion. The polarization, or difference in potential, in a corroding metal system is related to concentration differences between the surface and the bulk solution. (2) In a membrane treatment process, the phenomenon in which retained solutes accumulate at the membrane surface in concentrations greater than the bulk stream. *See also* boundary layer.

concentration tank A settling tank of relatively short detention period in which sludge is concentrated by sedimentation or flotation before treatment, dewatering, or disposal. *See also* sedimentation basin.

concentration time (1) The period of time required for storm runoff to flow from the most remote point of a catchment or drainage area to the outlet or point under consideration. It is not a constant, but rather varies with the depth of flow and the condition of the channel. (2) The time at which the rate of runoff equals the rate of rainfall of a storm of uniform intensity.

concentration units The amount of a substance per unit volume: in the US customary system, milligrams

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per liter; in Système International, moles per cubic meter.

concentrator A solids-contact unit used to decrease water content of a sludge or slurry.

conchoidal fracture Refers to a mineral that shows no cleavage when fractured. Cleavage is the tendency of a substance to break along defined planes. In a conchoidal fracture, the mineral does not break along defined cleavage planes; rather, the conchoidal fracture results in irregular breaking, producing concave-shaped edges where the fracture has occurred. Unlike a crystal, it does not break along a molecular plane, so regular geometric shapes are not produced.

concrete pipe A conduit manufactured from portland cement and aggregates combined with different forms of reinforcement, used to convey water.

concrete pressure pipe A conduit or pipe manufactured from portland cement and aggregate, reinforced with steel wire or bar. Four of five configurations incorporate a steel cylinder; the fifth type does not. Reinforced concrete cylinder pipe consists of a concrete core, an embedded steel cylinder, and mild steel reinforcement cast into the pipe wall. Prestressed concrete cylinder pipe includes two types, consisting of a steel cylinder either lined with or embedded in structural concrete, wrapped by prestressing wire, and coated in portland cement mortar or concrete. Bar-wrapped concrete cylinder pipe consists of a steel cylinder lined with portland cement mortar or concrete and wrapped with a mild steel bar, all coated with portland cement mortar. Reinforced noncylinder pipe consists of a concrete core reinforced with one or more steel bar cages; its use is limited to low-pressure applications. Concrete cylinder pipes are joined by steel joint rings, while noncylinder pipes may have steel or cast concrete joint rings.

condensate (1) Condensed vapors from a heat exchanger, also called distillate. (2) The product from a distillation water treatment process.

condensation (1) Conversion from the vapor state to the liquid state, such as the production of condensate or distillate from a distillation plant. This is caused by the formation of water droplets around condensation nuclei or on surfaces when a saturated air mass contacts these surfaces. A common example is the formation of water droplets on the outside of windows in air-conditioned buildings in humid climates. (2) A chemical reaction with two or more molecules joining to form a more complex compound, such as in the case of polymerization.

condensation nucleus A particle on which condensation of water vapor begins in the free atmosphere, where it invariably takes place on hygroscopic dust or hygroscopic gases. The common sources of such dust and gases are sea salt, products of combustion, and dust blown from the earth's surface.

condensed time A foreshortened time base used in developing an infiltration capacity curve in hydrological studies. Time condensation is applied for a period during a storm when the rain intensity is less than infiltration capacity. This is necessary to meet the requirement that the volume of infiltration under the curve of infiltration capacity must equal the observed volume of infiltration.

condensor *See* capacitor.

conditional water right The legal preservation of a priority date that provides a water user time to develop a water right while preserving a more senior date. It becomes an absolute right when the water is actually put to beneficial use. *See also* beneficial use.

conditioned water Any water that has been treated by one or more processes (e.g., adsorption, deionization, reverse osmosis) to improve the water's usefulness, aesthetic quality, or both by reducing undesirable substances (e.g., iron, hardness) or undesirable conditions (e.g., color, taste, odor).

conductance A measure of the conducting power of a solution, equal to the reciprocal of the resistance.

conductance units *See in the Units of Measure section.*

conductivity (specific conductance) A measure of the ability of a solution to conduct electrical current. Its value is inversely proportional to the solution's electrical resistance. The conductivity value is commonly used in water-desalting processes as a means to evaluate desalting efficiency and to estimate the total dissolved solids concentration; the conductivity value of a water sample is multiplied by an empirical factor representative of the typical total dissolved solids/conductivity ratio for the specific type of water. The units of conductivity are often reported as micromhos per centimeter at 25° Celsius, but this is not a Système International unit; multiplying such a value by 10^{-4} converts the value to units of siemens per meter.

conductivity bridge A means of measuring conductivity whereby a conductivity cell forms one arm of a Wheatstone bridge, a standard fixed resistance forms another arm, and a calibrated slide wire resistance with end coils provides the remaining two arms. A high-frequency alternating current is supplied to the bridge.

conductivity detector A type of detector frequently used in conjunction with an ion chromatograph. Ions present in the elution solvent conduct an electrical current that is converted into a detector response. The conductivity measured is proportional to analyte concentration.

conductivity units *See in the Units of Measure section.*

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conductometric detection An ion chromatography detection technique based on changes in eluent conductivity. *See also* conductivity.

conductor A substance that permits the flow of electricity, especially one that conducts electricity with ease.

conductor casing The outer casing of a well. The purpose of this casing is to prevent contaminants from surface waters or shallow groundwaters from entering a well.

conduit Any artificial or natural duct, either open or closed, for conveying fluids.

cone of depression The depressed groundwater elevations that form around a well during pumping, caused by the loss of water from storage in the nearby aquifer materials. Also called cone of influence. *See also* circle of influence; drawdown; well cone of influence; zone of influence.

cone of influence The depression, roughly conical in shape, produced in the water table by the pumping of water from a well. *See also* circle of influence; cone of depression.

cone valve A valve with a housing and tapered plug containing a hole that is operated by turning the tapered section. The valve is open when the hole is parallel with the flow and closed when the hole is perpendicular to the flow. A cone valve is designed so that the tapered section can be lifted slightly for easier rotation and forced back against the housing for closing.

confidence interval An interval constructed around the mean of sample data that includes the true population mean for a specified percentage of repeated samples taken. The data are assumed to be random and normally distributed, so the percentage of confidence is based on the standard deviation of the sample data. A confidence interval of two standard deviations on either side of the sample mean will include the population mean in about 95 percent of repeated samples. This same statistical method can be applied to the predicted values in multiple regression analysis, such that the standard error of the estimate is substituted for the standard deviation. In epidemiology, the confidence interval is preferred over the *p*-value because more information is conveyed about the magnitude of an association and its range of values (confidence limits). *See also* confidence limit; odds ratio; probability value; standard deviation; standard error of the coefficient; standard error of the estimate; t-test.

confidence level *See* confidence interval.

confidence limit An upper or lower bound specified by the confidence interval surrounding a statistical mean. *See also* confidence interval.

confined aquifer An aquifer overlaid by a confining bed that has significantly lower hydraulic conductivity than the aquifer.

confined groundwater Water contained in a confined aquifer. Pore water pressure exceeds atmospheric pressure at the top of the confined aquifer. *See also* confined aquifer.

confined space (1) A space that is configured so that an employee can bodily enter and perform assigned work but that has limited or restricted means for entry and exit and is not designed for continuous employee occupancy. (2) A space defined by the concurrent existence of the following conditions: (a) existing ventilation is insufficient to remove any dangerous air contamination, oxygen deficiency, or both that may exist or develop, and (b) ready access or egress (getting out) for the removal of a suddenly disabled employee (operator) is difficult because of the location of the opening(s), size of the opening(s), or both. *See also* dangerous air contamination; oxygen deficiency.

confined space entry The passing of an employee through an opening into a permit-required confined space. The purpose of such entry includes work activities in that space. Entry is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

confined water *See* confined groundwater.

confining bed A geologic unit of low hydraulic conductivity that is adjacent to one or more aquifers. It may lie above or below the adjacent aquifer.

confining stratum An impervious stratum or confining layer directly above or below a stratum or layer bearing water. *See also* confining bed.

confirmed test The second major step of the multiple-tube fermentation test. It confirms that positive results from the presumptive test are caused by coliform bacteria. *See also* completed test; presumptive test.

conflict manhole Obsolete term; *see* personnel access opening.

conflict personnel access opening Obsolete term; *see* personnel access opening.

confluence A junction or flowing together of streams; the place where streams meet.

confluent Flowing together to form one stream.

confluent growth The growth of bacterial colonies that are not discretely separated on a growth medium.

confluent stream A stream that unites with another; a fork or branch of a river, especially when the streams are nearly equal in size.

confocal laser scanning microscope A special laser light source microscope that keeps illumination and detection confined to the same spot in a specimen at any one time. Only what is in focus is detected, registered

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electronically, and contributes to generation of a complete optical image of the specimen. To build up an image, the point probe is scanned over the field of view and the final image is generated electronically from a serial signal derived from the output of one or more photomultipliers.

confocal laser scanning microscopy (CLSM) Practice of using a confocal laser scanning microscope.

confounding bias A potential source of error in evaluating an epidemiologic association between exposure and disease. Confounding bias must be avoided because it may incorrectly convey the appearance of such an association. For example, the confounding characteristic rather than the putative exposure may be responsible for all or much of the observed risk. This bias results when one or more variables that cause the disease exist and are also associated with exposure. Confounding bias is potentially present in all studies and does not result from an error of the investigator. This bias can be minimized if certain procedures are followed during the study design (matching, randomization) and during data analysis (multivariate analysis, stratification).

confounding factor A variable other than the specific exposure being evaluated that is associated with both the exposure and outcome of interest and may bias an analysis of the effect of that exposure. *See also* confounding bias.

congenital malformation An abnormal structure in certain limbs or organs that was present at birth. Increased risks of some of these abnormalities appear to be caused by microbial, chemical, and physical agents in the environment.

Congressional Budget Office (CBO) A government office established by the Congressional Budget Act of 1974 (2 US Code 601) to provide the US Congress with basic budget data and analyses of alternative fiscal, budgetary, and programmatic policy issues. The Congressional Budget Office provides Congress with biannual forecasts of the economy and analyses of economic trends and alternative fiscal policies; prepares a 5-year cost estimate for carrying out any public bill or resolution reported by congressional committees; is responsible for furnishing the House and Senate budget committees by February 15 of each year with a report that discusses alternative spending and revenue levels and alternative allocations among major programs and functional categories; and undertakes studies requested by the Congress on budget-related issues.

Congressional Record The US government publication published each day Congress is in session to document the deliberations, actions, and proceedings of the US Congress.

conical plug valve A valve in which the moving plug is conical. This type of valve is opened by unscrewing the plug from the seat and turning it through an angle of 90°. It is also called a cone valve.

conjugate *See* conjugation reaction.

conjugate base A chemical species that can accept a proton and is related to an acid by the difference of that proton (e.g., chloride ion [Cl^-] is the conjugate base of hydrochloric acid [HCl]).

conjugate depths The depths before and after a hydraulic jump. These depths are also called sequent depths.

conjugation reaction Generally a detoxification reaction that occurs in an organism exposed to a chemical or its active metabolite. Such a reaction usually involves the biochemical addition of a conjugate (metabolite of normal biological constituents) to increase the water solubility of the chemical, thereby increasing the chemical's rate of elimination via the urine. Common conjugates include glucuronides, glycine, sulfate, glutathione, and taurine.

conjunctive use A water supply management concept in which groundwater and surface water supplies are managed jointly to produce a larger and more stable economic yield of water than operating the two supplies independently. One such scheme may be to use surface water supplies as a base supply and then supplement with groundwater in times of drought.

conjunctive water management The management of both surface water and groundwater resources in a region where the surface water and groundwater systems are hydraulically interactive, in order to satisfy water demands and place limited stress on either resource.

conjunctivitis Inflammation of the conjunctiva, the mucous membrane that lines the inner surface of the eyelid and the exposed surface of the eyeball.

connate seawater Ancient seawater entrapped in sediments at the time of their deposition. Connate seawater can be a source of bromide ions. *See also* bromide; connate water.

connate water Subsurface water that was not buried with a geologic unit but has been out of contact with the atmosphere for a large portion of a geologic period.

connecting system *See* joining system.

connection band A collar or coupling that fits over adjacent ends of pipe to be joined and that, when drawn tight, holds the pipe together either by friction or by mechanical bond.

connection charge A charge assessed by the utility to recover the cost of connecting the customer's service line to the utility's facilities, typically covering only the direct and indirect costs of physically tying the service line into the main. In this case, the payment is

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considered a service charge. When this charge includes system backbone capacity costs in addition to direct hook-up costs, it is considered a contribution of capital by the customer or other agency applying for service. Such an all-inclusive connection charge is also called a system development charge.

connection fee *See* connection charge.

connectivity The establishment of logical relationships or topology between graphic features, for instance, linking a water main junction to its connecting pipes.

consecutive system entry point (CSEP) The location at which a consecutive water system buys or otherwise receives some or all of its finished water from a wholesale system. *See also* consecutive water system.

consecutive water system A public water system that buys or otherwise receives some or all of its finished water from another public water system on a regular basis (at least 60 days per year), i.e., not only during an emergency.

consensus method An analytical procedure that is intended to represent the collective agreement of a representative number of experts in the particular subject, using a consensus decision process that seeks agreement of the majority of participants and resolves or mitigates the objections of the minority to achieve the most agreeable decisions.

consent order A legally binding agreement between water utility owner(s) and a regulatory agency prescribing a set time period for the water utility to complete prescribed tasks.

consequent stream A stream for which the course has been controlled in terms of direction and location by the general slope of the surface topography.

conservation (1) The act of conserving; preservation from loss, injury, destruction, decay, or waste. (2) The protection of rivers, aquifers, watersheds, wetlands, forests, and other natural resources. *See also* water conservation.

conservation district A governmental entity that acts to protect soil and water.

conservation master plan A plan, usually an integral component of a water system master plan, that defines the demand management measures available to a utility, the cost of implementing them, the benefit–cost relationship (ratio) of each measure, and a recommended set of the most cost-effective conservation measures in order to achieve a prescribed amount of conservation over an extended period, usually 20 years.

conservation of energy The principle that the total amount of energy in an isolated system remains unchanged while internal changes of any kind occur. In hydraulics, this principle dictates that the energy of water at any point in a waterway is equivalent to the energy at any other point plus or minus friction losses.

conservation-oriented rate A water rate structured to encourage efficient use of water and discourage water waste. It is also known as conservation pricing.

conservation rate An increased rate of charge for water use over an established amount per billing cycle to discourage overuse and waste.

conservation rate structure *See* conservation-oriented rate.

conservation storage Storage of water for future useful purposes such as municipal supply, power, or irrigation.

conservative constituent A chemical that essentially maintains its concentration in passing through a unit treatment process. For example, coagulation can remove turbidity and organic carbon, but it does not reduce the bromide ion concentration; thus, bromide ion is called a conservative constituent in this circumstance.

consolidated formation A geologic material for which the particles are stratified (layered), cemented, or firmly packed together (hard rock). Such a formation usually occurs at a depth below the ground surface. *See also* unconsolidated formation.

consolidating pressure zones Placing two or more service areas of different pressure gradients into one larger area with equal pressure. *See also* pressure gradient.

consolidation (1) In geology, any or all processes by which loose, soft, or liquid earth materials become firm and coherent. (2) A merger or acquisition of one or more small systems, usually by a larger system.

consolidation sedimentation (1) Any or all processes by which loose, soft, or liquid earth materials become firm and coherent. (2) In soil mechanics, the adjustment of saturated soil in response to increased load, involving removal of water from pores by an increase in pressure and a decrease in void ratio.

consortium In microbiology, a heterogeneous group of microorganisms found to be associated with a biochemical process. For example, in the biodegradation of a complex hydrocarbon mixture such as crude oil, a variety of microorganisms, including different types of bacteria and fungi, may be involved to achieve complete mineralization of the crude oil.

constant (1) A universally accepted value for a certain parameter. (2) An unchanging number with or without fractional values.

constant-flow stirred-tank reactor *See* continuous-flow stirred-tank reactor.

constant-rate filtration The most common method of filter operation, in which the filters are operated at a constant rate. The rate is controlled either by (1) an effluent valve that is gradually opened as head loss increases throughout the filter run or (2) a variable water

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surface above the filter media that gradually rises to increase the applied head as head loss accumulates.

constant-speed pump A centrifugal pump designed to operate at a constant speed. For a given system head loss, the pump will deliver a constant flow rate. As head loss increases, flow rate will decrease, and vice versa. The extent to which the flow rate will increase or decrease as system head loss fluctuates is dependent on the shape of the pump curve. *See also* pump characteristics curve.

constant spring A spring in which variation in discharge from maximum to minimum does not exceed one third of the average discharge.

constriction In a waterway, an obstruction that confines the flow to a narrower section or to a smaller area, thus throttling the flow. Natural gorges, bridge piers, weirs, and orifices are examples of constrictions. This term is sometimes used synonymously with the term *contraction.*

constructed conveyance In broad terms, for the purposes of defining a public water system under the Safe Drinking Water Act (SDWA), any artificial conduit, such as a ditch, culvert, waterway, flume, mine drain, or canal. A constructed conveyance does not include water that is delivered by bottle, other package unit, vending machine, or cooler; nor does it include water that is trucked or delivered by a similar vehicle. Water bodies or waterways that occur naturally but that are altered by humans may, in some cases, be constructed conveyances. The US Environmental Protection Agency issued guidelines, published on Aug. 5, 1998 (63 *Federal Register* 41939–41946), regarding interpretation of the definition of *public water system,* including *constructed conveyance,* which is defined in Section 1401(4) of the SDWA. *See also* public water system.

construction The overall activities associated with assembling and building components of a facility.

construction joint A temporary joint along a plane or surface in a structure composed of homogeneous material such as earth or concrete. This joint allows for ceasing to place additional material for a certain amount of time, such as overnight or several days, and allows for forming complex concrete pours.

construction work in progress (CWIP) A utility's investment in facilities under construction but not yet dedicated to service. The inclusion of CWIP in the rate base varies from one regulatory agency to another.

consumer confidence report (CCR) An annual report that community water systems must deliver to their customers summarizing information regarding source water, detected drinking water contaminants, and other information. A CCR is intended to educate and inform the public regarding the quality of its drinking water. The US Environmental Protection Agency established requirements for issuance of consumer confidence reports on Aug. 19, 1998 (63 *Federal Register* 44512–44536). Community water systems must issue CCRs annually by July 1, covering the previous full calendar year.

Consumer Product Safety Commission (CPSC) An independent US government agency established by the Consumer Product Safety Act (15 US Code 2051 et seq.). The commission consists of five commissioners, appointed by the president of the United States with advice and consent of the US Senate, one of whom is appointed chair. The commission protects the public against unreasonable risks of injury from consumer products; assists consumers in evaluating the comparative safety of consumer products; develops uniform safety standards for consumer products and minimizes conflicting state and local regulations; and promotes research and investigation into the causes and prevention of product-related deaths, illnesses, and injuries.

consumption pattern The variation in the amount of water a customer uses over a period of time.

consumptive use The loss of irrigation water to the atmosphere via transpiration or evaporation. *See also* evapotranspiration.

consumptive waste The water that returns to the atmosphere without benefiting people.

contact angle A parameter used to characterize the wettability of solids. It is defined as the angle at which the edge of a drop strikes the surface of a solid. It can be determined by using Young's equation:

$$\cos\Theta = \frac{\sigma S - \sigma LS}{\sigma L}$$

Where:

Θ = the contact angle
σL = the surface tension of the liquid
σS = the surface free energy of the solid
σLS = the interfacial tension between the liquid and solid

contact chamber Any large tank in which water can be mixed with and allowed to react with a disinfectant or other chemical agent.

contact dermatitis An inflammatory reaction of the skin that has as its basis an allergic reaction. The response can be a result of a chemical or biochemical that comes in contact with the skin.

contact filter A filter used in a water treatment plant for the partial removal of turbidity before final filtration. *See also* preliminary filter; roughing filter.

contact flocculation A process in which coagulated water is passed through a coarse-media or gravel bed

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that acts as a flocculation system, thereby reducing the time to produce a settleable or filterable floc. Reducing the time may be important for plants treating very cold water, portable plants, pressure plants, or plants treating water with low total dissolved solids that do not respond readily to metal salt coagulants. *See also* flocculation.

contactor (1) A vertical pressure vessel used to hold an activated carbon bed. (2) An electric switch, usually magnetically operated. *See also* reactor.

contactor hydrodynamics The hydraulic behavior and pathways of a fluid in a reactor or contactor. The hydrodynamics dictate the extent of short-circuiting or the extent to which the reactor behaves as a plug flow system. The hydrodynamics change as flow rate increases or decreases in a fixed-volume contactor. *See also* plug-flow reactor; short-circuiting.

contact roughing filter A filter used in a water treatment plant for the partial removal of turbidity before final filtration. *See also* preliminary filter; roughing filter.

contact spring A spring forming at a lithologic contact when a more permeable unit overlies a less permeable unit. *See also* cliff spring.

contact tank A tank used in water treatment to promote contact between treatment chemicals or other materials and the body of liquid treated.

contact time The time in which a chemical or constituent is in contact with another reacting chemical or constituent. The contact time in a basin or storage vessel can be expressed on a theoretical basis (i.e., the volume divided by the flow rate) or on a measured basis using tracer studies that account for contactor hydrodynamics. Contact time is not to be confused with $C \times T$. *See also* contactor hydrodynamics.

container valve The valve mounted on a chlorine container or cylinder.

containment protection Backflow protection on the water supply line to a premises that is installed as close to the service connection to the public water system as possible. *See also* premises isolation.

contaminant Any physical, chemical, biological, or radiological substance or matter in water.

Contaminant Candidate List (CCL) *See* Drinking Water Contaminant Candidate List.

Contaminant Selection List *See* Drinking Water Contaminant Candidate List.

contaminant source inventory A record of the activities on a watershed or aquifer recharge area that have a potential to contaminate water.

contaminated aerosol A fine suspension of liquid droplets sprayed into the air that contains one or more organisms such as the bacterium *Legionella pneumophila.*

contamination Any introduction into water of microorganisms, chemicals, wastes, or wastewater in concentrations that make the water unfit for its intended use.

contingency management An approach to handling adverse conditions that (1) emphasizes that no one best way exists at all times and in all situations and (2) recognizes differing abilities of people at various times and in actual circumstances. This approach is also called situational management.

contingency plan A document that details the intended actions of a water utility under specified adverse conditions.

contingency planning A process wherein specific alternatives are given to provide direction in the event of unforeseen occurrences.

continuing education A planned or mandated program in which those in a profession or occupation attend formal classes, seminars, training sessions, and so on to keep informed of new developments in their specific discipline.

continuity equation An axiom stating that the rate of flow past one section of a conduit is equal to the rate of flow past another section of the same conduit plus or minus any additions or subtractions of water flow between the two sections. *See also* storage equation.

continuous acoustic monitoring The permanent or scheduled listening, frequently with a waterphone, to hydrants, valves, or other points of access on a water main to detect water leaks. *See also* waterphone.

continuous air supply A grade D air that is supplied to a worker who is wearing a hood or helmet while working in a hazardous environment. *See also* grade D air.

continuous-backwash filter A modification of a rapid granular filter in which the filter bed is divided into multiple compartments with the filtrate flowing to a common effluent channel. A traveling backwash system equipped with a backwash collection system washes each cell in succession as it continuously or intermittently traverses the length of the filter.

continuous belt filter press (CBFP) A belt filter press to which sludge is fed continuously for dewatering. *See also* belt filter press.

continuous blowoff flushing The process of allowing water to continually run from a blowoff to maintain a chlorine residual or prevent discolored water from forming, thus enhancing the water quality in the distribution system.

continuous control *See* proportional integral derivative control.

continuous feed method A method of disinfecting new or repaired mains in which chlorine is continuously

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added to the water being used to fill the pipe, so that a constant concentration can be maintained.

continuous-flow centrifugation (1) Nonstandard method of concentration of protozoan parasites (i.e., *Cryptosporidium* and *Giardia*) from large volume water samples. (2) Method of separating residuals from water by passing the water continuously through a centrifuge. *See also* centrifuge.

continuous-flow centrifuge *See* continuous-flow centrifugation.

continuous flow operation The process wherein a continuous and steady flow of water is processed for treatment through the media. *Contrast with* intermittent flow operation.

continuous-flow pump A displacement pump within which the direction of the flow of water is not changed or reversed.

continuous-flow stirred-tank reactor (CFSTR) A reactor in which the contents are completely mixed on a continuous basis. In theory, flow introduced to the continuous-flow stirred-tank reactor is immediately mixed to a uniform concentration upon entering the reactor, and therefore fractions of the flow will be exiting as soon as they enter. Steady-state conditions prevail, and no accumulation of constituents occurs in the reactor with time. Continuous-flow stirred-tank reactors are a fundamental component of reactor theory, although few true applications exist in water treatment. A rapid mix basin for adding coagulant chemicals, if mechanically mixed at high intensity, is one example of a treatment process that approximates this behavior.

continuous-flow tank A tank through which liquid flows continuously at its normal rate of flow, as distinguished from a fill-and-draw or batch system.

continuous immunomagnetic collection An antibody capture technique used for the selective separation of viruses and protozoa. The process involves the capture of target organisms by a specific antibody attached to a magnetic bead.

continuous interstice An interstice that occurs in (1) granular material, (2) a fracture in a rock formation, or (3) a tubular opening in soluble rocks or lava and that is connected with other interstices.

continuous liquid–liquid extraction (CLLE) An isolation technique based on the distribution of analytes between two partially soluble solvents. In continuous extraction, an organic solvent phase is recycled so that analytes have multiple opportunities to partition from the aqueous phase. Continuous extractors can be used to extract contaminants from very large volumes of water and for samples that may cause emulsions or other problems if the sample were shaken.

continuously stirred tank reactor (CSTR) *See* continuous-flow stirred-tank reactor.

continuous mode A mode of water treatment operation in which the feedwater input and process output flow(s) are continuous. *Contrast with* batch mode.

continuous online integrity testing method An integrity test procedure for membranes that can take place when the membranes are in normal production service. According to the US Environmental Protection Agency Long-Term 2 Enhanced Surface Water Treatment Rule, continuous indirect online integrity testing requires monitoring filtrate water quality using a method that is indicative of particulate matter removal at a frequency of at least once every 15 minutes. For microfiltration or ultrafiltration membrane processes, online turbidity meters or particle counters are often used. *See also* direct integrity testing; indirect integrity testing; membrane integrity.

continuous sample A sample taken from water that flows from a particular place in a plant to the location where samples are collected for testing. Personnel may obtain grab or composite samples from this continuous stream. Frequently, several taps (faucets) will flow continuously in the laboratory to provide test samples from various places in a water treatment plant. Possible changes in water quality may occur during travel to the sampling tap. *See also* composite sample; grab sample.

continuous sludge-removal tank A sedimentation tank equipped to permit the continuous removal of sludge.

continuous-stave pipe A pipeline made of wooden staves, constructed so that the staves—which form the barrel of the pipe—are placed in a continuous line from one end of the pipeline to the other. Such a pipe is assembled in place in the field with staggered joints and held to position and tightness by encircling steel bands.

continuous stream A stream that does not have interruptions in course. It may be perennial, intermittent, or ephemeral, but it does not habitually have wet and dry stretches.

continuous-wave ultraviolet (CWUV) light Term implying that an ultraviolet (UV) source emits light over a continuous set of wavelengths because *wave* is generally understood to mean wavelength or frequency. Commercially available mercury-vapor low-pressure, low-pressure high-output, and medium-pressure ultraviolet lamps are examples of continuous-wave UV sources. Some confusion exists in the literature because continuous-wave does not address time. Therefore, lamps such as pulsed UV lamps are also continuous-wave systems but not continuous in time. *See also* low-pressure ultraviolet lamp; low-pressure

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high-output ultraviolet lamp; medium-pressure ultraviolet lamp; pulsed ultraviolet light.

contour A line of equal elevation above a specified datum, usually mean sea level.

contour basin A basin made by levees or borders following contours, with occasional cross levees.

contour farming A conservation-based method of farming in which farming operations (e.g., plowing, planting, cultivating, and harvesting) are performed on the contour at right angles across (rather than up and down) the slope to reduce soil erosion, protect fertility, and use water more efficiently. *See also* contour strip farming.

contour interval The difference in elevation between adjacent contours on a map.

contour line A line joining points having or representing equal elevations.

contour map A map showing the configuration of the surface by means of contour lines drawn at regular intervals of elevation, such as one for every 10 meters. A crowding of the contour lines indicates steepness.

contour plot *See* contour map.

contour strip farming A kind of contour farming in which row crops are planted in strips, between alternating strips of close-growing, erosion-resistant forage (e.g., grass, grain, hay) crops.

contract An agreement between two or more parties for the doing or not doing of something specified for adequate compensation. A contract is legally enforceable and provides remedies if the contract is breached.

contract demand The water quantity authorized by contract between a water utility and a large-use customer who requires a significant amount of the total capacity of the utility. The agreement fixes the terms and conditions under which the water utility will provide water to the customer. Such an agreement has also been called contract capacity.

contracted-opening discharge measurement A determination (by indirect measurement) of peak discharge following a flood based on a field survey of high-water marks and channel and bridge geometry at a bridge constriction. Discharge is computed on the basis of an evaluation of energy changes between the approach section and the downstream side of the constriction.

contracted weir A rectangular notched weir that has (1) a crest width narrower than the channel across which it is installed and (2) vertical sides extending above the upstream water level. These features produce a contraction in the stream of water as it leaves the notch.

contracting reach A reach of channel wherein flow is accelerating. The velocity head at a downstream cross section of the reach exceeds the velocity head at an upstream cross section.

contraction (1) The extent to which the cross-sectional area of a jet, nappe, or stream is decreased after passing an orifice, a weir, or a notch. (2) The reduction in cross-sectional area of a conduit along its longitudinal axis. *See also* constriction.

contraction coefficient A coefficient in a formula for calculating the discharge of a weir, orifice, or other constriction in a waterway, introduced to correct the result because the water stream's cross-sectional area will contract to a size smaller than the nominal area of the constriction after the fluid passes the constriction. The contraction coefficient is equal to the ratio of the smallest cross-sectional area of the fluid after passing the constriction to the nominal area of the constriction.

contract operation and management The provision of water utility services by a private company under contract (rather than another water system).

contribution in aid of construction An amount of money, services, or property that a water utility receives at no cost from any person, government agency, or other entity. It represents an addition or transfer to the capital of the utility and is used to offset the acquisition, improvement, or construction costs of any utility property, facilities, or equipment used to provide utility services to the public. It includes amounts transferred from advances for construction representing (1) any unrefunded balances of expired refund contracts or (2) discounts resulting from the termination of refund contracts. Contributions received from government agencies and others for relocating water mains or other plant facilities are also included. These contributions are nontaxable as income to a water utility, but the cost that a customer pays toward the provision of water service is taxable income. When a customer requests water service to a building or area, a cost may be incurred by the water system in providing that service. It may be inexpensive or involve the construction of new distribution system facilities. In any case, material and labor costs are typically involved with any required work by the water system to provide water service, and the customer requesting the service may be required by the water system to pay a portion of these costs.

control (1) A condition in which specific quality criteria have been achieved in a laboratory analysis. For example, an analysis is said to be in control when a series of standards or samples have met a set of conditions such as precision or accuracy. (2) A type of sample used to assess the quality of an analytical process. (3) A section or reach of an open conduit or stream channel where artificial or natural conditions, such as

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the presence of a dam or a stretch of rapids, make the water level upstream a stable indicator of the discharge. Controls may be complete or partial. Complete control exists if the elevation of the water surface upstream of the control is entirely independent of fluctuations of the water level downstream from it. Partial control exists if downstream fluctuations have some effect on the upstream water level. (4) A waterway cross section that serves as a bottleneck for a given flow and that determines the energy head required to produce the flow. In the case of open channels, the control is the point where the flow is at critical depth; hydraulic conditions upstream of this point are wholly dependent on the characteristics of the control section and are entirely independent of hydraulic conditions downstream of the point. In the case of closed conduits, the control is the point where the hydrostatic pressure in the conduit and the cross-sectional area of flow are definitely fixed, except in cases where the flow is limited at some other point by a hydrostatic pressure equal to the greatest vacuum that can be maintained unbroken at that other point. (5) The ability to monitor, regulate, and/or secure a process such as water treatment or water distribution via the use of data gathering, assessment, and supervision equipment. Use of a fully automatic control process is referred to as "closed loop" control, while a process that includes any part of manual controls is referred to as an "open loop" control process. *See also* process control; supervisory control and data acquisition.

control action The particular mathematical relationship between an automatic controller's input and output. This term is synonymous with the term *control mode.*

control algorithm An iterative process for varying the settings of pumps and valves in response to changing conditions.

control block A group of membranes, often with common piping, that are arranged so they can be controlled independently or isolated from other membrane groups. *See also* process train.

control character A specific character embedded in a data stream that causes some other display action to occur. Examples include uppercase (capital) or linefeed control characters. Such characters specify functions or operations such as capital line feed, underline, or highlight and are used to direct a video display or printer.

control chart A plot of analytical results that illustrate the state of statistical control exhibited over a series of measurements. A control chart is typically one of two types: a property chart or a precision chart. Sometimes called Shewhart charts, these plots are important tools in quality assurance.

control equipment Mechanical, electrical, and hydraulic devices used to turn other machines on or off or to change their operating characteristics.

control float A float installed in a tank or body of liquid to control the pumps.

control flume A flume arranged for measuring the flow of water, generally including a constricted section wherein a minimum energy head exists at all stages.

control group A set of substances or organisms used to compare with a similar set that has undergone one or more modifications.

controlled discharge Regulation of effluent flow rates to correspond with flow variations in receiving waters in order to maintain established water quality.

controlled globe valve An electrically or hydraulically remotely operated globe valve. *See also* globe valve.

controlled variable A quantity or condition that is measured and controlled.

controller A device that controls the starting, stopping, or operation of a device or piece of equipment. *See also* filter rate-of-flow controller.

control limits Specifications on a control chart beyond which a given point in a system would be unlikely to be in statistical control. The value, calculation, or both of a control limit depends on the type of control chart.

control lines *See* control limits.

control loop (1) The combination of all instruments and devices that directly sense a condition or control a field element. (2) The path through the control system between the sensor that measures a process variable and the controller that controls or adjusts the process variable.

control mode *See* control action.

control point A reference point used to perform absolute orientation, or georeferencing, of graphic information system data. Control points can be used for horizontal orientation, vertical orientation, or both; they can be derived from field surveys, aerotriangulation, or documents published by recognized institutions such as the National Geodetic Survey, US Geological Survey, US Department of Transportation, and other federal, state, or local government agencies.

control reach A section or reach of an open conduit or stream channel where artificial or natural conditions, such as the presence of a dam or a stretch of rapids, make the water level upstream a stable indicator of the discharge. *See also* control.

control relay An electromechanical device used to switch one or more electrical control signals in response to a trigger signal. Control relays contain a switch of one or more poles that is operated by an

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electromagnet. They are usually small because they are designed to carry control signals rather than power. It is also known as a power relay.

control section A waterway cross section that serves as the bottleneck for a given flow and determines the energy head required to produce the flow. *See also* control.

control system A system that senses and controls its own operation on a close, continuous basis. Many different types of control algorithms exist, including proportional, integral, and derivative control. *See also* derivative action; integral action; proportional action.

control works (1) All the structures, devices, and so on located at the head or diversion point of a conduit or canal. A control works is practically the same thing as a diversion works (i.e., an intake heading). (2) Structures and reservoirs constructed to reduce the flood peaks on streams subject to damaging floods.

convection In physics, mass motions within a fluid, resulting in transport and mixing of the properties of that fluid. Convection is caused by the force of gravity and by differences in density caused by nonuniform temperature.

convection current An ascending or descending (vertical) movement of water in a settling basin or lake, caused by differences of temperature or density (when the density of an upper stratum becomes greater than that of the underlying stratum).

convective precipitation Precipitation resulting from vertical movement of moisture-laden air that, on rising, cools and precipitates its moisture.

conventional aeration (CA) The process of adding air to a treatment basin by mechanical means (surface aerators) or by submerged air diffusers that are supplied by compressors.

conventional filtration *See* conventional water treatment; direct filtration; in-line filtration.

conventional filtration treatment *See* conventional water treatment.

conventional flushing The process of discharging water from a fire hydrant or blowoff at selected locations to maintain or enhance the water quality in a distribution main.

conventional tillage The traditional method of farming in which soil is prepared for planting by completely inverting it with a moldboard plow. Subsequent working of the soil with other implements is usually performed to smooth the soil surface. Bare soil is exposed to the weather for some varying length of time depending on soil and climatic conditions.

conventional treatment *See* conventional water treatment.

conventional ultraviolet light *See* low-pressure ultraviolet lamp.

conventional water treatment The use of coagulation, flocculation, sedimentation, filtration, and disinfection, together as sequential unit processes, in water treatment. This process is also called complete treatment.

convergence The coming together of two or more mathematical functions to a single point. The point of convergence is commonly referred to as the solution.

converging tube A tube for which diameter decreases, usually at a uniform rate, along its longitudinal axis from the end at which the liquid enters.

conversion (1) The process of converting nondigital data from hard copy maps or other sources into digital format. This term usually refers to the capture of graphic features and their incorporation into a geographic information system database; it also applies to the conversion of digital data from one format to another. (2) A short transition section in a conduit uniting two other sections that have different hydraulic elements; a transition. (3) In a membrane water treatment system, the amount of permeate, filtrate, or product flow divided by the amount of feedwater, commonly expressed as a percentage. In this instance, conversion is also called recovery.

conversion factor A numerical constant by which a quantity with its value expressed in units of one kind is multiplied to express the value in units of another kind.

conversion franchising A process in which selected employee groups of a utility or company are encouraged to form a private business with a guaranteed initial contract for a determined period of time with the utility as an incentive.

converter Generally, a direct current generator driven by an alternating current motor.

convex stream bank A stream bank that has its center of curvature away from the channel.

conveyance capacity The water capacity of a conveyance such as a pipe, channel, conduit, or ditch.

conveyance loss Water lost during conveyance (via a pipe, channel, conduit, ditch, or in related facilities such as water storage tanks) as a result of leakage, evaporation, or operator error such as storage tank overflows or inadvertently opened drain line valves. For drinking water systems, water audit methods consider these losses to be real losses.

coolant A fluid used to cool mechanical equipment and prevent overheating. Coolants include water or other solutions that have higher coefficients of specific heat (i.e., can absorb more heat energy for a fixed increase in temperature).

cooling coil A coil of pipe or tubing containing a stream of hot fluid that is cooled by the transfer of heat to a cold fluid outside the coil. Conversely, the

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coil may contain a cold fluid to cool a hot fluid in which the coil is immersed.

cooling tower A hollow, vertical structure with internal baffles to break up falling water so that it is cooled by upward-flowing air and by evaporation of water.

cooling water Water used to reduce temperature.

cool-season turf grass Turf grass that usually is not damaged by subfreezing temperatures and does not lose its color unless average ambient temperatures drop below 32° Fahrenheit (0° Celsius) for an extended period. Cool-season grass experiences the most growth during spring and fall and grows less during summer, when it goes dormant. It thrives in shady, cool areas and is optimally suited for northern climates where temperatures range from 60º to 75º Fahrenheit. Such grasses include bluegrass, Kentucky bluegrass, perennial rye grass, red fescue, and tall fescue.

cooperative A group of small water systems joining together for the purpose of buying drinking water supplies—such as water treatment chemicals, equipment, and services—at a reduced cost.

coordinated phosphate treatment A boiler treatment process using phosphate buffers to avoid the presence of hydroxyl alkalinity.

coordinate geometry (COGO) The common shorthand term for the technique of using mathematical algorithms to compute coordinates from geometric descriptions such as bearings and distances. The coordinates are stored and used to generate graphic map displays.

coordinate system A framework used to define the position of a point, line, curve, or plane, as well as derivative map features, within a two- or three-dimensional space.

COP *See* certificate of participation.

copolymer A polymer consisting of two or more different monomers (building blocks).

copper (Cu) A common reddish metallic element (atomic number 29). In nature, copper is found in the ores of azurite, azurmalachite, chalcocite, chalcopyrite, covellite, cuprite, and malachite. It is ductile and malleable and is used to manufacture pipe and other products used in water and treatment. Copper has various industrial uses and, as copper sulfate, is used to control algal growths. It is regulated in the distribution systems of public water supplies by the US Environmental Protection Agency at an action level of 1.3 milligrams per liter. Ninety percent of the samples collected at consumers' taps must be below the action level. *See also* copper sulfate.

copperas ($FeSO_4 \cdot 7H_2O$) A common name for ferrous sulfate heptahydrate.

copper–copper sulfate electrode (CSE) A copper rod partially immersed in a copper sulfate solution inside a cylindrical tube with a porous bottom, creating the cathodic half of a galvanic cell. The copper sulfate provides excellent soil contact, much better than would a bare copper rod. A reference electrode made with this cell is used in making field measurements of pipe-to-soil potentials.

copper pipe *See* copper tubing.

copper service A small water line constructed with copper material extending from the water main to the building plumbing.

COPPERSOL (copper solubility) A straightforward computer software program that develops solubility diagrams for copper, considering carbonate, hydroxide, and phosphate complexes at a given temperature and ionic strength. The expected solids formed at equilibrium are also determined.

copper sulfate ($CuSO_4 \cdot 5H_2O$) A chemical prepared from copper and sulfuric acid (H_2SO_4). It is usually used to control algal growths. Copper sulfate is also called blue vitriol, blue copperas, bluestone, and cupric sulfate.

copper tubing A conduit made from copper that has been heated and forced through dies to form a hollow cylindrical body of a required size for water services or plumbing pipes.

copper–zinc filters High purity granular brass (copper–zinc alloy) particles or turnings that are sometimes used in point-of-use drinking water filters for their claimed effectiveness in removing chlorine, hydrogen sulfide, lead, mercury, and iron from potable water. High-purity copper–zinc granules are also used in shower heads to dechlorinate shower water for the reported purpose of reducing the deleterious effect of chlorine on human hair. Properly designed filters are reported to meet the drinking water maximum contaminant levels for copper and zinc.

coprecipitation The simultaneous precipitation of a normally soluble component with a macro-component from the same solution by the formation of mixed crystals, by adsorption, occlusion, or mechanical entrapment.

coprostanol *See* fecal sterol.

Co-Pt (chloroplatinate) unit (also cpu) *See under* color unit *in the Units of Measure section.*

Corbicula fluminea *See* Asiatic clam.

core (1) A small cylindrical sample of rock removed by a core drill. (2) A section constructed in the center of an earth-fill or rock-fill dam along its axis to prevent the passage of water through the dam. When the section is made of concrete, it is usually called a core wall. It may also consist of puddled clay, timber, rolled or tamped earth, or fine material deposited underwater.

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core boring A boring from which a sample of rock, and occasionally soil, is obtained by the use of a drill bit that cuts out a core of the material. The size of the core usually varies from 1⅛ to 2 ¼ inches (28.6 to 57.2 millimeters); however, calyx drills are sometimes used to take 12-inch to 48-inch (305-millimeter to 1,220-millimeter) cores. The term *core boring* is also applied to similar cores taken from concrete or other materials in place for testing purposes.

core drill An instrument for boring holes in rock or other material to obtain a cylindrical sample of the material passed through.

core drilling A method of drilling with a hollow bit and core barrel to obtain a rock core.

core sample A sample of the medium obtained to represent the entire bed depth when the bed is being analyzed for capacity or usefulness. A hollow tube is sent down through the bed to extract the sample.

core wall A wall of masonry, sheet piling, or puddled clay built inside a dam or embankment and usually along the axis to provide resistance to seepage.

corey hydrant A type of dry barrel hydrant in which the main valve closes horizontally and the barrel extends well below the connection to the pipe. It is also known as an Iowa hydrant.

coring The mechanical cultivation of turfgrass using hollow tines to remove cores of turf. This approach improves soil texture and increases air and water movement.

corona An electrical discharge effect that causes the ionization of oxygen and the formation of ozone (O_3).

corona discharge A discharge of electricity causing a faint glow adjacent to the surface of an electrical conductor and, similarly, adjacent to the dielectrics in an ozone (O_3) generator during ozone production. Corona discharge results from electrical discharge and indicates the ionization of oxygen and formation of ozone in the surrounding air.

coronavirus A human respiratory virus; a single-stranded ribonucleic acid virus, 70–120 nanometers in size, that replicates in the cytoplasm.

corporation cock A valve for joining a service pipe to a street water main. It is usually owned and operated by the water utility or department. It cannot be operated from the surface. A corporation cock is also called a corporation stop or ferrule.

corporation stop *See* corporation cock.

Corps *See* US Army Corps of Engineers.

correlation A statistical term indicating the relationship between two variables.

correlation coefficient A measure of closeness of a regression line to the data set, often symbolized by *r* and equal to the square root of the coefficient of determination.

correlation matrix A matrix containing correlation coefficients between pairs of variables listed in the first row and the first column.

correlative right A doctrine of water ownership stating that water use during a drought will be shared among users proportional to the areal extent of the land owned by the competing users.

corrode To destroy gradually by electrochemical action.

corrosion The gradual deterioration or destruction of a substance (usually a metal) or its properties as a result of a reaction with the substance's surroundings.

corrosion cell The combination of an anode, a cathode, an external circuit (or connection between the anode and cathode), and an internal circuit (or conducting solution between the anode and cathode) that can cause corrosion. The electrons generated at the anode migrate to the cathode, and the positive ions generated at the anode migrate to the cathode. Different forms of corrosion can occur as a result of the distribution of anodic and cathodic areas over the corroding material.

corrosion control (1) Any water treatment method that keeps the metallic ions of a material, typically a conduit, from going into solution, e.g., increasing the pH of the water, removing free oxygen from the water, or controlling the carbonate (CO_3^{-}) balance of the water. (2) The sequestration of metallic ions and the formation of protective films on metal surfaces by chemical treatment.

corrosion index A prediction of the corrosivity of a water. In practice, no index has been developed that adequately predicts the corrosiveness of all waters. Most indexes do not predict corrosion per se; they predict the tendency for a water to dissolve or precipitate a solid, such as calcium carbonate ($CaCO_3$).

corrosion inhibitor A substance that slows corrosion by forming a protective film on the interior surface of pipes and tanks.

corrosion pitting A localized concentration of corrosion that can result in pipe failure within several months of installation. It is also known as "pitting." Copper is the most common metal affected by pitting.

corrosion prevention The act of reducing or eliminating deterioration caused by corrosion. Three methods of corrosion prevention exist: (1) selecting and using an inert material or one that is highly resistant to deterioration, (2) providing a coating on the material of concern such that the metal is separated from the aqueous environment, and (3) altering the water composition such that deterioration is lessened.

corrosion rate A measure of the loss of metal from a surface caused by corrosion over time. It is the speed, usually an average, with which corrosion progresses. Corrosion rates may be curvilinear or linear with

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time, although they are often expressed as though they were linear. They are often reported in units of milligrams per square decimeter per day for weight changes, or mils per year for thickness changes.

corrosion-resistant material A material that resists corrosion after prolonged placement in the environment in which the material was intended to be used. Corrosion-resistant materials do not contribute unacceptable amounts of corroded material into the processed water.

corrosion scale The material formed on the surface of the pipe as a result of corrosion or corrosion control treatment. Scale may result from precipitation of a constituent present in the water, such as calcium carbonate ($CaCO_3$), or from the interaction of the metal and the water during passivation. Scales may be very thin and uniform over the surface of the pipe, or they may be relatively thick, thereby decreasing pipe diameter and increasing roughness.

corrosion treatment Treatment to minimize the loss of metal from the pipe or appurtenance, the uptake of the metal by the water during delivery to consumers, or both. Two general corrosion treatment approaches exist: precipitation and passivation. Precipitation involves forming a precipitate in the potable supply that deposits onto the pipe wall to create a protective coating. Passivation involves causing the pipe material and the potable supply to interact in such a way that metal compounds are formed on the pipe surface, creating a film of less soluble material.

corrosive Tending to deteriorate material, such as pipe, through electrochemical processes.

corrosivity An indication of the corrosiveness of a water. The corrosiveness of a water is described by the water's pH, alkalinity, hardness, temperature, total dissolved solids, dissolved oxygen concentration, and Langelier saturation index. *See also* corrosion index; Langelier saturation index.

cosmic-ray-produced nuclides Isotopes, usually radioactive, such as tritium, beryllium-7, and carbon-14, formed by high-energy space particles (e.g., electrons and nuclei) or cosmic rays, interacting with certain atmospheric and terrestrial elements.

cosmic water Water that comes in from space with meteorites.

cost allocation The procedure for classifying or assigning the costs of service to functional cost components for subsequent distribution to respective customer classes. This process is used as part of rate setting, helping to ensure that customers are charged according to their contribution to the costs of providing water service.

cost–benefit analysis *See* benefit–cost analysis.

cost–benefit ratio *See* benefit–cost analysis.

cost of capital The long-term cost of borrowing to a water utility (expressed as a percent). For a not-for-profit utility, the cost of capital is usually the average interest rate (weighted by size) for all outstanding bond issues. For a for-profit utility, the cost of capital is usually calculated as the weighted average (in proportion to balance sheet accounts) of both long-term debt and equity (stock) used to fund the capital requirements. The cost of capital is generally in the 5 to 10 percent range, depending on the amount of inflation in the interest rate; the required return on equity is generally in the 10 to 15 percent range, which is the expected stockholder's return on invested capital. *See also* rate of return; return on investment.

cost of debt The effective rate that a water utility pays on its total debt. The amount is determined by taking the weighted average cost of outstanding debt securities. It is also known as the embedded cost of debt. The cost of each security should include issuance expenses, discounts/premiums, and coupon payments. Under most circumstances, only long-term debt is used in the embedded debt-cost determination.

cost of service The total cost of providing any service, such as drinking water, to customers.

cost-of-service analysis A process of determining how to assign costs to various groups of customers for services provided. The purpose of a cost-of-service analysis is to determine an equitable basis for allocating the costs of providing water to those who receive the service. Fairness requires allocation of costs among customer groups commensurate with their service requirements for total volume of water, peak rates of use, location, and other factors. The base–extra-capacity approach to rate structure design is one method of allocating the cost of service. *See also* base–extra-capacity approach to rate structure design.

cost-of-service rate analysis Analysis of the cost of providing service to a customer or group of customers for the purpose of establishing water rates and/or water rate structures. *See also* cost allocation.

cost sensitivity analysis An evaluation of the cost impact from the utilization of alternative assumptions about prices of inputs, efficiencies of input use, or comparison of alternative processes.

cost sharing A publicly financed program through which society, as the beneficiary of environmental protection, shares part of the cost of pollution control with those who must actually install the controls.

coulomb (C) *See in the Units of Measure section.*

coulombs per kilogram (C/kg) *See in the Units of Measure section.*

coulometric cell An apparatus used in a coulometric titration. It consists of a sealed vessel containing a sample and two electrodes. One of the electrodes

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generates a reagent that reacts with the analyte; the second electrode completes the circuit.

coulometric titration A titration method measuring the quantity of electricity passed during an electron exchange involving the substance being determined.

Council on Environmental Quality (CEQ) A three-member council appointed by the president of the United States that formulates and recommends national policies to the president to promote improving the quality of the environment.

countercurrent efficiency The advantage of a granular activated carbon (GAC) adsorber in permitting partially spent GAC to adsorb impurities before the semiprocessed stream comes in contact with fresh GAC. This allows the maximum capacity of the GAC to be used.

countercurrent flow *See* countercurrent operation; upflow.

countercurrent operation The operation of two components of a unit process in a manner such that they flow in opposite directions. For example, injecting a feed gas into a vessel in the opposite direction as the fluid flow or sludge flowing in the opposite direction to water are countercurrent operations.

countercurrent regeneration Regeneration of an ion-exchange resin such that the flow of the regenerant across the resin during regeneration is in the opposite direction of the flow of the process stream during exhaustion of (or treatment with) the resin. *Contrast with* cocurrent regeneration. *See also* regeneration.

counterion An ion of opposite charge with respect to another ion.

counts per minute (cpm) *See in the Units of Measure section.*

coupling (1) A device to connect the ends of two pipes. (2) A compression fitting to attach the ends of service pipe or tubing. (3) A steel or cast-iron sleeve with a gasket and retainer glands on each end bolted together across the sleeve to apply compression against the ends of two connecting water mains.

coupon A piece of metal or other material used to evaluate the rate of corrosion or deterioration caused by exposure to the water of interest. *Coupon* is a broad term and may include a length of pipe from the water distribution system or a specially prepared, preweighed pipe segment used in pipe loop testing. Coupons may be visually inspected, weighed to determine metal loss, chemically tested to determine scale composition, physically measured to determine depth of pits, or subjected to a variety of other tests including X-ray diffraction and scanning electron microscopy.

coupon bond A security that has no identification as to owner. It is presumed to be owned by the bearer of the bond. Such bonds are no longer issued since Congress required full registration of all new issues as of July 1, 1983. Notes are still bearer designated.

coupon rate The interest rate specified on interest coupons attached to a bond. The coupon rate is also called the nominal interest rate.

coupon test A method of determining the rate of corrosion or scale formation by placing metal strips (coupons) of a known weight in the pipe.

covalent bond A type of chemical bond in which electrons are shared. *See also* ionic bond.

cover (1) The depth of earth material from the top of a water main to the ground surface to prevent freezing of the water in the pipe. (2) The roof, fixed or flexible, over a reservoir in the distribution system.

coverage ratios The margin of safety ratios associated with bonded indebtedness and preferred stocks, reflecting the ratio of the actual or projected net revenue available for debt service or other costs. These ratios range from debt-service coverage of principal and interest, to interest only, to all fixed charges, including preferred stock dividends and lease payments. Coverage may be expressed as a ratio or as a percentage. Minimum attained ratios are often specified as part of a bond issue's covenants as a form of protection for investors.

cover crop A crop that provides temporary protection for delicate seedlings and/or provides a canopy for seasonal soil protection and improvement between normal crop production periods. Except in orchards where permanent vegetative cover is maintained, cover crops usually are grown for one year or less. When plowed under and incorporated into the soil, cover crops are also referred to as green manure crops.

covered storage A water reservoir or tank that is enclosed, including bottom, sides, and top, to prevent contamination.

***Coxiella burnetii* (*C. burnetii*)** Gram-negative, intracellular bacterium that causes Query (Q) fever in humans and animals. Q fever is an acute febrile disease characterized by sudden onset, chills, headache, weakness, malaise, severe sweats, pneumonitis, pericarditis, hepatitis, and generalized infections. Up to half of infections are asymptomatic, and fewer than l percent of cases result in fatality. Transmission is commonly by airborne dissemination in dust from contaminated premises (airborne organisms may be carried more than 0.5 mile downwind), by direct contact with infected animals and their birth products (especially sheep), wool from sheep, straw, fertilizer, and laundry of exposed persons. Raw milk from infected cows has been responsible in some cases.

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coxsackie virus An *Enterovirus* classified as a picornavirus, about 20 to 30 nanometers in diameter, containing single-stranded ribonucleic acid. Humans appear to be the only natural host. Coxsackie viruses have been implicated in a variety of diseases, from common-cold symptoms to aseptic meningitis and pericarditis to fatal myocarditis of the newborn. Twenty-four group A and six group B serotypes can be distinguished by type-specific antigens on the virion surface.

CP *See* cathodic protection; concentration polarization.

CPE *See* comprehensive performance evaluation; cytopathic effect.

C. perfringens *See Clostridium perfringens.*

cpm *See* counts per minute *in the Units of Measure section.*

C. polyspora *See Crenothrix polyspora.*

CPR *See* cardiopulmonary resuscitation.

cps *See* cycles per second *in the Units of Measure section.*

CPSC *See* Consumer Product Safety Commission.

C. psittaci *See Chlamydophila psittaci.*

CPU *See* central processing unit.

cpu *See* cytopathic unit *in the Units of Measure section.*

cpu (also Co-Pt unit) *See* color unit *in the Units of Measure section.*

CPVC *See* chlorinated polyvinyl chloride.

C. raciborskii *See Cylindrospermopsis raciborskii.*

crack *See* filter crack.

cradle (1) One of a series of piers supporting a pipe laid above or below ground, spaced so that the pipe itself furnishes its own structural bridge. (2) A continuous concrete bed placed in the bottom of a trench to support and partially envelop a pipe, particularly where the trench is in soft ground or where bearing support is inadequate to carry the load of pipe and backfill material.

cradle-to-grave management Requirement of the Resource Conservation and Recovery Act (RCRA) that hazardous waste be handled in a manner that does not endanger human health and that minimizes the possibility of the waste being released into the environment. This responsible handling has to be documented by the generator of the waste, the hazardous waste transporter, and the treatment, storage, or disposal facility that receives the waste. This is termed cradle-to-grave management of the waste. Laboratories will generally be generators of hazardous waste. They are required to store the wastes properly, limit the amount of wastes stored, obtain an US Environmental Protection Agency identification number, have wastes transported or treated by authorized persons, keep records of hazardous wastes generated, and submit reports to the US Environmental Protection Agency. Some of these requirements are less stringent for generators of small amounts of hazardous wastes stored for short periods of time.

crank-and-flywheel pump A steam-driven reciprocating pump with a crankshaft on which a flywheel is mounted for storing energy during the early part of the stroke and imparting it to the liquid piston or plunger during the latter part of the stroke after the steam is cut off in the steam cylinder.

created wetland A persistent upland or shallow water area converted into a wetland through human activity.

creation Actions performed that establish nontidal wetlands on upland sites.

creek (1) A small stream of water that serves as the natural drainage course for a drainage basin of small size. The term is a relative one as to size; some creeks in a humid region would be called rivers if they occurred in an arid region. (2) A small tidal channel through a coastal marsh. (3) The short arm of a stream.

creep The movement of water under or around a structure built on permeable foundations. *See also* piping.

Crenothrix polyspora (C. polyspora) Filamentous, sheathed, iron bacteria that are considered nuisance bacteria because the slimes they produce create problems in water treatment and distribution systems, particularly in waters for industrial use, such as cooling and boiler waters. They metabolize reduced iron in their environment and deposit it as hydrated ferric oxide on or in their mucilaginous secretions.

cresol red An acid–base indicator dye. The color of the solution changes as the pH changes: pH 2–3, orange or amber; pH 7.2, yellow; pH 8.8, red.

crest (1) The top of a dam, dike, spillway, or weir, to which water must rise before passing over the structure. (2) The highest elevation reached by floodwaters flowing in a channel.

crest control A control method in which a device on the crest of the spillway of a dam is used to raise or lower the crest when variations in flow of the stream occur. The device may consist of flashboards, a radial drum, a tilting gate, or a bear-trap crest.

crest gate A gate installed on the crest of the spillway of a dam, operated to vary the discharge over the spillway.

crevasse A break in a levee through which floodwater discharges.

CRFM model *See* comparative risk framework methodology model.

cribiform plate A plate that is perforated like a sieve.

crib weir A low diversion weir built of log cribs filled with rock.

crisis communication The methods and activities used to manage relationships with internal and external audiences during a temporary interruption in normal agency operations, such as a natural disaster or system

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failure, as well as when there are accusations of mismanagement or other personnel issues.

crisis management Steps taken to solve problems during an emergency or unexpected situation. Generally accomplished through the use of preplanned emergency procedures.

crisis response chart An emergency planning tool to show alternate job duties in an organization in times of an emergency or disaster.

critical asset A facility or system that is determined to be of high importance in carrying out the mission of the utility (such as treatment plants and primary reservoirs).

critical bed depth The depth of granular activated carbon (GAC) that is partially spent in a GAC adsorption bed. This depth lies between the fresh GAC and the spent GAC, defining the zone where adsorption takes place to the extent required to reach a selected effluent concentration target. The zone defined by this depth is equal to or less than the mass transfer zone, depending on the target removal. The critical bed depth is sometimes simply called the critical depth. *See also* mass transfer zone.

critical coagulant concentration The coagulant concentration that produces the best settled water quality.

critical depth (1) The depth of water flowing in an open channel or partially filled conduit corresponding to one of the recognized critical velocities. (2) *See* critical bed depth. *See also* critical velocity.

critical-depth discharge measurement A determination (by indirect measurement) of peak discharge following a flood based on a field survey of high-water marks and channel and control-section geometry. The discharge is computed on the basis of critical flow (flow at minimum energy) theory.

critical drawdown period A parameter associated with the water supply characteristics of a lake or reservoir, equal to the length of time between the beginning of reservoir drawdown and the time when the lowest useful water surface elevation has been reached.

critical drought The design drought, or drought of record, for a surface water impounding reservoir or lake.

critical flow condition The state of flow at which the specific energy is a minimum for a given discharge. In equation form,

$$V_c = \sqrt{gD_c}$$

Where (in any consistent set of units):

V_c = critical velocity
g = gravitational constant
D_c = hydraulic depth = A_c/B_c
A_c = cross-sectional area of the flow
B_c = surface width of the open channel

For a rectangular channel,

$$V_c = \sqrt{gY_c}$$

Where (in any consistent set of units):

Y_c = critical water depth

See also Belanger's critical velocity; critical velocity; specific energy.

critical gradient (1) The channel slope for a given discharge where flow and critical flow occur at the same depth of flow. (2) The minimum grade of a conduit that will produce critical flow.

Critical Infrastructure Protection Advisory Group (CIPAG) Group established by the Association of Metropolitan Water Agencies to coordinate efforts within the water sector to address protection of the nation's water and wastewater infrastructure from both physical and cyber threats.

critical level A reference line representing the level of the check valve seat within a backsiphonage control unit. It is used to establish the height of the unit above the highest outlet or flood level rim.

critical micelle concentration (CMC) The surfactant concentration at which monomers begin to assemble in ordered, colloidal aggregates (micelles). At surfactant concentrations less than a compound-specific threshold value, surfactant molecules exist predominantly in monomeric form, with some fraction being adsorbed at system interfaces.

critical moisture content For a saturated soil, the moisture content at which—when a sample is subjected to shear (either confined or unconfined specimens)—the tendency of the sample is neither to expel nor to suck in water.

critical point drying A procedure used in preparing specimens for scanning electron microscopy. It eliminates forms of distortion such as shrinkage and wrinkles that ordinarily might occur if a specimen is air dried. *See also* scanning electron microscopy.

critical pressure The minimum pressure necessary to liquefy a gas that is at critical temperature.

critical resonance frequency size The chemical effects of sonolysis on organic matter by ultrasonic irradiation are a direct result of the formation of cavitation microbubbles. The sonolysis induces the formation of cavitation microbubbles with each successive ultrasonic frequency until the bubbles reach a critical resonance frequency size, resulting in their violent collapse. The rapid implosion of cavitation bubbles creates a thermal dissociation to yield extremely reactive radicals. *See also* cavitation; radical; sonolysis.

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critical slope *See* critical gradient.

critical temperature The temperature above which a gas cannot be liquefied solely by an increase in pressure.

critical velocity The velocity in an open channel for which the flow reaches the critical flow condition. This critical velocity is equal to the velocity at which a long wave of low amplitude propagates itself in water with a depth equal to the critical depth. *See also* Belanger's critical velocity; critical depth; critical flow condition.

CRM *See* customer relations management.

crop coefficient (K_c) A factor used to adjust reference evapotranspiration and calculate water requirements for a given plant species.

crop rotation A system of farming in which a regular succession of different crops are planted on the same land area, as opposed to cultivation of the same crop time after time (monoculture).

crop water requirement (CWR) The amount of water required to grow a specific crop, usually expressed as a depth of water in inches or feet.

cross A pipe fitting with four branches arranged in pairs, with each pair forming one axis and the axes at right angles.

crossbrace A horizontal member of a shoring system installed across to the sides of the excavation, the ends of which bear against either uprights or wales.

cross-connection The physical connection of a safe or potable water supply with another water supply of unknown or contaminated quality or such that the potable water could be contaminated or polluted.

cross-connection control The enforcement of an ordinance or other legal statement regulating cross-connections.

cross contamination (1) Contamination that occurs in a mixed bed deionizer unit when anion and cation resins are mixed together after regeneration as a result of a system malfunction. (2) The intermixing of two water streams that results in unacceptable water quality for a given purpose.

crossflow (1) An operating condition, in some types of pressure-driven membrane water treatment processes, where the feedwater and resulting concentrate or retentate pass tangentially across the surface of the membrane and the permeate passes in a perpendicular direction through the membrane barrier. With hollow-fiber membranes, crossflow commonly means that pressurized feed passes tangentially through the inner lumen of the membrane fibers and that the permeate flow direction is inside out, or lumen to shell side (opposite the permeate flow direction, as in a transverse-flow hollow-fiber membrane). (2) Flow that is at right angles to an inclined plate settler. *See also* hollow-fiber membrane; inclined plate settler; transverse flow.

crossflow filtration A type of filtration that uses the shear force of tangential flow across the membrane surface (during suspension recirculation) to keep the particle buildup to a minimum. However, particle boundary layers cannot be completely eliminated by a crossflow of low fluid velocity that exists at the membrane surface. Ultrafiltration and reverse osmosis are examples of crossflow filtration. Crossflow filtration is also called tangential flow filtration. *See also* normal flow filtration.

crossing (1) The portion of a river between two bends, in one of which the flow is clockwise and in the other the flow is counterclockwise. (2) The relatively short and shallow length of a river between bends. (3) In rivers, flow over a shoal or bar between successive bendways.

cross leakage (1) Water leakage between the demineralized and concentrate streams in a membrane stack used in the electrodialysis process. (2) In an electrodialysis process, the permeation of water through the membrane from the concentrate stream to the demineralized stream in the membrane stack.

cross-linkage The bonding of linear polymers into a resinous product. Cross-linking with a material such as divinylbenzene produces a tridimensional exchanger product. The degree of cross-linkage is a factor of the resin's ability to withstand chemical oxidation. Standard softening resin is usually 8 percent cross-linked with divinylbenzene. Anion resins can be from 2 percent to 8 percent cross-linked. Acrylic compounds can also be used instead of divinylbenzene for cross-linking. *See also* cross-linking; polymer.

cross-linked Pertaining to chains of polymer molecules attached by cross-linking.

cross-linking The attachment of two chains of polymer molecules by bridges composed of either an element, a group, or a compound that join certain carbon atoms of the chains by primary chemical bonds. Cross-linking increases the chains' strength, chemical resistance, or both. Cross-linking is used in the manufacture of some types of ion-exchange resins and polyamide composite membranes. Cross-linking also occurs in nature, for example, in substances made up of polypeptide chains that are joined by the disulfide bonds of the cystine residues, as in certain proteins. Cross-linking can be effected artificially, either by the addition of a chemical substance (cross-linking agent) and exposing the mixture to heat or by subjecting the polymer to high-energy radiation (e.g., vulcanization of rubber with sulfur or organic peroxides). *See also* polymer; protein.

cross multiplication A method used to determine if two ratios are in proportion. In this method, the

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numerator of the first ratio is multiplied by the denominator of the second ratio. Similarly, the denominator of the first ratio is multiplied by the numerator of the second ratio. If the products of both multiplications are the same, the two ratios are in proportion to each other.

cross section A plane that is perpendicular to an axis, such as the axis of flow.

cross-sectional area The area of a plane in a tank or vessel that is at a right angle to the direction of the flow. The cross-sectional area is expressed, for example, in square feet or square meters.

cross-sectional bed area The area of activated carbon in a filter bed through which the stream flow is perpendicular.

cross-sectional epidemiologic study An analytical epidemiologic study in which information about disease status and exposures relate to the same period of time. The time sequence between exposure and disease status cannot necessarily be inferred.

crown The top of a levee, embankment, roadway, or pipe.

crown gate A canal-lock head gate.

crude mortality rate *See* death rate; crude rate.

crude rate A measure of morbidity and mortality computed for the whole population. A crude rate does not take into account population characteristics (confounding variables)—such as age, race, or gender—that may also affect morbidity or mortality; this feature is a disadvantage. Crude rates should not be used to compare populations in different geographic areas or time periods. Rates should be standardized, or specific rates should be computed; e.g., age-specific rates can be compared for the various age groups. *See also* standardized mortality rate; standardized rate.

Crustacea Aquatic arthropods having a body covered with a hardshell or crust, such as lobsters, shrimps, crabs, and barnacles.

cryptosporidiosis A protozoan infection (via *Cryptosporidium* spp.) of the epithelial cells of the gastrointestinal, biliary, and respiratory tracts of humans and other vertebrates, including birds, reptiles, rodents, cats, dogs, sheep, and cattle. In humans, the average incubation period is 7 days and the infectious dose is low. The primary symptom is profuse, watery diarrhea with cramping abdominal pain, but infection is often asymptomatic. In immunologically healthy individuals, symptoms usually end in 30 days; however, immunocompromised persons, especially AIDS patients, may be unable to clear the infection and illness may be prolonged, contributing to death. Cryptosporidiosis occurs worldwide, with children, animal handlers, people who have close personal contact with infected persons, and travelers most likely to be infected. Person-to-person transmission occurs by hand-to-mouth transfer of oocysts from feces of an infected person, especially in institutions and day-care centers. Animal-to-person contact and waterborne transmission are also important. In 1993, contamination of the Milwaukee, Wis., water system caused more than 400,000 cases of this disease; over 1,000 people were hospitalized. *See also Cryptosporidium;* oocyst; waterborne disease.

Cryptosporidium A widespread intestinal coccidian protozoan parasite about 3.5 micrometers in diameter, causing diarrhea and capable of infecting humans, birds, fish, and snakes. It is responsible for waterborne disease outbreaks.

***Cryptosporidium* inactivation device (CID)** An ultraviolet unit specifically designed to inactivate *Cryptosporidium* oocysts. It consists of two chambers, each with a nominal 2-micrometer pore diameter filter and three 85-watt low-pressure mercury lamps. The oocysts are captured on the first filter, and the ultraviolet dose is established. The oocysts are then backflushed into the second chamber, where they are trapped until properly irradiated.

crystallizer An evaporator used to concentrate salts, producing crystalline solids. Commonly, feed salt is combined with recirculating brine and passes to a shell-and-tube heat exchanger for heating and subsequent discharge to a vortex chamber, where evaporation takes place and crystals form. The remaining brine is recirculated. Crystallizers are sometimes used in zero-discharge wastewater treatment facilities and for concentrate disposal in some small-scale desalting systems. *See also* zero discharge.

CSA *See* Canadian Standards Association.

CSE *See* copper–copper sulfate electrode.

CSEP *See* consecutive system entry point.

CSHO *See* compliance safety health officer.

CSI *See* calcite saturation index.

CSR *See* customer service representative.

CST *See* capillary suction time.

CSTR *See* continuously stirred tank reactor.

CT *See* contact time.

C* × *T The product of disinfectant concentration (in milligrams per liter) determined before or at the first customer and the corresponding disinfectant contact time (in minutes). It is also called the *CT* value and also designated as *CT* or $C \bullet T$. Units are milligram minutes per liter. *See also* $C \times T_{99.9}$.

***C* × $T_{99.9}$** The $C \times T$ value required for 99.9 percent (3-log) inactivation of *Giardia lamblia* cysts. These values appear for a variety of disinfectants and conditions in Tables 1.1–1.6, 2.1, and 3.1 of Section 141.74(b)(3) in the *Code of Federal Regulations*. Units are milligram minutes per liter.

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CTA *See* comprehensive technical assistance.

CTA membrane *See* cellulose triacetate membrane.

cu *See* color unit *in the Units of Measure section.*

cubature The cubic content or volume of tidal water as determined by computing the discharges and average currents of a cross section of a waterway from the tidal rises and falls upstream of the section. Cubature is essentially the arithmetic integration of the equation of continuity.

cube One cubic foot (0.028 cubic meters) of cation resin or filter medium.

cubic feet (ft^3) *See in the Units of Measure section.*

cubic feet per hour (ft^3/h) *See in the Units of Measure section.*

cubic feet per minute (ft^3/min, CFM, cfm) *See in the Units of Measure section.*

cubic feet per second (ft^3/s, CFS, cfs) *See in the Units of Measure section.*

cubic inch ($in.^3$) *See in the Units of Measure section.*

cubic meter (m^3) *See in the Units of Measure section.*

cubic spline A mathematical procedure to draw a smooth line through a series of observational data. A cubic spline can be roughly defined as a running interpolation of cubic polynomials.

cubic yard (yd^3) *See in the Units of Measure section.*

culture The growth of living microorganisms in a medium.

cultured enterocytes Specialized intestinal epithelial cells (e.g., Caco-2 cells).

culture medium A nutrient substance used to grow (culture) microorganisms. It may be a liquid (broth) or a solid medium made by adding agar as a solidifying agent.

culture tube A hollow, slender glass tube with an open top and a rounded bottom used in microbiological testing procedures such as the multiple-tube fermentation test.

culvert (1) A closed conduit for the free passage of surface drainage water under a highway, railroad, canal, or other embankment. (2) In highway usage, a bridge waterway structure having a span of less than 20 feet (6.1 meters).

culvert flow discharge measurement A determination (by indirect measurement) of peak discharge following a flood based on a field survey of high water marks and channel and culvert geometry. Discharge is computed on the basis of an evaluation of energy changes between the approach section and the control section.

cumulative data function A data function that determines the cumulative or integrated value of dependent variable *y* for a given value of the independent variable *x*.

cumulative effects (1) Effects that are irreversible or slowly reversible such that repeated exposure to a chemical or infectious agent leads to increasing severity of an adverse health effect. The chemical can be in the system for a very short time. (2) Health effects that can arise from the accumulation of a toxic form of a chemical in a tissue with repeated exposure. By definition, the chemical is poorly eliminated from the tissue.

cumulative exposure The summation of exposures of an organism to a chemical over a period of time.

cumulative impact analysis A review of the cumulative economic, environmental, and social impacts of proposed water activities and projects associated with development within a drainage area or ecosystem.

cumulative runoff The total volume of runoff over a specified period of time. Successive summations are frequently plotted against time to produce a mass curve. *See also* mass diagram.

cumulose deposit A deposit formed from the accumulation of organic matter, with small amounts of rock waste included.

cuprichloramine A mixture of copper sulfate ($CuSO_4 \cdot 5H_2O$), ammonia (NH_3), and chlorine (Cl_2), used as an algicide.

cupric hydroxide ($Cu(OH)_2$) A blue, water-insoluble powder. Cupric hydroxide is a copper corrosion byproduct frequently associated with drinking water distribution system materials. It is predicted to be a copper solubility controlling solid in newly installed copper plumbing systems.

cupric sulfate *See* copper sulfate.

cuprite (Cu_2O) Copper(I) oxide. A maroon corrosion product of copper and copper alloys, typically found in the layer closest to the pipe wall. It often forms a protective layer in copper tubing, preventing further corrosion. When associated with copper pitting corrosion, cuprite crystals have a distinct cubic crystal habit.

CUR *See* activated carbon usage rate.

curb A precast concrete liner for a dug well.

curb cock *See* curb stop and box.

curb inlet An intake structure to allow stormwater to enter a storm sewer from a roadway gutter. It is configured to the shape of the curb and gutter to provide for easy installation and efficient operation. *See also* catch basin.

curb stop *See* curb stop and box.

curb stop and box A shutoff valve in a water service line buried near the curb of a customer's premises, with a box or housing over the valve extending to the surface of the ground for access to the valve.

cured-in-place lining A cement–mortar mixture applied to the interior of steel or iron pipe water mains after they have been installed. The lining is spun onto the interior by centrifugal force and then worked with

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a cone-shaped trowel or spiral rotating trowel to smooth the surface of the lining. The lining can be applied to either new or old unlined pipe after that pipe has been scraped and cleaned.

curie (Ci) *See in the Units of Measure section.*

curing time (for residuals) The period of time required, following treatment, for residuals to be suitable for ultimate disposal.

current The speed of electrical charge movement, or the "flow rate," of electricity, measured in amperes. *See also* Ohm's law.

current annual real losses (CARL) The volume of water lost from reported leaks, unreported leaks, background losses, and operator error (storage tank overflows, inadvertently open drain valves) during the water audit reporting period. The ratio of the CARL to the unavoidable annual real losses (UARL) is the infrastructure leakage index (ILI), a powerful performance indicator for benchmarking leakage performance among water utilities. *See also* infrastructure leakage index; unavoidable annual real losses.

current density As used in desalting, amperage per unit area flowing through a stack; current flow through a stack per unit cross-sectional area.

current density units *See in the Units of Measure section.*

current diagram A graphic representation showing the velocities of flood and ebb currents and times of slack and strength over a considerable stretch of the channel of a tidal waterway. The times relate to the tide or current phases at some reference station.

current difference The difference between the time of slack water or strength of current in a locality and the time of the corresponding phase of the current at a reference station for which predictions are given in a current table.

current efficiency In desalting processes, the theoretical power required for a particular job outcome compared to (i.e., divided by) actual power consumed.

current meter A water-measuring device that uses the velocity of water flowing through the device to turn a turbine wheel, which in turn reflects the volume of water passing through the device.

current-meter rating The operation of developing for a given current meter the relationship between the revolutions of its wheel or screw per unit of time (usually 1 minute) and the velocity at which the meter travels through still water. With such a relationship established in graphical, algebraic, or tabular form, the velocity of water passing the meter when it is held in a stationary position can be determined.

current pole A pole used in observing the direction and velocity of water current. The standard pole used by the US Coast and Geodetic Survey is about 3 inches (76 millimeters) in diameter and 15 feet (4.6 meters) long and is weighted at one end to float upright with roughly the top 1 foot (0.3 meters) out of the water. As the pole is carried by the current out from an observing vessel, its direction and the amount of line passing over a fixed reference point during a specified interval indicate the direction and velocity of the current.

current regulator A device that automatically holds electric current within certain limits.

current span The amount of electric current moving through a pipe, calculated based on a measurement of the difference in voltage between two locations along the pipeline.

current table A table that gives daily predictions of the times of slack water and of the times and velocities of the flood and ebb maximums, usually supplemented by current differences and constants by which additional predictions can be obtained for other places.

curtain A wall or diaphragm of concrete or steel, or a trench filled with clay slurry or impervious earth, extending into the foundation of a dam or levee and either making a watertight connection with the dam or its impervious facing or extending into the body of the dam a considerable distance. Its purpose is to prevent or reduce the passage of water under the dam and the foundation material or through the upper layers of the foundation material. A curtain is sometimes called a cutoff.

curtain drain A drain constructed at the upper end of an area to be drained to intercept surface water or groundwater flowing toward the protected area from higher ground and carry it away. A curtain drain is also called an intercepting drain.

curtain wall A deep cutoff wall used under an overflow masonry dam on pervious foundations to stop underflow by lengthening the path of travel of underflowing water and thereby providing resistance to seepage greater than the hydrostatic head of the water impounded by the dam.

curvature factor A numerical quantity used to express the energy loss caused by one or more sharp curves in a pipeline in terms of the velocity head of water flowing in the line.

curve (1) A graph representing the changes in value of physical or statistical quantities. (2) A continuous bending.

curve fitting A mathematical procedure to develop an equation defining a series of observations. Curve fitting is often performed by the method of least squares to define the parameters of the assumed equation to best describe the observations.

CUSA *See* certified utility safety administrator.

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customer accounting system A computer software program that manages customer accounts including addresses, contacts, and financial, consumption, and, in some cases, relational attribute data such as tap sizes and location information.

customer classification The grouping of customers into homogeneous classes (typically, residential, commercial, and industrial) for rate-making and other purposes. A utility may break these down into more specific groups, such as subdividing the residential class into single-family residential and multi-family residential classes. The industrial class may also be split into small industry, large industry, and special. Other special classifications may include hospitals, universities, military establishments, and wholesale water districts.

customer costs Costs that relate to serving customers irrespective of the amount or rate of water use.

customer information system (CIS) A system that manages, processes, and controls information for each utility customer, the customer's premises, the individual facilities that serve that customer, water usage, and accounting. The system supports and controls interactions with the customers, most notably meter reading and billing.

customer meter inaccuracies A major component of apparent losses, as specifically defined in the International Water Association/American Water Works Association (IWA/AWWA) water audit method. Meter inaccuracy can occur because of meter wear, improper sizing or installation, aggressive water, and other causes. Such conditions result in an apparent loss because of the understated volume registered and a loss of a portion of the revenue to which the water utility is entitled.

customer relations management (CRM) (1) A strategy used to learn more about customer needs and behaviors in order to develop stronger relationships with them. (2) Using the Internet for such applications as electronic billing and payment, customer self-service, account management, and customer needs and preferences. *See also* business-to-business site.

customer service All elements of providing water that meets all health standards to a consumer: delivery, sufficient pressure, measuring the amount delivered, billing at regular intervals, and communicating with the customer to understand service needs.

customer service representative (CSR) One of the personnel within a utility who are trained to answer questions from customers that range from billing to pressure problems and taste-and-odor complaints.

customer service system A system that develops and generates a response to customers' problems or inquiries.

cusum chart A chart produced from a statistical process control technique that allows systematic trends to be determined from data where simple presentation of raw data may hide an underlying pattern. In the case of filtration, the daily mean filtered water turbidity is calculated for each filter. The difference between this value and a target value is plotted against date. The target value may be a fixed turbidity target (e.g., 0.1 nephelometric turbidity units), the mean of all the daily values, or the mean turbidity achieved in the previous month. The cusum chart should show if the filters behave in a similar way if one or more consistently produces higher- or lower-turbidity water. A change in gradient of the cusum line may indicate a significant operating change. Cusums may be reset monthly, with the mean turbidity from the previous month from either the individual filter or the bulk filtrate set as the new target value. A statistician may use a V-mask to determine the point when the gradient changed.

cutaneous irritation An inflammatory response of the superficial cells of the skin.

cutin A waxy substance that, combined with cellulose, forms the plant cuticle, a substance nearly impervious to water that covers all surfaces of a plant. This hydrophobic coating could limit the sanitizing efficiency of washing or treating fruits and vegetables with sanitizers.

cut-in repair coupling A coupling designed with a middle ring, two sleeves, and end rings bolted together with gaskets, such that parts can be inserted in a small gap in a water main and then reconnected to cover the gap. This type of coupling is normally used where a bell on the pipe had to be removed to repair a leak near the joint.

cut-in valve A specially designed valve used with a sleeve that allows the valve to be placed in an existing main.

cutoff (1) A more direct channel, formed either naturally or artificially, connecting two points on a stream channel, shortening the original length of the channel and increasing its slope. (2) *See* curtain. (3) Water stop.

cutoff control valve A faucet or showerhead retrofit device that enables the user to shut off water flow (e.g., while shampooing) and restart it at the previous temperature.

cutoff ratio The ratio of the length of a cutoff to the original length of the river.

cutoff trench A trench excavated below the normal base of a dam or other structure and filled with relatively impervious material to reduce percolation under the structure.

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cutoff wall A thin wall or footing constructed downward from, under, or around the head wall and lip wall of a dam to provide resistance to seepage.

cutwater The angular edge of a bridge pier, shaped to lessen to the flow of water, ice, debris, and so on.

CWA *See* Clean Water Act.

CWIP *See* construction work in progress.

CWR *See* crop water requirement.

CWS *See* community water system.

CWSS *See* Community Water Supply Study.

cwt *See* hundredweight *in the Units of Measure section.*

CWUV light *See* continuous-wave ultraviolet light.

CWWA See Canadian Water and Wastewater Association.

cyanazine (C_2H_5NH-C_3N_3(Cl)-$NHC(CH_3)_2CN$) The common name for the herbicide 2-((4-chloro-6-(ethylamino)-*s*-triazin-2-yl)amino)-2-methylproprionitrile. *See also* herbicide.

cyanide (CN^-) An inorganic ion. Hydrogen cyanide (HCN) has various industrial uses, including use as a rodenticide or pesticide. Sodium cyanide (NaCN) is used in, for example, the extraction of gold and silver from ores, electroplating, and insecticides or fumigants. Cyanide's presence in drinking water (as free cyanide) is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.2 milligrams per liter. *See also* fumigant; insecticide; pesticide; rodenticide.

cyanobacteria Phylum of bacteria that are aquatic prokaryotic organisms that contain chlorophyll a, and so can undertake photosynthesis. These organisms were formerly and incorrectly called blue-green algae. Previously, it was thought that only plants could photosynthesize, and so these organisms were mistakenly categorized as primitive plants, or algae. Some of these organisms release odorous chemicals that are associated with tastes and odors in drinking water supplies, such as geosmin and 2-methylisoborneol, which exhibit earthy, musty odors. Some of the species produce cyanotoxins that are toxic to aquatic life. *See also* geosmin; 2-methylisoborneol; prokaryote.

cyanobacterial toxin Complex organic compounds produced by many types of cyanobacteria such as *Anabaena, Aphanizomenon,* and *Microcystis.* Toxins produced by *Anabaena* and *Aphanizomenon* are neurotoxins (affecting the nervous system) and those produced by *Microcystis* are hepatotoxins (affecting the liver).

cyanogen bromide (CNBr) A disinfection by-product formed during the ozonation or chloramination of bromide-containing waters. *See also* disinfection by-product.

cyanogen chloride (CNCl) A disinfection by-product formed in low levels during chloramination. It can also be produced during the chlorination of cyanide-containing waters, though alkaline chlorination will destroy the cyanogen chloride. Cyanogen chloride has an industrial use in tear gas. *See also* disinfection by-product.

cyanogen halide (CNX) A class of disinfection by-products produced primarily during chloramination. *See also* cyanogen bromide; cyanogen chloride.

cyanosis A dusty bluish or purplish discoloration of the skin or mucous membranes caused by insufficient oxygen delivery to tissues. One potential cause associated with drinking water is production of methemoglobinemia by excessive levels of nitrates (after conversion to nitrite) or chlorite.

cyber business Use of the Internet for recruiting employees, filling job vacancies, and procurement activities, including purchasing items and obtaining qualification of vendors and contractors, among many others.

cyber threat A malicious attack or threat of attack against a computer-operated system (such as SCADA systems and business networks) the intent of which may be to cause harm to the utility or to access information about the utility.

cycle In alternating current electrical systems, one complete change in direction of current flow from zero to maximum to zero in one direction, then to maximum and back to zero in the opposite direction.

cycle of fluctuation The total time occupied by a period of rise and a succeeding period of decline of a water table. The most common kinds of cycles are daily, annual, and secular (or cycles extending over longer periods). A cycle of fluctuation is also called a phreatic cycle.

cycles of concentration The number of times an initial solids concentration in a liquid is increased by removal of liquid volume (and weight), thus increasing the solids. For example, if water has a solids concentration of 500 milligrams per liter and is evaporated to half the original liquid volume, the solids concentration becomes 1,000 milligrams per liter, or twice the original concentration. If the water is evaporated to one fourth of its original liquid volume, the solids concentration becomes 2,000 milligrams per liter, or four times the original concentration. For boiler water applications, the number of cycles of concentration is the ratio of circulating water solids concentration to makeup water solids concentration. The number of cycles of concentration for boiler water is controlled by the blowdown rate of the circulating water from the system and makeup water quantity and quality; it is limited by the solubility of solids in the system and the use of chemical additives (e.g., acid, scale inhibitors). To reduce the cycles of concentration, the

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blowdown rate is increased; to increase the cycles of concentration, the blowdown rate is reduced. *See also* blowdown.

cycles per second (cps) *See in the Units of Measure section.*

cyclic depletion Withdrawal of water at a rate in excess of the average rate of supply over a secular cycle. *See also* seasonal depletion.

cyclic peptide A class of organic compounds that have one or two closed rings and are composed of amino acid residues linked together with amide bonds. Some cyclic peptides have antibiotic properties. Another group of cyclic peptides, cyclic peptide hepatotoxins produced by certain cyanobacteria, can cause acute or chronic health effects in humans and animals and are a major concern to the water industry.

cyclic pressure rating The pressure rating obtained as the result of performance tests in accordance with ASTM D2992, procedure A. This conservative approach results in lower pressure ratings for pipes than static testing but is useful in comparing competitive products.

cyclic recovery The gradual rise in elevation of the water table caused by additions of water, usually extending over several years and following a period of cyclic depletion.

cyclic storage The accumulation in storage of water in a reservoir during one or several years of greater-than-average supply, the holding of such water for 1 or more years, and the releasing of it for use during a period of years when the supply would otherwise be insufficient. Cyclic storage is also called overyear storage.

cyclone degritter A centrifugal sand-and-grit removal device.

cyclone separator A conical unit used for separating particles by centrifugal force. It is also called a cyclone precipitator. *See also* hydroclone.

cyclonite ($C_3H_6O_6N_6$) The common name for the explosive symtrimethylene trinitramine; also known as RDX (royal demolition explosive).

Cyclospora A genus of protozoan organisms that are distributed worldwide. They infect both immunocompetent and immunosuppressed children and adults, causing explosive, watery diarrhea (usually self-limiting, even in immunosuppressed subjects), anorexia, fatigue, and weight loss. The organisms are thought to be waterborne with some seasonal incidence. *See also Cyclospora cayetanensis.*

Cyclospora cayetanensis (C. cayetanensis) A one-celled coccidian parasite distributed worldwide, related to *Cryptosporidium parvum.* It is similar to *Cryptosporidium* but with larger spores. Oocysts of *C. cayetanensis* are about 9 to 10 micrometers in size, about twice the size of *Cryptosporidium* oocysts. Sometimes found in foods and drinking water, the organism causes intestinal illness in both immunocompetent and immunosuppressed children and adults. *See also Cyclospora.*

cycrophilic *See* psychrophilic range.

cylinder A metal container to hold pressurized gas, such as chlorine for disinfecting in water.

cylinder gate A gate installed in a dam to control the flow from a reservoir. It consists of a steel cylinder that is open at the top and bottom and has a balanced water pressure on the inside and outside surfaces. The cylinder forms a seat over the opening and closes it when seated.

cylinder valve *See* container valve.

cylindrospermopsin The toxin cylindrospermopsin is produced by the cyanobacteria *Cylindrospermopsis raciborskii, Aphanizomenon ovalisporum,* and *Umezakia natans.* Most common in tropical and arid zone water bodies, it has also been detected in North and South America, Europe, and New Zealand. The main mechanism of this toxin is believed to be inhibition of protein synthesis. Ingesting contaminated water or fish can cause hepatitis-like symptoms, kidney damage, and intestinal illness. The common presence of cylindrospermopsin in drinking water, particularly in tropical regions, poses a public health problem. Treatment techniques including chlorination, ozonation, and ultraviolet radiation have the ability to degrade cylindrospermopsin, but the formation of by-products may be of concern if they remain toxic.

Cylindrospermopsis raciborskii (C. raciborskii) First identified in New Zealand, this planktonic freshwater Cyanobacterium is becoming increasingly prevalent in water bodies worldwide. When found in large quantities, it can produce toxins that are hepatotoxic.

C. youngae *See Citrobacter youngae.*

cyst The infectious stage for *Giardia,* 7 to 10 micrometers long and refractile to light when viewed with a brightfield microscope. *See also* oocyst.

cysteine conjugate-lyase An enzyme that catalyzes the cleavage of chlorovinyl-cysteine conjugates on the cysteine ($HSCH_2CH(NH_2)COOH$) side of the sulfur atom, yielding several reactive metabolites (e.g., thioketenes) that can react with nucleophilic centers on proteins and nucleic acids. Researchers have proposed that this pathway is responsible for toxic and carcinogenic effects of trichloroethylene ($CHCl=CCl_2$) and tetrachloroethylene ($Cl_2C=CCl_2$) in the kidney.

cysticerci cysts *See* cysticercosis.

cysticercosis An infection caused by the pork tapeworm, *Taenia solium.* Infection occurs when the tapeworm larvae enter the body and form cysticerci.

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Tapeworm eggs are passed in the bowel movement of a person who is infected. These tapeworm eggs are spread through food, water, or surfaces contaminated with feces. This can happen by drinking contaminated water or food, or by putting contaminated fingers in the mouth. Once inside the stomach, the tapeworm egg hatches, penetrates the intestine, travels through the bloodstream, and may develop into cysticerci in the muscles, brain, or eyes.

cytochrome b_5 reductase A flavoprotein responsible for transferring electrons from nicotinamide-adenine dinucleodide phosphate to cytochrome b_5 to initiate the microsomal metabolism of foreign and endogenous chemicals.

cytochrome oxidase The terminal oxidase of the mitochondrial electron transport system. It is most generally studied as a complex of cytochromes a + a_3. The mitochondrial electron chain serves to transfer electrons from substrates to oxygen in a way that captures the energy in the form of adenosine triphosphate that can be used for cellular functions.

cytochrome P450 A family of hemeproteins that are localized in the smooth endoplasmic reticulum of cells (particularly the liver) and are thought to be responsible for the metabolism of chemicals foreign to the body. Many of these enzymes also have endogenous substrates that participate in a variety of cellular functions. The different isoforms of P450 have a wide variety of substrate specificities. Moreover, specific isoforms of P450 are frequently increased in concentration in response to exposure to a chemical. This may result in an increased or decreased toxic response to subsequent exposures to the chemical, depending on whether the P450 metabolizes the chemical to a more or less toxic form.

cytopathic Pertaining to cell death or morphological changes within a cell.

cytopathic effect (CPE) An effect consisting of morphologic alterations of host cells, usually resulting in cell death.

cytopathic unit (cpu) *See in the Units of Measure section.*

cytoplasm The protoplasm outside a cell nucleus.

cytosol The fluid matrix in the interior of cells. The internal constituents of a cell are said to be in the cytosol if they are not associated with the clearly particulate bodies within the cell (e.g., nucleus, mitochondria, peroxisomes, endoplasmic reticulum). Sometimes this definition is an operational one, depending on how the constituent distributes when cells are lysed and the contents analyzed by ultracentrifugation. The operational definition should not be confused with what occurs in vivo.

cytostome The mouth aperture (opening) of certain protozoa.

cytotoxic *See* cytotoxicity.

cytotoxic effects *See* cytotoxicity.

cytotoxicity Lethal injury to cells. In addition to compromising the function of the tissue or organ in which these cells occur, the repeated induction of cytotoxic effects in vivo can, through repeated activation of repair processes, contribute to the development of chronic and less reversible effects in a tissue (e.g., fibrosis, cirrhosis of the liver, cancer).

CZE *See* capillary zone electrophoresis.

CZMA *See* Coastal Zone Management Act.

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D

D *See* dalton *in the Units of Measure section.*

d *See* day *in the Units of Measure section.*

2,4-D *See* 2,4-dichlorophenoxyacetic acid.

da *See* deka *in the Units of Measure section;* darcy *in the Units of Measure section.*

DADMAC *See* diallydimethylammonium chloride.

DAF *See* dissolved air flotation.

daily flood peak The maximum mean daily discharge occurring in a stream during a given flood event.

daily flow The volume of water that passes through a plant in 1 day (24 hours). It is more precisely called daily flow volume.

dalapon (CH_3CCl_2COOH) The common name for 2,2-dichloropropionic acid. Dalapon is an herbicide regulated in drinking water by the US Environmental Protection Agency at a maximum contaminant level of 0.2 milligrams per liter.

dalton (D) *See in the Units of Measure section.*

dam A barrier constructed across a watercourse for the purpose of creating a reservoir, diverting water into a conduit or channel, creating a head that can be used to generate power, improving river navigability, or a combination of these goals. Dams are classed as fixed or movable and may be of such types as gravity, arch, earth, rock fill, or combinations.

dam site A location where the topographical and other physical conditions are favorable for the construction of a dam, or any site where a dam has been built, is being built, or is contemplated.

dam toe The downstream edge at the base of a dam.

dam top Usually a top of a roadway, a top or an earth top of a parapet, a top of a gate, a top of nonoverflow masonry, or a top of a spillway. Tops vary with dam design.

dangerous air contamination An atmosphere presenting a threat of death, injury, acute illness, or disablement caused by the presence of flammable or explosive toxic or otherwise injurious or incapacitating substances: (1) Dangerous air contamination caused by the flammability of a gas or vapor is defined as an atmospheric concentration of the gas or vapor greater than 10 percent of its lower explosive (lower flammable) limit. (2) Dangerous air contamination caused by a combustible particulate is defined as an atmospheric concentration greater than 10 percent of the minimum explosive concentration of the particulate. (3) Dangerous air contamination caused by the toxicity of a substance is defined as an atmospheric concentration immediately hazardous to life or health.

Daphnia A microscopic crustacean found in water. It is also known as a water flea.

***Daphnia* toximeter** Continuously running test system instrument that uses *Daphnia* (commonly known as water fleas) as a sensitive organism for monitoring water quality. The device detects harmful compounds by way of behavior analysis of *Daphnia.* If significant changes in movement occur, an alarm is sounded.

DAPI/PI *See* 4'6-diamidino-2-phenylindole/propidium iodide.

Darcian velocity *See* Darcy velocity.

darcy *See in the Units of Measure section.*

Darcy law An equation used to compute the discharge of water flowing through an aquifer. The law states that the discharge is equal to the product of hydraulic conductivity, cross-sectional area perpendicular to flow, and hydraulic gradient. It is the fundamental equation of motion used in nearly all groundwater computations.

$$Q = KA(\Delta h/\Delta l)$$

Where (in any consistent set of units):

Q = the flow
K = the hydraulic conductivity
A = the cross-sectional area perpendicular to the flow
Δh = the difference in hydraulic head
Δl = the length traveled

The term $\Delta h/\Delta l$ is called the hydraulic gradient.

Darcy velocity The velocity, or specific discharge, V, calculated by Darcy law, where Q is set equal to VA (velocity times cross-sectional area), so that the form of the Darcy law becomes:

$$V = -K(\Delta h/\Delta l)$$

Where:

V = Darcy velocity
K = the hydraulic conductivity
Δh = the difference in hydraulic head
Δl = the length traveled

See also Darcy law.

Darcy–Weisbach equation *See under* Darcy–Weisbach formula.

Darcy–Weisbach formula The formula for calculating friction-induced head loss in pipes is

$$h_L = f\left(\frac{L}{D}\right)\left(\frac{V^2}{2g}\right)$$

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Where (in any consistent set of units):

h_L = the head loss
f = the friction factor, dimensionless
L = the length of pipe
D = the diameter of the pipe
V = an average velocity
g = the gravitational constant

See also Swamee–Jain expression.

Darcy–Weisbach roughness coefficient The roughness coefficient (f) in the Darcy–Weisbach formula. It is dimensionless. *See also* Darcy–Weisbach formula.

dark repair An enzyme-mediated microbial process that removes and regenerates a damaged section of deoxyribonucleic acid (DNA) using an existing complementary strand of DNA. Dark repair refers to all microbial repair processes not requiring reactivating light.

D'Arsonval meter An electrical measuring device, consisting of an indicator needle attached to a coil of wire, placed within the field of a permanent magnet. The needle moves when an electric current is passed through the coil.

data annotation Textual annotation on a map or graphic display that is derived from a feature attribute or database element.

database (1) A large collection of data, organized so that it can be expanded, updated, analyzed, and retrieved rapidly for various uses; a specific grouping of data within the structure of a database management system that has been defined by a particular use, user, system, or program. The data are organized so that they can be expanded. A database consolidates many records that were previously stored in separate files so that a common pool of data records serves as a single central file for many processing applications. (2) A set of interrelated records that is stored on a computer, for direct access by multiple users for subsequent analysis. It is highly structured to minimize redundant data.

database management system (DBMS) A software package providing the ability to store and retrieve information.

data censoring method In statistics, a method to assess data in a population, even though some data may be outside the limits of the test. For example, a number, n, units are taken randomly from a population to determine if the population's failure rate is acceptable. In the typical test scenario, the units run a fixed time T to see if they survive or fail. The data obtained are called Censored Type I data. Another (much less common) way to test is to decide in advance to see exactly r failure times and then test until they occur. For example, 100 units could be put on test to see at least half of them fail. Then $r = 50$, but T is unknown until the 50th fail occurs. This is called Censored Type II data.

data collection unit (DCU) A device used in some automatic meter-reading systems to collect and collate data for input to the billing system.

data conversion The transformation of existing manual maps and data or other data such as charts to computer-readable format.

data dictionary A database that serves as a catalog containing information about map features or attributes. The catalog may define data file and element names, sources, accuracy, date of entry or update, and other characteristics of the data and their sources.

data dispersion (1) Dissimilarity between two sets of data. (2) The archaic term used by statisticians for variance. *See also* variance.

data flow diagram A tool used in conducting structured designs that illustrate the flow of data between processes in a system.

data format A specific order in which data are organized.

data handling error As specifically defined in the International Water Association/American Water Works Association (IWA/AWWA) water audit method, apparent losses caused by customer consumption and billing data errors. These apparent losses are caused by errors in the meter reading, data transfer, accounting, or archival function of customer consumption management.

data input The process of entering data into a computer. The task of entering graphic data often utilizes a scanning or digitizing process or both.

data layer A specific homogeneous facility, such as a water distribution network with all its appurtenances (valves, hydrants, and so forth), or utility mapped over base map data.

data mining (DM) model Statistical database technique to uncover hidden patterns and subtle relationships in data and to infer rules that allow prediction of future results.

data questionnaire A questionnaire organized to collect data from various processes, including water treatment plants and distribution systems.

data structure The organization of data in memory and its connection to specific items of information appearing in a set of data. Specific data structures are also used to facilitate manipulating and analyzing data. Basic types of data structure include files, lists, arrays, records, trees, and tables, each of which allows different operations to be performed on the original data.

dateometer A small calendar disk attached to motors and equipment to indicate the year in which the last maintenance service was performed.

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datum (1) An agreed-on standard point or plane of stated elevation, noted by permanent benchmarks on some solid, immovable structure, from which elevations are measured or to which they are referred. (2) Any position or element in relation to which others are determined, e.g., the horizontal control system used in mapmaking. (3) Any numerical or geometrical quantity or set of such quantities that may serve as a reference or base for other quantities.

datum line A line from which heights and depths are calculated or measured. It is also called a datum plane or datum level.

day (d) *See in the Units of Measure section.*

day tank A treatment chemical storage vessel that contains a diluted concentration in a feed volume suitable for a short period, typically from 1 to 3 days. For example, dry or viscous polymers are often diluted, or "aged," in day tanks prior to application. A day tank is also called an age tank. *See also* polymer aging.

dB *See* decibel *in the Units of Measure section.*

DBA *See* dibromoacetaldehyde.

DBAA *See* dibromoacetic acid.

DBAN *See* dibromoacetonitrile.

DBCA *See* dibromochloroacetaldehyde.

DBCAA *See* dibromochloroacetic acid.

DBCAN *See* dibromochloroacetonitrile.

DBCM *See* dibromochloromethane.

DBCNM *See* dibromochloronitromethane.

DBCP *See* 1,2-dibromo-3-chloropropane.

1,1,1-DBCP *See* 1,1,1-dibromochloropropanone.

DBIM *See* dibromoiodomethane.

DBMS *See* database management system.

DBNM *See* dibromonitromethane.

DBP *See* disinfection by-product.

1,1-DBP *See* 1,1-dibromopropanone.

[DBP_0] *See* instantaneous disinfection by-product concentration.

[DBP_t] *See* terminal disinfection by-product concentration.

DBPFP *See* disinfection by-product formation potential.

DBPP *See* disinfection by-product precursor.

DBPR *See* Disinfectants and Disinfection By-Products Rule.

DBPRAM *See* disinfection by-product regulatory assessment model.

DBT *See* design basis threat.

DC *See* direct current.

DCA *See* dichloroacetaldehyde.

DCAA *See* dichloroacetic acid.

DCAN *See* dichloroacetonitrile.

DCDA *See* double check detector backflow-prevention assembly.

DCF model *See* discounted cash-flow model.

DCIM *See* dichloroiodomethane.

DCNM *See* dichloronitromethane.

1,1-DCP *See* 1,1-dichloropropanone.

1,3-DCP *See* 1,3-dichloropropanone.

1,1,1-DCP *See* 1,1,1-dichloropropanone.

DCPA *See* dimethyl-2,3,5,6-tetrachloroterephthalate.

DCS *See* distributed control system.

DCU *See* data collection unit.

DCVA *See* double check valve assembly.

D/DBP *See* disinfectant/disinfection by-products.

DDC *See* direct digital control.

DDD *See* dichlorodiphenyl dichloroethane.

DDE *See* dichlorodiphenyl dichloroethylene.

DDT *See* dichlorodiphenyl trichloroethane.

DE *See* diatomaceous earth; district engineer.

deactivation The loss of catalytic activity by an absorbent or a catalyst.

dead end A section of a water distribution system that is not connected to another section of pipe by means of a connecting loop. Such portions of a distribution system can experience lower flows than surrounding portions, which can lead to water quality problems caused by somewhat stagnant water. Examples of problems include tastes or odors, bacteriological growth, loss of chlorine residual, or any combination of these.

dead-end filtration A flow pattern in which all water flows through the medium or membrane (as opposed to crossflow filtration), thus allowing a buildup of a particulate layer on or near the surface of the medium and requiring periodic backwashing, repeated cleaning, or cartridge replacement.

dead-end flow A flow pattern in which all the feedwater passes through a filtration medium during service operating mode.

dead-end membrane filtration *See* dead-end filtration.

dead leg *See* dead end.

deadline The date and time by which a program, project, or product must be completed.

dead storage Storage below the lowest outlet levels of a reservoir, not available for use.

dead time Any definite time period required for any process material to propagate or travel between two different locations. Dead time can occur in the measuring system, the controller, or any of the process streams.

dead water (1) Standing or still water. (2) Water in a boiler, settling tank, or similar equipment that fails to circulate to the extent required for proper functioning of the equipment.

dead well A shaft or well driven through an impermeable stratum to allow water to drain through to a permeable one. A dead well is also called an absorbing well, drain well, or negative well.

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dead zone An area or zone in a tank or basin where little or no flow or mixing occurs. In flocculation, a dead zone is a section or location (such as a corner) that has little or no water movement.

deaerate To reduce or eliminate oxygen or air from a liquid or from granular activated carbon.

deaeration *See* deaerate.

deaerator A device that removes oxygen or air from a liquid. *See also* degasifier.

dealkalization Any process for the reduction of alkalinity in a water supply. Dealkalization is generally accomplished by a chemical feed process or combined cation- and anion-exchange systems.

Dean vortex A helical flow or a controlled centrifugal instability that can be used to reduce concentration polarization and membrane fouling during nanofiltration. It is a secondary tangential flow that creates a self-cleaning flow mechanism when induced within a crossflow filtering system.

Dean vortex membrane filtration Crossflow membrane filtration in which secondary tangential flows are created in the bulk flow and at the membrane surface (such as by coiling tubular-shaped membranes in a spiral or coiled arrangement) to reduce particle buildup, minimize concentration polarization, and improve hydraulic performance (e.g., increase specific flux) and selectivity (i.e., rejection). *See* also crossflow filtration.

death rate A rate expressing the proportion of a population who die of a certain disease or of all causes in a given period, usually a calendar year. The denominator is the average total population in which the deaths occurred. The rate is usually multiplied by 1,000 to produce a rate per 1,000 (another convenient multiplier of 10 can also be used). Morbidity can also be expressed in this manner, i.e., crude morbidity rate. The death rate is sometimes called the crude mortality rate. *See also* crude rate; standardized mortality rate; standardized rate.

debenture A long-term debt instrument that is not secured by a mortgage on specific property.

debris Generally solid wastes from natural and artificial sources deposited indiscriminately on land and water. *See also* detritus; flotsam; jetsam; litter; trash.

debris basin A basin formed behind a low dam or excavated in a stream channel to trap debris or bed load carried by mountain torrents. Such a basin requires periodic cleaning of debris by excavation to restore capacity.

debris cone A fan-shaped deposit of soil, sand, gravel, and boulders deposited at the foot of a range of hills or mountains by a stream that flows from the higher area or where the velocity of the stream is reduced sufficiently to cause such deposits.

debris dam A fixed dam built across a stream channel to catch and retain debris such as sand, gravel, silt, or driftwood.

debris flow An unsorted mixture of water, rock, soil, and earth material that moves downslope as a mass. Such flows are common in areas where vegetation is lacking and surface water runoff reaches drainageways rapidly.

debris rack *See* bar screen.

debromoaplysiatoxin A toxin produced by some cyanobacteria in warmer seas; contact with the organism while swimming can cause "swimmer's itch" or seaweed dermatitis, but ingesting the toxin does not have any known effects.

debt An obligation resulting from the borrowing of money or from the purchase of goods and services. These obligations are usually classified by length of time they are expected to be outstanding: short-term, usually a year or less, or long-term, extending beyond one year. Short-term debt frequently is the result of operational activities, while long-term debt is most often associated with capital improvements.

debt service The amount of money necessary to pay interest and principal requirements for a given year or series of years over which the debt is repaid.

debt service reserve fund A fund established (at the beginning of a contract) to cover debt service for some period of time in the event of a revenue shortage, often one year's debt service. It is an emergency fund that provides security to the investors that there will be sufficient moneys available to meet principal and interest payments in periods of revenue shortages. If the funds are accessed, the contract (covenant) requires that they be replaced within a specified time period.

decant To draw off the liquid from a basin or tank without stirring up the sediment in the bottom.

decantation The process of drawing off a supernatant liquid without disturbing the underlying lower liquid layers and the precipitate.

decarbonate To reduce or eliminate carbon dioxide (CO_2) from a liquid.

decarbonation *See* decarbonate.

decarbonator A device that removes carbon dioxide (CO_2) from a liquid. *See also* degasifier.

decationize The exchange of cations for hydrogen ions by a strong acid cation exchanger operated in the hydrogen cycle.

decentralized processing A distribution of computer processing tasks among separate processors.

decentralized treatment system Privately owned water and wastewater system having little or no distribution pipes. *See also* private water supply; public water system.

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decentralized wastewater treatment system An on-site or cluster wastewater system that is used to treat and dispose of relatively small volumes of wastewater generally originating from individual or groups of dwellings or businesses that are located relatively close to each other.

decentralized water treatment The use of point-of-use (POU) or point-of-entry (POE) devices and possibly bottled water to provide a feasible and cost-effective means of delivering safe water to small communities.

dechlorination The process of removing chlorine (HOCl, OCl^-) from solution. Dechlorination may be required (1) when high dosages are provided to destroy tastes and odors or to reduce their concentration in the distribution system, (2) to reduce the potential toxic effect of a chlorinated discharge to aquatic life, (3) to protect downstream processes, such as zeolite softeners, from the oxidative effects of chlorine, or (4) to reduce chlorinous tastes in drinking water (particularly bottled water). Dechlorination is typically achieved through chemical addition of a reducing agent, the most common of which is sulfur dioxide (SO_2).

dechlorination agent A chemical used to reduce the chlorine residual for the purpose of sample preservation. Commonly used dechlorination agents include sodium thiosulfate ($Na_2S_2O_3 \cdot 5H_2O$), sodium sulfite (Na_2SO_3), ammonium chloride (NH_4Cl), and ascorbic acid ($C_6H_8O_6$). *See also* dechlorination.

deci *See in the Units of Measure section.*

decibel *See in the Units of Measure section.*

deciliter *See in the Units of Measure section.*

decision tree A decision matrix developed by the US Environmental Protection Agency that estimates the number or percentage of public water systems that are affected by a new regulation and would be expected to choose any one of a predetermined set of alternatives for complying with the regulation. The decision matrix is used to develop national cost estimates for meeting a new regulation by multiplying the number of systems expected to choose a particular compliance option by the unit cost of that option and then summing across all options considered.

declining block pricing A rate design wherein the unit price of water to all classes of users declines with each succeeding block of use, resulting in both incremental and average cost of water decreasing with increased customer use. This was the traditional rate structure in the United States for many years. It recognizes the lower unit cost of water associated with the relatively level demands of large industrial customers compared to the peaking demands of, for example, residential customers. Because of scarcity of water in many areas, a desire to encourage customers to conserve the resource, and escalating capital costs, many utilities have converted the declining block rate structure into single unit rates, seasonal rates, and inclining block rates.

declining block rate *See* declining block pricing.

declining rate filtration A filtration process in which the filter rate gradually decreases throughout the course of the filter run. A flow-restricting orifice is used in the effluent piping to control the maximum rate when the filter is clean. As the filter clogs with solids, resistance through the filter bed increases, which causes the flow rate to decrease as flow is shifted to other, cleaner filters in the treatment plant.

decolorization The process of removing color bodies such as tannins or humic acid from water by means of oxidation, coagulation–filtration, adsorption, or ion exchange.

decomposition The conversion of chemically unstable materials to more stable forms by chemical or biological action. If organic matter decays when no oxygen is present (i.e., under anaerobic conditions or putrefaction), undesirable tastes and odors are produced. Decay of organic matter when oxygen is present (i.e., under aerobic conditions) tends to produce much less objectionable tastes and odors.

decreasing block rate *See* declining block pricing.

decree An ordinance or edict promulgated by a civil authority or a judicial order.

decross-linking The alteration of an ion-exchange resin structure by destruction of the cross-linked polymer (such as divinylbenzene) as a result of very aggressive chemical attack—by chlorine (HOCl, OCl^-), ozone (O_3), or hydrogen peroxide (H_2O_2), for example—or heat. Decross-linking causes increased moisture content in an ion-exchange resin and physical swelling of the beads.

dedicated capacity The portion of the water utility's total capacity that is set aside, or dedicated, for use by an individual large-use customer or group (class) of customers whose total use is a significant part of the utility's total capacity requirement.

dedicated metering Metering of water service based on a single type of use, as in separate metering for landscape irrigation only.

deduct meter A separate meter for connections to irrigation systems or other consumptive water uses, such as cooling towers. Because irrigation water and most cooling water are consumed rather than returned to the wastewater system, the volumes recorded by a deduct meter are subject only to water charges, not wastewater charges.

DEE *See* diethyl ether.

deep-bed filtration A type of filter in which the medium is deeper than a standard design of 2 to 3 feet

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(0.6 to 0.9 meters). A deeper bed is often combined with larger filter media to allow deeper penetration of particles, thereby more effectively using the full volume of the bed in collecting particles. Deep-bed filters are also used with ozonation to provide a larger surface area for removing biodegradable components formed by ozone.

deep-discount bond A bond that typically does not pay any annual interest; instead, the bondholder is rewarded in appreciation of the principal payable. *See also* zero-coupon bond.

deep injection well A well discharging under pressure to a deep subsurface stratum. Such a well is often used for disposal of liquid waste streams to a suitable confined poor-water-quality aquifer that is generally considered unusable for other purposes.

deep percolation The movement of groundwater through deeply buried permeable rocks.

deep seepage That portion of the runoff that escapes from a reservoir through the underlying earth or rock strata, below any possible intercepting cutoff constructed at the dam.

deep well A drilled well for the extraction of water, salt, gas, oil, or other minerals.

deep-well injection The disposal of waste by pumping into a deep well discharging to an aquifer that is not a water supply.

deep-well pump A pump used for lifting water from deep wells. The pumping mechanism is usually installed within the well at a considerable distance below the surface. The pump may be of a reciprocating or centrifugal type.

deep-well turbine pump A centrifugal pump adapted for deep-well use and consisting of a series of stages. Each stage comprises a set of vanes in a case or bowl, and the number of stages increases with the operating head.

deethylatrazine A metabolite of triazine pesticides. This and other triazine degradation by-products are listed as unregulated contaminants. *See also* unregulated contaminant.

defecate To excrete waste matter from the intestinal tract.

deferred serial bond A serial bond in which the first installment does not fall due for 2 or more years from the date of issue.

deferrization In water treatment, the removal of soluble compounds of iron from water.

deficiency (1) The amount or amounts by which quantities fall short of a given demand. (2) The amount by which the natural flow of a stream or other source of water supply fails to meet the demand for irrigation, hydroelectric power, domestic consumption, or other purposes. (3) The amount by which the precipitation during a given period falls short of the normal precipitation for that period.

DE filter *See* diatomaceous earth filter.

DE filtration *See* diatomaceous earth filtration.

defined-substrate technology (DST) A microbiological testing technology based on the ability of coliform bacteria to produce an enzyme that reacts with a substrate, *ortho*-nitrophenyl-β-D-galactopyranoside, to release a compound that produces a yellow color. When used in conjunction with another substrate, 4-methylumbelliferyl-β-D-glucuronmide, the technique can be used to detect both total coliform bacteria and *Escherichia coli* within 24 hours. Commercial kits using this technology are available.

defluoridation The removal of fluoride through treatment by lime softening of high-magnesium water, ion exchange, or activated alumina. *See also* activated alumina; ion exchange; lime softening.

defoliant An herbicide (e.g., 2,4-dichlorophenoxyacetic acid) that removes leaves from trees and growing plants. *See also* 2,4-dichlorophenoxyacetic acid; herbicide.

deformable Pertaining to suspended solids that extrude into the interstices of a filter cake and cause rapid filter plugging.

degasification The removal of dissolved gases from water to reduce their impact on water quality, filter operation (via air binding), pump cavitation, corrosion, or other parameters. Degasification is accomplished by mechanical methods (e.g., a degasifier or venturi), chemical methods, or a combination of both. *See also* air binding; cavitation; corrosion; degasifier; stripping.

degasifier A device that removes dissolved gases, such as carbon dioxide (CO_2) or hydrogen sulfide (H_2S), from water. The removal rate is dependent on the concentration of the gas in the liquid phase compared to the equilibrium concentration of the gas in the liquid phase for the partial pressure of the gas in the gas phase, as determined by Henry's law. Commonly, the water falls downward by gravity through packing media, and air passes in a countercurrent direction driven by forced or induced draft fans or blowers. The air removes (strips) the gas or gases from the water. *See also* deaerator; decarbonator; Henry's law; stripping.

degasify To reduce the concentration of one or more gases and other volatile substances from a liquid.

degassing *See* degasification.

degradation (1) The loss of capacity, reduction of resin particle size, excessive swelling of resin particles, or any combination of these factors resulting in a lessening of the ion-exchange capabilities of a resin. This may occur as a result of the type of service

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for which the resin was used, the solution concentrations used, heat, or aggressive operating conditions. (2) A decrease in the quality of a water. (3) A reduction in performance of a unit process used to treat water. (4) The changing of an organic material or substrate into smaller, less complex compounds, principally by biological means.

degrade To convert complex materials to simpler compounds by biological, chemical, or physical treatment. *See also* biodegradable.

degraded wetland A wetland altered by human action through impairment of some physical or chemical property in a way that results in reduced habitat value or other reduced functions (e.g., by flood storage).

degrading river A section of a stream or river where the bottom elevation is declining because of erosion. *See also* aggrading river.

degree (1) On the Celsius temperature scale, $^1/_{100}$ of the interval from the freezing point to the boiling point of water under standard conditions; on the Fahrenheit scale, $^1/_{800}$ of this interval. (2) A unit of angular measure; the central angle subtended by $^1/_{360}$ of the circumference of a circle. *See also* degree *in the Units of Measure section.*

degree, kelvin *See* kelvin *in the Units of Measure section.*

degree, temperature *See* temperature degree.

degree Baumé (Bé) *See* Baumé degree.

degree Celsius (°C) *See in the Units of Measure section.*

degree Fahrenheit (°F) *See in the Units of Measure section.*

DEHA *See* di(2-ethylhexyl) adipate.

DEHP *See* di(2-ethylhexyl) phthalate.

dehydration (1) The chemical or physical process whereby water in chemical or physical combination with other matter is removed. (2) The geologic process in the weathering of rocks or soils whereby water is given up and a new mineral compound formed.

deionization The removal of all ionized minerals and salts (both organic and inorganic) from a solution by a two-phase ion-exchange procedure. First, positively charged ions are removed by a cation-exchange resin in exchange for a chemically equivalent amount of hydrogen (H^+) ions. Second, negatively charged ions are removed by an anion-exchange resin for a chemically equivalent amount of hydroxide (OH^-) ions. The hydrogen and hydroxide ions introduced in this process unite to form water molecules. This process is also called demineralization by ion exchange. *See also* demineralization; demineralize.

deionize *See* deionization.

deionized (DI) water A type of reagent water used in the laboratory to prepare blanks, standards, and so on. It is typically prepared in the laboratory by passing tap water through a series of ion-exchange cartridges. Many of the major constituents in tap water, such as minerals, are essentially removed during deionization.

deionizer A device used to remove all dissolved inorganic ions from water.

DEIS *See* Draft Environmental Impact Statement.

deka *See in the Units of Measure section.*

delay The element of a physical protection system designed to impede adversary penetration into or exit from a protected area.

delayed filter start Startup of a filter after backwash, with a period of time of perhaps one half hour or more between the backwash and startup. It is also known as resting a filter. If done for a time that is not excessive, resting a filter can, in some treatment plants, enable the filter to produce better-quality water when filtration is started, reducing the magnitude of the initial turbidity spike, or its duration, or both.

delayed hypersensitivity Sensitivity to a chemical or biological agent that develops only after prior exposure. It essentially pertains to an allergic reaction to the agent, mediated via the immune response.

delayed neurotoxicity (1) A specific neuropathy that is produced by certain organophosphorous compounds, including some (but not all) pesticides that have been developed in this class. This neuropathy takes some time to develop and is to be distinguished from the effects of these compounds on the inhibition of acetylcholinesterase; such inhibition is the primary effect responsible for the compounds' neurotoxic effects in insects and is largely responsible for the acute effects of organophosphorous pesticides. The delayed neurotoxic effect is produced by those organophosphorous pesticides (a) in which the alkyl side chains are hydrolyzed away before the esteratic bond between the pesticide and enzymes can hydrolyze and (b) that inhibit the so-called neurotoxic esterase. (2) A toxicity to the nervous system that takes some time to develop, e.g., the peripheral neuropathies produced by acrylamide ($CH_2CHCONH_2$) or n-hexane ($CH_3(CH_2)_4CH_3$).

delayed toxicity An adverse chemically induced effect that has some minimum latent period before it becomes manifest in terms of overt symptomatology. In some ways this delay is more apparent than real. For example, the action of a carcinogen to induce mutation in a cell occurs rapidly, but the development of a malignant tumor as a result of that effect on a single cell will take years or even decades before it can be detected.

delimiter A special character designating the beginning or end of a field or string of characters. Such a character is commonly used in data strings.

D

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deliquescence The ability of a dry solid to become a saturated solution by absorbing water from the air.

delivered ultraviolet (UV) dose *See* ultraviolet dose.

delivered ultraviolet (UV) dose distribution The probability distribution of delivered ultraviolet doses that microorganisms receive in a flow-through diagram UV reactor; typically shown as a histogram.

delivered water A public or private utility water plant's finished product water that is carried through a water main network of pipes and arrives at the points of use (homes, institutions, and business facilities). When performing an International Water Association/American Water Works Association (IWA/AWWA) water audit on an annual basis, the total delivered water for the year is known as the system input volume. *See also* water audit.

delta (1) An alluvial deposit, often in the shape of the Greek letter delta (?Δ), from which it derives its name, that is formed where a stream drops its debris on entering a body of quieter water. (2) The terminal deposit of a river.

delta agent *See* delta virus.

ΔE^0 *See* standard cell potential.

delta E^0 (ΔE^0) *See* standard cell potential.

ΔP *See* delta *P*.

delta *P* (ΔP) The pressure drop or loss by flowing fluid in a pressurized system caused by the velocity and turbulence of the flowing fluid, restrictions the fluid flows through, and the roughness of wetted surfaces. *See also* pressure drop.

delta virus A virus found most frequently in patients who receive massive blood transfusions, in intravenous drug users, and in close personal contacts of infected subjects. Infection with the delta virus is dependent on co-infection with hepatitis B and the production of hepatitis B surface antigen. The delta virus appears to be a defective virus that can interfere with replication of the hepatitis B virus. It is also known as the delta agent.

deluge shower A safety device used to wash chemicals off the body quickly.

DEM *See* digital elevation model.

demand (1) The amount of electric power that may be required during a certain time interval. (2) The amount of water needed for delivery to sustain adequate flow and pressure levels in a certain time interval in a water distribution system. Components of demand include customer consumption; real losses from distribution system leakage; storage overflows; improperly opened drain valves; fire-flow demands; unauthorized consumption; and consumptive use and waste.

demand charge An amount charged by electrical utilities in addition to the normal power rate to take into account the extra power capacity needed to supply an electric motor's increased current demand when the motor is starting.

demand costs Costs associated with the facilities that meet peak demands for water delivery, such as maximum-day, minimum-hour, or other rates.

demand curve A curve that defines the amount of water that customers are willing to buy at different rates, all other things being equal. The demand for water is usually defined by means of an econometric model (regression analysis) that analyzes historical demand and allows for other influences on demand, such as number of occupants (by age), household income, lot size, topography, and weather.

demand factor The ratio of the peak or minimum demand to the average demand.

demand forecasting The process of anticipating amounts of water required to meet customers' maximum hourly, daily, and annual requirements.

demand initiated regeneration (DIR) A method of automatically initiating regeneration or recycling in filters, deionizers, or softeners after a predetermined metered volume of water has been processed. In a softener or deionizer, regeneration may be triggered automatically based on a sensor reading. All operations, including bypass (of hard or soft water depending on design), backwashing, brining, rinsing, and returning the unit to service, are initiated and performed automatically in response to the demand for treated water.

demand management Strategic practices that optimize water supply, treatment, and delivery requirements to assist long-term sustainability of water resources. Demand-management measures include water-efficiency improvements (low-flow plumbing fixtures, water-efficient landscaping), minimizing water waste and loss (leakage management), conservation-oriented pricing, changes in water-consumption practices (using recycled water for irrigation), and public education. Some demand-management measures can be implemented by consumers on their own, while others are implemented through utility-sponsored programs.

demand meter (1) An instrument that measures the average power of a load during some specific interval. (2) A meter that will record the maximum rate of water consumption over a specific interval.

demand pattern Profile and characteristics of the demand requirements of the system, specific customer class or classes, or an individual customer, indicating the frequency, duration, and amount of demand placed on the water production and delivery system. These patterns can be important factors in sizing facilities to meet customer and fire-suppression needs.

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demand uncertainty A margin of safety included in demand forecasting to cover the variability of the combination of those factors that are most likely to affect the short- or long-term forecast being made. Water demand forecasts are affected in the short run by such factors as weather departures from normal; water rate changes; conservation measures that are implemented; water shortage (drought) restrictions; and various economic variables that include changes in unemployment, household income, housing starts, and tourist visits. In the long run, the reliability of demand forecasts is affected by additional forces, such as changes in population growth, mix of household formation, family size, upkeep of water distribution system infrastructure to minimize the growth of real leakage losses, naturally occurring conservation effects (mostly from more efficient water fixtures), and supply availability.

demanganization In water treatment, the removal of compounds of manganese from water.

demineralization The removal of dissolved minerals and inorganic constituents from water to meet water quality standards, improve aesthetic quality, or reduce corrosivity. Commonly used treatment techniques for demineralization include chemical coagulation or lime softening for heavy metals and activated alumina. *See also* activated alumina; coagulation; deionization; desalting; ion exchange; lime softening.

demineralize To reduce the concentrations of minerals and inorganic constituents from water by ion-exchange deionization or desalting processes such as distillation, electrodialysis, and reverse osmosis. *See also* deionization; desalting.

demineralized stream (1) A water stream from which minerals have been removed. (2) For an electrical-driven membrane treatment system (e.g., electrodialysis), the stream in a membrane stack in which the concentrations of ions have been reduced as a result of ion transfer through the membranes to the concentration stream.

demineralized water *See* bottled purified water.

demineralizer A device that demineralizes water.

***de minimis* risk** A risk that is so low as to be considered negligible. It is from the Latin *de minimis*, which means insignificant, minimal, or trifling.

demographic breakdown Classifications of a population or audience by common characteristics such as age, gender, household income, and so on.

demonstration of performance (DOP) Under the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), water systems may conduct field studies to demonstrate that the performance of their water system for removing or inactivating *Cryptosporidium* is superior to the presumptive credit granted by the US Environmental Protection Agency, and thereby receive a higher removal or inactivation credit.

demonstration of performance (DOP) credit A provision of the US Environmental Protection Agency's proposed Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) that allows Primacy Agencies to grant site-specific physical log-removal and/or log-inactivation credit for *Cryptosporidium* based on demonstration of performance by the water system.

denaturing gradient gel electrophoresis (DGGE) Molecular technique that separates deoxyribonucleic acid (DNA) fragments of the same size by their denaturing profile, i.e., how double-stranded DNA (dsDNA) becomes single-stranded DNA (ssDNA). The dsDNA fragment is electrophoresed through a gradient of increasing denaturant. As it moves through the gel, it partially melts and undergoes both a conformational and mobility change. The point in the gel when the dsDNA fragment melts and becomes ssDNA (and almost stops) depends on the nucleotide sequence in the melted region. This method is powerful at separating same-size DNA fragments or polymerase chain-reaction products based on sequence.

denitrification The conversion of nitrite (NO_2^-) and nitrate (NO_3^-) to molecular nitrogen (N_2), nitrogen dioxide (NO_2), or a mixture of these two gases. Denitrification is accomplished by biological means under reducing conditions in the absence of free dissolved oxygen (i.e., via anaerobic respiration). *See also* biological denitrification; nitrate removal.

denominator The part of a numerical fraction below the line. A fraction indicates division of the numerator by the denominator. *See also* numerator.

dense, nonaqueous phase liquid (DNAPL) A liquid compound that is immiscible with water and for which the density is greater than water. Chlorinated solvents (e.g., tetrachloroethylene) and related compounds are examples of dense, nonaqueous phase liquids.

density The mass of a substance per unit volume.

density current A flow pattern that is moderated by the different densities of at least two liquids in a mixture. For example, salt water in tidal-influenced rivers establishes a countercurrent flow beneath the freshwater flow. Temperature can also influence density; as water temperature increases in settling basins, density currents caused by the lower-temperature influent water can disturb settling patterns. A density current is also called a convection current.

density flow That movement of water near or on the surface of a reservoir, as an underflow or interflow, caused by the introduction of water that is different in terms of

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temperature, salinity, suspended solids content, or some other quality and so has a different density.

density functional theory (DFT) A theory that defines the density of adsorbed liquids and gases in terms of their proximity to the adsorbant surface. According to the theory, density is inversely proportional to the distance from the adsorbant surface. The theory has particular importance in determining pore volume and pore size distribution for activated carbon based on argon or nitrogen adsorption isotherms, or both.

density-gradient flotation Laboratory method for the separation of protozoan parasites from extraneous debris in a water sample.

density of coliforms The concentration of organisms per unit volume of water examined. For drinking water analysis, the standard sample volume is 100 milliliters. In food analysis, the density is expressed in terms of the number of organisms per gram.

density of snow The ratio of (1) the volume that a given quantity of snow would occupy if it were reduced to water to (2) the volume of snow, expressed as a percentage. When a snow sampler is used, the density of snow is the ratio of the scale reading of water on the sampler to the length of the snow core or sample, expressed as a percentage. This value is numerically equal to the specific gravity of the snow.

density stratification The formation of identifiable layers of different densities in bodies of water. *See also* thermal stratification.

density units *See in the Units of Measure section.*

dental (denticle) *See* dentated sill.

dental fluorosis A condition resulting from excessive intake of fluoride. At low exposures it is manifested as mottling of the teeth that becomes quite marked as exposure increases. As the severity of this condition increases, the teeth become more brittle and subject to breakage.

dentated Having dental-like projections.

dentated sill A notched sill installed at the end of an apron to reduce the velocity of flowing water and the resulting scour below the apron or to promote aeration.

deoxygenation The depletion of the dissolved oxygen in a liquid either under natural conditions associated with the biochemical oxidation of organic matter present or by addition of chemical reducing agents.

deoxyribonucleic acid (DNA) A polymeric chemical that encodes genetic information that is transmitted between generations of cells. The code is rendered in the form of four purine and pyrmidine bases—adenine ($C_5H_5N_5$), thymine ($C_5H_6N_2O_2$), guanine ($C_5H_5N_5O$), and cytosine ($C_4H_5N_3O$)—placed in specific sequences referred to as codons (a three-base unit) that code for specific amino acids. The sequence of codons determines the sequence of amino acids in proteins that are synthesized from this template. *See also* c-deoxyribonucleic acid probe hybridization; codon.

deoxyribonucleic acid (DNA) adduct A chemical metabolite that is covalently bound to deoxyribonucleic acid. Adducted DNA can either be repaired or cause insertion of an inappropriate base in the opposing or neighboring bases; the latter case leads to a mutation. If the mutation occurs in a critical part of the DNA, it will produce a protein product that has altered functional capabilities. This results in a cell that inappropriately expresses proteins involved in the regulation of the cell cycle; it can be responsible for a variety of toxic effects, including developmental toxicities and cancer.

deoxyribonucleic acid (DNA) chip technology The miniaturization of gene sequencing technologies, allowing for many assays and their related procedures to be performed concurrently. Using conventional molecular and biochemical techniques, strands of identified deoxyribonucleic acid are fabricated, purified, and embedded on a glass or nylon substrate. In use, DNA chips provide researchers with information on thousands of genes simultaneously.

deoxyribonucleic acid (DNA) fingerprinting A technique that allows for the comparison of deoxyribonucleic acid sequences of any two living organisms. DNA is digested with a restriction enzyme that cuts the DNA into fragments at specific sites. These fragments are separated by gel electrophoresis according to size. This process is repeated with different enzymes, each of which cuts the DNA at different sites. The fragments of DNA are detected by short pieces of labeled DNA that bind specifically to the target sequences, and a detailed genetic fingerprint of an individual cell is constructed from the resultant patterns. The DNA fingerprint is the same for every cell, tissue, and organ of an individual. *See also* genetic fingerprinting.

deoxyribonucleic acid (DNA) repair The process for correcting errors that have been introduced into deoxyribonucleic acid. This process is catalyzed by a wide variety of enzyme systems that recognize certain types of alterations in DNA.

Department of Agriculture *See under* US Department of Agriculture.

Department of Commerce *See under* US Department of Commerce.

Department of Interior *See under* US Department of Interior.

Department of Labor *See under* US Department of Labor.

Department of Natural Resources (DNR) The agency within a state government responsible for protection of natural resources.

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Department of Transportation *See under* US Department of Transportation.

Department of Transportation (DOT) hazard class One of the 9 classes indicating the type of hazardous material being transported. The classes are as follows: class 1, explosive; class 2, gases; class 3, flammable liquid; class 4, flammable solid; class 5, oxidizer; class 6, poison (other than gases); class 7, radioactive material; class 8, corrosive material; class 9, miscellaneous hazard.

departure The difference between any single observation and the normal.

dependable capacity The capacity of a utility that can be relied on for service during all but exceptional circumstances.

dependable yield, groundwater *See under* groundwater safe yield.

dependable yield, river *See under* river safe yield.

dependable yield, surface water *See under* impoundment safe yield.

dependent variable An outcome or variable for which the magnitude is dependent on other variables. In graphical operations the ordinate (*y*-axis) variable is generally referred to as the dependent variable because its value depends on the value of the abscissa (*x*-axis) variable. *See also* regression analysis.

depletion (1) The continued withdrawal of water from a stream or from a surface water or groundwater reservoir or basin at a rate greater than the rate of replenishment. (2) The exhaustion of natural resources, usually in connection with commercial exploitation and usually recorded in monetary terms. *See also* streamflow depletion.

depletion curve (1) That part of a hydrograph extending from the point of termination of the recession curve to the point of a subsequent rise or alteration of inflow when additional water becomes available for stream flow. (2) That part of the hydrograph representing the rate of water flow or seepage from groundwater storage into the stream channels.

depletion hydrograph A hydrograph of discharge from water bodies depicting the drainage from groundwater, swamps, and lakes during long rainless periods of no recharge. The rate of this drainage is an indication of the rate at which storage in those water bodies is being depleted; the rates of drainage (as well as storage) decrease with time.

deposit Material left in a new position by a transporting agent such as gravity, human activity, ice, water, or wind.

deposition (1) The material that collects on the inside surface of a distribution system pipe as a result of suspended material in the water. (2) The material that forms in a water heater or utensil when water is heated.

depot A facility, such as a utility customer service office, mall, fire station, or park, that serves as a distribution center for water conservation retrofit materials.

depreciation An accounting method that allows the original cost of an asset (e.g., building, equipment, pipeline) to be deducted over its useful life as an expense on the annual income statement of the utility. (Land is not depreciated.) In for-profit entities, depreciation is an allowable tax deduction in deriving taxable income. Because the asset is paid for with cash or borrowed funds at the time of purchase, depreciation is a noncash expense item each year during the asset life that many utilities use as a convenient means of allocating funds for equipment replacement. Physical damage to an asset or obsolescence can cause the asset to be written off long before its expected useful life; on the other hand, if an asset lasts longer than the expected life, accounting depreciation simply stops when the total cost is written off.

depreciation rate The annual rate at which the values of capital assets are expected to be reduced because of wear and tear, decay, inadequacy, and obsolescence, assuming that normal maintenance activities are performed. Calculating the rate requires an estimate of the useful life of the asset.

depression head The magnitude of the lowering of the water surface in a well, and of the water table or piezometric surface adjacent to the well, resulting from the withdrawal of water from the well by pumping. *See also* drawdown.

depression spring A spring formed when the water table reaches a land surface formed by a depression in the local topography.

depression storage Precipitation that collects in puddles on the land surface.

depth–area–duration curve A set of curves that show the variation in depth of rainfall for a given design event (e.g., a 100-year event) as a function of the surface area covered by the storm and the duration of precipitation.

depth filtration (1) A filtration process in which water flows through progressively smaller pore spaces in a filter media bed. Depth filters are designed to entrap particles throughout the mass of filter media, as opposed to a surface filter, where only the surface layer does the actual filtering. Depth filtration is also called multimedia filtration. (2) In Britain specifically, a filter in which all the depth of media participates in removing particles, as opposed to surface filtration or cake filtration, where only the top layer effectively removes particles from the water.

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depth-integrated sample A sample that represents the water-suspended sediment mixture throughout the water column so that the contribution to the sample from each point is proportional to the stream velocity at that point. A depth-integrated sample is also called an integrated sample.

depth of flotation The vertical distance from (1) the surface of the water in which a body is floating to (2) the point on the body farthest below the water surface.

depth of runoff The total volume of runoff from a drainage basin divided by the basin's area. For convenience in comparing runoff with precipitation, the term is usually expressed in inches of depth over the drainage area during a given period of time.

depth of water The depth of a volume of water spread over a given area, usually expressed in inches, feet, acre-inches per acre, or acre-feet per acre.

depth profile A graphic representation of (1) the change with depth in a physicochemical characteristic of a body of water or (2) the varying depth of a body of water.

depth to water The depth of the water table below the surface of the earth.

depuration Cleansing or purifying, or becoming cleansed or purified.

deregulation The act, generally by a change of law, of eliminating or reducing rules and orders previously promulgated by an agency in authority.

derivative action The control mode that varies the controller's output in proportion to the derivative (rate of change) of the controlled variable. Derivative action is also called rate action or derivative control. *See also* proportional integral derivative control.

derivative control *See* derivative action.

derivative factor The amount of derivative action used in a particular control loop.

derivatization The process by which a chemical substance is derived from another substance. For example, esterification is a type of derivatization reaction in which an organic acid is converted into an ester. *See also* esterification.

derivatizing reagent A reagent used in chemical analysis to react with analytes of interest to generate a species that is more amenable to detection by a particular method. It is commonly used to prepare samples for analysis by gas chromatography.

Derjaguin-Landau-Verwey-Overbeek (DLVO) theory A theory describing colloidal interactions considering electrical double layer repulsion and van der Waals attraction. It suggests that the stability of a colloidal system depends on the potential energy of the entire system. This theory was developed independently by B.V. Derjaguin and L.D. Landau from Russia and E.J.W. Verwey and J.T.G. Overbeek from the Netherlands. *See also* electrical double layer; van der Waals forces.

dermal contact Contact of a substance with skin.

dermal exposure Contact between a chemical and the skin.

dermal toxicity test A test of a chemical's potential to produce corrosive damage to the skin or to produce hypersensitivity reactions in the skin.

dermatitis Typically a redness and swelling of the skin.

dermatotoxin Any chemical that damages the skin.

desalinate *See* desalting.

desalination *See* desalting.

Desalination and Water Purification Research and Development (DWPR) Program A program initiated in 1997 by the US Bureau of Reclamation's Office of Research and Natural Resources with the stated primary goal "to develop more cost-effective, technologically efficient, and implementable means to desalinate water." It was formerly called the Water Desalination Research and Development (DesalR&D) Program.

desalination plant A water treatment plant that conducts a desalting process.

desalination ratio In the electrodialysis process, the salt concentration in the demineralized stream divided by its concentration in the feed stream.

desalinization *See* desalting.

Desalnet Jointly produced by US Bureau of Reclamation and the American Water Works Association, a CD-ROM database that includes available desalination and advanced water treatment technology information.

desalt *See* desalting.

desalting A water treatment process, such as distillation, reverse osmosis, or electrodialysis, that removes dissolved mineral salts and other dissolved solids from water.

desander A device for removing sand from drilling fluids during water well construction.

descaling The removal of encrustations within a pipe either by mechanical means such as flushing or pigging or by a chemical interaction with the scale that results in dissolution.

descending block rate *See* declining block rate.

descriptive epidemiologic study A study of population statistics pertaining to health. Descriptive studies primarily summarize routinely collected health-related data (e.g., cancer incidence rates) to reveal patterns of disease occurrence and observations about the association of disease with certain characteristics, including age, gender, race, occupation, geographic location, and time of occurrence. Information is not available from the individuals within the population

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studied about their exposures, risk factors, and disease status. *See also* ecologic epidemiologic study.

descriptive statistics A set of statistical parameters describing various features of a data set.

desiccant A drying agent that is capable of removing or absorbing moisture from the atmosphere in a small enclosure.

desiccation A process used to remove virtually all moisture.

desiccator A tightly sealed container used to cool heated items before they are weighed. This prevents the items from picking up moisture from the air and increasing in weight.

design (1) The process of developing plans and specifications for the construction and implementation of an engineering system. (2) The result of that process.

design analysis In engineering reports, the tabulation and consideration of the physical data, present requirements, and probable future requirements pertaining to an engineering project. Such analysis should include the main features and principles of the design.

designated basin An area in which the use of groundwater is assumed not to impact the major surface river basin to which the designated basin would otherwise be tributary.

design basis threat (DBT) The threat against which a facility should defend and protect after conducting a vulnerability or risk assessment. The design basis threat depends on the capabilities that are assigned to a potential adversary and the effectiveness of the system against that adversary.

design–build An alternative method of designing and constructing a facility in which one entity both designs and constructs the facility. Under some circumstances, this approach can accelerate the schedule and may lower costs compared to a traditional approach, in which the facility is designed by one entity and then bid so that a contractor constructs the project. However, the owner often accepts more risk in a design–build approach.

design–build–maintain A design–build contract with an added provision to provide all maintenance, repairs, and replacements for a negotiated price over a set period of time.

design–build–operate A design–build contract with an added provision to provide personnel required and to assume responsibility for operating a facility for a negotiated price over a fixed period of time.

design criteria (1) Engineering guidelines specifying construction details and materials. (2) Objectives, results, or limits that must be met by a facility, structure, or process in performance of its intended functions. *See also* design loading.

design flood (1) The largest flow that a reservoir, channel, or other works can accommodate without damage or with limited damage. (2) The flood adopted for use in determining the hydraulic proportions of a structure, such as the outlet works of a dam, the height of a dam or levee, or the maximum water level in a reservoir. A design flood is also called a plan flood.

design life The projected or expected years of service for a major water utility component, or portion thereof, as developed by the designer and verified by the utility or owner.

design loading The flow rates and constituent concentrations that determine the design of a process unit or facility necessary for proper operation.

design point The mark on the head–capacity curve of a pump characteristics curve that indicates the head and capacity at which the pump is intended to operate for best efficiency in a particular installation.

design pressure *See* pressure rating.

design standard A commonly accepted standard professional engineering practice used to ensure that project construction accurately reflects design goals.

design storm (1) The storm for which a hydraulic structure such as a bridge, culvert, or dam is designed. (2) The rainfall estimate corresponding to an enveloping depth–area–duration curve for the selected frequency of the storm.

desilting basin A settling basin for removal of silt from river or stormwater flows. *See also* sedimentation basin.

desilting works Basins installed just below the diversion structures of canals to remove the bed loads, suspended sand loads, and some of the heavier silt loads from the water.

desorption The movement of a previously adsorbed constituent into a liquid phase. Desorption can occur (1) when the liquid phase concentration decreases significantly, resulting in a driving force from the high-concentration adsorption surface to the low-concentration solution, or (2) when a more strongly adsorbed chemical is introduced into the liquid stream. *See also* adsorption.

destabilization of pipe film The chemical dissolution or physical separation of a film from the pipe surface. The film may have been placed on the pipe during the manufacturing process, it may develop as a result of the corrosion process, it may result from precipitation of a chemical constituent in the water onto the pipe, or it may result from addition of a corrosion inhibitor. Water quality conditions, flow velocity changes, changes of flow direction, physical abrasion, vibration, or pipe movement may cause the film to dissolve, loosen, or detach.

destabilization zone *See* zone of coagulation.

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destratification The mixing of established, layered zones within a medium. Thermal layers that produce fixed aerobic and anaerobic zones in reservoirs can be destratified by mechanical means or temperature changes. Filter media that are layered as a result of particle size or density differences can be destratified by intense agitation during backwashing. *See also* aerobic condition; anaerobic condition; backwash; stratification; thermal stratification.

Desulfovibrio A genus of anaerobic bacteria found in water, sediments, and soils, characterized by an ability to use sulfate (SO_4^{2-}) as an electron acceptor, producing hydrogen sulfide (H_2S) as the final reduction product. *See also* sulfate-reducing bacteria.

detection In security, the determination that an unauthorized action has occurred or is occurring. Detection includes sensing the action, communicating the alarm to a control center, and assessing the alarm.

detection lag The time period between the moment a change is made and the moment when such a change is finally sensed by the associated measuring instrument.

detection limit *See* limit of detection.

detector check A check valve that is used on a fire system and has a small bypass meter or indicator system that shows usage or that water has passed through the check valve.

detention dam A dam, usually small, constructed to impound or retard surface runoff temporarily. It is also used to bring about the deposition of soil being carried away by runoff of surface water. *See also* soil-saving dam.

detention reservoir A reservoir in which water is stored for a relatively brief period of time, with part of the water being retained until the stream can safely carry the ordinary flow plus the released water. Such reservoirs usually have outlets without control gates and are used for flood regulation. A detention reservoir is also called a retarding reservoir.

detention tank Any vessel used to hold flow to even out surges, allow sedimentation, or provide time for physical, chemical, or biological reactions. *See also* contact tank; equalization; sedimentation basin.

detention time The average length of time a drop of water or a suspended particle remains in a tank or chamber. Mathematically, it is the volume of water in the tank divided by the flow rate through the tank.

detergent Any material with cleansing powers: soaps, synthetic detergents, artificial alkaline materials, solvents, and abrasives. In common domestic usage, the term is often used to refer to synthetic detergents.

deterioration A change in the quality of a sample over a period of time as a result of improper preservation techniques.

determinant of water quality *See* water quality parameter.

determination The quantitative analysis of a specific analyte; e.g., a method for the determination of chloroform ($CHCl_3$) in water.

deterministic model A model in which a unique outcome for the unknown parameter can be obtained as opposed to a probability of certain solution determined by a probabilistic model. The unknown parameter can be a unique number or a unique set of solutions to a particular problem.

deterministic process A phenomenon determined by antecedent causes, with the same causes consistently producing the same effects.

detoxication Generally, the inactivation of a chemical as a toxin. More specifically, this term usually refers to the metabolism of the chemical to a form that is less toxic to the organism. However, metabolism is also frequently responsible for producing the toxic form of the chemical. Therefore, the terms *detoxication* and *metabolism* should not be used interchangeably.

detritus Finely divided, nonliving, settleable material that is suspended in water.

deuterated internal standard A compound that has a known proportion of an isotope and can be used to calibrate a mass spectrometer. For the purposes of calibration, a known number of hydrogen atoms in a compound are replaced with deuterium. The deuterated compounds behave in a chromatograph very much like the compound with a natural proportion of the isotope. However, the mass/charge ratio can be distinguished in a mass spectrometer as a result of the increase in the mass/charge ratio of the deuterated compound. *See also* mass spectrometer.

deuterium A hydrogen isotope having an atomic weight of 2.0147.

deuterium background correction An instrumental technique of compensating for interferences in atomic absorption spectrophotometry. In this approach, a deuterium arc lamp is commonly used as a continuum source for the lower ultraviolet wavelengths. Another continuum source is required for visible (higher) wavelengths.

deuterium oxide (D_2O) The chemical name for heavy water, which is similar in structure and composition to ordinary water except that the hydrogen present has an atomic weight of 2.0147 instead of 1.008.

developed length The length of a line of pipe along the center line of the pipe and fittings.

developed water A legal term that applies to (1) groundwater that is artificially brought to the surface or to the land and that otherwise would have run to waste or not have appeared in any known source, or (2) an artificially induced flow of water in a stream.

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developmental toxicity Functional as well as structural abnormality that can be induced by physical and chemical agents during normal differentiation and maturation of an organism. A teratogenic effect is an example of a developmental toxicity. *See also* teratogenic effect.

development impact fee (DIF) A fee that represents a pro rata share of an agency's cost to provide additions to the infrastructure to serve new development. The DIF is paid by the customers who benefit from the improvements. For existing customers, it is paid at the time the project is approved. For new customers, the fee is usually paid by developers, who pass the cost along to customers in the purchase price of the homes. To qualify as a fee (rather than as a tax), the levy must represent costs reasonably borne for the benefits provided, and the money collected must be used for the purposes for which the fee was established. *See also* capacity charge.

deviation The difference between the controlled variable and the controller set point. Deviation is also known as process error.

device driver A program that provides an interface between the operating system and application software to support output on a specific peripheral device. The device driver translates commands issued through application software into instructions that a device, such as a plotter, can interpret to perform a certain function.

device server A computer component used to connect multiple nonintelligent devices—such as nonintelligent terminals, instruments, query stations, plotters, and printers—to a local area network. A device server contains computer processors dedicated to supervising communications between the devices and the network.

dewater *See* dewatering of sludge.

dewaterability The characteristic of a sludge relating to the ability to have water extracted and thus produce a higher solids concentration. As the dewaterability increases, the ability to generate a lower-volume, higher-solids-concentration sludge also increases. Sludges can be dewatered by gravity (e.g., a thickener or a drying bed) or mechanical means (e.g., a belt filter press). *See also* belt filter press; sludge.

dewatered sludge The solid residue remaining after removal of water from a wet sludge by drainage, evaporation, or filtration. Dewatering is distinguished from thickening in that dewatered sludge may be transported by solids-handling procedures.

dewatering The process of partially removing water. It may refer to the removal of water from a basin, tank, reservoir, or other storage unit, or to the separation of water from solid material.

dewatering lagoon Impoundment specifically designed to dewater water treatment residuals. Such a lagoon would be designed with underdrains and a method to decant the supernatant.

dewatering of reservoirs A physical method for controlling aquatic plants in which a water body is completely or partially drained and the plants allowed to die.

dewatering of sludge The removal of water in sludge to reduce sludge volume and facilitate disposal. Sludge can be dewatered by mechanical means (e.g., a belt filter press or centrifuge) or by gravity and evaporation (e.g., a thickener or a drying bed). *See also* belt filter press; centrifuge; residuals drying bed.

dewatering process liquids A stream containing liquids generated from a unit used to dewater solids for disposal. Processes may include centrifuges (which produce a stream called centrate), belt processes (which produce a stream called pressate), vacuum filters (which produce a stream called filtrate), and monofills (which produce a stream called leachate).

dew point The temperature of an air mass when water condensation will begin.

dew point depression The difference, in degrees, between the prevailing temperature and the current dew point.

dew point hygrometer A hygrometer for indicating the dew point, from which the relative humidity can be calculated when the air temperature is known.

dezincification The parting of zinc from an alloy. In some cases, zinc is lost, leaving a weak, brittle, porous, copper-rich residue behind.

DF *See* domestic flow.

DFT *See* density functional theory.

DGGE *See* denaturing gradient gel electrophoresis.

DHAA *See* dihaloacetic acid.

DHAN *See* dihaloacetonitrile.

DHS (Department of Homeland Security) *See* US Department of Homeland Security.

diabetes A disease in which the body does not produce or properly use insulin. Because insulin is needed by the body to convert sugar and starches to energy, treatment requires the administration of daily insulin. There are three major types of diabetes: Type 1, Type 2, and gestational diabetes. Type 1 results from the body's failure to produce insulin, and Type 2 is characterized by insulin resistance, a condition in which the body fails to properly use insulin. Gestational diabetes occurs post-pregnancy in some women. The most common type of diabetes is Type 2, while Type 1 accounts for only 5 to 10 percent of reported cases of diabetes. Because Type 1 often, but not exclusively, affects children, it was previously called insulin-dependent diabetes mellitus (IDDM), childhood, or juvenile diabetes.

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diagnostic index A method of determining the proactive replacement of drinking water distribution main in contrast to reactive repair. Models that produce a diagnostic index are in two general categories: those that assume a networkwide approach and those that model individual pipe behavior.

dialdehyde A class of organic compounds that have two aldehyde (HC=O) functional groups in the chemical structure (e.g., glyoxal). Some dialdehydes are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. *See also* aldehyde; glyoxal; ozonation by-product.

diallydimethylammonium chloride (DADMAC) An ionic water soluble organic compound. Its polymerized form, poly(diallydimethylammonium chloride), is a cationic polymer commonly used in water coagulation and flocculation.

dialysate The stream being depleted of salt in electrodialysis.

dialysis (1) The separation of small molecules from larger molecules in a solution by means of a semipermeable membrane. It occurs as a result of differing diffusion rates and is driven by concentration differences across the membrane barrier. (2) A process that takes advantage of the selective permeability of certain membranes to separate a solute from solution. In medicine, dialysis is used to remove waste products of metabolism from the blood of patients who are in renal failure. It is also frequently used to remove chemicals from the blood of poisoned individuals. (3) A membrane technique that can be used to transport analytes from one liquid to another. The major driving force for transport of solutes is the concentration gradient. Dialysis membranes have typically been used to remove salts and low-molecular-weight solutes from solution. In addition, dialysis membranes have been used to concentrate higher-molecular-weight organic matter and biological matter, such as viruses.

dialysis encephalopathy A progressive brain disease. Some forms of the disease have been associated with aluminum contamination of dialysis fluids, while the cause of other forms is still unclear.

diameter The length of a straight line measured through the center of a circle from one side to the other.

4', 6-diamidino-2-phenylindole ($C_{16}H_{15}N_5 \cdot 2HCl$)/ propidium iodide ($C_{27}H_{34}N_4I_2$) (DAPI)/(PI) Two fluorogenic vital dyes used to assess the viability of *Cryptosporidium* oocysts in vitro. If an oocyst is 4'6-diamidino-2-phenylindole positive, it is assumed to be viable; if it is propidium iodide positive, it is assumed to be dead.

diaphragm A thin, flexible partition (disk) that is supported at the edges and is used to transmit pressure from one substance to another while keeping them from direct contact.

diaphragm float A float mounted on a truck that runs on rails along a straight and uniform section of a channel in which the velocity is to be gauged. It can be lowered quickly into the water, made to occupy nearly the whole area of the channel during the run, and lifted out at the end. Measuring the float's velocity yields the water velocity.

diaphragm-type metering pump A pump in which a flexible rubber, plastic, or metal diaphragm is fastened at the edges in a vertical cylinder. As the diaphragm is pulled back, suction is exerted and the liquid is drawn into the pump. When it is pushed forward, the liquid is discharged.

diapositive A positive photographic transparency (the mirror image of a photograph negative).

diarrhea An abnormally frequent discharge of fluid fecal matter from the bowel, sometimes accompanied by vomiting and fever (from the Greek *dia*, meaning "through," and *rhoia*, meaning "a flow"). It is a symptom of infection by bacterial, viral, and parasitic agents that cause enteric diseases (e.g., cholera, shigellosis, salmonellosis, yersiniosis, giardiasis, camplyobacteriosis, cryptosporidiosis, and viral gastroenteritis). Diarrheal illness can be divided into several clinical syndromes: (1) simple diarrhea, managed by oral rehydration without specific identification of etiology; (2) dysentery, with scanty stools containing blood, mucous, or both; (3) persistent diarrhea of 14 or more days; (4) severe diarrhea, as seen in cholera; (5) minimal diarrhea associated with persistent vomiting, typical of viral gastroenteritis; and (6) hemorrhagic colitis, with watery diarrhea containing gross blood but no fever. *See also* gastroenteritis.

diatom A type of algae that is commonly found in freshwater and marine environments. Thousands of species, which are characterized by a cell wall composed of polymerized silica (exoskeleton), have been identified. Large deposits of diatoms are mined as diatomaceous earth, which is used in specific situations as filter media in water treatment. In addition, certain types of diatoms can contribute to taste-and-odor problems in drinking water supplies. *See also* diatomaceous earth.

diatomaceous earth (DE) The microscopic remnants of the discarded outer surface of diatoms. DE is also called fuller's earth. It is the medium most commonly used in precoat filtration. *See also* diatomaceous earth filter; diatomaceous earth filtration.

diatomaceous earth (DE) filter A pressure filter using a medium made from diatoms. The water is forced through the diatomaceous earth by pumping.

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diatomaceous earth (DE) filtration A filtration method in which diatomaceous earth is used as the filtering medium. Initially, a 1/8 to 3/16-inch (2- to 5-millimeter) thick layer, or precoat, is applied to a septum or filter element. During operation, diatomaceous earth is fed continuously until a terminal head loss is reached, after which the filter influent is shut off and the diatomaceous earth layer falls off and is discharged. This type of filtration is used most frequently for swimming pools and is best applied to source waters that have consistently low turbidity. *See also* surface filtration.

diatomic molecule A molecule containing only two atoms, such as hydrogen as H_2 or oxygen as O_2.

diatomite A processed natural material, chiefly the skeletons of diatoms, used as a filter medium.

diatomite filtration *See* diatomaceous earth filtration.

diazinon ($(CH_3)_2CHC_4N_2H(CH_3)O)PS(OC_2H_5)_2$) The generic name for the insecticide *O,O*-diethyl *O*-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate. *See also* insecticide.

diazomethane ($H_2C{=}N^+{=}N^-$) A methylating agent used in organic synthesis. Diazomethane is used to derivatize haloacetic acids, converting them to their corresponding methyl esters, so that they can be analyzed by gas chromatography. *See also* haloacetic acid.

diazomethane derivatization A method that uses diazomethane to convert haloacetic acids, ketoacids, and other organic acids to their methyl esters for subsequent gas chromatography analysis. *See also* diazomethane; gas chromatography; haloacetic acid; ketoacid.

dibromamine ($NHBr_2$) The brominated analog of dichloramine ($NHCl_2$), which can be formed during the chloramination of bromide-containing water. *See also* bromamines.

dibromoacetaldehyde (DBA) ($CHBr_2CHO$) A halogenated acetaldehyde in which two hydrogen atoms have been replaced by two bromine atoms. It is a disinfection by-product formed in chlorinated water high in bromide. *See also* disinfection by-product; haloacetaldehydes.

dibromoacetic acid (DBAA) ($CHBr_2COOH$) A haloacetic acid containing two bromine atoms. It is formed to a significant extent during the chlorination of waters containing moderate amounts of bromide (Br^-). It may also be formed during the ozonation of bromide-containing waters. *See also* haloacetic acid.

dibromoacetonitrile (DBAN) ($CHBr_2C{\equiv}N$) A haloacetonitrile containing two bromine atoms. It is formed to a significant extent during the chlorination of waters containing moderate amounts of bromide (Br^-). It may also be formed during the ozonation of bromide-containing waters. *See also* haloacetonitrile.

dibromochloroacetaldehyde (DBCA) (CBr_2ClCHO) A halogenated acetaldehyde in which three hydrogen atoms have been replaced by two bromine atoms and one chlorine atom. It is a disinfection by-product formed in chlorinated water high in bromide. It is not stable in drinking water, especially at high pH, and it can undergo hydrolysis reactions to form dibromochloromethane. *See also* disinfection by-product; haloacetaldehydes.

dibromochloroacetic acid (DBCAA) ($CBr_2ClCOOH$) A haloacetic acid containing two bromine atoms and one chlorine atom. *See also* haloacetic acid.

dibromochloroacetonitrile (DBCAN) (CBr_2ClCN) A halogenated acetonitrile in which three hydrogen atoms have been replaced by two bromine atoms and one chlorine atom. It is a disinfection by-product formed in chlorinated water high in bromide. *See also* disinfection by-product; haloacetonitrile.

dibromochloromethane (DBCM) ($CHClBr_2$) A trihalomethane containing two bromine atoms and one chlorine atom. *See also* trihalomethane.

dibromochloronitromethane (DBCNM) (CBr_2ClNO_2) A brominated analog of chloropicrin in which three hydrogen atoms of nitromethane have been replaced by two bromine atoms and one chlorine atom. It is a disinfection by-product formed in chlorinated water high in bromide. *See also* disinfection by-product; halonitromethanes; trichloronitromethane (chloropicrin).

1,2-dibromo-3-chloropropane (DBCP) ($CH_2BrCHBrCH_2Cl$) A volatile organic chemical used as a soil fumigant for nematode control on crops. It has been detected in groundwater. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.0002 milligrams per liter. The US Environmental Protection Agency has canceled all uses for this pesticide, which is also called dibromochloropropane.

1,1,1-dibromochloropropanone (1,1,1-DBCP) ($CBr_2ClCOCH_3$) A halogenated propanone in which three hydrogen atoms have been replaced by two bromine atoms and one chlorine atom. It is a disinfection by-product formed in chlorinated water high in bromide. It is unstable in drinking water and can undergo hydrolysis reactions to form dibromochloromethane. *See also* disinfection by-product; halopropanones.

dibromoiodomethane (DBIM) ($CHBr_2I$) An iodinated trihalomethane formed in chlorinated water high in iodide. It may cause medicinal odors in drinking water. *See also* disinfection by-product; trihalomethane.

dibromonitromethane (DBNM) A brominated halonitromethane in which two hydrogen atoms of nitromethane have been replaced by two bromine

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atoms. It is a disinfection by-product formed in chlorinated water high in bromide. *See also* disinfection by-product; halonitromethanes.

1,1-dibromopropanone (1,1-DBP) ($CHBr_2COCH_3$) A halogenated propanone in which two hydrogen atoms of propanone have been replaced by two bromine atoms. It is a disinfection by-product formed in chlorinated water high in bromide. *See also* disinfection by-product; halopropanones.

DIC *See* dissolved inorganic carbon.

dichloramine ($NHCl_2$) A disinfectant produced from the mixing of chlorine and ammonia (NH_3). Typically, this chloramine species is produced to a lesser extent than monochloramine (NH_2Cl). However, chloramination at a low pH (e.g., 7), high chlorine-to-ammonia–nitrogen ratios (e.g., 7:1 by weight), or both results in higher levels of dichloramine. *See also* chloramines; chlorine-to-ammonia–nitrogen ratio; monochloramine.

dichloroacetaldehyde (DCA) ($CHCl_2CHO$) A halogenated acetaldehyde in which two of the three alpha hydrogen atoms of acetaldehyde have been replaced by chlorine atoms. It is a disinfection by-product in chlorinated water. *See also* disinfection by-product; haloacetaldehydes.

dichloroacetic acid (DCAA) ($CHCl_2COOH$) A haloacetic acid containing two chlorine atoms. Typically, this substance and trichloroacetic acid are the principal haloacetic acids formed during chlorination, except for in waters containing moderate amounts of bromide (Br^-). *See also* haloacetic acid; trichloroacetic acid.

dichloroacetonitrile (DCAN) ($CHCl_2C{\equiv}N$) A haloacetonitrile containing two chlorine atoms. Typically, this is the principal haloacetonitrile formed during chlorination, except for in waters containing moderate amounts of bromide (Br^-). *See also* haloacetonitrile.

dichlorobenzene ($C_6H_4Cl_2$) An aromatic hydrocarbon with two chlorine atoms attached to a benzene ring. Two dichlorobenzene isomers (*ortho*- and *para*-) are regulated by the US Environmental Protection Agency. *See also* aromatic hydrocarbon; *ortho*-dichlorobenzene; *para*-dichlorobenzene.

***ortho*-dichlorobenzene ($C_6H_4Cl_2$)** The common name for 1,2-dichlorobenzene. This volatile organic chemical has various industrial uses, including use as a solvent, fumigant, or insecticide. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.6 milligrams per liter. *See also* fumigant; insecticide; solvent; volatile organic compound.

***para*-dichlorobenzene ($C_6H_4Cl_2$)** The common name for 1,4-dichlorobenzene. This volatile organic chemical has various industrial uses, including use as an insecticide, germicide, or fumigant. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.075 milligrams per liter. *See also* fumigant; germicide; insecticide; volatile organic compound.

dichlorodiphenyl dichloroethane (DDD) ($(ClC_6H_4)_2CHCHCl_2$) The generic name for 1,1-dichloro-2,2 bis-(*para*-chlorophenyl) ethane, an insecticide (now discontinued) that was formerly applied to many fruits and vegetables. It is also referred to as tetrachlorodiphenylethane. *See also* insecticide.

dichlorodiphenyl dichloroethylene (DDE) ($(ClC_6H_4)_2C{:}CCl_2$) A degradation product of dichlorodiphenyl trichloroethane that has been found as an impurity in that substance's residues. *See also* dichlorodiphenyl trichloroethane.

dichlorodiphenyl trichloroethane (DDT) ($(ClC_6H_4)_2CH(CCl_3)$) A generic name for 1,1,1-trichloro-2,2-bis (*para*-chlorophenyl) ethane, an insecticide–pesticide that is not biodegradable and is ecologically damaging. Its agricultural use in the United States was prohibited in 1973. *See also* dichlorodiphenyl dichloroethylene; insecticide; pesticide.

1,1-dichloroethane (CH_3CHCl_2) A volatile organic chemical used as a solvent. *See also* solvent; volatile organic compound.

1,2-dichloroethane ($ClCH_2CH_2Cl$) A volatile organic chemical that has various industrial uses, including use as a solvent. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.005 milligrams per liter. It is also called ethylene dichloride. *See also* solvent; volatile organic compound.

1,1-dichloroethylene ($Cl_2C{:}CH_2$) A volatile organic compound. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.007 milligrams per liter. *See also* volatile organic compound.

1,2-dichloroethylene (ClHC:CHCl) A volatile organic chemical that has various industrial uses, including use as a solvent. It exists as *cis* and *trans* isomers. Both isomers are regulated by the US Environmental Protection Agency. *See also* isomer; solvent; volatile organic compound.

***cis*-1,2-dichloroethylene (ClHC:CHCl)** An isomer of 1,2-dichloroethylene in which the chlorine atoms are at adjacent corners of the molecule. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.07 milligrams per liter. *See also cis;* 1,2-dichloroethylene; isomer.

***trans*-1,2-dichloroethylene (ClHC:CHCl)** An isomer of 1,2-dichloroethylene in which the chlorine atoms are at opposite corners of the molecule. Its presence in

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drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.1 milligrams per liter. *See also* 1,2-dichloroethylene; isomer; *trans.*

dichloroiodomethane (DCIM) ($CHCl_2I$) An iodinated trihalomethane formed in chlorinated water high in iodide. It may cause medicinal odors in drinking water. *See also* disinfection by-product; trihalomethane.

dichloromethane (CH_2Cl_2) The legal label name for methylene chloride, a volatile organic chemical primarily used as a solvent. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.005 milligrams per liter. *See also* solvent; volatile organic compound.

dichloronitromethane (DCNM) A chlorinated halonitromethane in which two hydrogen atoms of nitromethane have been replaced by two chlorine atoms. It is a disinfection by-product formed in chlorinated water. *See also* disinfection by-product; halonitromethanes.

2,4-dichlorophenol ($Cl_2C_6H_3OH$) A synthetic organic chemical used in organic synthesis. In addition, 2,4-dichlorophenol can be formed during the chlorination of water. *See also* chlorophenol; synthetic organic chemical.

2,4-dichlorophenoxyacetic acid (2,4-D) ($Cl_2C_6H_3OCH_2COOH$) A selective weed killer and defoliant. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.07 milligrams per liter. *See also* defoliant.

1,2-dichloropropane ($CH_3CHClCH_2Cl$) A volatile organic chemical with various industrial uses, including use as a solvent or nematocide. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.005 milligrams per liter. It is also known as propylene dichloride. *See also* nematocide; solvent; volatile organic compound.

1,3-dichloropropane ($CH_2ClCH_2CH_2Cl$) A volatile organic chemical. *See also* volatile organic compound.

2,2-dichloropropane ($CH_3CCl_2CH_3$) A volatile organic chemical. *See also* volatile organic compound.

1,1-dichloropropanone (1,1-DCP) ($CHCl_2COCH_3$) A halogenated propanone in which two of the six hydrogen atoms of propanone have been replaced by chlorine atoms. It is a disinfection by-product in chlorinated water. *See also* disinfection by-product; halopropanones.

1,3-dichloropropanone (1,3-DCP) ($CH_2ClCOCH_2Cl$) A halogenated propanone in which two of the six hydrogen atoms of propanone have been replaced by chlorine atoms. It is a disinfection by-product in chlorinated water. *See also* disinfection by-product; halopropanones.

1,1,1-dichloropropanone (1,1,1-DCP) ($CHCl_2COCH_3$) A halogenated propanone in which two of the six hydrogen atoms of propanone have been replaced by chlorine atoms. It is a disinfection by-product in chlorinated water. *See also* disinfection by-product; halopropanones.

1,1-dichloropropene (CCl_2:$CHCH_3$) A volatile organic chemical. *See also* volatile organic compound.

1,3-dichloropropene ($CHCl$:$CHCH_2Cl$) A soil fumigant. *See also* fumigant.

DIC microscopy *See* differential interference contrast microscopy.

dieldrin ($C_{12}H_{10}OCl_6$) The generic name for an insecticidal product containing not less than 85 percent 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,exo-5,8-dimethanonapthalene and not more than 15 percent active related compounds. Dieldrin is a stereoisomer of endrin. *See also* endrin.

dielectric constant An electrical property related to the polarizability of a medium such as water. Measurements are made in groundwater, and changes in the dielectric constant compared to a baseline indicate the presence of contaminants.

diene An aliphatic hydrocarbon that contains two double bonds (e.g., 1,3-butadiene: $H_2C{=}CHHC{=}CH_2$). A diene is also referred to as a diolefin. *See also* aliphatic compound; hydrocarbon.

diethyl ether (DEE) ($(C_2H_5)_2O$) An ether used as a solvent in analytical chemistry to extract polar organic compounds from water. It is also known as an ethyl ether. *See also* ether; solvent.

di(2-ethylhexyl) adipate (DEHA) ($(CH_2CH_2COOCH_2CH(C_2H_5)C_4H_9)_2$) A synthetic organic chemical used as a plasticizer or solvent. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.40 milligrams per liter. *See also* plasticizer; solvent; synthetic organic chemical.

di(2-ethylhexyl) phthalate (DEHP) ($C_6H_4(COOCH_2CH(C_2H_5)C_4H_9)_2$) A synthetic organic chemical used as a plasticizer for many resins and elastomers. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.006 milligrams per liter. *See also* plasticizer; synthetic organic chemical.

N,N-diethyl-p-phenylenediamine (DPD) ($(C_2H_5)_2NC_6H_4NH_2$) A reagent used in the determination of a chlorine residual. A DPD method is commonly used in the field as part of a colorimetric test kit. Variations of the DPD method can be performed in the laboratory in the form of a titration with ferrous ammonium sulfate or a spectrophotometric method. *See*

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also N,N-diethyl-p-phenylenediamine–ferrous ammonium sulfate test.

N,N-diethyl-p-phenylenediamine (DPD) methods Methods for the determination of chlorine residual in water using N,N-diethyl-p-phenylenediamine as a reagent. These methods are available for both volumetric (titration) and colorimetric determinations. They are generally simpler than amperometric methods. *See also* amperometric methods; N,N-diethyl-p-phenylenediamine.

N,N-diethyl-p-phenylenediamine–ferrous ammonium sulfate (DPD-FAS) ($Fe(SO_4)•(NH_4)_2SO_4•6H_2O$) test A test for the determination of chlorine residual. In this test, N,N-diethyl-p-phenylenediamine is used in the laboratory with a titration of ferrous ammonium sulfate. *See also* N,N-diethyl-p-phenylenediamine.

DIF *See* development impact fee.

differential carbon dioxide transfer The difference in the transfer of carbon dioxide at the air–water interface in jar tests as compared to full-scale treatment plants. This difference may lead to errors in predicting full-scale plant performance with jar tests. *See also* jar test.

differential gauge A pressure gauge used to measure the difference in pressure between two points in a pipe or receptacle containing a liquid.

differential intake An intake formed by a hollow, low-diversion dam with a longitudinal slot for intercepting a part of the stream flow and conducting it to a pipeline at one or both ends of the dam.

differential interference contrast (DIC) microscopy Modification of phase microscopy that emphasizes edges and lines of the specimen that may aid in its identification. It is a method commonly used to identify protozoan parasites.

differential plunger pump A reciprocating pump with a plunger designed so that it draws the liquid into the cylinder on the upward stroke but has double action on the discharge stroke. *See also* double-action reciprocating pump.

differential pressure The relative difference in pressure between two pressure sources or across some restriction, e.g., across a differential measuring meter that includes an orifice plate or a venturi tube. A differential pressure representing head loss caused by pipe friction can be measured with a rigid U-tube connected at two points along a water line by long, flexible, small-diameter connecting tubes.

differential pressure (DP) cell An instrument used for determining the difference in pressure between two hydraulically connected locations. For example, a differential pressure cell could be used to determine head loss through a filter. *See also* differential pressure gauge; head loss.

differential pressure gauge An apparatus used to measure the pressure difference between two points in a system. The primary application is for the calculation of flow when the device senses a pressure differential in a venturi-type flow element. The difference in pressure between the upstream entrance to the inlet cone, on one hand, and the throat of the cone, on the other, is proportional to the flow through the element; this difference is also commonly used to indicate head loss across a filter element. Most elements utilize electronic signals generated by strain-gauge–type elements mounted on a metallic diaphragm.

differential pulse polarography (DPP) A technique used in the electrochemical analysis of a variety of analytes, such as metal cations and anions. It is based on the difference in current generated between two polarographic cells.

differential settling A method of flocculation in which particle contact is promoted as a result of the different settling velocities of various particles. *See also* orthokinetic (shear) flocculation; perikinetic flocculation.

differential surge tank A combination of an orifice surge tank and a normal surge tank working together to dampen surges or control sudden pressure changes in a water distribution system or transmission main.

differential thermal analysis (DTA) One of a group of techniques used in analyzing the manner in which materials change when heated. It can be used to study phase transitions in materials. In differential thermal analysis, the behavior of a sample when heated is compared to the analogous behavior of a reference material. The technique is most often applied to the characteristics of materials, especially polymers, but could also be used to determine the specific heat of water.

diffraction A modification of the behavior of light or other radiation as it passes by the edge of an aperture. It is an interference phenomenon caused by the wave nature of radiation; the rays of light appear to be deflected, and they produce light and dark bands on a surface. Some laboratory instruments, such as spectrophotometers, use diffraction gratings as part of their optical system to disperse the radiation. Selected wavelengths of radiation can then be used in spectroscopic analysis.

diffused aeration The dissolution of air or oxygen by the use of coarse-bubble spargers or fine-bubble porous disks or tubes. Examples of uses for diffused aeration include removing volatile compounds from water and increasing the oxygen concentration in water.

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diffused air Small air bubbles formed below the surface of a liquid to transfer oxygen to the liquid.

diffused air aeration Aeration produced in a liquid by air passed through a diffuser.

diffused surface water (1) Floodwater that has escaped from a stream channel. (2) Water derived from rainfall, melting snow, seepage, or springs that is on its way to a stream but has not reached a definite channel.

diffuser (1) A section of a perforated pipe or porous plates used to inject a gas, such as carbon dioxide (CO_2) or air, under pressure into water. (2) A type of pump.

diffuser bowl The segment of a turbine pump that houses one impeller stage.

diffuser plate A porous plate used in aeration tanks to diffuse air or other gases in various water treatment processes. *See also* diffuser.

diffuser tube An air tube used in aeration tanks to diffuse air or other gases in various water and treatment processes. *See also* diffuser.

diffuser vane A vane installed within a pump casing (on diffuser centrifugal pumps) to change velocity head to pressure head.

diffusing pit A form of diffusing well.

diffusing well A well into which water is injected to restore water to an aquifer. *See also* inverted well.

diffusion A process whereby molecules or particles move and intermix because of a concentration gradient driving force; the movement of a compound within a medium or from one medium to another. For example, longitudinal diffusion refers to the movement of a compound in a conduit at a speed either faster or slower than the mean velocity of the solution, whereas boundary layer diffusion refers to the movement of a compound to or from a solution through a boundary layer surrounding a particulate medium. Molecular diffusion is quantified by Fick's law. *See also* Fick's law of diffusion.

diffusion aerator An aerator that blows air under low pressure through submerged porous plates, perforated pipes, or other devices so that small air bubbles rise through the water continuously.

diffusion dialysis An electrolyte mixture separation process driven by a concentration gradient across an anion-exchange membrane. Metals can be removed from solutions by having the metal solution on one side of the membrane and deionized water on the other side. Anions and hydrogen ions diffuse through the membrane into the deionized water compartment, and the metals and other cations are rejected by the membrane. *See also* dialysis.

diffusion feeder A chemical feed system in which chemicals are added to a water stream in controlled quantities. These chemicals provide pipeline or metal surface protection, disinfection, or both. A diffusion feeder is designed in such a way that a small stream of water is diverted through a tank so that the water flows over the chemical material; a small amount of the chemical is then diffused (dissolved) into the water and carried back to the main water line. A diffusion feeder is also called a bypass feeder.

diffusion van A fixed or removable casting in a pump between the impeller and the casing with liquid passages designed to convert velocity head to pressure head.

diffusion well A well constructed to conduct surface water or other surplus water into an aquifer to increase the groundwater supply. Such a well is also called a recharge well.

diffusive-air flow test Test applied to microfiltration and ultrafiltration membrane processes. This direct integrity test method applies air at a specific pressure (typically about 80 percent of the bubble point pressure of the membrane) to one side of a fully wetted membrane, and the pressure loss over a given time period is monitored. Air diffuses through the membrane pores according to Fick's law of diffusion. If the pressure decline is greater than a fixed value for the membrane and system, the membrane system is considered compromised, possibly from a broken membrane fiber (for hollow-fiber membranes). *See also* bubble point; direct integrity testing; Fick's law of diffusion.

digital Pertaining to the discrete numerical representation of information. *Contrast with* analog.

digital capture device A device that converts an analog image, such as a hard copy map or aerial photograph, to digital form by optically reading the tone or color variation of the analog image and converting it to a raster form suitable for display and analysis.

digital computer model (1) A model of groundwater or surface water flow, contaminant transport, or both such that the aquifer or stream is described by numerical equations that have specified values for boundary conditions and are solved using a digital computer. (2) A model of pipeline flow, contaminant transport, or both for which the distribution system is described by hydraulic equations (with specified values for forcing functions) and storage conditions. These equations are solved using a digital computer. (3) A model of any water-related system that is described by numerical equations and solved on a digital computer. For instance, a spreadsheet that does $C \times T$ calculations for disinfection is a digital computer model.

digital correlator An electronic device or computer system that picks up sounds from a water leak and

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indicates its location by graphic form or approximate distance from a defined point in readout numbers.

digital elevation model (DEM) A digital cartographic representation of the surface of the earth or a subsurface feature through a series of three-dimensional coordinate values. Such a model is also called a digital terrain model.

digital light micrography A technique in which electronic images of specimens are generated with the assistance of a digital camera attached to a light microscope. The format of these images allows for compact storage and convenient sharing among users.

digital line graph (DLG) A standard file structure for cartographic digital data established and used by the US Geological Survey that contains point coordinates describing planimetric and contour data such as boundaries, drainage lines, transportation routes, and features.

digital readout A readout of an instrument in the form of a direct, numerical display of the measured value.

digital service unit A peripheral device that enables data transmission between computer devices via an outside communication carrier. These units connect devices across digital lines that support both voice and data transmission.

digital terrain model (DTM) *See* digital elevation model.

digitization The process of converting analog data, such as an analog map, into a digital format for use by a computer program.

digitizer *See* digitizing tablet.

digitizing A technique used to convert graphic information from analog to digital form, in which maps are retraced by using a digitizing tablet and cursor. The map to be digitized is mounted on a digitizing tablet. The scale, angle of rotation, and area coverage are registered with the computer system through a standard procedure. The user then digitizes each map feature by pointing the cursor and pushing appropriate buttons.

digitizing table A large, free-standing digitizing tablet.

digitizing tablet A peripheral device used to convert graphic information from analog to digital form for use in a computer. The user moves a cursor to select positional points on a hard copy map mounted on the surface of the digitizing tablet; these points are transmitted by electrical signals from the cursor to the tablet. Conductors in the tablet receive the signals and convert them to relative tablet positions. A tablet may be placed on a horizontal surface such as a table.

dihaloacetic acid (DHAA) (CHX_2COOH) A halogenated acetic acid in which two of the three alpha hydrogen atoms of acetic acid have been replaced by halogen atoms. It is a disinfection by-product in chlorinated water. Three common dihaloacetic acids are dichloroacetic acid, bromochloroacetic acid, and dibromoacetic acid. *See also* disinfection by-product; haloacetic acid.

dihaloacetonitrile (DHAN) ($CHX_2C{\equiv}N$, where X is Br, Cl, or both) A haloacetonitrile containing two halogen atoms (normally chlorine [HOCl, OCl^-], bromine [Br], or both). It is a disinfection by-product in chlorinated water. Three common dihaloacetonitriles are dichloroacetonitrile, bromochloroacetonitrile, and dibromoacetonitrile. *See also* haloacetonitrile.

dihalogen-substituted acetic acid (DXAA) Acetic acid with two halogen atoms substituted for two hydrogen atoms. *See also* haloacetic acid.

dihydrogen oxide (H_2O) Water.

dike (1) An embankment constructed to prevent overflow of water from a stream or other body of water. (2) An embankment constructed to retain water in a reservoir. The term *dam* is usually used for a structure constructed across a watercourse or stream channel, and *dike* is used for one constructed solely on dry ground. (3) A vertical or steeply inclined wall of igneous rock that has been forced into a fissure in a molten condition and has consolidated there. Dikes may obstruct the passage of groundwater.

diketone A class of organic compounds that have two ketone (R-(C=O)-R) functional groups in the chemical structure (e.g., dimethyl glyoxal). Some diketones are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. *See also* dimethyl glyoxal; ketone; ozonation by-product.

dilute solution A solution that has been made weaker, usually by adding reagent water.

dilute stream *See* demineralized stream.

dilution The act of adding more solvent or water to a given solution to make the solution less concentrated. Sometimes this is done to attain the proper concentration, sometimes to make the solution easier to handle.

dilution bottle A heat-resistant glass bottle used for diluting bacteriological samples before analysis. It is also called a milk dilution bottle or French square.

dilution gauging A method of measuring the flow of water by introducing a constant flow of a solution of known concentration for a sufficient length of time at one section of a water conduit and then determining the resulting dilution of this solution at another downstream section. Chemical gauging, electrochemical gauging, and radioactive solution gauging are different forms of dilution gauging.

dilution method A technique for determining the discharge in a flowing stream by dilution of a tracer injected at a known concentration and flow rate. The method assumes that no tracer compound is in the

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water upstream of the injection point and that complete mixing occurs between the injection point and the measuring point. The formula to compute discharge is

$$Q_S = Q_T \frac{C_T - C_S}{C_S}$$

Where (in any consistent set of units):

Q_S = the volumetric flow rate in the stream
C_T = the concentration of the tracer in the injection fluid
Q_T = the injection fluid volumetric flow rate
C_S = the measured concentration in the stream downstream of the injection point

DIME file *See* dual independent map encoding file.

dimensionless unit hydrograph A unit hydrograph for which the discharge values are expressed as the ratio of actual discharge to the peak value and the time values are expressed as the ratio of actual time to the time in which the peak discharge value occurs. The hydrograph is called dimensionless because the discharge ratio and time ratio have no units. *See also* unit hydrograph.

dimer An oligomer (a polymer molecule consisting of only a few monomer units) composed of two molecules of the same chemical composition. *See also* polymer.

dimethyl glyoxal ($CH_3COCOCH_3$) A diketone created during the reaction of ozone (O_3) with natural organic matter. *See also* diketone; ozonation by-product.

dimethyl-2,3,5,6-tetrachloroterephthalate (DCPA) ($C_6Cl_4(COOCH_3)_2$) An herbicide.

dimethyl-2,3,5,6-tetrachloroterephthalate (DCPA) di-acid degradate A degradation product of DCPA ($C_6Cl_4(COOCH_3)_2$), which is an herbicide. *See also* herbicide.

dimethyl-2,3,5,6-tetrachloroterephthalate (DCPA) mono-acid degradate A degradation product of DCPA ($C_6Cl_4(COOCH_3)_2$), which is an herbicide. *See also* herbicide.

dimictic Pertaining to lakes and reservoirs that freeze over and normally go through two stratification and two mixing cycles within a year.

dimple spring *See* depression spring.

2,4-dinitrophenol ($C_6H_3OH(NO_2)_2$) A synthetic organic chemical with various industrial uses, including use in dyes, preservation of lumber, manufacture of photographic developer, and explosives manufacture. *See also* synthetic organic chemical.

2,4-dinitrotoluene ($C_6H_3CH_3(NO_2)_2$) A synthetic organic chemical with various industrial uses, e.g., in organic synthesis, dyes, and explosives. *See also* synthetic organic chemical.

2,6-dinitrotoluene ($C_6H_3CH_3(NO_2)_2$) A synthetic organic chemical. *See also* synthetic organic chemical.

dinoseb ($CH_3(C_2H_5)CHC_6H_2(NO_2)_2OH$) The legal label name for 2,4-dinitro-6-sec-butylphenol, a synthetic organic chemical used as an insecticide, ovicide, and herbicide. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.007 milligrams per liter. *See also* herbicide; insecticide; ovicide; synthetic organic chemical.

1,4 dioxane ($OCH_2CH_2OCH_2CH_2$) A solvent stabilizer typically associated with trichloroethane. It is also present in a variety of paint products. Several states set drinking water guidelines for 1,4-dioxane. *See also* 1,1,1-trichloroethane; 1,1,2 trichloroethane.

dioxin Typically, a specific dioxin, i.e., 2,3,7,8-tetrachlorodibenzo-p-dioxin, which is a chlorinated hydrocarbon that occurs as an impurity in the herbicide 2-(2,4,5-trichlorophenoxy)propionic acid. In addition, other environmental sources exist for this highly toxic and persistent contaminant, which is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.00000003 milligrams per liter.

DIP *See* ductile-iron pipe.

1,2-diphenylhydrazine ($C_6H_5NHNHC_6H_5$) A synthetic organic chemical. *See also* synthetic organic chemical.

diplopia A disorder of vision that causes objects to appear double.

dipole array A particular arrangement of electrodes used in electrical resistivity surveys. Three configurations are in common usage: Wenner array, Schlumberger array, dipole–dipole array. The arrays differ principally in electrode spacing and relative orientation.

DIPRA *See* Ductile Iron Pipe Research Association.

diquat ($(C_5H_4NCH_2)_2Br_2$) The commercial name for 6,7-dihydrodipyrido(1,2-a:2-,1-c)pyrazidinium salt (1,1-ethylene 2,2-di-pyridium dibromide), an herbicide and plant growth regulator. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.02 milligrams per liter. *See also* herbicide.

DIR *See* demand initiated regeneration.

direct-acting reciprocating pump A steam-driven reciprocating pump in which the steam piston is directly connected to the liquid piston or plunger through the piston rod.

direct-connected pump A power pump directly connected to the power unit that operates it by some form of coupling or clutch. Such a pump is also called a close-coupled pump.

direct cross-connection *See* actual cross-connection.

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direct current (DC) A unidirectional electrical current that does not change in value over time (or changes so little that the change can be neglected). It is measured in amperes.

direct debt The debt an entity has incurred in its own name or assumed through the annexation of territory or consolidation with another entity.

direct deoxyribonucleic acid (DNA) reactive mechanisms Chemicals that directly interact with DNA to cause disease.

direct digital control (DDC) A type of control, often used in heating, ventilation, and air conditioning systems (HVAC), in which a digital controller (usually a microcompressor) is directly connected to the controlled devices. *See also* distributed control system.

direct filtration A method of filtration in which coagulated and flocculated particles are applied directly to a filtering medium from the flocculation basin without passing through a sedimentation tank or a flotation device. It is not to be confused with direct in-line filtration. *See also* coagulation; direct in-line filtration; filtration; flocculation.

direct fire costs Those costs incurred solely for the purpose of fire protection.

direct fire pressure The pressure required in the pipes of a water distribution system to provide adequate fire streams without the use of fire department pumpers when the fire hose is connected directly to the hydrant.

direct flow (1) *See* dead-end flow. (2) Water diverted from a stream or river without interruption between diversion and use except for incidental purposes, such as filtration or settling.

direct injection A technique in which samples are injected into an analytical instrument without prior treatment of the sample.

direct in-line filtration A method of filtration in which coagulated particles are flocculated "in-line" prior to and during direct application to a filtering medium. A dedicated basin for flocculation, sedimentation, or flotation is not provided. Direct in-line filtration is not to be confused with direct filtration (which uses a dedicated flocculation basin). It is also called in-line filtration. *See also* direct filtration; filtration; flocculation.

direct integrity monitoring method *See* direct integrity testing.

direct integrity testing For membrane processes, a physical test applied to a membrane to identify or isolate integrity breaches, or both. Air pressure-hold, diffusive air flow, sonic, and bubble-point tests are direct integrity test methods for microfiltration and ultrafiltration membrane processes. *See also* acoustic sensing; air pressure–hold test; bubble point; bubble-point test; diffusive-air flow test; fluorescently labeled microsphere.

directional flushing A systematic approach to cleaning water mains that uses water at a high velocity in one direction from a clean source to the area to be flushed.

direct labor Labor directly expended or applied in productive operations, as distinguished from that not directly connected with a productive process.

direct laboratory reporting Electronic transfer of water quality data from the laboratory to the regulatory agency or water supplier.

direct material A material that can be identified with a particular product or service and the cost of which can be charged directly to that product or service.

direct nonpotable-water reuse The use of community wastewaters treated to a sufficient degree that they are acceptable for a wide range of nonpotable uses, such as irrigation, and direct discharge into a nonpotable distribution system that provides service to customers who obtain their potable water from a separate system. *See also* direct reuse; nonpotable reuse; water reuse.

Directorate for Information Analysis and Infrastructure Protection (IAIP) A component of the Department of Homeland Security charged with assessing current and future threats, mapping those threats against vulnerabilities, issuing timely warnings, and taking preventive and protective action.

direct oxidation The direct combination of substances with oxidants, e.g., oxidation of substances in drinking water by the direct application of oxidizing agents such as chlorine.

direct plating Taking a sample aliquot from a specimen and applying it directly to a culture plate.

direct potable-water reuse The use of community wastewaters treated to a sufficient degree that they are acceptable for drinking and direct discharge into a potable-water distribution system. This practice has not been adopted by or approved for any community in the United States. *See also* direct reuse; potable reuse; water reuse.

direct precipitation Water that falls directly onto a lake, reservoir, or stream without passing through any land phase of the runoff cycle.

direct reuse The use of reclaimed water for nonpotable or potable purposes without first discharging to a water supply source. Direct reuse for a public drinking water supply is not accepted by the American Water Works Association or regulatory agencies. *See also* direct nonpotable-water reuse; direct potable-water reuse.

direct right *See* direct flow; *see also* dead-end flow.

direct runoff Water that flows over the ground surface or through the ground directly into streams, rivers, or lakes.

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direct shear strength Soil property that can be used to assess the bearing capacity and stability of a soil or similar material. In some cases, the direct shear strength of water treatment plant residuals has been measured to establish suitability for their use as a landfill cover material.

direct total microbial count An analytical method for assaying bacteria in water. This procedure is described in *Standard Methods for Examination of Water and Wastewater,* #9216. It is a technique that can be used to evaluate the amount of bacteria retained on a filter. The bacteria are stained with a fluorescent reagent and counted with an epifluorescence microscope, which is designed to illuminate the stained bacteria by fluorescence. The technique detects both viable and nonviable bacteria.

direct-wire control A system that controls equipment at a site via wires running from the equipment to the on-site control panel.

Dirichlet condition A boundary condition common in groundwater modeling such that the head is known at the boundary of the flow field.

disaster preparedness A plan of action for an event that would cause widespread distress and/or destruction (includes an event that may occur but is not probable).

disc A circular piece of metal used in many valves as the movable element that regulates the flow of water as the valve is operated.

disc filtration *See* cloth media filtration.

discharge The volume of water flowing past a specific point in a water system in a given period of time. Typical units are cubic meters per second, gallons per minute, million gallons per day, and cubic feet per second.

discharge area The cross-sectional area of a waterway, used to compute the discharge of a stream, pipe, conduit, or other carrying system.

discharge capacity The maximum rate of flow that a conduit, channel, or other hydraulic structure is capable of passing.

discharge coefficient A coefficient by which the theoretical discharge of a fluid through an orifice, weir, nozzle, or other passage must be multiplied to obtain the actual discharge.

discharge curve A curve that expresses the relationship between the discharge of a stream or open conduit at a given location and the stage or elevation of the liquid surface at or near that location. It is also called a rating curve or discharge rating curve.

discharge head The pressure measured at the center line of a pump discharge and very close to the discharge flange, converted into meters or feet of head. The pressure is measured from the center line of the pump to the hydraulic grade line of the water in the discharge pipe.

discharge hydrograph A hydrograph of the discharge or flow of a stream or conduit.

discharge measurement (1) A determination of the quantity of water flowing per unit of time in a stream channel, conduit, or orifice at a given point by means of a current meter, rod float, weir, Pitot tube, or other measuring device or method. The operation includes not only the measurement of the velocity of water and the cross-sectional area of the stream of water, but also the necessary subsequent computations. (2) The numerical results of a measurement of discharge, expressed in appropriate units. *See also* stream gauging.

discharge piping The piping system or pipe header through which water flows from the outlet side of a pump, pump station, or reservoir.

discharge rate The volume of flow of water over a given time discharged by a pump, fire hydrant, hose bib, spillway, or other facility past a given point, usually the outlet. The flow is expressed in units of volume per time, such as cubic meters per day, liters per minute, cubic feet per second, or gallons per minute.

discharge rating curve A curve showing the relationship between the discharge of a gate, meter, or other hydraulic structure or instrument and the pertinent hydraulic conditions that affect the discharge.

discharge table A table showing the relationship between the gauge height and the discharge of a stream or conduit at a given gauging station.

discharge valve A valve located on the outlet side of a pump or on the piping system where water flows from a reservoir.

discharge velocity *See* specific discharge.

disconnect switch A hand-operated switch for isolating electrical power from a device to permit safe maintenance on the device. The switch must open all power conductors running to the load and is always lockable in the off (or open) position. It is not necessarily the same as a loss-of-signal switch, which is used to prevent operation of electrical equipment. *See also* loss-of-signal switch.

discontinuous interstice A small open space or interstice that is not connected with another interstice. It usually occurs in lava or other effusive igneous rock of a vesicular texture. A rock that has only discontinuous interstices is not permeable.

discount As applied to the securities issued or assumed by a utility, the excess of the par or face value of the securities plus interest or dividends accrued at the date of the sale over the cash value of the consideration received from their sale.

discounted cash-flow (DCF) model A model, often used in rate making, for estimating the investor

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required rate of return on common equity. By definition, the DCF model contends that the market price of a common stock is equal to the cumulative present value of all future cash flows to investors produced by said common stock.

discount rate A rate that is used to restate, or discount, future cash flows to their net present value. It usually represents the long-term cost of funds for a project or program. The discount rate can also be thought of as the interest-earning rate on an investment instrument, such as 6.0 percent on a long-term bond or 5.0 percent on short-term deposits in a financial institution. The discount rate includes both an inflation component and a real return-on-investment component. The real component is the long-term real return on the investment, usually calculated at about 3.0 percent, and the balance of the return rate is inflation. *See also* inflation; net present value; return on investment.

discrete dynode detector A type of electron multiplier consisting of an array of individual electrodes, or dynodes, that are used in mass spectrometers to carry out the electron multiplication process and detect the ions passed by the mass spectrometer. Use of the discrete dynode detector is gradually replacing use of the channel electron multiplier detector in inductively coupled plasma–mass spectrometry. The discrete dynode detector's higher sensitivity, longer lifetime, and wider dynamic range are all desirable features. *See also* inductively coupled plasma–mass spectrometry.

discrete sedimentation Sedimentation in which the removal of suspended solids is a function only of terminal settling velocity. It is also called free settling or type I settling. *See also* flocculant; type III settling.

disease Any change from a state of health; an interruption in the normal functioning of a body structure.

disease-causing bacteria Pathogenic bacteria capable of infecting a host and causing disease.

disincentive fee A monetary charge intended to discourage a specific activity or behavior, for example, an extra fee imposed on every acre-foot of water pumped from an underground aquifer.

disinfectant An agent that destroys or inactivates harmful microorganisms. *See also* disinfection.

disinfectant contact time The time in minutes that it takes for water to move from the point of disinfectant application or the previous point of disinfectant residual measurement to a point before or at the point where residual disinfectant concentration (C) is measured. Disinfectant contact time in pipelines must be calculated based on plug flow by dividing the internal volume of the pipe by the maximum hourly flow rate through that pipe. Disinfectant contact time within mixing basins and storage reservoirs must be determined by tracer studies or an equivalent demonstration. *See also* $C \times T$.

disinfectant decay The loss or decline of disinfectant concentration or residual over time. Strong oxidizing disinfectants such as ozone or chlorine dioxide typically exhibit more rapid loss of the residual chemical, whereas a weaker oxidant such as chloramine exhibits a slower decay of its residual.

disinfectant demand The amount of disinfectant required to meet a given disinfection goal. The characteristics of the water to be treated and the desired disinfectant residual will affect the amount of disinfectant required. Examples of constituents that consume oxidants (such as disinfecting chemicals) include turbidity, natural organic matter, taste- and odor-causing compounds, ammonia, sulfur, iron, and manganese. The oxidant demand exerted by such constituents must be met before a disinfectant residual can be achieved. *See also* chlorine demand; oxidant demand.

disinfectant/disinfection by-products (D/DBP) A group of disinfectants and the chemical by-products resulting from the application of those disinfectants that have been selected by the US Environmental Protection Agency for regulation.

disinfectant residual An excess of disinfecting chemical—such as chlorine, ozone, chlorine dioxide, or chloramines—left in the water after treatment. The presence of residuals indicates that an adequate amount of disinfectant has been added at the treatment stage to ensure completion of all reactions with some disinfectant remaining. *See also* chlorine demand; disinfectant demand; oxidant demand.

disinfectant residual decay *See* disinfectant decay.

disinfectant residual decay kinetics The rate at which a given disinfectant residual concentration declines over time. Typical units are milligrams per liter-time.

disinfectant-resistant pathogen *See* disinfection-resistant pathogen.

Disinfectants and Disinfection By-Products Rule (DBPR) A national primary drinking water regulation promulgated by the US Environmental Protection Agency to regulate drinking water disinfectants and by-products of disinfection. Stage 1 became effective in 2001 and set maximum contaminant levels (MCLs) for total trihalomethanes (TTHMs) and haloacetic acid (HAA5) and established required levels of disinfectants in the distribution system. Stage 2 was published in 2006. It required that water utilities monitor to determine the locations of highest occurrence of TTHMs and HAA5 in their systems and changed how compliance with the MCLs was calculated. *See also* Stage 1 Disinfectants and Disinfection

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By-Products Rule; Stage 2 Disinfectants and Disinfection By-Products Rule.

disinfectant stability The ability of a disinfectant to resist degradation. The degradation could be caused by self-decomposition with or without light, or reaction with organic and inorganic compounds.

disinfection (1) The process of destroying or inactivating pathogenic organisms (bacteria, viruses, fungi, and protozoa) by either chemical or physical means. (2) In water treatment, the process in which water is exposed to a chemical disinfectant—chlorine (HOCl, OCl^-), chloramines ($NHCl_2$ or NH_2Cl), chlorine dioxide (ClO_2), iodine, or ozone (O_3)—for a specified time period to kill pathogenic organisms.

disinfection benchmarking Required under the Interim Enhanced Surface Water Treatment Rule (IESWTR), Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR), and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), the determination of the minimum monthly inactivation of *Giardia* and/or viruses achieved by a water treatment plant under actual operating conditions over a 12-month period. The disinfection benchmark is determined from the disinfection profile.

disinfection by-product (DBP) A chemical by-product of the disinfection process. Disinfection by-products are formed by the reaction of the disinfectant, natural organic matter, and the bromide ion (Br^-). Some disinfection by-products are formed through halogen (e.g., chlorine or bromine) substitution reactions; i.e., halogen-substituted by-products are produced. Other disinfection by-products are oxidation by-products of natural organic matter (e.g., aldehydes—RCHO). Concentrations are typically in the microgram-per-liter or nanogram-per-liter range. *See also* aldehyde; bromide; cyanogen halide; disinfection; haloacetic acid; halogen; halogen substitution; natural organic matter; oxidation by-product; ozonation by-product; total organic halogen; trihalomethane.

disinfection by-product formation potential (DBPFP) The amount of disinfection by-products (DBPs) formed during a test in which a source or treated water is dosed with a relatively high amount of disinfectant (normally chlorine—HOCl, OCl^-) and is incubated (stored) under conditions that maximize DBP production (e.g., neutral to alkaline pH, warm water temperature, contact time of 4 to 7 days). This value is not a measure of the amount of DBPs that would form under normal drinking water treatment conditions, but rather an indirect measure of the amount of DBP precursors in a sample. If a water has a measurable level of DBPs prior to the formation potential test (e.g., in a prechlorinated sample), then the formation potential equals the terminal value measured at the end of the test minus the initial value. *See also* disinfection by-product; disinfection by-product precursor.

disinfection by-product precursor (DBPP) A substance that can be converted into a disinfection by-product during disinfection. Typically, most of these precursors are constituents of natural organic matter. In addition, the bromide ion (Br^-) is a precursor material. *See also* bromide; disinfection by-product; natural organic matter.

disinfection by-product regulatory assessment model (DBPRAM) A computer model used by the US Environmental Protection Agency in developing the Disinfectants and Disinfection By-Products Rule. The empirically based model assesses disinfection by-product formation based on source water quality and treatment plant operations, while simultaneously taking into account disinfection criteria and other water quality standards and objectives. *See also* Disinfectants and Disinfection By-Products Rule.

disinfection profiling Required under the Interim Enhanced Surface Water Treatment Rule (IESWTR), Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR), and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), the measurement and compilation of actual operating data necessary to calculate the daily or weekly *Giardia* and/or virus log inactivation for a water treatment plant over a period of a year or more.

disinfection-resistant pathogen A microorganism, generally a bacterium, that shows less susceptibility to inactivation by a chemical disinfectant than related organisms or other strains of the same organism. Usually, the resistance shown is not great and the organism can be inactivated by increasing the exposure time at the same disinfectant concentration or by increasing the disinfectant concentration and maintaining the same exposure time. Complete resistance to a disinfectant is rare or nonexistent. Spores of spore-forming bacteria and *Mycobacterium* species are more disinfection resistant than other bacteria. Cysts and oocysts of pathogenic protozoa (*Giardia* and *Cryptosporidium*), as well as spores of fungi, are considered disinfection resistant because they are not inactivated by the disinfectant concentrations and contact times normally used in drinking water treatment processes. *See also Cryptosporidium;* cyst; *Giardia; Mycobacterium;* oocyst.

disintegration The breaking down of a substance into its component parts.

disk drive A peripheral mass storage device using magnetic or optical technology that enables direct and quick storage and retrieval of computer data.

disk friction Friction occurring in a turbine between (1) the water above and below the runner and (2) the

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stationary parts and upper and lower covers of the turbine.

disk operating system (DOS) A computer operating system developed by IBM® and Microsoft® Corporation that was the standard in the computer industry until the development of Windows® by Microsoft®.

disk-type meter A water-measuring device containing a measuring chamber in which a disk is actuated by the passage of water. The nutating motion marks the discharge of a quantity of water through the measuring chamber and is translated into units of volume on a register dial.

dispatcher station The central location from which an operator controls equipment at one or more remote sites. It also refers to an office from which work crews are dispatched or moved to other locations.

dispersant A surface-active substance added to a suspending medium to promote and stabilize a dispersion. *See also* dispersion.

dispersed hepatitis A virus (HAV) A virus preparation such that individual virus particles are homogeneously dispersed in the preparation, as compared to clumping or cell-associated virus particles.

dispersion (1) The phenomenon in which a solute flowing in groundwater is mixed with uncontaminated water and becomes reduced in concentration. Dispersion is caused by differences in pore velocity and differences in flow paths at a small scale in the aquifer. A similar phenomenon is caused by turbulence in surface water systems. (2) A uniform and maximum separation of extremely fine particles, often of colloidal size.

dispersion index A measure of the short-circuiting of liquid through a continuous-flow tank. For example, the Morrill index, a common dispersion index, is the ratio of the time in which 90 percent of a unit volume of liquid passes through the tank to the time in which 10 percent of that unit volume passes through, t_{90}/t_{10}.

displacement device A toilet retrofit device, such as a dam, bag, bottle, and so forth, designed to displace toilet tank water.

displacement meter A water meter that measures the quantity of flow by recording the number of times a container of known volume is filled and emptied. Displacement meters are used primarily for relatively low flows.

displacement pump A device to move or lift water by using a piston to apply force directly to the water leaving a cylinder. Water is drawn into the cylinder through the inlet valve as the piston moves back, creating a partial vacuum with the outlet valve closed. The force is then applied to the water, which is forced out of the outlet valve at a higher pressure or lift.

displacement time The average period of detaining or holding a moving liquid in a tank or channel (tank volume less dead space, divided by rate of discharge). It is sometimes called the displacement period.

displacement velocity In settling tanks, the rate of displacement of the contents by inflowing liquid.

display A visual exhibit designed to catch the eye. Objectives may include creating or maintaining a specific perception of the organization, maintaining contact with important audiences, or generating requests for more information.

disposable component Any component of a piece of water treatment equipment or water treatment system that is manufactured to be disposed of instead of repaired or reused, e.g., a cartridge filter element.

disposal site That portion of the waters of the United States where specific disposal activities are permitted, consisting of a bottom surface area and any overlying volume of water. In the case of wetlands on which surface water is not present, the disposal site consists of the wetlands surface area.

disposal well A shallow well used to place surface runoff and treated water into aquifers. Disposal wells differ from aquifer storage and recovery wells in that a disposal well employs the treatment capacity of an aquifer to purify the water before any subsequent withdrawal. The aquifer is used as a storage and filtration facility in this case.

dispositional antagonism *See* antagonism.

disposition of complaint The official completion of a complaint investigation, including an assessment of the customer's satisfaction.

disproportionation The simultaneous oxidation and reduction of a substance, such that two molecules of the same compound can react to form two other molecules. For example,

$$Cl_2^0\ (aq) + H_2O \leftrightarrow H^+ + HO(Cl^{+1}) + Cl^{-1}$$

Here, the valence of chlorine both increases (oxidation) and decreases (reduction).

dissimilatory nitrate reduction The process by which nitrate is reduced to nitrite by bacteria using nitrate as the terminal electron acceptor in anaerobic respiration. Similar dissimilatory reduction processes occur with other compounds (e.g., dissimilatory perchlorate reduction, dissimilatory arsenate reduction).

dissociation The process by which a chemical combination breaks up into simpler constituents—such as atoms, groups of atoms, ions, or multiple different molecules—without any change in valence. Often this breakdown is reversible, as in the case of ionization. *See also* ionization.

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dissociation constant (1) Most generally, the rate at which two reversibly bonded chemical species separate from one another. This constant depends very heavily on the matrix in which the chemicals are placed or found. Specifically, in biochemistry, pharmacology, and toxicology, it is the concentration of a drug or toxin in solution at which a macromolecular binding site is half-saturated by the chemical. An apparent dissociation constant (known as the Michaelis constant, K_m) can be determined by examining the effects of various concentrations of the substrate on the rate of its conversion to product or by the extent to which varying the concentrations of a ligand activates a response that is mediated by a receptor. The inverse of K_m is defined as the affinity (or association constant) of a drug or chemical for the macromolecular binding site. (2) A value describing the tendency of a molecule to ionize in a solution at a given temperature. For example, the dissociation constant of acetic acid (CH_3COOH) in water at 77° Fahrenheit (25° Celsius) is 1.76×10^{-5}, which corresponds to pK_a 4.8. Thus, at a pH of 4.8, 50 percent of the acetic acid is ionized and 50 percent is unionized. This type of dissociation constant is also called the ionization constant. *See also* Michaelis–Menten equation.

dissociation in water The splitting of molecules dissolved in water into positive and negative ions. It is more properly termed *ionization.*

dissolved air flotation (DAF) A process in which air is dissolved into water under high pressure and is subsequently released into the bottom of a treatment unit to float solids. Upon release, the lower pressure in the unit results in the formation of bubbles that collect particles as they rise to the surface. The floated particles are then skimmed for subsequent processing. This process is effective in removing low-density particles and algae. Conventional dissolved air flotation refers to units with nominal hydraulic loadings of 5 to 15 meters per hour. *See also* high-rate dissolved air flotation; whitewater blanket.

dissolved carbon dioxide The carbon dioxide (CO_2) that is dissolved in a liquid medium, typically expressed in milligrams per liter. The saturation concentration is dependent on several factors, including partial pressure, temperature, and pH. *See also* partial pressure.

dissolved concentration The amount per unit volume of a constituent of a water sample filtered through a 0.45-micrometer pore-diameter membrane filter before analysis.

dissolved constituent *See* dissolved solids.

dissolved gases The sum of gaseous components that are dissolved in a liquid medium. Typical dissolved gases found in water include oxygen (O_2), nitrogen (N_2), carbon dioxide (CO_2), methane (CH_4), and hydrogen sulfide (H_2S), among others. High concentrations of dissolved gases can result in filter air binding and pump cavitation. *See also* air binding; cavitation.

dissolved inorganic carbon (DIC) The fraction of inorganic carbon (the carbonate [CO_3^{2-}], bicarbonate [HCO_3^-], and dissolved carbon dioxide [CO_2]) in water that passes through a 0.45-micrometer pore-diameter filter.

dissolved load The portion of the stream load that is carried in solution.

dissolved matter That portion of matter or solids, exclusive of gases, that is dispersed in water to produce a homogeneous liquid. According to the definition used in the water treatment industry, dissolved matter is that portion of the total matter that will pass through a 0.45-micrometer pore-diameter membrane filter.

dissolved minerals Inorganic salts held in solution in potable water. Dissolved minerals make up a portion of the dissolved solids in water. The sizes of the particles are used to differentiate between dissolved and particulate matter, with various size ranges being used. The dissolved solids in a water sample are determined by filtering the water, evaporating it, and weighing the residue.

dissolved organic bromine (DOBr) A surrogate measurement of the total quantity of dissolved bromine-substituted organic material in a water sample. The presence of bromine-substituted organic molecules in source water is typically caused by synthetic organic chemicals, whereas in finished water it is typically caused by disinfection by-products and high-molecular-weight, partially halogenated aquatic humic substances. Dissolved organic bromine is also called total organic bromine, adsorbable organic bromine, or carbon adsorbable organic bromine. *See also* aquatic humic substance; disinfection by-product; halogen-substituted organic material; surrogate measurement; synthetic organic chemical.

dissolved organic carbon (DOC) That portion of the organic carbon in water that passes through a 0.45-micrometer pore-diameter filter. For most drinking water sources, the dissolved organic carbon fraction represents a very high percentage of the total organic carbon pool. It is composed of individual compounds as well as nonspecific humic material, although humic substances account for a large portion of dissolved organic matter in natural waters. Typically, the dissolved organic carbon level provides some indication of the amount of disinfection by-product precursors in a water source. After filtration, dissolved organic carbon is determined in the same manner as total organic carbon. Organic carbon

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concentrations should be reported as dissolved organic carbon only if the sample has been filtered through a 0.45-micrometer pore-diameter filter before analysis. *See also* disinfection by-product precursor; nonpurgeable organic carbon; particulate organic carbon; purgeable organic carbon; total organic carbon.

dissolved organic chlorine (DOCl) A surrogate measurement of the total quantity of dissolved chlorine-substituted organic material in a water sample. The presence of chlorine-substituted organic molecules in source water is typically caused by synthetic organic chemicals, whereas in finished water it is typically caused by disinfection by-products and high-molecular-weight, partially halogenated, aquatic humic substances. Dissolved organic chlorine is also called total organic chlorine, adsorbable organic chlorine, or carbon adsorbable organic chlorine. *See also* aquatic humic substance; disinfection by-product; halogen-substituted organic material; surrogate measurement; synthetic organic chemical.

dissolved organic halogen (DOX) *See under* total organic halogen.

dissolved organic halogen formation potential (DOXFP) *See under* total organic halogen formation potential.

dissolved organic matter (DOM) That portion of the organic matter in water that passes through a 0.45-micrometer pore-diameter filter. Dissolved organic carbon represents the carbon portion of this matter. For aquatic humic substances, the carbon level typically represents approximately 50 percent of the organic matter (the rest being hydrogen, oxygen, nitrogen, and sulfur). *See also* aquatic humic substance; dissolved organic carbon.

dissolved organic nitrogen (DON) A group of nitrogen-containing compounds that are in dissolved organic form in water.

dissolved oxygen (DO) The concentration of oxygen in aqueous solution, which is often expressed in units of milligrams per liter. It is usually determined by one of two methods: a dissolved oxygen probe or Winkler titration.

dissolved solids In operational terms, the constituents in water that can pass through a 0.45-micrometer pore-diameter filter. *See also* total dissolved solids.

dissolved zinc Generally, that portion of the total zinc in water that passes through a 0.45-micrometer pore-diameter filter. Zinc most commonly enters the domestic water supply from deterioration of galvanized iron or dezincification of brass.

distal site Farthest away from the point of origin along the course of any asymmetrical structure.

distillate A liquid produced by condensation of vapors of that liquid, forming the product of a distillation process.

distillation (1) A purification process in which a liquid is evaporated and its vapor is condensed and collected. For water treatment, distillation is used as a desalting technique in such processes as multistage flash distillation, multiple-effect distillation, and vapor compression. (2) A group of techniques used to separate components of liquid mixtures for purification, isolation of analytes, or the minimization of interferences. All types of distillation are based on the equilibrium between liquid and vapor. The two most commonly used types are simple distillation and fractional distillation.

distilled water A type of reagent water prepared by boiling a source water (usually tap water) and condensing the vapor for the purpose of purification. Many of the major constituents in tap water, such as minerals, are essentially removed during distillation. Distilled water is often prepared in the laboratory and can then be used to prepare standard solutions and blank samples.

distributed control system (DCS) A control system of a process where the control system is not located at a central location. In a DCS, many digital processors (usually computers) are directly connected to the controlled devices.

distributed generation Small decentralized power plants located next to the end users. These plants can supply power to a single location or pump power directly into regional or national electricity grids.

distributed laser light-scattering turbidimetry A method for monitoring membrane integrity by using multiple sensor points to track membrane breakthrough.

distributed system A system in which processing tasks, data, or both are distributed among separate computers on a network.

distribution The system or process by which a commodity (e.g., water) is delivered to customers.

distribution coefficient The ratio of the concentration of a solute in phase A to the concentration of that same solute in phase B at equilibrium, in cases when the ratio is dependent on the initial concentration of the solute before partitioning occurs. The distribution coefficient is a way to express the ability of a particular method to extract a component from a matrix. It is similar to, but distinct from, the partition coefficient and distribution constant. *See also* distribution constant; partition coefficient.

distribution constant (*K*) The ratio of the concentration of a solute in phase A to the concentration of that same solute in phase B at equilibrium, in cases when

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the ratio is independent of the initial concentration of the solute before partitioning occurs. The distribution constant is a way to express the ability of a particular method to extract a component from a matrix. It is similar to the distribution coefficient but is the preferred term when the partitioning of the solute between phases is independent of the initial concentration of the solute before partitioning. *See also* distribution coefficient; partition coefficient.

distribution graph In hydrology, a unit hydrograph in which the ordinates of flow are expressed as percentages of the volume of the hydrograph. *See also* unit hydrograph.

distribution load control center A central site with equipment for one or more operators to monitor and operate an entire distribution system.

distribution main Any pipe in a water distribution system other than a service line.

distribution of toxicant The sites in the body where a chemical will locate given an oral, inhalation, or dermal exposure. Caution must be exercised in interpreting data purporting to describe a chemical's distribution. Frequently, data are provided on the distribution of a label attached to a compound. However, where the chemical and label can be separated by metabolism, this type of data provides very little useful information. Moreover, the site at which a chemical is deposited in the highest concentration does not necessarily reflect the organ in which the greatest effect will be observed. Data on the distribution of a chemical can provide insight on whether the chemical is likely to accumulate in the body, but this should not be considered a substitute for quantitative pharmacokinetic data.

distribution point A sampling point at which water quality is representative of that within the distribution system.

distribution reservoir A reservoir connected with the distribution system of a water supply project, used primarily to accommodate fluctuations in demand that occur over short periods (several hours to several days) and to provide local storage in case of emergency, such as a break in a main supply line or failure of a pumping plant.

distribution sample A sample of water taken from the distribution piping or a site served by the distribution system.

distribution storage A tank or reservoir connected with the distribution system of a water supply. It is used primarily to accommodate changes in demand that occur over short periods such as peak periods and fire flow and also to provide local storage for use during emergencies, such as a break in a main supply line or failure of a pumping plant.

distribution system A system of conduits (laterals, distributaries, pipes, and their appurtenances) by which a primary water supply is distributed to consumers. The term applies particularly to the network of pipelines in the streets in a domestic water system.

distribution system characteristic curve A plot of the total dynamic head versus total discharge in a water distribution system. The plot shows the required head to supply water to the system at a particular total flow so that users will have sufficient water pressure. The plot considers all head losses in the system. The curve is used in conjunction with pump characteristic curves to determine optimal (minimum energy) pump operation strategies for different water demands and to evaluate elevated storage. *See also* pump characteristics curve.

distribution system entry point The point at which treated drinking water enters the water distribution system. It is also known as the entry point to the distribution system.

distribution system equivalent (DSE) A sample result used to represent water quality in the water distribution system, even though the sample may not have been taken at the specific location of interest. If sampling conditions are representative of the distribution system location of interest, then the sample may be considered a distribution system equivalent (DSE) sample. Such samples were taken under the US Environmental Protection Agency Information Collection Rule (ICR).

distribution system evaluation requirement *See* initial distribution system evaluation.

distribution system model *See* initial distribution system evaluation.

distribution uniformity (DU) A measure of the efficiency of irrigation from above. It is calculated by analyzing the results of catch-can tests or by applying a formula to the dimensions and specifications of an irrigation plan.

distributor A fitting, usually installed at the top and bottom of the tank in a loose media system, that is designed to produce even flow through all sections of an ion exchanger or filter media bed and to function as a retainer of the media in the tank. It may also be called a diffuser. *See also* collector.

district engineer (DE) The principal engineer of a district of the US Army Corps of Engineers who is responsible for reviewing and issuing Clean Water Act Section 404 permits, unless the decision to issue a permit is elevated to a higher administrative level.

district metered area (DMA) A hydraulically discrete part of a water distribution network, with water supplied by one or more open supply mains that are metered and closely monitored on a permanent basis. Nightflow analysis is employed to segregate

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estimates of legitimate consumption versus leakage occurring in the district metered area. *See also* waste metering.

district metering The process of monitoring water flows into hydraulically discrete sections of a water distribution system to determine system integrity and the presence of leaks.

disturbed area An area where vegetation, soil, hydrology, or a combination of all three has been significantly altered, thereby making a wetlands determination difficult.

disturbed wetland A wetland directly or indirectly altered from a natural condition (including changes via natural perturbations) yet retaining some natural characteristics.

disulfoton ($(C_2H_5O)_2P(S)SCH_2CH_2SCH_2CH_3$) The generic name for the insecticide *O*,*O*-diethyl *S*-[2-(ethylthio)ethyl] phosphorodithioate. *See also* insecticide.

diuresis An increased excretion of urine.

diurnal (1) Occurring during a 24-hour period, as in diurnal variation. (2) Occurring during the daytime (as opposed to nighttime).

diurnal demand curve A plot of water demand versus time for a 24-hour period. Time is plotted on the *x* axis and demand is plotted on the *y* axis. The curve depicts a typical period of time (average day, maximum day, minimum day, and so on) and is used to simulate the daily operation of the network, especially the cycling of system storage.

diurnal fluctuation (1) The cyclic rise and fall of the water table or stream flow during a 24-hour period in response to changes in evapotranspiration draft from groundwater. (2) Any daily variation in a groundwater characteristic, such as flow or dissolved solids.

diuron ($C_6H_3Cl_2NHCON(CH_3)_2$) The generic name for the herbicide 3-(3, 4-dichlorophenyl)-1,1-dimethyl urea. *See also* herbicide.

divalent *See* divalent ion.

divalent ion An ion with two positive or negative electrical charges, such as ferrous ion (Fe^{2+}) or sulfate ion (SO_4^{2-}).

diverging tube A tube for which the diameter increases, usually at a uniform rate, along its longitudinal axis from the end at which the liquid enters.

diversion The use of part of a stream flow as a water supply.

diversion area That portion of an adjacent area beyond the normal groundwater or watershed divide that contributes water to the groundwater basin or watershed under discussion.

diversion box A type of diversion chamber.

diversion chamber A chamber in a water treatment plant that contains a device for drawing off all or part of a flow or for discharging portions of the total flow to various outlets.

diversion channel (1) An artificial channel constructed around a town or other point of high potential flood damages to divert flood water from the main channel for the critical reach. (2) A channel carrying water from a diversion dam. *See also* bypass channel.

diversion cut A channel cut around the side of a reservoir past the end of a dam to convey flood discharge from the stream above the reservoir into the stream below the dam; a bypass channel.

diversion dam A fixed dam built to divert part or all of the water from a stream out of and away from its course. *See also* overflow weir.

diversion gate A gate, having one of many different forms, that may be closed to divert flow from one channel to another.

diversion works Dams, pumping plants, and all appurtenant structures by means of which water is diverted from a stream or other body of water. *See also* headworks.

diversity index A nondimensional value relating the numbers of individuals of all species present to the number of species present at a site. The term is most commonly used in biological studies.

diverting weir *See* overflow weir.

divide The line that follows the ridges or summits forming the boundary of a drainage basin (watershed) separating one drainage basin from another. A divide is also called a watershed divide.

dividend payment Money paid by an investor-owned water utility to its shareholders based on its earnings and cash needs. Dividends are often paid on a quarterly basis, reflecting the financial performance of the utility over the prior three months.

divining rod A stick, usually a forked branch of a certain kind of tree, that some people claim can be used to locate underground sources of water. This belief still persists in many sections of the United States, although no scientific basis has ever been found for it. A divining rod is also called a dowsing rod.

divinylbenzene (DVB) ($C_6H_4(CH{:}CH_2)_2$) A polymerization monomer used as a cross-linking agent by polymerization with styrene monomer in the manufacture of many synthetic ion-exchange resin products. The degree of divinylbenzene cross linkage is a factor in exchanger resistance to chemical oxidation. Standard cation resin usually contains about 8 percent divinylbenzene. Macroporous resins contain over 12 percent divinylbenzene cross-linking. *See also* cross-linking.

division box A device for splitting and directing discharge from a head box to two separate points of application. *See also* splitter box.

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divisor A device used in soil conservation studies that controls the continuous separation and diversion of a representative fraction of the runoff from experimental areas. The diverted fraction is retained and analyzed to furnish a basis for calculating the total losses of soil and water from the area.

DI water *See* deionized water.

dL *See* deciliter *in the Units of Measure section.*

DLG *See* digital line graph.

DLI *See* Drycleaning and Laundry Institute.

DM model *See* data mining model.

DNA *See* deoxyribonucleic acid.

DNA adduct *See* deoxyribonucleic acid adduct.

DNA chip technology *See* deoxyribonucleic acid chip technology.

DNA fingerprinting *See* deoxyribonucleic acid fingerprinting.

DNAPL *See* dense, nonaqueous phase liquid.

DNA repair *See* deoxyribonucleic acid repair.

DNR *See* Department of Natural Resources.

DO *See* dissolved oxygen.

doble nozzle A nozzle, used in an impulse turbine, that is opened or closed by a pin or needle moving longitudinally along the axis of the jet and that may be adjusted to give a symmetrical jet of any effective area ranging downward from that obtained at full nozzle opening to that obtained at a fully closed position.

DOBr *See* dissolved organic bromine.

DOC *See* dissolved organic carbon.

DOC (Department of Commerce) *See* US Department of Commerce.

DOCl *See* dissolved organic chlorine.

DOE (Department of Energy) *See* US Department of Energy.

DOI (Department of Interior) *See* US Department of Interior.

DOL (Department of Labor) *See* US Department of Labor.

dolomite ($CaCO_3$•$MgCO_3$) An equimolar combination of calcium carbonate ($CaCO_3$) and magnesium carbonate ($MgCO_3$) that occurs in nature as a hard rock. Upon calcination it becomes dolomitic lime, containing 30 to 50 percent magnesium oxide (magnesia, MgO) and 50 to 70 percent calcium oxide (CaO).

dolomitic lime Lime containing 30 to 50 percent magnesium oxide (magnesia, MgO) and 50 to 70 percent calcium oxide (CaO).

DOM *See* dissolved organic matter.

domestic Pertaining to municipal (household) water services as opposed to commercial and industrial water. The term is sometimes used to include the commercial component.

domestic consumption The quantity or quantity per capita of water used for residential purposes. Typically, domestic consumption refers to indoor (human consumption, plumbing, washing, bathing) and outdoor (lawn and garden irrigation) uses of water supplied by a municipality or district, or self-supplied. Domestic consumption is usually measured as the amount of water used per day.

domestic filter A small filter used in the home to purify a water supply. Such a filter is also called a household filter, point-of-use filter, or home treatment filter.

domestic flow (DF) The flow in a water distribution system required to meet the normal demand for residential and commercial usage. This flow excludes fire flow, industrial flow, and separate irrigation flow, which would be added to domestic flow to determine the total system flow.

domestic hot water Hot water that is generated from a public water supply at a residence.

domestic meter A water meter installed on a consumer's service line; a service meter.

domestic service The pipes to provide water service for a house. It is the same as house service.

domic acid A neurotoxin produced by some marine plankton in the western United States. Domic acid can cause shellfish poisoning.

dominance (1) In a wetland, the spatial extent of a plant species. (2) The condition of being (a) the most abundant single plant species in a vegetation stratum such that, when all species are ranked in descending order of abundance and cumulatively totaled, it immediately exceeds 50 percent of the total dominance measure (e.g., area cover or basal area) for the stratum; or (b) any additional species that accounts for 20 percent or more of the total dominance measure for the stratum.

dominance measure The means or method by which dominance is established, including area coverage and basal area. The total dominance measure is the sum total of the dominance measure values for all species that form a given stratum.

dominant lethal mutation An alteration in the base sequence of a developing organism's deoxyribonucleic acid that is incompatible with life. The site of the mutation occurs in the code of one or more proteins that have a function critical to maintaining life.

dominant resistance The condition of having a gene that codes for a factor that increases a cell's ability to survive certain insults. To be dominant, this gene need not be present on both alleles of deoxyribonucleic acid; one allele is sufficient. Plasmids with dominant resistance are frequently incorporated into bacteria in a way that can allow the bacteria to be selectively

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recovered from a medium containing other bacteria. For example, a mutated gene for ampicillin resistance can be placed in a bacterium to induce mutations; after enough time has passed, colonies of ampicillin-resistant bacteria can be detected based on the mutated gene.

dominant species In a wetland, a plant species in a given stratum that, when all plant species in that stratum are ranked in descending rank order and cumulatively totaled, either (1) immediately exceeds 50 percent of the total dominance measure or (2) accounts for 20 percent or more of the total dominance measure for the stratum.

DON *See* dissolved organic nitrogen.

donnan dialysis process An electrolyte mixture separation process driven by an electrochemical gradient across an ion-exchange membrane. For metal salt removal, hydrogen ions diffuse through a cation membrane from a low pH (acidic) solution compartment into the compartment with the metal salt, creating a potential that acts as a driving force causing the metal ions to move through the membrane to the low pH solution compartment. *See also* dialysis.

donnan loop *See* donnan dialysis process.

donor strain The bacterial strain that contains the deoxyribonucleic acid that will be transferred to the recipient strain during mating.

DOP *See* demonstration of performance.

Doppler-effect flowmeter An instrument for determining the velocity of fluid flow from the change in the observed frequency of an acoustic or electromagnetic wave. This change in frequency is caused by relative motion between the observer and particles or discontinuities in the flowing fluid. Such an instrument that uses a wave of very high frequency is called a Doppler ultrasonic flowmeter.

Doppler ultrasonic flowmeter *See* Doppler-effect flowmeter.

DOS *See* disk operating system.

dosage A specified quantity of a material applied to a specified quantity of a second material, e.g., a certain number of milligrams per liter alum applied as a coagulant in water purification.

dosage control strategy The technique used by an ultraviolet (UV) system to control the delivered dosage that typically involves adjusting the lamp power or turning on or off banks of UV lamps to respond to changes in UV absorbance, lamp intensity, and flow. Typically, the dosage control strategy is different for low-pressure, low-pressure high-output, and medium-pressure systems.

dose (1) The concentration of a chemical to which a person is exposed. This chemical can be measured as a gas, liquid, or solid. (2) The amount of chemical presented to an organism. A dose can be expressed in a variety of ways with varying degrees of accuracy. For example, a dose could be expressed as a concentration in drinking water, but this will yield varying doses depending on the amount of water that is consumed. Moreover, the dose that is consumed (the external dose) is only an indirect measure of the dose that reaches an active site other than the skin or mucous membranes in the body (the internal or systemic dose). Measures of external dose are inherently less accurate than measures of internal or systemic dose, except when the target tissue is the skin or mucous membranes. Therefore, in the following sequence, progressively greater accuracy of dose is achieved if the dose is expressed either as: the concentration in drinking water (least accurate); the dose per unit body weight or per unit surface area; the concentration of the parent compound in blood; the concentration of the parent compound in plasma water; the concentration of the active metabolite in blood plasma; or the concentration of the active metabolite in the aqueous phase contacting a cell in a particular tissue (most accurate). The most accurate method of expressing dose is when the actual measurement of the amount of the active metabolite interacting with the receptor responsible for producing the effect (usually a macromolecule) is used. Knowledge of the dose at the target site is extremely important for interspecies extrapolations. The most common ways of comparing doses between species is on the basis of amount per unit body weight or amount per unit of body surface area. The latter convention is most rationally used when the action of the chemical is lessened by metabolism, because the extent of metabolism generally corresponds better to surface area rather than body weight. Thus, larger animals are considered less sensitive to a particular dose than smaller animals. This is the assumption that is made in assessing risks from chemical carcinogens. In addition, many carcinogens are activated by metabolism, further suggesting that small animals should be more sensitive than large animals. These general assumptions are, however, much better replaced by specific data that establish, first, which form of the chemical is responsible for the effect, and second, the relative rates of the formation and elimination of the active form. This allows accurate description of the "effective" doses in both the experimental animal and the human and avoids the use of assumptions. *See also* benchmark dose; lowest-observed-adverse-effect level; no-observed-adverse-effect level; reference dose.

dose distribution The probability distribution of delivered ultraviolet doses that microorganisms receive in a flow-through ultraviolet reactor; typically shown as a histogram. *See also* ultraviolet dose.

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dose–effect curve A curve describing the relationship between the amount of chemical to which an organism is exposed and the frequency or intensity of the response that is produced. The relationship between dose and the frequency of response is the one most often dealt with in risk assessment.

dose–effect surface analysis A three-dimensional graphical means of analyzing the additive effects of a variety of chemicals.

dose equivalent The adsorbed dose from ionizing radiation, modified by factors that account for differences in biological effectiveness caused by the type of radiation and its distribution in the body.

dose of radioactivity A quantity of ionizing radiation. This term is often used in the sense of an exposure dose, expressed in roentgens, which is a measure of the total amount of ionization that the quantity of radiation could produce in air.

dose rate The amount of chemical administered to an organism per unit time. In vivo, this rate is commonly expressed as milligrams per kilogram body weight per day. It could also be expressed as the area under the concentration-versus-time curve for a body fluid such as blood or for an in vitro system.

dose rate of radioactivity The amount of ionizing (or nuclear) radiation to which an individual would be exposed per unit of time. It is usually expressed in terms of roentgens per hour or in submultiples of this unit, such as milliroentgens per hour. The dose rate of radioactivity is commonly used to indicate the level of radioactivity in a contaminated area.

dose response The effect of the dose of an agent administered or received on the incidence of an adverse health effect.

dose–response curve A graph showing how increasing doses of a substance (such as a chemical) is related to some effect on the body.

dose–response evaluation A component of risk assessment that describes the quantitative relationship between the amount of exposure to a substance and the extent of toxic injury or disease.

dose–response experiment Any experiment, either biological or chemical, designed to obtain information on a dose response. The focus of such an experiment could be microbial inactivation data, optimal coagulant concentrations, or health effects.

dose–response model A formal mathematical formula that is applied to a set of data and describes the relationship between the dose of an agent that has been administered and the recipient's response. These models can take diverse forms, but the two most fundamental forms are graded dose–response models and the so-called all-or-none stochastic models. Graded models deal with the increasing intensity of response that is observed within an individual as the dose increases. All-or-none models are actually based on a distribution of sensitivities observed within a population; thus, at any one dose a certain proportion of the population would respond while the remaining individuals would not. In this case, as the dose increases, a progressively larger proportion of the population is assumed to respond. The all-or-none model is most frequently used in risk assessments and in extrapolating response information to doses considerably below the tested doses. The results of these extrapolations are expressed in terms of the number of deaths from a particular disease (e.g., cancer) within a population exposed for a given time. In either model type, uncertainty or safety factors are applied to account for deviations of the data from real-world responses.

dose–response relationship (1) The quantitative relationship between the amount of exposure to a substance and the extent of toxic injury produced. (2) The relationship between the dose of a drug and the patient's response to that dose.

dosimeter An instrument for measuring and registering total accumulated exposure to ionizing radiation.

dosing tank Any tank used in applying a dosage. Specifically, a dosing tank is used for intermittent application of a liquid to subsequent processes.

DOT (Department of Transportation) *See* US Department of Transportation.

dot-blot A method of detecting viruses that involves immobilizing the nucleic acid of the virus onto nitrocellulose and detecting the nucleic acid by hybridizing it to a probe of complementary homologous nucleic acid.

DOT hazard class *See* Department of Transportation hazard class.

double-action reciprocating pump A reciprocating pump for which the suction inlet admits water to both sides of the plunger or piston. This arrangement affords a more or less constant discharge.

double-barrel bond A revenue bond backed by a specific source of revenue to which the issuing government adds a general obligation pledge, which can invoke the taxing authority of the issuer. This kind of bond is sometimes called a combination bond. By adding the general obligation pledge, risk is reduced to the investor and a lower interest rate can be obtained.

double-blind study An investigation of the effect of a drug as compared with a placebo on human subjects where neither the subjects, nor the administrator of the sample, nor the assessor of the outcome knows whether the sample is the drug or a placebo. This process prevents certain biases. A study where the person

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assigning the drug treatment is also unaware of which treatment a person receives is called a triple-blind study. *See also* blind study.

double bond The binding together of two atoms by two pairs of electrons (rather than one pair as found in single bonds). Typical double bonds found in organic chemicals in water include carbon–carbon (C=C) and carbon–oxygen (C=O) double bonds.

double check detector backflow-prevention assembly (DCDA) A specially designed backflow assembly composed of a line-size approved double check valve assembly with a bypass containing a specific water meter and an approved double check valve assembly to prevent backflow into the distribution system. The meter registers low rates of flow generally up to 3 gallons per minute (0.2 liters per second) and shows a registration for all rates of flow. This unit is used on closed-system fire lines and fire sprinkler systems to detect usage. Usage should occur only during a fire or during testing of the system and not as a source of water.

double check valve An assembly device consisting of two check valves with a gate valve on each end and with connections that provide points for testing to ensure positive shutoff of the check valves used for backflow prevention.

double check valve assembly (DCVA) An assembly composed of two single, independently acting check valves. An approved assembly includes tightly closing shutoff valves located at each end of the assembly and suitable connections for testing the watertightness of each check valve.

double coagulation The application of coagulant to liquid at two separate points in the water treatment process.

double filtration The filtration of water through two or more slow sand filters in series, through a rapid granular filter and then through a slow sand filter, or through two rapid granular filters in series.

double gate valve *See* double check valve.

double-layer compression A mechanism for destabilizing particles in which high-ionic strength solutions or solutions with high concentrations of total dissolved solids produce correspondingly high concentrations of counterions in the diffuse layer of particles. This mechanism reduces the range of repulsive interaction between similar colloidal particles, thus allowing attractive forces to dominate and coagulation to occur. For example, when a low–ionic strength river carrying colloidal particles flows into high–ionic strength seawater, the particles are destabilized by double-layer compression and settle out to form deltas. *See also* adsorption–destabilization; bridging; sweep-floc coagulation.

double-layer theory *See* zeta potential.

double-main system (1) A distribution system with mains on both sides of the street. (2) A system with separate water mains for domestic and firefighting use.

double mass curve A plot on arithmetic cross section paper of the cumulated values of one variable against the cumulated values of another or against the computed values of the same variable for a concurrent period of time.

double-pan balance A balance in which a material is weighed by being placed on one pan while counterbalancing brass weights are placed on the other pan.

double-pass membrane system A membrane system in which the filtrate or permeate is further processed by a subsequent membrane system. *See also* pass.

double-pass reverse osmosis system A reverse osmosis system in which the permeate is further processed by a subsequent reverse osmosis system. *See also* pass.

double-stranded deoxyribonucleic acid (dsDNA) *See* deoxyribonucleic acid.

double-stranded ribonucleic acid (dsRNA) *See* ribonucleic acid.

double-suction impeller An impeller with two suction inlets, one on each side of the impeller.

double-suction pump A centrifugal pump with suction pipes connected to the casing from both sides.

downflow The downward flow of water or a regenerant through an ion-exchange or filter media bed during any phase of the operating cycle. This is the flow pattern found in conventional column operation: in at the top, out at the bottom of the column. The pattern may also be called cocurrent flow in ion-exchange systems.

downflow softening The softening process in which water enters at the top of the softener bed column and passes downward through the cation resin and out the bottom. In this process, the brining also takes place in the same cocurrent direction.

downgradient The direction groundwater flows, similar in concept to *downstream* for surface water, such as a river.

downstream The direction toward which a stream flows.

downtime The time during which a machine, factory, conduit, or other item is shut down for repairs, replacement, or other work.

dowsing rod *See* divining rod.

DOX (dissolved organic halogen) *See under* total organic halogen.

DOXFP (dissolved organic halogen formation potential) *See under* total organic halogen formation potential.

DP cell *See* differential pressure cell.

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DPD *See* N,N-diethyl-p-phenylenediamine.

DPD–FAS *See* N,N-diethyl-p-phenylenediamine–ferrous ammonium sulfate.

D. polymorpha *See Dreissena polymorpha.*

DPP *See* differential pulse polarography.

dr *See* dram *in the Units of Measure section.*

drab A conduit or channel constructed to carry off, by gravity, liquids other than wastewater, including surplus underground water, stormwater, or surface water. It may be an open, lined or unlined ditch or a buried pipe.

draft (1) The act of drawing or removing water from a tank or reservoir. (2) The water that is drawn or removed from a tank or reservoir. (3) A written document prepared for review.

Draft Environmental Impact Statement (DEIS) A document that describes in great detail the effect a construction project will have on the local environment, prepared for review and consideration following the procedures established by regulatory agencies under the National Environmental Policy Act.

draft tube (1) An extension of the wheel passages in a hydraulic turbine from the point where the water leaves such passages down to the tailrace level. It may consist of pipes or passages constructed in the powerhouse structure. It allows the waterwheel and connected machinery to be constructed at higher elevations—usually above a possible high-water or flood level—without sacrificing any of the total height of power drop. It may also reduce velocity head losses in the water leaving the wheel.

draft tube loss The loss of energy, caused by eddies and friction, that occurs when water passes through a draft tube.

drag The resistance offered by a liquid to the settlement or deposition of a suspended particle.

drag coefficient (C_D) A measure of the resistance to sedimentation or flotation of a suspended particle, as influenced by the particle's size, shape, density, and terminal velocity. It is the ratio of the force per unit area to the stagnation pressure, and it is dimensionless.

drain A pipe, conduit, or receptacle in a building that carries liquids by gravity to waste. The term is sometimes limited to referring to the disposal of liquids other than wastewater.

drainable sludge Sludge that can be dewatered readily by gravity.

drainage Any of several means of changing the hydrologic conditions of wetlands, including lowering groundwater or surface water levels through pumping or ditching or otherwise altering water flow patterns.

drainage area The area of a drainage basin or watershed, expressed in square meters, acres, square miles, or other units of area. A drainage area is also called a catchment area, drainage basin, watershed, or river basin.

drainage basin *See* drainage area.

drainage by well The removal of surplus or excess surface water or groundwater by (1) sinking wells to a porous formation in which the hydrostatic head is lower than that of the water on the surface to be drained and then carrying off the surface water through these wells, or (2) pumping the excess water into irrigation or drainage canals. When filled with stones, the well is called a dry well.

drainage canal A canal built and used primarily to convey water from an area where surface and soil conditions provide no natural outlet for precipitation.

drainage coefficient The discharge of an underdrainage system, expressed in inches (or centimeters) of depth of water that must be removed from the drainage area in 24 hours.

drainage divide The boundary between adjacent drainage basins. It is typically represented by a topographically high area.

drainage equilibrium A condition existing in an area where the quantity of water reaching the water table from all sources over a reasonable period of time just equals the quantity of water drained from the water table through all means during that time. The resulting position of the water table remains essentially unchanged over such a period of time.

drainage gallery A gallery in a masonry dam, parallel to the crest, that intercepts leakage from the water face and conducts it away from the downstream face.

drainage right The legal right of a landowner to dispose of excess or unwanted water that accumulates on his or her land over the land of others. Applicable common and statutory law and interpretations thereof vary widely among the various states.

drainage system (1) A system of conduits and structures for effecting drainage. (2) A surface stream or a body of impounded surface water, together with all surface streams and bodies of impounded surface water tributary to it.

drainage water (1) Water that has been collected by a drainage system and discharged into a natural watercourse. (2) Water flowing in a drain, derived from groundwater, surface water, or stormwater.

drainage well (1) A vertical shaft constructed in masonry dams to intercept seepage before it appears at the downstream face. (2) A well installed to drain surface water or stormwater into underground strata. It is also called a dry well. *See also* absorbing well.

drained Pertaining to a condition in which the level or volume of groundwater or surface water has been reduced or eliminated from an area by artificial means.

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drain line (1) The sewer pipe that carries wastewater from toilets and other drain connections inside a building; sometimes used to refer to the sewer pipe located outside the building and connected to the sewer main. (2) A pipeline that is used to carry backwash water, regeneration wastes, or rinse water from a water treatment system to a drainage receptacle or waste system.

drain well *See* disposal well.

DRAM *See* dynamic random access memory.

dram (dr) *See in the Units of Measure section.*

draw A natural depression or swale. This term also applies to a small watercourse in some parts of the United States.

drawback The reverse flow of permeate from the permeate side across a reverse osmosis membrane to the feed-concentrate side as a result of osmosis. *See also* drawback tank; osmosis.

drawback tank A tank used in some reverse osmosis systems (e.g., hollow-fiber seawater reverse osmosis systems) that provides permeate (desalted membrane product water) to the membrane modules during system depressurization. The natural phenomenon of osmosis causes permeate to flow backward through the membranes when there is a loss of feed pressure during shutdown; these vacuum conditions may cause damage if an adequate backflow water supply is not available.

drawdown (1) The drop in water elevation of a body of surface water as a result of the withdrawal of water. (2) The amount the water level in a well drops once pumping begins. In this case, drawdown equals the static water level minus the pumping water level. *See also* circle of influence; cone of depression; well cone of influence; zone of influence.

drawdown curve A graph of drawdown versus time or drawdown versus distance, used to determine hydraulic characteristics of water supply aquifers.

drawdown method A testing procedure in which water is pumped from a well and in which drawdowns in the same wells, nearby wells, or both, are recorded. Analysis of the time, drawdown, and distance relationships provides information on the hydraulic characteristics of the surrounding aquifer.

dredged material Material that is excavated or dredged from waters.

dredging (1) A physical method for controlling aquatic plants in which a dragline or similar mechanical equipment is used to remove plants and the bottom mud in which they are rooted. (2) The removal of sediment.

Dreissena polymorpha (D. polymorpha) The taxonomic name for the zebra mussel. These mussels can form dense aggregates on hard surfaces (such as intake pipes) that can restrict water flow even in large-diameter piping, increase sedimentation rates, and promote surface corrosion. *See also* zebra mussel.

drenching shower A safety device used to wash chemicals off the body quickly.

drift (1) The difference between the actual value and the desired value (or set point) characteristics of proportional controllers that do not incorporate reset action. (2) The wandering of the controlled variable around its set point. Drift is also called offset.

drift barrier An artificial barrier built across a stream to catch driftwood. It may be of any form, from a simple wire fence to a barrier of massive piers with heavy cables strung between them.

drift diameter A measure of the effective minimum inside diameter of a pipe, including ovality and longitudinal warpage over a given length of pipe.

drift tube A portion of a time-of-flight mass spectrometer in which ions are separated. *See also* time-of-flight mass spectrometer.

drilled well A well that is constructed either by cable tool or rotary methods, usually to depths of 50 feet (165 meters) or more, and has the capacity to provide water for household, municipal, industrial, or irrigation requirements.

drilling Subsurface investigation performed by cutting holes down to the desired depth, with or without the removal of borings. *See also* boring.

drilling foam A bubbly drilling fluid made by injecting a small volume of water and surfactant (detergent) into an airstream. The foam is used to carry drilling cuttings to the surface, stabilize the borehole, and lift large volumes of water during drilling. Foam drilling is used only in unconfined aquifer formations.

drill log A chronological record of the soil and rock formations that were encountered in the operation of sinking a well, with either their thickness or the elevations of the tops and bottoms of each formation given. *See also* well log.

drinking water Water that meets or exceeds all applicable federal, state, and local requirements concerning safety. Drinking water is also called potable water. *See also terms under* water.

Drinking Water Contaminant Candidate List (CCL) A list of contaminants issued by the US Environmental Protection Agency that are known or anticipated to occur in public water systems and that may require regulation under the Safe Drinking Water Act (Section 1412(b)(1)). The first Drinking Water Contaminant Candidate List was published March 2, 1998 (63 *Federal Register* 10274–10287), and the list is updated every 5 years.

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Drinking Water Contaminant Candidate List (CCL) Research Plan A plan developed by the US Environmental Protection Agency of research needed in order to decide whether or not contaminant(s) on the CCL should be regulated.

drinking water equivalent level (DWEL) An estimated exposure (in milligrams per liter) that is interpreted to be protective against adverse health effects other than cancer over a lifetime of exposure, assuming all exposure is from drinking water ingestion.

Drinking Water Infrastructure Needs Survey (DWINS) A survey conducted by US Environmental Protection Agency every 5 years as required by the Safe Drinking Water Act, to collect the information needed to identify the infrastructure funding needs of community public water systems for a 20-year planning period.

drinking water priority list (DWPL) A list of contaminants that are known or anticipated to occur in public water systems and that may require regulation, published by the US Environmental Protection Agency as required by Section 1412(b)(3) of the Safe Drinking Water Act.

drinking water regulation A regulation set by a state or by the US Environmental Protection Agency that applies to public water systems. *See also* National Primary Drinking Water Regulation; National Secondary Drinking Water Regulation.

Drinking Water Research Division (DWRD) *See* Water Supply and Water Resources Division.

drinking water standard (DWS) A numerical limit established by a state or federal agency for contaminants that may be found in drinking water.

drinking water standard, primary *See under* National Primary Drinking Water Regulation.

drinking water standard, secondary *See under* National Secondary Drinking Water Regulation.

Drinking Water State Revolving Fund (DWSRF) A fund established by the Safe Drinking Water Act to provide capitalization grants to states to develop state revolving loan funds to help finance drinking water system infrastructure improvements, ensure source-water protection, enhance operation and management of drinking-water systems, and otherwise promote local water-system compliance and protection of public health. It is also referred to as an SRF fund. *See also* state revolving loan fund.

drinking water treatment facility The structures, equipment, and processes required to treat, convey, and distribute potable water.

drinking water treatment plant (WTP) The central facility for the production of potable water, containing all treatment processes and appurtenances exclusive of the distribution system.

drip irrigation An irrigation method in which water is slowly applied through porous piping that has small openings. Drip irrigation reduces runoff and overall water consumption by avoiding the oversaturation that can result from irrigation methods using higher flow rates.

drip leg A small piece of pipe installed on a chlorine cylinder or container that prevents collected moisture from draining back into the container.

driven well A shallow, usually small well (having a diameter of 1.5 to 3.0 inches [4 to 10 centimeters]) constructed without the aid of any drilling, boring, or jetting device by driving a series of connected pipe lengths into unconsolidated material to a water-bearing stratum.

drive shoe A protecting end attached to the bottom of a drive pipe and casing.

driving The process of extending excavations horizontally.

droop The decrease in outlet pressure of a pressure regulator that results from an increase in flow rate. Usually stated as a percentage, inches of water column, or pounds per square inch, droop shows the difference between the outlet pressure at published maximum flow rate and the outlet pressure setting made at low flow rates.

drop (1) A structure in an open conduit or canal installed for the purpose of dropping the water to a lower level and dissipating its energy. It may be vertical or inclined; in the latter case it is usually called a chute. A drop is sometimes called a drop spillway. (2) The difference in water surface elevations upstream and downstream of a bridge or other constriction in a stream or conduit.

drop-down curve The longitudinal shape of the water surface in a stream or open conduit upstream from a point where a sudden fall occurs, as when flowing water passes over a dam, weir, or other obstruction. In uniform channels the curve is convex upward. *See also* backwater curve; surface curve.

dropping head The decreasing head on an orifice or outlet pipe that may occur when inflow into a tank or reservoir is less than the outflow. The dropping head causes a continuing reduction in the rate of discharge.

drop pipe The suction pipeline below a deep-well pump.

drop test A method to measure water leakage whereby in-system storage facilities or supplies are shut down and then the drop in the water level in the storage facilities or the drop in pressure in the system downstream from the facility or supply is measured.

drought A normal, recurrent feature of climate that occurs in virtually all climatic zones (although its characteristics vary significantly from one region to another). Drought occurs primarily because of a

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deficiency of precipitation over an extended period of time, usually a season or more, resulting in a water shortage. There are many definitions of drought, with four main types: meteorological, hydrological, agricultural, and socioeconomic drought.

drought condition The hydrologic conditions during a defined drought period in which rainfall and runoff are below average, often reducing the capacity and availability of water supplies. The severity of drought conditions is often relative to the demands that humans and society place on water supplies.

drought management Actions and policies that alter the management of water supplies and customer water demands to mitigate the impacts of drought, e.g., implementation of conservation measures, such as outdoor watering restrictions to preserve water supplies. Drought management includes response actions that are typically staged to correspond to drought indicators that reflect the severity of drought conditions for a specific area or water supply system.

drought price A set of special inclining block prices that are part of a comprehensive demand management program implemented by many utilities during periods of acute supply shortage (crisis situations). The total program might include public awareness, restrictions on use, monitoring of use, various indoor and outdoor conservation measures, and drought prices—all aimed at achieving a necessary reduction in demand. When the crisis is over, the drought prices are discontinued and replaced with a rate structure that reflects the new budget and supply conditions.

drought-year supply The average annual supply of a water system during a defined drought period.

drowned weir A weir that, when in use, has the water level on the downstream side at an elevation equal to or higher than the weir crest. The rate of discharge is changed by the presence of the tailwater. A drowned weir is also called a submerged weir.

drug metabolism The conversion of a chemical to a series of products by enzymatic activity in an organism. In mammalian systems, the most prominent site of drug metabolism is in the smooth endoplasmic reticulum of the liver. However, metabolism of some chemicals occurs in other subcellular fractions and in other organs. This local metabolism can play an important role in the toxicology of a chemical. In some cases, metabolism detoxifies the chemical, but in others it can convert the chemical to a reactive form that induces toxicity. For this reason, steps in the metabolism of drugs and other chemicals are divided into two phases. Phase 1 metabolism involves the production of a reactive metabolite, whereas phase 2 reactions tend to detoxify these reactive metabolites. The former reactions are conducted by cytochrome P450 isoforms, whereas the latter phase involves various conjugation reactions with other biochemicals to form glucuronides, sulfates, glutathione conjugates, and so on.

drum gate A movable crest gate used at a dam to control spills or overflows. It is in the form of a sector of a circle hinged at the apex. The arc face effects a water seal with the edge of a recess into which the gate may be lowered. The gate is raised and held up by the pressure of water admitted to the recess from the headwater. It is lowered by closing the inlet port to the recess and draining the water from it.

dry alum Aluminum sulfate that has been purchased in the lump, ground, or granular form for use in dry feed machines. *See also* alum, liquid alum.

dry barrel fire hydrant A device installed and spaced on a distribution system to supply water for fire protection, designed with a special fitting to connect to fire hoses or fire pumps and with a valve and drain system to allow the barrel of the hydrant to drain when the valve is turned off, protecting the hydrant from freezing.

dry-bulb temperature The temperature of air measured by a conventional thermometer.

dry chemical feeder A mechanical device that feeds chemicals in a dry form. Dry chemicals are typically loaded into a hopper, from which they are conveyed into a conduit for dilution or direct feed by a screw conveyer. The rate may be controlled volumetrically or gravimetrically (by weight). *See also* screw conveyer.

Drycleaning and Laundry Institute (DLI) An association of dry-cleaning businesses, formerly the International Fabricare Institute.

dry connection A connection to a water line installed when the line is not in service or during construction.

dry deposition Material deposited by the atmosphere on the earth's surface outside periods of precipitation.

dry feeder *See* dry chemical feeder.

drying bed *See* residuals drying bed.

dry pit An enclosure in which a pump or piece of mechanical equipment is not in contact with the solution being pumped. A dry pit is located adjacent to a wet well or basin that contains the liquid. A dry pit provides easy access for pump maintenance, although connections between the dry pit and wet well must be sealed properly to prevent leakage. *See also* wet well.

dry-salt saturator tank A brine tank, usually full of undissolved salt and with saturated brine below the undissolved salt. This is the type of brine tank used with most automatically regenerated home softeners because it does not require refilling with salt as often as other tank types. *See also* wet-salt saturator tank.

dry solids (DS) A measure of the mass of solids on a dry weight basis. In chemical analyses, a measurement

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of the dry solids in a solution yields a total solids concentration. The dry solids in a sludge provides an understanding of the amount of solids disposed of in a completely dewatered sludge. Certain land disposal requirements for sludge are based on the amount of dry solids per unit area per time.

dry spell (1) A period, usually of not less than 2 weeks' duration, during which no measurable rainfall occurs in a certain place or region. When it extends to a month or more, a dry spell is considered to be a drought. (2) A period of not less than 4 days during which the daily maximum temperature remains at least 5–7° Fahrenheit (3–4° Celsius) greater than the normal maximum and the relative humidity continues at less than 50 percent.

dry strength The extent to which a soil is dry and crumbles into individual grains or fine powder on its own or under modest pressure.

dry suspended solids The weight of the suspended matter in a sample after drying for a specified time at a specified temperature.

dry tap A connection made to a main that is not loaded with water. *Compare with* wet tap.

dry-top hydrant A dry-barrel hydrant in which the threaded end of the main rod and the revolving or operating nut are sealed from water in the barrel when the main valve of the hydrant is in use.

dry weather flow The flow of water in a stream during dry weather, usually contributed entirely by groundwater. *See also* base flow; minimum flow.

dry weight capacity The capacity of a storage container expressed in terms of the dry weight of the chemical being stored.

dry well (1) A well that yields no water. (2) A dry compartment in a pumping station, near or below pumping level, where the pumps are located. (3) A common name for a drainage well. *See also* drainage well; pump pit.

dry year A year of drought during which the precipitation or stream flow is less than normal. Drought severity is usually expressed in terms of a probability or a return period.

DS *See* dry solids.

dsDNA (double-stranded deoxyribonucleic acid) *See* deoxyribonucleic acid.

DSE *See* distribution system equivalent.

dsRNA (double-stranded ribonucleic acid) *See* ribonucleic acid.

DST *See* defined-substrate technology.

DTA *See* differential thermal analysis.

DTM *See* digital terrain model.

DU *See* distribution uniformity.

dual coagulation A coagulation process that is used for more than one purpose. For example, coagulation can be used to remove both particles and naturally occurring organic material.

dual distribution system Two separate water piping systems distributing water to customers, one carrying potable water and the other conveying lesser-quality water (e.g., nonpotable reclaimed water) for reuse purposes.

dual-flush device A toilet retrofit device designed to use only a portion of the toilet tank water for a liquid flush and the complete tank of water (full flush) to remove solids.

dual independent map encoding (DIME) file A geographic file based on line segments produced by the US Bureau of the Census for each standard metropolitan statistical area in the United States. It is also called a geographic base file–dual independent map encoding (GBF–DIME) file when street segments are assigned geographic coordinates.

dual-media filter A filter containing two types of granular filtering media with different sizes and specific gravities to maintain media stratification after backwashing. Anthracite coal and sand are the most commonly used media in dual-media filters. *See also* anthracite coal; filter.

dual-media filtration A filtration method designed to operate at a filtration rate higher than conventional rapid granular filters by using two different types of filter media, usually sand and finely granulated anthracite.

dual-membrane system A water treatment membrane system composed of two different types of membranes in series, e.g., a surface water system that uses a microfiltration or ultrafiltration membrane system for particle removal followed by a nanofiltration or reverse osmosis system for dissolved material removal. A dual-membrane system is also called an integrated membrane system.

dual programming The use of an irrigation controller to schedule the frequency and duration of irrigation cycles to meet varying water requirements of plants served by a system. Grouping plants and laying out irrigation circuits on the basis of similar water requirements will facilitate dual programming. If more than two groups are involved, the process is known as multiple programming.

dual-purpose plant A plant with two production outputs. This term is commonly used to refer to a facility that is both producing electric power and desalting seawater. Waste heat from the electrical generating equipment is used (recovered) to lessen energy requirements for the water-desalting process facilities located at the same site.

dual system *See* dual distribution system.

duct A tube or channel for the conveyance of a fluid; a conduit.

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ductile-iron pipe (DIP) A water pressure pipe made from a material similar to cast iron, with the primary graphite in a nodular or spheroidal form as a result of the addition of an inoculant such as magnesium to molten iron of appropriate composition. These structural changes increase strength and flexibility.

Ductile Iron Pipe Research Association (DIPRA) A nonprofit corporation whose members are manufacturers of ductile-iron pipe and fittings used by water, wastewater, and industrial facilities. The association's purpose is to provide research and engineering information to its members, utilities, industries, and the public relating to ductile-iron pipe.

due diligence The efforts necessary to bring an intent to appropriate water to fruition; actions that demonstrate a good-faith intention to complete an undertaking within a reasonable time period.

duff The more or less firm organic layer in forests. It consists of fallen vegetative matter in the process of decomposition, including everything from the litter on the surface to the pure humus below.

dug well A shallow, large-diameter well constructed by excavating with power machinery or hand tools instead of drilling or driving. Typically a dug well is constructed for an individual residential water supply and yields considerably less than 100 gallons per minute (380 liters per minute).

dumb Pertaining to the lack of intelligence of a database element (or a user workstation annotation incorporated into a map or engineering drawing) that exists only as a graphical element and is not linked to another graphical element or a corresponding attribute database.

dump power Power available in excess of primary and secondary power, usually for short periods of time during exceptionally favorable generating conditions. Dump, secondary, and off-peak power are not completely separable.

dump truck A vehicle used to haul earth material in the construction or maintenance of systems. It has a bed that will tilt to allow the material to be easily unloaded or dumped.

duodenojejunal aspirate Aspirate from the area containing duodenum and jejunum (the first portion of the small intestine), that can be analyzed for the presence of pathogens.

duplex pump A reciprocating pump consisting of two cylinders placed side by side and connected to the same suction and discharge pipe. The pistons move so that one exerts suction while the other exerts pressure, with the result that the discharge from the pump is continuous.

duplicate samples Samples obtained by dividing one sample into two or more identical subsamples.

Dupuit assumptions A set of assumptions used in the analysis of flow in unconfined aquifers. Solutions based on these assumptions are quite useful in practical problems. The assumptions are that (1) the hydraulic gradient is equal to the slope of the water table, and (2) the streamlines are horizontal and equipotential lines are vertical in the aquifer.

duration area curve A curve that shows the area beneath a duration curve at any value of the flow and is therefore the integral of duration with respect to stream flow. When the duration curve is plotted as a percentage of time, the resulting duration area curve shows the average flow available at less than a given discharge.

duration curve A graph showing the percentage of time that the given flows in a stream will be equaled or exceeded. The curve is generated based on a statistical study of historical stream flow records. *See also* intensity–duration frequency curve.

duration of inundation The length of time that water stands above the soil surface or that water fills most soil pores near the soil surface. Typically this term refers to a period during the growing season.

Durbin–Watson (DW) test The standard test used to determine whether serial correlation exists in a time series. The computed value of this test can range from 0, indicating extreme positive serial correlation, to 4.0, indicating extreme negative serial correlation. A Durbin–Watson value of 2.0 indicates no serial correlation.

duty In the sense of legal duty to the victim: a legally enforceable obligation to conform to a particular standard of conduct. Except in malpractice and strict liability cases, the duty is set by what a "reasonable man of ordinary prudence" would have done. There is a general duty to prevent foreseeable injury to a victim.

duty of water The amount of water that, through careful use without waste and management, is reasonably required to be applied to a tract of land for a length of time adequate to produce the maximum quantity of crops that are ordinarily grown there.

DVB *See* divinylbenzene.

DWEL *See* drinking water equivalent level.

DWINS *See* Drinking Water Infrastructure Needs Survey.

DWPL *See* drinking water priority list.

DWPR *See* Desalination and Water Purification Research and Development Program.

DWS *See* drinking water standard.

DWSRF *See* Drinking Water State Revolving Fund.

DW test *See* Durbin–Watson test.

DXAA *See* dihalogen-substituted acetic acid.

dye A conservative, nonreactive substance, the concentration of which can be measured analytically, used as a tracer in water treatment applications and as

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a means to identify leaks in potable and nonpotable water piping networks. *See also* tracer.

dye dilution method Part of the dilution method that introduces a dye (sometimes fluorescent) as the tracer compound. *See also* dilution method.

dyke *See* dike.

dynamic discharge head The difference in height measured from the pump center line at the discharge of the pump to the point on the hydraulic grade line directly above it.

dynamic equilibrium (1) A condition wherein the recharge to an aquifer is equal to the amount of natural discharge. (2) A condition in which the inflows to a system exactly equal the outflows from the system.

dynamic head *See* total dynamic head.

dynamic image analysis A technique for capturing and analyzing images of suspended particles in a flowing sample. It incorporates a digital camera, illumination and magnification modules, an innovative fluid handling system, and image processing software. The images are processed in real time to directly determine particle sizes and concentrations.

dynamic membrane A membrane having a surface-layer coating of substances removed from the water such that this deposited layer also acts as a filtration barrier.

dynamic model A physical model of an object such that the dimensions, weights, and moments of inertia of the model are proportional to the full-sized object. Such a model is also said to have dynamic similarity.

dynamic pressure head When a pump is operating, the vertical distance from a reference point (such as a pump center line) to the hydraulic grade line.

dynamic random access memory (DRAM) The location where data are stored capacitively on a memory chip, requiring frequent recharge hundreds of times per second to avoid loss of the data. DRAM is a high-density, low-cost technology with operational speeds in the nanosecond range.

dynamic reaction An ion exchange reaction that takes place as the water moves past the exchange resin or resins.

dynamic-state extended-period simulation (EPS) A pipe network simulation comprising a series of steady-state runs that allow the user to view system operations over a period of time with defined intervals. EPS can model time-varying features, such as tank levels, head- or pressure-controlled valves, and the status of pumps and pipes.

dynamic suction head The distance from the pump center line at the suction of the pump to the point of the hydraulic grade line directly above it. Dynamic suction head exists only when the pump is below the piezometric surface of the water at the pump suction. When the pump is above the piezometric surface, the equivalent measurement is called dynamic suction lift.

dynamic suction lift The distance from the pump center line at the suction of the pump to the point on the hydraulic grade line directly below it. Dynamic suction lift exists only when the pump is above the piezometric surface of the water at the pump suction. When the pump is below the piezometric surface, the equivalent measurement is called dynamic suction head.

dynamic system A process or system in which motion occurs, as compared to static conditions with no motion. For example, an ion exchange system is considered a dynamic system because the continuous flow of the water to be treated creates continuous motion, as opposed to a static batch system in which the water does not move during the reaction process.

dynamic viscosity *See* absolute viscosity.

dynamic water pressure The water pressure at the inlet to a dynamic water-processing system.

dynamic water system *See* dynamic system.

dyne *See in the Units of Measure section.*

dysentery Severe bloody diarrhea, often fatal, caused by pathogenic microorganisms present in water.

dyspepsia Functional disturbance of the intestine, which can result in malnutrition.

dystrophic Pertaining to waters rich in humic materials, most present in colloidal form, and poor in nutrients and plankton.

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E

E *See* exa *in the Units of Measure section.*

e⁻ *See* electron.

EA *See* environmental assessment.

E. aerogenes *See Enterobacter aerogenes.*

EAP *See* emergency action plan.

early closure device A toilet retrofit device that takes advantage of the maximum water pressure in the tank provided by a full tank of water but closes the flapper early, saving a portion of water in the toilet tank.

early warning system An installation or process whose purpose is to provide warning of malicious attack well enough in advance to avoid serious consequences to the system.

earned surplus That part of a surplus that has arisen out of accumulated net income. It is also called retained earnings.

earth Unconsolidated material derived by weathering and erosion. In engineering practice, it is commonly called soil to distinguish it from rocks. It consists of gravel (boulders, cobbles, pebbles, and granules), sand, silt, and clay, including material of both inorganic and organic origin.

earth dam A dam for which the main section is composed principally of earth, gravel, sand, silt, and clay. An earth dam is sometimes called an earth-fill dam.

earth-dam paving Concrete slabs or stone blocks laid by hand, with or without mortar, on the water face of earth dams or levees to protect them against erosion by waves.

earthen reservoir A reservoir constructed in earth by using excavated material to form embankments. Such reservoirs may be unlined or lined with impervious materials.

earth flow The moderately rapid flow of large masses of slippery earth material. It occurs along the edges of clay terraces in certain glaciated valleys and in some mountainous regions where shale bedrock occurs. It is also called landslide flow.

earth-ground The primary electrical ground in a power system. All electrical power and lightning systems have conductors known as grounding conductors to carry errant currents safely into the earth, where the charge can be safely dissipated.

earthquake A slipping of the earth's plates pushing against each other. When the stored energy overcomes the friction between the two plates, the slipping movement results in shock waves being sent out.

earth's gravitational constant (*g*) As adopted by the International Committee on Weights and Measures, 32.174 feet per second squared (9.80665 meters per second squared). It is also called the acceleration of gravity.

earthy–musty odor A smell associated with soil–dirt or mold–mildew. In drinking water, geosmin is a common source of earthy odors and 2-methylisoborneol is typically associated with musty smells. Both of these chemicals are produced by certain cyanobacteria and actinomycetes. *See also* actinomycetes; cyanobacteria; geosmin; 2-methylisoborneol.

easement An acquired legal right to the use of land owned by others. An easement is ordinarily more restricted in scope than a leasehold.

ebbing-and-flowing spring A spring that has periods of relatively large continuous discharge at more or less regular and frequent intervals. Such springs may be classified as perennial or intermittent. Although the discharge of such a spring somewhat resembles that of a geyser in its rhythmic action, such discharge is caused by an entirely different cause, such as siphon action.

EBCDIC *See* Extended Binary Coded Decimal Interchange.

EBCT *See* empty bed contact time.

E. bieneusi *See Enterocytozoon bieneusi.*

Ebola virus One of two members of a family of ribonucleic acid (RNA) viruses called the Filoviridae. Humans can be exposed to Ebola virus from direct contact with the blood and/or secretions of an infected individual. The incubation period ranges from 2 to 21 days. The onset of illness is abrupt and is characterized by fever, headache, joint and muscle aches, sore throat, and weakness, followed by diarrhea, vomiting, and stomach pain. A rash, red eyes, hiccups, and internal and external bleeding may be seen in some patients.

EBPP *See* electronic billing presentation and payment.

(E)-2-bromo-3(dibromomethyl)-4-oxobutenoic acid *See under* bromo-3(dibromomethyl)-4-oxobutenoic acid.

ebullition The boiling of a liquid. Bubbles of saturated vapor form rapidly in the interior of the liquid and then rise to the surface and escape.

EC *See* electrical conductivity.

EC broth Microbiological media used to confirm the presence of *Escherichia coli* bacteria.

ECD *See* electron capture detector.

(E)-2-chloro-3-(bromochloromethyl)-4-oxobutenoic acid *See under* chloro-3-(bromochloromethyl)-4-oxobutenoic acid.

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(E)-2-chloro-3-(dibromomethyl)-4-oxobutenoic acid *See under* chloro-3-(dibromomethyl)-4-oxobutenoic acid.

(E)-2-chloro-3(dichloromethyl)-butendioic acid *See under* chloro-3-(dichloromethyl)-4-butendioic acid.

(E)-2-chloro-3-(dichloromethyl)-4-oxobutenoic acid *See under* chloro-3-(dichloromethyl)-4-oxobutenoic acid.

echo sounding A process of indirectly measuring depth by noting the time interval required for sound waves to go from a source of sound near the surface to the bottom and back again.

echovirus An acronym for the enteric cytopathogenic human orphan virus, a type of enterovirus that may cause diarrhea and aseptic meningitis.

E. cloacae *See Enterobacter cloacae.*

ecoefficiency Economically efficient use of natural resources by businesses with sustainable development as the main objective.

ecokinetics The study of the rates of uptake and metabolism of specific compounds by living organisms in an ecosystem. The term can also be applied to the apportioning of a compound among phases in an ecosystem.

E. coli *See Escherichia coli.*

***E. coli* F-amp** *See Escherichia coli* F-amp.

E*colite® test A test for drinking and ambient water approved by the US Environmental Protection Agency for the detection of total coliforms and *Escherichia coli*. Blue color development indicates the presence of coliform bacteria whereas blue color development with fluorescence indicates the presence of *E. coli.*

ecological amplitude The range of one or more environmental conditions in which an organism or a process can function.

ecological balance The state of an ecosystem in which the relative populations of the system's components remain approximately constant.

ecological community An aggregation of naturally sustaining and interdependent organisms interacting in the same area.

ecological equivalence The condition in which two or more species can, because of their similarity, occupy the same ecological niche and thus be able to replace each other.

ecological equivalent One of two or more analogous species in similar environmental contexts (i.e., distantly related species) displaying closely similar adaptive mechanisms.

ecological fallacy An error in inferring that a population association observed in an ecologic or descriptive epidemiologic study applies to individual members of that population. An ecologic study does not link an individual's disease to exposures or confounding characteristics of that individual, nor does it link individual exposure and confounding characteristics to each other. These linkage failures are the source of special biases of ecological studies that are often referred to as the ecological fallacy.

ecological indicator An ecological community or organism so strictly associated with given environmental conditions that its presence is indicative of the existence of these conditions.

ecologically sustainable development (ESD) A rate or level of development believed to enable an ecosystem to sustain itself.

ecological niche The status of an organism within its community that determines its feeding activities and interactions with other organisms, including enemies.

ecologic epidemiologic study A study using descriptive epidemiologic data, vital statistics, and other information (e.g., general air pollution measurements for a region) to determine associations. In contrast to analytical epidemiologic studies, populations rather than individuals within these populations are studied, and any association between exposure and disease is indirect. These studies are used primarily to create hypotheses for further research by analytical epidemiologic studies.

ecology The branch of biological science that involves the study of the relationships between the environment and the living organisms present.

econometric forecasting The use of regression analysis in water demand forecasting, including (as independent variables) economic variables such as population, employment, household income, home value, and water prices. The resulting methods or models are also used to define the demand curve(s) for water and the price elasticity for projecting future demand.

econometrics The use of statistical and mathematical methods in the field of economics to develop and verify economic theories.

economic depreciation The loss in value of goods or services resulting from external economic conditions affecting the character or degree of utilization.

economic development A stage or step in growth or advancement that benefits a business, community, or organization.

economic development rate A water rate established to entice commercial and industrial customers either to stay in or to relocate into the utility's service area. Such a rate provides a temporary or permanent subsidy to the specific customers who qualify, justified by (1) the benefits accruing to the utility through additional water sales to new residents resulting from additional employment, or (2) the overall benefit

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accruing to the community as a whole from increased employment and growth in economic development. *See also* negotiated rate.

economic forecast A prediction of future production, distribution, and use of income, wealth, and commodities.

economic groundwater yield The maximum rate at which water can be withdrawn artificially from an aquifer throughout the foreseeable future without depleting the supply or altering the chemical character of the water to such an extent that withdrawal at this rate is no longer economically possible. The economic yield varies with economic conditions and other factors, such as recharge, natural discharge, and pumping head. The term may be applied with respect to the economic feasibility of withdrawal from the standpoint of the actual organization that withdraws water artificially or from the standpoint of the entire economy of a river valley or other larger area to which the aquifer contributes water.

economic impact analysis An evaluation of the economic impacts of a proposed or final rule prepared by the US Environmental Protection Agency. An economic impact analysis is prepared for minor rules (those with an economic impact of under $100 million), whereas a regulatory impact analysis is prepared for rules having a major impact (those with an economic impact of over $100 million). *See also* regulatory impact analysis.

economic level of apparent losses (ELAL) A concept that requires determining the level of apparent losses where the sum of the cost of the apparent loss reduction actions (meter changeout, theft control, and so on) and the cost of lost revenue caused by apparent losses is at a minimum. The ELAL can be used for apparent loss reduction target setting.

economic level of leakage (ELL) The acceptable leakage level target for a water utility. ELL is found by determining the level of real (leakage) losses where the sum of the cost of the real loss reduction and the cost impact of the real losses is at a minimum. The ELL is used for leakage reduction target setting.

economics The social science that deals with the production, distribution, and consumption of wealth, as well as the various related problems of labor, finance, taxation, and so on.

economy In the desalting processes, the ratio of the mass of distilled water produced per 1,000 British thermal units (1,055 kilojoules) of heat input.

economy of scale A reduction in unit cost resulting from a distribution of fixed costs over a larger number of units. Fixed costs are those necessary to and resulting from the implementation of an activity or project and not directly related to the actual production of a single unit.

ecosystem The composite balance of all living organisms and plants and their ambient environment (air, water, and solid phases) in a defined area.

ecosystem dynamics The interaction of characteristic and measurable processes within an ecosystem, such as succession, energy flow, nutrient cycling, and community metabolism.

ecosystem function Within an ecosystem, the manner in which energy flows and material production varies in cycles.

ecosystem structure The functionally important components of an ecosystem and their pattern of interrelations and spatial arrangements. This term is generally applied to organisms.

ecotone A transition zone where two adjacent communities meet and blend together. The conditions are intermediary between those of the two neighboring communities.

ecotoxicological assessment The identification, evaluation, and assessment of aquatic environments, soils, and sediments that contain naturally occurring or anthropogenic substances posing a developmental or toxicological hazard to living organisms.

ecotoxicology A science that studies the response of the environment to insult by toxic substances.

ecotype (1) A local variety or subspecies that has appeared as a result of and is adapted to a specific set of ecological conditions. (2) A group of organisms within a species that have morphological or physiological characteristics adapting them to their environment.

ectocyst The outer layer of a cyst.

E. cuniculi *See Encephalitozoon cuniculi.*

ED *See* effective diameter; electrodialysis.

ED_{10} The diameter of the d_{10} size particle in a particle size distribution. The ED_{10} represents the particle diameter for which 10 percent of the particles in a sample, by weight, have a smaller or equivalent diameter. The ED_{10}, or d_{10}, is typically used in defining the size characteristics of filter media, such as anthracite or sand. Common units are millimeters. *See also* effective diameter; particle size distribution.

EDA *See* ethylenediamine.

EDB *See* ethylene dibromide.

EDC *See* endocrine disrupting compound.

eddy A circular movement occurring in flowing water, caused by currents set up in the water by obstructions or changes and irregularities in the banks or bottom of the channel.

eddy hydrant A type of dry-barrel hydrant in which the main valve closes against pressure (downward) and the barrel extends slightly below the connection

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to the pipe. *Compare with* standard compression hydrant.

edgematching The process of eliminating locational and content discrepancies in the representation of features at the edges of adjacent map sheets to create a continuous map.

EDI *See* electrodeionization.

EDM *See* electronic distance-measuring device.

EDM device *See* electronic distance-measuring device.

EDR *See* electrodialysis reversal.

EDTA *See* ethylenediaminetetraacetic acid.

eduction The process of bringing, sucking, or separating something out from something else, as in removing used filter sand from a filter box with a water slurry. *See also* eductor.

eductor A device used to mix a chemical with water. The water is forced through a constricted section of pipe (venturi) to create low pressure, which allows the chemical to be drawn into the stream of water or granular media to be removed from a vessel.

EE/O *See* electrical energy per order.

E. faecalis *See Enterococcus faecalis.*

E. faecium *See Enterococcus faecium.*

effect In water distillation, an evaporation–condensation step in which steam is condensed on one side of a heat transfer surface and salt water is evaporated on the other side using the available heat of condensation. *See also* multiple-effect distillation.

effective corrosion inhibitor residual The corrosion inhibitor residual concentration that is capable of controlling corrosion or metal uptake to a target level. Corrosion inhibitors employ passivation of the metal surface as a means of corrosion control.

effective date The date a national primary drinking water regulation becomes enforceable.

effective diameter (ED) A criterion used in evaluating the size of a soil or particulate mixture. Often used for determining the size of filtration media in drinking water treatment, the effective diameter is the particle diameter in millimeters for which 10 percent of the medium (by weight) has a diameter less than or equal to that value. The effective diameter is determined by processing a sample through a series of sieves with progressively smaller openings and then measuring the mass of material retained by each sieve. The sieve opening diameter is plotted as a function of the percent mass less than or equal to that given sieve diameter. The tenth percentile value is the effective diameter, d_{10} or ED_{10}. *See also* ED_{10}.

effective grain size *See* effective size.

effective groundwater velocity The actual or field velocity of groundwater percolating through water-bearing material. It is calculated as the volume of groundwater passing through a unit cross-sectional area in unit time divided by the effective porosity. It is also called actual groundwater velocity, field groundwater velocity, or true groundwater velocity.

effective head (1) The head available for producing energy in a hydroelectric plant after all losses from friction, eddies, the entrance, unrecovered velocity head at the mouth of a draft tube, and so on—except those chargeable to the turbine—are deducted. It is also called net head. (2) For reaction turbines, the difference between the total head at the entrance to the runner case and that in the tailrace at the draft tube. (3) For impulse turbines, the difference between the total head at the entrance to the nozzle and that at the lowest point of the pitch circle of the runner bucket.

effective height The total head against which a pump must work, measured in length units.

effective interest rate The rate of earnings on a bond investment based on the actual price paid for the bond, the coupon rate, the maturity date, and the length of time between interest dates.

effective opening The minimum cross-sectional area at the point of water supply discharge, measured or expressed in terms of the diameter of a circle or, if the opening is not circular, the diameter of a circle of equivalent cross-sectional area.

effective pore fraction The ratio of the porosity available for fluid flow to the bulk porosity of a sample.

effective porosity The volume of void spaces through which water or other fluids can travel in a porous material divided by the total volume of the material.

effective precipitable water In the context of rainfall, the greatest amount of precipitable water that can be removed from an atmospheric column by convective action.

effective precipitation The total amount of rainfall minus the volume lost to evapotranspiration, leaching, or both during a given time period; rainfall absorbed by soil and available to plants or turf when needed, expressed as a depth of water in inches, feet, acre-inches, or acre-feet.

effective rainfall Rain that produces surface runoff.

effective range That portion of the design range (usually the upper 90 percent) in which an instrument has acceptable accuracy. *See also* range; span.

effective size (ES) The granular medium particle diameter, d_{10}, for which 90 percent of a sample, by mass, has an equivalent or larger diameter. It is also called the effective grain size. Common units are millimeters. *See also* ED_{10}; effective diameter; uniformity coefficient.

effective storage The volume of water available for a designated purpose.

effective used energy The energy used annually to lift water to users and to give it operational pressure.

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effective velocity *See* effective groundwater velocity.

effect modifier A variable or characteristic that modifies the effect of an epidemiologic association (e.g., age is an effect modifier for many diseases).

effervescence The vigorous escape of small gas bubbles from a liquid, especially as a result of chemical action.

efficiency (1) A measure of the effectiveness of the operational performance of an ion exchanger, usually based on the ratio of output per unit of input. This ratio is often expressed as the amount of regenerant required to produce a unit of contaminant reduction capacity. Common units are pounds of salt per kilograin of hardness removed or kilograms of acid per kilogram of salt removed. (2) The percent reduction of contaminants that occurs with a specified medium volume and specified water contact time. (3) The value obtained (expressed as a percentage) by dividing the volume of product water produced by the total volume of feedwater fed to the particular unit or system. (4) A measure of the effectiveness of any operational performance. (5) The ratio of the resulting useful work to the energy expended to achieve the results. (6) The competence with which one completes one's duties. (7) The ability to produce a desired effect on a product, with a minimum of effort, expense, or waste. (8) The ratio of output power from a hydraulic machine to the input power. In pumps, mechanical efficiencies greater than 80 percent are typical. *See also* salt efficiency.

efficiency standard A value or criterion that establishes levels or conditions of water use in the ornamental landscape.

EfficientUtilities (EU) A Web-based service that connects buyers and suppliers in the water industry. EU and Environmental Network International have developed eProcurement and eBusiness software for the water industry that does not charge commissions or transaction fees on the goods and services procured using the software.

efficient water management practice (EWMP) An agricultural water conservation measure as adopted under the Memorandum of Understanding Regarding Urban Water Conservation in California.

effluent Water flowing from a structure such as a treatment plant. *Contrast with* influent.

effluent exchange The practice of using wastewater effluent as a source of replacement of upstream water diversions.

effluent launder A trough that collects the water flowing from a basin and transports it to the effluent piping system.

effluent quality The physical, biological, and chemical characteristics of a liquid flowing from a basin, reservoir, pipe, or treatment plant.

effluent seepage The diffuse discharge of groundwater to ground surfaces or into a surface water body. *See also* leakage.

effluent stream A stream or stretch of stream that receives water from groundwater in the zone of saturation. The water surface of such a stream stands at a lower level than the water table or piezometric surface of the groundwater body from which it receives water.

effluent weir A weir at the outflow end of a sedimentation basin or other hydraulic structure.

efflux tube A tube inserted into an orifice to provide for outward flow of water.

EGL *See* energy grade line.

E_h An electric potential in an oxidation–reduction reaction. This potential (in volts, hydrogen scale), called a "redox" potential, represents the relative tendency of ions to acquire electrons. The more positive the value, the more oxidizing (electron-rejecting) the solution; more negative values represent more reducing (electron-acquiring) conditions. Because electron activity can vary over wide ranges, expressing the E_h value as the dimensionless pE is often more convenient. Because electron activity varies with the pH of water, it is often useful to refer to graphs of E_h (or pE) as a function of pH. In this manner, the range of thermodynamically stable species can be illustrated. *See also* oxidation–reduction potential; oxidation–reduction reaction.

EHEC *See* enterohemorrhagic *Escherichia coli.*

E. hellem *See Encephalitozoon hellem.*

E. histolytica *See Entamoeba histolytica.*

EIA *See* enzyme immunoassay.

EIEC *See* enteroinvasive *Escherichia coli.*

18-megohm water A high-purity water that conducts electrical current poorly because of the lack of ionized impurities (electrolytes). It has an electrical resistivity of approximately 18 megohm-centimeters (180,000 ohm-meters) and a conductivity of 0.0556 micromhos per centimeter (0.00000556 siemens per meter) at a specified temperature, typically 77° Fahrenheit (25° Celsius). This type of water is also called ultrapure water.

EI ionization *See* electron impact ionization.

einstein *See in the Units of Measure section.*

E. intestinalis *See Encephalitozoon intestinalis.*

EIS *See* Environmental Impact Statement.

EJC *See* Engineers Joint Council.

ejection The process of forcing something out or expelling it.

ejector The portion of a chlorination system that feeds the chlorine solution into a pipe under pressure.

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ejector pump A shallow or deep-well pump operating on the venturi principle. An ejector pump is commonly referred to as a jet pump. *See also* jet pump; Venturi principle.

ELAL *See* economic level of apparent losses.

elastic demand Demand for a product (water) such that when a price increase (or decrease) is imposed, the resulting percentage change in quantity demanded is greater than the percentage change in price. Elasticity is defined as the percentage change in quantity demanded divided by the percentage change in price, which is always a negative term. With elastic demand, price elasticity is less than –1 (e.g., –1.1). The effect of elastic demand is that a utility's revenue will decrease with rate increases. Elastic demand rarely, if ever, applies to the water. *See also* inelastic demand; price elasticity (of demand).

elastic limit *See* proportional limit.

elastic modulus (modulus of elasticity) The elastic stiffness of a material, which represents the resistance of the material to deformation. For stress levels less than the proportional limit, the elastic modulus is calculated as the slope of the stress–strain curve.

elastomer A pliable, tough plastic material similar to rubber and having the same properties. An elastomer can be used to cover or partially cover a foam swab used in cleaning of water mains to prevent the foam from being damaged during flushing. *See also* polypig; swab.

elbow A pipe fitting that connects two pipes at an angle. The angle is always 90° unless another angle is stated. An elbow is also called an ell.

elbow draft tube A draft tube that makes a turn of approximately 90° after leaving the wheel, usually in order to save space or reduce the depth and quantity of excavation required.

ElCD *See* electrolytic conductivity detector.

electrical ballast An electrical component of an ultraviolet lamp that provides the proper voltage and current required to initiate and maintain the gas discharge within the ultraviolet lamp.

electrical conductivity (EC) The reciprocal of the electrical resistance in ohms, measured between opposite faces of a 1-centimeter cube of an aqueous solution at a specified temperature. Units, in Système International, are siemens per meter or square amperes cubic seconds per kilogram per cubic meter.

electrical consumption The quantity of electricity supplied to a piece or pieces of equipment in a specified amount of time, most often expressed in kilowatt-hours.

electrical demand The maximum rate at which electricity is used, most often expressed as kilowatts.

electrical double layer The electrically charged surface of a colloidal particle together with a diffuse surrounding layer of counterions. *See also* electrokinetic potential.

electrical energy per order (EE/O) A number used to evaluate the cost efficiency of photodegradation water treatment processes. Electrical energy per order is the electrical energy in kilowatt-hours required to lessen the concentration of a contaminant in water by one order of magnitude in 1,000 gallons (3,785 liters) of water. It is also known as the figure of merit.

electrical ground (1) Any common point in an electrical circuit against which electrical properties are measured. (2) The portion of an electrical power circuit that is connected to earth.

electrical grounding The connection of an appliance, such as a pump motor or electrical drill, to the ground to prevent short circuits and to eliminate the possibility that people will complete circuits and be fatally shocked by touching the appliance. *See also* earth-ground; ground fault interrupter.

electrical load The electrical demand for mechanical equipment, expressed in amperes, kilowatts, kilojoules, or horsepower.

electrical lockout device A piece of equipment that, when attached to a breaker, motor starter, or electrical switch, prevents the accidental startup of out-of-service equipment.

electrical logging A procedure used to determine the porosity (degree of spaces or voids) of formations during a search for water-bearing formations (aquifers). Electrical probes are lowered into wells, and an electrical current is induced at various depths. The measured resistance of various formations indicates the porosity of the material.

electrical potential units *See in the Units of Measure section.*

electrical resistance model An analog groundwater flow model based on the flow of electricity through a circuit containing resistors and capacitors.

electrical sensing zone (ESZ) instrument Device that measures size distribution of particles through use of the Coulter Principle. As each particle passes through the sensing zone, it displaces its own volume of conducting liquid. The volume of each particle is directly proportional to the change in impedance in the sensing zone through which it passes.

electrical sounding An earth resistivity survey made at one particular location by putting the electrode pairs of a dipole–dipole array, or the outer electrodes of a Schlumberger array, progressively further apart. It shows the change of apparent resistivity with depth for local ground conditions. *See also* dipole array.

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electrical stage In an electrodialysis system, a grouping of membrane cell pairs between one anode and one cathode.

electrical staging The addition of anode and cathode electrode pairs to an electrodialysis membrane stack to optimize the direct current electrical current efficiency. A single membrane stack may have one or more electrical stages.

electric bill A charge for electrical energy used by the utility during operations, with pumping being the largest use of energy. For large industrial users of electricity, the schedule typically consists of five components: (1) an administrative, or customer, charge; (2) a demand charge based on a percentage of the maximum electrical demand from the customer during the past 12 months; (3) a consumption or usage charge; (4) a fuel adjustment charge to account for volatility in the cost of the fuel used to generate the electricity; and (5) a distribution charge for delivery of the energy.

electric charge density units
See in the Units of Measure section.

electric charge units
See in the Units of Measure section.

electric current units
See in the Units of Measure section.

electric field strength units
See in the Units of Measure section.

electric flux density units
See in the Units of Measure section.

electric industry deregulation The process of converting the electric industry from a monopolistic to a competitive environment. In the United States, transmission and distribution functions of local electric utilities remain regulated. Specific details associated with the conversion differ on a state-by-state basis.

electricity The movement of electrical charge from one location to another.

electric power Force or energy that is derived from electricity and is at work or can be put to work.

Electric Power Research Institute (EPRI) A private, nonprofit research organization funded by electric utilities to create science and technology solutions for the global energy and energy services industry.

electric rate schedule The structure used by an electricity provider to determine a customer's electric bill. For large industrial users of electricity, the schedule typically consists of four components: (1) an administrative, or customer, charge; (2) a demand charge based on some percentage of the maximum electrical demand from the customer during the past 12 months; (3) a consumption or usage charge; and (4) a fuel adjustment charge to account for volatility in the cost of the fuel used to generate the electricity.

electric resistance units *See in the Units of Measure section.*

electric timer An electric control device that initiates regeneration of an automatic water softener or the recycle phase of a filter unit.

electric well log A record obtained by a traveling electrode used during a well investigation in rock. It is in the form of curves that represent the apparent values of the electric potential and electric resistivity or impedance of the rocks and their contained fluids throughout the uncased portions of a well.

electrochemical gauging A method for measuring the flow of water based on the nearly linear relationship between the concentration and electrical conductivity of a salt solution added to the water as a tracer.

electrochemical generation The development of an electric current arising from the electric potential between anions and cations. *See also* anion; cation; current; electrode potential.

electrochemical instrumentation power positioner An energy-regulating device for battery-powered detection, sensing, or monitoring of equipment.

electrochemical online method Method used to measure electrochemical activity via online monitoring. This method measures corrosion rates and morphology (pitting corrosion, stress crack corrosion, grain boundary corrosion, and so on) by measuring the electrochemical activity according to a variety of electrochemical techniques.

electrochemical oxidation An ex situ/in situ process that uses electricity, steel electrodes, and peroxide to degrade organic compounds. The treatment process works by introducing an electric current into the contaminated liquid or slurry. Addition of hydrogen peroxide into the electrolyzed liquid produce free radicals that break down organic compounds. The process is effective in removing many organics from groundwater.

electrochemical potential The driving force for initiating a chemical reaction, giving rise to a flow of electrons. Corrosion can occur whenever electrochemical potential differs between two points on a metallic surface. Differences in potential can be caused by minor metallurgical or physical differences on a pipe surface, by a connection of old and new pipe, by a connection of dissimilar metals, by cracks in a pipe, and so on.

electrochemical reaction (1) A chemical reaction involving the transfer of electrons, involving both oxidation (the loss of electrons) and reduction (the gaining of electrons). (2) Chemical changes produced by electricity (electrolysis) or, alternatively, the production of electricity by chemical changes (galvanic action). In corrosion, a chemical reaction is

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accompanied by the flow of electrons through a metallic path. The electron flow may come from an external source and initiate the reaction (e.g., electrolysis caused by a direct current electric railway), or the electron flow may be caused by a chemical reaction (as in the galvanic action of a flashlight dry cell).

electrochemical series A list of metals with the standard electrode potentials given in volts. The size and sign of the electrode potential indicate how easily an element will take on or give up electrons, or corrode. Hydrogen is conventionally assigned a value of zero.

electrochemical system A system for generating chemicals on site. Regularly used electrochemical systems in the drinking water industry are chlorine dioxide and sodium hypochlorite generation units. The chlorine dioxide electrochemical system meters sodium chlorite solution into an electrolytic cell, where it undergoes an electrochemical reaction and produces chlorine dioxide. The sodium hypochlorite generating system meters sodium chloride solution into an electrolytic cell, where it undergoes an electrochemical reaction and produces dilute sodium hypochlorite.

electrochemical theory Theory that describes electrochemical corrosion that occurs in a corrosion cell. There are four fundamental components in an electrochemical corrosion cell: an anode (oxidation), a cathode (reduction), a conducting environment for ionic movement (electrolyte), and an electrical connection between the anode and cathode for the flow of current.

electrochemistry The study of chemical reactions involving electricity, such as when a metal goes into solution as an ion or reacts in water with another element to form a compound and results in a flow of electrons.

electrocoagulation A coagulation process in which an aluminum or iron sacrificial anode is submerged in the process stream and an electrical current is applied, releasing iron or aluminum ions into solution. The electrocoagulation zone is mixed, as with a rapid mixer in a conventional coagulation plant, and the ferric and aluminum ions react with the water to form the metal hydroxide precipitates that are associated with a conventional coagulation process. *See also* coagulation, conventional water treatment.

electrode A device through which electric current flows into or out of a cell, apparatus, or liquid electrolyte. *See also* anode; cathode.

electrodeionization (EDI) A demineralization process employing a specialized electrodialysis membrane process containing mixed bed ion-exchange resin that is capable of producing high-purity water. Feedwater passes through ion-exchange resin located in dilute-flow stream channels between parallel anion-exchange membranes and cation-exchange membranes in a direct current (DC) field. Feedwater ions move toward the electrodes of opposite charge and are transported through the ion-exchange resin and ion selective membranes to concentrate-flow channels. The DC electrical field is operated to split water into hydrogen and hydroxide ions near the membrane and resin bead surfaces that continuously regenerate the resin. The ions removed from the feedwater are discharged from the system in the concentrate flow stream.

electrode method Any analytical procedure that uses an electrode connected to a millivoltmeter to measure the concentration of a constituent in water.

electrode potential A measure of the difference in charge between metals in contact with a fluid or electrolyte. This potential can generate a current and is an important aspect in determining the rate of corrosion in piping.

electrodialysis (ED) A desalting process driven by an electrical potential difference between oppositely charged electrodes. Ions are transferred by direct electric current flow through cation and anion membranes, depending on ion charge, from a less concentrated solution to a more concentrated one, leaving a demineralized stream.

electrodialysis reversal (EDR) An electrodialysis process in which the electrical polarity of the electrodes is reversed on a set time cycle, thereby reversing the direction of ions in the system for membrane scaling and fouling control. *See also* electrodialysis.

electrodynamic meter A device used to measure electrical power (in watts or kilowatts).

electrokinetic potential (ζ) The electrical difference between the firmly bound water layer surrounding a charged particle and the bulk water solution. This is often called the zeta potential. It can be computed operationally from the electrophoretic mobility. Zeta potential is used in water treatment as a way of optimizing coagulation. *See also* zeta potential.

electrolysis Chemical changes caused in an electrolyte by an electrical current. The US Environmental Protection Agency discourages the use of this word to mean "corrosion by stray currents."

electrolyte An ionic conductor (usually in aqueous solution).

electrolytic analysis The quantitative measurement of a chemical by (1) measuring the potential at an electrode or sensor or (2) passing a current through a liquid and measuring the quantity of material deposited on an electrode or the volume of gas released at an electrode.

electrolytic cell (1) A device in which the chemical decomposition of material causes an electric current

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to flow. (2) A device in which a chemical reaction occurs as a result of the flow of electric current. Chlorine and caustic soda (NaOH) are made from salt (NaCl) in this type of electrolytic cell.

electrolytic chlorine Chlorine produced by the electrolytic dissociation of hydrochloric acid (HCl) or one of its salts.

electrolytic conductivity detector (ElCD) A device used in the analysis of organic compounds by gas chromatography for the detection of individual organic compounds. This type of detector can be sensitive to a variety of compounds but is usually used in water analysis for the analysis of halogen-substituted compounds.

electrolytic corrosion cell An electrochemical cell in which an external direct current generates the corrosion. For this to occur, all elements of the electrochemical cell must be present: anode, cathode, a connection between the anode and cathode (internal circuit), and an electrochemical solution. *See also* anode; cathode.

electrolyzed salt brine A solution generated by electrolyzed sodium chloride solution for water disinfection. This solution is thought to contain chlorine and/or other disinfectants, but it has not been fully chemically characterized. *See also* mixed oxidant.

electromagnetic conductivity A measurement of an induced electrical field in earth to determine the ability of the earth to conduct electricity. Electromagnetic conductivity is the inverse of electrical resistivity. It is important in water prospecting and contaminant surveys. It is also known as electric conductivity and terrain conductivity.

electromagnetic inspection The nondestructive evaluation of a material such as wire rope or prestressed concrete pressure pipe.

electromagnetics The study of the combined effects of electricity and magnetism.

electromechanical instrumentation power positioners Any number of combination electronic and mechanical devices designed to control or monitor electrical equipment such as variable-speed motors. Because they have electronic components, they should be maintained as electrical equipment.

electrometric titration A titration in which the end point is determined by observing the change of potential of an electrode immersed in the solution titrated.

electromotive force (emf) Basic electrical force, measured in volts.

electromotive force units *See in the Units of Measure section.*

electromotive series A list of metals and alloys presented in the order of their tendency to corrode (or go into solution). It is also called the galvanic series. It is a practical application of the theoretical electrochemical series.

electron (e^-) One of the three elementary particles of an atom (along with protons and neutrons) in the simplified atom model. An electron is a tiny, negatively charged particle that orbits around the nucleus of an atom. The number of electrons in the outermost shell is one of the most important characteristics of an atom in determining how chemically active an element will be and with what other elements or compounds it will react. *See also* neutron; proton.

electron acceptor Any substance (a molecule or ion) that can accept electrons and thereby be reduced. For example, a Lewis acid is an electron acceptor (called an electrophile) that can combine with another molecule or ion by forming a covalent bond with two electrons from the second molecule or ion. *See also* covalent bond; electron donor; Lewis acid; oxidant.

electron beam process A process for disinfection that uses gamma radiation, sometimes from a cobalt-60 source.

electron capture detector (ECD) A device used in the analysis of organic compounds by gas chromatography. Most of the electron capture detectors used today make use of a radioactive foil coated with nickel-63. Electron capture detectors are especially sensitive to halogen-substituted compounds.

electron donor Any substance (a molecule or ion) that can donate electrons. For example, a Lewis base is an electron donator (called a nucleophile) that forms a covalent bond by donating a pair of electrons. *See also* covalent bond; electron acceptor; Lewis base.

electronic asset information management system A computerized system that is used to manage asset life cycle, monitor profit and loss, calculate cost, and focus on asset optimization.

electronic billing presentation and payment (EBPP) A management system with inputs from meter reading, financial payments, late payments billing, and collection. It also allows customers to pay their bills over the Internet.

electronic distance-measuring (EDM) device A surveying instrument using laser and computer technology to digitally record distances and angles. It has replaced traditional optical surveying transits.

electronic meter reading (EMR) The use of handheld data entry terminals, computers, or other electronic technology to increase the productivity of the meter reader.

electronic path The movement of electrons through a complete electrical circuit.

electron impact (EI) ionization A mode of operation in mass spectrometry in which analyte molecules are bombarded with an electron beam, typically at an

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energy of about 70 electron volts. This bombardment produces a fragmentation pattern that is characteristic of the analyte and can form a basis for the identification of unknown compounds. This is the most commonly used ionization mode in mass spectrometry. Large electronic databases are available that contain thousands of mass spectra determined in the electron impact mode. *See also* chemical ionization; mass spectrometry.

electron impact mass spectrometry The most common mass spectrometric technique. *See also* electron impact ionization; mass spectrometry.

electron microscope An instrument that uses electric or magnetic fields to focus a beam of electrons in order to form an enlarged image of an object on a fluorescent screen or photographic plate. An electron microscope can magnify images up to a million times. The image of a virus is the result of the scattering of the electron beam by the electrons in the specimen. Types of electron microscopes include transmission electron microscopes, scanning electron microscopes, and reflection electron microscopes. *See also* scanning electron microscope.

electron microscopy The use of an electron microscope for various applications such as virus analysis.

electron spin resonance (ESR) A spectroscopic technique based on the absorption of microwave radiation by electrons in the presence of a magnetic field. It is similar to nuclear magnetic resonance. Although most compounds do not exhibit an electron spin resonance spectrum because they have an even number of electrons, the technique has been used to study reactions of free radicals. Compounds that contain unpaired electrons can be studied by this technique.

electron transfer (ET) The act moving an electron from one molecule or atom to another, occurring during electrochemical reaction. When receiving one or more electrons, the species is reduced. When losing one or more electrons, the species is oxidized. *See also* oxidation–reduction reaction.

electron volt (eV) *See in the Units of Measure section.*

electroosmose treatment A process for the removal of objectionable salts from water by passing the water through diaphragms from cell to cell containing anode and cathode poles.

electrophilic intermediates Electron-deficient chemical metabolites that will readily react with nucleophilic centers in macromolecules. Such reactions lead to the destruction of the functional capabilities of proteins and can result in mutations in deoxyribonucleic acid. If a chemical is too electrophilic, however, reactions with water may prevent it from reaching the macromolecular targets.

electrophoresis The migration of electrically charged particles in solution or suspension in the presence of an applied electric field. *See also* electrophoretic mobility.

electrophoresis apparatus A device used to separate charged particles in an electric field. The charged particles, such as simple ions, proteins, or living cells, may be separated depending on the selected apparatus and technique. A given apparatus can also allow the use of several electrophoretic techniques, such as free-zone capillary electrophoresis, isoelectric focusing, and micellar electrokinetic capillary chromatography.

electrophoretic mobility (EM) A measure of the ability of an ion or particle to migrate in an electric field. The electrophoretic mobility is equal to the migration velocity per unit field strength. The units are normally expressed in micrometers/second per volt/centimeter (also can be expressed as square centimeters per volt per second, although that unit is not explicit in relation to the experimental technique used for measuring EM). This term is often used in colloid analysis and coagulation. Electrophoretic mobility is related to the electrokinetic potential on a particle. *See also* electrokinetic potential.

electrophotometer A photometer that uses different colored glass filters to produce the desired wavelengths for analyses. It is also called a filter photometer.

electroporation The process in which an electric field alters the cell membrane of an organism to the point at which small pores open in the cell wall. The process can be used to enhance the effectiveness of conventional disinfectants or, with sufficient electric charge, cause leakage of the cell contents from within, leading to chemical imbalance and cell death. *See also* pulsed electric field.

electropositive filter A filter composed of a cellulose–diatomaceous earth resin mix, used for concentrating viruses from large volumes of water. Such a filter is also called a zeta plus filter.

electrospray ionization (ESI) A technique used as an interface in liquid chromatography–mass spectrometry in which analytes in a solvent are charged while passing through a capillary. This action frees the analytes from the solvent and they move on to a detector. The advantages of electrospray ionization over other types of interfaces include a combination of greater sensitivity and greater selectivity. *See also* liquid chromatography–mass spectrometry.

electrostatic plotter A peripheral device that produces hard copy graphic images in raster format.

electrostatic test A procedure for measuring or indicating the force that exists between charged bodies or particles. This force is expressed mathematically by

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Coulomb's law and can be measured or indicated with an electroscope.

electrotechnologies Electricity-based water treatment technologies, including ozonation, ultraviolet light irradiation, membrane separation, and others.

electrowin To extract a metal from solution by electrolysis.

element (1) Any of more than 100 fundamental substances that consist of atoms of only one kind and that constitute all matter. (2) Any single discrete part of a control system. (3) *See* cartridge.

elemental analysis A method for determining the carbon, hydrogen, nitrogen, oxygen, sulfur, and silicon content of a sample. The method involves the combustion or pyrolysis of dry material. Elemental analyses are often performed during the characterization of the natural organic matter in water. *See also* natural organic matter.

elevated eosinophilia A medical condition characterized by high counts of eosinophils, a type of white blood cell, in the blood or in the body tissue.

elevated storage Water stored or the capacity to store water at an elevation. This elevated water provides pressure in a water pressure plane, thereby allowing for controlled pumping rates, water for peak usage and fire protection, and minimized service interruptions during equipment maintenance requirements.

elevated tank A water storage facility located on and supported by a tower constructed at an elevation to provide useful storage and pressure for a water pressure plane.

elevation charge A surcharge added to the base water rate for customers at different elevations to recover the incremental costs incurred for pumping and storage to serve each higher elevation band. Elevation bands may be set, for example, in increments of 100 feet (30.5 meters) or 500 feet (152.5 meters).

elevation head The energy per unit weight of a fluid caused by the fluid's elevation above some reference point (called the reference datum). Elevation head is also called position head or potential head.

elevation view The view of an object showing the vertical dimensions and how the object would look rising from the ground. *See also* isometric view; plan view.

elimination half-life The time required to remove one half of a chemical from the body. Frequently, this is approximated by the terminal half-life for removal of the chemical from the blood compartment after the distributive phase of chemical absorption has been completed. It is the inverse of the elimination rate constant for a chemical from the body. The longer the half-life, the slower the rate constant. Elimination can occur by metabolism, excretion of the chemical, or both.

elimination rate constant The inherent rate at which a chemical is removed from the body. This includes removal from various repositories within the body. Frequently, this constant is approximated by the terminal rate constant for chemical removal from the blood compartment after the distributive phase of drug or chemical absorption has been completed. Mathematically, the elimination rate constant is the reciprocal of the elimination half-life.

ELISA *See* enzyme-linked immunosorbent assay.

ELL *See* economic level of leakage.

ell *See* elbow.

El Niño–Southern Oscillation (ENSO) An irregular cycle of warming and cooling of the sea surface temperatures of the tropical Pacific Ocean. The cycle has a length of about 4 years and is a natural part of the earth's climate system. The oceanic warming and cooling is accompanied by changes in air pressure above the Pacific Ocean (the "Southern Oscillation"), which is an interannual seesaw in tropical sea-level pressure between the eastern and western hemispheres. During El Niño, unusually high atmospheric sea-level pressures develop in the western tropical Pacific and Indian Ocean regions, and unusually low sea-level pressures develop in the southeastern tropical Pacific.

El Tor (eltor) vibrio *See Vibrio cholerae.*

eluent A solution used to remove particles adsorbed to a solid. Solutions of proteins–peptides (e.g., beef extract, skim milk) or detergents (distilled water solution) at pH 7 to 10 are often used if viruses are to be removed.

elute To remove particles adsorbed to a solid. This is usually accomplished by treating the solid with a chemical that reverses adsorption.

elution (1) The process of separating or washing out adsorbed material, especially by use of a solvent. (2) In ion exchange, the stripping of ions from the medium by passing a more highly concentrated ionized solution through the ion-exchanger bed.

elution curve A relationship illustrating the concentration of ions, in equivalents per liter, as a function of bed volume for the regeneration of ion-exchange resin. The elution curve, similar to a breakthrough curve, provides an understanding of the regeneration level required to achieve a desired resin conversion and regenerant efficiency. *See also* bed volume; breakthrough; ion exchange; regeneration.

EM *See* electrophoretic mobility.

EMAP *See* Environmental Management and Programs.

embedded cost of debt *See* cost of debt.

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embedded cost-of-service The use of actual operating and capital costs based on historical data to calculate the cost of providing a service to a customer or class of customers. These costs do not reflect estimates of either operational or capital costs to provide service in the future.

embedded knowledge-based system A complex simulation model that is enhanced by the application of rule-based pre- and postprocessors. *See also* computer-aided modeling system.

embedded water *See* virtual water.

embolism A blockage of a blood vessel. This is frequently the result of a blood clot that has broken free from one area of the circulatory system to be lodged in the fork of an artery. Such clots cause the acute damage associated with strokes, myocardial infarctions (i.e., heart attacks), or both.

embryo An organism in the early stages of its development as before emergence from the egg; the young of a mammal in the early stages of development within the womb.

embryolethality The process of producing death of an embryo.

embryonation To develop into the embryo stage.

embryotoxic A chemical or other agent that exerts greater toxicity for the embryo than for the pregnant woman or animal.

EMC *See* event mean concentration.

emergency action plan (EAP) A plan developed by a water utility that defines actions that will be taken in case of an emergency.

emergency management All aspects of management to prepare for, respond to, or recover from a natural or anthropogenic disaster.

emergency planning The process of preparing and documenting an operations plan to be used when a natural or anthropogenic disaster interrupts the delivery of goods or services for a period of time.

Emergency Planning and Community Right-to-Know Act (EPCRA) Act that establishes requirements for federal, state and local governments, Indian tribes, and industry regarding emergency planning and "community right-to-know" reporting on hazardous and toxic chemicals. The Community Right-to-Know provisions help increase the public's knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment. States and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment. The act was formerly referred to as SARA Title III.

emergency preparedness plan A thought-out and tested procedure to deal with known hazards in a particular area, either anthropogenic or natural.

emergency response plan (ERP) A documented plan that describes the actions that a community water system (CWS) would take in response to various major events. A major event refers to: credible threats, indications of terrorism, or acts of terrorism; major disasters or emergencies such as hurricanes, tornadoes, storms, earthquakes, fires, flood, or explosion regardless of cause; and catastrophic incidents that leave extraordinary levels of mass casualties, damage, and disruption severely affecting the population, infrastructure, environment, economy, and government functions.

Emergency Response Protocol Toolbox A planning tool developed by the US Environmental Protection Agency designed to help the water sector to effectively and appropriately respond to intentional contamination threats and incidents. The toolbox is organized in a modular format and is of value to drinking water utilities, laboratories, emergency responders, state drinking water programs, technical assistance providers, and public health and law enforcement officials. The six modules provide guidance and information that can be used by the water sector to identify, characterize, and remediate a variety of contamination incidents.

emergency source A source of water supply that is not the regular source or auxiliary source but is developed during an emergency for temporary use.

emergency storage The volume of water stored and reserved for use during catastrophic situations, such as a supply-line break, a pump station failure, or contamination of part of the source of supply.

emergent plant A rooted plant that has parts extending above a water surface, at least during portions of the year, but does not tolerate prolonged inundation.

emergent weed An aquatic plant, such as a cattail, that is rooted in the bottom mud of a water body but projects above the water surface.

emergent wetland That portion of a wetland dominated by erect, rooted, herbaceous vegetation as the uppermost vegetative stratum.

emerging pathogen Any disease-causing organism that has been recently isolated and/or characterized and threatens to increase in the near future. For example, *Enterocytozoon bieneusi*, first described in 1985, is a parasite that produces a highly resistant infectious spore and is most frequently involved in human microsporidiosis.

emf *See* electromotive force.

eminent domain The power of a government entity to seize property or take private property for the benefit of the public.

emission A venting of gas or radiation from a building or piece of equipment.

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emission spectroscopy A chemical analytical technique used to determine metal elements in water by measuring the well-defined characteristic radiation given off by each respective element as the thermally excited element returns from an atomic vapor state to its fundamental state. *See also* atomic absorption spectrophotometric method; inductively coupled plasma spectroscopy; spectroscopy.

emission spectrum The relative light power emitted by an ultraviolet lamp as a function of wavelength.

emission standard A maximum level of contaminants allowed in airborne discharges based on applicable regulatory requirements that may be imposed by national, regional (state or province), or local agencies.

emitter A drip irrigation component that dispenses water to plants at a predictable rate, measured in gallons or liters per hour.

emphysema A disease of the lung that functionally results in a loss of the lung's normally high surface area for exchanging gases. This effect occurs in a variety of ways, but the process ultimately involves the coalescence of alveolar spaces. It is sometimes accompanied by fibrotic changes that further reduce the compliance of the lung (i.e., its ability to expand and contract and move air in and out of the alveoli). Individuals with emphysema are extremely sensitive to conditions that modify the availability of air to the lung or the exchange of oxygen across the membranes in the lung. The nose and lung are sensitive organs to orally administered compounds.

empirical equation A mathematical expression developed based on actual observations, rather than on theory alone, to predict the value of one variable based on several other variables.

empirical model *See* empirical equation.

empty-bed contact time (EBCT) A standard convention or measure of the time during which a water to be treated is in contact with the treatment medium. The empty-bed contact time is calculated by dividing the empty volume in a contactor that will be occupied by the treatment medium by the flow rate

$$\text{EBCT} = V/Q$$

Where (in any consistent set of units):

V = the volume of the vessel

Q = the flow rate

Because the treatment medium, such as granular activated carbon, will occupy some volume, the empty-bed contact time overestimates the actual time that the flow resides in the contactor. *See also* granular activated carbon.

empyema Pus in a body cavity, such as the pleural cavity or gall bladder.

EMR *See* electronic meter reading.

EMS *See* environmental management system.

EMSL *See* Environmental Monitoring Systems Laboratory.

emulsifying agent An agent capable of modifying the surface tension of emulsion droplets to prevent coalescence. Examples are soap and other surface-active agents, certain proteins and gums, water-soluble cellulose derivatives, and polyhydric alcohol esters and ethers.

emulsion A heterogeneous liquid mixture of two or more liquids not normally dissolved in one another but held in suspension (one in the other) by forceful agitation or by emulsifiers that modify the surface tension of the droplets to prevent coalescence. *See also* emulsifying agent.

emulsoid A colloid that is readily dispersed in a suitable medium and may be redispersed after coagulation.

EMX *See* (E)-2-chloro-3-(dichloromethyl)-4-oxobutenoic acid.

encapsulate To enclose or seal off. For example, a tank being sandblasted to remove lead-base paint would be encapsulated.

encased membrane system *See* pressurized membrane system.

encephalitis Inflammation of the brain. It may be caused by a specific viral infection (one of several arthropod-borne viruses), or it may be the result of a viral infection (e.g., influenza, herpes, chickenpox).

Encephalitozoon A genus of parasitic protozoa of the Microsporidia phylum. There are eight species of *Encephalitozoon,* all of which are parasitic to mammals and infect various organs, most typically the brain and kidneys.

Encephalitozoon cuniculi (E. cuniculi) A species of Microsporidia that can infect a wide variety of hosts, including humans. It is a potentially life-threatening opportunistic pathogen that infects the brain.

Encephalitozoon hellem (E. hellem) Species of Microsporidia infecting humans and birds.

Encephalitozoon intestinalis (E. intestinalis) Species of Microsporidia associated with gastrointestinal disease in humans. It has been identified in tertiary wastewater effluent, surface water, and groundwater.

encrustation The built-up material on the inside of a potable water pipe or appurtenance caused by the precipitation of a mineral, such as calcium carbonate ($CaCO_3$); or by corrosion of an exposed metal, resulting in the formation of tubercles. Encrustations may result in a rough or smooth surface and normally restrict flow by reducing diameter or increasing roughness. *See also* tubercle.

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endangered species Animals, birds, fish, plants, or other living organisms that are threatened with extinction by anthropogenic (human-caused) or natural changes in their environments and that are identified and protected under the Endangered Species Act.

Endangered Species Act (ESA) Public Law 93-205, enacted in 1973, creating a national program to prevent the extinction of imperiled animals and plants. The law was amended in 1984 (Public Law 98-327) and in 1988 (Public Law 100-478). It defines the requirements for declaring a species endangered.

endangerment assessment A site-specific risk assessment of the actual or potential danger to human health or welfare and the environment from the release of hazardous substances or waste. The endangerment assessment document is prepared in support of the Comprehensive Environmental Response, Compensation, and Liability Act or the Resource Conservation and Recovery Act.

end-around baffles A series of physical obstacles within or between unit processes that reduce short-circuiting by requiring the flow to pass in sequence around the ends of the baffles, encouraging mixing. In addition, this arrangement may be used in multistage flocculation basins to ensure contact with the mixing devices in each stage. *See also* baffle; flocculation; over-and-under baffles.

end bell A device used to hold the rotor and stator of a motor in position.

end contraction (1) The extent of the reduction in width of the nappe caused by a constriction caused by the ends of the weir notch. (2) The walls of a weir notch that does not extend across the entire width of the channel of approach.

endemic Pertaining to the constant presence of a disease, infection, or other health-related event in a community or geographic area.

endemic illness *See* endemic.

endocarditis Inflammation of the endocardium (the thin, endothelial, serous membrane that lines the interior of the heart).

endocrine An organ responsible for secreting hormones into the bloodstream to exert their effects on distant elements of the body. Examples include the thyroid gland, the pancreas, and adrenal glands.

endocrine disrupting compound (EDC) *See* endocrine disruptor.

endocrine disruptor An exogenous chemical substance or mixture that alters the function(s) of the endocrine system and thereby causes adverse effects to an organism, its progeny, or (sub)populations.

endocrine disruptor screening program A program mandated by the Food Quality Protection Act, requiring the US Environmental Protection Agency to screen pesticide chemicals and environmental contaminants for their potential to interfere with hormone function in humans and wildlife.

endocyst Within the cyst.

endocytosis A process of cell ingestion in which the plasma membrane folds inward to bring a substance into a cell; i.e., the substance enters the cell without passing through the cell membrane.

endogenous respiration Autooxidation by organisms in biological processes.

endoplasmic reticulum A membranous structure within the cell that has specialized functions in the synthesis and processing of proteins and in the metabolism of drugs and chemicals to which the organism is exposed. Increasing evidence exists that some of the systems found in the endoplasmic reticulum also have some role in the regulation of cellular activities. Drug and chemical metabolism occurs in the so-called smooth endoplasmic reticulum. Protein synthesis occurs in the rough endoplasmic reticulum. The particles adhering to rough endoplasmic reticulum are ribosomes that are responsible for specialized functions in protein synthesis.

endoscope Instrument adapted for use in examining the inside of machinery and observing the interior of granular media filter beds. It was originally used to conduct visual examinations of hollow organs inside the human body.

endospore A dormant stage of the life cycle of certain groups of bacteria, notably the aerobic genus *Bacillus* and the anaerobic genus *Clostridium,* that are widely found in soils. Spores are highly resistant to desiccation (drying), heat (many can withstand boiling for 30 minutes), and chemicals. Endospores are small, generally about $0.5 \times 1.0 \times 1.5$ micrometers, and they may be spherical, cylindrical, or ellipsoidal. They are commonly called spores. Because spore-forming bacteria generally occur in abundance in soils, they are carried into drinking source surface waters by surface runoff. Spores are removed as particulates by the coagulation, flocculation, and filtration processes in water treatment, as are *Cryptosporidium* oocysts. In addition, *Bacillus* species are not pathogenic to humans and pose no health threat. By evaluating the levels of indigenous spores in source water and after treatment steps, one can use spores to assess the effectiveness of water treatment processes. In the mid-1990s, the removal of spores or the aerobic bacilli by treatment processes was shown to parallel the removal of total particles (greater than 1 micrometer) and particles in the size range of 3.1 to 7 micrometers. The latter size range corresponds to the size range for *Cryptosporidium* oocysts; thus, removal of aerobic *Bacillus* spores may prove to be a useful

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surrogate for *Cryptosporidium* oocyst removal. If levels of indigenous spores are not high enough to follow through the water treatment processes, a suspension of *Bacillus subtilus* spores can be used in jar or bench test procedures. These bacteria will not grow in filter beds of a pilot plant or full-scale plant.

endospore detection method A simple bacteriological culture method for detecting endospores. It is much easier and quicker than the method used to monitor for the presence of *Giardia* cysts or *Cryptosporidium* oocysts. The water sample to be examined is pasteurized by heating to 17° Fahrenheit (80° Celsius) and held at that temperature for 12 minutes to kill any vegetative *Bacillus* cells. The sample is then rapidly cooled in an ice bath. The spores are not killed by this procedure. Once the sample is cooled to 95° Fahrenheit (35° Celsius) or less, appropriate sample aliquots are filtered through 47-millimeter-diameter, 0.45-micrometer pore-diameter membrane filters, and each filter is transferred to the surface of a petri plate (60 × 15 millimeter in diameter, loose lid) containing solidified nutrient agar plus trypan blue dye (15 milligrams per liter), and is incubated at 95° Fahrenheit (35° Celsius) for 20 to 22 hours. All colonies that arise on the membrane filter are considered to be spore formers and are counted and recorded.

endosymbiosis A type of symbiotic association in which one symbiont dwells within the other.

endothall ($C_8H_{10}O_5$) A generic name for 7-oxalobicyclo-[2.2.1]-heptane-2,3-dicarboxylic acid—a synthetic organic chemical used as a defoliant or an herbicide. It is used as the sodium, potassium, or amine salt. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.10 milligrams per liter. *See also* defoliant; herbicide; synthetic organic chemical.

endotheliochorial placenta A placental type that has only the endothelial layer of the maternal tissue, so that the chorionic villi bathe in the maternal blood. This type of placenta is found in dogs and cats.

endothermic Pertaining to a chemical process in which heat is absorbed. For example, melting ice absorbs heat and therefore represents an endothermic process.

endotoxin A heat-resistant pyrogen (specifically a lipopolysaccharide) found in the cell walls of certain disease-producing bacteria.

end point The final state once a chemical reaction is completed. For example, suppose a chemical is added, drop by drop, to a sample until a certain color change (blue to clear, say) occurs. This new color condition is called the end point of the titration. In addition to a color change, an end point may be reached by the formation of a precipitate or the reaching of a specified pH. An end point may be detected by the use of an electronic device such as a pH meter.

endrin ($C_{12}H_8OCl_6$) A generic name for 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-endo-5,8-dimethanonaphthalene. Endrin is a stereoisomer of dieldrin, both of which are insecticides. Endrin in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.002 milligrams per liter. *See also* dieldrin; insecticide.

end-suction pump A centrifugal pump with the suction and discharge ports located at right angles to each other. Such a pump is also called a single-suction pump because the water enters the impeller from only one side.

end user A consumer of water, e.g., a residential, commercial, industrial, institutional, or agricultural water customer.

end uses of water The places and ways where end users, such as homeowners, use water, such as through plumbing fixtures, appliances, lawn watering, leakage, and so on. The term also applies to nonresidential water users, including businesses, industrial sites, institutional facilities, and farms.

energy In a mechanical sense, the capacity for doing work and overcoming resistance. Many other forms of energy exist: electrical, chemical, hydraulic, and so forth. *See also* power; work.

Energy and Water Quality Management System A collection of individual software programs that together provide information to individuals who use a water company's computer systems to solve water quality and energy management problems associated with carrying out the water company's mission.

energy barrier The electrostatic force between two particles that must be overcome to allow particle flocculation and aggregation to occur. This force results from the interaction between the diffuse layers of the two particles, both of which are similarly charged. These charges are partially offset by attraction through van der Waals forces. The energy barrier is sometimes called the energy hill. *See also* van der Waals forces.

energy budget A quantitative account of inputs, transformations, and outputs of energy in an ecosystem.

energy conservation A reduction in energy usage through the application of more efficient equipment, through varying equipment usage to take advantage of a stepped rate structure for electricity, through the use of variable-speed drives to reduce pump cycling (shutoff and restart), or through other operational measures.

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energy density units
See in the Units of Measure section.

energy dispersive spectroscopy A group of techniques used to analyze the atomic structure of materials. For example, in the case of energy dispersive X-ray spectroscopy, a given element produces a characteristic peak or pattern of peaks. Dispersion involves the change in refractive index of a material as a function of wavelength. In laboratory instruments, dispersion of radiation often occurs by the use of a prism or diffraction grating. Normal dispersion occurs when the change in refractive index increases with increasing frequency (decreasing wavelength). When the reverse occurs, absorption takes place. The absorption of radiation by materials serves as the basis for a number of types of spectroscopic analyses. *See also* spectroscopy.

energy dissipation The transformation of mechanical energy into heat energy. In fluids, this is accomplished by viscous shear. The rate of energy dissipation in flowing fluids varies with the scale and degree of the turbulence. Baffles, the hydraulic jump, and other damping methods are used to dissipate energy.

energy flow The one-way passage of energy (largely chemical) through any ecosystem, entering via photosynthesis, being exchanged through feeding interactions, and, at each stage, being reduced to heat.

energy grade line (EGL) A line joining the elevations of the energy heads; a line drawn above the hydraulic grade line by a distance equivalent to the velocity head of the flowing water at each section along a stream, channel, or conduit. It is sometimes called the energy gradient line or energy line.

energy gradient The slope of the energy line of a body of flowing water with reference to a datum plane.

energy gradient line The line representing the gradient that joins the elevations of the energy head. *See also* energy grade line.

energy head The height of the hydraulic grade line above the center line of a conduit plus the velocity head of the mean-velocity water in that section.

energy line *See* energy grade line.

energy management system A group of approximately 13 programs used by electric utilities for optimizing control of generation and transmission.

Energy Policy Act (EPAct) of 1992
Act that established, among other things, national maximum water use (flow) requirements for toilets, urinals, showerheads, and faucets. For example, toilets manufactured after Jan. 1, 1994 (except commercial toilets and blowout toilets), could use no more than 1.6 gallons (5.4 liters) per flush and faucets and showerheads manufactured after the same date could use no more than 2.5 gallons (9.5 liters) per minute. The act was amended in 2005.

Energy Policy Act of 2005 *See* Energy Policy Act of 1992.

energy recovery A method whereby energy remaining from a process, which would otherwise be lost, is recovered to lessen the overall process energy requirement. In reverse osmosis desalting systems treating highly brackish or seawaters, energy recovery devices such as impulse turbines, turbopumps, turbochargers, and external work exchangers are commonly used to recover residual pressure from the membrane concentrate stream to help reduce system energy consumption.

energy source Thermal, chemical, mechanical, pneumatic, or hydraulic energy that is stored or used in the operation of equipment.

Energy Star® A US government-supported program that educates and informs consumers and businesses about energy use and energy efficiency, including energy-efficient products such as appliances and equipment. The Energy Star® label identifies products, practices, and new homes and buildings that are energy efficient.

energy system The energy flow and the cycling of numerous elements and materials, including the energetic equivalent of the materials.

energy transfer process Any process that transfers energy from one component in an ecosystem to another.

energy units *See in the Units of Measure section.*

enforcement Administrative or legal procedures and actions to require compliance with legislation or associated rules, regulations, or limitations.

engine A machine that converts energy derived from fuel into mechanical work. It operates independently of any other energy source. *Contrast with* motor.

engineer A person trained in science and concerned with putting scientific knowledge to practical uses and using that training to solve problems.

engineering The science concerned with putting scientific knowledge to practical uses. It is divided into different branches, such as civil, electrical, mechanical, chemical, industrial, and environmental engineering.

engineering drawing A scale drawing of a community's street layout, including the distribution system and sewer pipes. Typically, 1 inch (or 2.5 centimeters) on the map is equivalent to a certain number of feet (or meters). The drawing typically delineates pipe sizes and valves where pipes connect.

engineering strain The deformation divided by the initial length. *See also* strain; true strain.

engineering stress The force divided by the original area of the specimen. *See also* stress; true stress.

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engineering structure A structure in which the various members or parts have been predetermined in size, shape, and composition, in order that they may withstand such physical forces or loads as may reasonably be expected to act on or against them.

Engineers Joint Council (EJC) An organization founded in 1945 to foster cooperation among engineering societies. It lost influence around 1967 when two major engineering societies dropped out. It was replaced in 1980 by the American Association of Engineering Societies. *See also* American Association of Engineering Societies.

English rule (of capture) A groundwater ownership doctrine that holds that property owners have the right of absolute ownership of the groundwater beneath their land. This doctrine is also known as the right of capture.

enhanced coagulation The addition of excess coagulant for improved removal of disinfection by-product precursors by conventional coagulation–sedimentation–filtration treatment. In the Disinfectants and Disinfection By-Products Rule, the removal of total organic carbon is used as a performance indicator for the removal of disinfection by-product precursors. The Disinfectants and Disinfection By-Products Rule requires no conversion to optimized coagulation practices, but rather enhancement of an existing process to remove specified levels of total organic carbon based on influent water quality. Enhanced coagulation can also be used to remove arsenic during the coagulation process. *See also* coagulation; Disinfectants and Disinfection By-Products Rule; disinfection by-product precursor; optimized coagulation; total organic carbon.

enhanced slow sand filtration The use of pretreatment or posttreatment to improve the water quality or maintenance and operation, or both, of a conventional slow sand filter. Pretreatment options have included roughing filters; coagulation, flocculation, and sedimentation; ozonation; granular activated carbon; and filter fabrics over the sand medium. Posttreatment options have included granular activated carbon.

enhanced softening The improved removal of disinfection by-product precursors by precipitative softening. In the Disinfectants and Disinfection By-Products Rule, the removal of total organic carbon is used as a performance indicator for the removal of disinfection by-product precursors. The removal of magnesium hardness can also be an indicator of enhanced softening for total organic carbon control. *See also* Disinfectants and Disinfection By-Products Rule; disinfection by-product precursor; enhanced coagulation; precipitative softening; total organic carbon.

Enhanced Surface Water Treatment Rule (ESWTR) The working title of the national primary drinking water regulation while it was under development by the US Environmental Protection Agency to include *Cryptosporidium* within the scope of the Surface Water Treatment Rule. This regulation was subsequently divided into three regulations: the Interim Enhanced Surfaced Water Treatment Rule (IESWTR), passed in 1998; the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR), passed in 2002; and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), passed in 2005. Together, these regulations required all water utilities using surface water to monitor and provide treatment to reduce the risk of the occurrence of *Cryptosporidium* in finished water. *See also* Interim Enhanced Surface Water Treatment Rule; Long Term 1 Enhanced Surface Water Treatment Rule; Long Term 2 Enhanced Surface Water Treatment Rule.

enhanced wetland An existing wetland where human activity increases one or more values, often with an accompanying decline in other wetland values. Wetland values include, but are not limited to, creation of wetlands, aquatic productivity, pollutant assimilation, flood storage capacity, and wildlife habitat.

enhancement Actions performed to provide additional protection to, or create or improve the functions of, a nontidal wetland.

enlargement loss The loss of head in a conduit resulting from eddy losses occasioned by a sudden change in velocity of water caused by enlargement in the cross-sectional area of the conduit.

enol A chemical compound containing both a double bond and a hydroxyl group (–OH), forming an intermediate and reversible product.

enolization A chemical process by which a carbonyl compound (CH–C=O) is converted to an enol (C=C=OH) under acidic conditions or to an enolate ion ($C=C-O^-$) under basic conditions. For example, in the haloform reaction, the enolization of acetone (CH_3–(C=O)–CH_3) yields the enolate $CH_2=(C-O^-)-CH_3$ under alkaline conditions, the first step in the production of chloroform ($CHCl_3$).

ENSO *See* El Niño–Southern Oscillation.

Entamoeba histolytica (E. histolytica) A parasitic protozoa, present in water, that causes dysentery.

enteric Of intestinal origin, especially with respect to wastes or bacteria.

enteric adenovirus *See* adenovirus.

enteric bacteria Gram-negative, nonspore-forming, facultative anaerobic, rod-shaped bacteria (bacilli) of the family Enterobacteriaceae found in the intestinal

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tracts of animals. This family of bacteria is broadly divided into three groups based on lactose utilization: the lactose fermenters, the coliforms (the genera *Escherichia, Enterobacter,* and *Klebsiella*); the lactose nonfermenters (the genera *Salmonella, Shigella,* and *Proteus*); and the slow lactose fermenters, the paracolon bacteria (organisms of the Bethesda–Ballerup and Arizona groups [genus *Citrobacter*], the Hafnia, and the Providencia).

enteric virus Any virus that inhabits the alimentary and gastrointestinal tracts. Many such viruses are stable in the feces and wastewater and can be transmitted through contaminated water supplies.

Enterobacter A genus of lactose-fermenting bacteria belonging to the family Enterobacteriaceae.

Enterobacter aerogenes (E. aerogenes) One of the species of bacteria included in the coliform group. These bacteria are often of nonfecal origin.

Enterobacter cloacae (E. cloacae) A lactose-fermenting bacterium belonging to the family Enterobacteriaceae. *E. cloacae* is a type of bacterium that is one of the coliform group of bacteria used as sanitary indicators for drinking water quality.

Enterobacteriaceae Family of enteric bacteria that are catalase-negative, oxidase-negative, nonspore-forming, gram-negative bacilli. These ubiquitous microorganisms are found in the environment and on plants. The family Enterobacteriaceae includes the genera *Escherichia, Edwardsiella, Citrobacter, Salmonella, Shigella, Klebsiella, Enterobacter, Hafnia, Serratia, Proteus, Yersinia,* and *Erwinia. Escherichia coli,* which inhabits the human intestinal tract, is used as an indicator of fecal contamination. *See also* enteric bacteria.

***Enterobacter* species** A reference to bacteria identified as belonging to the genus *Enterobacter,* used when one is referring to similar organisms collectively or when incomplete characterization precludes species identification.

Enterococcus Genus of gram-positive bacteria of the family Enterococcaceae. These organisms are generally found in human and animal feces and their presence in water is an indication of fecal pollution.

Enterococcus faecalis (E. faecalis) A species of the Enterococcaceae family that is resistant to penicillin. *Enterococcus* infections account for 12 percent of all nosocomial infections; of those, approximately 80 percent are caused by *E. faecalis.* Infections include abdominal, skin, urinary tract, and blood stream. *See also Enterococcus faecium.*

Enterococcus faecium (E. faecium) A species of the Enterococcaceae family that is resistant to several types of antibiotics including quinolones and aminoglycosides (i.e., vancomycin). *Enterococcus* infections account for 12 percent of all nosocomial infections; of those, approximately 20 percent are caused by *E. faecium.* Infections include abdominal, skin and skin structure, urinary tract, and blood stream. *See also Enterococcus faecalis.*

Enterocytozoon bieneusi (E. bieneusi) A species within the group of obligate, intracellular, spore-forming Microsporidia and belonging to the family Enterocytozoonidae. *E. bieneusi* spores are the infective stage of the protozoa that are excreted with feces and can be recovered also in duodenal and biliary fluid. Spores are oval in shape and are difficult to differentiate from bacteria. *E. bieneusi* is an opportunistic pathogen and is a cause of diarrhea related to human immunodeficiency virus. Intestinal infection gives rise to chronic diarrhea and a malabsorption syndrome.

enterohemorrhagic *Escherichia coli* (EHEC) *Escherichia coli* strains that have been associated with hemorrhagic colitis and that produce one or more verotoxins. *E. coli* O157:H7 is an important pathogen that has been implicated in foodborne and waterborne disease and causes severe illnesses, such as hemorrhagic colitis, hemolytic uremic syndrome, and thrombocytopenic purpura. *See also Escherichia coli* O157:H7.

enterohepatic circulation A process in which natural metabolites (e.g., bilirubin, bile acids), drugs, chemicals, their metabolites, or combinations of these are absorbed from the intestine into the blood. Then they pass into the liver, where they may be concentrated in bile to be secreted into the intestine, where the chemical or its metabolite can be reabsorbed from the intestine. The process frequently involves the formation of various conjugates of the chemical or metabolite in the liver cell and hydrolysis or other degradation of the conjugate in the intestine by microflora.

enteroinvasive *Escherichia coli* (EIEC) *Escherichia coli* strains that produce an invasive dysentery type of diarrheal illness in humans.

Enterolert® Microbiological method for the detection of *Enterococci. See also Enterococcus.*

enteropathogenic *Escherichia coli* (EPEC) *Escherichia coli* strains that cause diarrhea not related to (1) heat-labile or heat-stable enterotoxins, (2) *Shigella*-like invasiveness, or (3) verotoxin production. These organisms are an important cause of infantile diarrhea in many developing countries.

enterotoxigenic *Escherichia coli* (ETEC) *Escherichia coli* strains that cause diarrhea by production of heat-labile enterotoxins, heat-stable enterotoxins, or both. ETEC organisms are the most common cause of travelers' diarrhea, and infections are acquired primarily by ingestion of contaminated food or water.

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enterotoxin A toxin produced by bacteria that is specific for intestinal cells and causes the symptoms of food poisoning.

enterovirus A taxonomical group of viruses that replicate initially in the cells of the enteric tract. They include polio viruses, coxsackieviruses, echoviruses, and the hepatitis A virus. These are small (22 nanometers across) ribonucleic acid viruses.

enterprise fund Any of various major activities for which separate sets of accounting books are often established to track costs and performance. In a city, for example, water, wastewater, and solid waste—as well as schools, streets, and law enforcement—could be separate enterprise funds, so that each has separate accounting to measure costs and revenues within the total city budget. Many enterprise funds are established and operated to be self-sufficient.

enthalpy A thermodynamic property defined as the sum of the internal energy plus the product of pressure and volume. In equation form,

$$H = U + pVf$$

Where:

H = the enthalpy, in British thermal units (kilojoules)
U = the sum of the internal energy, in British thermal units (kilojoules)
p = the pressure, in pounds force per square inch absolute (kilopascals)
V = the volume, in cubic feet (cubic meters)
f = a conversion factor = 144/778 for US customary units (1 for Système International units).

The term pV is usually viewed as the flow work, i.e., the work associated with pushing a fluid along. Enthalpy is a useful property in open system analysis, i.e., analysis involving flow. It can be viewed as the sum of the thermal and mechanical energy associated with a given state.

entrain To trap bubbles in water either mechanically through turbulence or chemically through a reaction.

entrainment (1) The carryover of drops of liquid during a process such as distillation. (2) The trapping of bubbles produced in a liquid either mechanically through turbulence or chemically through a reaction.

entrainment separator A device to remove entrapped droplets from a vapor stream in a desalting process. It is also called a demister.

entrance head The head required to cause water to flow into a conduit or other structure.

entrance loss The head necessary to overcome resistance to the entrance of water into a conduit or other structure. This head is lost in eddies and friction at the inlet of the conduit.

entrance pit (1) An excavation to allow access to a below-ground-level work location for beginning and exiting a tunnel. (2) An excavation below ground level to provide access to a water line.

entrance well A well or opening at the surface of the ground, constructed to receive surface water that is then conducted to a sewer. It is also called an inlet well.

entropy A thermodynamic property that is a measure of the disorder or uncertainty at the microscopic scale. On the macroscopic scale, it can be viewed as a measure of the degradation in the quality of energy. For example, the second law of thermodynamics puts a higher "value" on 1 joule of energy at 1,000° Celsius than on 1 joule of energy at 100° Celsius. On the macroscopic scale, the change in entropy for a given process can be defined as the integral of the reversible heat transferred divided by the absolute temperature.

entropy units *See in the Units of Measure section.*

entry permit A checklist that includes working conditions, hazard evaluations, equipment, and personnel requirements to be performed or assessed before entry into a confined space. The permit is to be reviewed and signed by a supervisor.

entry point A specific location at which water enters the distribution system where compliance monitoring is required to document compliance with a National Primary Drinking Water Regulation. Entry points are generally specified by the primacy agency for each well, well field, and surface water treatment plant in a water system. *See also* National Primary Drinking Water Regulation; primacy agency.

entry point to the distribution system (EPDS, EPTDS) *See* entry point.

envelope The lipid-rich outer coat that covers the nucleocapsid (protein coat) of many but not all viruses.

envelope curve A smooth curve covering either all peak values or all trough values of certain quantities, such as rainfall or runoff, plotted against other factors, such as area or time. In general, none of the peak values goes above the curve in the former case, called the maximum envelope curve, and none of the minimum points falls below in the latter, called the minimum envelope curve.

envelope pipe A large pipe used as an outer shell to house a smaller pipe conveying a liquid. The envelope pipe provides protection and access to the primary pipe and is typically employed where difficult logistics exist, such as pipe crossings under streambeds, railroads, or major highway crossings, or within bridge structures.

Envirofacts Data Warehouse A series of databases operated by various program offices within the US Environmental Protection Agency. Access to the

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information is available via the Internet. One section of Envirofacts is the Safe Drinking Water Information System (SDWIS), which contains regulatory compliance information on public water supplies. Violations of regulations derived from the Safe Drinking Water Act are listed in SDWIS. *See also* Safe Drinking Water Information System.

environment A general description of the air, water, and land that support the life of an organism and receive its waste products. *See also* ecosystem.

environmental alteration The selection of an electrolytic backfill material to eliminate or reduce the rate of corrosion in buried pipes. It is also called trench improvement.

environmental assessment (EA) A brief document that provides sufficient information to a US Army Corps of Engineers district engineer on the potential environmental effects of a proposed action and, if appropriate, recommends whether to begin preparation of an environmental impact statement or issue a Finding of No Significant Impact.

environmental document A written material dealing with environmental subject matters, e.g., an environmental impact statement or an environmental assessment.

environmental engineering The application of the principles of engineering to maintain and improve the environment for the protection of human health, for the protection of nature's beneficial ecosystems, and for the enhancement of the quality of human life with respect to environment-related issues. The practice of environmental engineering as a profession includes several scientific disciplines, e.g., engineering, biology, chemistry, biochemistry, mathematics, microbiology, physics, ecology, epidemiology, and hydraulics. It entails design, construction, maintenance, operation, process control, and administration and management of facilities and structures utilized for the protection of public health and the environment, with particular reference to (1) the procurement, treatment, and distribution of public drinking water supplies; (2) the collection, treatment, and disposal of municipal and industrial wastewaters and stormwater runoff; (3) the collection, treatment, and disposal of municipal solid wastes (e.g., garbage, trash) and hazardous wastes, whether liquid or solid; (4) the treatment, abatement, and prevention of indoor and outdoor air pollution from whatever source; (5) the abatement of noise pollution; and (6) the control of the quality of surface waters, groundwaters, and watersheds. Environmental engineering was formerly called sanitary engineering.

environmental epidemiology The use of epidemiologic methods for assessing the human health effects that may be associated with biological, physical, and chemical contaminants in the environment. Indicators of disease, rather than the disease itself, are often studied. Frequently the exposures to environmental contaminants are low and small magnitudes of risk are observed.

environmental equity Equal protection from environmental hazards for individuals, groups, or communities regardless of race, ethnicity, or economic status. This applies to the development, implementation, and enforcement of environmental laws, regulations, and policies and implies that no population of people should be forced to shoulder a disproportionate share of negative environmental impacts of pollution or environmental hazard because of a lack of political or economic strength. It is also called environmental justice.

environmental health The welfare of an individual as influenced by his or her environment, including the effects of biohazards, pollution, working and living conditions, and so on. *See also* industrial hygiene.

environmental impact A change in the environment resulting from specific actions or materials. *See also* product stewardship.

Environmental Impact Statement (EIS) An analysis required under Section 404 of the national Clean Water Act when a project would discharge dredged or fill material in waters of the United States. It is conducted to determine adverse effects on municipal water supplies, shellfish beds (including spawning and breeding beds), wildlife, aquatics, recreational areas, and so on.

environmentally sensitive Having an awareness of human activities that may have an adverse effect on an ecosystem.

Environmental Management and Programs (EMAP) A US Environmental Protection Agency research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of current ecological conditions and forecasts of future risks to natural resources.

environmental management system (EMS) According to the US Environmental Protection Agency, "a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency." Examples of practices at a water treatment plant might be reduction of electric power consumption or modification of the treatment process to reduce the amount of chemicals required. A utility laboratory may reduce the use of solvents by switching from separatory funnels for extraction of

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organic analytes from samples to using solid-phase extraction techniques.

Environmental Monitoring Systems Laboratory (EMSL) A laboratory of the US Environmental Protection Agency's Office of Research and Development responsible for developing analytical methods for environmental pollutants.

environmental protection agency (EPA) A federal, state, or local unit of government established to consolidate programs dealing with air, water, solid waste, and other environmental concerns within one agency. The authority and scope of activity are determined by the legislation establishing the agency. *See also* regional office; US Environmental Protection Agency.

environmental quality The set of characteristics of the environment that generally indicates its desirability for human activity.

Environmental Quality Incentives Program (EQIP) A US Department of Agriculture program, with US Environmental Protection Agency cooperation, that provides assistance in an incentive-based approach that combines information and education, research and technology transfer, and direct technical and financial assistance.

environmental racism *See* environmental equity.

environmental stress A perturbation likely to cause an observable change in an ecosystem.

Environmental Technology Verification (ETV) Program A US Environmental Protection Agency program that develops testing protocols and verifies the performance of innovative technologies that have the potential to improve protection of human health and the environment.

enzyme A protein (or occasionally a nucleic acid molecule) that catalyzes chemical reactions.

enzyme conjugate Commonly used in immunoassays for detection, a derivative of the analyte of interest and an enzyme. The derivative competes with the analytes of interest for sites (surface-bound antibodies). Unbound derivatives are washed out, and the enzyme components of the bound derivatives are reacted with substrates to generate species that can be measured colorimetrically. The more analytes of interest that are bound, the lower the amount of bound derivatives and thus the lower the colorimetric reading.

enzyme immunoassay (EIA) An assay that involves enzyme-labeled antibodies. Manufacturers produce enzyme immunoassay kits that contain everything necessary to perform a fixed number of assays. An enzyme immunoassay is commonly used for virus detection or for confirmation of the presence of viruses that had previously been detected via cell culture methods.

enzyme immunoassay (EIA) kit *See* enzyme immunoassay.

enzyme induction A process by which a new enzyme is synthesized as a means of increasing enzyme activity within certain cells. The body uses this effect for a variety of regulatory purposes in responding to varying environmental conditions. A special case of enzyme induction in toxicology involves increased activity of enzymes responsible for the metabolism of chemicals that are foreign to the body. These responses are usually most prominent in the liver but are by no means confined to this organ.

enzyme-linked immunosorbent assay (ELISA) A test that involves the reaction of specific antibodies with target antigens (i.e., viruses). A positive reaction is measured by a colorimetric method whereby the enzyme–antibody–antigen complex, when present, will degrade a substrate for a color change.

***E*⁰** *See* standard electrode potential.

eosinophilia An increase in the number of eosinophils (any microorganism, cell, or histological element easily stained by eosin dye) in the blood.

EP *See* extraction procedure.

EPA *See* environmental protection agency.

EPAct *See* Energy Policy Act of 1992.

EPANET model A computer software program developed by the US Environmental Protection Agency to simulate hydraulic and water quality conditions within pressurized pipe networks. The EPANET program, software in the public domain, is used as the core of various commercially available hydraulic models. A network can consist of pipes, nodes, pumps, valves, and storage tanks and reservoirs. This model can track the flow of water in each pipe, the pressure at each node, the height of water in each tank, and the concentration of chemical species throughout the network during a simulation period of multiple time steps. In addition to chemical species, water age and source tracing can also be simulated. *See also* Hardy Cross method; Hazen–Williams formula; pipeline network analyzer; series-parallel reducible network.

EPCRA *See* Emergency Planning and Community Right-to-Know Act.

EPDS, EPTDS (entry point to the distribution system) *See* entry point.

EPEC *See* enteropathogenic *Escherichia coli.*

ephemeral Pertaining to a transient or short-lived phenomenon.

ephemeral stream (1) A stream that flows only in direct response to precipitation. Such a stream receives no water from springs and no continued supply from melting snow or other surface sources. Its channel is above the water table at all times. (2) A stream or

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stretch of a stream that does not flow continuously during periods of as much as 1 month.

epichlorohydrin (chloropropylene oxide, C_3H_5OCl) A highly volatile, unstable liquid epoxide. It is a major raw material for epoxy and phenoxy resins and has other industrial uses. It is a treatment chemical that is regulated in drinking water under the Phase II Rule for synthetic organic contaminants and inorganic contaminants. *See also* epoxide; Phase II Rule; synthetic organic chemical.

epichlorohydrin-dimethylamine (EPI-DMA) A widely used cationic polymeric coagulant of relatively low molecular weight (<500,000) and linear structure. It is in a class called polyquaternary amines. Each monomer unit contains a nitrogen atom bound to four carbon atoms and carries a positive charge. It is typically used to increase the rate of aggregation of negatively charged particles by an adsorption and surface charge neutralization mechanism.

epidemic An occurrence of cases of disease in a community or geographic area clearly in excess of the number of cases normally found (or expected) in that population for a particular season or other specific time period. Most epidemiologists use the terms *epidemic* and *outbreak* interchangeably. When the excess disease is confined to a small or limited population or area, the term *outbreak* is preferred. An epidemic occurring over a very wide area and usually affecting a large proportion of the population is called a *pandemic.*

epidemic, common source *See* common source epidemic.

epidemic curve A graph showing the distribution of cases of disease by time of onset. From this curve, information can be obtained about the median incubation period and nature of the outbreak (e.g., point source or person-to-person spread, secondary spread).

epidemiologic study A study of human populations to identify causes of disease. Such studies often compare the health status of a group of persons who have been exposed to a suspect agent with that of a comparable nonexposed group. *See also* analytic epidemiologic study; case-control epidemiologic study; cohort epidemiologic study; cross-sectional epidemiologic study; descriptive epidemiologic study; ecologic epidemiologic study; experimental epidemiologic study; longitudinal epidemiologic study; observational epidemiologic study.

epidemiology The study of the determinants and distribution of injuries and diseases in human populations.

epidermis The superficial (outer) layer of skin cells.

epifluorescence microscope A microscope in which (1) the specimen to be observed is illuminated from above by short-wavelength (ultraviolet) light that excites dyes or naturally fluorescent material in the specimen, and (2) visible light is reflected upward from the specimen to the ocular. In transmission microscopy, light from a light source below passes through the specimen to the ocular.

epigenetic Pertaining to a process, response, or effect that is not mediated through modification or utilization of genetic information encoded in deoxyribonucleic acid.

epigenetic carcinogen A chemical or other agent that produces cancer without directly affecting deoxyribonucleic acid (DNA). Mechanisms by which a chemical could contribute to cancer without it or one of its metabolites binding to DNA include (1) stimulating rates of cell division by killing normal cells and providing a selective advantage to the growth of cells having altered genotypes that render them resistant to the chemical, or (2) directly stimulating division of these altered cells without similarly stimulating the division of normal cells. A third possibility identified in recent years is that certain chemicals prevent the death of cells with altered genotypes by an active process called apoptosis. Whereas genotoxic chemicals are assumed to increase the risk of cancer with a linear relationship to dose, epigenetic carcinogens are more likely to involve sublinear relationships with dose. This is most easily conceptualized with cytotoxic agents, for which no increase in cancer risk exists unless the dose has reached a level where some cell killing has occurred. *See also* apoptosis; genotoxic carcinogen.

epilimnion The upper water layer in a stratified lake. *See also* destratification; hypolimnion; metalimnion; stratification; thermocline.

epiornithic Shared among members of a bird population; commonly refers to epidemic diseases.

epiphyte A plant that grows on other plants or nonliving structures without drawing its nourishment from them (as opposed to a parasite).

epistemology Broadly, the theory of knowledge. The study of the grounds and methods of knowledge, focusing on its validity and limits.

epithelial membranous tissue Usually in a single layer, composed of closely arranged cells separated by very little intercellular substance and forming the covering of most internal surfaces, organs, and the outer surface of an animal body.

epitheliochorial placenta A placental type that has all six layers interposed between maternal and fetal circulation. This placental type is found in pigs, horses, and donkeys.

epizootic An epidemic of disease in an animal population.

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epoxidation A chemical process whereby an oxygen bridge is formed across a double bond.

epoxide An organic compound resulting from the union of an oxygen atom with two other atoms (usually carbon) that are joined in a ring. Epoxides contain a reactive group. They are three-membered cyclic ethers. Some epoxides may be created during the reactions of ozone (O_3) with natural organic matter. *See also* ether.

epoxy-lined pipe *See* epoxy lining.

epoxy lining A protective coating on the inside of a water main or steel water tank, which is made of an epoxide to help prevent corrosion of the piping material.

EPRI *See* Electric Power Research Institute.

e-procurement Utilization of the Internet to purchase supplies and materials and obtain bids for required service.

EPROM *See* erasable programmable read-only memory.

EPS *See* extracellular polymeric substance.

EPS (extended-period simulations) *See under* dynamic-state extended-period simulation.

EPTC *See S*-ethyl di-*N*,*N*-propylthiocarbamate.

eq, eq wt *See* equivalent weight.

EQIP *See* Environmental Quality Incentives Program.

eq/L *See* equivalents per liter in *the Units of Measure section.*

equal-energy depth One of two alternate depths in an open-channel cross section that can occur for a given flow rate and head, provided that the specific head exceeds the minimum needed for flow to occur.

equalization A means of providing a more uniform flow rate and composition for a water supply by using a reservoir that receives water from a pump or treatment system, evens out the incoming flow variation, and permits temporary water withdrawal in excess of the pump or treatment system capacity.

equalization storage The quantity of water from storage that enters the system during peak demand periods to augment other sources of supply. Equalization storage is replenished during off-peak demand periods.

equalizing basin *See* equalizing reservoir.

equalizing reservoir A reservoir interposed in a water supply system (or other hydraulic system) at any point between source and consumer to furnish elasticity of operation to the distribution system, so that different portions of the system may be more or less independent of each other. An equalizing reservoir is also called a balancing reservoir.

equilibrium (1) A condition in which reversible chemical reactions are simultaneously taking place in such a manner (i.e., at an equivalent rate) that no change in the net concentration of the substances involved in the chemical processes occurs. As a result of these simultaneous reactions, the substances involved in the reactions can be shown to be in a constant ratio to each other. (2) The state in which the action of multiple forces produces a steady balance or seeming lack of change. This may be caused by a true stop in action or by continuing actions that neutralize each other, resulting in no net change.

equilibrium constant The number prescribing the conditions of equilibrium for a given reversible chemical reaction.

equilibrium shift A change in the relative concentrations of reacting substances such that a different reaction or reaction rate is caused. For example, a change in the relative concentrations of sodium and calcium ions will dictate both the exchange rate and the selection of which ions will be adsorbed to and released from ion-exchange resin beads.

equipluve A line on a rainfall map connecting places that have the same value of the pluviometric coefficient. *See also* pluviometric coefficient.

equipment Any mechanical device or supplies required to support the construction and operation of engineering facilities.

equipotential line A line drawn on a two-dimensional groundwater flow field map such that the total head is the same for all points along the line.

equipotential surface A geometric surface in a three-dimensional groundwater flow field such that the total hydraulic head is the same everywhere on the surface.

equity The net worth of a business, consisting of capital stock, capital (or paid in) surplus, earned surplus (or retained earnings), and occasionally, certain net worth reserves. The net worth is the difference between what the company owns (its assets) and what it owes (its liabilities).

equivalence point The point at which the same number of equivalents of two reactants have been added (i.e., no excess of either reactant exists). During a titration, a suitable indicator is added to yield an end point that coincides with the equivalence point, although, as a rule, a difference between the end point and the equivalence point usually exists. In acid–base reactions, neutralization is achieved at the equivalence point. *See also* end point; equivalents per liter *in the Units of Measure section;* neutralization; titration.

equivalent (eq) *See* equivalent weight.

equivalent calcium carbonate *See* as calcium carbonate.

equivalent customer The designation for the number of fictitious customers whose water use through an 5/8 inch meter (single-family unit) is the same as the water use of a large-use customer. This calculation is based on a composite of all elements of cost differences between the single-family unit customer and the large-use customer. It is normally expressed as the ratio of the single-family unit customer to the large-use customer. For

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example, if the large-use customer is equivalent to 10 single-family use customers, the ratio is 10:1.

equivalent meter A means of expressing different sized water meters in terms of an equivalent number of "standard" size meters. The 5/8-inch or 3/4-inch meter size is often used as the standard in terms of which all other meters are expressed. For example, a 1-inch meter is equivalent in capacity to two and one half 5/8-inch meters. Equivalent meters are often used in ratemaking to assess customer monthly service charges based on meter size and to distribute capacity costs based on meter size in developing connection charges.

equivalent meter-and-service ratio The ratio of the capacity of larger meters and services to those of a base meter size, such as the 5/8-inch meter typically used for residential customers. *See also* equivalent meter.

equivalent pipes Two pipes or two systems of pipes in which the losses of head for equal rates of flow are the same. A single pipe is equivalent to a system of pipes when the same loss-of-head condition is satisfied.

equivalent residential unit A means of expressing different levels of residential customer demand for water in terms of an equivalent number of least-size residential demand accounts. If the base residential demand is 300 gallons (1,135 liters) per day per account, then other customer groups' accounts would be expressed in terms of the equivalent number of these least-size accounts. In this manner, the customer may be said to be paying for a proportionate share of the share of the capacity that customer is using. This concept is sometimes used to determine capacity costs for new accounts and to develop monthly service charges based on meter size. *See also* equivalent customer; equivalent meter.

equivalents per liter (eq/L) *See in the Units of Measure section.*

equivalent weight (eq, eq wt) A weight of a substance based on the formula weight and number of reactive protons associated with the substance. For an element, the equivalent weight is the atomic weight divided by the number of reactive protons. For example, calcium has an atomic weight of 40 and has two reactive protons, so its equivalent weight is 40/2 = 20. For a compound, the equivalent weight is the molecular weight divided by the number of reactive protons. For example, sodium chloride (NaCl) has a molecular weight of 58.5 and one reactive proton, so the equivalent weight is 58.5/1 = 58.5. Calcium carbonate ($CaCO_3$) has a molecular weight of 100 and two reactive protons (in the Ca^{2+} ion), so the equivalent weight is 100/2 = 50. Equivalent weight is also known as combining weight. *See also* oxidation number; valence.

erasable programmable read-only memory (EPROM) A read-only memory chip that can be erased, either electrically or by high-intensity ultraviolet light. After it is erased, the chip is reprogrammed in a read-only function mode.

Erlenmeyer flask A bell-shaped container used for heating and mixing chemicals and culture media.

erosion The wearing away of a material by physical means, often caused by the presence of abrasive particles in the stream.

erosion corrosion Deterioration of a surface by the abrasive action of moving fluids. This phenomenon is accelerated by the presence of solid particles or gas bubbles in suspension.

ERP *See* emergency response plan.

error A false or mistaken result in a study or experiment. In epidemiology, error refers to random error and bias (systematic error). *See also* bias; random error.

error control system A system for controlling equipment operation based on the difference between actual and desired values of the output. *See also* process error.

error estimates *See* standard error of the estimate.

erythema edema A redness of the skin and swelling as caused by chemical poisoning or sunburn.

erythematous nodule A nodule that has redness associated with it.

ES *See* effective size.

ESA *See* Endangered Species Act.

ESA (ethane sulfonic acid) *See under* alachlor ethane sulfonic acid.

escape A wasteway installed in a conduit to discharge, when necessary, all or part of the conduit's flow.

escarpment A more or less continuous series of cliffs or sharp slopes oriented in the same direction, often at the edge of a plateau, resulting from erosion or faults.

Escherichia coli (E. coli) A gram-negative, facultatively anaerobic, nonspore-forming bacillus commonly found in the intestinal tracts of humans and other warm-blooded animals. In environmental microbiology, *Escherichia coli* is considered the primary indicator of recent fecal pollution. *See also* coliform bacteria; fecal coliform.

***Escherichia coli (E. coli)* F-amp** A strain of *Escherichia coli* bacteria that contains the F-amp plasmid, which codes for resistance to ampicillin and streptomycin. This strain is used in the detection of F+ ribonucleic acid coliphages. *See also* male-specific host *Escherichia coli* F-amp.

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***Escherichia coli* O157:H7** A strain of *Escherichia coli*—serologically identified as O-antigen 157, H-antigen 7—that produces enterotoxin (Vero cytotoxin) and causes diarrheal illness. It has been identified as the disease agent in a variety of foodborne and waterborne disease outbreaks. This strain of *E. coli* can cause severe bloody diarrhea that may be followed by kidney problems caused by hemolytic uremic syndrome. *See also* pathogenic *Escherichia coli.*

***Escherichia coli* strain HS (pFamp) R** A strain of *Escherichia coli* bacteria that contains the F-amp plasmid that codes for resistance to ampicillin and streptomycin. This strain is used in the detection of F+ ribonucleic acid coliphages. *See also* male-specific host *Escherichia coli* F-amp.

ESD *See* ecologically sustainable development.

ESI *See* electrospray ionization.

ESR *See* electron spin resonance.

ester (R-CO-O-R') An organic compound formed by the reaction between a carboxylic acid and an alcohol with the elimination of a molecule of water.

esterification The process by which an ester is formed. The usual reaction is that of an acid (organic or inorganic) with an alcohol or other organic compound rich in hydroxyl (–OH) groups. Derivatization of haloacetic acids (to their methyl ester forms) with diazomethane is an esterification reaction. *See also* derivatization; diazomethane; ester.

estrogen blocker A drug, such as tamoxifen, used to block the action of the hormone estrogen in some breast cancer treatments.

estrogenic endocrine disruption Interference with hormone function by estrogen or estrogen-like chemicals. *See also* estrogenic endrocrine disruptors.

estrogenic endocrine disruptors Synthetic or natural chemicals that act on the endocrine systems of humans and animals by mimicking, blocking, and/or interfering in some manner with the natural instructions of hormones to cells. These chemicals include many pharmaceutical chemicals, pesticides, and heavy metals.

estrogen mimic Any chemical that can act similarly to estrogen in interfering with normal hormone function.

estuary A passage in which the tide meets a river current, especially an arm of the sea at the lower end of a river; a firth.

ESWTR *See* Enhanced Surface Water Treatment Rule.

ESZ instrument *See* electrical sensing zone instrument.

ET *See* electron transfer; evapotranspiration.

ETAW *See* evapotranspiration of applied water.

ETEC *See* enterotoxigenic *Escherichia coli.*

ether (R-O-R') A class of organic compounds in which an oxygen atom is interposed between two carbon atoms (organic groups) in the molecular structure.

ethernet A local area network (LAN) system on which computers transmit and receive over the same common medium. Before transmitting, individual computers listen to the line to ensure that no other computer is using the network. Collision detection and retransmit software corrects for simultaneous transmissions. Ethernet connections include many different types of coaxial cables and optical fibers with data transfer rates ranging from 10 to 1,000 megabits per second.

ethology The study of the behavior of animals under natural conditions.

ethylbenzene ($C_6H_5C_2H_5$) A volatile organic compound used as a solvent. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.7 milligrams per liter. *See also* solvent; volatile organic compound.

***o*-ethyl *s*-2-diisopropylaminoethylmethyl phosphonothiolate (VX) ($C_{11}H_{26}NO_2PS$)** An oily chemical warfare agent classified as a nerve agent, commonly referred to as VX nerve gas. It is the most well-known of the V-series of nerve agents and has the texture and feel of high-grade motor oil, with low viscosity and low volatility. A guideline for the maximum allowable amount of this chemical warfare agent in military drinking water has been developed by the National Research Council. This chemical is also called ethyl {[2-[di(propan-2-yl)amino] ethylsulfanyl} methylphosphinate. *See also* National Research Council.

***S*-ethyl di-*N,N*-propylthiocarbamate (EPTC) ($C_2H_5SC(O)N(C_3H_7)_2$)** An herbicide. *See also* herbicide.

ethylenediamine (EDA) A flammable, colorless, viscous, fuming liquid with an ammonia-like odor. One of its derivatives, ethylenediamine tetraacetic acid, is commonly used in laboratory for hardness titration and referred to as EDTA. *See also* ethylenediaminetetraacetic acid.

ethylenediaminetetraacetic acid (EDTA) ($(HOOCCH_2)_2NCH_2CH_2N(CH_2COOH)_2$) An organic chelating agent that forms very stable complexes with calcium, magnesium, and other divalent ions; is used as an analytical reagent (e.g., in hardness titration); and is in some detergents, cleaning agents, and scale preventatives.

ethylene dibromide (EDB) ($BrCH_2CH_2Br$) A fumigant used for grains and tree crops. This chemical has other industrial applications as well. It is regulated in drinking water under the Phase II Rule for synthetic organic contaminants and inorganic contaminants at

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a maximum contaminant level of 0.00005 milligrams per liter. *See also* fumigant; Phase II Rule; synthetic organic chemical.

ethylene thiourea (ETU) ($NHCH_2CH_2NHCS$) The common name for 2-imidazolidinethione, a chemical with various industrial uses, including use as an insecticide or fungicide. *See also* fungicide; insecticide.

etiologic agent The agent responsible for the postulated cause of a disease.

etiology The postulated causes of disease, specifically those that initiate the pathogenic mechanisms. *See also* pathogenesis.

ET_o *See* reference evapotranspiration.

ETSW *See* extended terminal subfluidization wash.

ETU *See* ethylene thiourea.

ETV (Environmental Technology Verification) Testing Program *See under* NSF Environmental Technology Verification Testing Program.

ETV Program *See* Environmental Technology Verification Program.

EU *See* EfficientUtilities.

eugonic media Media that encourages luxuriant growth.

eukaryote A cell in which the nucleoplasm is surrounded by a membranous envelope through at least part of each cell reproductive cycle; i.e., the cell has a true nucleus. This term is sometimes spelled *eucaryote.*

eukaryotic Pertaining to a eukaryote.

eukaryotic intestinal parasite A living organism with a membrane-bound nucleus that maintains prolonged contact in the gastrointestinal tract of another living organism to meet some of its basic nutritional needs.

euphotic Characteristic of the upper part of a lake in which sufficient light penetrates for photosynthesis.

euploidy The condition of any cell that contains the proper or normal number of chromosomes.

Eurasian watermilfoil *See* milfoil.

EUREAU *See* European Federation of National Associations of Water and Waste Water Services.

European Federation of National Associations of Water and Waste Water Services (EUREAU) An organization representing the common interests of its member associations with regard to community legislation and European standards relevant to water supply and wastewater.

eutrophic Pertaining to reservoirs and lakes that are rich in nutrients and very productive in terms of aquatic animal and plant life.

eutrophication An accelerated aging of a surface water body caused by excess nutrients and sediments (over biological needs) entering the water body.

eutrophic lake *See* eutrophic reservoir.

eutrophic reservoir A reservoir rich in nutrients and characterized by large quantities of planktonic algae. In this type of reservoir, the input of oxygen-demanding materials has depleted dissolved oxygen, resulting in anoxic or anaerobic conditions, which potentially result in the formation of hydrogen sulfide (H_2S), release dissolved iron and manganese from sediments, lower the pH, and increase concentrations of carbon dioxide (CO_2). *See also* anaerobic condition; anoxic condition.

E_v *See* bulk modulus of elasticity of water.

eV *See* electron volt *in the Units of Measure section.*

evanescent wave A wave formed when a sinusoidal wave is (internally) reflected off an interface at an angle greater than the critical angle so that total internal reflection occurs. The intensity of these waves decays exponentially (rather than sinusoidally) with distance from the interface at which they are formed.

evaporating dish A glass or porcelain dish in which samples are evaporated to dryness by high heat.

evaporation A process in which a liquid is changed by volatilizing (boiling) to a gaseous state at a set of temperature and pressure conditions. *See also* distillation; sublimation.

evaporation, actual *See* actual evaporation.

evaporation, potential *See* potential evaporation.

evaporation area The surface area of a body of water, and of any adjacent moist land to which water was supplied from the body of water, from which water is lost to the atmosphere by evaporation.

evaporation chamber That part of a distillation system in which water is changed into vapor.

evaporation discharge Discharge into the atmosphere of water, in the gaseous state, derived from the saturation zone. Evaporation discharge may be divided into vegetal discharge and soil discharge.

evaporation gauge A means of measuring evaporation. *See also* atmometer.

evaporation opportunity The ratio of the actual rate of evaporation to the potential rate. This ratio is also called the relative evaporation.

evaporation pan A pan used to hold water during observations for determining the quantity of evaporation at a given location. Such pans are of various sizes and shapes, the most common shape being circular or square. *See also* atmometer; floating pan; land pan; standard National Weather Service pan.

evaporation pond A constructed liquid containment with a free surface designed to promote evaporation, thereby reducing the volume of the liquid (e.g., a pond for disposing waste concentrate from a water-desalting process).

evaporation rate The quantity of water, expressed in terms of depth of liquid water, evaporated from a given water surface per unit of time. It is usually

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expressed in inches or millimeters of depth per day, month, or year.

evaporative concentration A technique used to increase the concentration of a solute by progressively vaporizing the solvent. For example, a Kuderna–Danish apparatus is used to concentrate analytes from an extraction solvent.

evaporative cooler A temperature-controlling unit that uses evaporation for cooling. An evaporative cooler works on the principle that energy is needed to evaporate water. Therefore, hot air is pumped from the affected area through water, and as the water evaporates the air is cooled. The cooled air is pumped back into the temperature-controlled area. These systems work most effectively in arid regions such as the southwestern United States, where evaporation rates are high.

evaporativity The potential rate of evaporation, as distinguished from the actual rate. *See also* potential evaporation.

evaporator A device in which a liquid is evaporated by the application of heat.

evaporimeter An instrument for measuring evaporation. *See also* atmometer.

evapotranspiration (ET) (1) Water lost from the surface of soils and plants through evaporation and transpiration, respectively. (2) Water vapor given off by plants through their leaves.

evapotranspiration (ET) irrigation controller A device that attaches to an automatic irrigation system and controls the watering schedule based on local evapotranspiration and other weather data downloaded from a satellite.

evapotranspiration, actual *See* actual evapotranspiration.

evapotranspiration, potential *See* potential evapotranspiration.

evapotranspiration of applied water (ETAW) The portion of plant evapotranspriation provided by irrigation, expressed as a depth of water in inches or feet.

evapotranspiration potential Water loss that would occur if a deficiency of water never existed in the soil for use by vegetation.

evapotranspiration tank A tank, filled with soil and provided with a water supply, in which representative plants are grown to determine the amount of water transpired and evaporated from the soil under observed climatic conditions. Such a tank is sometimes improperly referred to as a lysimeter.

event mean concentration (EMC) The average concentration of a contaminant in stormwater arising from a single storm event. The mean concentration is dependent on the sampling frequency and flow rate during each sampling event.

event tree approach A method of creating scenarios for studying certain risks by predicting the possibility of failure of safety measures in complex systems.

EWMP *See* efficient water management practice.

exa (E) *See in the Units of Measure section.*

examination of water An investigation to determine the physical, chemical, and biological characteristics of water. *See also* water analysis.

excavation The removal of material to create a trench, hole, or cut in the earth's surface, resulting in a change in all or part of the elevation of a site.

exceedance probability The probability that a randomly selected event or sample exceeds a given value. For example, if the iron concentration is greater than 0.3 milligrams per liter in 100 out of 1,000 samples, the probability that a random sample has an iron content greater than 0.3 milligrams per liter is 10 percent.

excessive encrustation The buildup of precipitates on the inside of a pipeline such that pipe diameter is reduced, flow is blocked, and head loss increases. Calcium carbonate ($CaCO_3$), when present in concentrations greater than its solubility, is a common cause of encrustation. *See also* encrustation; tuberculation.

excessive use Water use that exceeds a threshold for what is considered normal use, e.g., high volumes of water used for lawn irrigation that cause runoff and violate efficiency standards or watering restrictions.

excess-lime treatment A modification of the lime–soda ash method of precipitative softening that uses additional lime to remove magnesium compounds.

excess rainfall That part of the rain of a given storm that falls at intensities exceeding the infiltration capacity and is thus available for direct runoff. *See also* net rainfall; storm flow.

exchange A process by which, under certain conditions, water may be diverted out of priority at one point by replacing a like amount of water at a location downstream.

exchange capacity *See* rated capacity.

exchanger *See* ion exchanger.

exchange site A location on each bead of ion-exchange resin that holds mobile ions available for exchange with other ions in the solution passing through the resin bed. In cation water softening, for example, mobile sodium ions located at the various exchange sites are exchanged for calcium or magnesium ions in the water being softened. Exchange sites are also called functional groups.

exchange tank *See* portable exchange tank.

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exchange velocity The rate at which one ion is displaced in favor of another in an ion exchanger.

excimer An excited dimer (for example, Xe_2). An excimer is formed when an electron from a corona discharge collides with a gas molecule and raises the molecule to an excited state; this excited molecule then collides with another molecule of gas to form an unstable excimer that spontaneously decays, generating ultraviolet light at a specific wavelength. The gases of primary interest for water and wastewater treatment (i.e., argon, krypton, xenon, fluorine, chlorine, bromine, and iodine) emit at wavelengths that either inactivate microorganisms, destroy organic pesticide molecules, or both. *See also* corona discharge; dimer; excited state; inactivation; pesticide; ultraviolet light.

excited state A higher-than-normal energy level (vibrational frequency) of the electrons of an atom, radical, or molecule resulting from absorption of photons (quanta) from a radiation source (e.g., an arc, flame, spark) in any wavelength of the electromagnetic spectrum. *See also* photon; radiation.

exclusion chromatography *See* high-performance liquid chromatography.

excystation The biological process of releasing sporozoites or trophozoites from a *Cryptosporidium* oocyst or a *Giardia* cyst in vivo or in vitro.

exemption A time extension allowed under the Safe Drinking Water Act for compliance with a National Primary Drinking Water Regulation. *See also* variance.

exhaustion The state of an ion exchanger or other adsorbent that is no longer capable of useful ion exchange or adsorption as a result of the initial supply of available exchangeable ions being depleted or the adsorption sites being occupied. A unit that is exhausted requires regeneration to restore its capacity to treat water. *See also* regeneration.

exhibit *See* display.

existing route replacement of lead pipe The replacement, in the same location, of lead pipe with pipe made of a different material.

exit loss The loss of head that occurs when a stream of water passes out of a hydraulic structure and assumes a lower velocity. Such loss is essentially caused by loss of velocity head.

exon The portion of a strand of deoxyribonucleic acid or m-ribonucleic acid that codes for a portion of a protein. *See also* intron.

exopolymer Any of several types of macromolecular polymeric materials released extracellularly by microbial cells. These polymeric materials may include polysaccharides, mucopolysaccharides, glycoproteins, proteins, and nucleic acids. Other terms such as *glycocalyx, slime, capsule,* and *sheath* have all been used in referring to microbial extracellular polymeric materials. *See also* extracellular polymeric substance.

exopolysaccharide A complex molecule composed of monosaccharides linked together by glycosidic bonds that are released or extruded from the cells of microorganisms such as bacteria and algae. Exopolysaccharides are one of several types of extracellular polymeric substances excreted by microorganisms in biofilms. *See also* extracellular polymeric substance.

exothermic Pertaining to a chemical process in which heat is released. For example, combustion is an exothermic process because heat is released.

exothermic water/gas-shift reaction A chemical reaction ($H_2O + CO \Leftrightarrow CO_2 + H_2$) that occurs during the reactivation of activated carbon. *See also* reactivate.

exotic species A plant or animal that is not indigenous to a region, i.e., one that has been intentionally or accidentally introduced and is often persisting in the area.

expandable memory Computer memory that is used in addition to the disk operating system memory. It is composed of internal random access memory chips that act as a memory pool that can be mapped into one or more conventional memory areas.

expanding reach A reach of a channel wherein the flow is decelerating. The velocity head at the downstream cross section is less than the velocity head at the upstream cross section.

expansion coupling A pipe coupling that permits relative movement of the two joined pipes.

expansion flow Fluid flow in a conduit where the cross-sectional area increases, resulting in a decrease in velocity and an increase in pressure.

expansion joint A specific location in a structure or pipeline designed to allow for fluctuations in length or size caused by changes in temperature.

***ex parte* communication** Off-the-record communication between regulatory agency personnel responsible for a particular rulemaking and another party that could influence the content of the agency's rulemaking.

expenditure The act of using up or spending goods and services or money.

expense account An arrangement whereby an employer pays for certain expenses of employees in connection with work.

experimental design The process of planning and organizing an experiment properly to ensure that the right type and quantity of data is generated in order to answer the questions of interest as clearly and efficiently as possible. The specific questions that the experiment is intended to answer must be clearly identified before carrying out the experiment. In addition, an attempt should be made to identify known or expected sources of variability in the experimental

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factors, because one of the main aims of a designed experiment is to reduce the effect of these sources of variability on the answers to questions of interest. Experimental design is carried out in order to improve the precision of the answers that may be obtained from the experiment.

experimental epidemiologic study An epidemiologic study in which the investigator has control over the assignment of exposure for human subjects. Each study participant is assigned, usually at random, to an exposure classification. Because knowingly causing harm to individuals in such a study is clearly unethical, these studies are generally considered only in special circumstances—prophylactic trials to prevent disease or therapeutic trials to treat established disease processes. They may involve whole communities or groups of individuals. Experimental studies are sometimes referred to as intervention studies, clinical trials, or clinical epidemiology studies.

experimental matrix A design of an experiment with a set of independent and dependent variables called the matrix. It is used as part of a statistical approach to generating a maximum amount of information from a minimum number of experiments.

expert system A computer system using rule-based logic to simulate human intelligence.

explosimeter A device for measuring the concentration of potentially explosive fumes. It is also called a combustible-gas indicator.

explosive limit *See* lower explosion limit; upper explosion limit.

exponent An indication of the number of times a base number is to be multiplied by itself. For example, a base number of 3 with an exponent of 5, written 3^5, indicates that the base number is to be multiplied together five times: $3^5 = 3 \times 3 \times 3 \times 3 \times 3 = 243$.

exponential dose–response function A dose–response relationship where the increase of dose (quantity or duration) results in an increase of risk according to an exponential function.

exponential function A mathematical function containing exponential terms, e.g., e^x.

exponential increase An increase of some physical quantity according to an exponential function.

exponential model A model often used in drinking water for modeling disinfection decays or microbial inactivation. It has the mathematical form

$$y = e^x$$

Where:

y = the dependent variable (e.g., the residual chlorine in milligrams per liter)

x = the independent variable (e.g., time in minutes)

It is often used to develop dose–response relationship for various types of infection. Other models used for this purpose include beta-Poisson model and Weibull–Gamma model. An exponential model of dose–response relationship is typically described in the following form:

$$P = 1 - e^{(r)(Dose)}$$

Where:

P = the probability of infection (i.e., response to the dose)

Dose = dose can be in any typical unit, such as number of oocysts per milliliter

r = the probability of a single pathogen to produce a response (illness, infection, or mortality)

exponential risk assessment model A model used to assess the risk from exposure to pathogens such as the coxsackieviruses in water. It takes the form:

$$P_i = 1 - e^{[-(1/k)N]}$$

Where:

P_i = the probability of becoming infected

N = number of viruses ingested

k = a constant estimated from dose–response experiments with coxsackievirus type B4

export file A file created by a software program to export data to another application.

exposure (1) The condition of being subject to legal liability. (2) Contact with a chemical, physical, or microbial agent. Being precise when exposure to various agents is discussed is important because different routes of exposure can have greatly different health impacts. Exposure can best be expressed in terms of the agent's free concentration at the site in the body where the agent exerts its toxic effect. This is preferred because many factors modify the delivery of an external exposure to a chemical or microbial agent to the active site. Practical considerations frequently require exposure to be expressed in terms of units of agent administered per unit of body weight or unit of body surface area. *See also* dose.

exposure assessment The determination or estimation (in qualitative or quantitative terms) of the magnitude, frequency, duration, route, and extent (number of people) of exposure to a chemical. *See also* dose.

exposure biomarker A substance, structure, or process that can be measured in a human as a result of exposure. For example, trichloroacetic acid is an exposure biomarker for disinfection by-products.

exposure coefficient A quantitative value of the amount of contaminated medium contacted per day based on

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information on the frequency, mode, and magnitude of contact with the contaminated medium.

exposure control plan A strategy to limit legal liability or biological or chemical contact.

exposure determination The process of ascertaining the job classifications in which employees have occupational exposure to any hazard, as determined by listing all tasks (as well as procedures or groups that have closely related tasks) where exposure can occur.

exposure incident An instance of a person being exposed to an infectious material through open cuts, mucous membranes, eyes, nose, or indirect exposure by touching a contaminated object.

exposure level (chemical) The amount (concentration) of a chemical at the absorption surfaces of an organism.

exposure scenario A set of conditions or assumptions about sources, exposure pathways, concentrations of toxic chemicals, and populations (numbers, characteristics, and habits) that aid the investigator in evaluating and quantifying exposure in a given situation.

expression The dewatering of a filter cake or sludge, after gravity drainage, by physical compression of the filter cake or sludge.

ex situ Not in its original place. Contaminated soil that is excavated and incinerated to remove volatile and synthetic organic chemicals is said to be treated ex situ because the soil is removed from its original place in the environment.

Extended Binary Coded Decimal Interchange (EBCDIC) A standard that assigns 8-bit codes to standard keyboard characters. This is a data format common in operating systems of mainframe computers. *See also* American Standard Code for Information Interchange.

extended-period calibration Calibration of simulation models for unsteady-state applications using field or laboratory data collected over an extended period.

extended-period simulation (EPS), dynamic-state *See* dynamic-state extended-period simulation.

extended terminal subfluidization wash (ETSW) Procedure that extends the normal backwash duration at a subfluidization flow rate (with little or no bed expansion) for an amount of time sufficient to displace the entire volume of water contained in the filter cell.

extension agent A government official who serves as a consultant to agriculture.

external corrosion Corrosion or deterioration of the outside of a pipe or appurtenance, i.e., the side of the pipe that does not carry or is not exposed to the potable water. External corrosion may be caused by soil or bedding conditions, surface characteristics, moisture conditions, grounding procedures, other utility structures, and so on. Cathodic protection systems are often used to mitigate external corrosion.

external exposure Exposure measured in terms external to the body. Examples include concentrations of a chemical in drinking water or a dose that is administered by a nonsystemic route (e.g., by stomach tube rather than intravenous injection).

externality A cost or benefit that is associated with providing water service but is not typically reflected in the water utility's cost-of-service analysis for rates. Externalities are often associated with adverse environmental effects, such as reduced river flows or loss of animal habitat land. Including the cost (or benefit) of externalities in the cost-of-service for water would make the price of water reflect its true economic cost, but the practice raises policy and practical issues, especially with regard to equity, because the external costs are invariably difficult to accurately assess and are not paid out of pocket as cash disbursements.

external load Any load placed on the outside of a pipe from backfill, traffic, or other sources. It is also known as a superimposed load.

external water treatment Preparation of the source water to be used for boiler feedwater or boiler makeup water outside the boiler. This preparation may include such steps as cation-exchange softening, pH modification, or dealkalization. *See also* internal water treatment.

extracellular Located or occurring outside a cell or cells.

extracellular polymeric substance (EPS) A substance released extracellularly by microbes, usually bacteria. These substances are primarily polysaccharides and exist as highly hydrated gels and fibers surrounding, encapsulating, or connecting a consortium of microbial species in an aquatic environment (i.e., a biofilm).

extracellular slime Any extracellular polymeric substance elaborated by microorganisms that allows them to adhere to solid substrata. Extracellular slime may also be referred to as slime, glycocalyx, capsule, or sheath. It is also called extracellular polymeric substance.

extracellular water The portion of the water found in an organism that exists outside of cellular membranes. In humans and other mammals, it includes water within the vasculature and in the interstitial spaces (i.e., spaces between cells). Specialized fluids, such as cerebrospinal fluid, are also included in the extracellular water.

extractable metal That part of a metal from a sediment, soil, or water sample that is found in the filtrate after treatment of the sample with hot or cold dilute mineral

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acid followed by filtration through a 0.45-micrometer pore-diameter filter.

extraction A separation technique used to increase the concentration of a solute, remove interferences from a matrix, or both. Many types of extraction exist and are frequently used in the chemical analysis of water. The extraction technique is used to isolate the analyte from the water matrix, increase the analyte concentration for better response from a detector, and minimize interferences that may hinder detection of the analyte.

extraction procedure (EP) A specific protocol for isolating an analyte for the purpose of increasing its concentration, minimizing interferences, or both.

extraintestinal Outside the intestine.

extramedullary erythropoiesis The process of synthesizing the formed elements of the blood outside of the bone marrow. This occurs in mammals in utero and immediately after birth when a significant fraction of the blood cells are formed in the liver.

extrapolation (1) Projection of empirical or graphical trends to estimate the value of a dependent variable (*y* value) for a known value of the independent variable (*x* value) that is beyond the range of experimental observation. For engineering purposes, extrapolation of empirical or graphical trends is generally acceptable for a small range (less than or equal to 10 percent) of *x* values beyond the range of actual observations. (2) In risk assessment, the use of data from one species of animals to estimate risks in another without specific data justifying this use. The process of extending dose-response data to doses less than those that have actually been tested by some mathematical process is referred to as low-dose extrapolation. Frequently, the extent of this extrapolation spans several orders of magnitude (e.g., extrapolating from 1 in 1,000 to 1 in 10,000,000) between the doses tested and the environmental concentrations being evaluated.

extremely hazardous chemicals A list of chemicals designated by the US Environmental Protection Agency that require special reporting and handling to protect workers and communities.

eye irritation A process by which a chemical produces inflammation and corrosive damage to the eye.

eyewash A safety device used to wash chemicals from the eyes. The device, which resembles a drinking fountain, directs a gentle spray of water into each eye.

eyewash station A flushing fountain designed to wash debris or chemicals from the eyes at a flow rate of approximately 3 gallons (12 liters) per minute.

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F

F *See* Faraday constant.

F *See* farad *in the Units of Measure section.*

f *See* frequency.

f *See* femto *in the Units of Measure section.*

F344 rat The Fischer 344 rat strain that is used by the National Toxicology Program in cancer bioassays. It is considered to be the "standard" rat for these tests. The F344 strain is an inbred albino rat (*Rattus norvegicus*) with a pedigree stretching back to the experiments of Maynie Rose Curtis of Columbia University. She began brother–sister matings with rat number 344 produced by the breeding pairs obtained from a commercial supplier of rats, Fischer, in 1920.

FAAS *See* flame atomic absorption spectrophotometry.

FAB gas chromatography–mass spectrometry *See* fast atom bombardment gas chromatography–mass spectrometry.

FAC *See* facultative plant; free available chlorine.

FACA *See* Federal Advisory Committee Act.

facilitated diffusion A biological mechanism for accelerating the movement of substrates and other chemicals across cellular membranes. The process usually involves a protein that acts as a carrier molecule. This mechanism is particularly important for moving chemicals that are highly polar or have high molecular weights that preclude high rates of diffusion through the lipid environment of biological membranes.

facility expansion charge *See* capacity charge.

facility identifier A unique identifier, assigned to facilities such as personal access openings, valves, and fire hydrants, that is usually annotated on maps and entered into a geographic information system or relational database, to provide a unique key and link between database records pertaining to that facility.

facility maintenance system (FMS) A means of providing and recording preventive and scheduled equipment maintenance.

factored pooling A process of assigning water allocations by estimating the rates of water use and calculating allocations before consumption and billing.

factorial experimental design A test plan in which experimental parameters are selectively varied to optimize the amount of information that can be obtained on the effect of individual parameters without requiring that every unique test condition be studied.

FACU *See* facultative upland plant.

facultative Having the ability to live under different conditions, e.g., with or without free oxygen.

facultative bacteria Bacteria that can adapt themselves to grow and metabolize in both the presence and absence of oxygen.

facultative organism A microbe capable of adapting to either aerobic or anaerobic environments.

facultative plant (FAC) A plant species that is about equally likely to occur in a wetland or nonwetland environment; e.g., an estimated 34 to 66 percent of the members of that species are found in wetlands, and the rest are found in nonwetlands.

facultative upland plant (FACU) A plant species that usually occurs in nonwetlands (an estimated 67 to 99 percent of such plants are found there) but occasionally is found in wetlands (an estimated 1 to 33 percent).

facultative wetlands plant (FACW) A plant species that usually occurs in wetlands (an estimated 67 to 99 percent of such plants are found there) but occasionally is found in nonwetlands (an estimated 1 to 33 percent).

FACW *See* facultative wetlands plant.

Fahrenheit degree *See* degree Fahrenheit *in the Units of Measure section.*

Fahrenheit scale A temperature scale in which equal mixtures of water, ice, and salt produce a value of 0°. The point where water freezes was taken as 32° on this scale, which has 180 equal units between the freezing and boiling of pure water. This scale was invented by Daniel G. Fahrenheit (1686–1736), a German physicist. *See also* degree Fahrenheit *in the Units of Measure section.*

failure-to-perform exclusion *See* policy exclusion.

FAIMS-MS *See* high-field asymmetric wave-form ion mobility mass spectrometry.

fall (1) A sudden difference in elevation in the bed of a stream of sufficient extent to cause the entire stream of water passing over it to drop vertically for some distance before resuming its course. (2) The vertical distance between the water surface elevations of two points on a stream or conduit. *See also* drop; slope.

fall increaser A device connected with a draft tube to increase the discharge by reducing the tailwater pressure.

fallout Radioactive debris that resettles to the earth after a nuclear explosion. Fallout takes two forms. The first, local fallout, consists of the denser particles injected into the atmosphere by the explosion. These particles descend to the earth within 24 hours near the site of the detonation and in an area extending downwind for some distance (often hundreds of miles or kilometers), depending on meteorological

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conditions and the force of the detonation. The other form, worldwide fallout, consists of lighter particles that ascend into the upper troposphere and stratosphere and are distributed over a wide area of the earth by atmospheric circulation. These particles are brought to the earth, mainly by rain and snow, over periods ranging from months to years. When atmospheric testing of nuclear devices was permitted, fallout contaminated surface waters.

fall velocity The velocity applied to any rate of fall. *See also* standard fall velocity.

false negative An error of detection in which the detector does not signal the measurement of a target in a sample yet the target was present in the sample. It assumes the detector was capable of measuring the target in the first place and that the target was within the limits of detection for the detector.

false positive A positive coliform result from a noncoliform bacterium. In testing a drinking water sample for the presence of coliform bacteria, some types of noncoliform bacteria may give a result that resembles a positive coliform result either in the presumptive step by the most probable number (MPN) method or in the membrane filter method. Further testing, called confirmation (for the MPN method) or verification (for the membrane filter method), is required to establish whether the positive result is real or a false positive. *See also* completed test; confirmed test; presumptive test.

falsifiability The possibility of a statement, hypothesis, or theory being proven false.

FAME *See* fatty acid methyl ester.

family A taxonomic category ranking below an order and above a genus.

FAP *See* fatty acid profile.

farad (F) *See in the Units of Measure section.*

Faraday constant (*F*) The quantity of electricity that can deposit (or dissolve) 1 gram-equivalent weight of a substance during electrolysis. It is equivalent to 96,489 coulombs. Thus, 1 faraday of electricity will reduce 1 mole of silver ion (Ag^+) or 0.5 mole of copper ion (Cu^{2+}) to the metal form.

Faraday's law A law of electrochemistry stating that the amount of any substance dissolved or deposited in electrolysis is proportional to the total electric charge passed.

FAS *See* ferrous ammonium sulfate.

fascine A round bundle of brush from 1 to 3 feet (0.3 to 1 meter) in diameter and 10 to 20 feet (3 to 7 meters)—and occasionally up to 500 feet (17 meters)—long used to make a foundation mat; to make a revetment to protect a shore against erosion; to accumulate sand or silt on the bed of an estuary; or to make a mat to protect a streambed from scour around piers, bridge abutments, dike breeches, or similar points.

fast atom bombardment (FAB) gas chromatography–mass spectrometry An ionization technique used in the analysis of biological molecules and other materials of fairly high molecular weight, as well as in conjunction with liquid chromatography and capillary electrophoresis. The technique involves a beam of energetic atoms, such as argon, aimed at a sample on a direct insertion probe. Desorbed ions are then analyzed in the mass spectrometer. The technique can be used in either a static or continuous flow mode, with the latter mode being more sensitive.

fast-response testing A method or instrument that provides real-time results or results within a time frame short enough to respond rapidly.

fast rinse A process in which rinse water is applied to a softener bed at the end of brine regeneration at a faster rate of flow than that for which the brine was applied. Brine, because of its greater density, moves down through the bed more slowly than regular water. If rinsing were to continue at this slower rate until the chloride concentration had dropped to the acceptable level at which the softener unit could be returned to service, the time required would be excessive. After the higher concentrations of brine have passed from the unit, little is gained by prolonging the rinse time. Thus, the rinse rate during the last few minutes is increased approximately fivefold to complete the rinse cycle. This fast rinse quickly removes the last traces of chloride and significantly reduces the regeneration time.

fast-track design A method of project delivery that deviates from the usual approach in which a complete set of plans and specifications is prepared and bid to the contracting community. In a fast-track design, a design firm teams with a contractor; the contractor begins constructing the project according to partial plans, making design decisions "in the field," and communicating with the designer. A fast-track design is implemented to accelerate a project. The owner may not save money and typically sacrifices some control over the final quality of the project.

fate and transport model A modeling tool that can be used to understand how chemicals enter our environment, how they are changed in the environment, and how they move in different media such as air, water, and soil.

fathom To find the depth of something; to sound. *See also in the Units of Measure section.*

fathometer An instrument used in measuring the depth of water based on the time required for a sound wave to travel from the surface to the bottom and for its echo to be returned.

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fatigue Permanent structural damage in a material subjected to fluctuating stress and strain.

fatigue corrosion *See* stress corrosion.

fatty acid A carboxylic acid derived from or contained in an animal or vegetable fat or oil. A saturated fatty acid ($CH_3(CH_2)_iCOOH$, where $i = 0–20$) has the carbon atoms of the alkyl chain connected by single bonds, whereas an unsaturated fatty acid (like the monounsaturated fatty acid $CH_3(CH_2)_i\ CH{=}CH(CH_2)_jCOOH$, where $i + j \geq 14$) has one or more double bonds between the carbon atoms in the alkyl chain. *See also* carboxylic acid; saturated; unsaturated.

fatty acid methyl ester (FAME) (R–COOCH$_3$) A fatty acid with the active hydrogen replaced by the methyl group of methanol. The esterification of a fatty acid (R–COOH) by methanol (CH_3OH) yields the fatty acid methyl ester ($R–COOCH_3$). The methyl esters of fatty acids have higher vapor pressures than the corresponding acids and are more easily distilled. *See also* esterification; fatty acid.

fatty acid profile (FAP) The array of fatty acids that an organism (usually a bacterium) contains when grown in a pure culture under specified conditions. It can be used in a manner similar to a fingerprint for identification of the organism.

fatty acid profiling The process of extracting the fatty acids from a pure culture of a bacterial isolate, esterifying the fatty acids, and analyzing them using a gas chromatograph to generate a profile of the fatty acids that were extracted. *See also* esterification.

faucet A device for controlling or shutting off the flow of water from a pipe by opening or closing the device.

faucet aerator A device inserted into the faucet head (or a complete faucet head itself) that reduces faucet water flow while adding air to the water to create the impression of more water.

faucet restrictor A device inserted inside a faucet behind the particle trap screen that forces water through a small opening. Faucet restrictors are usually incorporated into low-flow faucet aerators.

fault-dam spring A spring created by the occurrence of a fault of low permeability in alluvial material. The fault acts as a dam in backing up groundwater to the surface and causing that water to appear as a spring.

fault spring A spring fed by juvenile water and deep groundwater, usually hot and mineralized, that rises through a deep-rooted fault or fissure. Groups are sometimes collectively known as thermal or hot springs. A fault spring is also called a fissure spring.

fauna The animals of a given region or period considered as a whole.

FAVAD model *See* fixed and variable area discharge path model.

fbm *See* feet board measure *in the Units of Measure section.*

FB reactor *See* fluidized bed reactor.

FBRR *See* Filter Backwash Recycle Rule.

FC *See* fecal coliform.

FCE *See* final control element.

F+ coliphage A bacteriophage that infects the bacterium *Escherichia coli* via attachment to F pili located on the cells. *See also* F pilus; F-specific coliphage.

***F*-curve** A graphical representation of a cumulative data function.

FDA *See* fluorescein diacetate; Food and Drug Administration.

FDC *See* fire department connection.

feasibility determination A determination made by the US Environmental Protection Agency under Section 1412 of the Safe Drinking Water Act (SDWA) that a technology, treatment technique, or other means is feasible and is a best available technology under the terms of Section 1412. The SDWA states that this determination must involve examining for efficacy under field conditions (not solely under laboratory conditions), and it must take cost into consideration.

feature A graphic element or entity in a digital database, e.g., a water valve symbol in a geographic information system database.

febrile Of, pertaining to, or characterized by fever; feverish.

fecal coliform (FC) Members of the total coliform group of bacteria that are characterized by their ability to ferment lactose at 112.1° Fahrenheit (44.5° Celsius) and that are considered more specific indicators of fecal contamination than are coliforms that ferment lactose only at 95° Fahrenheit (35° Celsius). *Escherichia coli* and some *Klebsiella pneumoniae* strains are the principal fecal coliforms. *See also* coliform bacteria; *Escherichia coli.*

fecal contamination Contamination of soil or water by feces from warm-blooded animals.

fecal detection A determination of water contamination by fecal matter from warm-blooded animals through the identification of specific bacterial groups such as fecal coliform or fecal streptococci.

fecal indicator Fecal coliform (including *Escherichia coli,* fecal streptococci, or other bacterial groups), originating in humans or other warm-blooded animals, that indicate contamination by fecal matter.

fecal matter Matter (feces) containing or derived from animal or human bodily wastes that are discharged through the anus.

fecal–oral pathogen A disease-causing microorganism that originates in fecal material and is ultimately ingested orally. These microorganisms are also commonly described as waterborne and foodborne

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pathogens. Examples include *Cryptosporidium parvum, Rotavirus, Campylobacter jejuni,* and *Shigella.*

fecal–oral route of exposure *See* fecal–oral transmission.

fecal–oral transmission The conveyance of an infectious disease through contact with human or animal excreta that contain the infectious agent. The transmission of infection can be either direct or indirect. Contaminated drinking water can be one of several possible sources of infection, and an epidemiologic investigation is required to determine the source and mode of transmission. *See also* transmission of infection.

fecal sterol Compound found in human fecal material and a product of bacterial metabolism of cholesterol in the intestinal tract. The fecal sterol coprostanol is excreted by a variety of mammals and has been used to monitor wastewater residuals to detect fecal pollution in live-aboard marinas. In the absence of large livestock herds or marine mammal populations, high concentrations in sediments most likely indicate recent human fecal pollution.

fecal streptococci *See* fecal streptococcus.

fecal streptococcus (FS) A gram-positive bacterium used as an indicator of possible sewerage contamination because it is generally found in human and animal feces. *See also Enterococcus.*

feces Excrement from the gastrointestinal tract, consisting of residue from food digestion and bacterial action.

fecundity index A measure of fertility in reproductive studies. It is formally defined as the percentage of copulations that result in pregnancy. *See also* fertility index.

Federal Advisory Committee Act (FACA) Public Law 92-463 (5 US Code Appendix), enacted by the US Congress in 1972 to provide uniform standards for the operation of advisory committees within the US government's executive branch, to monitor the number of committees and their activities, and to ensure that the public will have access to the committees' deliberations.

Federal Emergency Management Agency (FEMA) A department of the US government responsible for emergency planning, preparedness, mitigation, response, and recovery, as well as for working with the states to plan, organize, and train for responding to disasters.

Federal Energy Regulatory Commission (FERC) An independent, five-member commission that sets rates and charges for the transportation and sale of natural gas and for the transmission and sale of electricity; licenses hydroelectric power projects; and establishes rates or charges for the transportation of oil by pipeline, as well as the valuation of such pipelines. Members of the FERC are appointed by the US president.

Federal Geodetic Control Committee (FGCC) A committee established by the US government that has developed and published geodetic control standards and specifications for the United States describing the methods, equipment, and procedures used to achieve specified accuracy levels. The responsibility to coordinate this committee was assigned to the National Geodetic Survey of the Department of Commerce through the National Oceanic and Atmospheric Administration. A subcommittee on geodetic data, the Federal Geodetic Control Subcommittee (FGCS), was established by the FGCC to promote standards of accuracy and correctness in geodetic data.

Federal Geographic Data Committee (FGDC) A group created by the federal Office of Management and Budget to promote the exchange of information and ideas on technology and methods for collecting and using digital cartographic data. FGDC was formerly named the Federal Interagency Coordinating Committee on Digital Cartography.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) The US law, codified generally as 7 US Code 136–136y, that establishes a regulatory and enforcement program administered by the US Environmental Protection Agency to govern the use of pesticide products.

Federal Power Act (FPA) An act (16 US Code 791a *et seq.*) amended several times since enactment in 1920, that established the Federal Power Commission, now the Federal Energy Regulatory Commission, to issue licenses for the construction and operation of hydroelectric facilities in any water over which the US Congress has jurisdiction.

Federal Register A US government document published every federal working day by the Office of the Federal Register. It provides official public notice of federal agencies' proposed regulations, final regulations, and other actions.

Federal Reporting Data System (FRDS) A database maintained by the US Environmental Protection Agency for tracking public water system compliance with national primary drinking water regulations. It is accessible to the public through the agency's Web site.

Federal–State Toxicology and Regulatory Alliance Committee (FSTRAC) An ad hoc committee of federal and state toxicology and regulatory professionals that generally meets twice a year and is supported administratively by the US Environmental Protection Agency's Office of Water's Health and Ecological Criteria Division.

feed and bleed An ultrafiltration term borrowed from old-fashioned boiler operators. When applied to an ultrafilter design, it refers to the use of multiple stages of ultrafilter units such that the feedwater is

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controlled at a rate equal to the permeate plus concentrate flow rates and the reject water from the initial ultrafiltration stages is recirculated to subsequent stages.

feedback The circulating action between a sensor measuring a process variable and the controller that controls or adjusts the process variable. For example, chemical feeders are often controlled through links to rate-of-flow devices.

feedback control A type of control that measures the output of a process and adjusts one or more inputs to cause the output to assume a desired value or set point.

feed channel spacer *See* feed spacer.

feed-concentrate spacer *See* feed spacer.

feed distributor For hollow-fiber reverse osmosis permeators, a plastic mesh cylinder found at the core of the fiber bundle that is designed to distribute the feed flow evenly. *See also* membrane element.

feed-forward control A type of control that measures one input of a process and adjusts one or more other inputs to cause the output to assume a desired value.

feed-forward control principle A way of minimizing the impact of disturbances on a system. A device (feed-forward controller) reads disturbances while they affect a process and reacts quickly to eliminate them by communicating with the process so the process continues with little or no interruption. The design of the feed-forward controller arises directly from the model of the controlled process.

feed pressure The pressure at which water is supplied to a water treatment device. *See also* operating pressure.

feed pump A pump used to add water treatment chemicals, either liquids or in solution, to the water being treated. These pumps are often very accurate in their delivery of what is being pumped.

feed spacer For spiral-wound membrane elements, a plastic netting placed between the flat sheet membrane leaves to provide space for feed and concentrate flow and to increase the turbulence of the feed-concentrate flow stream. *See also* membrane element.

feedwater The water to be treated that is fed into a given water treatment system.

feedwater treatment (1) Treatment of raw or source water prior to another downstream process. (2) Any chemical or other treatment of water to be used in boilers or manufacturing processes that requires removal of certain minerals, steps to make the water stable with respect to corrosion, or both. (3) Any treatment prior to a membrane process to remove substances that may plug, foul, or damage the membranes or may allow the membrane system to operate at a higher recovery or greater efficiency. *See also* pretreatment; water correction.

feet (ft) *See in the Units of Measure section.*

feet board measure (fbm) *See in the Units of Measure section.*

feet per hour (ft/h) *See in the Units of Measure section.*

feet per minute (ft/min) *See in the Units of Measure section.*

feet per second (ft/s) *See in the Units of Measure section.*

feet per second squared (ft/s^2) *See in the Units of Measure section.*

feet squared per second (ft^2/s) *See in the Units of Measure section.*

Feigenbaum index A corrosion index related to hard-saline waters. It was developed in Israel for waters of the Negev Desert region. Tests led to the following corrosion index:

$$Y = AH + B[Cl^- + SO_4^{2-}]\exp(-1/AH) + C$$

Where:

$A = 0.00035$
$B = 0.34$
$C = 19.0$

$$H = \frac{[Ca^{2+}][HCO_3^-]^2}{[CO_2]}$$

(All concentrations are expressed as milligrams bicarbonate per liter.) Field tests indicate less corrosion with higher Y values; these test results may be generalized as follows: $Y > 500$, mild corrosion; $200 < Y < 500$, moderate corrosion; $Y < 200$, high corrosion.

FEIS *See* Final Environmental Impact Statement.

FEMA *See* Federal Emergency Management Agency.

female end Obsolete term; substitute *inside threaded connection* or *bell end*. *See also* male end.

femto *See in the Units of Measure section.*

Fenton's reagent A ferrous salt (e.g., ferrous sulfate [$Fe(SO_4)$]) that acts as a catalyst for the production of hydroxyl radicals (•OH) from hydrogen peroxide (H_2O_2). During the reaction, the ferrous salt is oxidized to the ferric form and can participate in other chemical reactions, such as coagulation or metal complexation.

FEP *See* free erythrocyte porphyrin.

FERC *See* Federal Energy Regulatory Commission.

fermentation A process in which an organic substrate is broken down by fermentative metabolism of a microorganism culture (yeast or bacterium) to form stable intermediate metabolic products. Some examples of commercially important fermentation processes include wine making, beer brewing, production of ethyl alcohol, cheese making, and vinegar production.

F

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fermentative Causing chemical reactions induced by living or nonliving ferments that split complex organic compounds into relatively simple substances.

fermentative respiration A form of anaerobic respiration in which metabolic products formed during catabolic breakdown of organic substrates serve as the final electron acceptors, forming stable fermentation products.

ferric (or iron) sludge The material produced as a result of adding a ferric-based coagulant to a raw water, and subsequent coagulation and sedimentation. Ferric sludge contains the hydrolyzed floc formed by ferric's reaction with the raw water and the particulate matter removed by the process.

ferric chloride ($FeCl_3$) An iron salt used as a coagulant in water treatment. The iron has a valence of +3. *See also* coagulant; iron salt; natural organic matter.

ferric hydroxide ($Fe(OH)_3$) A coagulant precipitate used to remove turbidity, natural organic matter, and arsenic from water. Addition of iron salt coagulant to water results in ferric hydroxide formation. *See also* coagulant; iron salt; natural organic matter.

ferric iron (Fe^{+3}) Small solid iron particles containing trivalent iron, usually as gelatinous ferric hydroxide ($Fe(OH)_3$) or ferric oxide (Fe_2O_3), which are suspended in water and visible as "rusty water." Ferric iron can normally be removed by filtration. It is also called precipitated iron or iron +3.

ferric sulfate ($Fe_3(SO_4)_3$) An iron salt used as a coagulant in water treatment. The iron has a valence of +3. *See also* coagulant; iron salt; natural organic matter.

ferrihydrite (FeOOH) A mostly amorphous polymorph of goethite. Ferrihydrite is an iron corrosion by-product found in drinking water distribution systems.

ferron A reagent (7-iodo-8-hydroxyquinoline-5-sulfonic acid) used for measuring dissolved aluminum.

ferrous ammonium sulfate (FAS) ($Fe(SO_4)\cdot(NH_4)_2SO_4\cdot 6H_2O$) Part of the N,N-diethyl-p-phenylenediamine–ferrous ammonium sulfate method, which is used for determining the presence of chlorine. *See also* N,N-diethyl-p-phenylenediamine.

ferrous chloride ($FeCl_2$) A soluble iron salt. *See also* coagulant.

ferrous iron (Fe^{+2}) A reduced form of iron. When ferrous salts are added to water, the ferrous iron can act as a reducing agent. Ferrous iron is also referred to as iron +2. *See also* ferrous salt; reducing agent.

ferrous oxide (FeO) A black powder that is insoluble in water.

ferrous salt A class of iron salts that includes ferrous chloride ($FeCl_2$) and ferrous sulfate ($Fe(SO_4)$). It is used in drinking water treatment as a coagulant, reducing agent, or both. *See also* coagulant; ferrous chloride; ferrous sulfate; reducing agent.

ferrous sulfate ($Fe(SO_4)$) An iron salt used as a coagulant in water treatment. The iron has a valence of +2. *See also* coagulant.

fertility (F) plasmid A circular piece of deoxyribonucleic acid (DNA) located outside the chromosome. It has a molecular weight of 6.3×10^7 and was originally found in *Escherichia coli.* It contains genes that code for its transfer by bacterial conjugation (bacterial mating), including genes for production of the fertility-pili, which are hollow tubes of protein that extend from the bacterial cell by 2 to 20 micrometers and act as portals for DNA entry into the cell.

fertility index An index of the ability of male animals to impregnate female animals or the ability of female animals to conceive. The male fertility index is defined as the percentage of males impregnating females relative to the total number of males exposed to fertile, nonpregnant females. The female fertility index is the percentage of females who conceive after exposure to fertile males. *See also* fecundity index.

fertilization The result of genetic combination of a sperm with an ovum to form a zygote.

fertilizer A substance (manure or chemical mixture) used to make soil more fertile.

FGCC *See* Federal Geodetic Control Committee.

FGDC *See* Federal Geographic Data Committee.

FIA *See* flame ionization analysis; flow injection analysis.

fiber bundle For hollow-fiber membrane elements or permeators, the membrane fiber assembly that can be removed from its pressure vessel.

fiberglass A generic term for a plastic material containing glass fibers for reinforcement. The plastic is composed of a resin that is hardened by an exothermal chemical process. Fiberglass is often used as a material of construction when corrosion is a concern, such as for chemical storage tanks.

fiber optic array Optical fibers that are utilized as deoxyribonucleic acid (DNA) sensors through the use of DNA probes. Upon hybridization of the probe to its fluorescent target, labeled double-stranded DNA is formed that can be analyzed.

fiber optics The use of fine glass fibers for transmitting signals by means of optical light.

fiber optic transmission A technology that relies on fine glass or plastic threads or fibers for data transmission. Each fiber is capable of sending digital data via light waves in the cable (the data is transmitted as pulses of light generated by lasers). It is particularly popular for local area networks (LANs).

fiber-reinforced plastic (FRP) A nonmetallic material often made with fiberglass, resin, and other

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compounds. FRP tanks and piping are commonly used, especially with corrosive liquids. *See also* fiberglass.

Fibre Channel A data transfer architecture for storage networking that was created by an alliance of computer manufacturers and data storage device manufacturers. The American National Standards Institute (ANSI) standardized this application in 1994. The most prominent among the Fibre Channel Standards is the Fiber Channel Arbitrated Loop.

fibrosarcoma A sarcoma (i.e., tumor that has the appearance of embryonic connective tissue) that is derived from fibroblasts that produce collagen. These tumors are frequently highly malignant. Fibrosarcoma is a frequent finding in animal studies of chemicals.

fibrosis The formation of tissue that has a fibrous appearance. It is a frequent result of injury where fibrous tissue replaces the cells that are functionally important to a particular organ. The resulting tissue becomes more rigid and frequently restricts blood flow in and out of the tissue. In the lung it also reduces the ability of the lung to expand and contract, reducing the amount of air that can be exchanged with the environment. In the liver, fibrosis ultimately results in cirrhosis. Fibrosis could follow liver-damaging doses of organics (e.g., chloroform).

fibrous aciculate monoclinic malachite ($Cu_2CO_3(OH)_2$) A green ore of copper, consisting of fibrous, needle-like crystals with a monoclinic structure.

Fick's law of diffusion A law of chemistry and physics stating that the rate of mass transfer of a substance by diffusion through a medium is proportional to the concentration gradient of the substance in the medium. Substances diffuse from a place of higher concentration to a place of lower concentration. In equation form,

$$\text{diffusive flux (mass per area per time)} = D\frac{\Delta C}{X}$$

Where (in any consistent set of units):

D = the coefficient of diffusion, in area per time

ΔC = the change in concentration of the substance from point A to point B in the medium, in mass per unit volume

X = the distance from point A to point B in the medium, in length

In engineering terms,

$$\text{diffusive flux (mass per area per time)} = k(C_A - C_B)$$

Where (in any consistent set of units):

k = the mass transfer coefficient, in length per time

C_A, C_B = the concentrations of the substance at points A and B in the medium, in mass per volume

See also molecular diffusion.

fictive component A subset of a complex polymeric molecular structure that behaves similarly to the complex polymeric molecule in the context of a treatment process. For example, natural organic matter could be divided into several fictive components for modeling adsorption of natural organic matter on granular activated carbon.

FID *See* flame ionization detector.

field blank A water quality sample for which highly purified water is run through the field-sampling procedure and sent to the laboratory to detect whether any contamination of the samples is occurring during the sampling process.

field capacity (1) The maximum amount of water that the unsaturated zone of a soil holds against the pull of gravity. It is the soil moisture content of a sample in which the force of gravity acting on the water is equal to the air–water interface tension in the sample. (2) The approximate quantity of water that can be permanently retained in the soil in opposition to the downward pull of gravity. It may be expressed in terms of percentage of dry weight or as a depth for a given depth of soil. The length of time required for a soil to reach field capacity varies considerably with various soils, being approximately 24–48 hours for sandy soils, 5–10 days for silt clay soils, and longer for clays. Field capacity is also called capillary capacity, field carrying capacity, maximum water-holding capacity, moisture-holding capacity, or normal moisture capacity. *See also* specific retention.

field carrying capacity *See* field capacity.

field groundwater velocity The actual or field velocity of groundwater percolating through water-bearing material. It is measured by the volume of groundwater passing through a unit cross-sectional area per unit time divided by the effective porosity. It is also called effective groundwater velocity, true groundwater velocity, actual groundwater velocity, or average linear velocity.

field moisture capacity *See* field capacity.

field permeability coefficient *See* hydraulic conductivity; permeability coefficient.

FIFRA *See* Federal Insecticide, Fungicide, and Rodenticide Act.

figure of merit *See* electrical energy per order.

filamentous algae Algae that grow in a thread-like manner, having either single or branched strands. Filamentous algae may form wiry growths or tangled mats in source waters, and some attach to reservoir walls or to basin walls in water treatment plants.

F

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file transfer protocol (FTP) A method of transferring files to and from remote computers.

filler gate A small gate, installed in a larger sliding gate, that admits water to fill the conduit or passage on the dry side of the larger gate and equalize the water pressure on both faces of the larger gate, thereby reducing the friction in opening the larger gate. A filler gate is also called a bypass gate or bypass valve.

fill material Any material used for the primary purpose of replacing an aquatic area with dry land or changing the bottom elevation of a water body. This term does not include any pollutant discharged into the water primarily to dispose of waste; that type of activity is regulated under Section 402 of the Clean Water Act.

film flow The movement of suspended water in any direction through a system of interconnecting films that adhere to the surfaces of solid particles or to the walls of fractures in the zone of aeration. In a capillary fringe, film flow may occur through interstices that are completely filled with water. Film flow is caused by an imbalance between gravitational forces, adhesion forces, and film pressure forces. The flow is laminar, and head loss varies directly with flow velocity. Film flow is also called capillary migration, capillary movement, or capillary flow.

film pressure The inward pull or pressure acting on the water–air surface of a film system of suspended water in soils composed principally of mobile or fringe water. The surface is curved, with the concavity toward the air space. The magnitude of the film pressure is controlled by surface tension and surface pressure. The magnitude of surface tension in suspended water is influenced by the chemical character of the soil solution and the temperature. The magnitude of the surface pressure in suspended water is controlled by the size and shape of the interstices between soil grains as established by soil texture and structure. In a capillary fringe, the additional controlling factor of solid–liquid contact angle exists.

film theory A theory relating to the mass transfer of gas or liquid across an interface between the two. The theory states that two essentially stagnant films form, one on either side of the interface. Molecular diffusion controls the movement of molecules across these films. *See also* aeration; Fick's law of diffusion; mass transfer; molecular diffusion; stripping.

filovirus Virus of the family Filoviridae. These ribonucleic acid viruses are the Ebola (subtypes: Ebola Sudan, Ebola Zaire, Ebola–Ivory Coast, and Ebola Reston) and Marburg viruses, both requiring biosafety level P4 for laboratory handling. Both Ebola and Marburg viruses cause hemorrhagic fever characterized by the acute onset of fever, headache, joint and muscle aches, sore throat, and weakness, followed by diarrhea, vomiting, and stomach pain. In some patients, a rash, red eyes, hiccups, and internal and external bleeding may be observed.

filter (1) In the laboratory, a porous layer of paper, glass fiber, or cellulose acetate used to remove particulate matter from water samples and other chemical solutions. (2) The screening, removal, or both of harmful pollutants, as through respirators and dust masks. Many filters are compound specific. (3) A unit process containing a small-diameter medium, such as sand, that is designed to remove particulate matter from a liquid stream. (4) The use of a cloth or a thickness of powder, often referred to as a cake, that is permeable to water but collects particles on its surface or in its pores (e.g., diatomite); principally applied to sludge dewatering (also used in small supplies, emergency drinking water treatment, or swimming water clarification). Filters may operate by gravity or by externally applied pressure. *See also* filter aid.

filter, negatively charged *See* negatively charged filter.

filter, positively charged *See* positively charged filter.

filterable constituent *See* dissolved solids.

filterable residue *See* total dissolved solids.

filterable residue test *See* total dissolved solids test.

filter adsorbance A process combining particle removal and organic matter adsorption into a single step. The process often involves using granular activated carbon (GAC) in place of anthracite or anthracite and sand as the filter medium. The filter/adsorber will often have an empty bed contact time less than that of a GAC contactor. Thus, the GAC must be replaced regularly to maintain removal of organic matter. *See also* granular activated carbon capped filter; granular activated carbon–sand filter.

filter agitation A method used to achieve more effective cleaning of a filter bed. It usually involves using nozzles attached to a fixed or rotating pipe installed just above the filter media. Water or an air–water mixture is fed through the nozzles at high pressure to help agitate the media and break loose accumulated suspended matter. Filter agitation can also be called auxiliary scour or surface washing. *See also* surface wash.

filter aid An agent (such as diatomite) that improves filtering effectiveness in some way, such as by enhancing the retention of particles or increasing the permeability of the filter to water flow. A filter aid is either added to the suspensions (body feed) to be filtered or placed on the filter as a layer (precoat) through which the liquid must pass.

filter alum *See* alum; dry alum; liquid alum.

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filter area The effective area, expressed in square feet or meters, through which water approaches the filter media. It is also called the surface area.

filter backwash A process in which retained particles on a filter are removed by reversing the flow direction. *See also* backwash.

filter backwash rate A measurement of the number of gallons (or liters) per unit time flowing upward (backward) through a square foot (or meter) of filter surface area. Mathematically, it is the backwash flow rate divided by the total filter area. It is typically expressed in gallons per square foot per minute or liters per square meter per second.

filter backwash recycle The practice of recycling spent filter backwash water to the head works or other location within a water treatment plant.

Filter Backwash Recycle Rule (FBRR) A US Environmental Protection Agency rule requiring systems that recycle to return specific recycle flows through all processes of the water system's existing conventional or direct filtration system or at an alternate location approved by the primacy agency.

filter bed (1) A tank for water filtration that has a false filter bottom covered with granular media. (2) A pond with sand bedding, as in a sand filter or slow sand filter. (3) A type of bank revetment consisting of layers of filtering medium such that the particles gradually increase in size from the bottom upward. Such a filter allows the groundwater to flow freely, but it prevents even the smallest soil particles from being washed out.

filter boil *See* boil.

filter bottom The underdrainage system for collecting the water that has passed through a rapid granular filter and for distributing the wash water that cleans the filtering medium.

filter box A rectangular filtering unit of a rapid granular filter plant.

filter cake The layer of fine material that deposits on the upgradient (upstream) side of any filter. Over time, the filter cake increases the head loss and decreases the performance of the filter. Sometimes the filter cake itself is the desirable end product of filtration. Filter cake formation can be problematic in cases where the filter cannot be cleaned easily, e.g., filter packs around well screens. The term *filter cake* is most often used to describe the dewatered product from a filter press. *See also* belt filter press; filter press; plate-and-frame filter press.

filter clogging The effect occurring when fine particles fill the voids of a rapid granular filter.

filter crack A crevice that develops in filter media as a result of dirty media or excessive polymer doses. Cracks may develop within the filter bed itself or at the wall between the filter wall and the bed. As the dirty, cohesive filter media are packed together because of the pressure drop (head loss) that occurs in the bed, shrinkage of the bed may cause cracks to appear. Water can pass through the cracks much more readily than through the porous bed, resulting in poor filtered water quality.

filter crib A water treatment works intake consisting of a wooden crib in an excavation in the bed of a stream, filled with gravel and covered with 3–4 feet (0.9–1.2 meters) of sand to the level of the streambed, into which a suction pipe is placed and connected to a pump on shore or elsewhere to draw filtered water for use as a potable supply.

filter drawdown The process of lowering the free water surface above filter media. Filter drawdown typically is performed prior to filter backwash.

filtered wastewater Oxidized, coagulated, clarified wastewater that has been passed through natural, undisturbed soils or filter media, such as sand or diatomaceous earth, so that its turbidity does not exceed an average operating turbidity of 2 nephelometric turbidity units and does not exceed 5 nephelometric turbidity units more than 5 percent of the time during any 24-hour period.

filtered-water reservoir A reservoir for the storage of filtered water in sufficient capacity to prevent the need for frequently varying the rate of filtration with variations in demands. It is also called a clearwell or clear-water reservoir.

filter efficiency The operating usefulness of a filter as measured by various criteria, such as percentage reduction in turbidity, bacteria, particles, *Giardia* cysts, or *Cryptosporidium* oocysts. It is sometimes expressed in terms of a log removal, with 90 percent removal being 1-log removal, 99 percent being 2-log removal, 99.9 percent being 3-log removal, and so on.

filter excavation box A box with four sides but no top and no bottom. This box is placed in a granular media filter bed and used as a caisson in which a worker can stand and excavate filter media with a shovel, to perform an inspection of the filter bed, the filter support material, or filter bottom at a particular location within a filter. A filter excavation box would typically have an area of about 10 square feet (0.9 square meters), to provide sufficient working room for the person excavating the media from within the box.

filter floor The concrete floor above the plenum, into which filter nozzles have been placed. The filter floor supports the support gravel, if gravel is used, and the filter media. *See also* nozzle floor.

filter gallery A gallery provided in a water treatment plant for the installation of the conduits and valves and for a passageway to provide access to them. *See also* pipe gallery.

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filtering crucible A small porcelain container with holes in the bottom used in the total suspended solids test. It is also known as a Gooch crucible.

filtering medium Any material through which water is passed for the purpose of purification or treatment.

filter loading rate A measurement of the volume of water applied per unit time to each unit of filter surface area, i.e., flow rate into the filter divided by the total filter area. It is typically expressed in units of gallons per minute per square foot or meters per hour.

filter media The selected materials in a filter that form a barrier to the passage of filterable suspended solids. Filter designs include (1) loose media filters with particles lying in beds or loosely packed in column form in tank-type filters, or (2) cartridge-type filters that may contain membranes or fabric, fiber, bonded-ceramic, precoat, or cast solid-block filter media. The media used in some filters are chemically inert, such as sand, which performs only a mechanical filtration. Other filter media are multifunctional, chemically reactive media, such as calcite, granular activated carbon, magnesia, manganese dioxide (MnO_2), and manganese greensand.

filter operating table The table set in front of a filter on the operating floor of a rapid granular filtration plant. It supports all the equipment for the control and operation of that filter, usually including the loss-of-head gauges and rate-of-flow gauges.

filter pack A gravel or sand cylinder placed around the intake screen of a well to filter fines from the water before the water enters the well. It is used to protect the pump, as well as to prevent the well screen from clogging.

filter paper Paper with pore diameters usually between 5 and 10 micrometers, used to clarify chemical solutions, collect particulate matter, and separate solids from liquids.

filter plant The processes, devices, and structures used by a water treatment works for filtration of water.

filter press A piece of mechanical equipment designed to dewater sludge by applying pressure between two plates or belts. Dewatered sludge, or filter cake, is ultimately disposed of (e.g., via a landfill or acceptable alternative) and the filtrate is discharged to an acceptable disposal option or is treated for recycling. *See also* belt filter press; plate-and-frame filter press.

filter-pressed sludge Sludge that has been dewatered by being squeezed in filter presses.

filter profile A required element of an individual filter self-assessment under the Interim Enhanced Surface Water Treatment Rule (IESWTR) or Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR). It is a graphical representation of individual filter performance for turbidity removal over time.

filter rate The rate of application of material to some process involving filtration, e.g., application of water to a rapid granular filter.

filter rate-of-flow controller A valve or orifice plate on the effluent line from a filter, used to control the flow rate through the filter. A valve can be modulated by a flow-measuring device to select the flow rate desired, whereas an orifice plate has a fixed opening and can control the maximum flow rate through the filter only when the filter is clean. *See also* Venturi meter.

filter rating *See* micron rating.

filter resting *See* delayed filter start.

filter ripening A process by which granular media filter performance gradually improves at the beginning of a filter run as particles are deposited and act as collectors for subsequent particles applied to the filter. Filter ripening can last anywhere from a few minutes to more than an hour depending on the characteristics of the filter influent and the filter design. It is desirable for filters to ripen in less than 15 minutes because filtered water during the ripening process is often wasted. Filter ripening consists of five phases: (1) the lag phase consisting of clean backwash water from the underdrain; (2) the media disturbance and intramedia remnant stage, with water containing particles dislodged from media and remaining in pore water; (3) the upper filter remnant stage, when backwash remnant particles from the water over the media pass through the bed; (4) the influent mixing and particle stabilization stage, in which filter influent water has blended with the upper filter remnant water; and (5) the dispersed remnant and filter media conditioning stage, in which particles attached to filter media become collectors and improve filter efficacy. These phases only occur in rapid rate filtration, not with slow sand filtration. *See also* rapid granular filter.

filter run (1) The interval between the cleaning and washing operations of a rapid granular filter. (2) The interval between the changes of the filter medium on a sludge-dewatering filter.

filter sand Sand that is prepared according to detailed specifications for use in filters.

filter self-assessment An assessment conducted by water plant personnel that evaluates why a filter at their plant may not be performing properly. A self-assessment would evaluate the filter profile, filter media conditions, hydraulic loading conditions, media design, and backwashing practice. Based on individual filter monitoring requirements in the Interim Enhanced Surface Water Treatment Rule (IESWTR) and

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the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR), some systems may be required to conduct an individual filter self-assessment. Specifically, a system must conduct an individual filter self-assessment for any individual filter that has a measured turbidity level greater than 1.0 nephelometric turbidity units in two consecutive measurements taken 15 minutes apart in each of three consecutive months.

filter strainer A perforated device inserted in the underdrains of a rapid granular filter through which the filtered water is collected and through which the wash water is distributed when the filter is washed. It is sometimes called a strainer head.

filter tank The concrete or steel basin that contains the filter media, gravel support bed, underdrain, and wash water troughs.

filter-to-waste A practice of discharging filtered water directly to disposal immediately following backwashing. Filter-to-waste is typically performed for a period of 5 to 10 minutes following backwash, or until the filtered water is of acceptable quality. This is one technique for dealing with the initial high spike of turbidity that results when a filter is restarted after backwashing; filter-to-waste is also called rewash. *See also* filter ripening.

filter underdrain A system in a filter designed to collect filtered water and evenly distribute backwash water. Typical underdrain designs include perforated pipe systems, precast or plastic blocks, strainers, and porous plates, among others. *See also* filter bottom.

filter wash The reversal of flow through a rapid granular filter to wash clogging material out of the filtering medium and relieve conditions causing loss of head. Filter wash is also called backwash.

filter washtrough A set of conduits, located above the filter media and open at the top, that are designed to collect filter backwash water. The bottoms of filter troughs should be at an elevation that permits the filter media to expand adequately during backwashing without coming in contact with the bottom of the trough.

filter-wash waste tank A reservoir or basin to collect filter wash water prior to further treatment and disposal.

filtrate The liquid that has passed through a filter.

filtration The removal of suspended materials in a fluid stream by passage of the fluid through a filter medium. *See also* water filtration plant.

filtration avoidance criteria for surface water Specific requirements established by the US Environmental Protection Agency that a public water system using surface water or groundwater under direct influence of surface water must meet to avoid installation of filtration as required by the Surface Water Treatment Rule (SWTR).

filtration–elution Method of concentration of small numbers of microorganisms from large volumes of water by passing the water through a filter that traps the organisms which can then be recovered in a smaller volume of liquid.

filtration plant *See* filter plant.

filtration rate The hydraulic loading rate on a filter, typically expressed as a flow rate per unit area. It is typically expressed in units of gallons per minute per square foot or meters per hour. *See also* approach velocity.

filtration requirement A requirement of a regulatory agency that water systems using surface water or groundwater under direct influence must provide filtration treatment or meet specific criteria to avoid installing filtration. The US Environmental Protection Agency requires filtration under the Surface Water Treatment Rule (SWTR), Interim Enhanced Surface Water Treatment Rule (IESWTR), and Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR).

filtration spring A spring that percolates from numerous small openings in permeable material. It is also called a seepage spring.

fimbriae A fringe-like part or structure.

final control element (FCE) The actual device used to adjust a process. Motor speed controllers, chemical feeders, and control valves are common examples.

Final Environmental Impact Statement (FEIS) An environmental impact statement that has been reviewed and approved following the procedures established by regulatory agencies under the National Environmental Policy Act.

final rulemaking A rule promulgated by a US federal agency that has been prepared after consideration of public comments submitted in response to a proposed rulemaking.

Finding of No Significant Impact (FONSI) A formal determination by the US Army Corps of Engineers, based on an environmental assessment, that an action produces no significant impact on the quality of the human environment, thereby avoiding the requirement for an Environmental Impact Statement.

fine rack Generally, a rack that has clear spaces of 1 inch (2.5 centimeters) or less between its bars.

fines The finer-grained particles of a mass of soil, sand, or gravel.

fine sand Sediment particles having diameters between 0.125 and 0.250 millimeters.

finger levee An L-shaped berm built alongside a stream channel to impound water but not entirely stop the flow of the stream. Such structures are commonly used in artificial groundwater recharge activities.

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finished water Water that has passed through a water treatment plant, such that all the treatment processes are completed, or finished. This water is ready to be delivered to consumers. It is also called product water.

finite-element model A particular kind of digital computer model, typically based on a mesh formed of a number of polygonal cells or elements. The mathematical expressions are usually based on integrated descriptions of the modeled process.

finite resource A natural resource, such as coal, oil, or water, that is definable and measurable.

finite segment model A mathematical technique for simulation of time-dependent variables using explicit time integration.

fire cistern A cistern constructed for storing water to be used in fighting fires. The water may be stored to supplement the distribution system or to be used as an emergency supply in case the water mains serving the area should break.

fire demand The required fire flow and the duration for which it is needed, usually expressed in gallons or liters per minute for a certain number of hours. This term can also be used to denote the total quantity of water needed to deliver the required fire flow for the specified number of hours.

fire demand rate The rate of flow, usually expressed in gallons or liters per minute, that is needed at a specified residual pressure for firefighting at a particular location or in a certain area. *See also* required fire flow.

fire department connection (FDC) An inlet equipped with one or more couplings to which a fire hose can be attached and through which water can be delivered by fire department pumpers to sprinkler, standpipe, yard main, or other fire protection systems.

fire extinguisher (type A, B, or C) A device used to put out fires. Fire extinguishers are classified as to the types of fires they should be used on: A, trash, wood, and paper; B, liquids and grease; and C, electrical equipment.

fire flow The rate of flow, usually expressed in gallons or liters per minute, that can be delivered from a water distribution system at a specified residual pressure for firefighting. When delivery is to fire department pumpers, the specified residual pressure is generally 20 pounds per square inch (138 kilopascals).

fire flow demand The quantity of water required specifically for firefighting, generally determined by a fire department.

firefly luciferase test *See* adenosine triphosphate bioluminescence assay.

fire hydrant A specifically designed fitting that serves as a connection point on a distribution system to provide water for fire protection directly through a fire hose or to a fire pumper.

fire line service charge A fire line connection charge that is separate from the domestic water charge based on the cost of service for providing water to the fire line. Fire lines are normally not metered; therefore, the cost is proportioned out according to the size of the fire line service per month or by other means of applying the cost, such as inch-foot (diameter and length) of the fire line.

fireplug An early form of fire hydrant, originally a wooden plug used to stop a hole bored through a wooden water pipe to allow water to be withdrawn for firefighting. The term is still used to denote a fire hydrant.

fire pressure The pressure necessary in water mains at those times when water is used for firefighting. This term applies to cases in which the pressure for firefighting is increased to greater than the pressure normally maintained for general use.

fire protection The ability to provide water through a distribution system for fighting fires in addition to meeting the normal demands of water usage.

fire protection charges Charges made to recover the cost of providing both public and private fire protection service to the communities served by a utility. Such charges typically include the direct capital-related and maintenance costs for fire hydrants and private connections, as well as applicable indirect costs for supply, treatment, transmission, and distribution of water to the fire protection facilities.

fire pump A stationary pump installed solely to provide water for fire protection. Such a pump may be used to supply sprinkler, standpipe, yard main, and other types of fire protection systems.

fire service A connection to a water distribution system to provide water for a private fire sprinkler or fire protection system.

fire service connection A pipe extending from a main to supply a sprinkler, standpipe, yard main, or other fire protection system.

fire service detector check meter A special device for use on fire service connections consisting of a weighted check valve with a disk meter in a bypass. The disk meter measures small rates of flow only; the weighted check valve opens for large rates of flow so that the loss of head is relatively small, but these large rates of flow are not measured.

fire service meter A special type of meter causing a relatively small loss of head at high rates of flow, for use on fire service connections.

fire stream The stream of water issuing from a nozzle fastened to a fire hose that is used to extinguish fire. *See also* standard fire stream.

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fire supply In municipal use, the quantity of water required for extinguishing fires, in addition to that required for domestic, industrial, and public use.

fire system A separate system of water pipes or mains and their appurtenances installed solely to furnish water for extinguishing fires.

firewall An integrated combination of security measures set up on a network to prevent unauthorized access.

firm annual yield *See* firm yield.

firm pumping capacity The available capacity of a pumping system when the largest unit is out of service.

firmware Software in the form of either data or programs or both with embedded applications that perform analysis or similar functions. Firmware can be a combination of both hardware and software, such as memory chips with functions in addition to storage capacity.

firm yield The ability of a reservoir, a water supply utility, or both to supply water.

first draw The water that immediately comes out when a tap is first opened. This water is likely to have the highest level of lead and copper contamination from plumbing.

first-draw residential lead sample A tap sample required by the Lead and Copper Rule consisting of the first 1 liter of water drawn from either a residential cold-water kitchen or bathroom faucet, where the water sampled has remained motionless in the pipe and faucet for at least 6 hours prior to sampling.

first-draw sample *See* first-draw residential lead sample.

first-draw tap sample *See* first-draw residential lead sample.

first-order kinetics *See* reaction order.

first-pass effect The fraction of a chemical that is cleared from the blood by a single pass through the liver. Liver metabolism can substantially reduce the amount of an ingested chemical that is introduced into the systemic circulation. This reduction occurs because the blood in the capillaries that contact the small intestine empty into the portal vein that takes the blood to the liver before it is returned to the heart.

FISH *See* fluorescence in situ hybridization.

fish bioassay Exposure of fish to various levels of a chemical under controlled conditions to determine safe and toxic levels of the test chemical.

fish biomonitor An aquatic biomonitor that uses a species of fish as the biological monitoring system for indication of changes in the chemical, biological, or physical characteristics of water in which the fish are immersed. Among the conventional parameters monitored are ventilation rate, strength of ventilation, gill purge (cough) rate, and body movement rate.

fish elevator A type of fishway permitting fish to pass upstream around and over a dam. *See also* fish ladder.

Fisher's exact test A statistical test used to determine if there are nonrandom associations between two categorical variables.

fishery A place where fish live and are able to reproduce.

fish ladder An inclined trough carrying water from above to below a dam at a velocity against which fish can easily swim. Various types exist, some with baffles to reduce the velocity of the water and some consisting of a series of boxes with water spilling down from one to the next. Their installation at dams is required in many states to allow fish to pass upstream to reach their spawning grounds.

fish screen A screen placed across the head of or inside an intake canal or pipeline to prevent fish from entering. In some parts of the United States, installations of such screens are required at head gates on all streams that fish inhabit.

fish toxicity (1) Impairment of fish development during one or more life stages as a result of prolonged exposure to a toxic material at sublethal levels. (2) The immediate death of fish exposed to a material at acutely toxic concentrations.

fishway A device constructed in connection with a dam and usually consisting of a series of pools, one above the other, with low falls between. It allows fish to pass upstream and downstream over the dam. Fishways are necessary on many streams where fish periodically migrate upstream to the headwaters to spawn and the young fish come downstream again. One form is called a fish elevator, another a fish ladder. *See also* fish ladder.

fission The splitting of a heavy nucleus into two roughly equal parts (which are nuclei of lighter elements), accompanied by the release of a relatively large amount of energy and frequently one or more neutrons. Fission can occur spontaneously but is usually caused by the absorption of gamma rays, neutrons, or other particles. *Contrast with* fusion.

fissured soil Soil that has little cohesion and a preference to break along definite lines of fracture with little opposition (type C soil).

fissure spring A spring that issues from a large fissure. *See also* fault spring.

fissure water Water in open fractures, usually abundant only near the ground surface.

fitting A general classification of piping materials that join pipes together or connect to a pipe, including such items as tees, bends, wyes, corporations, plugs, caps, unions, and reducers. *See also* pipe fitting.

fittings, class *See* pipe class.

500 series methods A group of analytical methods published by the US Environmental Protection

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Agency for the detection of organic compounds in drinking water.

fix To add chemicals in the field that prevent the water quality indicators of interest in a sample from changing before final measurements are performed later in the lab. *See also* sample preservation.

fixed and variable area discharge (FAVAD) path model A model developed to assess the pressure-leakage relationship in piping networks. Losses from fixed area leakage paths (cracks in metal pipe) vary according to the square root of the system pressure, while discharges from variable area paths (splits in plastic pipe that expand, background losses) vary according to pressure to the power of 1.5. As there will be a mixture of fixed and variable area leaks in any distribution system, loss rates vary with pressure to a power that normally lies between the limits of 0.5 and 1.5. The simplest version of the FAVAD model, suitable for most practical predictions, is: Leakage Rate, L (volume/unit time) varies with pressure, P^{N1}, where the N1 exponent's value is unique to the system being modeled, or

$$L_1/L_0 = (P_1/P_0)^{N1}$$

The higher the N1 value, the more sensitive existing leakage flow rates are to changes in pressure. The FAVAD concepts allow accurate forecasting of the increase or decrease of leakage loss rates in a pipe network because of changes in operating pressure. *See also* pressure management; step testing.

fixed asset A piece of permanent property, such as land, buildings, machinery, equipment, rights, and benefits (tangible and intangible), that is permanently used in the rendering of a service or in the production of a product.

fixed bed (1) The filter or ion-exchange medium retained in a vessel. (2) A media bed that is "contained," that is, filled to the top or to the restraining barrier with filter media and is not capable of being expanded during backwashing.

fixed-bed column A treatment unit containing media that remain stationary during the course of treatment. Once the treatment capacity is exhausted, the media may be fluidized to remove contaminants or replaced. Examples of fixed-bed columns are gravity and pressure filters, ion-exchange columns, and granular activated carbon filter columns. The water to be treated typically flows downward through the bed.

fixed capital The investment represented by fixed assets.

fixed charge (1) The carrying and operating cost of any business or project that continues to occur whether or not the business operates or produces anything. (2) A charge that cannot be escaped, shifted, or altered, such as interest, rent, taxes, and amortization.

fixed cost In economics, a cost that does not vary with the amount of product produced. Examples are rent, insurance, taxes, and most general and administrative expenses, such as executive salaries, personnel department costs, and public relations costs. *See also* breakeven analysis; semivariable costs; variable costs.

fixed dam A type of dam that has a fixed elevation for the outlet or overflow and has no provision such as gates for allowing releases. A fixed dam may have a movable crest arrangement, such as flashboards or tainter gates, to change elevation of the water surface. *See also* flashboard; tainter gate.

fixed distributor A distributor consisting of perforated pipes, notched troughs, sloping boards, or sprinkler nozzles, all of which remain stationary when the distributor is operating. *See also* distributor.

fixed film A type of microbiological population in which the microorganisms are attached to a medium through which a water to be treated flows. For example, a biologically active filter is a fixed film process that removes biodegradable contaminants. *See also* biological treatment processes.

fixed-grade node A node within a model network at which the pressure is specified. It is also known as a supply node.

fixed groundwater Water in saturated rocks so fine grained that the water is assumed to be permanently attached to the rock particles. Although the occurrence of water in such rock bodies is not fully understood, most of these formations in the zone of saturation will permit slow movement of water under a hydraulic gradient, although their well yields will be negligible.

fixed liability A liability that is to be paid 1 year or more after the date of a balance sheet.

fixed matter The residue (particulate material, dissolved material, or both) that remains behind (i.e., is immovable or fixed) despite action to remove it, e.g., the residue remaining after heating or burning a substance to drive off the volatile solids. *See also* fixed solids.

fixed moisture Moisture held in the soil below the hygroscopic limit.

fixed nozzle An immovable nozzle used in filter backwash to introduce backwash water or surface wash. Fixed nozzles can be connected to piping in the gravel support layer of a rapid granular filter to provide even distribution of backwash water over the entire area of the filter. Fixed nozzles also can be attached to a piping grid above the filter media to

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provide surface wash during the backwash cycle. *See also* backwash; rotary surface washer; surface wash.

fixed point arithmetic A method of storing and calculating numbers that makes use of a fixed location for the decimal point in the field of each number. Early computer programmers experienced difficulty in utilizing and keeping track of a fixed decimal; thus, almost all computer programmers now utilize floating point notation. *See also* floating point arithmetic.

fixed solids The residue of total suspended solids, dissolved solids, or both after ignition (burning) or heating of a water sample for a specified time at a specified temperature. This term is used in the laboratory analysis of the solids content of water. *See also* fixed matter; volatile solids.

fixture branch In plumbing, the water supply pipe between a fixture supply pipe and the water distribution pipe.

flagellate A microorganism that moves by the action of a tail-like projection.

flagellum A long filamentous process; whip-like extensions of certain cells or unicellular organisms typically used for locomotion.

flame arrester A device incorporating a fine-mesh wire screen or tube bundle inserted in a vent or pipe and designed to resist the flashback of flame.

flame atomic absorption spectrophotometry (FAAS) An instrumental technique used for the analysis of metals in which the sample is atomized in a flame. This approach is typically used for low milligrams per liter concentrations.

flame ionization analysis (FIA) A widely used and generally applicable detector for gas chromatography. The effluent from the column is mixed with hydrogen and air and then ignited electrically, pyrolyzing most organic compounds to produce ions and electrons that can conduct electricity through the flame. Above the flame are electrically active plates that detect the ions and electrons to generate a current that is directed into a high-impedance operational amplifier for measurement.

flame ionization detector (FID) A device used to produce a response from organic compounds as they elute from a gas chromatographic column. This electrical signal is converted into peaks on a chromatogram, which can be used in the identification and quantification of organic compounds. The detector is useful in water analysis, because it responds to most organic compounds and does not respond to water.

flame photometric detector (FPD) A detector used in gas chromatography in which a sample burns in a hydrogen-rich flame to reduce and excite some species. The gas flow moves the excited species to a cooler emission zone above the flame where they decay and emit light, which is detected by a photomultiplier tube with the help of filters.

flame polished Melted by a flame to smooth out irregularities. Sharp or broken edges of glass (such as the end of a glass tube) can be rotated in a flame until the edge melts slightly and becomes smooth.

flame-spray repair method The repair of thermal-applied coatings by cleaning the surface and applying a molten powder to an area on which the original coating was melted using a hot flame or flame spray gun. This allows an overlap of the original coating and the repair spot. The repair is followed by a holiday (discontinuity) test and a thickness test.

flaming The act of passing a flame over the end of a faucet in order to kill bacteria before taking a water sample for bacteriological sampling. The procedure is no longer recommended because it may damage the faucet.

flammable Pertaining to substances that burn easily, strongly, and at a rapid rate.

flammable liquid A liquid that has a flash point at a temperature less than 100° Fahrenheit (37.8° Celsius).

flange A projecting rim, edge, lip, or rib.

flanged joint A pipe joint made by flanges bolted together.

flanged pipe A pipe provided with flanges so that the ends can be joined together by means of bolts.

flap gate A gate that opens and closes by rotation around one or more hinges at the top side of the gate.

flapper valve A valve seal, usually made of rubber or plastic materials, that controls the volume of water passing from a gravity-flush toilet tank to the bowl.

flap valve A valve that is hinged at one edge and that opens and shuts by rotating about the hinge. *See also* check valve.

flaring inlet A converging, funnel-shaped, or bell-mouthed entrance to a pipe or conduit, used to facilitate entry of water. *See also* bellmouth.

flaring tool A shaping tool used to enlarge or flare the end of copper tubing to make a connection. To create and shape a flare, a flare nut is placed on the tubing and the flaring tool is hammered into the end of the tubing. The flare nut is then compressed against the flare as the flare is tightened onto a connecting fitting, making a watertight connection that will not pull apart under pressure.

flashboard A temporary barrier of relatively low height and usually constructed of horizontal wooden planks, placed along the crest of the spillway of a dam to allow the water surface in the reservoir to be raised above the spillway level to increase the storage capacity. It is constructed so that it can be readily removed or lowered or carried away by high flow or floods.

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flashboard check gate A balanced crest gate that opens under a certain pressure on the flashboards that would otherwise cause the pins holding the flashboard in place to rupture.

flash distillation A distillation process in which hot incoming water at a high enough pressure to prevent boiling enters a chamber that is at reduced pressure, causing some of the water to "flash" (i.e., evaporate quickly into steam). For seawater desalting, multistage flash distillation is commonly used.

flash dryer A furnace used for drying sludge in which small particles of partly dewatered sludge are sprayed into a stream of air heated to the ignition temperature of the sludge's dry solids content.

flash evaporator A device used for flash distillation. *See also* flash distillation.

flash flood A flood of short duration with a relatively high peak rate of flow, usually resulting from a high-intensity rainfall over a small area.

flash mixer A device for quickly dispersing chemicals uniformly throughout a liquid.

flash mixing A method of mixing chemicals into solution by imparting a high velocity gradient to them, typically by mechanical means. In water treatment, flash mixing is typically associated with the addition of coagulant or softening chemicals at the beginning of the treatment process. *See also* velocity gradient.

flash point The minimum temperature at which a liquid gives off enough vapor to mix with air and allow a flame when the vapor is ignited.

flash range The difference between the maximum brine temperature and the temperature of the brine blown down from the last stage of a multistage flash evaporator.

flashy stream A stream in which flows collect rapidly from the steep slopes of the catchment, thereby causing flood peaks to occur soon after a rain. The flows in such a stream usually subside as rapidly as they increase. Rapidly varying turbidity, particle count, and particle size are also characteristics of this type of stream.

flask A container, often narrow at the top, used for holding liquids. Many types of flasks exist, each with its own specific name and use.

flat A level surface with little or no change in elevation; a level tract along the banks of a river.

flat-crested weir A weir for which the crest is (1) horizontal in the direction of flow and (2) of appreciable length when compared with the depth of water passing over it.

flat fee A set fee charged to a water customer regardless of the amount of water used in a month. For example, a customer may be charged $20 a month for water, no matter how much is used. The fee may be based on a number of conditions, such as size of service pipe, number of water fixtures or outlets, land frontage, or other arbitrary measures, usually fixed by law.

flat rate *See* flat fee.

flat-sheet membrane A membrane manufactured in flat-sheet form. Flat-sheet pressure-driven membranes used for water treatment are commonly assembled into spiral-wound or plate-and-frame configurations. *See also* membrane element; plate-and-frame membrane configuration; spiral wound.

flat slope A conduit slope less than the critical slope for a particular discharge. Such a slope is also called a mild slope.

flavonoid hesperetin An organic compound abundant in oranges that is of potential significance in prevention and treatment of disease, especially as an anticancer compound. This compound has been used as a model compound for natural organic matter in disinfection by-product formation studies. *See also* natural organic matter.

flavor A combination of taste-and-odor sensations experienced when a sample is taken into the mouth. Flavor results from stimulation of the taste buds and the olfactory bulb. *See also* odor; taste.

flavor profile A systematic analysis of a water sample for the characteristics of taste or odor. The approach uses a panel of participants that have been trained and "calibrated" according to a protocol. Results from a flavor profile analysis can be helpful in the operation of a water treatment plant and in investigating customer inquiries.

flavor profile analysis (FPA) A descriptive analysis method that develops a flavor and odor profile (list of attributes and each attribute's intensity) of a sample by using a panel of trained, human sensory analysts. It was adapted from the flavor profile method that was developed to test foods and beverages. *See also* flavor profile.

flexible coupling (1) A joint or connection in a pipeline that will allow movement in the pipeline without failure in the joint. Such a coupling is sometimes called fault protection. (2) A section of pipe made from material that is formed, shaped, or manufactured to bend easily without failure. (3) A connection that transmits load or power between the shafts of a motor and pump and that allows for alignment variations caused by temperature changes.

flexible cover A cover on a process unit constructed in such a manner that the material assumes the shape of the volume to be contained. Flexible covers often are constructed of synthetic materials and are used on a finished water reservoir, "floating" on the surface of

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the water contained in the reservoir to protect the water from contamination.

flexible joint Any joint between two pipes that permits one of them to be deflected without disturbing the other pipe.

flexural strength The ability of a material to bend (flex) without breaking.

float (1) The concentrated solids collected at the surface of a dissolved air flotation treatment unit. (2) Sludge formed by flotation during water treatment. *See also* dissolved air flotation.

float control A float device, triggered by changing liquid levels, that activates, deactivates, or alternates equipment operation.

floaters Material that is lighter than water and floats during clarification or sedimentation processes of water and wastewater treatment, normally removed by skimming the top of the water.

float gauge A device for measuring the elevation of the surface of a liquid. The actuating element of a float gauge is a buoyant float that rests on the surface of the liquid and rises or falls with it. The elevation of the surface is measured by a chain or tape attached to the float.

float gauging The act of measuring the velocity of water flowing in a stream or conduit by means of floats placed in the water.

floating on the system A method of operating a water storage facility such that daily flow into the facility approximately equals the average daily demand for water. When consumer demands for water are low, the storage facility will be filling. During periods of high demands, the facility will be emptying.

floating pan An evaporation pan floating on a body of water.

floating point arithmetic A method of calculating that uses number quantities represented by a number called the mantissa in conjunction with a power or exponent of the number base. The actual number is obtained by multiplying the mantissa by the power of the number base. For example, 0.628475×10^2 is a floating point number; 62.8475 is the fixed point version of the same value. Computer programmers want to keep track of the decimal point easily; they want it in the same place every time. Hence, they prefer floating point arithmetic. Floating point arithmetic is also easier to use for large numbers. *See also* fixed point arithmetic.

floating weed An aquatic plant, such as a water lily, that entirely or in part floats on the surface of the water.

float mechanism A simple mechanical device used to determine fluid level.

float run The fixed distance over which any type of float is timed.

float switch An electrical switch operated by a float in a tank or reservoir and usually controlling the motor of a pump.

float tube (1) A tube for which the tube opening is held a certain level below the surface of the water by a float that goes up and down with the water level. (2) A vertical pipe connected to the wet well of a pumping station, in which a float is placed to actuate a float switch for controlling the pumps.

float valve A valve in which the closure to an opening, such as a plug or gate, is actuated by a float to control the flow into a tank.

floc Collections of smaller particles that have come together (agglomerated) into larger, more separable particles as a result of the coagulation–flocculation process.

floc aging time Period between coagulant addition and filtration. In treatment processes where adsorption of contaminants to the coagulant is desired (such as arsenate adsorption to iron oxides), an increase in the time between coagulant addition and filtration allows more time for adsorption and can result in lower residual concentrations of the contaminant (in this example, arsenic).

floc blanket clarifier A settling tank in which floc is retained in a thick blanket such that it promotes particle coalescence and enhances thickening and particle removal as fresh floc passes through it. The basin can be operated in upflow or downflow fashion, although upflow is more common.

flocculant A water-soluble organic polyelectrolyte that is used alone or in conjunction with inorganic coagulants, such as aluminum or iron salts, to agglomerate solids present in water to form large, dense floc particles that settle rapidly. *See also* coagulant.

flocculant aid *See* coagulant aid.

flocculant settling The settling of flocculant particles in dilute suspension. The particles flocculate during settling; thus, they increase in size and settle at a faster velocity as time passes. *See also* type II settling.

flocculating agent *See* flocculant.

flocculating tank A tank used for the formation of floc by the gentle agitation of liquid suspensions, with or without the aid of chemicals.

flocculation The water treatment process following coagulation that uses gentle stirring to bring suspended particles together so they will form larger, more separable clumps called floc.

flocculation agent A coagulating substance that, when added to water, forms a flocculant precipitate that will entrain suspended matter and expedite sedimentation. Examples are alum ($Al_2(SO_4)_3 \cdot 14H_2O$), ferrous sulfate ($FeSO_4$), and lime ($Ca(OH)_2$). *See also* coagulant.

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flocculation limit The water content of a soil when it is in the condition of a deflocculated sediment (i.e., with individual soil particles configured generally parallel to each other microscopically).

flocculation ratio The void ratio of a soil when it is in the condition of a deflocculated sediment.

flocculator A device to enhance the formation of floc in a liquid. Mixing energy can be provided by mechanical means or head loss.

floc density A characteristic of floc that relates to settling velocity and volume of floc. The higher the floc density, the more rapidly the floc particles will settle and the lower the resulting sludge volume. The higher the ratio of particles (turbidity) removed to the coagulant dosage, the higher the floc density.

floc retention test A procedure used to assess the cleanliness of filter media after backwashing and the amount of floc and dirt contained in a filter bed before backwashing. In the floc retention test, core samples of filter media are shaken in filtered water to remove floc and dirt retained in the filter bed. The test includes a scale of values for interpretation of the turbidity resulting from shaking the core samples in water to wash off the floc and dirt.

flood (1) A relatively high flow as measured by either gauge height or discharge quantity. (2) Any flow equal to or greater than a designated basic flow.

flood basin The part of a river valley that is outside the natural stream bank and is subject to flooding, particularly where the bank is higher than the valley floor and where a basin is formed between the bank and the sidehill.

flood benefit The value of a proposed flood protection works as estimated in terms of damage that would be avoided or other advantageous effects.

flood control The use of structural and nonstructural methods intended to reduce or eliminate the effects of flood events on people, buildings, or property.

flood control storage Storage of water during floods for later release as soon as channel capacities permit.

flood control works Structures and reservoirs constructed to reduce the flood peaks on streams subject to damaging floods.

flooded Pertaining to a condition in which the soil surface is temporarily covered with flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources.

flood event A series of flows of water in a stream constituting a distinct progressive rise and culminating in a peak, crest, or summit, together with the recession that follows the peak or crest.

flood flow The discharge of a stream during periods of flood.

flood forecasting The prediction of stream flow discharge events of specific flow rates. Forecasting takes into account drainage basin characteristics, rainfall duration and frequency information, and soil characteristics to predict the magnitude and frequency of flooding events.

flood frequency The frequency with which the maximum flood may be expected to occur at a site in any average interval of years. Frequency analysis defines the *n*-year flood as the flood that will, over a long period of time, be equaled or exceeded on the average once every *n* years. Thus, the 10-year flood would be expected to occur approximately 100 times in a period of 1,000 years; of these, 10 would be expected to reach the 100-year magnitude (i.e., they would be 100-year floods). Flood frequency is sometimes expressed in terms of a percentage of probability. For example, a probability of 1 percent would correspond to a 100-year flood; a probability of 10 percent would correspond to a 10-year flood. *See also* flood probability.

flood level The stage of a stream at a time of flood.

flood level rim That level from which liquid in plumbing fixtures, appliances, or vats could overflow to the floor when all drain and overflow openings built into the equipment are obstructed.

flood peak The maximum rate of flow, usually expressed in units of volume per unit time, that occurred during a flood.

floodplain (1) The area described by the perimeter of the probable limiting flood. (2) That portion of a river valley that has been covered with water when the river overflowed its banks at flood stage.

flood probability The probability of a flood of a given size being equaled or exceeded in a given period. A probability of 1 percent corresponds to a 100-year flood; a probability of 10 percent corresponds to a 10-year flood. *See also* flood frequency.

flood protection works Structures built to protect lands and property from damage by floods.

flood relief channel A channel constructed to carry flood water in excess of the quantity that can be carried safely in the stream. Such a channel is also called a bypass channel or floodway.

flood rim *See* flood level rim; overflow rim.

flood routing The process of progressively determining the timing and shape of a flood wave at successive points along a river. *See also* flow routing; routing.

flood source area That portion of a drainage basin where conditions of precipitation and cover, topography, or land use favor frequent flooding.

flood spreading The flooding of gravelly or otherwise relatively pervious lands to recharge a groundwater basin. *See also* spreading; water spreading.

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flood stage An arbitrarily fixed and generally accepted gauge height or elevation above which a rise in the water surface elevation is termed a flood. It is commonly fixed as the stage at which overflow of the normal banks or damage to property would begin.

flood training Investing time and money necessary to provide skilled personnel and equipment required to analyze historical flood data and prepare plans and guidance on how to protect a utility and keep it operating in times of flood.

flood wave A rise in stream flow to a crest in response to runoff generated by precipitation, as well as the stream flow's subsequent recession after the precipitation ends.

floodway *See* flood relief channel.

floor stand A device that is mounted over a valve, usually on the floor surface, and used for operating a gate valve (by hand) and indicating the extent of opening.

flora The plants of a particular region or period considered as a whole.

flotation A method for removing coagulated particles by introducing air to attach and float particles to the surface. Collected particles are skimmed and discharged to solids processing. *See also* dissolved air flotation.

flotation costs The costs incurred by the issuer of securities incident to the planning and sale of securities. Also known as issuance costs, these costs include the cost for underwriters, feasibility studies, printing, advertising, the fees of counsel, costs of presentations to potential investors, and the value of staff time and facilities required in the planning and sale of the bonds. They ordinarily do not include the costs of holding elections when required as a part of the process of authorization.

flotsam Debris from natural sources or human activity that floats on oceans, lakes, and rivers. *See also* jetsam.

flow (1) The movement of a stream of water or other fluid from place to place; movement of silt, water, sand, or other material. (2) A fluid that is in motion. (3) The quantity or rate of movement of a fluid; the discharge; the total quantity carried by a stream. (4) To issue forth or discharge. (5) The liquid or amount of liquid per unit time passing a given point. *See also* discharge rate; Newtonian flow; Reynolds number.

flow, steady *See* steady flow.

flow, unsteady *See* unsteady flow.

flowage The movement of liquid through a series of structures, such as a treatment plant. *See also* flow line.

flow augmentation The release of water stored in a reservoir or other impoundment to increase the natural flow of a stream.

flow-balancing tube For reverse osmosis water-desalting systems using multiple, parallel hollow-fiber permeators, the specifically sized tubing or pipe section from each individual permeator that provides the needed pressure drop to equalize concentrate flow rates from each permeator to help balance permeate recovery from individual permeators.

flow-based method A method of controlling ultraviolet (UV) reactors that uses validated reactors that operate within acceptable flow ranges, without control of lamp intensity output. The validation determines a minimum UV irradiance sensor set point that must be maintained to ensure adequate dose delivery. It is also called set-point operation.

flow cell A sensing element or combination of elements, such as electrodes, that is immersed in a flowing fluid and continuously measures some property of the fluid, such as pH, dissolved oxygen, or electrical conductivity.

flowchart A description of logical steps in a computer algorithm. *See also* flowsheet.

flow coefficient *See* coefficient.

flow controller An in-line device or orifice fitting in a treatment device's piping that will regulate and control the flow of water or regenerant over a broad range of inlet water pressures. Some types are manually adjustable.

flow control valve A cylindrical pressure-compensating valve installed to regulate the flow of water. Such a valve is rated in gallons or cubic meters per minute or day. *See also* filter rate-of-flow controller.

flow cytometer An instrument used for counting, examining, and sorting microscopic particles suspended in a stream of fluid.

flow cytometry A method for measuring and then analyzing the signals that result as particles flow in a liquid stream through a beam of light. The instrument used for this method is known as a flow cytometer.

flow demand The flow required to satisfy demands on a system, such as fire demand.

flow diffuser A device to distribute flow and promote blending of two fluid streams.

flow duration curve A duration curve of stream flow. *See also* duration curve.

flow equalization The use of storage tanks to control a changing flow of water and make it nearly uniform with time.

flow index The slope of a flow curve of a standard liquid-limit test of soils, plotted with water content as the ordinate on an arithmetic scale and number of

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flows as the abscissa on a logarithmic scale. The flow index is also called the fluvial index.

flowing sample A well-flushed sample, normally one that is collected from the water distribution system after the sample line has been flushed. Coliform sampling is normally done on a flowing sample. Flowing samples are normally used to gather general water quality characteristics about the system. *Contrast with* first-draw residential lead sample; standing sample.

flowing well A well that penetrates an aquifer in which the water has sufficient energy to make water flow from the well without pumping. *See also* artesian well.

flow injection analysis (FIA) A technique used in water analysis to automate some tests that are often conducted by traditional chemical methods. A water sample is injected into a continuously flowing stream of liquid, where the sample disperses in a reproducible manner. Reagents are mixed into the flowing stream and the solution flows through a detector, where the analyte is measured. In addition to automating traditional chemical methods, flow injection techniques tend to consume small volumes of reagents and sample.

flow jetting The placing of water in trench backfill material to settle the material by flooding or by forcing the water into the backfill with pressure using a short length of pipe attached to a water hose.

flow level control The use of gates, dams, or other barriers in a flume, partially filled pipe, or stream to maintain the desired water depth in the channel.

flow line A path that fluid particles follow in a fluid system; e.g., the flow lines to a well are radial toward the well.

flow-line aqueduct An aqueduct placed at such an elevation that the hydraulic gradient is lower than the crown of the aqueduct, so that the aqueduct never flows full.

flow measurement A measurement of the quantity of water flowing through a given point in a given amount of time, such as gallons or cubic meters per day.

flowmeter An instrument used to measure volume, pressure, and flow rate for water and chemicals in a liquid or gaseous state in a pipe or system.

flow net A set of intersecting equipotential lines and flow lines representing two-dimensional steady flow through porous media.

flow-normalized head loss Head loss in an operating filter, with the data adjusted (normalized or standardized) to a standard rate of filtration. When clean bed head loss data are normalized for flow and water temperature, data collected from different seasons and at different filtration rates can be compared.

flow-nozzle meter A water meter of the differential-medium type in which the flow through the primary element (nozzle) produces a pressure difference (or differential head), which the secondary element (float tube) then uses as an indication of the rate of flow.

flow-paced feed system A system for feeding chemicals in which the rate of application is proportional to the flow into which the chemicals are being fed. In this manner, the concentration of the chemical in the flow stream remains constant as flow changes.

flowpath The direction of water flow through a distribution system from the water source or origin to the end point, such as a water storage facility, or end use.

flow-proportional composite
See flow-proportional composite sample.

flow-proportional composite sample A sample obtained by (1) continuous pumping at a rate proportional to the flow, (2) mixing equal volumes of water collected at time intervals inversely proportional to the volume of flow, or (3) mixing volumes of water that are proportional to the flow and were collected during or at regular time intervals. This approach produces a sample that is representative of true conditions over the sampling time period.

flow-proportional control A method of controlling chemical feed rates by having the feed rate increase or decrease as the flow increases or decreases.

flow rate A measure of the volume of water moving past a given point in a given period of time. *See also* average flow rate; instantaneous flow rate.

flow recording The process of documenting the quantity or rate of the flow of a fluid past a given point. The recording is normally accomplished automatically.

flow regulator A structure installed in a canal, conduit, or channel to control the flow of water at an intake or to control the water level in a canal, channel, or treatment unit. *See also* filter rate-of-flow controller; regulated flow.

flow restrictor A washer-like disk that fits inside faucets or showerheads to restrict water flow.

flow routing A mathematical procedure for predicting the changing rate of flow as a function of time at various points along a watercourse. *See also* flood routing.

flowsheet A diagrammatic representation of the progression of steps in a process, showing their sequence and interdependence. A flowsheet is sometimes also called a flowchart.

flow test (1) A measurement of water flowing in a distribution pipe, usually accomplished with a pitometer. (2) The measurement of water discharging from a fire hydrant at a certain pressure to determine the quantity of water available from the hydrant for firefighting. It is also known as a fire flow test. (3) The

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measurement of water discharged from a pump at different heads to establish a flow curve for the pump. *See also* pressure test.

flow-through time (1) The time required for a volume of liquid to pass through a basin, identified in terms of the time characteristic being measured, such as mean time, modal time, or minimum time. These various times may be estimated from tracer recovery curves. Dyes, electrolytes, and radioactive substances are used as tracers. The T_{10} time—the time at which 10 percent of the tracer has passed through the system—is important in calculating the $C \times T$ values for disinfection. (2) The average time required for a small volume of liquid to pass through a basin from inlet to outlet. *See also* $C \times T$; disinfectant contact time.

flow tube One type of primary element used in a pressure differential meter. It measures flow velocity based on the amount of pressure drop through the tube. It is similar to a Venturi tube.

flow yield *See* recovery.

fluence rate *See* ultraviolet intensity.

fluence rate modeling Technique that can estimate microbial disinfection kinetics as a function of ultraviolet (UV) doses. The UV fluence rate (i.e., UV dose) accounts for reflection and refraction of UV light in a UV disinfection system. *See also* microbial disinfection kinetics.

fluid (1) A substance having molecular particles that easily move and change their relative positions without separation of the mass and that easily yield to shear stress. (2) Capable of flowing; liquid or gaseous. *See also* gas; liquid.

fluidization The process of suspending a particulate medium such that the particles are mobile and are not continually in contact with each other. For example, filter media are fluidized during backwashing to remove entrapped particulates. *See also* backwash.

fluidization velocity (1) The upward velocity of a granular filter backwash flow that is sufficient to fluidize a filter bed. (2) The upward velocity of a fluid in a vessel that is sufficient to suspend the particles in the vessel in a more or less stationary position with respect to the direction of fluid flow. *See also* fluidization.

fluidization wash A granular filter backwash that achieves fluidization velocity for the filter media contained in the filter bed. *See also* fluidization; fluidization velocity.

fluidize (1) To make fluid. (2) To suspend or move finely divided particles in a stream of gas or liquid. *See also* fluidized.

fluidized Pertaining to a mass of solid particles that is made to flow like a liquid by injection of water or gas. In water treatment, a bed of filter media is fluidized by backwashing water through the filter. *See also* backwash.

fluidized bed (FB) reactor A pressure vessel or tank that is designed for liquid–solid or gas–solid reactions. The liquid or gas moves upward through the solid particles at a velocity sufficient to suspend the individual particles in the fluid. Ion exchangers, granular activated carbon adsorbers, and some types of furnaces and kilns use fluidized bed reactors.

fluidized-bed backwash *See* fluidization wash.

fluidized bed crystallization *See* pellet-softening process.

fluidized-bed granular activated carbon adsorption An adsorption process in which an upward flow maintains an approximate 10 percent expansion of the granular activated carbon media. This allows for the passage of suspended particles to minimize head loss and for extended operation without backwashing. A loss of fine granular activated carbon particles in the effluent is often a problem.

fluidized bed pellet reactor *See* pellet reactor.

fluidized bed treatment A biologically active treatment column or bed in which the support medium with attached biomass is fluidized by the upward flow of water. The fluidized bed provides a high surface area that promotes rapid mass transfer and increased biomass attachment.

fluid mechanics The science of motion of fluids, based on physical analysis and experimental verification.

fluid network analyzer *See* pipeline network analyzer.

fluid ounce (fl oz) *See in the Units of Measure section.*

fluid potential A measure of the energy per unit weight of water. It is often used to calculate the rate of water movement through some conduit. Fluid potential normally includes velocity potential, pressure potential, and gravitational (elevation) potential.

fluid velocity log A set of flow rate measurements in a borehole as a function of depth. This type of log can be interpreted to determine which strata in an aquifer can produce economically useful quantities of water.

flume An open conduit of wood, masonry, or metal constructed on a grade and sometimes elevated. It is sometimes called an aqueduct.

fluorescein (resorcinolphthalein, $C_{20}H_{12}O_5$) An orange-red compound that exhibits intense fluorescence in alkaline solutions and is used to dye water in order to trace the water's course and movement. It is relatively harmless in low concentrations (though it will still fluoresce).

fluorescein diacetate (FDA) A nonpolar, nonfluorescent substance which enters the cells freely and can break into one brightly fluorescing fluorescein and two acetates. It is commonly

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used for study of cell membranes and as a viability stain for organisms.

fluorescence The emission of light by excited molecules. The emitted light will be at the same or lower energy than the incoming light. This phenomenon is used as the basis for detecting certain compounds, such as symmetrically conjugated organic compounds like benzene. *See also* immunofluorescence.

fluorescence characterization A property of some atoms and molecules to absorb light at a particular wavelength and to subsequently emit light that appears in the form of glowing, distinctive colors. This property is widely used for microscopic examination of organisms.

fluorescence detector A device used in the analysis of trace organic compounds. It is composed of excitation and emission filters that can be specified or changed for the detection of specific types of compounds. These detectors are very sensitive to certain types of organics, such as aromatic compounds. Fluorescence detectors have been used in water analysis to determine the presence of certain compounds interfaced with a high-performance liquid chromatograph. *See also* fluorimeter.

fluorescence immunofluorescence
See immunofluorescence.

fluorescence in situ hybridization (FISH) An analytic method used to evaluate the phylogenetic identity, morphology, number, and spatial arrangements of microorganisms in the environment. The technique involves the use of oligonucleotide probes to permeabilize whole microbial cells. The probes hybridize to their complementary target sequence in the ribosomes. *See also* oligonucleotide probe.

fluorescence microscope A microscope used for observing and studying microscopic specimens that can absorb light (exciting light) of one wavelength and emit light (emitted light) of a longer wavelength. The longer-wavelength light emitted is called fluorescence.

fluorescence microscopy A technique in which microorganisms are first stained with a dye and then examined under a microscope with a fluorescent light attached. The fluorescing dye highlights areas of the microorganisms in order to help identify the species and/or its characteristics.

fluorescent antibody Antibody attached to a fluorescent molecule.

fluorescent antibody (FA) test A technique to identify an organism using a fluorescently labeled antibody specific to the organism.

fluorescent dye A substance used for measuring a feeble water current and determining the path of movement of currents and sediment. Such a dye must be stable, have a color strikingly different from that of the water, be harmless and cheap, and have the property of emitting radiation as a result of absorption of incident irradiation generated in a measuring device. *See also* fluorescein.

fluorescent-dyed polystyrene microsphere
See fluorescently labeled microsphere.

fluorescently labeled microsphere A microsphere with a fluorescent compound on or in it. Fluorescently labeled polystyrene microspheres have been used for membrane system integrity testing by adding virus-size microspheres to the feedwater and monitoring the fluorescence of filtrate or permeate. *See also* nonbiological surrogate.

fluorescing microsphere *See* fluorescently labeled microsphere.

fluoridation The process of adding fluoride to water to help prevent tooth decay.

fluoride ion (F^-) A halide ion. Fluoride salts are added to drinking water for fluoridation to prevent dental cavities, to a level of approximately 1.0 milligrams per liter, depending on temperature. Naturally occurring fluoride is regulated by the US Environmental Protection Agency at a maximum contaminant level of 4.0 milligrams per liter. *See also* fluoridation; halide.

Fluoride Rule The national primary drinking water regulation set for fluoride by the US Environmental Protection Agency.

fluorimeter An instrument that measures the visible light emitted when a fluorescent substance is irradiated with ultraviolet light. In water studies, fluorescent dyes are frequently used as tracers.

fluorochrome A chemical dye—e.g., fluorescein (resorcinolphthalein, $C_{20}H_{12}O_5$) and rhodamine B ($C_{28}H_{31}ClN_2O_3$)—that emits colored light when excited by an appropriate wavelength of light. These dyes can be coupled readily to antibody molecules to form conjugated fluorescent dyes that can be used to specifically stain the antigenic reactive sites of the target microorganisms. These organisms can then be visualized using a fluorescence microscope with an excitation wavelength appropriate for the fluorescent dye attached to the antibodies. *See also* immunofluorescence.

fluoroelastomer Any elastomeric high polymer (an elastic substance resembling rubber) containing fluorine.

fluorogenic substrate technology *See* chromogenic substrate technology.

fluorosis The staining or pitting of the teeth caused by excessive amounts of fluoride in water.

fluorspar (CaF_2) Natural calcium fluoride. Fluorspar may be used as a direct source of fluoride for water fluoridation, in which case an alum ($Al_2(SO_4)_3 \cdot 14H_2O$) solution is used to dissolve the fluorspar. *See also* fluoridation.

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fluosilicic acid (H_2SiF_6) *See* hydrofluosilicic acid.

flush (1) To open a cold-water tap to clear out the water that may have been sitting for a long time in the pipes. In new homes, to flush a system means to send large volumes of water gushing through the unused pipes to remove loose particles of solder and flux. (2) To force large amounts of water through piping to clean out piping, tubing, or storage or process tanks.

flush hydrant A hydrant with outlets at or below grade.

flushing The act of running water through a distribution system or water main in order to remove debris, discolored water, or chemical solutions in order to clean the line or system.

flushing chamber A tank or reservoir used to store water used for flushing a line or sewer where quick release increases the volume of flow.

flushing program A systematic or preventive maintenance program designed to flush dead-end water mains or distribution systems to prevent discolored water or stale water from occurring. This program involves flowing or flushing designated fire hydrants on a routine or scheduled basis to replace water in the distribution system that has remained static over a period of time.

flush valve A valve used to expel water and sediment from irrigation lines.

flush water The water that is discharged from a blowoff, fire hydrant, or open pipe to remove debris or discolored water from a distribution system. Such flushing normally takes place from a line being placed in service or from a line that has only one end connected.

fluvial Of or pertaining to one or more rivers; produced by the action of a stream or river; growing, living, or existing in or near a stream or river.

fluvial deposit Sediment deposited by the action of streams. It is also called an alluvial deposit.

fluvial erosion Erosion caused by the action of streams.

fluvial index *See* flow index.

fluviation Collectively, all the numerous activities of streams.

fluvioglacial stream A stream that obtains its water and much of its load from melting glacial ice.

flux (1) A substance applied to surfaces that are to be joined to clean and free them from oxides and promote their union. Typically fluxes are used after cleaning copper pipe in preparation for soldering or brazing. Overuse or improper use of fluxes can cause corrosion. (2) The amount of a substance that passes a point in space per unit area per unit time. (3) For a membrane separation process, the flow rate of solvent (water) or salt (or specific solute) through the membrane area. For a pressure-driven membrane, when flux is not specified as a solvent or solute flux, it is commonly assumed to be a solvent flux. *See also* flux rate (solvent, water).

flux decline *See* flux rate decline.

fluxing lime *See* lime.

flux rate (solvent, water) For a membrane separation process, the volume or mass of permeate passing through the membrane per unit area per unit time. Flux rate is commonly expressed in gallons per square foot per day, or cubic meters per square meter per second, or meters per second.

flux rate decline The decrease in flux rate over a time period. For a pressure-driven membrane process, flux rate decline is commonly used to quantify the hydraulic performance decline caused by membrane compaction, fouling, and other factors. It is calculated as the rate of decline of the temperature-corrected solvent (water) mass transfer coefficient over a specified time period. *See also* solvent (water) permeability coefficient; temperature correction factor.

FMA (free mineral acidity) *See under* mineral acidity.

FMS *See* facility maintenance system.

foam The frothy substance composed of an aggregation of bubbles on the surface of liquids and created by violent agitation or by the admission of air bubbles to liquid containing surface-active materials, solid particles, or both. Foam is also called froth.

foam swab *See* swab.

foci of infection Small areas of a cell culture that shows signs of virus replication. The initial sites (foci) of infection usually spread to infect the entire culture.

fog drip Water dripping to the ground from trees or other objects that have collected moisture from windblown fog. The dripping is in some instances as heavy as light rain.

follicular cell Generally, the epithelial cells that surround ovarian follicles. However, a follicle is simply a pouch-like depression or cavity, and can be found in a variety of other specialized structures within the body, e.g., hair follicles or thyroid follicles. The reproductive effects of chemicals involve follicular cells.

folliculitis Inflammation of a follicle (an approximately spherical group of cells containing a cavity).

follow-up monitoring Monitoring required for lead, copper, and other water quality parameters after a public water system installs treatment.

fomites Articles contaminated by pathogens that convey infection. Toys, soiled diapers and clothes, drinking cups, and door handles are examples of possible fomites.

fonofos ($C_{10}H_{15}OPS_2$) The common name for the insecticide and soil fumigant ethylphosphonodithioic acid *O*-ethyl *S*-phenyl ester. *See also* fumigant; insecticide.

F

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FONSI *See* Finding of No Significant Impact.

Food and Drug Administration (FDA) A US federal agency that, among other activities, regulates bottled water as a food.

food chain A set of relationships describing which organisms eat or are eaten by which other organisms (predator and prey). A food chain can be a means of concentrating certain types of toxic chemicals in the tissues of the predator chain. These chemicals are generally very nonpolar, such as the polychlorinated biphenyls, dioxins, and dibenzofurans. However, chemicals that may be sequestered by specific biological processes also bioaccumulate (e.g., lead and cadmium).

Food Security Act (FSA) Public Law 99-198 (16 US Code 3801–3845), amended several times since enactment in 1985, governing farming practices and programs. It is also called the Farm Bill.

food web A series of interconnected food chains forming interlocking patterns.

foot *See* feet *in the Units of Measure section.*

foot of water *See in the Units of Measure section.*

foot per second per foot *See in the Units of Measure section.*

foot-pound, torque *See in the Units of Measure section.*

foot-pound, work *See in the Units of Measure section.*

foot valve A check valve placed on the lower section of a water system, such as on the suction side of a pump or at the bottom of a well with a submersible pump, to prevent water from draining out of the system or back into a well.

forage fish Small fish eaten by predatory fishes as prey.

force The agent or cause that is capable of putting a mass in motion or that alters the motion of a mass. In equation form (in any consistent set of units), force equals mass times acceleration.

forced aeration The application of pressurized air below the surface of a liquid through diffusers or other devices to promote the formation of small bubbles.

forced-draft aeration A process to promote absorption of oxygen or air into water. Water enters the aeration tower from the top and cascades over slats or trays, while a blower located at the bottom of the tower forces air from the bottom through the tower. *See also* induced-draft aeration.

forced-draft degasifier A device for removing gases from water in which, commonly, the water is distributed at the top of a column and falls by gravity while air or other gas is blown in from the bottom, moves in an upward direction, and removes the volatile gases from the water. *See also* degasifier, forced-draft stripping.

forced-draft stripping Air stripping that uses a blower to force air through the packed tower from the bottom while water enters the top of the packed tower and cascades over the packing media. *See also* air-stripping; forced-draft degasifier; induced-draft stripping; packed tower aeration; stripping.

force main A pressure pipe joining the pump discharge at a water-pumping station with a point of gravity flow.

force potential The sum of the kinetic energy, elevation energy, and pressure at a point in an aquifer. Because the kinetic energy (velocity head) is neglected in most groundwater problems, force potential is taken as equal to the hydraulic head times the acceleration of gravity times the density of the liquid (in any consistent set of units).

force units *See in the Units of Measure section.*

forebay A small reservoir or pond located at the head of a water treatment plant, used to store water in relatively small quantities to compensate for variations in flow that occur over short periods of time, usually not exceeding several hours.

forebay area (1) Any holding reservoir supplying water to a water treatment plant. (2) In groundwater hydrology, a free groundwater basin that serves as recharge area to an artesian basin.

forecasting The use of mathematical procedures for predicting behavior based on historical data. Forecasting can be applied to budgeting processes, statistical modeling, population growth, or any function requiring a predictive capability.

foreign water Water that is found in a particular stream or other body of water but that originated in another drainage basin. In some states, the legal rights to the use of such water are different from the rights to the use of stream water that originated within the stream's own drainage basin.

forested wetland That portion of a wetland dominated by woody vegetation greater than about 20 feet (6 meters) in height.

forest influence Effects of forest or brush on climate, water, and soil.

formaldehyde (CH_2O) An aldehyde created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. Typically, formaldehyde is the most prevalent aldehyde produced during the ozonation of drinking water. It is quite biodegradable and can readily be removed during biological filtration. *See also* aldehyde; biological filtration; ozonation by-product.

formalin A 37 percent by weight aqueous solution of formaldehyde with some methanol.

formalin-fixed cysts or oocysts Cysts or oocysts preserved in formalin storage media. Storage in formalin renders the organisms noninfectious.

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formalin inactivation of *Cryptosporidium* Storage of *Cryptosporidium* oocysts in formalin. Storage reduces infectivity of these organisms and stabilizes the solution by preventing growth of other microorganisms; oocysts may not be rendered noninfectious by this procedure, however, and should be considered possibly infectious and handled as such.

format *See* data format.

formation A geologic group of rock or soil of similar consolidation that forms an identifiable lithologic unit. An aquifer composed of sand and gravel and bounded by clay layers is an example of a formation.

formation packer A set of inflatable bladders lowered into a well to vertically isolate different parts of its depth.

formation potential (FP) The future expectation of the creation of disinfection by-products (DBPs), measured individually or as a group, following the addition of a disinfectant to produce a target residual, in a given time and under a given set of environmental conditions (e.g., temperature, pH). When a formation potential is being reported, all conditions of the test should also be reported. Formation potential tests tend to produce near the maximum DBP concentration possible with whatever disinfectant is being tested. *See also* disinfection by-product formation potential; simulated distribution system test; total organic halogen formation potential; trihalomethane formation potential.

formazin A polymeric material used to prepare a primary reference standard suspension for turbidity.

formazin turbidity unit (ftu) *See in the Units of Measure section.*

form loss of head A loss of head caused by the change in shape of the waterway, distinct from a loss of head caused by friction or roughness.

formula (1) A mathematical function. (2) A shorthand way of writing the elements present in a molecule and the number of atoms of each element present in each of the molecules (e.g., carbon dioxide's formula is CO_2). Such a formula is also called a chemical formula.

formula weight *See* molecular weight.

fortified *See* spiked.

forward mutation A change in the naturally occurring genomic sequence. Such a mutation may lead to the synthesis of a protein with altered function, or it may have little effect on the organism. The main use of this term is in contrast to the genetically engineered organisms that are most frequently used in mutagenesis tests. Those organisms contain a mutation that makes them dependent on exogenous sources of nutrients (e.g., the histidine-dependent *Salmonella* strains used in the Ames test for bacterial mutagenicity). A reverse mutation may occur after exposure to a test chemical at the specific locus of the gene that makes the organism dependent on a nutrient. This event will render the organism capable of growing on media deficient in the nutrient. Reverse mutations at specific loci are much easier to detect than forward mutations because a selective medium simplifies detection of the mutant. *See also* mutagenesis; reverse mutation.

forward osmosis A membrane separation process that uses natural osmotic pressure as the driving force. A solution or mixture with relatively high osmotic pressure is placed on one side of a special permselective membrane, and feedwater having lower osmotic pressure is placed on the other side of the membrane barrier; the net osmotic pressure differential causes water to move through the membrane to the concentrated mixture side, and the membrane would reject unwanted substances in the feedwater. *See* osmotic pressure; permselective membrane.

fossil water Interstitial water that was buried at the same time as was the original sediment.

fouling (1) The accumulation of undesirable foreign matter in a filter or ion-exchange media bed, causing clogging of pores or coating of surfaces and inhibiting or limiting the proper operation of the bed and the treatment system. (2) The reduction in adsorption capacity of granular activated carbon as a result of other material occupying the adsorption surface. For example, granular activated carbon can be fouled by naturally occurring organic matter in drinking water, thereby limiting the absorption of specific microcontaminants. (3) In a membrane water treatment process, the deposition of material such as colloidal matter, microorganisms, and metal oxides on the membrane surface or in its pores, causing a change in membrane performance (e.g., flux decline). (4) A gelatinous, slimy accumulation resulting from the activity of organisms in water. This type of fouling may be found on concrete, masonry, and metal surfaces (tuberculation). *See also* preloading.

fouling index One of several types of empirically obtained values that is used to characterize membrane feedwaters and is indicative of the amount of particulate and colloidal matter present. Index values are calculated from empirical formulas using data obtained by filtering a water sample through a specified filter media disk under controlled conditions and measuring the change in flow rate over time. *See also* membrane fouling index; modified fouling index; plugging factor; silt density index.

fouling potential In membrane process treatment, the degree to which the feed stream contains substances that may foul a membrane system and cause a decline in performance. Potential foulants include suspended

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and colloidal solids, metal oxides, microbial matter, organic compounds, and other solutes. The feedwater colloidal fouling potential for some membrane processes is sometimes estimated based on turbidity, the silt density index, or other empirical measurements. *See also* silt density index.

fountain A spring of water issuing from the earth; the source or head of a stream of water.

fountain aerator An aerator in the form of a fountain with tight horizontal basins of various diameters, the largest basin being found at the bottom. The ensemble resembles an ornamental fountain.

fountain flow The manner in which water flows from the open end of a vertical pipe, rising a certain distance and then spreading out in an umbrella-like shape.

fountain head The head in a saturated confined aquifer.

fountain jet The stream of water issuing from and over the horizontal circumference of a vertical pipe.

Fourier transform infrared (FTIR) analysis A spectroscopic technique that provides information on the molecular structure of a substance. Detectors employing this technique have been interfaced to a variety of separation devices, such as gas and liquid chromatographs. A computer is an important part of such an instrument setup; it allows for rapid recording of the spectra of organic compounds. The Fourier transform, a mathematical method of separating a waveform or function into sinusoids of different frequency that sum to the original waveform, is used for data analysis.

4-log removal *See under* log removal.

4-methylumbelliferyl-β-D-glucuronide *See under* methylumbelliferyl-β-D-glucuronide.

fourneyron wheel An outward-flow waterwheel.

4',6-diamdino-2-phenylindole/propidium iodide *See under* diamdino-2-phenylindole/propidium iodide.

four-way valve A valve constructed with four waterways and with a movable element operated by a quarter turn to provide passage between either pair of adjacent waterways.

FP *See* formation potential.

FPA *See* Federal Power Act; flavor profile analysis.

FPD *See* flame photometric detector.

F pilus (F pili, pl.) A short, hair-like attachment structure that projects from the cells of certain bacteria involved in mating. Found on cells that donate deoxyribonucleic acid (DNA) (conjugation). F pili also act as receptor sites for some bacteriophages, providing them with a site of attachment to the bacterial cell.

F plasmid *See* fertility plasmid.

F_r *See* Froude number.

fractal index A measure of the manner in which solids deposit on a surface. It can be used to predict sludge volume and density.

fractional factorial experimental design A fractional factorial design of experiments that includes selected combinations of factors and levels. It is a carefully prescribed and representative subset of a full factorial design. A fractional factorial design of experiments is useful when the number of potential factors is relatively large, because the fractional factorial design reduces the total number of runs required.

fractionate To separate into fractions or parts.

fracture spring A spring created via fracturing or jointing of a rock.

fracture trace The surface representation of a fracture zone, often with valleys and stream segments running along the zones. The trace may be a line of characteristic vegetation, a linear soil-moisture pattern, or a linear topographic feature such as a sag or cliff. *See also* fracture zone.

fracture zone A zone in geologic formations where fractures are plentiful. Wells located in these zones can be very productive water sources, whereas wells drilled between fracture zones may not yield any water.

fragment model A subdivision of a system that can be modeled independently of the larger system. A large, complicated system is sometimes broken down into fragment systems, such as pressure zones, to facilitate analysis.

framed dam A low, fixed dam that is generally built of timber framed to form a water face and supported by struts.

frame-shift mutation A change in the sequence of purine and pyrimidine bases within deoxyribonucleic acid (DNA) that results from the loss (or gain) of bases in combinations that are not divisible by 3. Essentially, this changes the reading frame of the sequence and in turn alters the arrangement of amino acids in the protein that is synthesized from this DNA template. *See also* codon; mutagenesis.

Francisella tularensis (F. tularensis) A small, gram-negative, nonsporing aerobic bacillus with two main serotypes: Jellison Type A (highly virulent) and Type B (mild disease). Tularemia, also commonly known as "rabbit fever," is most commonly spread by direct contact with rabbits, rodents, and arthropods. Tularemia is usually contracted by handling infected animal carcasses, consuming contaminated food or water, or inhaling the bacteria. *Francisella tularensis* is highly infectious, with only a few tens of bacteria needed to develop the disease. Symptoms generally include fever, chills, joint and muscle pain, headache, weakness, and sometimes pneumonia. People who develop

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pneumonic tularemia experience chest pain, bloody sputum, and difficulty breathing. An attack with this agent against an unprotected population would be extremely disabling and could cause a large number of deaths. The most likely method of delivery would be as an aerosol. The bacterium is tolerant of low temperatures and can survive in surface waters.

Francis turbine A reaction turbine of the radial inward-flow type.

Francis wheel An inward-flow waterwheel.

frank pathogen An infective agent for which multiplication in or on a host organism usually results in disease of the host. *See also* infectious agent; pathogenic organism; virulence.

***F*-ratio** A statistic used in regression analysis to test the significance of independent variables and the regression as a whole. The ratio is computed by dividing the amount of variance explained by the model by the amount of unexplained variance. The resulting ratio can then be compared to a standardized table of *F* values to determine the level of confidence that can be placed in the relationship. The standard *F*-test values are uniquely determined by the degrees of freedom in the numerator (the number of variables included) and in the denominator (the number of observations included in the analysis) and by the level of confidence that is desired for the test (90, 95, or 99 percent). A calculated *F*-ratio (or *F*-value) of about 3.0 is generally considered adequate at the 95 percent confidence level, with at least 30 observations to support the hypothesis that the regression relationship did not occur by chance.

frazil ice Small ice crystals that can block water intakes.

FRDS *See* Federal Reporting Data System.

free acid form The regenerated form of a weak acid cation exchanger. *See also* weak acid cation exchanger.

free ammonia Ammonia (NH_3) that is free in solution, not bound up as in chloramines. *See also* chloramines.

free available chlorine (FAC) The amount of chlorine available as dissolved gas (Cl_2), hypochlorous acid (HOCl), and hypochlorite ion (OCl^-), that is not combined with ammonia (NH_3) or other compounds in water and that is available for disinfection or oxidation. *See also* hypochlorite ion; hypochlorous acid.

free available chlorine residual The free chlorine residual formed once all the chlorine demand has been satisfied. The chlorine is not combined with other constituents in the water. *See also* chlorine demand.

free base form The regenerated form of a weak base anion exchanger. *See also* weak base anion exchanger.

freeboard (1) The vertical distance from the normal water surface to the top of a confining wall. (2) The vertical distance from the media surface to the underside of a trough in a granular filter. This distance is also called available expansion.

free carbon dioxide Carbon dioxide (CO_2) present in water as gas or as carbonic acid (H_2CO_3) but not including carbon dioxide in combination, as in the carbonates or bicarbonates.

free chlorine *See* free available chlorine.

free chlorine residual *See* free available chlorine residual.

free convection Motion caused only by density differences within the fluid. It is also called gravitational convection.

free energy A measure of the thermodynamic driving energy for a chemical reaction. The change in free energy associated with a chemical reaction is a useful indicator of whether the reaction will proceed spontaneously. In chemistry, free energy is also known as the Gibbs function or Gibbs free energy. *See also* Gibbs free energy.

free erythrocyte porphyrin (FEP) Protoporphyrin IX found in the red blood cells. It is also known as free erythrocytic protoporphyrin. It is a precursor of heme, requiring only the insertion of iron to complete the synthesis. Iron is inserted by an enzyme called ferrochetalase that is inhibited by certain heavy metals, particularly lead. In lead-poisoned individuals, FEP accumulates in the immature red cells; this accumulation can easily be detected because protoporphyrin IX is fluorescent. Consequently, protoporphyrin IX is used as a sensitive and easily administered prescreen for excessive exposure to lead. *See also* heme.

free flow A condition of flow through or over a structure such that the flow is not affected by submergence of the structure or the existence of tailwater downstream of the structure.

free groundwater Groundwater in the interconnected interstices in the saturation zone. It extends down to the first impervious barrier and moves under the influence of gravity in the direction of the slope of the water table. *See also* phreatic water.

free ligand The fraction of a chemical that has dissociated from its binding site on a protein or chelating agent. The free ligand reaches equilibrium with the bound ligand. Interactions between a chemical and its binding site are considered to be specific if the interaction is responsible for inducing a response within the body. Nonspecific interactions also occur, however, and are generally thought of as a way of reducing the chemical's availability for distribution throughout the body. Ligands also form complexes with certain biological macromolecules in order to exert effects on the body. This latter type of complex is usually referred to as a drug-receptor complex. *See also* ligand; ligand binding site.

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free mineral acidity (FMA) *See* mineral acidity.

free radical A chemical that possesses an unshared electron. Such chemicals are usually quite reactive. Free radicals that are generated in the metabolism of chemicals within the body are frequently held responsible for mediating toxic responses. One of the outcomes of the resulting free radical is lipid peroxidation. *See also* hydroxyl radical; lipid peroxidation.

free residual chlorination The application of chlorine to water to produce a free available chlorine residual equal to at least 80 percent of the total residual chlorine (the sum of free and combined available chlorine residual). *See also* free available chlorine.

free residual chlorine *See* free available chlorine residual.

free settling The settling of discrete, nonflocculent particles in dilute suspension such that no apparent flocculation or interaction occurs between particles. *See also* Stokes's law; type I settling.

free surface The boundary surface of a liquid that is in contact with the atmosphere. It is also called the free water surface.

free surface energy The free energy in a liquid surface produced by the unbalanced inward pull exerted by the underlying molecules on the layer of molecules at the surface. For purposes of calculation, a hypothetical tension equal to the free surface energy is assumed to be acting in all directions parallel to the surface. This mathematical equivalent of free surface energy is called surface tension.

free water Suspended water that constitutes films covering the surfaces of solid particles or the walls of fractures but is in excess of pellicular water. Free water can move in any direction under the pull of the resultant of the force of gravity and unbalanced film pressure. It is also called mobile water.

free weir A weir that is not submerged; a weir in which the tailwater is below the crest or the flow is not in any way affected by tailwater.

freeze-drying An effective method for long-term preservation of bacteria and other microorganisms. It involves the removal of water from frozen microorganism suspensions by sublimation under reduced pressure. It is also called lyophilization.

freeze–thaw conditioning *See* freeze–thaw residuals dewatering.

freeze–thaw cycles A process to separate solids from water in open beds by alternately freezing and thawing the mixture.

freeze–thaw residuals dewatering A process of improving the dewaterability of residuals by allowing the residuals to freeze. Freezing residuals causes the water in the gelatinous material to crystallize and, upon thawing, leaves a granular solid of coffee ground consistency. The process can be accomplished naturally in northern climates or by mechanical means in other areas.

freezing A process in water desalting whereby salt water is cooled under controlled conditions to form ice crystals, remaining dissolved solids are washed out, and the separated ice is melted to produce freshwater.

freezing process In desalting operations, the separation of salt from water by the formation of salt-free ice crystals.

French drain An underground passageway for water through the interstices among stones placed loosely in a trench.

French square *See* dilution bottle.

Freon® Registered trademark by Dupont for several different chlorofluorocarbons (CFCs) used primarily as working fluids in refrigeration and air conditioning.

frequency (*f*) (1) For a periodic quantity, the number of periods per unit time:

$$f = (1/T)$$

Where:

f = the frequency
T = the period (in units of time)

Frequency is measured in hertz. (2) The degree of regularity of (a) coverage of an area by surface water or (b) saturation of the soil. It is usually expressed as the number of years the soil is inundated or saturated during part of the growing season of the prevalent vegetation (e.g., 50 years per 100 years) or as an inundation frequency such as once every year, once every 2 years, or once every 5 years.

frequency analysis A method of evaluating vegetation in an area by establishing a transect and counting the occurrences of plant species at various sampling points along the transect.

frequency curve A graphical representation of the frequency of occurrence of specific events. The event that occurs most frequently is termed the mode. When the mode coincides with the mean value, the curve is symmetrical, but when it differs from the mean, the curve lacks symmetry and is termed a skew frequency curve. *See also* duration area curve; probability plot.

frequency distribution A description of the frequency of occurrence of certain values for a parameter within a data set. *See also* probability distribution.

frequency units *See in the Units of Measure section.*

frequent flooding Flooding that is likely to occur often during usual weather conditions (i.e., has more than a 50 percent chance of occurring in any year or will occur more than 50 times in 100 years).

freshet A great rise or overflowing of a stream caused by heavy rains or melted snow.

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fresh–salt water interface An idealized location in coastal aquifer systems where the inland, fresh groundwater meets the offshore, saline groundwater. Because freshwater is less dense than saline water, the interface has vertical as well as horizontal variation. Pumping in the freshwater zone can cause the interface to move inland.

freshwater Water having a relatively low mineral content. Freshwater is generally considered to be water containing less than 500 or 1,000 milligrams per liter of total dissolved solids, depending on location.

freshwater lens Occurrence of freshwater found above salt water, commonly associated with coastal areas where aquifers contain both fresh and saline water.

fretting corrosion *See* stress corrosion.

Freundlich adsorption constant (K_F) An indicator of the adsorptive capacity of an adsorbent for a solute. It appears in the Freundlich equation, which mathematically describes the observed dependence of the amount of solute adsorbed on an adsorbent such as activated carbon. This constant is empirically determined from a Freundlich isotherm, in which a plot of the logarithm of the loading (q, the amount of solute adsorbed per unit of adsorbent) versus the logarithm of the equilibrium concentration of the solute remaining in solution (C_e) in any consistent set of units yields a straight line with an intercept of log K_F. If the data are plotted on log–log paper, K_F equals the loading when $C_e = 1$. The Freundlich constant is useful for interpreting the relative strengths of the adsorption of compounds on the adsorbent when the experimental conditions of temperature, contact time, and pH value are the same. *See also* activated carbon; adsorption; adsorption isotherm; Freundlich isotherm.

Freundlich capacity coefficient *See* Freundlich adsorption constant.

Freundlich isotherm An adsorption relationship that describes the equilibrium state of adsorbate, adsorbent, and solution at a given temperature. The Freundlich isotherm takes the form of

$$q = K_F C_e^{1/n}$$

Where (in any consistent set of units):

q = the mass of adsorbate per mass of adsorbent at equilibrium
C_e = the concentration of the adsorbate in dilute solution when adsorption equilibrium is reached
K_F = the Freundlich adsorption constant
$1/n$ = the slope of the straight-line isotherm when q is plotted as a function of C_e on log–log paper

See also Langmuir isotherm.

friability An expression of the ability of ion-exchange beads to resist cracking under hydrostatic operation.

friction factor (C) A measure of the resistance to flow of fluid in a conduit as influenced by wall roughness. *See also C* factor.

friction head loss The head lost by water flowing in a stream or conduit as a result of the disturbances set up by the contact between the moving water and its containing conduit, as well as by intermolecular friction. In laminar flow, the head loss is approximately proportional to the first power of the velocity:

$$h_L = 64\nu\left(\frac{L}{D^2}\right)\left(\frac{V}{2g}\right)$$

Where (in any consistent set of units):

h_L = the friction head loss
L = the conduit length
D = the conduit diameter
V = the mean velocity
g = the gravitational constant
ν = the kinematic viscosity of the fluid

In turbulent flow, friction head loss is proportional to a higher power, approximately the square of the velocity:

$$h_L = f\left(\frac{L}{D}\right)\left(\frac{V^2}{2g}\right)$$

Where:

f = the friction coefficient

Although, strictly speaking, head losses such as those caused by bends, expansions, obstructions, and impacts are not included in this term, the usual practice is to include all such head losses under this term. Friction head loss is also called friction head.

friction loss *See* friction head loss; head loss.

friction slope The friction head or loss per unit length of conduit. For most conditions of flow, the friction slope coincides with the energy gradient, but where a distinction is made between energy losses caused by bends, expansions, impacts, and so on, a distinction must also be made between the friction slope and the energy gradient. In uniform channels, the friction slope is equal to the bed or surface slope only for uniform flow.

friction weir *See* free weir.

fringe water Free water occurring in the saturated capillary fringe above the water table and completely filling the smaller interstices. It may consist solely of capillary water, or it may be combined with water in transit to the water table. It moves with the capillary fringe as the latter rises and falls with the water table.

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FRNA coliphage *See* infectious male-specific F-specific ribonucleic acid coliphage.

frontal precipitation Precipitation occurring at a boundary between pockets of cool and warm air.

front-end loader A wheeled or track-mounted tractor with a hydraulically operated bucket mounted on the front to move earth material and especially to load the material into trucks.

front of levee The side of the levee next to the river, facing away from the protected area. It is sometimes called the river side.

frost bottom A section of a meter case designed to break easily without damaging other parts of the meter when water freezes within the meter.

frost box A box surrounding a water meter or water pipe and containing some heat insulator such as mineral wool, excelsior, or sawdust, to prevent the water from freezing.

Froude number (F_r) A numerical quantity used as an index to characterize the type of flow in a hydraulic structure where the force of gravity (as the only force producing motion) acts in conjunction with the resisting force of inertia. It is equal to the square of a characteristic velocity of the system (the mean, surface, or maximum velocity) divided by the product of a characteristic linear dimension (such as diameter or depth) and the gravitational constant, all expressed in consistent units so that the combinations will be dimensionless. The Froude number is used in open-channel flow studies or in cases in which the free surface plays an essential role in influencing motion. It is given by the following equation:

$$F_r = \frac{V^2}{gL}$$

Where (in any consistent set of units):

F_r = Froude number
V = the characteristic velocity
g = the gravitational constant
L = the characteristic linear dimension

FRP *See* fiber-reinforced plastic.

FS *See* fecal streptococcus.

FSA *See* Food Security Act.

F-specific coliphage A bacteriophage that infects the bacterium *Escherichia coli* via attachment to F pili located on the cells. *See also* F+ coliphage.

FSTRAC *See* Federal–State Toxicology and Regulatory Alliance Committee.

ft *See* feet, foot *in the Units of Measure section.*

ft^2 *See* square foot *in the Units of Measure section.*

ft^3 *See* cubic feet *in the Units of Measure section.*

ft/h *See* feet per hour *in the Units of Measure section.*

ft^3/h *See* cubic feet per hour *in the Units of Measure section.*

FTIR analysis *See* Fourier transform infrared analysis.

ft/min *See* feet per minute *in the Units of Measure section.*

ft^3/min *See* cubic feet per minute *in the Units of Measure section.*

FTP *See* file transfer protocol.

ft/s (also fps) *See* feet per second *in the Units of Measure section.*

ft/s^2 *See* feet per second squared *in the Units of Measure section.*

ft^2/s *See* feet squared per second *in the Units of Measure section.*

ft^3/s *See* cubic feet per second *in the Units of Measure section.*

ftu *See* formazin turbidity unit *in the Units of Measure section.*

F. tularensis *See Francisella tularensis.*

fugitive water Leakage from impounding reservoirs or an irrigation system.

full duplex A data transmission term meaning that data can be simultaneously transmitted and received at the same time. *Compare with* half duplex; simplex.

fuller's earth The microscopic remnants of the discarded outer surface of diatoms used in precoat filtration. Fuller's earth is also called diatomaceous earth.

full-face shield A shatterproof plastic shield worn to protect the face from flying particles and chemicals.

full fluidization backwash A method of backwashing in which the backwash water is added at a sufficient rate that the media grains separate from one another and become freely supported by the liquid. This allows dislodged particles to be fully released from the bed during backwash.

fulvic acid A complex organic compound of unknown specific structure that can be either soil derived or aquagenic in origin. When present in water, fulvic acids are major precursors of disinfection by-products. *See also* aquagenic organic matter; aquatic fulvic acid; disinfection by-product precursor.

fume hood A large enclosed cabinet equipped with a fan to vent fumes from a laboratory. Chemicals are mixed and heated under the hood to prevent fumes from spreading through the laboratory.

fumigant A toxic agent in vapor form that destroys rodents, insects, infectious organisms, and so on. It is a type of pesticide. *See also* pesticide.

function A role that a wetland serves: (1) reduction of pollutant loadings, including excess nutrients, sediment, and toxics; (2) attenuation of floodwaters and stormwaters; (3) shoreline stabilization and erosion control; (4) breeding ground and habitat for many species of plants and wildlife, including fish, birds,

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and mammals, extending to threatened and endangered species and species in need of conservation; (5) food chain support; and (6) timber production.

functional antagonism In pharmacology and toxicology, a general case where the effect of one chemical (or drug) is offset by the effect of a second chemical acting on a second physiological process.

functional assessment A valuation of physical, chemical, and biological processes or attributes in a wetland that are vital to the system's integrity.

functional cost analysis Analysis of the costs of producing water or other products organized around specific activities or functions, such as water supply, water treatment, water distribution, customer services, or administration.

functional equivalency The ability of a restored or created ecosystem to perform ecosystem services, such as floodwater storage or pollutant detoxification, that are indistinguishable in effects from corresponding services performed by natural ecosystems.

functional group *See* exchange site.

functionally required area In a landscape design, a portion of an ornamental landscape intended to serve a specific function, e.g., for pedestrian traffic, sports, or recreational activities.

function argument A parameter used to define a mathematical function. For example, if a function were defined to calculate the cost of a chemical feed system based on the feed rate of the chemical in pounds per day and the unit cost of the chemical in dollars per pound, the arguments of the function would be chemical feed rate and chemical unit cost.

funding bonds Bonds issued to retire outstanding floating debt and to eliminate deficits.

fund management The process whereby a group, organization, or individual administers sums of money set aside for a specific purpose. One example is a pension fund for retired employees.

fungal, fungi *See* fungus.

fungicide Any substance that kills or inhibits the growth of fungi. *See also* fungus.

fungus (pl. fungi) Eumycete; eukaryotic organism classified as a plant, simple or complex, lacking chlorophyll and a vascular system. Simple forms are single celled (yeasts); higher forms have branched filaments and complicated life cycles (molds and mushrooms).

funnel A utensil made of glass or plastic and used in the laboratory for pouring liquids into flasks and other containers.

fuse A device for limiting the amount of electrical current in a circuit. When an excessive current flows, the interior conductor of the fuse melts because of the heat generated by the current, thereby opening the circuit. Unlike a circuit breaker, a fuse cannot be reused; it must be replaced.

fused disconnect A switch device that allows electrical current to be interrupted automatically when a replaceable fuse in the switch fails. This device is used to isolate a circuit or piece of electrical equipment from a power source when the level of current is too high.

fusible plug A safety device on a chlorine cylinder below the outlet valve that melts at 158° Fahrenheit (70° Celsius) for protection from excessive pressure when the cylinder is heated.

fusion In physics, the process by which the nuclei of two light elements combine to form the nucleus of a heavier element and release substantial amounts of energy. *Contrast with* fission.

futile call In the context of water rights, a situation in which a more recent (junior) priority is allowed to continue to divert water in spite of a downstream senior call, when curtailing the more recent priority would not produce any more water for the senior call.

future capacity The capacity for service somewhat in excess of immediate requirements. It is built into a utility in anticipation of increased demands for service resulting from higher uses by existing customers or growth in the service area.

fuzzy filter A prefilter designed for use when clarification does not provide the desired amount of turbidity removal, so named because of the appearance of the material. It is made of synthetic fiber, resulting in a porous material (a form of polyvaniladane). The medium has a quasi-spherical shape and is approximately 1.25 inches (31.75 millimeters) in diameter. The medium is highly porous (approximately 88 to 90 percent) and compressible. Because the filter medium is compressible, the porosity and the collector size of the medium can be altered according to the characteristics of the influent. The system operates at higher than usual filtration rates (30 gallons per minute per square foot). The filter medium also represents a departure from conventional filter media in that the fluid can be filtered through the medium as opposed to flowing around the medium as with granular media filters. *See also* polyurethane foam filter.

fuzzy logic An approach to approximate reasoning for which the rules of inference are approximate rather than exact. It can be used to manipulate incomplete, imprecise, or unreliable information and is used extensively in the field of artificial intelligence. *See also* artificial intelligence.

***F*-value** *See F*-ratio.

FWS (Fish and Wildlife Service) *See* US Fish and Wildlife Service.

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G

G *See* Gibbs free energy; mean velocity gradient; universal gravitational constant *in the Units of Measure section;* velocity gradient.

G *See* giga *in the Units of Measure section.*

$\overline{G}$ *See* mean velocity gradient.

G^0 *See* standard free energy.

g *See* earth's gravitational constant *in the Units of Measure section.*

g *See* gram *in the Units of Measure section.*

GA *See* tabun.

GA-based model *See* genetic-algorithm–based model.

gabion A long basket lowered in place on a wire and filled with earth stones to serve the same purpose as a fascine. It is also called a pannier. *See also* fascine.

GAC *See* granular activated carbon.

GAC_{10} Granular activated carbon filter beds with an empty bed contact time of 10 minutes based on average daily flow and an activated carbon reactivation frequency of every 180 days.

GAE *See* granulomatous amoebic encephalitis.

gaining stream A stream for which the flow is partially or completely composed of water discharged from an underlying aquifer.

gal *See* gallon *in the Units of Measure section.*

β-GAL *See* β-D-galactosidase.

β-D-galactosidase (β-GAL) An enzyme, sometimes called lactase, that catalyzes the breakdown of lactose into glucose and galactose. It is the basis for tests for detecting the coliform group bacteria using defined-substrate technology. *See also* defined-substrate technology.

β-D-galactoside A glycoside derived from galactose. It is a substrate for the enzyme β-D-galactosidase, part of the lactose operon (group of genes) of lactose-fermenting bacteria such as the coliform group.

gal/flush (also gpf) *See* gallons per flush *in the Units of Measure section.*

gal/ft^2 *See* gallons per square foot *in the Units of Measure section.*

Galileo number (N_{Ga}) The reciprocal of the sedimentation number. It is used in describing the sedimentation properties of particles and in calculating the minimum upflow velocity in a granular filter to produce fluidization.

$$N_{Ga} = \frac{\rho D^3 g (\rho_s - \rho)}{\mu^2}$$

Where (in any consistent set of units):

ρ = the fluid density
D = the particle diameter
g = the gravitational constant
ρ_s = the density of the particle
μ = the absolute viscosity

gallery (1) An underground structure designed and installed to collect subsurface water. (2) A passageway in a structure, such as a dam or a water treatment plant, used to obtain access to interior parts, to carry pipes, or to house machinery. (3) An underground conduit, reservoir, or passage.

Gallionella A bacterial genus of unicellular, colorless, curved, rod-shaped bacteria that secrete a ribbon-like stalk from the concave side of the cell. The stalk is characteristically twisted. These organisms are generally considered iron bacteria because of their occurrence in iron-bearing waters and because iron oxide (Fe_2O_3) is deposited in or on the stalks. They are considered nuisance bacteria because of their association with fouling in pipes that convey iron-containing groundwaters used for drinking water or industrial uses.

Gallionella ferruginea (G. ferruginea) A bacterium designated as the type species of the genus *Gallionella.* It is one of several types of bacteria that use iron in their metabolism and are capable of depositing gelatinous ferric hydroxide ($Fe(OH_3)$). *See also Gallionella;* iron bacteria.

gallon *See in the Units of Measure section.*

gallons per capita per day (gpcd) *See in the Units of Measure section.*

gallons per day (gpd) *See in the Units of Measure section.*

$gallons\ per\ day\ per\ square\ foot\ (gpd/ft^2)$ *See in the Units of Measure section.*

gallons per flush (gal/flush) *See in the Units of Measure section.*

gallons per hour (gph) *See in the Units of Measure section.*

gallons per minute (gpm) *See in the Units of Measure section.*

$gallons\ per\ minute\ per\ square\ foot\ (gpm/ft^2)$ *See in the Units of Measure section.*

gallons per second (gps) *See in the Units of Measure section.*

$gallons\ per\ square\ foot\ (gal/ft^2)$ *See in the Units of Measure section.*

gallons per square foot per day (gfd) *See g*allons per day per square foot *in the Units of Measure section.*

gallons per year (gpy) *See in the Units of Measure section.*

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galvanic cell An electrolytic cell capable of producing electrical energy by electrochemical action. The decomposition of materials in the cell causes an electric current (electrons) to flow from cathode to anode.

galvanic corrosion Corrosion that is increased because of the current caused by a galvanic cell. It is sometimes called couple action.

galvanic corrosion protection A procedure that reduces galvanic corrosion. For example, coating of a metal with zinc (galvanizing) is a commonly practiced form of galvanic corrosion protection. In the presence of moisture, the zinc becomes an anode and the underlying substrate a cathode (especially iron or steel). Corrosion attacks the zinc, leaving the base metal intact.

galvanic coupling A cell consisting of two dissimilar metals in contact with each other (i.e., a coupling) and with a common electrolyte.

galvanic series A listing of metals and alloys according to their corrosion potential.

galvanization The process of coating a metal with zinc.

galvanize To coat a metal (especially iron or steel) with zinc.

galvannealing Extension of the iron content of a galvanized pipe all the way to the pipe surface. When properly performed, the galvanizing process produces a coating that gradually changes in composition from the pure iron of the pipe to the pure zinc surface that protects the pipe. Under certain manufacturing conditions, however, the iron content of the alloy layer extends all the way to the surface, compromising the protection normally afforded by the galvanizing processes. Among the manufacturing conditions that can cause galvannealing are (1) zinc dip that is too hot, (2) keeping the iron pipe in the zinc dip too long, or (3) certain impurities in the metals.

gametes *See* gametogenesis.

gametogenesis The formation of male and female sex cells (sperm or ova), which are also referred to as gametes.

γ *See* gamma *in the Units of Measure section.*

gamma (γ) *See in the Units of Measure section.*

gamma (γ) decay A nuclear reaction in which the nucleus of an atom emits a pulse of energy in the form of gamma radiation.

gamma (γ) irradiation Exposure of a food or substance to gamma rays to reduce the amount of pathogens in and on the food or substance.

gamma (γ) log A set of geophysical measurements of the background gamma radiation given off by a subsurface formation. The log can be interpreted to determine water-bearing and nonwater-bearing layers in an aquifer.

gamma (γ) ray High-energy, short-wavelength electromagnetic radiation emitted during radioactive decay. Energies of gamma rays are usually between 0.010 and 10 megaelectron volts. Gamma radiation usually accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best attenuated by dense materials such as lead and depleted uranium.

gamma–gamma (γ–γ) radiation log A set of geophysical measurements of the backscattered gamma radiation given off by a subsurface formation that is exposed to a gamma radiation source. The log can be interpreted to determine water-bearing and nonwater-bearing layers in an aquifer, as well as the porosity of the medium.

γ-glutamyltranspeptidase
See under glutamyltranspeptidase.

gang of wells A group of wells from which water is drawn by a single pump or other lifting device. A gang of wells is also called a battery of wells.

Gantt chart A means of graphically representing activities across a time scale, developed by Henry L. Gantt to assist with project management systems. Initially called bar charts, these graphic representations have since been renamed Gantt charts in honor of their inventor.

GAO *See* US Government Accountability Office.

gap junction A structure that passes through the plasma membrane of adjoining cells. These structures form channels that allow low-molecular-weight chemicals to pass between cells. They are thought to play an important role in communication between cells. The proteins that form the junctions disappear from the plasma membrane when cells undergo division. Gap junctional proteins are also lost when cells are treated with tumor promoters.

garnet A dense granular filter medium (specific gravity of 3.6–4.2) that is the bottom layer in multimedia, triple-media, or mixed media filters. Garnet is often used in rapid granular filters, with anthracite as the top layer, then sand, then garnet.

gas A state of matter characterized by very low density and viscosity (relative to liquids and solids); comparatively great expansion and contraction with changes in pressure and temperature; an ability to diffuse readily into other gases; and an ability to occupy almost completely uniformly the whole of any container. A perfect, or ideal, gas is one that closely conforms to the simple gas laws for expansion and contraction. (Use of the word *gas* for gasoline, natural gas, or the anesthetic nitrous oxide is acceptable only in informal communication.) *See also* gas constant.

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GA salt A very coarse grainy salt of ground alum size (hence the "GA") that was formerly used for regenerating zeolite water softeners and is sometimes used coincidentally with alum as a coagulant.

GASB *See* Governmental Accounting Standards Board.

GASB 34 *See Basic Financial Statements—and Management's Discussion and Analysis—for State and Local Governments.*

gas chlorination The application of chlorine gas (Cl_2) to water.

gas chlorinator A device for adding chlorine gas (Cl_2) to water. Chlorine that is stored as a liquid in cylindrical containers evaporates into the gaseous phase, is withdrawn from the cylinder by vacuum through a metering device (typically a rotometer), and is combined with water for injection into the flowstream.

gas chromatograph An instrument commonly used to separate organic compounds at trace concentrations. The major components of such an instrument are a sample injector, an oven, and a detector. A chromatography column, which is in the oven, links the injector port and the detector.

gas chromatography (GC) A technique commonly used in the analysis of organic compounds in water. In most cases, an extract of a water sample is injected into a gas chromatograph. Analytes are volatilized in an injector port and migrate as a gas through a chromatography column. The speed with which the analytes migrate depends on the relative affinity of the analyte for the stationary phase in the chromatography column. Compounds are identified based on their retention time in the column. *See also* stationary phase.

gas chromatography–electron capture detector (GC–ECD) A combination of analytic tools to separate and detect organic compounds in water. *See also* electron capture detector; gas chromatography.

gas chromatography–mass spectrometry (GC–MS) The combined use of a gas chromatograph and a mass spectrometer. This combination of instruments provides one of the most powerful techniques used in water analysis. Compounds that elute from a gas chromatographic column are detected in a mass spectrometer. The mass spectrometer serves as a powerful detection device that generates much more information about a compound than most other gas chromatographic detectors provide. *See also* mass spectrometry.

gas chromatography/mass spectrometry/mass spectrometry (GC/MS/MS) The combined use of a gas chromatograph and two phases of mass fragmentation (tandem mass spectrometer). The use of tandem mass spectrometry with gas chromatography allows analysis of low levels of organic compounds in highly contaminated samples. *See also* gas chromatography; mass spectrometer–mass spectrometer.

gas constant (*R*) The universal gas constant, equal to 0.08205 liter-atmospheres per mole-kelvin. In the ideal gas equation,

$$PV = nRT$$

Where:

P = pressure, in atmospheres
V = volume, in liters
n = concentration, in moles
T = temperature, kelvin

The gas constant is independent of pressure, temperature, or the number of moles in the sample; however, the numerical value of R depends on the units used to measure the parameters of the gas.

gas diffusion flow injection analysis (GDFIA) A technique for analyzing volatile species in a liquid sample. A sample containing a volatile species is transported to a cell equipped with a membrane. The permeability and resistivity characteristics of the membrane allow particular volatile gas species in the sample to permeate the membrane to react with an indicator dye for detection.

gas discharge A mixture of nonexcited atoms, excited atoms, cations, and free electrons formed when a sufficiently high voltage is applied across a volume of gas. Most commercial ultraviolet (UV) lamps use mercury gas discharges to generate UV light.

gasket A ring of material used to make a joint or connection watertight.

gas-lift flow area An area under which the subsurface water is under pressure because of the presence of gas that would force the water to rise to the ground surface if afforded an opportunity to do so.

gas membrane *See* gas separation membrane.

gas-phase chlorine dioxide (ClO_2) A strong oxidant that is produced by a chemical reaction between hydrochloric acid (HCl) and potassium chlorate ($KClO_3$). Chlorine dioxide is almost never used commercially as a gas because of its explosiveness. It is used only as a liquid in water treatment.

gas production The creation of a gas by chemical or biological means.

gas separation membrane A membrane used in gas separation processes, such as one used for producing a gas higher in oxygen content than air.

gas solubility coefficient The mass of gas that is absorbed by a unit quantity (e.g., milligrams per liter) of water at a given temperature when the water is exposed to a pure atmosphere of the gas under a barometric pressure of 1 atmosphere (101.3 kilopascals). The gas solubility coefficient was formerly called the solubility coefficient.

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gas trap A device, usually a bent section of drain line, in which enough water is retained to prevent the return or counterflow of obnoxious gases. *See also* gas vent.

gastric lavage An artificial "washing" of the stomach. Fluid is pumped in and out of the stomach to remove its contents. The process is frequently used in cases of poisoning if the poison has been recently ingested. It is used as an alternative to emetics (drugs that induce vomiting) in poisoned patients who are unconscious.

gastroenteric illness An illness affecting the gastrointestinal system. Such an illness is often caused by microbial infection, but it may also result from nonmicrobial causes.

gastroenteritis An inflammation of the mucous membranes of both the stomach and intestine that may result in a relatively mild to severe illness with a wide range of symptoms, usually including vomiting, diarrhea, and fever. Symptoms are usually acute but may also be chronic. Most cases are caused by microbial agents, but chemicals can also be responsible. In reports of waterborne disease outbreaks, the designation "acute gastroenteritis of undetermined etiology" is used to describe cases of illness in outbreaks where no specific etiologic (causative) agent has been identified. In some instances no etiologic agent is identified even after exhaustive laboratory analysis, but this problem is usually because of limited laboratory analysis or a lack of appropriate or timely clinical specimens collected during the epidemiologic investigation. Although in many waterborne outbreaks the symptoms of acute gastroenteritis of undetermined etiology may suggest a viral etiology, the illness may also be of bacterial or protozoan etiology. Acute viral gastroenteritis presents as a sporadic or epidemic illness. Several enteropathogenic viruses (e.g., rotaviruses) affect primarily infants and young children, resulting in a diarrheal illness that may be severe enough to produce dehydration; other enteric viruses (e.g., Norwalk-like viruses) affect primarily older children and adults and cause self-limiting sporadic illness or outbreaks (i.e., illnesses for which recovery does not require treatment). Acute bacterial gastroenteritis is characterized by diarrhea and some times vomiting and may be mild to severe, resulting in dehydration and occasionally septicemia if high numbers of the causative agent or its toxins are in the circulating blood. *See also* acute gastroenteritis illness; diarrhea.

gastroenteritis, acute *See* acute gastroenteritis illness.

gastrointestinal absorption of toxicants The movement of chemicals from the lumenal to the serosal side of the gastrointestinal tract (the stomach and intestines). Such movement depends on the nature of the chemicals and the intrinsic structure of the membranes present in these tissues. Because they are epithelial tissues, cells in the gastrointestinal tract are joined by tight junctions. These junctions prevent chemicals from moving between cells, generally forcing them to pass through the cells that make up the barrier between the two sides of the gastrointestinal tract. Polar compounds of very low molecular weight (less than 100) pass freely through the cell membranes, as do nonpolar compounds of molecular weights as high as 1,000. This reflects the essentially lipid character of the cell membrane. Chemicals and toxicants can also move through the membrane by a variety of more specific mechanisms, however. For example, they may be substrates for various carrier molecules that are responsible for transporting nutrients across the membranes. Pinocytosis, an engulfment of a small bit of extracellular fluid followed by a pinching off of a segment of the membrane to the interior of the cell, is another mechanism that can account for absorption of higher-molecular-weight substances.

gastrointestinal excretion of toxicants The elimination of chemicals that are not absorbed by the body (e.g., many heavy metals)—as well as a number of chemicals secreted into the intestine by a variety of processes—through feces. A major means of such excretion for very polar compounds or compounds that have been bonded with polar substances (e.g., glutathione conjugates, glucuronides, sulfates, taurine, glycine) is by active transport into the bile. The bile is subsequently secreted into the intestine, and the chemical or its metabolite is eliminated with feces. Activities within the intestine can render these chemicals reabsorbable in the small intestine, however. *See also* enterohepatic circulation.

gas vent A passage to permit the escape of gases.

gate A movable, watertight barrier for the control of a liquid in a waterway.

gate chamber A structure erected to house a valve or regulating device and provide access to the valve for maintenance and repair. If the chamber has a superstructure, it is termed a gate house.

gate house A superstructure built at the headworks of a canal, conduit, dam, or powerhouse to house the gates. *See also* gate chamber.

gate lift A device for operating a gate, usually in a vertical direction.

gate stem The rod attached to a gate and by which the gate is opened or closed. The rod serves to lift the gate for opening or to push it down for closing.

gate-type hydrant A hydrant having one main valve consisting of a vertical disk that moves in a vertical plane across the valve seat and is held closed against pressure by a wedge nut.

gate valve A mechanical device used to turn on or shut off the flow of water in a distribution or piping

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system. It is operated by turning a stem that raises or lowers a disk. This disk covers the flow way, pressing against a seat when closed; it moves into a space above the flow way when open, providing an unrestricted flow.

gate vault *See* gate chamber.

gateway A means of allowing an interconnection between computer networks that have different communications protocols.

gauge (1) A device for indicating the magnitude or position of an element in specific units when such magnitude or position is subject to change. Examples of such elements are the elevation of a water surface, the velocity of flowing water, the pressure of water, the amount or intensity of precipitation, and the depth of snowfall. (2) The act or operation of registering or measuring the magnitude or position of something when these characteristics are subject to change. (3) The operation of determining the discharge in a waterway by using both discharge measurements and a record of stage.

gauge, pipe *See* pipe gauge.

gauge correlation A stage–discharge relation between the gauge height and discharge of a stream or conduit at a gauging station. This relation is shown on the rating curve or rating table for the station.

gauge datum The elevation corresponding to the zero value of a gauge above a certain datum.

gauge height The height of a water surface as measured on a gauge, the zero value of the gauge being referred to some datum. *See also* stage.

gauge pressure As measured by a gauge, the water pressure that is in excess of atmospheric pressure at the referenced elevation. Gauge pressure is not the total pressure. Total water pressure (absolute pressure) also includes the atmospheric pressure exerted on the water. Because atmospheric pressure is exerted everywhere, however (against the outside of the main as well as the inside, for example), it is generally not written into water system calculations. Gauge pressure is reported in pounds per square inch or kilopascals. *Contrast with* absolute pressure.

gauging The process of determining the quantity of water flowing per unit of time in a stream channel, conduit, or orifice at a given point by means of current meters, rod floats, weirs, Pitot tubes, or other measuring devices or methods. *See also* discharge measurement; stream gauging.

gauging station A location on a stream or conduit where measurements of discharge are customarily made. The location includes a stretch of channel through which the flow is uniform and a control downstream from this stretch. The station usually has a recording or other gauge for measuring the elevation of the water surface in the channel or conduit.

Gaussian distribution The so-called normal distribution. It is bounded by a curve (the normal curve) that has as its maximum the mean value of a series of quantitative observations. The true normal curve will show an equal distribution of values greater than and smaller than the mean value (i.e., the mean value will approximate the median), and the probability that a particular value will be observed decreases the further that value diverges from the mean value. Values that are equally distant from the mean value in the positive and negative directions have equivalent probabilities of being observed. This distribution is a very important concept in statistics. One must be careful to apply appropriate statistical analyses to data sets if the distribution of data is not normal. *See also* chi-square distribution; Gumbel distribution; log-normal distribution.

gauze filtration A historical method for the recovery of viruses from water.

gauze number The number of openings per inch in a wire mesh. This number is used in specifying well screens and filter screens. For example, a mesh with a gauze number of 60 has openings that are 0.010 inches (0.25 millimeters) wide and 0.010 inches (0.25 millimeters) tall, or 60 openings per inch.

gavage Administration of a material by stomach tube.

GB *See* sarin.

GBF–DIME file *See* geographic base file–dual independent map encoding file.

GC *See* gas chromatography.

GC–ECD *See* gas chromatography–electron capture detector.

GC–MS *See* gas chromatography–mass spectrometry.

GC/MS/MS *See* gas chromatography/mass spectrometry/mass spectrometry.

GD *See* soman.

GDFIA *See* gas diffusion flow injection analysis.

gear A machine part that has cut teeth with form, size, and spacing so they mesh with teeth of same form, size, and spacing of another part to transmit or receive force and motion.

gear box A machine of different-diameter gears that connects a prime mover drive shaft to a driven piece of equipment and reduces the revolutions per minute. It is also called a gear reducer.

gear pump A rotary displacement pump that uses meshing gears that rotate in a housing, trapping water between the gear teeth in an inlet area, carrying it around to the outlet side, and imparting pressure. The meshing gears prevent water from returning to the inlet area.

gear reducer *See* gear box.

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Geiger counter A device used to detect radiation by collecting and observing the pulse of ions created in an enclosed volume of gas by the passage of energetic ionizing particles or rays. It is used primarily for detecting and measuring beta and gamma radiation.

gel (1) A borehole lubricant used in drilling, similar to drilling mud. (2) A compound injected into aquifers to temporarily reduce the permeability in specific locations and thus direct flow in a desired direction. The technology is borrowed from the enhanced oil recovery industry and may have some value in controlling and recovering contaminated groundwater.

gelatinous Pertaining to suspended solids that are slimy, deformable, and capable of causing rapid filter plugging.

gel electrophoresis A method that separates macromolecules such as nucleic acids or proteins on the basis of size, electric charge, and other physical properties.

gel layer The accumulated retained molecules on an ultrafiltration membrane. The formation of this layer limits flow rate, and continued accumulation can lead to a point at which any increase in pressure of the water will have no beneficial effect. *See also* ultrafiltration.

gel permeation chromatography (GPC) A separation technique based on the molecular weight of the analytes relative to the pore size of a stationary-phase gel. Because smaller molecules can enter the pores more easily than larger molecules, smaller molecules are retained longer in the column. This technique has been used in applications such as sample preparation and the determination of molecular weight distributions. Various materials have been used as the gel, such as dextran, agarose, and divinylbenzene/styrene.

gel resin A gel-based form of ion-exchange resin. Its pores are on the molecular scale, so no true pores exist.

gel resistance The resistance produced against the permeation of the water caused by the accumulation of the retained molecules on an ultrafiltration membrane. *See also* ultrafiltration.

gel zeolite A synthetic sodium alumina silicate cation-exchange product that was very widely used in residential water softeners prior to the development of divinylbenzene/styrene cation resin. It is also called siliceous gel zeolite. *See also* zeolite.

gene The functional unit of inherited information, expressed as a single trait. Genes are located on the chromosomes; each gene is coded for by a specific sequence of nucleotides in the deoxyribonucleic acid of the organism.

gene locus The location of a gene on a particular chromosome.

gene-locus mutation Small alterations in a deoxyribonucleic acid (DNA) sequence. These mutations are created by the insertion of an inappropriate base in the newly synthesized or repaired strand of DNA (a base substitution mutation) or by small deletions or additions of bases. Gene-locus mutation is also referred to as point mutation. *See also* frame-shift mutation.

gene mapping A pictorial representation of the locations of various genes on a chromosome, as determined by laboratory techniques.

gene probe A piece of deoxyribonucleic acid that is specific to a target sequence and will bind to that target sequence. It can be labeled with enzymes for radioactive, colorimetric, or chemiluminescent detection.

general duty clause A contract provision that may be applied in order to cite a particular hazard when no standard applies. Its reference number in the Occupational Safety and Heath Administration regulations is CFR 29 1910.5(f).

general fund The primary fund (bank account) of a utility through which cash receipts and disbursements flow and in which the cash reserves of the utility reside. Although strict accounting rules are applied to the administration of funds, the general fund is generally unrestricted as to use, unlike special-purpose funds that can be used only for the purpose for which they were created (e.g., schools, streets, law enforcement).

generalized linear model A regression model used to predict the probable likelihood of occurrence, such as the overall number of positive coliform samples that could occur per year and per distribution system zones. The model has been applied to distribution networks in the United Kingdom.

generally regarded as safe (GRAS) A legal term defining a group of food additives with established use in the food industry under the Food, Drug, and Cosmetic Act. Some of these additives have been controversial because they have not been subjected to the formal safety testing required for new additives to food.

general obligation (GO) bond A debt obligation issued by a government entity such as a state or municipality and backed by a pledge of the entity's full faith and credit. *See also* bond.

general permit An authorization that is issued on a nationwide or regional basis by the US Department of the Army or the US Environmental Protection Agency's National Pollution Discharge Elimination System for one or more categories of activities when (1) those activities are substantially similar in nature and cause only minimal individual and cumulative environmental impacts; or (2) the general permit would result in avoiding unnecessary duplication of regulatory control exercised by another federal, state,

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or local agency provided that the environmental consequences of the action have been determined to be individually and cumulatively minimal.

general-user bank A mitigation bank that can be used (i.e., allow withdrawal of credits) by a variety of unrelated entities.

generator A piece of equipment used to transform rotary motion (e.g., the output of a diesel engine) into electric current.

gene splicing A process in the laboratory of cutting and inserting gene sequences along a chromosome.

genetic algorithm An optimization process used in hydraulic modeling to seek a range of potential solutions rather than just one. An initial set of solutions is populated, which then mate and mutate over many generations to breed improved solutions. Genetic algorithm optimization can assess many potential solutions quickly, greatly aiding the decision-making process for the modeler.

genetic-algorithm–based model (GA-based model) Model allowing only the fittest solution to survive and propagate in successive generations. These models generate solutions that undergo constant changes by means of genetic operation of reproduction, mutation, and crossover. The solutions are ranked according to their fitness with respect to the objective function in which the fit individuals are more likely to reproduce and propagate to the next generation. Based on the fitness value, individuals (parents) are selected for the reproduction of the next generation by exchanging genetic information to form children (crossover). The result is a new generation normally with better fitness. *See also* genetic algorithm optimization modeling.

genetic algorithm optimization modeling Technique using a genetic algorithm-based model to determine the optimum solution that can be used for planning water distribution systems. Numerous alternatives are evaluated by computer to find the optimum solution based on the principles of survival of the fittest. During the development of the optimum solution, these models avoid becoming trapped in a local optimum solution suggested by traditional optimization technique but instead locate the global optimum solution. In each successive iteration, the weakest is eliminated from the gene pool, and the unique processes of mutation conspire to keep the species as strong as possible. *See also* genetic-algorithm–based model.

genetic engineering The practice of modifying genomic deoxyribonucleic acid.

genetic fingerprinting A technique for determining the likelihood that genetic material came from a particular individual or group. *See* deoxyribonucleic acid fingerprinting.

genetic mapping The process of determining the relative positions of genes on chromosomes.

genetic material Some quantity of deoxyribonucleic acid, the heritable information of living plants and animals.

genetic probe *See* gene probe.

genetic toxicology The study of the interaction of chemical or physical agents with the processes of heredity. Agents that produce damage to genes are responsible for a variety of diseases that are inherited, as well as for inducing cancer by inducing damage in somatic cells (i.e., nongerm cells).

genome The total deoxyribonucleic acid of an organism.

genotoxic Having the ability to induce damage to deoxyribonucleic acid (DNA) that results in a mutation apparent when the DNA replicates and upon division of that cell. In general, this term applies to a variety of mechanisms that can give rise to point mutations, as well as agents that produce overtly observable chromosomal damage (i.e., calstogens). Technically speaking, *genotoxic* is an inaccurate term because the gene will survive. Damage to DNA can result in toxicity to the cell, but this type of activity is not specifically considered genotoxic. *See also* nongenotoxic.

genotoxic activity The activity of a chemical, physical, or biological agent if that agent or one of its metabolites is capable of producing mutations that are successfully passed on to daughter cells. Such activity is known to be involved in the induction of cancer, birth defects, and other toxicities (though chemicals can produce these same effects by other mechanisms, too). Mutation is considered an irreversible event, so a linear relationship with dose at low response rates is assumed. *See also* carcinogen; nongenotoxic.

genotoxic carcinogen A chemical that induces cancer (1) by direct interaction with deoxyribonucleic acid (DNA), (2) through metabolites that induce damage to DNA, or (3) by indirectly giving rise to products that can damage DNA (e.g., by increasing oxygen radicals or reactive products of lipid preoxidation within the cell). Such damage increases the probability that errors will be made in the replication of DNA, resulting in a mutation that causes a protein with abnormal functional or control characteristics to be synthesized.

genotoxic effect *See* genotoxic.

genotoxin Genetic material capable of altering deoxyribonucleic acid.

genotype (1) The entire genetic constitution of an individual. (2) An individual allele at a specific locus within an individual. *See also* phenotype.

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genotyping A suite of methods that analyzes the specific genetic makeup (or genome, composed of four nucleotides) of living organisms. Examples of genotyping methods include sequencing, plasmid profile analysis, ribotyping, and macrorestriction analysis by pulsed-field gel electrophoresis. *See also* genetic fingerprinting.

genus A group of closely related species. Members of the same genus often have a number of common characteristics by which one can clearly see that the members are related.

Geobacillus stearothermophilus (G. stearothermophilus) Formerly classified as *Bacillus stearothermophilus*, an aerobic, spore-forming, thermophilic bacillus that is prominent in the composting process. It is also frequently used in demonstrating adequate treatment with steam sterilization. *See also* spore strip.

geochemistry A science that deals with the chemical composition and chemical reactions of the substances that make up the crust and pore water of the earth and are contained in the pore water.

geocode A spatial index code (e.g., an address or parcel number) identifying unique points, lines, or areas that are stored in both graphic and nongraphic data. Geocodes are used extensively in geographic information system database management algorithms.

geodesy A branch of applied mathematics that determines by observation and measurement the shape and size of the earth or a large part of its surface, as well as the exact locations of points on its surface.

geodetic control A network of surveyed and monumented points on the earth's surface for which the locations are established in accordance with national accuracy standards.

geodetic head The static head or total head, without deduction for velocity head or losses.

geographically referenced data Data that contain some spatial reference that can be used to link graphic features and nongraphic attribute data in a geographic information system through geocodes.

geographic base file–dual independent map encoding file (GBF–DIME file) A geographic file based on line segments, produced by the US Bureau of the Census for each Standard Metropolitan Statistical Area in the United States. These files were the basis for developing the Census Bureau's Topologically Integrated Geographic Encoding and Referencing file for urban areas.

geographic data Information that can be related to a physical location, such as a building, land parcel, or natural feature. Geographic data generally consist of both the graphic feature that indicates the spatial location and the attributes of that feature. The attributes may exist in the same data set as the graphic entities, depending on the data structure used, and may also exist in external tables that can be related to the feature by a unique identifier, such as parcel number, address, or facility identification.

geographic information system (GIS) A system that stores and links nongraphic attributes and geographically referenced data with graphic map features to allow a wide range of information processing and display operations, as well as map production, analysis, and modeling.

geographic reference system An *XYZ* coordinate system that locates specific places on the earth's surface for use in specifying points on a map.

geohydrology The study of the flow of water through the earth without considering the effects of the geology.

geological log A detailed description of all underground features discovered during the drilling of a well (e.g., depth, thickness, type of formation).

geology A branch of science devoted to the study of the earth. It primarily deals with the study of rocks, minerals, and soils, but certain aspects of water chemistry and atmospheric behavior are also in its domain.

geometric isomers Compounds that have the same groups attached to each carbon atom in a carbon–carbon double bond but for which the spatial arrangement is altered. The two spatial arrangements represent two different structural isomers of the same molecular formula. *See also cis;* isomer; *trans.*

geometric mean The *n*th root of the product of *n* given numbers. (It can also be calculated by taking the antilog of the mean of the logarithms of the individual numbers.) For example, the geometric mean of 6, 8, and 10 (three numbers, so $n = 3$) is the cube (third) root of $6 \times 8 \times 10$, or the cube root of $480 = 7.83$.

geomorphology The study of the evolution of landforms, not including the major forms of the earth's surface such as ocean basins and mountain chains.

geophone Small, inexpensive instrument for measuring ground motion. There are many different varieties for different applications. They are designed for earthquakes, machine vibrations, oil exploration, underground leak detection, mining, and so forth.

geophysical log A record of the structure and composition of the earth encountered during drilling of a well or similar type of test hole or boring.

geophysical method Any of several indirect methods of determining the structure and composition of underground geological formations. Each method is based on using different types of scientific equipment and phenomena. The phenomena involved include the rate of travel of sound waves, electrical currents, and radio waves through the lithosphere, as well as variation in gravitational or magnetic force.

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geophysiographic region A subdivision of the earth's relief according to geological landform.

geoprocessing and network analysis system A computer system incorporating geographic identifiers, or geocodes, used primarily for geographic analysis. The most common application is the assignment of planning, census, or statistical area identifiers to data records containing addresses by using a geographic reference file such as a dual independent map encoding file. *See also* geocode.

geosmin ($C_{12}H_{22}O$) The common name for *trans*-1,10-dimethyl-*trans*-9-decalol, an earthy-smelling chemical produced by certain cyanobacteria and actinomycetes. This odorous compound can be perceived at low nanogram-per-liter concentrations. Geosmin removal at a treatment plant requires either ozone (O_3) oxidation or activated carbon adsorption. *See also* actinomycetes; cyanobacteria.

geospatial information technology (GIT) Conversion of geographic location (mapping) information into a digital database that is then used to store volumes of data tied to particular geographic locations. It is used extensively in water utilities to store information such as materials of construction, size, length, number of complaints, number of repairs, and other critical construction and operational information.

geothermal Having to do with the heat of the interior of the earth.

germanium internal reflection element (IRE) A device used in attenuated total reflectance–Fourier transform infrared spectroscopy (ATR–FTIR) to collect data about membranes and thin films. More specifically, a thin film or membrane is attached to an IRE, and infrared radiation is focused onto the end of the IRE. The radiation is internally reflected down the length of the IRE. At each reflection, some radiation penetrates into the sample, and a reflectance spectrum unique to the sample material can be obtained.

germ cell A cell that serves a sexual reproductive function. In humans these cells are sperm and eggs (ova). *See also* ova.

germicidal effect *See* germicidal treatment.

germicidal effectiveness The relative inactivation efficiency of a process or disinfectant. For the ultraviolet (UV) process, each UV wavelength in a polychromatic emission spectrum is determined. This value is usually approximated by the relative absorbance of deoxyribonucleic acid at each wavelength, although individual microorganisms may respond differently. By convention, germicidal effectiveness of the 254-nanometer emission line by low-pressure UV lamps is considered to be unity. The germicidal effectiveness is typically used to rate a polychromatic, medium-pressure UV lamp output to reflect the germicidal energy of that specific source. *See also* low-pressure ultraviolet lamp; medium-pressure ultraviolet lamp.

germicidal range The range of ultraviolet wavelengths responsible for microbial inactivation in water (200 to 300 nanometers).

germicidal treatment Any treatment that kills microorganisms.

germicidal ultraviolet (UV) An ultraviolet light that peaks at a 253.7-nanometer wavelength and is of a wavelength between 200 and 300 nanometers. This range is known as the germicidal or short-wave ultraviolet band.

germicide A substance formulated to kill pathogens or microorganisms or to inactivate viruses. The germicidal properties of chlorine make it an effective disinfectant. *See also* disinfectant.

gestation index In reproductive toxicology, the percentage of pregnancies that result in the birth of live young.

GFAA *See* graphite furnace atomic absorption.

GFAAS *See* graphite furnace atomic absorption spectrophotometry.

gfd (also, gsfd, gpd/ft^2) *See* gallons per day per square foot *in the Units of Measure section.*

G. ferruginea *See Gallionella ferruginea.*

GFF *See* glass fiber filter.

GFI *See* ground fault interrupter.

Ghyben–Herzberg lens A sea-fed body of saline groundwater depressed by an overlying body of rain-fed groundwater.

Ghyben–Herzberg principle An equation relating the depth of a saltwater interface in a coastal aquifer to the height of the freshwater table above sea level. In equation form

$$z = \left(\frac{\rho_w}{\rho_s - \rho_w}\right) h$$

Where:

z = the depth of the saltwater interface below sea level, in feet (meters)

h = the elevation of the freshwater table above sea level, in feet (meters)

ρ_w = the freshwater density, in pounds mass per cubic foot (kilograms per cubic meter)

ρ_s = the saltwater density, in pounds mass per cubic foot (kilograms per cubic meter)

Giardia The genus name for a group of single-celled, flagellated, pathogenic protozoans found in a variety of vertebrates, including mammals, birds, and reptiles. These organisms exist either as trophozoites or as cysts, depending on the stage of the life cycle. *See also* cyst; trophozoite.

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Giardia intestinalis (G. intestinalis) Protozoan parasite that produces gastrointestinal symptoms when ingested by humans. The organism may be present in contaminated food and water. This species is also referred to as *Giardia lamblia.* It causes diarrheal illness.

Giardia lamblia (G. lamblia) The species of *Giardia* that is a common cause of human diarrheal disease. It is also known as *Giardia intestinalis.*

Giardia muris (G. muris) The species of *Giardia* found in rodents.

giardiasis A protozoan infection, principally of the upper small intestine, caused by *Giardia.* The median incubation period is 7 to 10 days, and the infectious dose is low—10 cysts have caused infection. Although infected persons are usually asymptomatic, infection may be associated with a variety of intestinal symptoms, such as abdominal cramps, chronic diarrhea, frequent loose and greasy stools, bloating, flatulence, fatigue, and weight loss. Malabsorption of fats or fat-soluble vitamins may occur. Occurrence is worldwide, with children found to be more frequently infected than adults. Person-to-person transmission occurs by hand-to-mouth transfer of cysts from the feces of an infected person, especially in institutions and day-care centers. Outbreaks often occur from ingestion of cysts in fecally contaminated water, especially unfiltered surface water, and less frequently from contaminated food. Reservoirs of infection include humans and wild and domestic animals. *See also* cyst; *Giardia lamblia; Giardia intestinalis;* waterborne disease.

Gibbs free energy (*G*) A function of state used to determine the spontaneity of a process; also called Gibbs energy, Gibbs function, or free energy in some applications. *See also* free energy; standard free-energy change; state function.

giga (G) *See in the Units of Measure section.*

gigabyte *See in the Units of Measure section.*

gigaliter (GL) *See in the Units of Measure section.*

G. intestinalis *See Giardia intestinalis.*

Girard turbine An impulse turbine with buckets shaped so that, upon leaving the wheel, the water has a relative velocity in the direction opposite to that of the wheel's motion.

GIS *See* geographic information system.

GIT *See* geospatial information technology.

GL *See* gigaliter *in the Units of Measure section.*

glacial lake (1) A lake occurring in the bottom of a valley that was formed by glacial action. (2) A body of freshwater on the land surface impounded by a dam of glacial ice.

glacial outwash sediment Sand and gravel sedimentary deposits placed by melting glaciers and resulting glacial or glaciofluvial streams. Fluvial glacial streams typically meander, creating wide glacial outwash plains at the end of glacial advances.

glacial stream A stream supplied by melting glacier ice.

glacier An extensive, usually slowly flowing body of ice formed on land in a cold region where more snow falls than is melted. The snow is transformed into ice by pressure and, together with frozen liquid water, constitutes the body of the glacier.

glacier burst A sudden release of a volume of water that has been impounded by a glacier.

glacier snow The compacted mountain snow that is in the intermediate stage between ordinary snow and glacier ice.

glaciofluvial stream A stream having melting glacial ice as the source of its water and much of its load.

G. lamblia *See Giardia lamblia.*

gland (1) A mechanical device usually bolted to a pump casing to keep a mechanical seat or to adjust packing in a stuffing box between a pump shaft and pump casing, so as to reduce or control water leakage along the pump shaft. A small amount of leakage along a pump shaft through the packing is necessary for lubrication of the shaft. (2) A mechanical device to retain and compress packing around a valve stem to prevent flow between the valve stem and valve bonnet.

glanders An infectious and potentially lethal disease caused by the bacterium *Burkholderia mallei* seen mainly in horses, mules, and donkeys. It can result from contact with other animals such as goats, dogs, or cats. The disease is caused by eating contaminated food or water. Transmission can also occur through skin abrasions, mucous membranes, and inhalation. Although it has been eradicated from North America, *B. mallei* is a possible bioterrorism agent.

glass, pipe and fittings *See* pipe class.

glass-distilled water Water that has been freed from dissolved and suspended matter by distillation in an all-glass system.

glass fabric A bidirectional reinforcing material made by the weaving of glass-fiber yarn.

glass fiber filter (GFF) A filter made of uniform glass fibers with a pore diameter of 0.7 to 2.7 micrometers. Such filters are used to filter fine particles and algae while maintaining a high flow rate.

Glauber salt ($Na_2SO_4 \cdot 10H_2O$) An anhydrous sodium sulfate salt compound.

glauconite ($K_{15}(Fe, Mg, Al)_{4-6}(Si, Al)_3O_{20}(OH)_4$ approx.) A natural dull-green iron potassium silicate mineral occurring abundantly in greensand. *See also* greensand.

gleyed Pertaining to a soil condition resulting from gleization (the weathering process that produces a

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gleisoil horizon) that is manifested by the presence of neutral gray, bluish, or greenish colors through the soil matrix or in mottles (spots or streaks) among other colors. Reduced iron is often involved.

global adjustments Systemwide adjustments made to a particular parameter. An example is applying a systemwide percentage change in water consumption (in a computer simulation model) to simulate a uniform change in demand.

global positioning system (GPS) A constellation of satellites originally developed by the US Department of Defense as a navigational aid that is now widely used for geodetic control surveying and personal navigation. The satellites transmit signals that are decoded by specially designed receivers to determine positions precisely (within centimeters). These measurements are made at a fraction of the cost of traditional first-order surveying techniques.

global water marketplace International competition among corporations for contracts to construct, operate, manage, and maintain government or privately owned water and wastewater plants throughout the world.

Global Water Partnership (GWP) A cooperative agreement between the US Environmental Protection Agency and the Global Water Research Coalition to collaborate and jointly fund research with water research organizations around the world.

Global Water Research Coalition (GWRC) A nonprofit organization formed by 12 world leading research organizations to serve as the collaborative mechanism for water research. The GWRC offers its members water research information and knowledge. It does not compete with the member organizations, but each member organization focuses on national and regional water research issues. The coalition focuses on water supply and wastewater issues and renewable water resources: the urban water cycle. The founding members of the GWRC are the Water Research Foundation (formerly Awwa Research Foundation), the Water Environment Research Foundation, and the WateReuse Foundation (United States); the Water Services Association of Australia and CRC for Water Quality and Treatment (Australia); Kiwa and Stowa-Foundation for Applied Water Research (Netherlands); Ondeo-CIRSEE and Anjou Recherche-Vivendi (France); TZW Water Technology Center (Germany); UK Water Industry Research (United Kingdom); and the Water Research Commission (South Africa).

globe valve A valve that has a round opening to let liquid pass and that closes when a stem is turned to press a disk against the round opening. Globe valves are used in plumbing where numerous openings and closings are anticipated.

globulin A plasma protein characterized by being "insoluble" in water but "soluble" in saline. This property results because salt, which is necessary to act as a counterion to charged groups on the protein, prevents ionic bonds from forming between molecules of the globulins; these bonds ordinarily cause the molecules to aggregate and precipitate. Note that the use of the term *soluble* is not precisely correct for proteins of this size; these proteins actually form a really fine suspension that is maintained by Brownian motion.

glomerulonephritis A variety of inflammatory processes that involve the capillary loops of the glomeruli in the kidney. The glomerulus is the structure within the kidney in which an ultrafiltrate of blood is formed that is eventually made into urine after the body reabsorbs a large fraction of the water and most nutrients. The inflammation is produced with chronic metal poisoning—mercury in particular but cadmium and lead as well. It tends to be an autoimmune response rather than a direct effect of these chemicals.

glory-hole spillway A vertical shaft having a funnel-shaped entrance and ending in an outlet tunnel, used to provide an overflow from a reservoir. It is also called a morning-glory spillway or shaft spillway.

glucuronic acid ($COOH(CHOH)_4CHO$) The acidic derivative of glucose (i.e., the aldehyde group has been oxidized to a carboxylic acid).

β-glucuronidase An enzyme that is capable of hydrolyzing the glycosidic linkage between glucuronic acid and a chemical possessing a hydroxyl group. It occurs in a variety of tissues (e.g., spleen, liver, and endocrine glands) but is also secreted by a number of bacteria found in the colon. The bacterial enzyme can hydrolyze off the glucuronide bonded to a drug, making it available for reabsorption. *See also* enterohepatic circulation.

β-D-glucuronidase (GUD) An enzyme that catalyzes the hydrolysis of β-D-glucopyranosiduronic derivatives into their corresponding aglycons and D-glucuronic acid. The presence of this enzyme in most *Escherichia coli* isolates and some *Shigella* and *Salmonella* strains allows for a useful and specific test for these organisms.

glucuronide A glycosidic complex of glucuronic acid with any chemical.

β-D-glucuronide A glycoside derived from glucuronic acid that is a substrate for the enzyme β-D-glucuronidase, an enzyme produced by 94 percent to 96 percent of *Escherichia coli* isolates tested.

glucuronyltransferase Any of a group of enzymes that are responsible for transferring glucuronic acid from uridine-5'-diphospho-D-glucuronic acid to form

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a glycosidic linkage with metabolites of foreign chemicals or biochemicals.

γ-glutamyltranspeptidase An enzyme that hydrolyzes the glutamic acid group from glutathione conjugates of various chemicals. It is a membrane-bound enzyme found in high concentrations in cells that exhibit absorptive or excretory functions (e.g., the bile ducts in the liver). This enzyme is also used as a marker for preneoplastic lesions in the livers of rats. Normal rat hepatocytes (parenchymal cells of the liver) do not express significant amounts of this enzyme. Hepatocytes that have been altered by treatment with genotoxic carcinogens will express much higher concentrations of this enzyme, allowing them to be detected with appropriate histochemical staining.

glutaraldehyde ($OHC(CH_2)_3CHO$) A chemical biocide used to sterilize high-purity water systems. For some types of reverse osmosis membrane systems, it may be used periodically at dilute concentrations to sterilize membranes and piping and as a membrane element storage (preservative) solution.

glutathione ($C_{10}H_{17}O_6N_3S$) A tripeptide of glycine, glutamic acid, and cysteine that has diverse roles in protecting cells from damage. Glutathione is frequently bonded with the metabolites of toxic chemicals. This most frequently results in inactivation of the chemical, but in special cases metabolites that are toxic, carcinogenic, or both (e.g., 1,2-dichloroethane) can be formed by conjugation with glutathione. The sulfur group of glutathione is used as an antioxidant for the cell because it easily forms disulfide bonds with itself or other thiol-containing biochemicals in the body. Processes exist to reduce these disulfide bonds by the reduced form of nicotinamide-adenine dinucleatide phosphate within the cell.

glutathione peroxidase An enzyme that uses glutathione to inactivate peroxides.

glutathione reductase An enzyme that regenerates glutathione that has been directly oxidized or oxidized by glutathione peroxidase.

glutathione-S-transferase Any of a group of enzymes that transfer glutathione to reactive metabolites of chemicals. This generally results in the detoxification of the chemical.

glycocalyx The extracellular slime that surrounds bacteria found in the biofilms that form on solid surfaces in contact with water. Such slimes consist of materials created by the bacteria and extruded from the cells. These materials are exopolymers that are primarily polysaccharide in nature. *See also* extracellular polymeric substance.

glycogen ($(C_6H_{10}O_5)_n$) A polymer of glucose that serves as a reserve for replenishing cellular and circulating levels of glucose. The levels and mobilization of glycogen in cells are intimately related and coordinated with other cellular functions through signaling pathways. Some of these pathways are responsive to insulin and a variety of autocrine (within the cell) and paracrine (affecting neighboring cells) factors. Human genetic diseases linked with the accumulation of glycogen are associated with an early induction of liver tumors.

glyoxal (OHCCHO) A dialdehyde created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. Glyoxal is often the second most prevalent aldehyde produced (after formaldehyde) during the ozonation of drinking water. Glyoxal is not as biodegradable as formaldehyde, but it can readily be removed on a biologically active carbon filter. *See also* biologically enhanced activated carbon; dialdehyde; formaldehyde.

glyoxylic acid (OHCOOH) An aldoacid created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. Glyoxylic acid can be removed during biological filtration. *See also* aldoacid; biological filtration.

glyphosate ($HO–CO–CH_2–NH–CH_2–PO–(OH)_2$) The common name for the isopropylamine salt of N-(phosphonomethyl)glycine. Glyphosate is a nonselective, postemergence herbicide. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.7 milligrams per liter. *See also* herbicide.

GMP *See* guaranteed maximum price.

G. muris *See Giardia muris.*

GN broth A broth used as a selective medium for cultivation of gram-negative (GN) bacteria.

gnotobiotic Pertaining to an animal that has been raised in germ-free (bacteria-free) conditions. Because these animals have no resident microflora, they are usually more susceptible to infection than are normal animals.

goat serum Substance used in microbiologic method to block nonspecific antibody binding.

GO bond *See* general obligation bond.

go-devil A scraper with self-adjusting spring blades inserted in a pipeline and carried forward by the fluid pressure to clear away accumulations, tuberculations, and similar coverings. *See also* polypig; scraper; swab.

goethite (α-FeOOH) A common corrosion by-product of iron-based distribution systems. It occurs in corrosion tubercles, hydrant flushes, and filter backwashes and varies from ocherous to reddish brown in color.

golden mussel *See Limnoperna fortunei.*

gonadal function The capacity of the gonads to produce gametes (i.e., sperm and ova) and to maintain a variety of secondary sexual characteristics (e.g., beards in men, enlarged breasts in females). Gonadal function refers primarily to the production of

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gametes, but altered function will also have impacts on secondary sexual characteristics.

Gooch crucible *See* filtering crucible.

goodness of fit The degree to which observed or experimental data correspond to an assumed mathematical model to describe the data set. Goodness of fit is indicated by the magnitude of the coefficient of determination. *See also* coefficient of determination.

Goodpasture's disease An inflammation of the glomerular capillaries of the kidney that is associated with the production of antibodies to proteins in the basement membrane (i.e., the membrane to which cells attach in the formation of an organ). The syndrome has been associated with excessive exposure to solvents, but the causal pathway has not been worked out in detail.

gooseneck A sweeping bend in a service line resembling the shape of a goose's neck that will allow soil movement without damaging the service line.

gopher A pneumatic or hydraulic self-propelled tool that can force its way through soil, avoiding disturbing the ground surface, to create a hole for installation of a small water line or service line.

gorge A narrow passage often formed by a river cutting through the wall of a canyon—especially one with steep, rocky walls—or through soft rock between mountains.

Gouy–Chapman theory *See* zeta potential.

Government Accountability Office (GAO) *See* US Government Accountability Office.

Governmental Accounting Standards Board (GASB) An independent, nongovernmental organization that establishes financial accounting and reporting standards for state and local governmental entities, which use these standards to guide the preparation of their external financial reports. Organized in 1984 by the Financial Accounting Foundation, the GASB is a sister organization to the Financial Accounting Standards Board (FASB), which establishes standards for private businesses. The Financial Accounting Foundation selects the members of the GASB and its Advisory Council, funds their activities, and exercises general oversight (except for the GASB's resolution of technical issues). External financial reporting following GASB standards demonstrates financial accountability to the public and is the basis for investment, credit, and many legislative and regulatory decisions. Auditors use GASB standards to determine whether a government follows generally accepted accounting principles (GAAP).

government-owned water utility A water utility created by the state or other government agency's legislative action, with the mandate that the utility's purposes are public purposes and that its functions are essential governmental proprietary functions. Its primary purpose is to provide its designated area with potable water in an adequate supply and at a reasonable cost so that people of the area may improve their health, safety, and welfare. A government-owned water utility may be part of a municipal government operation, a county agency, or a regional authority, or it may take some other form appropriate for the service area.

Government Printing Office (GPO) An agency of the US government established by the US Congress to execute orders for printing and binding placed by Congress and by departments and establishments of the federal government. It prepares catalogs and distributes and sells government publications through mail orders and government bookstores.

GPC *See* gel permeation chromatography.

gpcd *See* gallons per capita per day *in the Units of Measure section.*

gpd *See* gallons per day *in the Units of Measure section.*

gpd/ft^2 (also gfd, gsfd) *See* gallons per day per square foot *in the Units of Measure section.*

gpf (also gal/flush) *See* gallons per flush *in the Units of Measure section.*

gpg *See* grains per gallon *in the Units of Measure section.*

gph *See* gallons per hour *in the Units of Measure section.*

gpm *See* gallons per minute *in the Units of Measure section.*

gpm/ft^2 *See* gallons per minute per square foot *in the Units of Measure section.*

GPO *See* Government Printing Office.

GPS *See* global positioning system.

gps *See* gallons per second *in the Units of Measure section.*

gpy *See* gallons per year *in the Units of Measure section.*

gr *See* grain *in the Units of Measure section.*

grab sample A discrete sample taken under specific circumstances at a given time and location. A grab sample is easier to take than a composite sample, but it allows only a "snapshot" of the water quality at the time the sample was taken. A grab sample is most representative when the water quality is fairly constant. Many of the methods for the compliance monitoring of drinking water require that grab samples be taken.

grad *See in the Units of Measure section.*

gradation (1) The geologic process, including aggradation and degradation, of bringing the surface of the earth, or any portion thereof, to a common level or uniform slope. (2) The process of bringing the bed of a stream to a gradient (sharper or gentler) at which the water flowing in it is just able to transport the material delivered to it.

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grade (1) The elevation of the invert (or bottom) of a pipeline, canal, culvert, or similar conduit. (2) The inclination or slope of a pipeline, conduit, stream channel, or natural ground surface, usually expressed in terms of the ratio or percentage of number of units of vertical rise or fall per unit of horizontal distance. For example, a 0.5 percent grade would be a drop of 0.5 feet per 100 feet of pipe.

grade D air The type of air used in self-contained breathing apparatuses. It is also known as respirator air. The Compressed Gas Association sets standards for air grades A–J. Grade A is the ambient surrounding air, and Grade J is for very deep sea diving. Grade D air meets the following limits: hydrocarbons, 5 milligrams per cubic meter; carbon monoxide (CO), 20 parts per million; carbon dioxide (CO_2), 1,000 parts per million; oxygen (O_2), 19.5–23.5 percent; water vapor, none; no noticeable odors. *See also* self-contained breathing apparatus.

graded response An individual response to chemical exposure that increases in intensity as the dose is increased. (This is in contrast to responses that are considered stochastic or all-or-none.) For example, an individual who was exposed to a renal toxin would experience increasing damage as the dose of the toxin increased. On the other hand, a lethal dose–response curve describes the sensitivity of a population of individuals with varying sensitivity to the chemical.

graded stream A stream in which the channel has reached a stable form as a result of the stream's flow characteristics.

grade tunnel A waterway tunnel constructed with the elevation of the top above the hydraulic gradient.

gradient The rate of change of any characteristic per unit of length, i.e., the slope. The term is usually applied to such characteristics as elevation, velocity, and pressure. *See also* slope; velocity gradient.

gradient ion chromatography A technique in which the eluant strength is increased during the separation of analytes on an ion-exchange column. This is accomplished by mixing two or more elution solvents during the analytical run. A gradient approach typically reduces the analysis time compared to an isocratic approach, in which the elution solution is constant during analyte separation.

grading (1) The design of landscape contours to accommodate a site's uses and provide adequate storm drainage. (2) The process of constructing desired landscape gradients.

grading plan A plan drawn to scale that expresses the designed landscape gradient and elevation by showing contour lines or numeric notation of elevations.

gradual contraction A reduction in the cross-sectional area of a stream, channel, conduit, or other hydraulic structure that occurs over a considerable distance relative to the dimensions of the channel or conduit, such as depth or diameter.

graduated cylinder A tall, cylindrical, glass or plastic container with a hexagonal base and a pouring lip. It is used for measuring liquids quickly without great accuracy. Graduations are marked on the side.

grain (gr) *See in the Units of Measure section.*

grains per gallon (gpg) *See in the Units of Measure section.*

gram (g) *See in the Units of Measure section.*

gram-milliequivalent The equivalent weight (in grams) divided by 1,000.

gram-mole *See* gram molecular weight *in the Units of Measure section.*

gram-molecular weight *See* gram molecular weight *in the Units of Measure section.*

gram-negative In the Gram's stain method, classification for bacteria that lose the stain or become decolorized by alcohol. This is a primary identifying characteristic of certain microorganisms. *Contrast with* gram-positive. *See also* Gram's stain.

gram-negative broth *See* GN broth.

gram-positive In the Gram's stain method, classification for bacteria that are stained dark blue or violet. This is a primary identifying characteristic of certain microorganisms. *Contrast with* gram-negative. *See also* Gram's stain.

Gram's stain A common staining procedure used to differentiate bacteria into gram-negative and gram-positive categories. *See also* coliform bacteria.

grandparenting (1) In the context of operator certification, refers to the practice of exempting existing operators from certain initial certification requirements, such as having to have a high school education or equivalent and passing an exam. Grandparenting may be necessary to allow the many competent operators who have been successfully operating treatment facilities and/or distribution systems but who may not meet the initial requirements of certification to become certified. (2) In the context of drinking water compliance monitoring, refers to allowing a water utility to submit data collected for a period prior to the required compliance monitoring period, as long as the grandparented data met compliance monitoring requirements for data collection and data quality.

granular activated carbon (GAC) A form of particulate carbon manufactured with increased surface area per unit mass to enhance the adsorption of soluble contaminants. Granular activated carbon is used in fixed-bed contactors in water treatment and is removed and regenerated (reactivated) when the adsorption capacity is exhausted. In some applications, granular activated carbon can be used to

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support a biological population for stabilizing biodegradable organic material. *See also* biologically enhanced activated carbon; fixed-bed column; granular activated carbon capped filter; granular activated carbon–sand filter; powdered activated carbon.

granular activated carbon (GAC) capped filter A filter containing at least two different types of filtering media in which the top layer is granular activated carbon. The granular activated carbon provides some particle removal, but its primary purpose is to adsorb organic materials, including many taste-and-odor-causing compounds. These filters can also stabilize biodegradable organic materials if microorganisms are permitted to grow on the surface of the granular activated carbon. *See also* biologically enhanced activated carbon; granular activated carbon–sand filter; powdered activated carbon.

granular activated carbon (GAC) contactor A treatment unit process to remove organic material from water that contains only granular activated carbon and a support system. Contrast to a granular activated carbon capped filter or a granular activated carbon–sand filter. *See also* granular activated carbon capped filter; granular activated carbon–sand filter.

granular activated carbon (GAC) macropore Pores within an activated carbon grain that are more than 500 nanometers in width.

granular activated carbon (GAC) mesopore Pores within an activated carbon grain that are between 2 and 500 nanometers in width.

granular activated carbon (GAC) micropore Pores within an activated carbon grain that are less than 2 nanometers in width.

granular activated carbon (GAC) sandwich filter A modification of a slow sand filter for which a layer of granular activated carbon is sandwiched between two layers of sand in order to add an adsorptive removal capacity to the process of slow sand filtration and to further enhance the biological purification process. The operation and maintenance of a GAC sandwich filter should be identical with a conventional slow sand filter because the subsurface layer of GAC does not interfere with the normal sand cleaning operations. The upper sand layer acts as a normal slow sand filter, purifying the water by the combined processes of microstraining, settling, and biological degradation of dissolved and particulate organic matter. The GAC layer removes nonbiodegradable dissolved organics (such as pesticides, color, taste-and-odor-causing compounds, and precursors of disinfection by-products) and further enhances the biological decomposition of the natural organic matter. The bottom sand layer resumes the typical slow sand filter functions of ensuring the microbiological stability of the water and the high quality of the filtrate. The GAC sandwich technology comprises techniques of installing, removing, separating, and reprocessing the media; it was developed and patented by Thames Water Utilities.

granular activated carbon (GAC) transition pore *See* granular activated carbon (GAC) mesopore.

granular activated carbon–sand (GAC–sand) filter A dual-media filter in which the top layer is granular activated carbon and the bottom layer is sand. In retrofit applications, the granular activated carbon often replaces an anthracite layer to improve the adsorption of organic material, to stabilize biodegradable material when biologically active, or both. In most cases, the depth of the granular activated carbon is greater than in a granular activated carbon capped filter. *See also* granular activated carbon capped filter.

granular ferric hydroxide A granular material of pure ferric hydroxide that has high adsorption capacity for phosphate and arsenic.

granular media A material used for filtering water, consisting of grains of sand or other granular material.

granular soil A soil that looks and feels dry and breaks up into clumps with moderate pressure.

granulomatous amoebic encephalitis (GAE) A meningoencephalitis caused by freshwater amoebas. The causative organism is an *Acanthamoeba* spp. It may occur as a subacute or chronic disease with focal granulomatous lesions in the brain. The skin or lungs are primary sites of invasion.

graphic Pertaining to digital descriptions of map features and logical geographic relationships among features, drawings, and images in a geographic information system. Graphic features or geometric forms are described by seven elements: points, lines, areas, grid cells, pixels, symbols, and annotation. A geographic information system uses graphic data to generate a map or cartographic "picture" on a display device (computer screen), paper, or other medium.

graphical user interface (GUI) A user interface to an application or database that provides a set of menus using combinations of icons, buttons, dialog areas, and scroll bars. The user needs little understanding of the operating system, software commands, or data structure in order to use the interface. The objective of the GUI is to replace commands with an intuitive pictorial interface.

graphics Combinations of individual graphic features, generally referring to the contents of a file or database of graphic elements as opposed to tabular data. *See also* graphic.

graphite furnace *See* graphite furnace atomic absorption spectrophotometry.

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graphite furnace atomic absorption (GFAA) *See* graphite furnace atomic absorption spectrophotometry.

graphite furnace atomic absorption spectrophotometry (GFAAS) An electrothermal instrumental technique used for the analysis of metals. The sample is atomized in a graphite tube after the temperature is raised quickly. This approach is typically used for microgram-per-liter concentrations. Drinking water samples require a small volume of sample, typically 5–50 microliters, and minimal sample preparation. The spectrophotometer used is composed of a power supply, an atomizer, and a temperature programmer. A small aliquot of the sample is injected into a graphite tube. The temperature of the graphite tube is raised rapidly to atomize the metal in the path of the light source.

graphitization A solid-state transformation of nongraphitic carbon into graphite by means of heat treatment. In iron or steel pipe, graphitization refers to a thermodynamic transformation of the microstructure of the metal in which cementite or nodular carbon is transformed into graphite flakes.

grapple dredge A floating derrick with a clamshell, orange peel, or other type of grab bucket used for removing material below water in very deep water or in confined places.

GRAS *See* generally regarded as safe.

grass buffer strip Strategically placed buffer strips in the agricultural landscape that can effectively mitigate the movement of sediment, nutrients, and pesticides within and from farm fields. *See also* buffer strip.

grassed waterway A vegetated natural waterway used to conduct the accumulated runoff from cultivated land or fields in a strip-crop system.

grating A screen consisting of two sets of parallel bars transverse to each other in the same plane.

gravel Rock fragments 0.08–3 inches (2–75 millimeters) in diameter.

gravel bed *See* gravel support bed.

gravel pack Gravel surrounding a well intake screen, artificially placed ("packed") to aid the screen in filtering sand out of the aquifer. Gravel packs are usually needed in aquifers containing large proportions of fine-grained material.

gravel support bed A combination of various layers of different-sized gravel and coarse sand placed above the underdrain network to support filter or ion-exchange media beds. The gravel support bed contributes greatly to the collection of product water and the even dispersal of backwash water flow. *See also* backwash.

gravel-wall well A type of well used in a water-bearing formation containing a large proportion of fine-grained material to permit the passage of water at low velocity. Gravel is introduced around the screen or intake section of the well to increase the specific capacity and to prevent extremely fine material from flowing into the well. Depending on the level of construction detail, such a well may be called a gravel well, gravel-envelope well, gravel-filled well, or gravel-packed well.

gravimetric Of or pertaining to measurement by weight.

gravimetric analysis The process of taking measurements based on the weight of a substance. For example, in the determination of total solids in water, a known volume of water is evaporated to dryness; the weight of the residue is then weighed and expressed in milligrams per liter.

gravimetric dry feeder *See* gravimetric feeder.

gravimetric feeder A chemical feeder that adds specific weights of dry chemical.

gravimetric measurement Measurement on the basis of weight.

gravimetric procedure Any analytical procedure that uses the weight of a constituent to determine the constituent's concentration.

gravitational convection *See* free convection.

gravitational potential *See* gravity potential.

gravitational water Water that moves under the force of gravity.

gravity The force of attraction by which terrestrial bodies tend to fall toward the center of the earth.

gravity distribution A water supply that uses natural flow from a mountain reservoir or elevated tank to supply pressure.

gravity drainage The downward movement of water in the vadose zone caused by gravity.

gravity feed A system or device designed to move fuel, water, and materials from one point to another by force of gravity.

gravity filter A rapid granular filter of the open type for which the operating level is placed near the hydraulic grade line of the influent and through which the water flows by gravity.

gravity-flush toilet A toilet with a rubber stopper (flapper valve) that releases water from the toilet tank, after which gravity forces the contents of the toilet bowl through a trapway for discharge into the wastewater system.

gravity potential A potential resulting from the position of groundwater or soil moisture above a datum.

gravity spring A spring in which water flows from permeable material or from openings in a rock formation entirely under the action of gravity.

gravity system (1) A system of conduits (open or closed) in which the liquid runs on descending gradients from source to outlet and for which no pumping

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is required. (2) A water distribution system in which no pumping is required.

gravity thickener A device used for removing solids from water by settling and removal. Gravity thickeners are typically circular sedimentation basins that may use rotating arms to assist in the thickening process, depending on the sludge concentration.

gravity thickening A method for reducing the water content of a sludge by settling.

gravity water A supply of water that is transported from its source to its place of use by means of gravity, as distinguished from a supply that is pumped. *See also* free water.

gravity water supply A potable water supply available to consumers without pumping.

gravity wave A displacement or wave that forms and propagates at the free surface of a body of fluid after that surface has been disturbed and the fluid particles have been displaced from their original positions. Such waves form because of the role played by the restoring force of gravity.

gray (Gy) *See in the Units of Measure section.*

gray iron *See* cast iron.

graywater Untreated household used water—such as wash or rinse water from a sink, bathtub, or other household plumbing fixture, except a toilet—that does not contain human wastes.

grease An aggregate group of substances that can analytically be measured—along with oil—by extraction with trichlorotrifluoroethane. (The result of this extraction is called oil and grease.) Grease includes rendered animal fat, oily matter, and thick lubricants. *See also* oil.

green building (1) The design and construction of buildings that significantly reduce or eliminate adverse impacts on the environment. (2) The conservation of materials and resources in building construction and operation, including that for water, energy, and indoor environmental quality. (3) Conservation of materials and resources, including the use of rainwater harvesting systems, renewable energy, and recycled or reused construction materials. It is often referred to as "sustainable design."

greenfield plant A new water treatment plant, constructed on a site that was previously undeveloped.

greenhouse effect Warming of the earth's surface resulting from the capacity of the atmosphere to transmit short-wave energy (visible and ultraviolet light) to the earth's surface and to absorb and retain heat radiating from the surface.

greenhouse gas A gas, such as water vapor, carbon dioxide, tropospheric ozone, methane, or low-level ozone, that contributes to the greenhouse effect.

green industry (1) The trades, professions, and disciplines related to landscape and irrigation research, design, installation, and management. (2) The renewables industry.

green rust Any of the solids in a class of mixed valence iron (II) and iron (III) [Fe(II)–Fe(III)] hydroxides that consist of alternating positively charged trioctahedral metal hydroxide layers and negatively charged interlayers of anions such as carbonate (CO_3^{2-}), sulfate (SO_4^{2-}), or chloride (Cl^-). Green rust is formed readily when iron corrodes in the presence of oxygen or when ferric oxyhydroxides (such as ferrihydride or lepidocrocite) are dissolved under reducing conditions in contact with dissolved ferrous iron species at near-neutral pH. Green rust solids have been reported as a corrosion product of cast-iron water pipes and may be an important intermediate phase in oxidation–reduction processes.

greensand (1) A naturally occurring mineral that consists largely of dark greenish grains of glauconite and possesses ion-exchange properties. Greensand was the original product used in commercial and home cation-exchange water-softening units and was the base product for manufacturing manganese greensand zeolite products. (2) A filter that adsorbs soluble iron and manganese through the use of a sand medium coated with manganese dioxide (MnO_2). When chlorine (Cl_2) or potassium permanganate ($KMnO_4$) is added to the influent, the adsorbed iron and manganese are oxidized, thus "regenerating" the greensand filter.

green vitriol ($FeSO_4$) A common name for ferrous sulfate (copperas).

greywater *See* graywater.

gridiron layout *See* gridiron system; grid system.

gridiron system A system of distribution pipes in which, if one path is disturbed, alternative paths exist through which water can flow. *See also* grid system.

grid system A distribution system layout in which all ends of the mains are connected to eliminate dead ends. *See also* gridiron system.

grit Sand-like particles mixed with debris and mud.

groin A wall, crib, row of piles, stone jetty, or other barrier projecting outward from the shore or bank into a stream or other body of water for such purposes as protecting the shore or bank from erosion, arresting sand movement along the shore, or concentrating the low flow of a stream into a smaller channel. A groin is also called a wing, dam, jetty, or spur. *See also* bulkhead.

gross alpha (α) particle activity The total radioactivity caused by alpha particle emission, excluding radon and uranium, as inferred from measurements on a dry sample. Its presence in drinking water is regulated by

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the US Environmental Protection Agency at a maximum contaminant level of 15 picocuries per liter.

gross alpha radiation *See* gross alpha particle activity.

gross available head (1) The total difference in elevation between the water surface at the point on a stream where water is diverted from the stream and the water surface at the point where the water is returned to the stream. (2) The amount of fall in a stream that is available for hydroelectric power development. Gross available head is also called gross head.

gross beta (β) particle activity The total radioactivity caused by beta particle emission as inferred from measurements on a dry sample. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 4 millirems per year combined with photon emitters.

gross beta (β) radiation *See* gross beta particle activity.

gross duty of water The water requirement or duty measured at the point of diversion. It includes all water uses as well as all canal or conduit losses, seepage losses, evaporation and transpiration losses in the system, and all waste. It is also called the diversion duty of water or head-gate duty of water.

gross receipts tax Payments made to a government entity based on the gross revenues received by a water utility from its revenues, without regard to the cost of producing that revenue. It is based entirely on the amount received from customers.

ground An electrical connection to the earth or to a large conductor that is known to be at the same potential as the earth.

ground, electrical *See* electrical ground.

ground air The gases in the interstices of the aeration zone that open directly or indirectly to the surface and therefore "communicate" with the atmosphere. Ground air is also called soft air or subsurface air.

ground cover All plants except trees and grass (e.g., herbs, moss, and small shrubs) covering the soil, protecting it from temperature and humidity variations and from erosion.

ground fault circuit breaker
See ground fault interrupter.

ground fault interrupter (GFI) A device that detects voltage leakage on an electrical line and discontinues voltage to prevent the user from receiving an electrical shock. Each outlet protected by a ground fault interrupter should be marked.

grounding An electrical wiring practice that protects people and equipment from electrical voltage and sends the charge to the ground.

ground key valve A valve that can be closed or opened to full flow in a turn of the plug. Such a valve is generally used on water service pipes.

ground-level storage In any distribution system, storage of water in a shallow tank for which the bottom is below or at the surface of the ground. Booster pumps are ordinarily required to raise water from ground-level storage.

ground-penetrating radar A surface geophysical measurement device that operates based on the transmission of repeated pulses of electromagnetic waves into the ground. Some of the radiated energy is reflected back to the surface, and the reflected signal is captured and processed.

ground sills Underwater walls built at intervals across the bed of a channel in order to prevent excessive scour of the bed or to increase the width of the water surface.

ground storage A reservoir or tank for storage of water at or below ground level. It allows larger volumes of water to be stored relative to elevated storage, but generally ground storage water must be pumped to provide pressure unless the ground is higher than the pressure plane being served.

ground–voltage gradient A record of the voltage differences between each two points in a series of locations along the ground surface.

groundwater The water contained in interconnected pores located (1) below the water table in an unconfined aquifer or (2) in a confined aquifer.

groundwater, confined *See* confined groundwater.

groundwater, perched *See* perched groundwater.

groundwater, unconfined *See* unconfined groundwater.

groundwater aquifer *See* aquifer.

groundwater artery A body of permeable material encased in a matrix of less permeable or impermeable material and saturated with water that is under pressure (usually artesian).

groundwater basin A groundwater reservoir that is separate from neighboring groundwater reservoirs. A groundwater basin could be separated from adjacent basins by geologic boundaries or by hydrologic boundaries.

groundwater cascade The descent path of groundwater on a steep hydraulic gradient to a lower and flatter water table slope. A cascade occurs below a groundwater barrier or dam and at the point of contact between less permeable material and more permeable material downslope.

groundwater classification A scheme to categorize groundwater according to its quality.

groundwater dam A geologic formation that is impermeable or has a low permeability and that occurs in such a position that it impedes the horizontal movement of groundwater and consequently causes a pronounced difference in the levels of the water table on opposite sides.

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groundwater decrement All groundwater extracted from the groundwater reservoir beneath a given surface area by evaporation, transpiration, spring flow, effluent seepage, pumping from wells, and other underground loss or diversion.

groundwater depletion curve A graphical representation of groundwater recession after the flow created by direct runoff has passed. Such a curve is also known as a groundwater recession curve.

groundwater discharge Discharge of water from the saturation zone directly onto the land surface, into a body of surface water, or into the atmosphere by means of springs, wells, infiltration galleries, or infiltration tunnels and other subterranean channels. It is also called phreatic water discharge.

groundwater discharge area (1) An area in which groundwater is discharged through springs, wells, or percolation, is evaporated from the soil, or is transpired from vegetation. (2) The cross-sectional area of an aquifer through which groundwater is moving.

Groundwater Disinfection Rule (GWDR) The working name for the Ground Water Rule, a regulation of the US Environmental Protection Agency that established disinfection requirements for public water systems using groundwater. *See also* Ground Water Rule.

groundwater divide A boundary between two adjacent groundwater basins, represented by a high point in the water table or piezometric surface.

groundwater drain A drain that carries away groundwater; a drain laid below a pipe through wet ground to facilitate construction. A groundwater drain is also called an underdrain.

groundwater flow (1) The flow of water in an aquifer. (2) The movement of water through openings in sediment and rocks in the zone of saturation. (3) That portion of the discharge of a stream that is derived entirely from groundwater, through springs or seepage water. This flow is also called groundwater runoff.

groundwater hill A mound- or ridge-shaped feature of a water table or piezometric surface, usually produced by downward percolation of water to water-bearing deposits. Such a feature is also called a groundwater mound or groundwater ridge.

groundwater hydrology The branch of hydrology that deals with groundwater, its occurrence and movements, its replenishment and depletion, the properties of rocks that control groundwater movement and storage, and the methods of investigation and use of groundwater. Groundwater hydrology is sometimes called geohydrology or hydrogeology.

groundwater increment Water added to a groundwater reservoir from all sources: influent seepage from streams, rainfall, irrigation, and inflow of groundwater from outside the area under consideration.

groundwater infiltration (GWI) The seepage of groundwater into shafts and tunnels. It is desirable when the shafts are designed for collecting groundwater (e.g., skimmer wells, infiltration galleries) but undesirable when the shafts are designed for other purposes, such as mining or water transmission.

groundwater inventory A detailed estimate of the quantities of water added to the groundwater reservoir of a given area (groundwater increment) balanced against estimates of quantities abstracted or lost from the groundwater reservoir of the area (groundwater decrement). *See also* hydrologic inventory.

groundwater level The level below which the rock and subsoil, down to unknown depths, are saturated with water.

groundwater mining The long-term extraction of groundwater from an aquifer at a rate that far exceeds the natural and artificial replenishment rate of the aquifer. The intent in groundwater mining is to extract the water resource without any expectation of replacement.

groundwater model A tool to approximate the response of an aquifer to pumping, injection, contamination, and other natural and artificial hydraulic and hydrologic activities. The models can be very simple equations or complex computer programs, depending on the nature of the problem.

groundwater mound *See* groundwater hill.

groundwater overdraft The long-term withdrawal of groundwater at a rate that exceeds the amount of natural and artificial replenishment, resulting in a lowering of the groundwater level.

groundwater piracy The tapping of water that originates in another surface drainage basin by a solution channel in limestone terrain.

groundwater pressure head At a given point, the hydrostatic pressure expressed as the height of a column of water that can be supported by the pressure. In a tightly cased well where no discharge occurs, this is equivalent to the distance that a column of water rises.

groundwater province An area characterized by a general similarity in the mode of occurrence of groundwater.

groundwater recession A lowering of the groundwater level of an area.

groundwater recharge The replenishment of a groundwater source through percolation, injection, or other means. In arid areas that depend on groundwater as a primary source, using highly treated wastewater or other nonpotable water sources for groundwater recharge is becoming more common.

groundwater replenishment system *See* aquifer storage and recovery; groundwater recharge.

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groundwater reservoir A geologic formation that stores sufficient water to yield economically significant water to wells and springs. *See also* aquifer; groundwater basin.

groundwater ridge *See* groundwater hill.

Ground Water Rule (GWR) A regulation of the US Environmental Protection Agency that specifies the appropriate disinfection of groundwater used for a drinking water supply and addresses other components of groundwater systems to ensure public health protection.

groundwater runoff That portion of runoff that has infiltrated the groundwater system and has later been discharged into a stream channel as spring or seepage water. Groundwater runoff is the principal source of base or dry-weather flow for streams unregulated by surface storage, and such flow is sometimes called groundwater flow.

groundwater safe yield The amount of naturally occurring groundwater that can be economically and legally withdrawn from an aquifer on a sustained basis without creating an undesirable effect.

groundwater storage Water temporarily stored within the functional interstices of permeable rocks. *See also* groundwater reservoir.

groundwater storage curve A curve summing up the area under the groundwater depletion curve to show the volume of groundwater available for runoff at given rates of groundwater flow.

groundwater supply system A water system using wells, springs, or infiltration galleries to obtain subsurface water (groundwater) as its source of supply.

groundwater table (1) The upper surface of a body of unconfined groundwater. (2) The elevation of depth below the ground surface of such a water surface. In a confined aquifer, this elevation is defined by the static levels in wells that draw from the aquifer.

groundwater time of travel The elapsed time required by a fluid particle on a particular flow line to travel a prescribed distance. It is a common term in wellhead protection planning. It is commonly expressed in years. *See also* flow line.

groundwater trench A trench-shaped depression of the water table caused by effluent seepage into a drainage ditch or a stream.

groundwater turbulent flow Turbulent flow that occurs under high velocities in large openings in the saturation zone, as in cavernous limestone or lava rock.

groundwater under the direct influence of surface water (GWUDI) Water defined by the US Environmental Protection Agency in the Surface Water Treatment Rule as any water beneath the surface of the ground that has (1) significant occurrence of insects or other macroorganisms, algae, organic debris, or large-diameter pathogens such as *Giardia* spp., or (2) significant and relatively rapid shifts in water characteristics—such as turbidity, temperature, conductivity, or pH—that closely correlate with climatological or surface water conditions. The Enhanced Surface Water Treatment Rule amended the first item of this definition to include *Cryptosporidium.*

groundwater wave A wave-like movement of the water table in the direction of the latter's slope. It assumes the form of a groundwater mound or ridge. It is produced by a considerable addition of water to the water table in a relatively short time and over a relatively small area, and it flattens out as it progresses to lower levels. It is also called a phreatic wave.

Group A carcinogen (human carcinogen) As classified by the US Environmental Protection Agency, chemical contaminants for which there are known occupational or epidemiological studies showing that exposure can lead to cancer in humans.

Group B2 carcinogen (probable human carcinogen) As classified by the US Environmental Protection Agency, chemical contaminants for which there are limited occupational or epidemiological studies in humans but sufficient experimental evidence in animals that exposure can lead to cancer in humans.

Group C carcinogen (possible human carcinogen) As classified by the US Environmental Protection Agency, chemical contaminants for which there are limited occupational or epidemiological studies in humans and limited experimental studies in animals that exposure can lead to cancer in humans.

Group D carcinogen (not classifiable as to human carcinogenicity) As classified by the US Environmental Protection Agency, chemical contaminants for which there are inadequate studies in humans or animals that exposure can lead to cancer in humans.

Group E carcinogen (evidence of noncarcinogenicity for humans) As classified by the US Environmental Protection Agency, chemical contaminants for which there are sufficient studies in humans and animals to conclude that exposure will not result in cancer in humans.

group maximum contaminant level (MCL) The highest level of contaminants that the US Environmental Protection Agency allows in drinking water for a group of related contaminants. For example, the MCL for total trihalomethanes of 0.080 milligrams per liter is a group MCL, which is the sum of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

groups The vertical columns of elements in the periodic table. *See also* periodic table.

grout curtain An underground wall created by injecting grout into the ground that subsequently hardens

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to become impermeable. It is designed to stop groundwater flow in a certain area.

grouting The placement of grout in the subsurface by drilling and then injection.

growing season The portion of the year when soil temperatures are above biologic zero (41° Fahrenheit [5° Celsius]). The following growing season months are assumed for each of the soil temperature regimes: thermic, February–October; mesic, March–October; frigid, May–September; cryic, June–August; pergelic, July–August; isohyperthermic, January–December; hyperthermic, February–December; isothermic, January–December; and isomesic, January–December.

growth retardation Slowed growth following exposure of a developing organism (either in utero or postnatally) to chemical or physical agents. In toxicology, growth retardation is often considered a nonspecific chemical effect that can be mediated by such effects as depressed maternal appetite. In the absence of more specific damage (i.e., malformations), these mediating effects do not play a role in the assessment of a chemical's safety if they are produced only at the same dose levels that result in overt maternal toxicity.

groyne *See* groin.

grubbing The operation of removing stumps and roots.

gsfd (also gpd/ft², gfd) *See* gallons per day per square foot *in the Units of Measure section.*

G. stearothermophilus
See Geobacillus stearothermophilus.

Gt A dimensionless flocculation parameter obtained by taking the product of the velocity gradient, *G*, in reciprocal seconds, and the time of mixing of flocculation, *t*, in seconds. The *Gt* product is sometimes used as an overall indication of the mixing or flocculation energy imparted to water in a process and is proportional to the number of particles remaining at time *t* and the initial number of particles.

GtC A dimensionless group where *C* is the volumetric concentration (volume of the particles per unit volume of the suspension being flocculated), *G* is the mixing intensity, and *t* is the length of time of flocculation. This criterion of the flocculation process accounts for the dependence of flocculation on the floc volume concentration as well as the mixing intensity and time. The term α may also be added to account for coagulation efficiency.

guaranteed maximum price (GMP) A contract provision for purchases over time in which the cost of the material or service is subject to fluctuation over the term of the contract (for example, chemical or steel purchases). Establishes the upper limit at which the material or service can be charged during the contract period.

guard gate An additional pair of gates installed in front of lock gates for emergency use in case the lock gates cannot be operated.

GUD *See* β-D-glucuronidase.

GUI *See* graphical user interface.

guidance Recommendations and suggestions issued by a federal agency in a report, document, statement, letter, or other communication that expresses the views of the agency. Such guidance is not a regulation subject to the public review and development process under the Administrative Procedure Act, and it is not federally enforceable.

guide vane (1) A fixed or removable casting in a pump between the impeller and the casing, with liquid passages designed to convert velocity head to pressure head. (2) A fixed or adjustable device intended to direct the flow of liquid in a conduit or channel.

Guillain-Barré syndrome An autoimmune syndrome consisting of muscle weakness and paralysis, and great increase in the protein in the cerebrospinal fluid without corresponding increase in cells. The onset of symptoms can be rapid, but recovery can take months.

gullet An open-channel collector, typically used in a filtration process, that collects backwash water for subsequent discharge. Gullets can be used with or without backwash troughs. If backwash troughs are used, the backwash water flows over weirs into the troughs that then discharge to the gullet. If backwash troughs are not used, the gullet has a weir over which backwash water flows directly for collection.

gulmite screw The screw that holds the swivel part of a yoke connector for a portable exchange tank in place.

Gumbel distribution A statistical distribution used in flood frequency analysis to determine the probability that a given flow will occur within a given time interval.

gut (1) A narrow passage or contracted strait connecting two bodies of water. (2) A channel in otherwise less deep water, generally formed by water in motion. (3) The intestinal tract of an organism.

GWDR *See* Groundwater Disinfection Rule.

GWI *See* groundwater infiltration.

GWP *See* Global Water Partnership.

GWR *See* Ground Water Rule.

GWRC *See* Global Water Research Coalition.

GWUDI *See* groundwater under the direct influence of surface water.

Gy *See* gray *in the Units of Measure section.*

gypsum ($CaSO_4 \cdot 2H_2O$) A mineral composed of calcium sulfate ($CaSO_4$) with attached water molecules,

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or a rock primarily containing calcium sulfate. It is often used as a soil amendment to aid in building soil structure and permeability or in the preparation of gypsum cements. This term is sometimes used to refer to a type of scale consisting primarily of insoluble calcium sulfate that can form during a water-desalting process if the reject salt solution becomes concentrated beyond solubility. *See also* calcium sulfate.

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H

H *See* Henry's constant.

H *See* henry *in the Units of Measure section.*

h *See* height.

h *See* hecto *in the Units of Measure section;* hour *in the Units of Measure section.*

H^+ *See* hydrogen ion.

HA *See* Health Advisory.

ha *See* hectare *in the Units of Measure section.*

HAA *See* haloacetic acid.

HAA (hormonally active agent) *See under* endocrine disruptor.

HAA3 *See* sum of three haloacetic acids.

HAA5 *See* sum of five haloacetic acids.

HAA6 *See* sum of six haloacetic acids.

HAA9 *See* sum of nine haloacetic acids.

HAAFP *See* haloacetic acid formation potential.

Haber's law A rule of thumb stating that the concentration of a toxin times the time of exposure provides an equivalent effective dose. Haber's law has been primarily applied to respiratory irritants. It provides a generally conservative means of predicting safe levels to protracted exposures from the effects seen with shorter exposures. The law, however, has very limited application, and many examples exist where it clearly does not apply. Haber's law should never be used to predict short-term impacts from long-term exposures to a toxicant.

habitat The place where an organism, such as an animal or plant, lives.

habitat protection Measures aimed at maintaining or enhancing the quality of a habitat for the well-being of the species that inhabit it.

habitat value The suitability of an area to support a given evaluation species.

HACCP *See* hazard analysis critical control point.

Hagen–Poiseuille equation An equation for the relationship between the flow rate and the applied pressure drop for laminar flow through a circular tube:

$$Q = \frac{\pi \Delta P R^4}{8 \mu L}$$

Where:

Q = the flow rate (cubic inches per second; cubic centimeters per second)

ΔP = the pressure drop (pounds per square inch; dynes per square centimeter)

R = the radius of the tube (inches; centimeters)

μ = the fluid dynamic viscosity (pounds-second per square inch; dyne-second per square centimeter)

L = the length of the tube (inches; centimeters)

half duplex A data transmission term meaning that data can be transmitted in one direction only. *Compare with* full duplex; simplex.

half-life (1) The time during which one half of the atoms of a radionuclide undergo radioactive decay. It is the reciprocal of the rate constant for such decay. Half-lives of selected radionuclides are as follows: carbon-14, 5,730 years; hydrogen-3, 12.3 years; radon-222, 3.8 days. (2) A measure of the rate at which a chemical disappears from the body (i.e., biological half-life). The biological half-life can reflect the rates of several processes—at a minimum, the rate at which the chemical is biotransformed (i.e., metabolized) and the rate at which it is excreted. Metabolism and excretion through several pathways is not unusual.

halide (X^-) The ionic form of a halogen atom. *See also* halogen.

halite Rock salt, a mineral that is more than 95 percent sodium chloride (NaCl). It is also called native salt or fossil salt.

Hall detector A device used to detect specific types of compounds, such as halogen-substituted organics, as they elute from a gas chromatograph. R.C. Hall refined this type of detector in the early 1970s. This detector is also known as a Hall electrolytic conductivity detector or simply as an electrolytic conductivity detector. The electrolytic conductivity detector was originally developed by D.M. Coulson in the early 1960s.

hallucinogen Any of several chemical substances that are capable of altering sense perceptions, particularly sight, smell, and hearing. Hallucinogens are frequently referred to as mind-altering drugs. They can act by a variety of neurochemical mechanisms.

haloacetaldehydes A class of disinfection by-products in chlorinated water. There are nine species containing chlorine and/or bromine (two monohalogenated, three dihalogenated, and four trihalogenated species). The most commonly measured one is chloral hydrate. *See also* chloral hydrate; disinfection by-product.

haloacetamides A class of disinfection by-products in chlorinated water. There are monohalogenated, dihalogenated, and trihalogenated species. Base-catalyzed hydrolysis of haloacetonitriles can result in the formation of haloacetamides. Further hydrolysis can convert them into haloacetic acids. *See also* disinfection by-product; haloacetic acid; haloacetonitrile.

haloacetic acid (HAA) (CX_3COOH, where X = Cl, Br, H in various combinations) A class of disinfection by-products formed primarily during the

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chlorination of water containing natural organic matter. When bromide (Br^-) is present, a total of nine chlorine-, bromine-and-chlorine-, or bromine-substituted species may be formed. Trihalomethanes and haloacetic acids (HAAs) are the two most prevalent classes of by-products formed during chlorination, and subject to regulation under the Disinfectants and Disinfection By-Products Rule. *See also* chlorination; Disinfectants and Disinfection By-Products Rule; disinfection by-product; natural organic matter.

haloacetic acid formation potential (HAAFP) The amount of haloacetic acids formed during a test in which a source or treated water is dosed with a relatively high amount of disinfectant (normally chlorine) and is incubated (stored) under conditions that maximize haloacetic acid production (e.g., pH less than or equal to 8, warm water temperature, contact time of 4 to 7 days). This value is not a measure of the amount of haloacetic acids that would form under normal drinking water treatment conditions, but rather an indirect measure of the amount of haloacetic acid precursors in a sample. If a water has a measurable level of haloacetic acids prior to the formation potential test (e.g., in a prechlorinated sample), then the formation potential equals the haloacetic acid concentrations measured at the end of the test minus haloacetic acid concentrations measured at the start of the test. *See also* disinfection by-product precursor; haloacetic acid.

haloacetic acids, sum of five (HAA5) *See* sum of five haloacetic acids.

haloacetic acids, sum of nine (HAA9) *See* sum of nine haloacetic acids.

haloacetic acids, sum of six (HAA6) *See* sum of six haloacetic acids.

haloacetic acids, sum of three (HAA3) *See* sum of three haloacetic acids.

haloacetonitrile (HAN) ($CX_3{\equiv}N$, where X = Cl, Br, H in various combinations) A class of disinfection by-products formed primarily during the chlorination of water containing natural organic matter. Some amino acids (e.g., from algae) have been found to be precursors to haloacetonitriles (HANs). When bromide (Br^-) is present, a total of four chlorine-chlorine-and-bromine-, or bromine-substituted species may be formed. Monitoring for haloacetonitriles was required in the Information Collection Rule. *See also* amino acid; chlorination; disinfection by-product; Information Collection Rule; natural organic matter; precursor.

haloalcohol A halogenated alcohol that may form in chlorinated water as a disinfection by-product. *See also* disinfection by-product.

halocarboxylic acid A halogenated substituted carboxylic acid. Haloacetic acids are one group of halocarboxylic acids formed in chlorinated water. *See also* haloacetic acid.

haloform (CHX_3) Any of the trihalomethanes, one-carbon compounds containing three halogen atoms. *See also* halogen; trihalomethane.

haloform reaction Generally, the reaction of a methyl ketone (e.g., acetone [C_3H_6O]) with a halogen (e.g., chlorine) under base-catalyzed conditions. The initial product is an α,α,α-trihaloketone (e.g., 1,1,1-trichloroacetone). In basic solution, such trihaloketones undergo cleavage to yield as final products a haloform—e.g., chloroform ($CHCl_3$) and a carboxylic acid (R–COOH, where the number of carbon atoms ranges from 1 to 26). *See also* enolization; haloform; trihalomethane.

halofuranone *See* halogen-substituted furanones.

halogen Any of the chemical elements composing group 7A of the periodic table: fluorine, chlorine, bromine, iodine, and astatine. The term *X* is sometimes used to refer to a halogen in a chemical formula.

halogenated by-product *See* halogen-substituted by-product.

halogenated furanones A group of halogenated compounds that are derivatives of furanone. Some are in the ring form and others are in the open form. They are disinfection by-products formed in chlorinated water and are major contributors to the mutagenicity of the chlorinated water. The most well known halogenated furanone is 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone or MX. *See also* 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX); disinfection by-product.

halogenated nitrile *See* halogen-substituted nitrile.

halogenated organic material *See* halogen-substituted organic material.

halogenating species A chemical (e.g., hypochlorous acid [HOCl] or hypobromous acid [HOBr]) that can induce halogen substitution (i.e., the formation of halogen-substituted organic material). *See also* halogen-substituted organic material; halogen substitution; hypobromous acid; hypochlorous acid.

halogenation *See* halogen substitution.

halogen-demand-free phosphate buffer saline (HDFPBS) A specially prepared stock buffer solution used to conduct disinfection experiments with microorganisms. A halogen-demand-free buffer is defined as a buffer that loses no more than 10 percent of the initial halogen disinfection dose or 0.1 milligram per liter, whichever is less, during a holding time of 1 hour.

halogen-substituted by-product Typically, a disinfection by-product containing chlorine (from chlorination), bromine (from chlorination or ozonation of

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bromide-containing waters), or both. *See also* disinfection by-product.

halogen-substituted furanones A group of chlorinated or brominated ketones that has a furan ring or an oxygen atom in a five-member ring. Many of these halogenated furanones are detected in chlorinated water and potentially have higher health risks than trihalomethanes and haloacetic acids. 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone, the best known halogenated furanone, is a major contributor to mutagenicity of chlorinated drinking water and commonly referred to as MX. *See also* mutagenesis.

halogen-substituted nitrile An organic compound containing the –CN grouping and one or more halogen atoms. Haloacetonitriles ($CX_3C{\equiv}N$, where X = Cl, Br, H in various combinations) are a type of halogen-substituted nitrile. *See also* haloacetonitrile; halogen.

halogen-substituted organic material An organic compound containing one or more halogen atoms. Some halogen-substituted organic compounds are disinfection by-products, whereas others are synthetic organic chemicals. *See also* disinfection by-product; halogen; organic compound; synthetic organic chemical.

halogen substitution Incorporation of one of the halogen elements, usually chlorine or bromine, into a chemical compound. Typically the halogen atom is replacing a hydrogen atom. *See also* halogen.

haloketone (HK) (CX_3COCX_3, where X = Cl, Br, H in various combinations) A class of disinfection by-products formed primarily during the chlorination of water containing natural organic matter. The most commonly measured ones are halopropanones. When bromide (Br^-) is present, bromine-substituted species may be formed. The Information Collection Rule required monitoring of two haloketones (i.e., 1,1-dichloropropanone and 1,1,1-trichloropropanone). *See also* chlorination; disinfection by-product; halopropanones; Information Collection Rule; natural organic matter.

halonitromethanes (HNMs) A class of disinfection by-products formed in chlorinated water. There are nine species containing chlorine and/or bromine (two monohalogenated, three dihalogenated, and four trihalogenated species). The most commonly measured one is chloropicrin. *See also* disinfection by-product; trichloronitromethane (chloropicrin).

halophilic Thriving in a salt environment.

halophilic bacteria Salt-tolerant bacteria often found in solar salt that has not been fully kiln dried or in salt that may have been exposed to unsanitary conditions over a long period of time.

halophyte A plant that can tolerate high concentrations of dissolved minerals, particularly salts of chlorine, iodine, and bromine. Halophytes are also called salt-loving plants.

halopropanones A class of disinfection by-products formed in chlorinated water. They are one type of haloketone, based on a propanone structure. Halopropanones can be categorized into four groups: monohalopropanones, dihalopropanones, trihalopropanones, and tetrahalopropanones. Pentahalogenated and hexahalogenated propanones have been found to decompose immediately upon dissolution in water. The halogens in halopropanones can be on one carbon atom (up to three halogens) or the other carbon atom. *See also* disinfection by-product; haloketone.

Hamaker constant A constant associated with calculation of intermolecular forces. In 1937, H.C. Hamaker published a paper that extended the concept of van der Waals forces to include the energy of interaction between finite particles of various shapes, separated by distance. The concept was later extended to the case in which water is a medium. The magnitude of the Hamaker constant for materials in water is about 0.1^{-10} to 10^{-20} joules with the exact magnitude depending on the materials.

HAN *See* haloacetonitrile.

H&E stain *See* hematoxylin and eosin stain.

hand-held data entry terminal (HDET) A portable device used to record meter readings in the field, which are then transferred electronically to the billing system.

Hapalosiphon A type of filamentous cyanobacteria that produces microcystins.

Happel collector The particular geometry representing a single collector in a granular media filter. The geometry selected by J. Happel in 1958 and used by other modelers is a spherical granular media particle enveloped by a spherical volume of water that has the same volume as the pore volume for that particle.

haptenization The formation of a bond between a small molecular compound and a high-molecular-weight chemical (generally a protein) to form an antigenic substance (i.e., a compound to which the immune system will react by producing antibodies).

hard detergent A synthetic detergent that is resistant to biological attack. *See also* alkylbenzene sulfonate.

hardness A quality of water caused by divalent metallic cations and resulting in increased consumption of soap, deposition of scale in boilers, damage in some industrial processes, and sometimes objectionable taste. The principal hardness-causing cations are calcium, magnesium, strontium, ferrous iron, and manganese ions. Hardness may be determined by a standard laboratory titration procedure or computed from the amounts of calcium and magnesium expressed as equivalent calcium carbonate ($CaCO_3$).

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See also calcium carbonate equivalent; carbonate hardness; noncarbonate hardness.

hardness, total *See* total hardness.

hardness as calcium carbonate ($CaCO_3$) The value obtained when the hardness-forming salts are calculated in terms of equivalent quantities of calcium carbonate. This method of water analysis provides a common basis for comparison of different salts and compounds. *See also* calcium carbonate equivalent.

hardness leakage *See* leakage.

hardness number The resistance of a granular carbon to the degradation action of steel balls in a sieve column vibrator. It is calculated by using the weight of granular carbon retained on a particular sieve after the granular carbon has been in contact with the steel balls.

hardness sensor *See* sensor.

hardpan A layer of soil that has accumulated leached calcium-rich minerals from weathering and that is well cemented by the minerals and practically impenetrable by water. *Caliche* is another name used for hardpan.

hardpan spring A contact spring occurring above a layer of hardpan and flowing from a perched water table.

hardscape Landscaping constructed from nonliving materials, such as concrete, brick, and lumber.

hardware efficiency A value, expressed as a percentage or a decimal fraction, representing the portion of water applied by an irrigation system that benefits the intended plants.

hard water Generally, water that requires considerable amounts of soap to produce a foam or lather and that also produces scale in hot water pipes, heaters, boilers, and other units in which the temperature of water is increased materially. With respect to hardness, waters have been classified as follows: 0–25 milligrams per liter as calcium carbonate ($CaCO_3$), very soft; 25–75 milligrams per liter as $CaCO_3$, soft; 75–150 milligrams per liter as $CaCO_3$, moderately hard; 150–300 milligrams per liter as $CaCO_3$, hard; 300 milligrams per liter as $CaCO_3$ and up, very hard. *See also* hardness.

hard water scale *See* scale.

hardwire alarm An alarm device that utilizes direct wiring to transmit its signal to a monitoring station or other alarm recipient.

Hardy Cross method A mathematical method of analyzing flow in a water distribution system, devised by Hardy Cross in 1936. *See also* EPANET model; Hazen–Williams formula; pipeline network analyzer; series-parallel reducible network.

Harley Moon strain Strain of *Cryptosporidium* that was originally isolated from a calf and has been maintained by passage in neonatal calves.

Hartmannella A genus of small, free-living amoebae characterized by moderately or well-developed ectoplasm, a vesicular nucleus, an ellipsoidal or cylindrical mitotic figure, and no polar caps. Cysts are rounded with smooth or, in one species, slightly wrinkled surfaces.

Hartmannella vermiformis (H. vermiformis) A species of free-living amoebae, often found in potable water systems, that has been shown to be associated with the amplification of *Legionella pneumophila* (the Legionnaires' disease bacillus) in hot water tanks and hot water distribution systems.

harvesting A physical method for controlling aquatic plants in which the plants are pulled or cut and raked from the water body.

HAV *See* hepatitis A virus.

hazard abatement The correction of a known hazardous condition according to standards.

hazard analysis critical control point (HACCP) A point, identified during a systematic analysis of the potential hazards in a process, where hazards may be controlled and where such controls are deemed critical to consumer safety.

hazard communication The means or process of conveying needed information on materials and workplace dangers to employees. Such information includes standard operating procedures, personal protective equipment information, and material safety data sheets. This type of program is sometimes called a worker's right-to-know program.

hazard evaluation A component of risk assessment that involves gathering and evaluating data on the types of health injuries or diseases (e.g., cancer) that may be produced by a chemical or by the conditions of exposure under which injury or disease is produced.

hazard index The primary method for component-based noncancer risk assessment based on dose addition. It is defined as the weighted sum of the measures of exposure for the mixture of component chemicals. The weighting factor according to dose addition should be the relative toxic strength, also called potency. Calculating a hazard index is recommended for groups of toxicologically similar chemicals (i.e., chemicals usually viewed as having similarity in target organs such as liver, kidney, and so forth). The hazard index is calculated as:

$$\text{hazard index} = \sum_{1}^{n} \frac{\text{exposure level}}{\text{acceptable level characterized by a reference dose}}$$

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where *n* is the number of component chemicals. *See also* reference dose; toxicity equivalency factor.

hazardous atmosphere An atmosphere that may contain one or more hazardous gases that could cause an employee to pass out, be injured, or possibly be killed.

hazardous material Any solid, liquid, or gas that is detrimental to the health and safety of a person.

hazardous material spill An uncontrolled release of any solid, liquid, or gas that is detrimental to the health and safety of a person.

Hazardous Materials Transportation Act (HMTA) A Public Law enacted in 1988 (49 US Code Sec. 1801 *et seq.*) governing the transport of materials defined as hazardous under the act. Under this act, the US Department of Transportation has established an extensive and comprehensive regulatory program covering the classification, packaging, labeling, and transportation of hazardous materials.

hazardous substance Any material that is dangerous and poses a threat to public health or safety.

hazardous waste By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Hazardous waste possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or is included on special US Environmental Protection Agency lists of hazardous waste.

hazardous waste facility A depository where hazardous materials, as defined in federal regulations, are stored.

hazardous waste landfill An excavated or engineered site where hazardous waste is deposited and covered.

Hazardous Waste Operations and Emergency Response (HAZWOPER) Planning required by an employer under Occupational Safety and Health Agency standards 1910.120 and 1926.65 to determine how employees should react to hazardous material spills. The standards call for the emergency response team to receive training concerning the specific hazards of that location.

hazard summary (1) A list of all hazards that an employee may be exposed to, such as chemicals and equipment. (2) A list of all hazards a community or business may be exposed to, such as earthquakes and tornadoes.

Hazen method An empirical method to estimate the hydraulic conductivity of a sediment on the basis of grain size.

Hazen unit (HU) of color A color standard for natural waters introduced by Allen Hazen in the 1890s. Currently, the standard method for the visual determination of color is based on the platinum–cobalt (Pt–Co) color unit. *See also* color unit *in the Units of Measure section.*

Hazen–Williams *C* A friction coefficient representing the degree of roughness of the inside surface of a water main. *See also* Hazen–Williams formula.

Hazen–Williams formula A formula used to calculate the flow in a water main by applying a roughness or friction coefficient as a factor. It was developed in 1902 by Gardner Williams and Allen Hazen. The value of the coefficient indicates the condition of the inside surface of the pipe. The Hazen–Williams formula for determining head loss is

$$h_f = k_1 \frac{LQ^{1.85}}{C^{1.85}D^{4.87}}$$

Where:

h_f = head loss, in feet (meters)
k_1 = 4.72, in units of seconds$^{1.85}$ per feet$^{0.68}$ in US customary system (10.65, in units of seconds$^{1.85}$ per meter$^{0.68}$ in Système International units)
L = pipe length, in feet (meters)
Q = flow rate, in cubic feet per second (cubic meters per second)
C = Hazen–Williams roughness coefficient
D = pipe diameter, in feet (meters)

The value of *C* ranges from 60 for corrugated steel to 150 for clean, new asbestos–cement pipe. *See also* EPANET model; Hardy Cross method; pipeline network analyzer; series-parallel reducible network.

Hazen–Williams roughness coefficient *See* Hazen–Williams *C*.

hazmat *See* hazardous material.

HAZWOPER *See* Hazardous Waste Operations and Emergency Response.

HBV *See* hepatitis B virus.

H_2CO_3 *See* carbonic acid.

HCT-8 cells Illeoceacal carcinoma cell line used to detect infectious stages of *Cryptosporidium.*

HCV *See* hepatitis C virus.

HD *See* sulfur mustard.

HDB *See* hydraulic design basis; hydrostatic design basis.

HDET *See* hand-held data entry terminal.

HDFPBS *See* halogen-demand-free phosphate buffer saline.

HDPE *See* high-density polyethylene.

HDT *See* hydraulic detention time.

HDV *See* hepatitis D virus.

head The energy per unit weight of a liquid. In practical terms, head is the pressure at any given point in a water system. It may also be called pressure head or velocity head. Head is calculated as the pressure

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exerted by a hypothetical column of water standing at the height to which the free surface of water would rise above any point in a hydraulic system. Head is often measured in pounds per square inch or kilopascals. Head is sometimes expressed as the height of a column of water in feet or meters that would produce the corresponding pressure; this measurement may be called hydrostatic head.

headbox A chamber for mixing, collection, equalization, or a combination of these into which chemicals may be added so that the mixture may be distributed from the box to subsequent processing or treatment.

header A large pipe to which a series of smaller pipes are connected. Such a pipe is also called a manifold.

head flume A flume, chute, trough, or lined channel constructed at the head of a gully or at a terrace outlet to prevent cutting or scouring by running water.

head gate A gate or valve at the entrance of a waterway such as a conduit, penstock, treatment process, or canal.

head gate duty of water *See* gross duty of water.

head increaser A device connected with a draft tube to increase the discharge by reducing the tailwater pressure.

heading The place at which a canal or pipeline diverts water from a stream or other body of water.

head loss A reduction of water pressure (head) in a hydraulic or plumbing system. Head loss is a measure of (1) the resistance of a medium bed (or other water treatment system), a plumbing system, or both to the flow of the water through it, or (2) the amount of energy used by water in moving from one location to another. In water treatment technology, head loss is basically the same as pressure drop. *See also* head; pressure drop.

head loss probe A portable electronic instrument that can be used to measure the head loss within a filter bed during filtration or backwashing.

headpond A reservoir of water established at a given elevation to generate head for the production of energy. Headponds store water that can flow through turbines to generate electricity or can turn paddlewheels to operate equipment.

head race A channel that conducts water to a waterwheel; a forebay.

head radius The radius of the circular arc pattern of an overhead irrigation nozzle or sprayer.

headspace The space between the top of a filled liquid and the cover of a container. Because some volatile organic chemicals and disinfection by-products are relatively volatile, sampling for such constituents usually requires the bottle to be filled headspace-free in order to prevent volatile constituents from leaving the liquid phase and entering the headspace air. *See also* disinfection by-product; volatile organic compound.

headspace analyzer A piece of instrumentation that can be used to analyze for volatile organic chemicals and selected disinfection by-products. Typically the sample is warmed in order to volatilize organic compounds from the liquid phase into the headspace air above the sample. The headspace air is then swept with a gas to a detector that can measure the presence of volatile organic chemicals that may be present in the sample. *See also* disinfection by-product; headspace; volatile organic compound.

head-to-head spacing Spacing of irrigation nozzles so that the pattern of precipitation from one head completely overlaps the area between that head and an adjacent head.

headwall A steep cliff, usually the uppermost part of a bowl or amphitheater formed in a mountain.

headwater (1) The upper reaches of a stream near its source. (2) The region where groundwaters emerge to form a surface stream. (3) The water upstream from a structure.

headworks (1) All the structures and devices located at the head or diversion point of a conduit or canal. The term as used is practically synonymous with *diversion works* or *intake heading.* (2) The initial structures and devices of a water treatment plant.

Health Advisory (HA) A contaminant-specific document prepared and issued by the US Environmental Protection Agency for contaminants not regulated under the Safe Drinking Water Act. It provides technical guidance to public health officials on health effects, analytical methodologies, and treatment technologies in response to the public need for guidance during emergency situations involving drinking water contamination. *See also* guidance.

health contaminant Any substance or condition that may have any adverse effect on human health. Health contaminants in water are regulated as part of the National Primary Drinking Water Regulations enforced by the US Environmental Protection Agency and most states. *See also* drinking water standard.

health effect A modification in the health of an individual as a result of exposure to a chemical, physical, or infectious agent. The meaning of this term is vague, but it is usually thought of in terms of adverse effects on health rather than beneficial effects. Even with this additional specificity, what is meant by the term is not very clear. The opinions of what constitutes an adverse health effect vary widely. Some professionals include small decreases in enzyme activities, whereas others require that clear-cut disease and observable physical pathology be present.

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Health Effects Research Laboratory (HERL) The former name of the office within the US Environmental Protection Agency's Office of Research and Development. *See* National Health and Environmental Effects Research Laboratory.

health effects risk analysis The process of estimating the probability that an adverse effect will occur, given a particular set of exposure conditions.

health hazard (1) A cross-connection or potential cross-connection involving any substance that, if introduced into the potable water supply, could cause death or illness, spread disease, or have a high probability of causing such effects. (2) Anything that endangers human health.

health risk reduction and cost analysis (HRRCA) An analysis the US Environmental Protection Agency is required to conduct under the Safe Drinking Water Act to determine the health risk reduction and associated costs for compliance with a National Primary Drinking Water Regulation.

healthy workplace A variety of conditions, such as an environmentally safe working space, ongoing safety programs, the availability of employee study and tuition refund programs, and management encouragement of participation in company and community affairs; all programs that attract employees and provide incentives for staying and helping the utility achieve its mission.

heat Energy transfer by virtue of a temperature difference. *See also* energy; work.

heat budget The amount of heat necessary to raise water from the minimum temperature of winter to the maximum temperature of summer. It is usually referred to as the annual heat budget (of a large contained body of water, such as a lake).

heat capacity units *See in the Units of Measure section.*

heat exchanger A device providing for the transfer of energy as heat between two fluids.

heat-exchanger tank A tank used for heating water or sludge, usually equipped with coils to facilitate heat transfer.

heat flux density units *See in the Units of Measure section.*

heathland Uncultivated open, flat land of poor-quality soils and inferior drainage. Such land is typically covered by shrubs, mostly of the Ericaceae family.

heating The process of increasing the temperature of a solid, liquid, or gas.

heating, ventilating, and air conditioning (HVAC) A mechanical system in a building that provides for air circulation for heating, ventilation, and air conditioning.

heat of adsorption The energy given off during the adsorption of molecules.

heat of fusion (water to ice) The energy (not necessarily by heat transfer) released when water changes to ice. Its value is 144 British thermal units per pound mass (335 kilojoules per kilogram), the highest heat of fusion of all substances except liquid ammonia (NH_3). This high value, along with the lower density of ice and the 39.2° Fahrenheit (4° Celsius) temperature of maximum density, means that the subsurface temperature in deep ice-covered lakes does not fall to less than freezing.

heat of sublimation The energy that must be supplied (not necessarily by heat transfer) to convert ice directly into vapor. Its value is 1,222 British thermal units per pound mass (2,843 kilojoules per kilogram).

heat of vaporization The amount of energy (not necessarily by heat transfer) needed to change a given amount of liquid existing at a given temperature into a vapor. The heat of vaporization (evaporation) of water is the highest of all substances—970.3 British thermal units per pound mass (2,257.0 kilojoules per kilogram) for boiling temperatures at the standard atmospheric pressure—and is important in nature because it regulates the evaporation phase of the hydrologic cycle.

heat-resistant glass A generic term for commercially manufactured borosilicate glass, e.g., Pyrex® or Chemex®.

heat sensor A device that opens and closes a switch in response to changes in temperature. This device might be a metal contact, a thermocouple that generates a minute electrical current proportional to the difference in heat, or a variable resistor for which the value changes in response to changes in temperature. A heat sensor is also called a temperature sensor.

heat storage well A well used to store heated water for later recovery and use in aquifer-based heating and cooling systems. The relatively good thermal storage properties of rocks make the use of an aquifer as part of a heat pump system in temperate climates feasible.

heat stress An adverse condition that occurs when the body generates more heat than it can release. Symptoms are weakness, dizziness, headache, and nausea.

heat transfer An exchange of energy as heat from one fluid to another. It is also called heat exchange.

heat units *See in the Units of Measure section.*

heavy metal A metallic element with a specific gravity greater than 5, such as cadmium, copper, lead, and zinc.

heavy rain Rain that is falling at the time of observation with an intensity in excess of 0.30 inches per hour (7.6 millimeters per minute), or more than 0.03 inches (0.8 millimeters) in 6 minutes.

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heavy residuals Residuals in fluid form but with relatively low moisture content.

heavy water Water with an isotope of hydrogen that has an atomic weight of 2.0147 instead of 1.008. It is called dideuto hydrogen oxide or deuterium oxide.

hectare (ha) *See in the Units of Measure section.*

hecto *See in the Units of Measure section.*

HEEB irradiation *See* high-energy electron beam irradiation.

heel The lower zone of an ion-exchange bed that is "passed by" in either the softening, deionization, or dealkalization mode or during the application of regenerants. The presence of a heel is usually a result of the configuration of the vessel or the lack of a good underdrain distribution system.

height (*h*) The distance to the top of a structure from some datum plane, frequently the ground surface.

height of dam The difference in elevation between the roadway, walkway, or spillway crest and the lowest part of the excavated foundation along the axis of a fixed dam.

height of transfer unit (HTU) A process design term used in sizing of air stripping towers. The HTU relates the liquid loading rate to the overall mass transfer coefficient for the liquid phase. It has dimensions of length and is multiplied by the number of transfer units to determine the required tower height. *See also* number of transfer units.

Heinz bodies Inclusion bodies in erythrocytes (red blood cells) resulting from the oxidative damage and precipitation of hemoglobin. They can be produced by chemicals that induce oxidative stress, but they also arise from congenitally abnormal hemoglobins or from deficiencies in enzymes that protect against oxidative stress, reverse the oxidative damage that is induced, or both. *See also* inclusion body.

Hele Shaw model A physical model analog of groundwater flow that is based on the movement of viscous fluid between two closely spaced (transparent) plates.

helical sensor A spiral tube used to detect pressure changes.

Helicobacter pylori (H. pylori) A pathogenic bacterium that has been shown to be associated with duodenal ulcers in humans, although not all persons who have been found to harbor the organism are affected by ulcers. Transmission probably occurs via the fecal–oral route, which means that waterborne transmission could occur if water directly contaminated by feces from an infected person is ingested. Waterborne transmission was cited in at least one study involving poor-quality water used for drinking. The organism has also been linked to gastritis and gastric carcinoma (cancerous growth).

helminth ova Eggs of the helminth, an intestinal parasite.

hemacytometer An etched glass chamber with raised sides that will hold a quartz coverslip exactly 0.1 mm above the chamber floor. It is commonly utilized to enumerate tissue culture cells or protozoan parasites.

hemangiosarcoma A malignant tumor that arises from the proliferation of endothelial cells (e.g., blood vessel cells) and fibroblastic tissue (tissue giving rise to fibrous tissue). This type of tumor is produced in humans by vinyl chloride.

hematite (Fe_2O_3) Principal ore of iron, typically brilliant black to brick red in color. It is commonly found in iron corrosion by-product in drinking water distribution systems.

hematogenous Containing red blood cells.

hematopoiesis The formation and development of blood cells.

hematoxylin and eosin (H&E) stain A special histological stain that is widely used in medical diagnostics. It is also used in the neonatal mouse infectivity assay for *Cryptosporidium parvum* oocysts. *See also* neonatal mouse infectivity assay.

heme ($C_{34}H_{32}N_4O_4Fe$) A deep red pigment that contains reduced (ferrous) iron. Heme is found in red blood cells (hemoglobin). It is also found outside the body in the nonprotein portions of some organic molecules called hemoproteins. In water quality treatment, it may be referred to as heme iron, which is organically bound iron that can cause water to have a pinkish cast. *See* hemoglobin.

heme iron *See* heme.

hemiparesis Muscular weakness affecting one side.

hemochorial placenta A type of placenta in which the maternal blood comes into direct contact with the chorion (i.e., the outermost nonembryonic membrane surrounding the embryo). This is the type of placenta found in primates, including humans.

hemochromatosis A condition characterized by excess deposition of iron in tissues, particularly the liver, pancreas, and skin. It results in cirrhosis of the liver, diabetes mellitus, and bone and joint changes. A hereditary form exists that is called idiopathic hemochromatosis. Other forms are produced by repeated blood transfusions or consumption of excessive amounts of iron over a long period of time.

hemocytometer *See* hemacytometer.

hemodialysis The process of purifying a kidney patient's blood by means of a dialysis membrane. *See also* dialysis.

hemoendothelial placenta A placental type in which maternal blood comes in contact with the endothelium of chorionic vessels. Essentially this means that only one layer of cells makes up the placenta, whereas other placental types have as many as six. This type of placenta is found in rats, rabbits, and

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guinea pigs (animals commonly used in testing for teratogenic effects of chemicals). It is more porous than human placenta.

hemoglobin The respiratory protein of the red blood cells. It transfers oxygen from the lungs to the tissues and carbon dioxide (CO_2) from the tissues to the lungs. It is a conjugated protein consisting of approximately 94 percent globin (protein portion) and 6 percent heme ($C_{34}H_{32}N_4O_4Fe$). It consists of four polypeptides (two α-chains and two β-chains) and four heme groups. It has a molecular weight of 65,000. *See also* heme.

hemolysis The rupturing of red blood cells that sometimes occurs during hemodialysis. Hemolysis may be caused by the presence of chloramines in dialysis water.

hemolytic anemia A decrease in the concentration of erythrocytes (red blood cells) as a result of damage to the structure of the cell membranes. Hemolytic anemia can be induced by a variety of chemicals that induce oxidative stress. The most notable drinking water chemical producing such an effect in vivo is chlorite (ClO_2^-).

hemolytic reaction The lysis of red blood cells releasing hemoglobin. Usually a reaction caused by parasitism or immunopathogenic mechanisms.

henry (H) *See in the Units of Measure section.*

Henry's constant (*H*) A coefficient relating the gaseous-phase mole fraction or concentration of a contaminant to the liquid-phase mole fraction or concentration, as expressed in Henry's law. Knowing how Henry's law is being expressed is imperative to determine the proper units for Henry's constant. *See also* air-stripping; Henry's law.

Henry's law A relationship expressing the directly proportional relationship between the liquid-phase and gas-phase concentration of a substance at equilibrium and at a given temperature. Henry's law can be expressed in many forms. This expression is typically used in water treatment to evaluate the potential or extent to which (1) a contaminant will volatilize from the liquid phase to the gaseous phase or (2) a gas will dissolve into the liquid phase.

HEPA filter *See* high-efficiency particulate air filter.

hepatic Pertaining to the liver.

hepatitis An inflammation of the liver that can be produced directly or indirectly by a number of chemical contaminants of drinking water, as well as by infectious agents. A severe case, such as in fulminant viral hepatitis, can be fatal. Damage from milder hepatitis is largely reversible, however, as long as it is not sustained or repeated.

hepatitis A virus (HAV) A ribonucleic acid virus that is also known as infectious hepatitis. It is transmitted by fecal–oral person-to-person contact, by ingestion of contaminated food (e.g., shellfish), by fecally contaminated water, or by contaminated blood products. *See also* waterborne disease.

hepatitis B virus (HBV) A form of hepatitis virus also known as serum hepatitis. It is transmitted through the use of contaminated needles, syringes, and blood products. Hepatitis B virus causes a more severe form of hepatitis than other hepatitis viruses.

hepatitis C virus (HCV) A virus that is transmitted through contaminated blood. Hepatitis C virus is a major cause of hepatitis following transfusions in the United States.

hepatitis D virus (HDV) A circular single-stranded ribonucleic acid virus also known as hepatitis delta agent. The ribonucleic acid of the delta agent requires help from another virus, the deoxyribonucleic acid-containing hepatitis B virus, for transmission. *See also* delta virus.

hepatitis E virus (HEV) A virus that resembles a Norwalk virus or calicivirus in size and structure but causes hepatitis. Transmission is by the fecal–oral route, with fecally contaminated water being the most common vehicle of transmission. *See also* calicivirus; Norwalk virus.

hepatocellular carcinoma A malignant tumor of the liver that is derived from parenchymal cells (i.e., hepatocytes). This is the most frequent type of tumor to be induced in mice by disinfection by-products, including chloroform ($CHCl_3$) and the haloacetic acids. Dichloroacetate ($CHCl_2COO^-$) also produces these tumors in rats.

hepatocyte The parenchymal cell of the liver. These cells contain the bulk of the body's ability to metabolize foreign compounds. They also play a role in the formation of bile and the elimination of chemicals and other normal metabolites into the bile. The liver plays a central role in the coordination of intermediary metabolism in the body as well. Hepatocytes may be damaged by hepatotoxic chemical, physical, or microbial agents in contaminated water.

hepatoma A malignant tumor occurring in the liver. This term can apply to virtually any tumor in the liver, in contrast with the more precise meaning of a hepatocellular carcinoma. *See also* hepatocellular carcinoma.

hepatotoxic Pertaining to a chemical, physical, or microbial agent that damages hepatocytes. The term is sometimes extended to include toxicities to other cell types within the liver.

hepatotoxicity A substance or condition that damages the liver.

hepatotoxin A substance causing hepatotoxicity, damage to cells in the liver.

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heptachlor ($C_{10}H_5Cl_7$) A generic name for 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoin dene, a synthetic organic chemical used as an insecticide. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.0004 milligrams per liter. *See also* insecticide; synthetic organic chemical.

heptachlor epoxide ($C_{10}H_5Cl_7O$) A degradation product of heptachlor that also acts as an insecticide. This oxidation product of heptachlor occurs in soil and on crops when treatments with heptachlor have been made. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.0002 milligrams per liter. *See also* heptachlor; insecticide.

Hep-2 cells (HEP-2 cells) Cell line that can be used for the detection and isolation of certain organisms, including viruses, in samples.

herbicide A compound, usually a synthetic organic substance, used to stop or retard plant growth.

herd immunity The immunity of a group or community; the resistance of the group to an infectious agent based on the resistance of a high proportion of individuals within the group.

hertz (Hz) *See in the Units of Measure section.*

heterochromatin Tightly coiled chromatin that contains genetically inactive deoxyribonucleic acid.

heterogeneous Pertaining to a medium for which the characteristics vary in different locations; nonuniform.

heterogeneous advanced oxidation process An advanced oxidation process that takes place in more than one medium. An example is titanium dioxide (TiO_2) and ultraviolet light that create hydroxyl radicals in the fluid being treated. This process is also referred to as heterogeneous photocatalysis. It appears as an emerging destructive technology leading to the total mineralization of most of the organic pollutants. *See also* advanced oxidation process; homogeneous advanced oxidation process; hydroxyl radical.

heteroskedasticity In regression analysis, the extent to which the standard deviation of the residuals is not constant over the range of the independent variables. A key objective in regression analysis is to explain the variation in the dependent variable by means of independent, causal variables such that the unexplained or residual variation has a random pattern with a mean of zero and a constant variance over the ranges of independent variables. Sometimes a systematic pattern in the residuals can be eliminated by transforming the variables to logs (to remove a percentage change relationship), by including polynomial independent variables (to capture nonlinear relationships), or by including autoregressive terms (to compensate for systematic relationships with the residuals over time). If the heteroskedasticity cannot be removed, inferences about the linear regression model's parameters will not be reliable and the prediction risk of the regression model cannot be accurately estimated. When the variances for the random variables (observations) are identical over all values of the independent variable and are uncorrelated, the errors are specified as homoskedastic.

heterotroph An organism that metabolizes organic compounds as sources of carbon and energy.

heterotrophic Requiring organic compounds as nutrients.

heterotrophic microorganism A bacterium or other microorganism that uses organic matter synthesized by other organisms for energy and growth.

heterotrophic plate count (HPC) A bacterial enumeration procedure used to estimate bacterial density in an environmental sample, generally water. Other names for the procedure include total plate count, standard plate count (SPC), plate count, and aerobic plate count.

heuristic knowledge Rules of thumb developed by experience or education and applicable to a particular area of knowledge. The emphasis is on practical solutions to problems that are poorly structured or where insufficient data are available. Generally, heuristic knowledge represents good, or at least workable, solutions to problems, but it may not supply the best solutions in terms of economics, efficiency, or other measures. The "rule of 72" (72/annual interest rate, in percent) for calculating the doubling time of an investment is an example of heuristic knowledge.

HEV *See* hepatitis E virus; human enteric virus.

HEX *See* hexachlorocyclopentadiene.

hexachlorobenzene (C_6Cl_6) A synthetic organic chemical with various industrial uses, including use as a fungicide for seeds or as a wood preservative. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.001 milligrams per liter. *See also* fungicide; synthetic organic chemical.

hexachlorobutadiene ($Cl_2C{:}CClCCl{:}CCl_2$) A solvent for elastomers. *See also* solvent.

hexachlorocyclopentadiene (HEX) (C_5Cl_6) A synthetic organic chemical with various industrial uses, including use as a pesticide or fungicide. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.05 milligrams per liter. *See also* fungicide; pesticide; synthetic organic chemical.

hexametaphosphate A chemical that is used as a sequestering agent. Normally, a metal (M) hexametaphosphate would have the chemical formula $(MPO_3)_6$, in which the cyclic metal metaphosphate is based on

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rings of alternating phosphorus and oxygen atoms. The so-called sodium hexametaphosphate, however, is probably a polymer with the formula $(NaPO_3)_n$, in which *n* is between 10 and 20. *See also* sequestering agent; sodium hexametaphosphate.

hexavalent chromium (CrVI) *See* chromium.

hexidecimal A numbering system that uses 16 as its base (rather than 10, which is used by the standard decimal system). The first 10 digits are 0 through 9, and the next six are represented by A, B, C, D, E, and F. Computer memory addresses are conventionally expressed in hexidecimal.

HFSA *See* hollow-fiber stripping analysis.

HGAF *See* hydride generation atomic fluorescence.

HGL *See* hydraulic grade line.

HHW (higher high water) *See* higher high water *under* tidal water level.

hierarchical database A database structure in which data are stored based on parent–child or one-to-many relationships with explicit pointers that define the relationship between segments of a record.

hierarchy A group of people or things arranged in order, e.g., class, grade, or rank.

high-calcium lime A lime containing 95 to 98 percent calcium oxide (CaO).

high-capacity filter A filter that operates at a hydraulic rate higher than usual.

high-density polyethylene (HDPE) A polymer with many industrial applications, including use as a pipe material. Polyethylene $((H_2C{:}CH_2)_x)$ pipe can be used in low-pressure applications for transporting potable water and other liquids. *See also* polymer.

high-efficiency clothes washer A water- and energy-efficient washer that uses a maximum of 27 gallons of hot and cold water per load for a normal-size, 8-pound wash load in a standard residential washer with a 14-pound capacity.

high-efficiency particulate air (HEPA) filter A generic name for air filters used in chemical fume hoods or biological safety cabinets. The filters are designed for removal of a specified percentage of specific sized particles, depending on the requirements of a particular type of application.

high-energy electron beam (HEEB) irradiation A process that uses a high-energy electron beam to irradiate a contaminant of concern and modify its structure. Because the beam is powered by electricity, it can be shut on and off; no radioactive material is involved. While the beam is on, some shielding is necessary to protect workers from the high-energy electrons, though not nearly as much shielding as is necessary with gamma irradiation. Electron beams are not as penetrating as gamma irradiation and will only penetrate food up to about 3 centimeters. This process can be used to convert contaminants that are harmful and difficult to oxidize or difficult to degrade into less harmful by-products. It may potentially also be used to disinfect water on a small scale. Electron beam devices have been used to sterilize medical devices for many years.

high-field asymmetric wave-form ion mobility mass spectrometry (FAIMS-MS) A continuous flow mass spectrometric method that separates ions at atmospheric pressure and room temperature. By passing electrospray-generated ions through the instrument, the mixture of ions that is presented to the entrance of the mass spectrometer can be greatly simplified. This technique can remove the complex continuum of electrospray background ions, which typically limits the lower levels of detection of small ions. Thus, the detection limit for these ions can be improved by over a factor of 100 and it can provide extremely specific separation of complex mixtures without the need for time-consuming chromatography or sample derivatization. *See* electrospray ionization; mass spectrometry.

high-frequency ozonation Operation of an ozone (O_3) generator at frequencies equal to or greater than 1,000 cycles per second (1,000 hertz).

high-intensity pulsed ultraviolet (UV) light treatment A disinfection method that uses a high-intensity ultraviolet (UV) light source in a pulsed fashion. In a pulsed UV system, alternating current is converted to direct current and is stored in a capacitor. This energy is then released through a high-speed switch to form a pulse of intense radiation.

high-line jumper A pipe or hose connected to a fire hydrant and laid on top of the ground to provide emergency water service for an isolated portion of a distribution system.

high-performance liquid chromatography (HPLC) A technique that is able to separate compounds in the liquid state as they migrate through a chromatographic column. Analytes migrate through the column at a rate based on their relative affinity for the stationary phase versus the mobile phase. The technique has many applications in the analysis of organic compounds that may not be amenable to separation by gas or ion chromatography.

high-performance size-exclusion chromatography (HPSEC) *See* high-performance liquid chromatography; size exclusion chromatography.

high-pressure fire system A separate high-pressure water system consisting of extra-heavy mains, hydrants, pumps, and appurtenances installed solely for furnishing water for extinguishing fires at pressures suitable for direct hydrant hose streams.

high-pressure liquid chromatography *See* high-performance liquid chromatography.

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high-pressure membrane For pressure-driven membrane processes, a term sometimes used to refer to reverse osmosis and nanofiltration (as opposed to microfiltration and ultrafiltration). *See also* membrane; microfiltration; nanofiltration; reverse osmosis; ultrafiltration.

high-pressure membrane electrodialysis reversal A term typically referring to nanofiltration and reverse osmosis pressure-driven membranes, in which separation of dissolved or ionic contaminants from feedwater is accomplished by a solution–diffusion mechanism using semipermeable membranes. *See also* membrane; nanofiltration; reverse osmosis.

high-purity oxygen (O_2) A gaseous stream containing oxygen at concentrations greater than approximately 90 percent by weight. High-purity oxygen is produced by selectively liquefying constituents at reduced temperatures to isolate oxygen or by selectively adsorbing all constituents other than oxygen in a gaseous phase.

high-rate clarifier A settling unit operated at a higher hydraulic rate than conventional settling units but still achieving similar levels of particle removal. High-rate clarifiers often employ equipment such as tube or plate settlers to increase the available surface area for settling without increasing the overall area of the unit.

high-rate dissolved air flotation Flotation systems that can operate at 15 meters per hour to as high as 40 meters per hour, especially those over 20 meters per hour. Contrast this to conventional dissolved air flotation units operating at nominal hydraulic loadings of 5 to 15 meters per hour. *See also* dissolved air flotation; whitewater blanket.

high-rate microsand ballasted clarification *See* sand ballasted flocculation–sedimentation.

high-rate plate settler *See* inclined plate settler.

high-rate sedimentation *See* high-rate clarifier.

high-resolution light microscopy An advancement of light microscopy that involves bringing all surface features into focus by using a computer to combine the different elevations of a surface into one focused image. Elevation is indicated by using colors to denote different depths. Images of surfaces are initially gathered with advanced light microscopes such as a confocal laser scanning microscope or scanning electron microscope.

high-risk house A home that is likely to have high tap water lead and copper concentrations because it has lead service lines and/or copper pipe with lead-based solder.

high-risk subpopulation *See* sensitive subpopulation.

high salting The use of 15 pounds (6.8 kilograms) or more of salt (sodium chloride [NaCl] or potassium chloride [KCl]) to regenerate each 1 cubic foot (0.028 cubic meters) of cation resin. High salting is generally recommended for water with high total hardness and water containing high concentrations of dissolved heavy metals. *See also* hardness.

High Test Hypochlorite® (HTH®) Calcium hypochlorite ($Ca(OCl)_2$), a disinfectant with approximately 70 percent available chlorine. It is sometimes used to disinfect water storage tanks, water lines, and swimming pools.

high-to-low-dose extrapolation The process of predicting low-exposure risks to humans from the measured high-exposure–high-risk data collected in rodents.

high-voltage electrode During ozonation, the outlet post on a voltage transformer that produces more than 1,000 volts.

high-water line (1) The line of the shore of a river, lake, or sea that is ordinarily reached at high water. (2) Along the seashore, the intersection of the plane of mean high water with the shore.

high-water mark A mark on a structure or natural object, indicating the maximum stage of tide or flood.

high-water-use landscape A landscape with plants and features using water that requires 50 to 80 percent of reference evapotranspiration to maintain optimal appearance.

hindered settling The settling of particles in higher concentration than in type I or type II settling. The particles are so close together that interparticle forces hinder the settling of neighboring particles. The particles remain in a fixed position relative to one another, and all settle at a constant velocity. As a result, the mass of particles settles as a zone. *See also* type I settling; type II settling; type III settling.

hindleg paralysis A descriptive symptomatology associated with chemicals or other agents that produce peripheral neuropathy (i.e., damage to the peripheral sensory neurons, motor neurons, or both). Generally, in rodent species used in toxicological testing, the first overt sign of such effects is that the animal begins to drag its hind legs. Hindleg paralysis is produced by such chemicals as n-hexane, methyl butyl ketone, and acrylamide.

histogram A graphic tool for organizing and analyzing data. A modification of a bar chart, it is used to measure distributions that have central tendencies. It provides a quick view of the amount of variation in a set of data.

histograph A map or chart of a river or drainage system on which a series of time lines is placed. Each time line gives the time of transit of water from the given time line to the outlet of the system.

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histological Relating to the study of the structure of cells and tissues by microscope.

histology The study of the structure of cells and tissues, usually involving microscopic examination of tissue slices.

historical cost The actual cost, without consideration of depreciation or inflation, of constructing a building, facility, or plant at the time of construction.

historic basis An approach for calculating water allotments based on past water consumption.

HIV *See* human immunodeficiency virus.

HK *See* haloketone.

HLW (higher low water) *See* higher low water *under* tidal water level.

HMI *See* human–machine interface.

HMTA *See* Hazardous Materials Transportation Act.

HNMs *See* halonitromethanes.

H_2O The chemical formula for water (dihydrogen oxide).

HOBr *See* hypobromous acid.

HOCl *See* hypochlorous acid.

HOH A variation of the chemical formula for water (H_2O).

holdover storage The portion of the useful storage normally remaining in a reservoir at the end of the drawdown period and held over for use only in a critically dry year.

holiday A void in the coating of a pipe that will allow the passage of electrical current.

hollow cathode lamp A device used in atomic absorption spectrophotometry to produce light from a specific chemical element. Such a lamp contains a cathode constructed from the metal to be determined and an anode in a sealed glass cylinder filled with argon. The cathode emits a line of radiation that is characteristic of the particular metal being determined.

hollow dam A fixed dam, usually of reinforced concrete, consisting essentially of inclined slabs or arched sections supported by transverse buttresses. The load is taken by the slabs or arched sections and transferred to the foundation by the buttresses.

hollow-fiber membrane In a pressure-driven membrane system, a self-supporting membrane with a circular cross-sectional shape having a hollow central bore (typically with an inside diameter of about 1 millimeter or less). Depending on the type of membrane, the flow pattern may be "outside-in," where the feedwater is on the outside of the fiber and the central bore (lumen) carries permeate (or filtrate), or "inside-out," where the flow direction through the membrane is the opposite.

hollow-fiber membrane biofilm reactor A hollow-fiber membrane used for solids–liquid separation in a biofilm reactor.

hollow-fiber membrane configuration A type of membrane arrangement in a module, permeator, or element where many hollow-fiber membranes are installed in a single pressure vessel.

hollow-fiber stripping analysis (HFSA) A membrane extraction technique used in the analysis of volatile and semivolatile organic chemicals. Air is recirculated through a water sample, around a bundle of hollow-fiber membranes, and through an adsorbent trap. The technique is said to provide faster mass transfer of analytes than closed-loop stripping analysis. An application of the hollow-fiber stripping analysis technique is in the analysis of taste-and-odor-causing compounds in drinking water. *See also* closed-loop stripping analysis; taste and odor.

hollow-fiber ultrafiltration *See* hollow-fiber membrane.

hollow fine-fiber membrane A type of hollow-fiber membrane with a very small diameter (typically about 90 to 95 micrometers for the outside diameter, 40 to 45 micrometers for the inside diameter, with an outer thin skin barrier layer designed for a flow pattern from the outside to the inside) that is used in some reverse osmosis membrane products. *See also* hollow-fiber membrane.

hollow-stem auger A large drilling device that looks like a corkscrew but for which the stem (center) of the screw is hollow. Sampling and installation of equipment are routinely conducted in the space of the hollow stem.

home maintenance The inspection of plumbing fixtures for leaks, along with scheduled regular replacement of toilet flappers and ballcocks.

homeostasis A state of physiological equilibrium produced by a balance of functions and chemical composition within an organism.

home water treatment unit A treatment device attached to the service connection of an individual dwelling, or at the point of use (e.g., under a sink), to remove various contaminants. Home water treatment units can include such devices as granular activated carbon filters, membrane units, and water softeners. *See also* point-of-use treatment device; Water Quality Association.

Hom model An empirical equation devised by Leonard C. Hom in 1972 describing the killing of microorganisms or the inactivation of viruses by a disinfectant. It is a modification of the Chick–Watson model. The equation for a batch system at constant disinfection concentration or constant ultraviolet irradiation intensity is:

$$r = -k'm[t^{(m-1)}](C^n)N$$

Where:

r = the inactivation rate (organisms killed or inactivated per volume per time)

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k' = the rate constant of inactivation (presumed independent of disinfectant concentration)
N = the density of viable organisms at time t, in numbers per volume
t = the time of exposure, in minutes
C = the disinfectant concentration, in milligrams per liter
m = a constant
n = a constant (the coefficient of dilution)

This equation integrates to

$$\ln (N/N_0) = -k'(t^m)(C^n)$$

Where:

N_0 = the density of viable organisms at time 0 in numbers per volume

If $m = 1$, this indicates Chick–Watson kinetics. If m is greater than 1, the plot of $\ln N/N_0$ versus time yields a "shoulder." If m is less that 1, "tailing" occurs in the plot of $\ln N/N_0$ versus time. *See also* Chick–Watson model; modified Hom model.

homogeneous Having a uniform structure or composition throughout.

homogeneous advanced oxidation process An advanced oxidation process that takes place entirely in one medium, usually water. Examples include ozone plus hydrogen peroxide; ozone plus ultraviolet (UV) light; hydrogen peroxide plus UV light; and pulsed UV light plus hydrogen peroxide. *See also* advanced oxidation process; heterogeneous advanced oxidation process; ozone–hydrogen peroxide process; ozone–ultraviolet light process; pulsed ultraviolet light–hydrogen peroxide process; sonolysis; ultraviolet light–hydrogen peroxide process.

homogeneous solution diffusion (HSD) *See* solution diffusion model.

homogeneous surface diffusion model (HSDM) A mathematical model describing adsorption and desorption in a single-solute and multisolute system with similar-size adsorbents such as granular activated carbon. The solute in this case can be either a specific compound, multiple compounds, or group parameters. For the single-solute system, three equations are needed:

1. $$\frac{\partial C}{\partial t} = -V_s\frac{\partial C}{\partial z} - 3\frac{(1-\varepsilon)}{\varepsilon R}k_f(C - C_s)$$

Where:

C = the concentration of the contaminant in solution, in milligrams per liter or micromoles per liter
t = time, in seconds
V_s = the velocity in pores, in centimeters per second
z = the axial position in the granular activated carbon bed, in centimeters
ε = the porosity of the bed
R = the radius of the granular activated carbon particle, in centimeters
k_f = the liquid film transport coefficient, in centimeters per second
C_s = the concentration of the contaminant at the liquid–particle interface

2. $$\frac{\partial q}{\partial t} = \frac{D_s}{r^2}\left[\frac{\partial}{\partial r}\left(r^2\frac{\partial q}{\partial r}\right)\right]$$

Where:

q = the solute loading on the adsorbate, in milligrams per gram or millimoles per gram
D_s = the surface diffusion coefficient, in centimeters squared per second
r = the radial position within the granular activated carbon particle (radial coordinates), in centimeters

3. $$q_s = KC_s^{1/n}$$

Where:

q_s = the solute loading on the adsorbate at equilibrium, in milligrams per gram or millimoles per gram
K = the Freundlich capacity coefficient, in (milligrams per gram) (liters per milligram)$^{1/n}$ or (millimoles per gram) (liters per milligram)$^{1/n}$
$1/n$ = the Freundlich intensity coefficient

Solving these equations gives the chemical concentration as a function of position and time in a granular activated carbon bed, as well as the granular activated carbon loading as a function of time, position in the granular activated carbon particle, and position in the granular activated carbon bed. *See also* Freundlich isotherm.

homologous antisera Serum containing an antibody or antibodies derived from a consistent source.

homology The quality or condition of corresponding in structure and evolutionary origin; having the same linear sequence of genes as another chromosome.

homopolymer A polymer consisting of only one type of monomer (building blocks). Examples are polystyrene and polyethylene.

homoskedasticity In regression analysis, a condition in which the variances for the random variables (observations) are identical over all values of the independent variable and are uncorrelated. *See also* heteroskedasticity.

hood (1) A ventilation device used to remove gases from a work area, such as in a laboratory or paint

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booth. (2) A piece of protective equipment worn over the head during sandblasting or painting. If the environment is too harsh, fresh air is supplied to the user through the hood.

hook gauge A pointed, U-shaped hook attached to a graduated staff or vernier scale, used in the accurate measurement of the elevation of a water surface. The hook is submerged and then raised, usually by means of a screw, until the point just makes a pimple on the water surface.

hoop stress *See* burst strength.

horizon A layer or section of the soil profile, more or less well defined, occupying a position approximately parallel to the soil surface and having characteristics that have been produced through the operation of soil-building processes.

horizontal centrifugal pump A centrifugal pump with the shaft in a horizontal alignment and the impeller rotating in a vertical direction.

horizontal-flow tank A tank or basin, with or without baffles, in which the direction of flow is horizontal.

horizontal pump (1) A reciprocating pump in which the piston or plunger moves in a horizontal direction. (2) A centrifugal pump in which the pump shaft is in a horizontal position.

horizontal screw pump A pump with a horizontal cylindrical casing in which a runner with radial blades like those of a ship's propeller operates. The pump has a high efficiency at low heads and high discharges and is used extensively in drainage work. Such a pump is also called a wood screw pump.

horizontal-tube distillation Distillation using horizontally oriented evaporation tubes. *See also* multiple-effect distillation.

horizontal well A tubular well pushed approximately horizontally into a water-bearing stratum or under the bed of a lake or stream. Such a well is also called a push well.

hormesis A J- or U-shaped dose–response phenomenon. The hormesis concept challenges traditional views of a threshold dose for chemical toxicity.

hormonally active agent (HAA) *See* endocrine disruptor.

horsepower (hp) *See in the Units of Measure section.*

horsepower hour (hp•h) *See in the Units of Measure section.*

horseradish peroxidase A reagent for measuring hydrogen peroxide during advanced oxidation water treatment.

hose bib A location in a water line where a hose is connected. It is often called a faucet or sill cock.

host A person or other living animal, including birds and arthropods, that provides subsistence or lodging for an infectious agent under natural conditions. Some protozoa and helminths pass successive stages in alternate hosts of different species. In primary or definitive hosts, the parasite attains maturity or passes its sexual stage; in secondary or intermediate hosts, the parasite is in a larval or asexual state. A transport host is a carrier in which the organism remains alive but does not undergo development. In an epidemiologic context, the host may be a certain population group, and the biological, social, behavioral, and other characteristics of this population relevant to health are referred to as host factors.

host resistance Usually, the immunocompetence of an individual to resist invasion by an infectious agent. This term is sometimes applied (incorrectly) to describe resistance to chemical toxicities as well.

hot lime–cation softening The combination of a two-stage hot lime softening process followed by hot cation-exchange softening for complete hardness removal. *See also* hot process softening.

hot lime–soda softening A method of partially softening water by adding lime and soda ash to chemically precipitate the calcium, magnesium, iron, and silica at a water temperature of about 212° Fahrenheit (100° Celsius). This process also drives off carbon dioxide (CO_2). *See also* hot process softening; lime–soda ash softening.

hot lime softening A partial softening method that requires adding a lime slurry to water that is at about 212° Fahrenheit (100° Celsius) and then chemically precipitating and removing the calcium and magnesium hardness via sedimentation and filtering. *See also* hot process softening; lime softening.

hot plate An electrical heating unit used to heat solutions.

hot process softening Any of several softening–clarifying processes using lime, lime and soda ash, or lime and cation softening to treat water that is at or near the boiling point. Hot process softening can remove carbon dioxide (CO_2), silica (Si^{4+}), and precipitated magnesium (Mg^{2+}) and is used mainly for boiler feedwater preparation and sulfur mining. *See also* hot lime–cation softening; hot lime–soda softening; hot lime softening.

hot spot An area of soil that, through by survey and analysis or experience, is found to be more corrosive than surrounding soil.

hot water Water that has been heated to a temperature above that of the water in the street main.

hour (h, hr) *See in the Units of Measure section.*

house cistern A cistern in which rainwater is stored for household purposes.

household cost The cost to a household for a water system to meet a drinking water regulation. Annual household costs of meeting regulations are

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usually estimated by the US Environmental Protection Agency for proposed and final rules.

household detergent A detergent produced for retail marketing to individuals for use in home laundries. These detergents generally include anionic or nonionic surfactants plus phosphates (PO_4^{-3}) and minor ingredients such as perfumes, brighteners, and bleaches. *See also* detergent; surface-active agent.

household equipment *See* residential equipment.

household filter *See* home water treatment unit.

house service *See* domestic service.

Housing and Urban Development (HUD) The principal federal agency responsible for programs concerned with US housing needs, fair housing opportunities, and improvement and development of US communities. The US Department of Housing and Urban Development administers the following: Federal Housing Administration mortgage insurance programs that help families become homeowners and facilitate the construction and rehabilitation of rental units; rental assistance programs for lower-income families who otherwise could not afford decent housing; the Government National Mortgage Association mortgage-backed securities program that helps ensure an adequate supply of mortgage credit; programs to combat housing discrimination and affirmatively further fair housing; programs that aid community and neighborhood development and preservation; and programs to help protect the homebuyer in the marketplace.

H_2O_2/Vis–UV *See* ultraviolet light–hydrogen peroxide process.

H_2O_2/Vis–UV light process *See* ultraviolet light–hydrogen peroxide process.

hp *See* horsepower *in the Units of Measure section.*

HPC *See* heterotrophic plate count.

hp•h *See* horsepower-hour *in the Units of Measure section.*

HPLC *See* high-performance liquid chromatography.

HPLC-SEC (high-performance liquid chromatography–size exclusion chromatography) *See under* high-performance liquid chromatography; *see also under* size exclusion chromatography.

HPSEC *See* high-performance size-exclusion chromatography.

H. pylori *See Helicobacter pylori.*

hr *See* hour *in the Units of Measure section.*

HRRCA *See* health risk reduction and cost analysis.

HRT *See* hydraulic residence time.

HS *See* humic substance.

HSD *See* homogeneous solution diffusion.

HSDM *See* homogeneous surface diffusion model.

HSPF *See* hydrologic simulation program Fortran.

HTH® *See* High Test Hypochlorite®.

HTML *See* HyperText Markup Language.

HTU *See* height of transfer unit.

HU (Hazen unit) *See under* Hazen unit of color.

hub The bell end into which a spigot end is placed with a sealing gasket, gasket and gland, or poured lead joint, depending on the type of pipe. It is also called bell.

HUD *See* Housing and Urban Development.

human consumption As interpreted by the US Environmental Protection Agency, drinking, bathing, showering, cooking, dishwashing, and maintaining oral hygiene. This interpretation has been upheld by the courts, for example, in *United States v. Midway Heights County Water District,* 695 F. Supp. 1072, 1074 (E.D. Cal. 1988) ("Midway Heights"). *See also* bathing.

human enteric virus (HEV) Ingested virus that can infect the lining of the gastrointestinal tract.

human equivalent dose A dose that, when administered to humans, produces an effect equal to that produced by a certain dose in animals.

human exposure evaluation A component of risk assessment that involves describing the nature and size of a population exposed to a substance and the magnitude and duration of their exposure. The evaluation could concern past exposures, current exposures, or anticipated exposures.

human health risk The likelihood (or probability) that a given exposure or series of exposures may have damaged or will damage the health of individuals experiencing the exposures.

human immunodeficiency virus (HIV) A virus that spreads by blood and sexual contact and leads to the development of acquired immune deficiency syndrome. No evidence exists for casual transmission. Human immunodeficiency virus replicates in T-helper lymphocytes but can also infect a variety of other hematopoietic (blood) cells in the body.

human–machine interface (HMI) A means by which a human operator interacts with a supervisory control and data acquisition (SCADA) system. The human–machine interface of a SCADA system consists of color cathode ray tubes, mapboards, projection video, alarm annunciators, and alarm loggers.

human resources (1) All the persons employed by a business, utility, governmental agency, nonprofit organization, or association to accomplish the work and provide the service promised by the entity. (2) The name of a division within such organizations that interviews job applicants and deals with matters affecting employees.

humic acid A brown, polymeric constituent of soils, lignite, and peat. It is not a well-defined compound; rather, it is a mixture of polymers containing aromatic

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and heterocyclic structures, carboxyl groups, and nitrogen. Aquatic humic acids are major precursors of disinfection by-products. *See also* aquatic humic acid; aromatic heterocycle; aromatic hydrocarbon; disinfection by-product precursor; peat; polymer.

humic material Natural organic matter resulting from partial decomposition of plant or animal matter and forming the organic portion of soil. *See also* humic acid; natural organic matter.

humic substance (HS) *See* humic material.

humid (1) Containing or characterized by sensible moisture; moist or damp as applied to the atmosphere. (2) Characterized by precipitation adequate in amount and occurring at such times that agriculture can be carried on without irrigation, and by the possible need for drainage to remove excess moisture; having sufficient precipitation to support forest vegetation.

humidification The process of increasing the water vapor or moisture content.

humidity The condition of the atmosphere in terms of its content of water vapor.

humin The fraction of the soil organic matter that will not dissolve when the soil is heated with dilute alkali. *See also* humic material.

humoral immune function *See* humoral immunity.

humoral immunity The production of antibodies in lymphocytes or plasma cells following sensitization of an organism to a specific antigen. *See also* cell-mediated immunity; immunity.

humus Amorphous, colloidal matter in soil, usually of a dark color, remaining after most of the animal and plant tissues have decomposed.

hundredweight (cwt) *See in the Units of Measure section.*

hunting Periodic changes in the controlled variable from one side of the set point to the other as the controller overcorrects first in one direction, then in the other.

HVAC *See* heating, ventilating, and air conditioning.

H. vermiformis *See Hartmannella vermiformis.*

HW (high water) *See* high water *under* tidal water level.

HX *See* hydrogen halide.

hybrid biofilter A filter designed to perform both particle removal and biological treatment.

hybridization The laboratory technique of matching up and reannealing two single-stranded nucleic acid chains that complement each other. It is used for detecting a chain's complementary sequence or for targeting a specific sequence unique to a particular organism by means of a specific complementary probe.

hybrid membrane *See* hybrid membrane system.

hybrid membrane–adsorption system A membrane filtration system that uses an adsorbent, such as powdered activated carbon, upstream of the membrane to enhance organic removal performance. The adsorbent is separated from the filtrate (or permeate) by the membrane. *See also* adsorption; membrane.

hybrid membrane system A nonstandard membrane system with two or more modifications to obtain desired performance characteristics such as one with two types of membranes (e.g., reverse osmosis and nanofiltration membrane elements). *See also* membrane; nanofiltration; reverse osmosis.

hybrid plant A water treatment plant where two or more separate treatment processes are incorporated synergistically for improved overall performance or cost-effectiveness, e.g., a seawater-desalting plant with distillation and reverse osmosis processes using steam for energy input in such a way as to stabilize the power load requirements at the same time as producing an improved finished water quality by blending the desalted product waters from each process.

hybrid sorption-membrane process *See* hybrid membrane–adsorption system.

hydrant A device connected to a water main and provided with the necessary valves and outlets so that a fire hose may be attached for discharging water at a high rate for the purpose of extinguishing fires, washing down streets, or flushing out the water main. A hydrant is also called a fire plug.

hydrant barrel The vertical section of a fire hydrant containing the outlets for discharging water. The valve stem from the bonnet to the valve is located in this section. When the valve is turned off, water drains from this section to keep the hydrant from freezing.

hydrant bonnet The top part of a hydrant connected to the barrel, resembling a bonnet, that contains the operation nut to turn the hydrant on and off. The bonnet can be removed to allow repairs on the internal parts, such as replacement of the valve seat.

hydrant cap A casting with an inside thread designed to fit on the outside thread of a hydrant outlet nozzle and equipped with a special nut that fits a standard hydrant wrench to facilitate removal.

hydrant drain A device for draining the water from the barrel of a hydrant after use to prevent freezing in the barrel. The drain, operated by the main stem, is open when the hydrant is completely closed, allowing the water in the barrel to drain away.

hydrant map A mapped record that pinpoints the location of fire hydrants throughout the distribution system. Generally a plat-and-list or intersection map type. *See also* intersection map method; plat-and-list map method; valve-and-hydrant map.

hydrant Pitot blade A measuring device for determining the velocity of the water discharging freely

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into the air from one nozzle of a hydrant. It is used in order to determine hydrant flow.

hydrant size The net diameter of the valve seat of the main valve of a hydrant.

hydrant tee A special tee with a 90° elbow, also referred to as a setting tee. Such a tee is used where space is limited. The tee keeps the hydrant close to the water main. It can be installed in the same trench as the main and is anchored to the main.

hydrate A substance formed by combining water with a compound.

hydrated lime Limestone that has been "burned" and treated with water (H_2O) under controlled conditions until the calcium oxide (CaO) portion has been converted to calcium hydroxide ($Ca(OH)_2$). Hydrated lime is quicklime combined with water: $CaO + H_2O \rightarrow Ca(OH)_2$. *See also* quicklime.

hydration The chemical combination of water and another chemical to form another substance.

hydration water Water that combines with salts when they crystallize. *See also* water of crystallization.

hydraulic Referring to water or other fluids in motion.

hydraulic accumulator A device for storing energy by placing a fluid under pressure in a cylinder. The pressure can be released to accomplish work (e.g., operate brakes, open or close valves) when necessary.

hydraulically applied concrete Concrete that is placed under pressure by a pneumatic gun.

hydraulic barrier A groundwater divide that is typically created artificially through groundwater recharge activities to prevent or alter the movement of a contaminant (e.g., salt water) further into an aquifer system.

hydraulic bore A standing wave that advances upstream in an open conduit from a point where the flow has suddenly been stopped. The flowing water piles up in the channel against the obstruction that caused the stoppage, and as it reaches a height above the normal water surface approximately equal to its velocity head, the increased depth of water moves upstream in a wavelike shape, that is, a hydraulic bore. *See also* suction wave.

hydraulic classification The rearrangement during fully fluidized backwashing of ion exchange or other media particles according to size. As a result of fluidization, the smallest particles tend to rise to the top of the bed while the largest tend to sink to the bottom because of increased settling velocity. Hydraulic classification is also called classification or stratification.

hydraulic cleaning Any cleaning that is accomplished via a liquid under pressure and an orifice that provides a high-velocity flow and, consequently, a cleaning action.

hydraulic conductivity (*K*) A coefficient describing the relative ease with which water can move through a permeable medium. It is the constant of proportionality, *K*, in Darcy law:

$$Q = KA(\Delta h/\Delta l)$$

Where (in any consistent set of units):

Q = the flow
K = the hydraulic conductivity
A = the cross-sectional area perpendicular to the flow
Δh = the difference in hydraulic head
Δl = the length traveled

Typical units of hydraulic conductivity are feet per day, gallons per day per square foot, or meters per day (depending on the units chosen for the total discharge and the cross-sectional area). *See also* permeability; permeability coefficient.

hydraulic design basis (HDB) A level of ability of a unit process, or sequence of unit processes that must be accounted for in the process design to meet criteria associated with liquid loading or flow capacity. The hydraulic design basis for clarifier performance may be an overflow rate, whereas the hydraulic design basis for a treatment plant may be the peak flow that must be able to pass through basins and piping.

hydraulic detention time (HDT) The theoretical amount of time required for a given flow to pass through a unit process. It is calculated by dividing the volume of a unit process by the applied flow rate. It is also called the hydraulic residence time.

hydraulic dredge A scow carrying a centrifugal pump that has (1) a suction pipe reaching to the bottom to be excavated and (2) a discharge pipe connecting to a pipeline conveying material to a place of deposit. A hydraulic dredge is also called a sandpump dredge or suction dredge.

hydraulic element A quantity pertaining to a particular stage of flowing water or to a particular cross section of a conduit or stream channel, such as the depth of water, cross-sectional area of the water, hydraulic radius, wetted perimeter, mean depth of water, velocity, energy head, or friction factor.

hydraulic equation A statement of the law of mass conservation in terms of hydraulic variables. The equation can be expressed as

$$\text{inflow} = \text{outflow} \pm \text{changes in storage}$$

Usually one component of the equation is difficult to measure directly, but knowledge of the remaining components allows an individual to determine the value of the difficult component by solving the equation.

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hydraulic fill An earth structure or grading operation to which fill material is transported and deposited by means of water pumped through a flexible or rigid pipe.

hydraulic-fill dam An earth dam in which all or most of the materials have been transported to the dam and placed in the dam by dredging, sluicing, or pumping during construction. Generally, for greater imperviousness, the fine material in the sluiced earth is segregated and deposited along the center or axis of the dam to form a core.

hydraulic flocculation Flocculation attained by the flow of water through a baffled basin or channel. No mechanical stirring is used in hydraulic flocculation. *See also* baffled-channel system; end-around baffles; over-under baffles.

hydraulic flow net A drawing used for calculating pressures and velocities in a curving stream of water in cases where friction, impact, or eddy losses do not exercise a controlling effect. The hydraulic flow net is established by drawing (1) a system of streamlines so spaced that the rate of flow is the same between each pair of lines, and (2) a system of normal lines so spaced that the distance between the normal lines equals the distance between the streamlines.

hydraulic fracturing A technique of aquifer development in which fluid is injected at pressures that exceed the tensile stress of the aquifer, causing cracks to develop and propagate in the formation. These cracks serve as conduits for liquid flow to a production well. This technique is used extensively in petroleum recovery and is being investigated as a tool for increasing water production in rock-like aquifers and for contaminant recovery.

hydraulic friction The resistance to flow exerted on the perimeter or contact surface of a body of water moving in a stream channel or conduit caused by the roughness characteristic of the confining surface, which induces turbulence and consequent loss of energy. Energy losses arising from excessive turbulence, impact at obstructions, curves, eddies, and pronounced channel changes are not ordinarily ascribed to hydraulic friction. *See also* roughness coefficient.

hydraulic friction coefficient The ratio of actual discharge in a conduit or open channel to the theoretical discharge if the conduit were frictionless or the open channel free of turbulence. It is also called the roughness coefficient.

hydraulic grade *See* hydraulic grade line.

hydraulic grade line (HGL) A line (hydraulic profile) indicating the piezometric level of water at all points along a conduit, open channel, or stream. In a closed conduit under pressure, artesian aquifer, or groundwater basin, the line would join the elevations to which water would rise in pipes freely vented and under atmospheric pressure. In pipes under pressure, each point on the hydraulic profile is an elevation expressed as the sum of the height associated with the pipe elevation, the pipe pressure, and the velocity of the water in the pipe. In an open channel, the hydraulic grade line is the free water surface. Hydraulic profiles are commonly used to establish elevations through the processes that make up a treatment facility under maximum and minimum flow conditions.

hydraulic gradient The change in static head (pressure) per unit of distance in a pipeline in which water flows under pressure.

hydraulic head The height of the free surface of a body of water above a given point beneath the surface. *See also* head.

hydraulic jetting The process of using water forced through a well screen to suspend fine particles during well development.

hydraulic jump (1) In an open channel, a sudden and usually turbulent passage of water, under conditions of free flow, from a low stage below critical depth to a high stage above critical depth. During this passage, the velocity changes from supercritical to subcritical. The hydraulic jump represents the limiting condition of the slope of the surface curve, in which the surface tends to become perpendicular to the stream bed. (2) In a closed conduit, a sudden rise from flow that fills only part of the conduit at a supercritical velocity to flow that fills the conduit under pressure. The depth plus the pressure head downstream from the hydraulic jump equals the high stage obtained for open-channel flow. (3) To dissipate energy in an open channel or at the toe of a spillway section of a dam. (4) A device to promote turbulence. (5) An abrupt rise in water surface that may occur in an open channel when water flowing at a high velocity is retarded.

hydraulic loading The amount of water applied to a given treatment process, usually expressed as volume per unit time or volume per unit time per unit surface area.

hydraulic loss A loss of head attributable to obstructions, friction, changes in velocity, and changes in the form of the conduit.

hydraulic mean depth *See* hydraulic radius.

hydraulic model (1) A computer program that predicts pipe flows and pressures throughout a water distribution network. The model can be used to calculate and simulate various hydraulic conditions. (2) A flow system operated so that the characteristics of another similar system may be predicted. A model is generally a small-scale reproduction of the prototype, but it may be larger or geometrically distorted.

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A hydraulic model is used in studies of spillways, stilling basins, flood regulation, or river beds. It may also be called a hydraulic similitude model.

hydraulic permeability The rate of discharge through a unit cross-sectional area of soil normal to the direction of flow when the hydraulic gradient is unity. *See also* permeability coefficient.

hydraulic profile *See* hydraulic grade line.

hydraulic radius The cross-sectional area of a stream of water perpendicular to the flow divided by the length of that part of the water's periphery in contact with the containing conduit; the ratio of area to wetted perimeter. Hydraulic radius is also called hydraulic mean depth.

hydraulic ram A type of pump that uses water as a ram, utilizing kinetic energy or velocity head to force a small portion of water to a higher level by stopping the flow of the volume of water and applying the force to the small portion of the water to be pumped. A hydraulic ram is also called a water ram.

hydraulic reclassification *See* hydraulic classification.

hydraulic residence time (HRT) *See* hydraulic detention time.

hydraulic retention time *See* hydraulic detention time.

hydraulics That branch of science or engineering that deals with water or another fluid in motion.

hydraulic similitude *See* hydraulic model.

hydraulic size The grain diameter that uniform grains of filter media would have to be to cause the same loss of head as the variable size mixture of media usually employed in filtration (assuming the material has the same voidage or porosity). The hydraulic size is calculated from a sieve analysis and provides the media size parameter used in the Kozeny–Carman equation to calculate head loss for a given depth of this media at the flow rates and water viscosities to be encountered.

hydraulic slope The slope of the hydraulic grade line. *See also* hydraulic gradient.

hydraulic sluicing The process or operation of moving rock or soil by means of a jet or stream of water.

hydraulic stage *See* hydraulic staging.

hydraulic staging A setup for allowing multiple passes of water between electrodes used in an electrodialysis process, through a sequence of subsequent membranes in a pressure-driven membrane system, or through filters used in a filtration system to achieve further treatment.

hydraulic structure Generally, any major engineering device used to control flow or distribute water. *See also* canal; catch basin; clearwell; detention tank; equalization; headbox; reservoir; sedimentation basin; splitter box; stabilization tank; wet well.

hydraulic surge A sudden decrease in the flow velocity in pipelines accompanied by pressure increases that may in some cases cause rupture of the pipe. This pressure increase propagates as pressure wave in pipelines and the flow are under the hydraulic surge condition. *See also* pressure transient.

hydraulic turbine A prime mover using the pressure or motion of water for the generation of mechanical energy.

hydraulic turbocharger A pumping device for which two or more turbine impellers rotate on a single shaft and the hydraulic energy of one flow stream is transferred to another flow stream, e.g., in a high-pressure reverse osmosis system where the pressurized waste concentrate stream helps to boost the inlet feedwater pressure.

hydraulic valve A valve operated by means of a hydraulic cylinder or other hydraulic device.

hydrazine (H_2NNH_2) A liquid compound used as a strong reducing agent for transition metals and as an oxidation inhibitor for boiler feedwater and cooling water.

hydric soil A soil that is saturated, flooded, or ponded long enough during the growing season for anaerobic conditions to develop in the upper part.

hydride generation A technique for isolating several elements (arsenic, antimony, tin, selenium, bismuth, and lead) from the aqueous phase by first generating their hydrides in the sample and aspirating the sample to transfer the hydrides to a detector, such as an atomic absorption spectrophotometer.

hydride generation atomic fluorescence (HGAF) A method for analyzing several elements (arsenic, antimony, tin, selenium, bismuth, and lead) by first generating their hydrides in a sample and then transferring them to a fluorescence detector in the gas phase. *See* fluorescence; hydride generation.

hydro- Prefix meaning related to water, from the Greek word *hudr-*, which means "from water."

hydrocarbon An organic compound consisting exclusively of the elements carbon and hydrogen. Hydrocarbons (C_xH_y) are derived principally from petroleum, coal tar, and plant sources.

hydrocarbon pneumonia An inflammation of the lung with infiltration of fluid caused by aspiration of low-viscosity hydrocarbons into the lung after such hydrocarbons are swallowed. Ingestion of very small amounts (10 milliliters) of such hydrocarbons can be serious and even life-threatening. The lower the viscosity of the hydrocarbon, the more probable that it will produce hydrocarbon pneumonia.

hydrocerussite ($Pb_3(CO_2)(OH)_2$ or $2PbCO_3 \cdot Pb(OH)_2$) The mineral name for a form of basic lead carbonate, described by the formula noted. Hydrocerussite is

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formed readily on lead surfaces at a pH greater than approximately 8 in the presence of dissolved inorganic carbonate, making it an extremely important solid in controlling lead solubility in drinking water systems. Hydrocerussite tends to be light in color, frequently white, cream, or light bluish gray, and is easily mistaken for calcium carbonate ($CaCO_3$) in the absence of microscopic or chemical examination.

hydrochloric acid (HCl) A water-based solution of hydrogen chloride that is a strong, highly corrosive acid. Hydrochloric acid may be used as a regenerant for cation resin deionization systems operated in the hydrogen (H^+) cycle and in laboratory applications.

hydrochlorination *See* hypochlorination.

hydrochlorinator *See* hypochlorinator.

hydroclone The basic form of most separators that act on the principle of centrifugal force and are used to remove sand and abrasives from well water. A hydroclone is also called a cyclone precipitator or separator.

hydrodynamic dispersion The phenomenon in which a solute in groundwater flow is mixed with uncontaminated water, resulting in reduced concentrations of the dissolved compound. Hydrodynamic dispersion is roughly analogous to turbulent mixing in open flow systems, although the mechanisms and scale of the mixing are much different in the two cases.

hydrodynamics The study of the motion of, and the forces acting on, fluids.

hydroelectric power Electric power produced by using water power as a source of energy.

hydrofluosilicic acid (H_2SiF_6) A strongly acidic liquid used to fluoridate drinking water.

hydrogen (H) A nonmetallic element having an atomic number of 1. It occurs chiefly in combined form (e.g., in water, hydrocarbons, and other organic compounds). It is also available as a diatomic gas (i.e., H_2). *See also* hydrocarbon.

hydrogen-based membrane biofilm reactor A special hollow-fiber membrane reactor in which hydrogen gas is introduced through the fiber lumen and diffuses through the membrane wall where it is an electron donor and utilized by microorganisms that grow naturally as a biofilm on the outside of the membrane wall. It can be used for enhanced biological denitrification and reduction of perchlorate and other oxidized contaminants.

hydrogen bond The weak attraction between a hydrogen atom carrying a partial positive charge and some other atom with a partial negative charge. Hydrogen bonds occur in polar compounds, such as water, by the attraction of a hydrogen atom of one molecule to two unshared electrons of another molecule. Hydrogen bonds are less than one tenth as strong as covalent bonds in which electrons are actually shared by a pair of atoms, but they significantly affect properties such as the melting point, boiling point, and crystalline structure of a substance.

hydrogen chloride (HCl) A gas with a strong odor. Its water solution is called hydrochloric acid, which is commonly used in water laboratories.

hydrogen cycle A cation-exchange cycle in which the cation medium is regenerated with acid and all cations in the water are removed by exchange with hydrogen (H^+) ions.

hydrogenesis A process of natural condensation of the moisture in the air spaces in surface soil or rock.

hydrogen halide (HX) A class of inorganic compounds with varying acid strengths, including hydrochloric acid (HCl) and hydrofluoric acid (HF). *See also* hydrochloric acid.

hydrogen ion (1) In aqueous solution, a positively charged combination of a proton and a water molecule (hydrated, H_3O^+). (2) A single proton, usually abbreviated H^+.

hydrogen ion activity *See* hydrogen ion concentration.

hydrogen ion concentration A measure of acidity. It is an important concept in natural waters. The negative logarithm of the hydrogen ion concentration (activity) in moles per liter is operationally defined as the pH. The hydrogen ion concentration can affect the chemical constituents of water, chemical and biological reactivity, water treatment, and water analysis. *See also* pH.

hydrogenotrophic Requiring hydrogen to grow.

hydrogen peroxide (H_2O_2; H–O–O–H) Strong oxidizing agent used for bleaching and, to some extent, as a disinfectant. Ozone (O_3) in combination with hydrogen peroxide (i.e., peroxone), or ultraviolet light in combination with hydrogen peroxide, is used in some advanced oxidation processes to produce hydroxyl radicals (•OH). *See also* advanced oxidation process; disinfectant; hydroxyl radical; oxidant; ozone–hydrogen peroxide process; ultraviolet light–hydrogen peroxide process.

hydrogen peroxide/visible–ultraviolet (H_2O_2/vis–UV) light process *See* ultraviolet light–hydrogen peroxide process.

hydrogen sulfate A gas with a distinctive rotten-egg odor. Present in raw sewage, septic water, and wastewater residuals, and some groundwater, it can be oxidized by chlorine, ozone, or other oxidants.

hydrogen sulfide (H_2S) A toxic gas produced by the anaerobic decomposition of organic matter and by sulfate-reducing bacteria. Hydrogen sulfide has a very noticeable rotten-egg odor. Respiratory paralysis and death may occur quickly for people exposed to concentrations as low as 0.07 percent by volume in air.

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hydrogeochemistry The study of the chemical characteristics of groundwater and surface water in relation to areal and regional geology.

hydrogeologic assessment A systematic study of geologic and groundwater resources. Geologic studies focus on near-surface deposits and bedrock. Groundwater studies include flow systems, aquifer capacity, groundwater chemistry, and sand and gravel deposits. Interpretation of sensitivity to pollution is also part of the study.

hydrogeologic condition A condition stemming from the interaction of groundwater and the surrounding soil and rock.

hydrogeologic cycle *See* hydrologic cycle.

hydrogeologist A person who studies and works with groundwater.

hydrogeology *See* geohydrology.

hydrograph A graphic representation of the relationship of the flow, stage, or velocity of a canal or river at a given point as a function of time. Typically it refers to the relationship of discharge and time.

hydrographer (1) A person who makes surveys of bodies of water. (2) In some sections of the country, a person who measures the flow of streams or conduits.

hydrographic Pertaining to the measurement or determination of various characteristics of bodies of water.

hydrographic basin *See* drainage area.

hydrographic survey An instrumental survey made to measure and record physical characteristics of streams and other bodies of water within an area, including such things as location, areal extent and depth, positions and locations of high-water marks, and locations and depths of wells.

hydrography (1) The science of measuring and analyzing the flow of water, precipitation, evaporation, and allied phenomena. (2) The science of measuring and studying oceans, seas, rivers, other waters, and their marginal land areas, as well as the configurations of the underwater surface, including the relief, bottom materials, and coastal structures. In a computer modeling graphic database, these hydrographic features are represented by, for example, water boundaries, stream centerlines, and lake polygons. Such continuous linear features facilitate the structuring of elements into a logical network for modeling purposes.

hydroisobath A contour line on a map that shows the depth to the water table from the ground surface. All points on a particular contour have the same depth. *See also* water-table isobath.

hydroisopleth map A map showing the fluctuation of the water table with respect to time and space.

hydrokinetics The study of the motion of fluids without reference to related forces.

hydrologic area A state or region having similar mean annual flood characteristics.

hydrologic balance An accounting of all water inflow to, water outflow from, and changes in water storage within a hydrologic unit such as a drainage basin, aquifer, soil zone, lake, or reservoir over a specified period of time.

hydrologic budget An accounting of the inflow to, outflow from, and storage in a hydrologic unit such as a drainage basin, aquifer, soil zone, lake, reservoir, or irrigation project. *See also* available supply.

hydrologic cycle The natural process recycling water from the atmosphere down to (and through) the earth and back to the atmosphere.

hydrologic dam station A site at which information applicable to hydrologic studies is collected.

hydrologic inventory The process of (1) evaluating the items of inflow, outflow, and storage and (2) balancing the hydrologic equation.

hydrologic properties Those properties of soils and rocks that control the entrance of water and the capacity to hold, transmit, and deliver water. They include porosity, specific yield, specific retention, permeability, infiltration capacity, and direction of maximum and minimum permeability.

hydrologic simulation program Fortran (HSPF) A comprehensive watershed simulation model designed to simulate the hydrologic and associated water quality processes on pervious and impervious land surfaces, as well as in streams and well-mixed impoundments.

hydrology The science dealing with the properties, distribution, and circulation of water.

hydrolysate The product of hydrolysis.

hydrolysis A chemical reaction in which water molecules react with a substance to form two or more substances.

hydromechanics The science concerned with the equilibrium and motion of fluids and of bodies in or surrounding them.

hydrometric pendulum A device consisting of a metal ball suspended on a cord that is lowered into flowing water. After calibration, measuring the cord's inclination as caused by the current indicates the velocity of the current.

hydrometry (1) The measurement and analysis of the flow of water. (2) The determination of specific gravities of liquids.

hydronium ion *See* hydrogen ion.

hydroperiod The cycle of water depth variation and duration of coverage within a wetland over a period of time.

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hydrophilic Having a tendency or affinity to bind with water molecules or absorb water. *See also* hydrophobic.

hydrophilicity The degree to which a substance is hydrophilic. *See also* hydrophilic.

hydrophilic polyethersulfone filter Used for isolating particular dissolved organic carbon from a water sample. Hydrophilic polyethersulfone is known for its low protein binding.

hydrophilic polypropylene filter Used for isolating particular dissolved organic carbon from a water sample. Hydrophilic polypropylene is known for its low protein binding and compatibility with a large variety of solvents.

hydrophobic Having a tendency to repel water molecules. *See also* hydrophilic.

hydrophobic dissolved organic carbon A dissolved organic carbon fraction that does not typically reside in water. It is commonly referred to as the dissolved organic carbon fraction that can be separated by absorbing onto XAD-8 resin. *See also* dissolved organic carbon.

hydrophobicity The degree to which a substance is hydrophobic. *See also* hydrophobic.

hydrophone *See* waterphone.

hydrophyte A plant that grows in saturated soils or water.

hydropneumatic Pertaining to a water system (usually a small one) in which a water pump is automatically controlled (started and stopped) by the air pressure in a compressed-air tank.

hydropneumatic system A system that uses both air and water in its operation. An example is a pressure tank that uses an air chamber to maintain pressure in a well system even when the pump is not operating.

hydropneumatic tank A storage tank of a given volume that is under pressure and thereby establishes a pressure for the water distribution system to which it is connected. Small systems often use hydropneumatic tanks instead of elevated storage tanks to establish system pressure.

hydropneumatic wand A device used to break up mudballs in a filter bed. The device consists of a long pipe, with a tee-shaped end with nozzles that delivers air and water into the filter bed. It can be used at specific locations within the bed where backwashing and auxiliary scour are considered to be weak or not sufficiently effective.

hydropower *See* hydroelectric power.

hydroscopic Tending to absorb moisture from the atmosphere. Sodium chloride (NaCl) is one hydroscopic substance. This term is identical to the term *hygroscopic.*

hydroscopic water Water that is strongly attracted to the solid particles in a porous medium and held in place by surface tension forces. It typically cannot be removed from a sample except by forcing a phase change, usually by heating the sample in an oven.

hydrosphere The water of the earth, including surface lakes, streams and oceans, underground water, and water in the atmosphere.

hydrostatic design basis (HDB) The long-term hydrostatic hoop strength of a specific fiberglass pipe material for water service as determined by tests and detailed evaluation procedures in accordance with ASTM D2992.

hydrostatic head *See* head.

hydrostatic joint A joint of the bell-and-spigot type formed in a large water main by forcing sheet lead into the bell under hydraulic pressure.

hydrostatic level The level or elevation to which the top of a column of water would rise, if afforded opportunity to do so, from an artesian aquifer or basin or from a conduit under pressure.

hydrostatic press A hydrostatic machine for increasing an applied force. It consists of two connected cylinders, one much larger than the other, fitted with watertight pistons. Such a machine is also called a Bramah's press.

hydrostatic pressure (1) The pressure at a specific elevation exerted by a body of water at rest. (2) In the case of groundwater, the pressure at a specific elevation caused by the weight of water at higher levels in the same zone of saturation.

hydrostatic pressure testing The act of determining the pressure that a structure can withstand by exerting a force generated by a fixed water column or pump. For example, a finished water storage reservoir can be tested hydrostatically by filling with water to a predetermined height; the pressure at the base of the tank will then be equivalent to the product of the water depth and the water density. The vessel is then observed, tested for leaks, distortions, mechanical failure, or any combination thereof.

hydrostatics The study of water at rest.

hydrostatic sludge removal The discharge of sludge from hopper-bottomed sedimentation tanks by use of the hydrostatic pressure of the water above the sludge outlet.

hydrostatic test *See* hydrostatic pressure testing.

hydrostatic uplift (1) The upward pressure against the base of an impervious dam transmitted by water in the foundation from the water behind the dam. (2) Pressure on the upper surface of any horizontal joint or crack in a dam. *See also* uplift.

hydrosulfite ($(NaO)_2S_2O_4 \cdot 2H_2O$) A salt used for reducing chlorine residuals. *See also* sodium hydrosulfite.

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hydroturbine *See* turbopump.

hydroxide alkalinity Alkalinity caused by hydroxide ions (OH^-). It is also called hydroxyl alkalinity. *See also* alkalinity.

hydroxide ion (OH^-) The ion formed by an oxygen and a hydrogen atom. This term is used to describe the anionic hydroxyl radical that is partially responsible for the alkalinity of a solution.

hydroxyl (OH) The univalent group consisting of one atom of oxygen and one of hydrogen. It occurs in many inorganic compounds that ionize in solution to yield hydroxide ions (OH^-). It is also the characteristic group of alcohols. *See also* alcohol.

hydroxyl radical (•OH) A very strong oxidizing agent that can destroy many organic compounds in water. Various advanced oxidation processes are used to generate hydroxyl radicals. *See also* advanced oxidation process; organic compound; ozone–biodegradation process; ozone–hydrogen peroxide process; ozone–ultraviolet light process; pulsed ultraviolet light–hydrogen peroxide process; sonolysis; ultraviolet light–hydrogen peroxide process.

***p*-hydroxy-phenyl-acetic acid** A reagent used for the analysis of hydrogen peroxide during advanced oxidation water treatment.

hydroxypyromorphite ($Pb_5(PO_4)_3OH$) Green lead ore that can exist as crystals, typically having a green, yellow, or brown color. It is found in drinking water distribution system lead corrosion by-products.

hydrozone A portion of a landscape area having plants with similar water needs that either are not irrigated or are irrigated by a circuit or circuits having the same schedule.

hydrozoning The design practice of grouping plants by similar water requirements to maximize the potential efficiency of irrigation.

hyetal regions Divisions of the world defined according to rainfall characteristics.

hyetograph (1) A graphical representation of average rainfall, rainfall excess rates, or volumes over specified areas during successive units of time during a storm. (2) A self-registering rain gauge.

hyetography The study of the geographic distribution of rainfall.

hyetology The branch of meteorology that studies precipitation.

hygrograph A recording hygrometer.

hygrometer (1) An instrument for measuring the relative amount of moisture in the atmosphere. (2) An instrument for determining the dew point. *See also* psychrometer.

hygroscopic *See* hydroscopic.

hygroscopicity As applied to soil, the ability to absorb and retain moisture.

hygroscopic moisture *See* hydroscopic water.

hygroscopic water *See* hydroscopic water.

hyperactivity Any of a large constellation of clinical disorders. Most simply, hyperactivity is any disorder that results in abnormally increased motor activity. *See also* hyperkinetic syndrome.

hypercalcemia An excess of calcium in the blood.

hypercritical flow *See* shooting flow.

hyperfiltration Filtration using an extremely dense medium capable of separating dissolved ions from a feed stream. This term is sometimes, but not always, used synonymously with *reverse osmosis*. *See also* reverse osmosis.

hyperinfectious A higher than normal rate of infection among a population caused by an organism or illness.

hyperkinesis Abnormally increased motor activity. It is also referred to as hyperactivity. Hyperkinesis has been associated with lead intake, and drinking water can be a significant contributor to lead burdens.

hyperkinetic syndrome A childhood disorder that usually abates during adolescence. It is characterized by hyperactivity, fidgetiness, impulsiveness, excitability, distractibility, a short attention span, and difficulties in learning and perception. It includes disorders that respond paradoxically to a certain class of stimulant drugs (e.g., Ritalin) by an apparent calming of a child's activity. The syndrome has a variety of etiologies and in some cases is caused by overt brain damage. It has been associated with excessive exposure to heavy metals, such as lead, and some food additives. The food association is particularly weak, however.

hypermedia (1) A method of computer programming that allows for the networking of multimedia nodes connected by links and having the capability to reference, retrieve, and integrate different forms of geographic data, including vector maps, tabular database information, freeform text, raster images, engineering drawings, standard forms, photographs and other images, or audio records. A geographic information system is often viewed as the index to the variety of data or the "hub" of the multimedia system. (2) Richly formatted documents containing a variety of types of information, such as textual, image, movie, and audio.

hypersensitive animal *See* hypersusceptible animal.

hypersensitivity A condition of having an allergic response to a particular substance. The observed response is very much exaggerated relative to nonallergic individuals. Acute hypersensitivity reactions (type I, or anaphylaxis) can be immediately life-threatening. Type II reactions produce damage through the production of antibodies to tissue antigens, possibly resulting in chronic disease. Chronic toxicities of certain chemicals (e.g., chronic renal injury by mercury) can be mediated by the latter mechanism.

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hypersusceptible animal An animal whose sensitivity to a chemical, physical, or microbial agent is greater than average for the species or strain.

hypertension A disease that results in blood pressure that is routinely higher than normal. This term is less commonly applied to describing temporary increases in blood pressure caused by normal physiological states (e.g., a fight-or-flight response). Contaminants in drinking water can influence blood pressure.

HyperText Markup Language (HTML) A computer language used to structure text and multimedia documents and to set up hypertext links between documents, used extensively on the World Wide Web.

hypobromite A shortened name for hypobromite ion (OBr^-). *See also* hypobromite ion.

hypobromite ion (OBr^-) The ionized form of hypobromous acid (HOBr). Ozonation of hypobromite ion produces bromate (BrO_3^-). *See also* bromate ion; hypobromous acid.

hypobromous acid (HOBr) An acid used as a bactericide. During the disinfection of drinking water with chlorine (HOCl) or ozone (O_3), bromide ion (Br^-) is oxidized to hypobromous acid. Hypobromous acid reacts with natural organic matter to form bromine-substituted disinfection by-products. *See also* bactericide; bromide; disinfectant; disinfection by-product; natural organic matter.

hypochlorination Chlorination using solutions of calcium hypochlorite ($Ca(OCl)_2$) or sodium hypochlorite (NaOCl).

hypochlorinator A device used to chlorinate a liquid stream by adding chlorine in the form of liquid sodium hypochlorite (NaOCl, commonly called bleach) or calcium hypochlorite ($Ca(OCl)_2$).

hypochlorite A shortened name for hypochlorite ion (OCl^-). *See also* hypochlorite ion.

hypochlorite ion (OCl^-) The ionized form of hypochlorous acid (HOCl). *See also* hypochlorous acid.

hypochlorite of lime A combination of slaked lime and chlorine in which calcium oxychloride ($Ca(OCl)_2$) is the active ingredient. It is also called chlorinated lime.

hypochlorite solution An aqueous solution of a metallic salt of hypochlorite ion (OCl^-) that is used as a disinfectant and as a bleaching and oxidizing agent. *See also* disinfectant; hypochlorite ion; oxidant.

hypochlorous acid (HOCl) An acid used as a disinfectant and as a bleaching and oxidizing agent. During the disinfection of drinking water with chlorine (Cl_2), hypochlorous acid reacts with natural organic matter and bromide (Br^-) to form disinfection by-products. *See also* bromide; disinfectant; disinfection by-product; natural organic matter; oxidant.

hypolimnetic aeration Introduction of oxygen or air into a deep layer of a reservoir. The purpose of the aeration is to control eutrophication (by limiting release of phosphorus from sediment internal loading), maintain cold water fish species (by providing an aerated refuge in deep water during summer), control iron and manganese (by precipitation in an aerobic hypolimnion), and, in some circumstances, improve water quality (dissolved oxygen concentration) downstream from dams where the discharge is below thermal stratification and does not get aerated when released. The addition of dissolved oxygen to the hypolimnion is accomplished without changing the thermal or density profile of the body of water. *Contrast with* artificial destratification. *See also* artificial destratification; density stratification; destratification; overturn; thermal stratification.

hypolimnetic oxygenation The addition of pure oxygen to the hypolimnion, or deep layer, in a eutrophic reservoir to increase oxygen content without changing the thermal or density profile of the body of water. *See also* hypolimnetic aeration.

hypolimnion A region of relatively constant temperature below the thermocline and extending to the bottom in a thermally stratified body of water. *See also* epilimnion; thermocline.

hypotension Blood pressure that is lower than normal. *See also* hypertension.

hypothalamo-pituitary-gonadal axis A set of feedback relationships that regulate the activity of hormones involved in sexual development and reproductive functions. These relationships involve a brain region called the hypothalamus, as well as the pituitary gland and the testicles or ovaries. Chemicals that modify interactions between these organs or interfere with the ability of the endocrine system to control function in a variety of other organs are referred to as endocrine disruptors. *See also* endocrine disruptor.

hypothermia A lowering of a person's deep body or core temperature to less than 98.6° Fahrenheit (37° Celsius), usually following exposure to cold water temperatures or ambient air.

hypothesis A supposition, arrived at from observation or reflection, that can be tested (or evaluated) in an analytic investigation. In science, a null hypothesis is put forth in order that it might be refuted; the null hypothesis states that the results observed in a study, experiment, or test are no different from what might have occurred because of chance alone. In environmental epidemiology, the search for causal associations between diseases and environmental exposures involves a series of cycles in which epidemiologists examine existing hypotheses, formulate new hypotheses, and test the acceptability of these new hypotheses. An epidemiologic hypothesis

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should describe the following with a high degree of specificity: the population and its characteristics, exposure, disease, dose–response relationship, and time–response relationship. *See also* statistically significant.

hypoxia Reduced oxygen tension in tissues. It can have a variety of causes, such as decreased oxygen in the breathing zone, insufficient circulation, or compromised breathing. It can also be produced when chemicals such as carbon monoxide (CO), nitrate (NO_3^-), or chlorite (ClO_2^-) interfere with the oxygen-carrying capacity of the blood.

Hz *See* hertz *in the Units of Measure section.*

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I

IAIP *See* Directorate for Information Analysis and Infrastructure Protection.

IAST *See* ideal adsorbed solution theory.

iatrogenic transmission Transmission of a disease or condition by a physician through inadvertent or erroneous treatment.

IC *See* ion chromatography.

ICD *See* International Classification of Diseases.

ice The solid state of water.

ice gorge The choking of a stream channel caused by the piling up of ice against some obstruction, forming a temporary dam, and the subsequent release of the water impounded behind the dam caused by sudden bursting.

ice jam The choking of a stream channel caused by the piling up of ice.

ice pressure Pressure against a dam or other structure located in water caused by the expansion of ice caused by a change in temperature.

ice push A sudden increase in the ice pressure.

ICM *See* integrated catchment management.

icosahedral A geometric shape of a particular viral particle, made up by the protein coat and composed of 12 vertices, 20 triangular faces, and 30 edges.

ICPA (inductively coupled argon plasma) spectroscopy *See under* inductively coupled plasma spectroscopy.

ICP–AES (inductively coupled plasma–atomic emission spectroscopy) *See under* inductively coupled plasma spectroscopy.

ICP–MS *See* inductively coupled plasma–mass spectrometry.

ICP spectroscopy *See* inductively coupled plasma spectroscopy.

ICR *See* Information Collection Rule.

I/C/R *See* industrial/commercial/residential.

ICR method *See* Information Collection Rule Method.

ICRSS *See* Information Collection Rule Supplemental Survey.

ICS/UC *See* Incident Command System/Unified Command.

icterus A condition characterized by an excess of bile pigments in the blood and tissues that leads to a yellow color of the surface of the skin. It is also known as jaundice.

ID *See* inside diameter.

ID_{50} *See* infectious dose 50.

IDA *See* International Desalination Association.

IDDF *See* integrated disinfection design framework.

IDDM (insulin-dependant diabetes mellitus) *See under* diabetes.

IDEA *See* International Desalination Association.

ideal adsorbed solution theory (IAST) A theory describing a method to evaluate the competitive adsorption of contaminants in similar or different phases, independent of the form of the isotherm (e.g., Freundlich, Langmuir). *See also* competitive adsorption; Freundlich isotherm; Langmuir isotherm.

idiosyncratic reaction A reaction of an individual to a chemical exposure in a way unique to that individual or at least rare within a population. These reactions generally have a genetic basis by which the individual underexpresses a protein that performs some essential function.

IDLH *See* immediately dangerous to life or health.

IDSE *See* initial distribution system evaluation.

IE *See* ion exchange.

IEEE A large professional organization made up of electrical and electronics engineers and others in the technology field, originally called the Institute of Electrical and Electronics Engineers, which is now referred to by the letters IEEE alone. Its membership is worldwide, and its mission is to advance all areas of technology through the publication of standards and through student memberships. IEEE publishes the National Electrical Safety Code®, which sets standards for the safeguarding of persons during the installation, operation, or maintenance of electric supply and communication lines and associated equipment.

IEM *See* immunoelectron microscopy.

IEP *See* isoelectric point.

IESWTR *See* Interim Enhanced Surface Water Treatment Rule.

IFA *See* immunofluorescence assay.

IFE *See* individual filter effluent.

IFI *See* International Fabricare Institute.

igneous rock Rock formed from the cooling and solidification of magma (molten rock).

ihp *See* indicated horsepower.

ILI *See* infrastructure leakage index.

illuminance units *See in the Units of Measure section.*

illuviation A process of accumulation by deposition from percolating water of material transported in solution or suspension.

ilmenite ($FeTiO_3$) A high-density filtering material having a specific gravity of 4.68–4.76, sometimes used in triple-media media filters. Ilmenite is an iron titanium ore associated with hematite and magnetite. *See also* triple-media filter.

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image well An imaginary well used in modeling to simulate the effects of hydraulic boundaries on a pumping or recharge well.

imaginary wells An array of image wells used to simulate the effects of complicated hydraulic boundaries. *See also* image well.

Imhoff cone A clear, cone-shaped container marked with graduations used to measure the volume of settleable solids in a specific volume (usually 1 liter) of water.

immediate hypersensitivity An acute allergic response also referred to as anaphylaxis. If severe enough, such reactions can be life-threatening.

immediately dangerous to life or health (IDLH) A phrase used to describe an extremely hazardous atmosphere in the workplace that could cause injury or death very quickly.

immediate toxicological effect An adverse effect that develops rapidly after exposure to a chemical. It is usually discussed in relation to effects that have a substantial latent period before they develop.

immersed membrane A membrane in a vacuum-driven membrane system. *See also* vacuum-driven membrane system.

immersed membrane system *See* vacuum-driven membrane system.

immersed ultrafiltration (UF) membrane *See* immersed membrane.

imminent danger A threatening situation that may cause injury or loss of life if the conditions are not corrected quickly.

immiscible Not capable of being mixed.

immune surveillance The capacity of the immune system to respond by recognizing foreign materials, particularly those that produce infectious disease. This term can also be applied to the immune system's recognition of cells in the body that express specific antigens (e.g., tumor cells). Chronic chemical toxicities are frequently autoimmune effects. The chemical is metabolized to a reactive form that binds to a protein that is externalized on the exterior of a cell—e.g., on liver cells—and antibodies are formed; the next time an exposure occurs, the liver is damaged by an immune response. This effect occurs with chlorinated hydrocarbons. A syndrome referred to as Goodpasture's syndrome—a glomerulonephritis (i.e., kidney damage)—is produced by exposure to solvents.

immunity (1) A state of increased resistance to infectious disease. Generally, it is the result of the formation of antibodies or special cells (macrophages) to specific antigens expressed by the infectious agent. Immunity can be passive (e.g., the result of medical personnel administering antibodies) or active (e.g., the result of stimulating the individual's own immune system to respond to a particular antigen). (2) With respect to corrosion, the domain of pH and oxidation–reduction potential (variously called E, pE, or EMF) where oxidation of the metal cannot take place. The area of such immunity is sometimes referred to as the area of cathodic protection. *See also* cell-mediated immunity; humoral immunity; immunization.

immunity, acquired *See* acquired immunity.

immunity, active humoral *See* active humoral immunity.

immunity, passive humoral *See* passive humoral immunity.

immunization A natural or artificial development of resistance to a specific disease. *See also* infection; pathogenic organism.

immunocompromised Having an inability to respond appropriately to an infection because one or more components of the immune system are not functioning properly. This state can arise in a variety of ways; it may be inherited, induced by chemicals, or caused by infectious agents.

immunodeficiency A lack of one or more immune functions. This term can apply to deficiencies in either cell-mediated or humoral immunity. Immunodeficiency can also arise by a modification of the ability to control and integrate the various arms of the immune system. It can be congenital (i.e., a genetic disorder) or acquired (i.e., arising from viral infection, malnutrition, or a variety of disease states). *See also* acquired immune deficiency syndrome; cell-mediated immunity; humoral immunity.

immunoelectron microscopy (IEM) An electron microscopy technique that uses antibody labeling to identify the positions of specific proteins on the surface of a structure such as a ribosome.

immunofluorescence The emission of visible light by a compound that has been irradiated with ultraviolet light. For example, a fluorescent compound (i.e., a fluorescein) can be attached to an antibody. Bacterial, viral, or other antigens that react with the antibody can then be observed by illuminating the sample with ultraviolet light.

immunofluorescence assay (IFA) A methodology often used for protozoa that uses two separate antibodies, one labeled to detect the target, the other fluorescently labeled to detect the antibody bound to the target. The preparation may be viewed microscopically under ultraviolet light for fluorescence.

immunoglobin The class of proteins to which antibodies (i.e., IgG, IgM, IgA, IgD, IgE) belong.

immunomagnetic assay A method for detecting microorganisms or cells by using antibodies attached to magnetic particles for separation. *See also* antibody.

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immunomagnetic capture system A methodology in which target pathogens (i.e., *Cryptosporidium parvum, Enterococcus faecalis*) are bound to antibodies on microscopic magnetic beads and then separated from the rest of the sample by use of a magnet.

immunomagnetic separation (IMS) *See* immunomagnetic assay.

immunopathology Physically observable damage to organs and cellular elements important to the immune function (e.g., thymus, spleen, lymphocytes, bone marrow, and lymph nodes).

immunosuppression Intentional depression of the function of the immune system, usually for purposes of preventing rejection of transplanted tissues. Obviously, the difference between immunotoxicity and immunosuppression is more a matter of intent. Immunosuppressive drugs are often immunotoxic if their use is not well controlled.

immunotoxicity A toxic response of the immune system. It can be manifested as immunosuppression, uncontrolled proliferation (e.g., leukemia and lymphoma), altered host defense mechanisms against pathogens and neoplasia, allergy, or autoimmunity.

impact The striking of one body against another. When particles or streams of water suffer impact, an energy loss or, more accurately, an energy transformation results.

impact echo analysis The nondestructive test of a concrete structure using a stress wave propagation. *See also* stress wave propagation.

impact fee *See* capacity charge; development impact fee.

impact head A device used in irrigation wherein a type of single-stream rotor uses a lever driven by its own impact on the stream of water to rotate the irrigation nozzle in a full circle or arc. Impact heads produce irrigation areas with large radii and relatively low water application rates, but they do not provide matched water application rates for varying arc patterns (less than a full circle).

impact loss A loss of head in flowing water as a result of the impact of water particles on themselves or on some bounding surface.

impaired property exclusion *See* policy exclusion.

impedance The total opposition offered by a circuit to the flow of electric current.

impeller A rotating set of vanes in a pump designed to pump or lift water.

impeller pump Any pump in which the water is moved by the continuous application of power derived from some mechanical agency or medium. *See also* centrifugal pump.

Imperial gallon *See in the Units of Measure section.*

impermeable Not allowing, or allowing only with great difficulty, the movement of water; impervious.

impermeable layer A layer not allowing, or allowing only with great difficulty, the movement of water.

impervious Resistant to the passage of water.

impervious bed A bed or stratum through which water will not move.

impervious core A core of an earth dam constructed of puddled or compacted clay or other material, designed to place a water barrier between the upstream and downstream faces.

imperviousness coefficient The ratio, expressed as a decimal or as a percentage, of effectively impervious surface area to the total catchment or tributary area under consideration.

impetigo A contagious skin disease characterized by superficial pustules that burst and form characteristic thick yellow crusts.

impingement attack *See* erosion corrosion.

impingement corrosion *See* erosion corrosion.

implantation (1) In toxicology, the process by which a conceptus (a blastocyst, or 6–7 day postfertilization of the ovum) attaches to the endometrium. (2) The surgical insertion of a material or device in a tissue, usually for medical purposes. The material can be a drug or hormone. Examples of such devices are heart valves and pacemakers.

implicit bound constraints Constraints on the optimization problem that represent system performance criteria and may include constraints on junction node pressure, pipe velocity, tank water level, and pipe hydraulic gradient.

implicit system constraints Equality constraints on the network system that define the hydraulic equilibrium state of the system. They correspond to the conservation of mass at each junction node (flow continuity) and conservation of energy around each loop in the network.

impounded water Water that is stored in an artificial basin or dammed ravine by diverting flowing streams or collecting rainfall runoff, as in a reservoir.

impounding dam A barrier constructed across a watercourse to create a reservoir. *See also* dam.

impounding reservoir A reservoir in which surface water is retained for a considerable period of time, ranging from several months upward, and released for use at a time when the ordinary flow is insufficient to satisfy requirements. *See also* reservoir.

impounding reservoir safe yield *See* impoundment safe yield.

impoundment A pond, lake, tank, basin, or other space, either natural or artificial, that is used for storage, regulation, and control of water. *See also* reservoir.

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impoundment safe yield The maximum dependable draft that can be made continuously on a source of water supply during a period of years during which the probable driest period or period of greatest deficiency in water supply is likely to occur. For example, impoundment safe yields in the Midwestern United States are commonly based on low watershed flows experienced 1 year in a 50-year period (i.e., a 50-year drought cycle).

impregnated activated carbon Activated carbon with metals such as silver or copper that have been incorporated into its structure.

impressed-current corrosion protection A corrosion protection system that makes use of a permanent long life anode by supplying a continuous current to the metals to cancel the electrolytic (electrolysis) effect caused by corrosion cells.

impressed-current system A cathodic protection system that uses an outside source of power, converts it to direct current, and injects it into the soil through an anode bed. Such a system is also called a rectifier-ground-bed system.

improvements Buildings, other structures, and other attachments or annexations to land that are intended to remain so attached or annexed, such as sidewalks, trees, drives, tunnels, drains, and sewers.

impulse force The dynamic pressure of a jet or stream in the direction of its motion when its velocity in that direction is entirely destroyed. It is equal and opposite to the reaction force. *See also* reaction force.

impulse pump A type of pump that raises water by periodic application of a force suddenly applied and suddenly discontinued. The hydraulic ram is the most common example of such a pump. *See also* hydraulic ram.

impulse–reaction turbine A turbine in which both the impulse and reaction principles are used. *See also* impulse force; reaction force.

impulse turbine A type of turbine having rotor blades shaped such that the force of fluid jets striking the blades causes a shaft to rotate and transmit energy to a motor or other device. An impulse turbine is sometimes used for energy recovery in a seawater-desalting reverse osmosis system, where pressurized waste concentrate may be used to drive a turbine that recovers energy for the feedwater-pumping device.

IMR *See* infant mortality rate.

IMS *See* immunomagnetic separation.

IN *See* indicated number.

in. *See* inch *in the Units of Measure section.*

in.^{2} *See* square inch *in the Units of Measure section.*

in.^{3} *See* cubic inch *in the Units of Measure section.*

inactivation (1) The transformation of a chemical to a less toxic form. This term can also apply more broadly to a variety of means by which the activity of various biomolecules that are used in intracellular, intercellular, and hormonal signaling pathways occurs. For example, acetylcholine is released from nerves to pass a signal to muscles. This acetylcholine is inactivated by an enzyme called acetylcholinesterase. If a chemical interferes with this enzyme, severe poisoning will occur because acetylcholine will not be enzymatically cleaved to the relatively inactive products acetic acid and choline. (2) A process that renders viruses unable to reproduce or infect. Usually, a specific percentage of a population is affected over time. This effect can be accomplished by a variety of methods, e.g., heat, chemicals, or ultraviolet light. In contrast, the term *kill* is applied to other forms of life, such as bacteria, cysts, or algae.

inactivation kinetics The dynamics and rates at which organisms are rendered nonviable or noninfectious following chemical disinfection or other treatment techniques.

inactivation ratio The calculated $C \times T_{10}$ value divided by the $C \times T$ value required for 99.9 percent (3-log) inactivation of *Giardia lamblia* cysts, $C \times T_{10} / C \times T_{99.9}$. The sum of the inactivation ratios, or total inactivation ratio for a water treatment plant, is calculated by adding together the inactivation ratio for each disinfection segment. *See also* $C \times T$; $C \times T_{99.9}$.

incentive rate A rate that water utilities charge to encourage reductions in water use, particularly where water supplies are limited or uncertain. The incentive rate is typically a higher rate per unit of water for summer use, for summer use in excess of winter use (indoor use), or for consumption in excess of what is considered to be essential or nondiscretionary use irrespective of the time of year. *See also* inclining block rate.

inch (in.) *See in the Units of Measure section.*

inches per minute (in./min) *See in the Units of Measure section.*

inches per second (in./sec) *See in the Units of Measure section.*

inch-foot charge for water service *See* fire line service charge.

inch of mercury *See in the Units of Measure section.*

inch-pound (energy) (in.-lb) *See in the Units of Measure section.*

inch-pound (torque) (in.-lb) *See in the Units of Measure section.*

incidence The number of instances of illness or infection originating, or persons becoming ill or infected, during a period of time (e.g., the number of *new* cases of disease or infection) in a defined population within a specified period of time. *See also* incidence rate; prevalence.

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incidence of tumors The percentage of animals with tumors in a toxologic study of a contaminant.

incidence rate The rate at which people without a disease, illness, or infection develop the condition during a specified period of time. To calculate this rate, divide the number of new cases diagnosed or reported during a defined period of time by the number of people at risk during the time period.

incident command center An area used for the coordination and security of resources and personnel near an emergency or disaster. It is usually organized by a local fire department.

Incident Command System/Unified Command (ICS/UC) Management tool used to coordinate a response among agencies in one jurisdiction as well as those in multiple jurisdictions to an emergency response situation, such as a hazardous chemical spill. Understanding the concepts of ICS/UC is as important for local responders, who generally arrive on-scene first and thus are most likely to implement the management system, as it is for state and federal organizations that may be joining the ICS/UC.

incident management The process of managing an event or emergency utilizing the Incident Command System. *See also* Incident Command System/Unified Command.

incident rate The number of accidental incidents to which a workforce is exposed in a given time period, typically a year. Incident rates are based on the exposure of 100 full-time workers (40 hours per week, 50 weeks per year), equivalent to 200,000 employee-hours per year. Three incident rates are common:

$$\text{recordable rate} = \frac{\text{number of recordable events}}{\text{total number of productive hours worked during the period covered}} \times 200{,}000$$

$$\text{injury frequency rate} = \frac{\text{number of recordable injuries causing lost days}}{\text{total number of productive hours worked during the period covered}} \times 200{,}000$$

$$\text{severity rate} = \frac{\text{number of lost days}}{\text{total number of productive hours worked during the period covered}} \times 200{,}000$$

incineration Combustion or controlled burning of volatile organic matter in residuals and solid waste. It reduces the volume of the material while producing heat, dry inorganic ash, and gaseous emissions.

incinerator A device used for combustion of solid matter. Incinerators often are used for combusting semiliquid or dewatered materials, such as residuals. In drinking water treatment, incinerators also are used to regenerate or reactivate spent granular activated carbon to restore the porous structure and adsorptive capacity. *See also* regeneration.

incised river (1) A river that has cut its channel through the bed of a valley floor, as opposed to one flowing on a floodplain. (2) A river or stream that has formed its channel by the process of degradation.

inclined plate separator *See* inclined plate settler.

inclined plate settler A unit constructed of multiple parallel plates, approximately 2 inches (5 centimeters) apart and oriented at a 45° to 60° angle from the horizontal, to improve settling in a sedimentation basin. The units are placed at the end of a sedimentation basin (across the entire width), and flow travels upward through the plates and exits at the top prior to being discharged from the basin (a configuration called *counterflow*). Cocurrent and cross flow may also be used. The inclined plates provide a much shorter distance for particles to settle prior to being captured and are often used to maintain particle removal at higher flow rates, thereby reducing the need to construct additional basins.

inclined tube settler *See* tube settler.

inclining block rate A utility rate structure for which water rates increase for defined blocks of increased water use. (For example, $1.00 may be charged for each 1,000 gallons [3.8 cubic meters] used per month up to 5,000 gallons [18.9 cubic meters], and $1.50 may be charged for each 1,000 gallons used per month between 5,000 and 10,000 gallons [37.8 cubic meters].) This rate structure recognizes the higher unit costs of water associated with meeting peak demands. Inclining block rates are sometimes based on cost-of-service analysis, sometimes on the incremental cost of the next unit of supply needed to meet peak demands, and sometimes on the need to conserve water during peak use periods. Inclining block rates are also known as inverted rates because the rates are the opposite of traditional rates that discount water to high-volume users. *See also* inverted rate.

included gases Gases in isolated interstices in either the zone of aeration or the zone of saturation.

inclusion body An irregular, oval, or round-shaped body occurring in the nuclei or cytoplasm of the cells of the body.

increasing block rate *See* inclining block rate.

incremental cost The cost of water from the most recent (or next) increment of plant capacity and supply, as used in the marginal cost rate-setting concept. Under this rate-setting approach, the charge for all water sold reflects this cost even though the average cost is less. *See also* marginal cost pricing.

incrustant Dense solids formed as a crust on the inside surface of a pipe as a result of hardness and other

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characteristics of the water carried in the pipe. *See also* hardness; scale; tuberculation.

incubate (1) To maintain microorganisms at a temperature and in an environment favorable to their growth. (2) The holding of disinfection by-product formation potential samples to allow the formation of disinfection by-products. *See also* disinfection by-product formation potential.

incubation (1) The process of placing and holding microbial cultures under conditions favorable for growth. (2) The period of time and conditions necessary for a fertilized ovum to reach full development. (3) The storage of disinfection by-product formation potential samples.

incubation period The time interval between initial contact with an infectious agent and the appearance of the first symptom of the disease.

incubator A heated container that maintains a nearly constant temperature for use in developing biological cultures.

indenture The formal agreement between a group of bondholders, acting through a trustee, and the issuer as to the terms and security for bond debt. Ordinarily, it involves the placement of a lien upon either the revenue stream or the property being acquired from expenditure of the proceeds of the bond issue, or both. It also specifies any other conditions that must be met by the issuer, such as creation and maintenance of bond reserve funds.

independent variable (1) A variable in an equation that determines the values of other variables. For example, in the equation $y = ax + b$, the variable x is called the independent variable. (2) A variable hypothesized to influence the outcome under study (i.e., to cause a particular outcome or influence its variation). *See also* regression analysis.

index (1) An indicator, usually numerically expressed, of the relation of one phenomenon to another. (2) An indicating part of an instrument.

index case The first case of disease or other health condition in a defined population to come to the attention of the epidemiologist.

indexing A system in which water system maps are individually numbered for ease of reference.

index organism A microscopic organism for which the presence or absence in bodies of water indicates the presence or absence (and extent) of pollution or some other specific factor under study. An index organism is also called an indicator organism.

Indian tribe According to the Safe Drinking Water Act Section 1401, any Native American tribe having a federally recognized governing body that carries out substantial governmental duties and exercises powers over any area.

indicated horsepower (ihp) A measure of actual work required to compress and deliver a given fluid quantity, including all thermodynamic, leakage, and fluid friction losses.

indicated number (IN) In the testing of bacterial density by the dilution method, the number obtained by taking the reciprocal of the highest possible dilution (smallest quantity of sample) in a decimal series that gives a positive test.

indicating floor stand A device for operating a valve that indicates the extent to which the gate is open.

indicator (1) A substance that gives a visible change, usually of color, at a desired point in a chemical reaction, generally at a specified end point. (2) A device that indicates the result of a measurement. Most indicators in the water utility field use either a fixed scale and movable indicator (pointer), such as a pressure gauge or a movable scale and movable indicator, like those used on a circular flow-recording chart. This type of indicator is also called a receiver.

indicator bacteria In environmental engineering or bacteriology, bacteria used to signal conditions under which enteric pathogenic microbes may be present in treated drinking water.

indicator gauge A gauge that shows—by means of, e.g., an index, pointer, or dial—the instantaneous value of such characteristics as depth, pressure, velocity, stage, discharge, or the movements or positions of water-controlling devices. *See also* indicator; recorder; register.

indicator organism An organism that can be detected with relative ease and specificity and whose presence (or absence) has been shown to be correlated with a specific condition of interest. The condition of interest may be as specific as the potable quality of treated and disinfected drinking water or as broad as the assessment of the general level of pollution in an ecological system. In the latter case, several indicator organisms may be used.

indicator post An aboveground, post-like device attached to an underground valve and provided with (1) a wrench or handwheel for operating the valve and (2) a target designed to show whether the valve is open or shut.

indigenous Native to or occurring naturally in a particular environment or region.

indigo A reagent (potassium indigo trisulfonic acid) used for quantifying ozone residuals.

indigo trisulfonate A blue dye used in determining ozone concentration. It reacts instantly and quantitatively with ozone, and bleaching of its blue color is in direct proportion to the amount of ozone present. *See also* ozone.

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indirect bank protection A kind of works constructed in front of stream banks, rather than directly on them, with the intention of reducing the erosive force of the current either by deflecting the current away or by inducing deposition. An example of such protection is a dike; it may be made of timber or stone.

indirect charge A monetary charge that is a part of a total charge for producing something but is not directly related to production, e.g., overhead.

indirect cross-connection *See* potential cross-connection.

indirect discharge measurement A determination of the peak discharge (other than by a current meter) on the basis of the slope–area, contracted-opening, culvert, flow-over-dam, or critical-depth method. An indirect measurement also may be based on a survey of high-water marks after a flood.

indirect impedance approach A method of water analysis in which the electrodes of an impedance cell are not in direct contact with a sample. For example, indirect impedance technology can be used to detect certain microorganisms (e.g., coliforms) in water. The signal measured is caused by the carbon dioxide (CO_2) produced during the growth of the microorganisms being absorbed by a potassium hydroxide (KOH) agar (or liquid) around the electrodes. As the carbon dioxide is absorbed by the alkaline potassium hydroxide at pH values greater than 11, it is converted to bicarbonate (HCO_3^-), which in turn leads to a net change in molar conductivity that gives rise to the measured signal.

indirect integrity testing For membrane processes, a test applied to a membrane to identify or isolate integrity breaches, or both. Turbidity monitors, particle monitors and counters, and silt density index testing devices are indirect integrity methods for microfiltration and ultrafiltration membrane processes.

indirect nonpotable-water reuse The use of appropriately treated community wastewater discharged to receiving waters, either surface or underground, which is drawn, generally after additional treatment, for distribution for nonpotable purposes to customers who obtain their potable water from a separate system. *See also* indirect reuse; nonpotable reuse; nonpotable use; water reuse.

indirect potable-water reuse The use of water from streams that have upstream discharges of wastewater.

indirect reuse The use of reclaimed water for nonpotable or potable purposes by first discharging to a water supply source, such as fresh surface water or groundwater, where it mixes, dilutes, and may be transformed before being removed for reuse.

individual filter effluent (IFE) A point in a treatment process at which the effluent flow from an individual filter is isolated before it is blended with the effluent flows from other filters. Samples from this location can help determine the performance of that filter.

individual filter effluent (IFE) turbidity credit A provision of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), whereby a 0.5 log removal credit for *Cryptosporidium* is given to water systems that meet strict individual filter effluent turbidity requirements.

individual water supply A water supply to a single-family domicile. This term has replaced *private water supply* in the context of a supply used only by a single family.

indole A component of the amino acid tryptophan. Some bacteria have the ability to break down tryptophan for nutritional needs using the enzyme tryptophanase. When tryptophan is broken down, the presence of indole can be detected through the use of Kovac's reagent. Kovac's reagent, which is yellow, reacts with indole and produces a red color on the surface of the test tube.

indoor–outdoor rate An incentive rate for water use that water utilities implement to induce conservation of irrigation water. The incentive rate is usually set to discourage (1) irrigation beyond the level needed for normal lawn care and (2) other nondiscretionary outdoor uses. The outdoor (summer) rate and the block at which it applies are often based on the cost of meeting peak demands, but sometimes they are based on the need to conserve water during peak-use months. The indoor (winter) rate is sometimes set at less than the actual cost of service during the winter because the difference between the indoor and outdoor rates must be kept large enough to convince customers to reduce their outdoor use. However, the total revenue derived from the respective rates times their volumes must not exceed total revenue requirements.

indoor per capita water use Combined household water used indoors, such as that used for toilets, showerheads, tubs, faucets, clothes washers, dishwashers, and leaks, measured on a per capita basis.

indoor retrofit Refitting and repairing of indoor fixtures to increase indoor water use efficiency, such as the installation of water-restricting devices on toilets, showerheads, and faucets, and the repair of simple leaks.

indoxyl-β-D-glucuronide ($C_{14}H_{15}NO_7$–$C_6H_{13}N$) A chromogenic chemical compound used in bacterial culture media for the specific detection and enumeration of *Escherichia coli.* This compound is hydrolyzed by the enzyme β-glucuronidase to yield a

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glycone that is converted rapidly to indigo, which is dark blue in color.

induced-draft aeration A process to promote absorption of oxygen or air into water. Water enters the aeration tower from the top and cascades over slats or trays while a suction blower located at the top of the tower draws air from the bottom of the tower through the tower. *See also* forced-draft aeration.

induced-draft stripping Air stripping in which water enters the aeration tower from the top and cascades over slats or trays while a suction blower located at the top of the tower draws air from the bottom of the tower through the tower. *See also* forced-draft stripping; stripping.

induced infiltration *See* induced recharge.

induced recharge The recharge of water to an aquifer from an adjacent water source (e.g., a stream or lake) that occurs when the aquifer water table is lowered by pumping. The difference in head between the water source and aquifer causes water to recharge into the aquifer.

inductance An electrical property by which electrical energy is stored in a magnetic field. It is analogous to inertia in a hydraulic system. Induction has the effect of resisting changes in current flow. It is measured in henrys, or meters squared kilograms per second squared per ampere squared.

induction motor Any motor that relies on magnetic induction to couple energy into the rotor and create the necessary rotor currents.

induction period The period of time required for a specific cause to produce disease; the period of time from the causal action of a factor (e.g., chemical-induced mutation) to the initiation of the disease (e.g., cancer at a specific site). An induction period of many years may be required for cancer. *See also* incubation period; latency period.

inductively coupled argon plasma (ICPA) spectroscopy *See* inductively coupled plasma spectroscopy.

inductively coupled plasma (ICP) spectroscopy An atomic emission technique that is used in the analysis of metals. Modern inductively coupled plasma instruments have four main components: an inductively coupled plasma source, a spectrometer, sample introduction hardware, and a computer. The inductively coupled plasma source is composed of an argon plasma confined in a radio frequency induction coil. The technique is sensitive for many metals and can allow for the rapid, even simultaneous, determination of metals.

inductively coupled plasma–atomic emission spectroscopy (ICP–AES) *See* inductively coupled plasma spectroscopy.

inductively coupled plasma–mass spectrometry (ICP–MS) One of the "hyphenated techniques" in which two powerful instruments are linked. The inductively coupled plasma acts as the ion source for the mass spectrometer. For some elements, the sensitivity is higher than for graphite furnace atomic absorption techniques. They can be much faster than graphite furnace units, and so are useful in water analysis laboratories. *See also* graphite furnace atomic absorption spectrophotometry.

indurated sand Hardened sand, such as a soft sandstone.

induration A geologic process of hardening of sediments or other rock aggregates through cementation, pressure, heat, or other causes.

industrial-aid bond A bond issued by a governmental unit, the proceeds of which are used to construct plant facilities for private industrial concerns. Lease payments made by the industrial concern to the governmental unit are used to service the bond.

industrial/commercial/residential (I/C/R) The set of classifications of water utility customers based on service characteristics and demand patterns. These classifications are established to assign water rates that are nondiscriminatory and that meet, as nearly as possible, the cost of providing service to each customer class.

industrial consumption The quantity, or quantity per capita, of water supplied in a municipality or district for mechanical, trade, and manufacturing purposes during a given period, generally 1 day. The per capita use is generally based on the total population of the locality, municipality, or district. *Industrial use of water* is a more accurate term.

industrial ecology The study of integrated industrial, environmental, and economic systems that aims to find alternative production and consumption of goods and services to minimize waste and use of natural resources.

industrial hygiene The study of health as related to work environments. *See also* environmental health; safety program; toxicology.

industrial recycling The reuse of industrial process water, typically after required treatment.

industrial reuse The use of reclaimed or recycled water for nonpotable industrial purposes.

industrial solvent An organic solvent used for coatings (e.g., paints, varnishes, and lacquers), industrial cleaners, printing inks, extractive processes, and pharmaceuticals. *See also* solvent.

industrial water Water that is withdrawn from a source for sole use in an industrial water system.

industrial water conservation A practice employed to reduce the water consumed during industrial or manufacturing processes. Conservation can include both

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reducing the water used in a given application and reusing process water to reduce overall consumption.

industrial water consumption *See* industrial consumption.

industry water requirement The quantity of water required to produce a unit of product. It is the quantity of water ordinarily used, not necessarily the minimum that could be used.

inelastic demand Demand for a product (water) such that when a price increase (or decrease) is imposed, the resulting percentage change in quantity demanded is less than the percentage change in price. Elasticity is defined as the percentage change in quantity divided by the percentage change in price, which is always a negative term. With inelastic demand, the elasticity ratio is between zero and –1.0. The effect of inelastic demand is that a utility's revenue will increase with rate increases because the percentage increase in price is greater than the percentage decrease in quantity consumed. Water demand is virtually always inelastic.

inert fluorocarbons A group of chemically inert compounds containing carbon and fluorine. They are commonly used as plastics, nonstick coatings, lubricants, refrigerants, and solvents. A common inert fluorocarbon is tetrafluoroethylene, which is used to make a common plastic, polytetrafluoroethylene, or Teflon®.

inert media Synthetic resin beads or water treatment materials that are nonreactive. Inert media are used as natural nonreactive layers to more effectively separate the cation resin from the anion resin in mixed bed deionizers in order to allow each to be regenerated separately.

infantile methemoglobinemia The presence of methemoglobin (a modified form of oxyhemoglobin) in the blood. Methemoglobin contains ferric iron with normal hemoglobin (an oxidized heme). Oxygen is held firmly so it cannot be pumped off, therefore it does not function in respiration, resulting in anemia. *See also* blue-baby syndrome.

infant mortality rate (IMR) A measure of the annual rate of deaths for children less than 1 year old. The infant mortality rate is actually a ratio, but the word *rate* is universally used. To calculate this value, divide the number of deaths in a year for children less than 1 year of age by the number of live births in the same year; then multiply this ratio by 1,000 to obtain the infant mortality rate in terms of the number per 1,000 live births.

infection Entry and development or multiplication of an infectious agent (pathogenic microorganism) in humans or animals. Infection may be inapparent (asymptomatic), or it may result in disease.

infectious Capable of causing an infection.

infectious agent An organism capable of causing infection or infectious disease. *See also* pathogenic organism.

infectious disease A clinically apparent disease of humans or animals resulting from infection.

infectious dose The number of organisms that initiates colonization or disease in the host.

infectious dose 50 (ID_{50}) A dose of a given microorganism that, if applied to the total population, will infect 50 percent of the population.

infectious hepatitis An acute viral inflammation of the liver characterized by jaundice, fever, nausea, vomiting, and abdominal discomfort. It may be waterborne.

infectious male-specific F-specific ribonucleic acid (FRNA) coliphage A bacteriophage that infects the bacterium *Escherichia coli* via attachment to F pili located on the cells. *See also* F+ coliphage; F-specific coliphage.

infectivity titer A method to measure infectious dose through a series of dilutions performed in the laboratory.

in-filter DAF *See* in-filter dissolved air flotation.

in-filter dissolved air flotation (DAF) A process in which the dissolved air flotation clarifier is integrated into the filter bed, with clarification occurring as the floc is floated to the top of the clarifier, and the water is filtered through the medium in the bottom of the clarifier. This approach is sometimes used where saving space is a consideration.

infiltrate (1) To filter into. (2) To penetrate, by a liquid or gas, the pores or interstices of a porous material. (3) (archaic) Water containing materials dissolved during passage through a body of soil.

infiltration The flow or movement of water downward through soil.

infiltration capacity The maximum rate at which the soil, when in a given condition, can absorb falling rain or melting snow.

infiltration coefficient The ratio of infiltration to precipitation.

infiltration ditch A ditch that extends into the saturation zone, i.e., a ditch for which the bottom is below the water table in the saturation zone. The water flows from the saturated material by gravity into the ditch, and from there into a sump, well, or canal.

infiltration diversion Diversion of water from a stream by means of perforated pipes or other pervious conduits laid under the stream bed.

infiltration gallery A horizontal subsurface tunnel for intercepting and collecting groundwater by gravity flow.

infiltration head The water pressure at the point where subsurface water enters a sewer.

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infiltration index A rate of infiltration calculated from records of rainfall and runoff. Several different indexes exist, each calculated by a different method. A common index is the average rainfall intensity for a given storm such that, if this intensity is exceeded, the weight of rainfall will equal the weight of runoff.

infiltration rate (1) The rate at which water enters the soil or other porous material under a given condition. (2) The rate at which infiltration takes place, expressed in depth of water per unit time, usually in inches or centimeters per hour. (3) The rate at which groundwater enters an infiltration ditch or gallery, drain, sewer, or other underground conduit. This value is usually expressed in cubic feet per second, million gallons per day per mile of waterway, cubic meters per second per kilometer, or cubic meters per day per kilometer. Another common method of expression is as an equivalent depth (length) per unit time, which can be multiplied by the area of application to obtain volume per time.

infiltration tunnel A type of infiltration gallery.

infiltration volume The quantity of rainfall, expressed in depth (in inches or centimeters) over a given area, that passes below the root zone of plants and ultimately reaches the zone of saturation. *See also* deep percolation.

infiltrometer Typically a device that consists of two concentric rings driven into the ground. The rings are filled with water, and the time required for water to soak into the soil determines the rate at which water can percolate into the soil. The infiltration rate is usually expressed in inches or millimeters of water per unit time. *See also* lysimeter.

inflation A measurement of a period-to-period (monthly, quarterly, annually) percentage increase in prices for a product or service. To facilitate comparisons and a broad range of applications, inflation for hundreds of products is typically measured by means of price or cost indexes that express each period's price as a ratio with respect to a base period price. Examples of price indices are the consumer price index for a market basket of consumer goods and the *Engineering News Record's* construction cost index, which combines the major components of construction.

influence area *See* circle of influence; zone of influence.

influence basin The basin area within which the water table or other piezometric surface is lowered by a withdrawal of water during pumping. *See also* circle of influence; zone of influence.

influent Water or other liquid—untreated or partially treated—flowing into a reservoir, basin, treatment process, or treatment plant. *Contrast with* effluent.

influent seepage A movement of water from the land surface to the water table. This term is commonly used to describe flow from a stream to the adjacent or underlying groundwater body. *See also* influent stream; leakage.

influent stream A stream or stretch of stream that contributes water to the saturation zone. The water surface of such a stream stands at a higher level than the water table or piezometric surface of the groundwater body to which it contributes water. An influent stream is also called a losing stream.

influent water Subsurface water resulting from penetration of surface water or atmospheric precipitation into the lithosphere through large interstices or fractures.

influent weir A weir at the inflow end of a sedimentation basin or channel.

information collection request A formal request that federal agencies, under the Paperwork Reduction Act, must prepare to obtain clearance from the Office of Management and Budget for any activity that will involve collection of substantially the same information from 10 or more nonfederal respondents. Federal agencies may have to file such a request if information requirements are to be included in a rule (e.g., reporting, monitoring, or record-keeping requirements) or for other information-collecting activities (e.g., conducting studies or surveys, sending out application forms, performing audits).

Information Collection Rule (ICR) A rule issued by the US Environmental Protection Agency that required water utilities serving 10,000 people or more to conduct monitoring in order to gather data for use in developing the Stage 2 Disinfectants and Disinfection By-Products Rule and the Enhanced Surface Water Treatment Rule. The Information Collection Rule was promulgated on May 14, 1996 (*Federal Register,* 61(94):24354–24388).

Information Collection Rule Method (ICR Method) Analytical method developed by US Environmental Protection Agency (USEPA) for *Cryptosporidium* monitoring during the Information Collection Rule (ICR) data collection period. This method has been superseded by USEPA Method 1623/1622.

Information Collection Rule Supplemental Survey (ICRSS) A survey conducted by US Environmental Protection Agency to obtain data complementary to the data collected through the Information Collection Rule (ICR). Where the ICR only collected data from large water systems, the ICRSS included medium and small systems, as well as different source waters.

information management The process of understanding, managing, and utilizing the vast amount of

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data available as technology continues to change and improve.

Information Sharing and Analysis Center (ISAC) *See* Water Information Sharing and Analysis Center.

information technology (IT) (1) The group of people who are responsible for the implementation, operations, and support of computers, data, and enterprise business applications; the name of the part of an enterprise that deals with all things electronic. (2) Both the hardware and software of computer systems, often including networking and telecommunications, usually in the context of a business or other enterprise.

InfraGard A partnership between the FBI and the private sector. InfraGard is an association of businesses, academic institutions, state and local law enforcement agencies, and other participants dedicated to sharing information and intelligence to prevent hostile acts against the United States.

infrared radiation That portion of the electromagnetic spectrum between the microwave and visible regions. This generally covers wavelengths between 0.76 and 15 micrometers. The interaction of infrared radiation with organic molecules serves as the basis for a technique to identify such molecules. The unit of wavenumber, expressed in units of reciprocal centimeter (cm^{-1}), is often used in infrared spectrometry. The range of greatest interest in the qualitative analysis of organic compounds is 2.5–15 micrometers. *See also* wavenumber.

infrared spectrophotometry An analysis technique in which a sample's absorption of light in the infrared region is measured.

infrared spectroscopy Another name for infrared spectrophotometry. *See also* infrared spectrophotometry; spectroscopy.

infrastructure The basic installations and facilities on which the continuation and growth of a community depends, such as power, roads, wastewater and water plants, and transportation and communication systems.

infrastructure asset management Continual assessment of the usefulness, projected life expectancy, maintenance history, and other critical data of installations and facilities of the utility, with a long-range plan for financing major repairs or replacements.

infrastructure capital asset Any of the structures, conduits, and pipelines above and below ground that enable a utility to provide service to customers.

infrastructure leakage index (ILI) A performance indicator quantifying how well a distribution network is managed (maintained, repaired, rehabilitated) for the control of real (leakage) losses, at the current operating pressure. Mathematically, it is the ratio of current annual real losses (CARL) to the unavoidable annual real losses (UARL), or ILI = CARL/UARL. A low ILI value indicates that the water utility has managed its leakage down toward the level of the UARL, or the theoretical technical low limit of leakage achievable. As a dimensionless indicator, the ILI is a leading benchmarking leakage performance indicator used in international performance comparisons.

infusorial Very fine-grained earth that pours.

ingestion The passage of matter such as food, water, or foreign material (ranging from dirt to poisons) into the body by means of the mouth.

inhalation The breathing of vapor, gases, mist, or dust through the mouth or nose.

inhalation exposure Exposure to a chemical or infectious agent via the respiratory tract. The material may be a gas, vapor, fume, or particulate.

inhibition A mechanism for limiting corrosion of a pipe surface. Two general approaches to inhibition exist: precipitation and passivation. With precipitation, insoluble compounds are formed by adjusting water chemistry to cause calcium carbonate ($CaCO_3$) to precipitate on the pipe wall. With passivation, the pipe material itself participates in a reaction to form less soluble metal–hydroxide–carbonate compounds intended to protect the pipe. *See also* passivation.

inhibitor Any chemical substance that is added to a water supply (or solution of any kind) that interferes with ("inhibits") a chemical reaction. Inhibitors are sometimes used to help prevent precipitation or corrosion.

inhibitory toxicity Any demonstrable inhibitory action of a substance on the rate of general metabolism (including rate of reproduction) of living organisms.

in-house Involving the use of water utility staff (full-time, part-time, and temporary employees) to complete a project, as opposed to using a contractor.

initial abstraction retention The total amount of rainfall that may fall without causing a significant amount of direct runoff.

initial [Br^-]/average [Cl^+] molar ratio *See* bromide-to-FAC ratio.

initial compliance period The first full 3-year compliance period that begins at least 18 months after promulgation of a US Environmental Protection Agency drinking water regulation.

initial detention The volume of water on the ground, either in depressions or in transit, at the time active runoff begins.

initial distribution system evaluation (IDSE) A component of the Stage 2 Disinfectants and Disinfection By-Products Rule that requires affected water systems to determine the locations in the distribution system that are likely to have the highest TTHM and HAA5 concentrations. An IDSE can be

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based on existing monitoring data, modeling, or additional monitoring as specified by the rule.

initial improvement period The period of operation after backwashing and the start of a new run, in which the quality of water produced by a granular media filter may first deteriorate, experiencing an initial turbidity spike, and then improve until acceptable filter effluent quality is attained. *See also* filter ripening.

initial loss In hydrology, rainfall preceding the beginning of surface runoff. It includes interception, surface wetting, and infiltration unless otherwise specified.

initial precision and recovery (IPR) A component of an analytical method in which a laboratory fortifies several portions of a blank matrix with specified concentrations of the analytes of interest and the resulting samples are processed and analyzed. This process is termed a demonstration of capability. The mean recovery range and maximum standard deviation are the IPR acceptance criteria. The demonstration of capability has to be performed once by each analyst or when there is a significant change in the method (e.g., a new instrument) before samples can be analyzed.

initial rain The rain that falls in the beginning of a storm before the depression storage is completely filled. *See also* residual rain.

initial turbidity spike The high turbidity observed at the start of a filter run, after backwashing. *See also* filter ripening; initial improvement period.

initiator *See* tumor initiator.

injection technique A technique used to inject a sample (or extract) into a chromatographic instrument (e.g., a gas chromatograph). For example, in gas chromatography, extracts can be injected into a hot injection port (where they are flash vaporized and swept into the chromatographic column) or directly on-column at a "cold" temperature. *See also* gas chromatography.

injection well A well in which fluid is transmitted to a subterranean formation.

injector *See* ejector.

injured bacteria Bacteria that are physiologically damaged because of exposure to adverse physical or chemical conditions.

injury frequency rate *See* incident rate.

in-kind Closely approximating the characteristics of a wetland before it was adversely affected by a regulated activity.

in-kind replacement The provision or management of substitute resources to replace the functional values of the resources lost (e.g., in a restored wetland). Such substitute resources are physically and biologically the same (or nearly the same) as those lost.

in.-lb *See* inch-pound *in the Units of Measure section.*

inlet (1) A surface connection to a drain pipe. (2) A structure at the diversion end of a conduit. (3) The upstream end of any structure through which water may flow. (4) An intake.

inlet control Control of the relationship between headwater elevation and discharge by the inlet or upstream end of any structure through which water may flow.

inlet surface The well screen, perforated sections of casing, or other openings through which water from a water-bearing formation enters a well.

inlet well A chamber that serves as a suction well for pumps in a water-pumping station. *See also* wet well.

inlet zone The initial zone in a sedimentation basin that decreases the velocity of the incoming water and distributes it evenly across the basin.

in-line filtration A treatment process in which coagulant is injected directly into the influent piping to a filter. Rapid mixing, coagulation, and flocculation occur within the piping, and a sedimentation or flotation tank is not provided prior to filtering. *See also* coagulation; direct in-line filtration; flocculation; sedimentation.

in-line mixer *See* static mixer.

in./min *See* inches per minute *in the Units of Measure section.*

inorganic Pertaining to material such as sand, salt, iron, calcium salts, and other mineral materials. Inorganic substances are of mineral origin, whereas organic substances are usually of animal or plant origin and contain carbon. *See also* organic.

inorganic carbon Carbon present in an inorganic compound (e.g., carbon oxides, carbon disulfide [CS_2], and metallic carbonates such as calcium carbonate [$CaCO_3$]). *See also* organic carbon.

inorganic chemical A chemical substance not having carbon to hydrogen bonds.

inorganic compound A substance that is not derived from hydrocarbons. Examples include sodium chloride (NaCl), ferric hydroxide ($Fe(OH)_3$), and aluminum sulfate ($Al_2(SO_4)_3$).

inorganic contaminant (IOC) An inorganic substance regulated by the US Environmental Protection Agency (USEPA) in terms of compliance monitoring for drinking water. Contained on the agency's list are contaminants as diverse as asbestos, nitrate (NO_3^-), cyanide, and nickel. This abbreviation came into common use in the USEPA's Phase V drinking water regulations. An inorganic contaminant is sometimes called an inorganic chemical.

inorganic material A chemical substance of mineral origin, or more correctly, not of basically carbon structure.

inorganic matter Any chemical substance that does not arise from the process of living growth, is

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composed of matter other than plant or animal matter, and does not contain hydrocarbons or compounds of basically carbon structure. Examples are minerals and metals.

inorganic tin Inorganic salts of tin.

inorganic waste Discarded material such as sand, salt, iron, calcium, and other mineral materials that are only slightly affected by the action of organisms. Inorganic wastes are chemical substances of mineral origin, whereas organic wastes are chemical substances of an animal or plant origin.

inositol Any of nine isomeric alcohols, $C_6H_6(OH)_6$; especially one of these substances found in plant and animal tissue and classified as a member of the vitamin B complex.

inotropic action Chemical action to increase the strength of heart contraction. This action is associated with the cardiac glycosides (e.g., digitoxin or digoxin) that are frequently used to treat congestive heart failure. The inotropic effect is usually desired, but recognizing that these are very toxic compounds that occur naturally is also important.

in-parallel flow A piping arrangement that directs separate streams through two or more units of a treatment system in a balanced manner, with equal flow to each device, so that a higher total flow rate than that from a single unit can be achieved.

in-place relining The replacement of a pipe lining or water main after it has been installed and usually after it has been in service.

in-plant piping system The network of pipes in a particular facility, such as a water treatment plant, that carries the water or wastes for that facility.

in-plant study An evaluation of a unit process or system under full-scale conditions.

input horsepower The total power used in operating a pump and motor. It is equal to the brake horsepower divided by the motor efficiency expressed as a decimal.

input/output (I/O) Communication between a control device or computer and its user, another computer, or a field device.

inrush current *See* locked-rotor current.

in./s *See* inches per second *in the Units of Measure section.*

insanitary Not sanitary; unhealthy; liable to promote disease; contrary to principles known to promote or safeguard health.

insecticide A compound, usually a synthetic organic substance, used to kill insects.

in-series flow A piping arrangement in which the entire effluent flow from one unit of a water treatment system is fed to a second succeeding unit. This arrangement forces the water through multiple treatment units and achieves a greater reduction of contaminants than can be achieved by a single pass of water through a single unit.

insert valve A shutoff valve that can be inserted by a special apparatus into a pipeline while the line is in service under pressure.

inside diameter (ID) (1) The distance between two points on the interior surface of a round pipe or tank as measured along a straight line through the center. (2) The approximate or commercially assigned diameter of a pipe, such as a 6-inch (15-centimeter) pipe.

inside-out membrane filtration For hollow-fiber membrane processes, such as some types of microfiltration and ultrafiltration systems, filtration where the feedwater is applied to the inside (or lumen) of the fibers and the filtered filtrate/permeate, which passes through the membrane barrier, is collected on the outside (or shell) side of the fibers. *See also* lumen; microfiltration; ultrafiltration.

in situ A Latin term meaning "in its original place"; also, "in place" under ambient conditions. It is often used in the context of making measurements.

installation (1) The connecting or setting up and startup operations of any water treatment system. (2) The complete assembly of piping, valves, drain line, pumps, meters, and controls by which such equipment is connected into the water supply system.

instantaneous disinfection by-product concentration [DBP_0] The concentration of disinfection by-products at the time of sampling. In order to determine this amount in a chlorinated sample, the residual chlorine needs to be quenched with a dechlorination agent to stop any further disinfection by-product formation during the time period from sampling to analysis. Routine distribution system monitoring is commonly based on obtaining instantaneous samples. When a disinfection by-product formation potential test is performed on a prechlorinated sample, two parallel samples are collected; one sample is incubated (stored) with a chlorine residual present in order to determine the terminal disinfection by-product concentration [DBP_t], and the other sample is dechlorinated in order to determine the instantaneous disinfection by-product concentration. The disinfection by-product formation potential is equal to [DBP_t] – [DBP_0]. Note that the symbol [DBP_0] is used to represent instantaneous disinfection by-product concentration only in the context of disinfection by-product formation potential testing. *See also* dechlorination agent; disinfection by-product; disinfection by-product formation potential; terminal disinfection by-product concentration.

instantaneous flow rate A flow rate of water measured at one particular instant, such as by a metering device or by the following calculation:

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$$Q = AV$$

Where (in any consistent set of units):

Q = the flow rate of water

A = the cross-sectional area of the channel or pipe

V = the velocity of the water at one instant

instantaneous power (*p*) The time rate of transferring or transforming energy. At the terminals of a circuit, instantaneous power is the rate per unit time at which the energy is transmitted into or out of the circuit. It is often simply called power and is measured in watts (meters squared kilogram per second cubed).

instantaneous total trihalomethane concentration [$TTHM_0$] The concentration of total trihalomethanes at the time of sampling. In order to determine this amount in a chlorinated sample, the residual chlorine needs to be quenched with a dechlorination agent to stop any further trihalomethane formation during the time period from sampling to analysis. Routine distribution system monitoring is normally based on obtaining instantaneous samples. When a trihalomethane formation potential test is performed on a prechlorinated sample, two parallel samples are collected; one sample is incubated (stored) with a chlorine residual present in order to determine the terminal total trihalomethane concentration [$TTHM_t$], and the other sample is dechlorinated in order to determine the instantaneous total trihalomethane concentration. The total trihalomethane formation potential is equal to [$TTHM_t$] – [$TTHM_0$]. Note that the symbol [$TTHM_0$] is used to represent instantaneous total trihalomethane concentration only in the context of trihalomethane formation potential testing. *See also* dechlorination agent; terminal total trihalomethane concentration; total trihalomethanes; trihalomethane formation potential.

Institution of Water and Environmental Management *See* Chartered Institution of Water and Environmental Management.

instream flow The amount of water in a stream that supports recreational uses, fisheries, aquatic species, and other nonwithdrawal water uses.

instream use A water use that can be carried out without removing the water from its source, as in navigation and recreation.

instrumentation (1) The act of developing, equipping with, or using instruments, especially scientific instruments. (2) A set of instruments.

instrument detection limit The smallest amount of analyte that can be distinguished from an instrument's background signal.

insulated stream A stream (or stretch thereof) that is separated from the saturation zone in the surrounding formation and that neither contributes to nor receives water from that saturation zone.

insulation Material used to separate electric components, such as the resin material surrounding the windings of the stator in an electric motor.

insulator Any of many materials that can be forced to carry electricity only by application of a very strong electrical force.

Insurance Services Office (ISO) A group responsible for rating fire protection service districts within US cities.

intake (1) The works or structures at the head of a conduit into which water is diverted. (2) The process or operation by which water is absorbed into the ground and added to the saturation zone. (3) The flow or rate of flow into a canal, conduit, pump, stack, tank, or treatment process before treatment. *See also* discharge; outfall.

intake area The surface area on which water that eventually reaches an aquifer or groundwater basin is initially absorbed.

intake layer aeration Adding of dissolved oxygen to the water layer in a reservoir or impoundment that is being drawn into an intake.

intake pipe (1) The pipe at the head of a pipeline or system through which water enters. (2) In water supply, a pipeline conveying water by gravity from a source of supply in a stream or body of water to an intake well.

intake screen A screen placed across the head of, or in, an intake canal or pipeline to prevent fish from entering.

intake section The lower part of the well that lets water in while keeping aquifer materials out.

intake structure A structure or device placed in a surface water source to permit the withdrawal of water from that source.

intake works Structures at the location at which water is taken from a source of supply into a conduit for transportation to other locations.

intangible asset Any element of value pertaining to permanent property of a nonphysical nature, such as a franchise, trademark, patent, copyright, goodwill, or the cost of organizing, developing, and establishing such an asset.

intangible benefit A benefit or advantage of a water resource project that cannot be easily defined or formulated, e.g., a beneficial environmental value.

intangible cost A cost or disadvantage of a water resource project that cannot be easily defined or formulated, e.g., a disadvantageous environmental value.

integral action The control mode that varies the controller's output in proportion to the integral (sum over time) of the process error in the controlled variable. Integral action is also called integral control,

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reset action, or reset control. *See also* proportional integral derivative control.

integral control *See* integral action.

integral factor The amount of integral action used in a particular control loop.

integral joint A joint configuration in which the connection is an integral part of the pipe. A length of pipe with integral joints will have one outside-threaded connection and one inside-threaded connection.

integrated catchment management (ICM) An approach for coordinated operation and maintenance of either a surface water watershed or an urban stormwater system.

integrated cell culture–polymerase chain reaction (ICC–PCR) A technique that combines two methods: (1) traditional cell culture, and (2) polymerase chain reaction, for the direct detection of viruses in environmental samples. ICC–PCR produces results within 24 hours.

integrated circuit A unified collection of many individual circuits of transistors, resistors, and capacitors that are etched onto a small chip of silicone. Newer chips have millions of components and circuits on a single chip.

integrated compliance approach A plan of action taken by a water system that results in compliance with several or all regulatory requirements that affect that water system.

integrated disinfection design framework (IDDF) A method for determining site-specific disinfection requirements for a drinking water treatment facility by utilizing mathematical relationships for the (1) disinfection contactor hydraulics, (2) disinfectant demand and decay rate, and (3) pathogen inactivation kinetics.

integrated exposure assessment A summation over time of the magnitude of human exposure to a toxic chemical via all media.

integrated flow curve A curve representing a summation of all preceding water flows up to a given point in time. *See also* mass diagram.

integrated information management *See* information management.

integrated membrane system *See* dual-membrane system.

integrated pipeline strategy Making use of all available data in developing short- and long-range plans for water main rehabilitation and replacement to provide maximum benefits for minimum expenditures.

integrated reporting system A central database to coordinate programs to compile large amounts of information in easily read format to meet customer expectations of service, regulatory requirements, and maintenance of utility assets.

integrated resource management (IRM) The use of systematic procedures to allocate and use, in terms of timing and mix, all available assets to meet the objectives of a company or organization.

integrated resources planning (IRP) A comprehensive form of water utility planning that encompasses least-cost analysis of demand management and supply management options, as well as an open and participatory decision-making process, preparation of alternative planning scenarios, and a recognition of the multiple institutions concerned with water resources and the competing policy goals among them. *See also* demand management; supply management.

Integrated Risk Information System (IRIS) A database developed, maintained, and updated by the US Environmental Protection Agency that contains the agency's consensus positions on the potential adverse human health effects of approximately 500 substances. It contains summaries of qualitative and quantitative human health information.

integrated sample *See* depth-integrated sample.

integrated services digital network (ISDN) A telecommunications architecture designed to provide advanced telecommunication services. The network defines facilities and techniques to provide voice and data communications over the same medium.

integrated systems approach A technique for process improvement that examines the effects of a change in one unit of an organization on the entire organization. It is not possible to optimize overall organizational performance by attempting to optimize the performance of each unit because the activities of one unit will affect the activities of other units.

integrated water resources management *See* total water management.

integrated water utility business An organization that incorporates all utility functions—including planning, resource development and conservation goals, a long-term capital improvements program, operation and maintenance budgets, rates and fee schedules, billing, customer services, and so forth—into a cohesive operation that accomplishes the utility mission in a cost-effective manner.

integrating Pitot tube *See* Pitot-integrating tube.

integrating sphere spectroscopy A method of measuring the total radiant energy—scattered or unscattered—passing through a sample. With the aid of a special attachment on a spectrophotometer, a sphere with a highly reflective interior coating contains the scattered light, which is measured by a photodetector mounted at the bottom of the sphere.

integration method (1) A method of measuring and determining the mean velocity along a vertical profile of water flowing in a stream or conduit. A current

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meter is moved slowly and at a uniform rate of speed from the surface to the bottom and back again one or more times. The total number of revolutions of the meter wheel and the time spent are noted, and the average rotational speed (in revolutions per minute) of the meter wheel is computed. This method allows the velocity of the water throughout the entire vertical section to be integrated or summarized. (2) A method of determining the mean sediment concentration in a vertical profile by lowering a depth-integrating sediment sampler to the streambed and raising it to the surface again. This technique yields a mean sample of the suspended material being transported by the stream in that vertical profile.

integrator A device or meter that continuously measures and calculates (adds) total flows in cubic meters, liters, gallons, million gallons, cubic feet, or some other unit of volume measurement. Such a device is also called a totalizer.

integrity breaches For membrane processes, a compromised membrane or seal, such as a broken membrane fiber, which allows unwanted passage of substances from the feed to the filtrate or permeate.

integrity testing For a membrane system, a procedure that is performed to determine if a membrane, membrane system, or both is compromised (such as one with broken membrane fibers) that could allow contaminants from the feedwater to enter the filtered water. *See also* direct integrity testing; indirect integrity testing.

intensity–duration frequency curve A graphic method of representing the statistical probability of the magnitude, length, or both of precipitation events.

interaction The actions of one drug or chemical in modifying the effects of another. The effects can be additive, synergistic (superadditive), or inhibitory. A wide variety of specific mechanisms exist by which interaction can occur. However, these mechanisms are generally classified as chemical (i.e., the chemicals actually react with one another), physiological (i.e., their mechanisms tend to modify functions more or less independent of one another), or pharmacological (i.e., they actually act at the same site of action to modify one another's effects).

interactive decision tree A computer-based means of identifying and selecting available treatment technologies and/or actions that could be taken by a water system to achieve compliance in the most cost-effective manner. An appropriate strategy may include nontreatment alternatives, optimizing existing treatment, or selecting new technology.

interagency agreement An agreement between one or more federal agencies that clarifies, delineates, or both, the jurisdictions, responsibilities, or both, of the agencies in administering a particular law or regulatory program.

Interagency Perchlorate Steering Committee (IPSC) Intergovernmental committee formed in 1998 by order of the US Congress that was chartered to facilitate and coordinate accurate accounts of technological issues (occurrence, health effects, treatability and waste stream handling, analytical detection, and ecological impacts) related to perchlorate contamination of drinking water supplies and irrigation water supplies and to create information transfer links for interagency and intergovernmental activities regarding such areas of concern. Members of the committee include representatives from 24 agencies, including the US Environmental Protection Agency, Department of Defense, Department of Agriculture, US Geological Survey, and other federal and state agencies.

Inter-American Association of Sanitary and Environmental Engineering (Asociación Interamericana Ingeniería Sanitaria y Ambiental, AIDIS) An association of environmental engineers and scientists in the United States and Latin America.

interbasin transfer The movement of water from one watershed to another or one river basin to another, usually involving water rights and intergovernmental relations.

interception (1) The process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs, and other vegetation and then lost by evaporation, never reaching the surface of the ground. (2) The amount of precipitation intercepted.

interception loss That portion of precipitation caught by the foliage, twigs, and branches of trees, shrubs, and other vegetation and then lost by evaporation, never reaching the surface of the ground.

interceptometer A rain-collecting device placed under a tree or amid brush and crops. Its catch, or the amount collected, is compared with that of a rain gauge set in the open in order to determine the amount of rainfall loss by interception.

interconnection A physical connection between two water supply systems.

interface (1) A surface that is regarded as the common boundary between two bodies or spaces. (2) In an aquatic system, the area where the water and any solid surface are in contact. (3) In computers and electronics, a point of communication between two or more separate systems. Computers of different manufacture and operating systems use interfaces that enable them to communicate and operate with one another as an integrated system. (4) A physical link between instruments in which analytes are transferred from one component to another, often for the

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purpose of detecting the analytes, identifying them, or both.

interface turbidity The turbidity of filtered water at the interface of two layers of filtering material, such as at the interface of the anthracite and sand layers in a dual-media filter. Measurement of interface turbidity can provide plant operators with advance indication of possible turbidity breakthrough. *See also* dual-media filter; triple-media filter.

interfacial composite membrane A type of composite membrane made by chemical reactions of substances such as polymers at the support layer surface, creating the membrane's barrier layer.

interference fit A method of joining the pump impeller to the shaft by warming the impeller, then allowing it to cool and shrink around the shaft to provide a tight fit. A slot and key are generally used to prevent rotational slippage of the installed impeller. It is also known as a shrink fit.

interference substance Any of several substances with which chlorine reacts. These reactions must be completed before a chlorine residual can be available.

interflow That movement of water of a given density in a reservoir or lake between layers of water of different density. It is usually a result of the inflow of water of either a different temperature or a different sediment or salt content.

Interim Enhanced Surface Water Treatment Rule (IESWTR) A rule promulgated December 16, 1998, by the US Environmental Protection Agency (63 FR 69478–69521) that set requirements to better protect consumers against *Cryptosporidium* and other pathogens. The IESWTR applies to all public water systems that use surface water or groundwater under direct influence of surface water, and serve 10,000 persons or more. *See also* Long Term 1 Enhanced Surface Water Treatment Rule; Long Term 2 Enhanced Surface Water Treatment Rule.

Interim Primary Drinking Water Regulations (IPR) The first drinking water regulations promulgated as a result of the Safe Drinking Water Act (SDWA) of 1974. They became the National Primary Drinking Water Regulations pursuant to the 1986 amendments to the SDWA. *See also* National Primary Drinking Water Regulation.

interlaboratory quality assurance The complete program designed to ensure the reliability of data that a group of analytical laboratories has produced.

interlock An electric switch, usually magnetically operated, used to interrupt all (local) power to a panel or device when the door is opened or the circuit is exposed to service.

intermediate belt That portion of the zone of aeration that lies between the soil–water belt and the capillary fringe.

intermediate groundwater Water in the zone of aeration between fringe and soil water.

intermediate vadose water Subsurface water that lies between the soil–water belt and the capillary fringe.

intermediate water Water lying between the upper surface of the capillary fringe and the soil–water belt.

intermittent chlorination A technique of noncontinuous chlorination used to control biological fouling of surfaces.

intermittent flow An interrupted pattern of water usage that occurs in homes or commercial businesses—as opposed to the steady constant-flow patterns common in industry, such as in factories. This term may also be used to refer to on–off flow patterns of water through treatment units specified in testing standards to simulate customer water use patterns. *See also* continuous flow operation.

intermittent flow operation A method of operation in which supply, treatment, or both is not provided continuously. Intermittent operation may be required if (1) a system having a relatively fixed flow rate cannot meet the variation in demand or (2) a variable-flow system capacity is greater than the variation in demand. For example, well pumps and any associated treatment are often operated intermittently in small systems that have extremely variable demand or in large systems that use wells to meet peak demands in excess of the baseline demand requirement.

intermittent interrupted stream A stream that has intermittent stretches with intervening ephemeral stretches.

intermittent periodic spring A periodic spring that discharges intermittently.

intermittent spring A spring that discharges only during certain periods, ceasing at other periods. Such a spring is also called a temporary spring.

intermittent stream A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no extended supply from melting snow or other sources.

intermittent stretch *See* intermittent stream.

internal audit Evaluation of adherence to business and accounting policies and practices within an organization, conducted by the staff of the organization. Internal audits seek to identify potential problems and correct them before they become a public issue.

internal backflow In a pump, leakage around the impeller from the discharge to the suction side.

internal drainage *See* underground drainage.

internal friction Friction within a fluid (water) caused by cohesive forces.

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internal isolation Isolation, with respect to a potable water system, of a fixture, area, zone, or some combination thereof. Isolation at the fixture means installing an approved backflow preventer at the source of the potential contamination. Area or zone isolation entails confining the potential source within a specific area.

internal load The load or force exerted by the water pressure on the inside of a pipe.

internal water treatment The addition of treatment chemicals to makeup water used in steam generation for boiler operations. Chemicals are often added to prevent scale buildup or corrosive pitting of metal in boiler system components. *See also* external water treatment.

International Classification of Diseases (ICD) A classification of specific conditions and groups of conditions as determined by an internationally representative group of experts. Every disease entity is assigned a number. The complete list is periodically revised and published by the World Health Organization.

International Desalination and Environmental Association (IDEA) *See* International Desalination Association (IDA).

International Desalination Association (IDA) A nonprofit international association with stated goals to develop and promote the appropriate use of desalination and desalination technology worldwide in water supply, water reuse, water pollution control, water purification, water treatment, and other water sciences and technology.

International Drinking Water Supply and Sanitation Decade A plan that was developed and implemented on November 10, 1980, by the United Nations General Assembly with the goal of providing clean and adequate sanitation for all people by 1990. A second resolution was passed in 2004 that called for a greater focus on water-related issues. This resolution designated a 10-year period known as the International Decade for Action, Water for Life (2005–2015).

International Fabricare Institute (IFI) *See* Drycleaning and Laundry Institute (DLI).

International Organization for Standardization (ISO) The specialized international agency for standardization, comprising the national standards bodies of more than 150 countries. The object of the International Organization for Standardization is to promote the development of standards in the world with a view toward facilitating international exchange of goods and services, as well as developing cooperation in the sphere of intellectual, scientific, technological, and economic activity. ISO standards are in wide use throughout the world, in practically every area of technology, either directly or in the form of identical national standards. The ISO Central Secretariat is located in Geneva, Switzerland.

International Ozone Association (IOA) Formerly known as the International Ozone Institute; a not-for-profit educational association formed in 1973 to serve as the center of technology transfer and developments on ozone-related issues. The IOA conducts programs and research covering the transfer of ozone into water and wastewater and drinking water treatments.

International Ozone Institute (IOI) *See* International Ozone Association.

International Society of Automation (ISA) A professional society that represents the instrumentation and control industries and professions. The group has written standards on many subjects related to automation, provides education and training, and publishes books and technical articles on automation.

International Ultraviolet Association (IUVA) An organization incorporated as a nonprofit in April 1999, and dedicated to serving all professional fields with interests in ultraviolet (UV) technology. This list includes UV disinfection for drinking water, wastewater, and water for reuse; the fields of UV curing of adhesives, polymers, and inks; and the use of UV in such fields as biotechnology, forensic science, entertainment, suntanning, treatment/storage of foods, nondestructive testing, and so on.

International Water Association (IWA) An international organization formed in 1999 by the merger of the International Water Supply Association and the International Water Quality Association. The purpose of the IWA is to encourage the development of effective and sustainable approaches to water management by providing services and products to its worldwide membership.

International Water Supply Association (IWSA) A professional international organization concerned with the public supply of water through pipes for domestic, agricultural, and industrial purposes and the control, provision, and protection of the necessary water resources. In 1999, IWSA merged with the International Water Quality Association to form the International Water Association (IWA).

internship forum A structured mechanism, such as a Web-based matching service, wherein student qualifications and utility needs can be matched to simplify the process of hiring students.

interpolation A technique used to determine values that fall between the marked intervals on a scale.

interpretive report A publication that includes a summary and evaluation of the results of data collection programs according to study objectives or other preestablished goals.

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interquartile range The range of data between the twenty-fifth and seventy-fifth percentile values. *See also* box-and-whisker plot.

interrupted stream A stream that contains perennial stretches with intervening intermittent stretches, or intermittent stretches with intervening ephemeral stretches.

interrupted water table A water table that has a pronounced descent along a groundwater dam.

interrupting current The fault current that a fuse or circuit breaker is designed to interrupt before the current becomes destructive.

intersection map method A method of preparing and referencing valve-and-hydrant maps. The maps are drawn on a very large scale so the position and location of the valves, hydrants, and mains can be easily found and reviewed in the field. *Intersection* usually refers to a street intersection but can also refer to a critical location in the distribution system facilities.

interspecies extrapolation model A model used to extrapolate from results observed in laboratory animals to humans.

interstate carrier Any vehicle or transport that conveys passengers in interstate commerce.

interstice A very small open space in a rock or granular material. It is also called a void or void space. *See also* pore.

interstitial fibrosis The formation of fibrous material between normal components of a tissue or organ. *See also* fibrosis.

interstitial velocity The velocity of water within the pore, or interstices, of a granular media filter bed. It is the approach velocity divided by the porosity of the granular media. *See also* approach velocity.

interstitial water (1) Extracellular water within a tissue, i.e., the water found between cells. (2) Subsurface water found in the voids of rocks or in spaces between sediment particles.

interstream groundwater ridge A ridge in the water table between two effluent streams. Percolation toward the surface streams causes a residual groundwater ridge to develop.

intervention epidemiologic study *See* experimental epidemiologic study.

intestinal villous A cell of the mucosal lining of the intestine. *See also* brush borders; neonatal mouse infectivity assay.

intracellular Located or occurring within a cell or cells.

intracellular toxin A poisonous substance that is produced within a cell or cells.

intrahepatic cholestasis A type of liver toxicity. It is most frequently associated with compounds that have steroid-like character. These compounds have to be conjugated and secreted into the bile. Occasionally some of them appear to block the flow of bile, and the person becomes jaundiced. The jaundice is a result of the accumulation of bilirubin.

intrinsic rate constant A fundamental kinetic characteristic inherent to a biological or chemical reaction. It does not vary from application to application as would an observed rate constant. *See also* observed rate constant.

intrinsic water Ultrapure water that has essentially no ion or mineral content.

intron A noncoding sequence in deoxyribonucleic acid that serves as a spacer region between exons that actually code for a functional protein. In eukaryotic cells, a single gene usually consists of several exons that are linked by introns. The intron sequence is cleaved out of the resulting messenger ribonucleic acid prior to the latter being translated into a sequence of amino acids in a protein.

inundation A condition in which water temporarily or permanently covers a land surface.

invasive Tending to spread to healthy tissues or invading cells.

invasive plant A nonindigenous plant that invades landscapes and other types of vegetation, including that in wetlands and forests. Invasive plants replace native plant species and often form exotic monocultures where nothing else grows.

inverse sludge index The reciprocal of the sludge density index multiplied by 100. It is most commonly used to describe the property of a by-product of wastewater treatment processes. *See also* sludge density index.

invert The lowest point of the channel inside a pipe, conduit, or canal.

invertebrate Any animal without a backbone.

inverted block rates A schedule of water rates applicable to blocks of increasing water usage in which the usage in each succeeding block is charged at a higher unit rate than in the previous blocks. With successively higher rates charged as water usage increases, inverted block rates may reduce water usage, thus having a conservation effect.

inverted capacity The maximum rate at which a well will dispose of water admitted at or near its upper end by discharge through openings at lower levels. Where these lower openings are in a saturation zone, the inverted capacity is approximately equal to the product of the specific capacity and the available pressure head.

inverted rate A utility rate design whereby the unit price of water rises with each successive block, resulting in increasing costs with increasing customer usage. This is the opposite of a declining block rate. *See also* inclining block rate.

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inverted well A well in which the movement of water is in the reverse direction of that in an ordinary well. Water is admitted at or near the top of the well and discharged into a permeable bed through one or more openings at lower levels. An inverted well is used during groundwater recharge. *See also* diffusing well.

inverter A device that changes direct electric current to alternating electric current.

investor-owned water utility A public water system owned by an individual, partnership, corporation, or other qualified entity, with the equity provided by shareholders. Regulation may take the form of local or state jurisdiction.

in vitro A Latin term meaning "in glass." It refers to tests conducted in a test tube, flask, beaker, or other laboratory glassware, not performed within an animal host. *Contrast with* in vivo. *See also* excystation.

in vitro study A study of chemical effects conducted in tissues, cells, or subcellular extracts from an organism (i.e., not in the living organism).

in vivo A Latin term meaning "in life." It refers to tests conducted in a living organism. *Contrast with* in vitro.

in vivo study A study of chemical effects conducted in intact living organisms. *Contrast with* in vitro study.

inward-flow turbine A reaction turbine in which the water or steam enters the runners from the outside and flows toward the axis of the runner.

I/O *See* input/output.

IOA *See* International Ozone Association.

IOC *See* inorganic contaminant.

iodide-iodate actinometer A device used to determine the fluence rate of an ultraviolet light source. The fluence rate is defined as the radiant power of all wavelengths passing from all directions through an infinitesimally small sphere. The iodide/iodate complex absorbs in the biocidal range very well, allowing for the determination of the light output needed to disinfect water.

iodine (I) A nonmetallic element that is the heaviest and least reactive of the naturally occurring halogens. It may be used for disinfection. In both its liquid and vapor forms, iodine is readily adsorbed by activated carbon.

iodine number A surrogate value for the ability of an activated carbon product to adsorb organic substances that have low molecular weights. The iodine number of an activated carbon is equal to the milligrams of iodine at a concentration of 0.02 normal that can be adsorbed on 1 gram of activated carbon.

iodine treatment The addition of salts of iodine to water to prevent goiter, which is caused by an iodine deficiency.

iodoform (TIM) (CHI_3) An iodinated trihalomethane. It is a disinfection by-product and is commonly formed in chlorinated water high in iodide. It may cause a medicinal odor in drinking water. It is also commonly referred to as triiodomethane. *See also* disinfection by-product; trihalomethane.

iodometric chlorine test The determination of residual chlorine in water by addition of potassium iodide (KI) and titration of the liberated iodine (I_2) with a standard solution of sodium thiosulfate ($Na_2S_2O_3 \cdot 5H_2O$) with starch solution as a colorimetric indicator.

iodometric method A procedure for determining the concentration of dissolved oxygen in water. It is also known as the Winkler method. The azide modification of this method is commonly used because it is subject to fewer interferences.

IOI *See* International Ozone Institute.

ion An atom that is electrically unstable because it has more or fewer electrons than protons. Thus, it is an electrically charged particle. A positive ion is called a cation, and a negative ion is called an anion. In aqueous solution, ions may not actually exist as isolated charged atoms but tend to form a variety of hydrated complexes.

ion balance A type of calculation commonly used as one method to determine the completeness or accuracy of laboratory analyses of a water sample. For ionized solutes in natural waters, the concentrations of cations (typically expressed in milliequivalents per liter or milligrams per liter as calcium carbonate [$CaCO_3$] equivalents) equal the concentrations of anions in the same units.

ion chromatography (IC) A technique for separating substances based on ion exchange. It is commonly used for the analysis of anions and cations in water. Analytes migrate at differing speeds through an ion chromatography column based on their affinity for the stationary phase relative to the strength of the elution solution.

ion exchange (IX or IE) A reversible chemical process in which ions from an insoluble permanent solid medium (the ion exchanger—usually a resin) are exchanged for ions in a solution or fluid mixture surrounding the insoluble medium. The superficial physical structure of the solid is not affected. The direction of the exchange depends on the selective attraction of the ion-exchanger resin for the certain ions present and the concentrations of the ions in the solution. Both cation and anion exchange are used in water conditioning. Cation exchange is commonly used for water softening. *See also* anion exchange; cation exchange; deionization; water softening.

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ion-exchange chromatography *See* high-performance liquid chromatography.

ion-exchange membrane An ion-exchange resin cast in flat sheet form and used in electrodialysis and electrodialysis reversal systems. Such a membrane is essentially impermeable to water but readily passes ions. It is sometimes called an electrodialysis membrane. *See also* electrodialysis.

ion-exchange process *See* ion exchange.

ion exchanger A permanent insoluble material (usually a synthetic resin) containing ions that will exchange reversibly with other ions in a surrounding solution. Both cation and anion exchangers are used in water conditioning. The volume of an ion exchanger is measured in cubic feet or cubic meters of exchanger after the exchanger bed has been backwashed and drained and has settled into place. *See also* ion exchange.

ion-exchange resin A bead-like material that removes ions from water. It is used in deionizers. *See also* ion exchange; synthetic ion-exchange resin.

ion-exchange softener *See* ion-exchange water softener.

ion-exchange treatment The use of ion-exchange materials, such as resins or zeolites, to remove undesirable ions from a liquid and to substitute acceptable ions.

ion-exchange water softener A treatment unit used to remove calcium and magnesium from water by means of ion-exchange resins.

ion exclusion chromatography A set of techniques in which chemical separation is based on the size of the compound. Certain materials used in these separations contain cage-like structures of fairly uniform size within their crystals. Retention in a chromatography column depends on molecular size rather than on chemical characteristics of the analytes. Smaller molecules are retained longer in such columns because they can enter the pores more easily than larger molecules.

ionic bond A type of chemical bond in which electrons are transferred. *See also* covalent bond.

ionic charge The electrical charge of an ion caused by the surplus (positive charge) or deficit (negative charge) of electrons in the outer electron shell. *See also* ion.

ionic concentration The concentration of any ion in solution, usually expressed in moles per liter.

ionic constant A measure in absolute units of the extent to which a chemical compound or substance in solution will dissociate into ions. *See also* ion.

ionic proportion diagram A graph showing the percentage of major anions (bicarbonate [HCO_3^-], carbonate [CO_3^{2-}], sulfate [SO_4^{2-}], and chloride [Cl^-]) and cations (calcium [Ca^{2+}], magnesium [Mg^{2+}], sodium [Na^+], and potassium [K^+]), expressed in equivalents per liter, in a water body.

ionic size The nominal size of an ion.

ionic strength A measure of the chemical potential of electrolytes in solution. The ionic strength in a solution is defined by

$$\text{ionic strength} = \frac{1}{2}\sum(c_i z_i^{\,2})$$

Where:

c_i = the concentration of the ith ion, in moles per liter

z_i = the valence of the ith ion

The summation takes place over all the different kinds of ions in the solution.

ionic weight The weight of an ion as determined by the sum of the atomic weights of its components.

ionization The splitting or dissociation (separation) of molecules into negatively and positively charged ions.

ionization constant A factor related to the tendency of a particular compound to ionize. It is often expressed as pK_a, the negative logarithm of the ionization constant. The value of pK_a gives information on the charge of a compound relative to the aqueous pH. For example, acetic acid has a pK_a of 4.8, which means that at an aqueous pH less than 4.8, the compound is protonated (i.e., contains a proton [H^+]) and thus is in the acid form. Acetic acid ionizes at an aqueous pH greater than 4.8. An equal proportion of ionized and un-ionized species exist in solution when the pH is equal to the pK_a.

ionize To change or be changed into ions.

ion pair Two charged particles in solution joined together by electrostatic attraction. Two ions of opposite charge interact in such a manner that the resulting complex has a distinct chemical nature. Ion pair formation can be of interest to physical chemists who study concentrated salt solutions. Analytic chemists can make use of the formation of ion pairs to extract specific ions from solution. For example, methylene blue active substances can be extracted with an organic solvent after the cationic dye (methylene blue) has formed an ion pair with an anionic substance.

ion-pair extraction A technique for partitioning out of a solvent (usually water) an analyte based on the behavior of ions in solution. The mechanism for this extraction is the attraction of positively and negatively charged ions to form ion pairs. The ion pairs are more easily extracted into a suitable nonpolar organic solvent. This technique has been used to extract selected metals and organic compounds from aqueous solution. Examples of ion-pair reagents are tetraalkylammonium ions, which form complexes with selected inorganic and organic ions.

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ion product For ionized solutes, the mathematical product of the molar concentration of each ion raised to a power equal to the number of its ions in the solute. For example, for Na_2SO_4, the ion product would be $[Na^+]^2[SO_4^{2-}]$.

ion-selective electrode (ISE) A general term used to describe a variety of electrochemical probes used in the determination of specific analytes. Analytic methods are available using a pH meter in conjunction with an ion-selective electrode for the determination of ammonia (NH_3), calcium, dissolved oxygen, fluoride, and other analytes. Electrode potential is measured, often in millivolts, as a function of analyte concentration.

ion-selective membrane In the electrodialysis process, a membrane that allows specific ions to pass through more readily than other ions, especially one that is developed to remove one or more targeted ions more efficiently by having relatively high membrane permselectivity, even between ions of similar charge. An example is an anion-permeable membrane that readily allows bicarbonate (HCO_3^-) and chloride (Cl^-) to pass but has relatively high resistance to sulfate (SO_4^{2-}). *See also* permselective membrane.

ion selectivity *See* selectivity.

ion trap detector Device commonly used in mass spectrometry to form gaseous cations and anions and confine them for selective mass analysis.

ion trap mass spectrometer A type of detector used by analytic chemists and usually interfaced with a gas chromatograph. Ion traps were invented in the 1950s but were not commercially available until the 1980s. In contrast to other mass spectrometers, in an ion trap, both volatilization and mass analysis occur in the same part of the detector. Variations of radio frequency and direct current voltages allow the detector to dissociate molecules and then isolate and store ions. The detection levels that can be achieved with ion traps are generally much lower than with other types of mass spectrometers.

Iowa hydrant *See* corey hydrant.

IPR *See* initial precision and recovery; Interim Primary Drinking Water Regulations.

IPS *See* iron pipe size.

IPSC *See* Interagency Perchlorate Steering Committee.

IRE *See* germanium internal reflection element.

IRIS *See* Integrated Risk Information System.

IRM *See* integrated resource management.

iron An abundant element (Fe) found naturally in the earth. Dissolved iron is found in most water supplies. An iron concentration higher than 0.3 milligrams per liter causes red stains on plumbing fixtures and on other items in contact with the water. Dissolved iron can also be present in water as a result of corrosion of cast-iron or steel pipes, a frequent cause of red-water problems.

iron (or ferric) sludge The material produced as a result of adding an iron-based coagulant to a raw water, and subsequent coagulation and sedimentation. Iron sludge contains the hydrolyzed floc formed by iron's reaction with the raw water and the particulate matter removed by the process.

iron bacteria Any of several aquatic bacteria that (1) obtain energy by the oxidation of reduced iron in their habitat from the ferrous (Fe^{2+}) to the ferric (Fe^{3+}) state, or (2) cause the ferrous form to be dissolved or deposited indirectly as a precipitate of hydrated ferric oxide on or in the mucilaginous secretions around their cells or cell sheaths.

iron fouling The accumulation of iron on or within an ion-exchange resin bed or filter medium in such amounts that the capacity of the medium is reduced.

iron–manganese filtration A granular media filtration process that oxidizes soluble iron (Fe(II)) and manganese (Mn(II)) and removes resulting oxide/hydroxide (FeOOH(s), MnOOH(s), MnO_2(s)) precipitates by depth filtration. Typically the filter media (anthracite, greensand, sand, or other mineral) is coated with manganese oxides that first adsorb and then oxidize Fe(II) and Mn(II). The filter is backwashed periodically to remove the precipitated iron and manganese. An oxidizing agent such as potassium permanganate or chlorine is fed continuously or intermittently to regenerate the manganese oxides that facilitate the Fe(II) and Mn(II) oxidations.

iron-oxalic acid preloaded granular activated carbon (GAC) Granular activated carbon (GAC) that is pretreated with iron-oxalic acid to increase its adsorption capacity for target organic compounds. GAC is often preloaded during competitive adsorption studies.

iron oxide adsorption A process by which materials are adsorbed through interaction with a synthetic iron oxide (Fe_2O_3) surface applied to granular media. This process may possibly provide a method to remove naturally occurring organic matter from drinking waters.

iron oxide–coated media *See* oxide-coated medium.

iron oxide–coated olivine A material composed of a synthetic iron oxide (Fe_2O_3) applied to an inexpensive, mixed iron–manganese silicate (olivine) with physical properties somewhat similar to sand. This material has been successful in adsorbing naturally occurring organic matter found in drinking water.

iron oxide–coated sand A material used in a fixed-bed reactor to remove particles and organic matter. The sand is coated with an iron oxide prepared from a mixture of sodium hydroxide (NaOH) and ferric nitrate ($Fe(NO_3)_3 \cdot 6H_2O$) that is heated to "fix" the

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coating. The advantage of the iron oxide coating is that the coated sand is positively charged at neutral pH, thereby allowing oxidation–reduction reactions to occur with negatively charged particles and colloidal material and thus improving removal.

iron pipe size (IPS) A pipe designation based on the nominal inside diameter for pipe sizes J inch and larger in accordance with the American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI) standard B36.10M for wrought-iron and steel pipe. The outside diameter of each size remains the same, whereas the wall thickness varies as expressed by the schedule number of the pipe.

iron removal The removal of dissolved iron (Fe^{2+}) from water, typically by oxidation to a particulate state and then filtering. Iron is regulated on an aesthetic basis because it can result in a metallic taste and discoloration of fixtures.

iron salt An iron-based coagulant. *See also* coagulant; ferric chloride; ferric sulfate; ferrous salt.

iron vitriol ($FeSO_2$) A common name for copperas; ferrous sulfate.

IRP *See* integrated resources planning.

irradiance units *See in the Units of Measure section.*

irradiation The process of exposing a material to radiation for microbial inactivation, chemical activation, or creation of hydroxyl radicals (•OH). In industrial applications, process water may be irradiated to provide disinfection without leaving a disinfectant residual that may adversely affect industrial process efficiency. *See also* photon; radiation.

irregular weir A weir with a crest that is not of standard or regular shape.

irreversible toxic effect An adverse, irreversible effect on health induced by chemicals, e.g., the initiation of cancer by production of a mutation. Once established within a cell that has the capability to divide, a mutation is an irreversible effect. Similarly, disruption of physical development produces irreversible disfigurement (i.e., teratogenesis). Another example is the loss of neurons in the central nervous system of an adult mammal, a process considered irreversible because the capability for regenerating neurons does not occur. This finality stands in contrast to the killing of cells within the liver or kidney, where new cells can be generated. Repeated killing of cells in these tissues can, however, have irreversible consequences (e.g., cirrhosis of the liver) if it continues over time.

irrigation The artificial application of water to land to meet the water needs of growing plants not met by rainfall.

irrigation audit An onsite evaluation of an irrigation system to assess its water-use efficiency as measured by distribution uniformity, irrigation schedule, and other factors.

irrigation circuit (1) A group of irrigation components, including heads or emitters and pipes, controlled and operated simultaneously by a remote-control valve. (2) The area served by such components.

irrigation controller A mechanical or electronic clock that can be programmed to operate remote-control valves.

irrigation cycle A scheduled sequence of applying water by an irrigation circuit, defined by a start time and duration. Multiple cycles can be scheduled, separated by time intervals, to allow the applied water to infiltrate.

irrigation efficiency The ratio of irrigation water consumed by evaportranspiration to the total amount applied to a field or farm; the efficiency of irrigation water application and use, determined by calculating the amount of water beneficially applied divided by the total volume applied.

irrigation plan A two-dimensional plan drawn to scale expressing the layout of irrigation components and component specifications. The layout of pipes may be depicted diagrammatically, but the location of irrigation heads and the irrigation schedules should be specified.

irrigation requirement The quantity of water, exclusive of precipitation, that is required for crop production. It includes surface evaporation and other economically unavoidable water waste. *See also* duty of water; water requirement.

irrigation return flow The quantity of water that discharges off an irrigated plot after the water has been used by the crop. This water is frequently contaminated with unacceptable amounts of salt, fertilizer, and pesticides.

irrigation water Water artificially applied to lands to meet the water needs of growing plants. It does not include rainfall.

irrigation zone *See* hydrozone.

ISA *See* International Society of Automation.

ISAC *See* Information Sharing and Analysis Center.

ISDN *See* integrated services digital network.

ISE *See* ion-selective electrode.

ISO *See* Insurance Services Office; International Organization for Standardization.

isobar A line on a map connecting points of the same atmospheric pressure at a given altitude and instant.

isobaric Having equal atmospheric pressure.

isobath An imaginary line on the earth's surface, as represented on a map, connecting all points having

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the same vertical distance above a plane of interest, such as the upper or lower surface of an aquifer.

isochion A line of equal snow depth or equal water content of snow, as shown on a map. An isochion is also called an isonival.

isochlor An imaginary line on the earth's surface, as represented on a map, connecting all points of equal concentration of chlorides. It may be used to represent such points in groundwater, tidal estuaries, and other such bodies of water.

isochron In the graphical presentation of data, a line representing a contour of equal time.

isochrone *See* histograph.

isocratic Pertaining to a stage in the elution of analytes in ion chromatography or high-performance liquid chromatography for which the composition of the mobile phase is held constant during the separation of analytes.

isoelectric point (IEP) A pH at which the net charge on a compound is neutral. In electrophoretic separation, amphoteric compounds have equal positive and negative charges at the isoelectric point and fail to migrate. This phenomenon is also used in the separation of proteins by precipitation because the solubility of proteins is lowest at the isoelectric point. Good coagulation also occurs at the isoelectric point of the coagulant.

isohyet (1) An imaginary line on the earth's surface, as represented on a map, connecting all points of equal precipitation. (2) A line or contour representing equal concentration.

isohyetal map A map that shows, through the use of isohyets, the variation and distribution of precipitation occurring over an area during a given period.

isolate Something isolated from another substance.

isolated interstice A small open space or interstice, usually occurring in lava or other effusive igneous rock (i.e., rock that flowed out on the earth's surface) of a vesicular (small-hole) texture. *See also* discontinuous interstice.

isolation An extraction technique in which analytes are separated from the matrix for the purposes of increasing the analyte's concentration, minimizing interferences, or both. Examples include liquid–liquid extraction and solid-phase extraction. *See also* liquid–liquid extraction; solid-phase extraction.

isolation valve A valve installed in a pipeline to shut off flow in a portion of the pipe for the purpose of inspection or repair. Such valves are usually installed in the main distribution lines.

isomer A compound that has the same molecular formula but a different chemical structure relative to another compound. For example, 35 isomers have the molecular formula C_9H_{20}. Isomers can have different chemical properties even though the numbers and types of atoms are identical.

isometric view An orientation of a three-dimensional figure such that the length, width, and height characteristics are accurately and dimensionally represented to an observer. For example, the isometric view of a rectangular box is oriented such that one vertical edge occupies the foremost location in a three-dimensional drawing, with the width and length of the box each shown with dimensional accuracy at a 30° angle from horizontal relative to this vertical edge.

isonival *See* isochion.

isopach map A contour map for which the contours are lines of constant thickness. Such a map is used to depict geologic structures such as aquifers.

isopercentile (1) Having equal percentages. (2) A line connecting points of equal percentage of rainfall, usually drawn on a map that shows the annual or monthly rainfall at each rain gauge station as a percentage of the annual long-average figures for that station.

isophthalic acid A component of resins and coatings that is used for exterior coatings to improve weathering and corrosion resistance.

isopiestic line An imaginary line on the earth's surface, as represented on a map, connecting all points at which water in a water-bearing formation would rise to the same elevation if free to do so; a line connecting all points of equal pressure in a water-bearing formation under pressure; a line connecting all points of equal altitude on the upper surface, or water table, of an unconfined aquifer.

isopiestic map A map showing, by means of isopiestic lines, the shape of the piezometric surface of an aquifer. Such a map is also called a piezometric map. *See also* piezometric surface.

isopleth A line on a chart or map drawn through points of equal value.

isopluvial line (1) A line on a map connecting all points that have the same pluvial index for a given length of storm and a given period of time. (2) An isohyet. *See also* pluvial index.

isopluvial map A map showing isopluvial lines.

isopolyester Unsaturated polyester based on isophthalic acid.

***p*-isopropyltoluene ($CH_3C_6H_4CH(CH_3)_2$)** A solvent, also known as para-cymene. *See also* solvent.

ISO standard *See* International Organization for Standardization.

isostatic Subject to equal pressure from every side; being in hydrostatic equilibrium.

isotherm (1) A line connecting points having a common temperature, used in a two-dimensional thermal representation. For example, isotherms are shown on

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weather maps to illustrate regions with common temperatures. In water treatment, isotherms may be used in a cross section of a settling basin to illustrate density currents induced by temperature differences. (2) In adsorption, a relationship that specifies the surface concentration of the material being adsorbed on the adsorbent medium as a function of the concentration of adsorbate in solution at equilibrium. *See also* Freundlich isotherm; Langmuir isotherm.

isothermal (1) Pertaining to the operation of a gas chromatograph with a constant oven temperature, as opposed to temperature programming in which the oven temperature is programmed to increase at a certain rate. The choice of isothermal versus temperature-programming conditions is dependent on how well the analytes can be resolved at a constant temperature or whether a variation in oven temperature is required to facilitate resolution of closely eluting compounds. (2) *See* isothermy. *See also* gas chromatography.

isothermy In limnology, a state in which a lake or pond is at the same temperature throughout and is well mixed. Periods of isothermy occur in spring and autumn in dimictic lakes. A state of isothermy is also called an isothermal.

isotope One of two or more atoms or elements that have the same atomic number (occupy the same position in the periodic table) but that differ in other respects such as atomic weight and number of neutrons in the nucleus. Examples of isotopes are hydrogen (^{1}H), deuterium (^{2}H), and tritium (^{3}H).

isotropic Having the same properties in all directions. This term is used in the context of a medium's elasticity, conduction of heat or electricity, or radiation of heat or light. Cubic (isometric) crystals transmit light equally in all directions, as do liquids, gases, most glasses, and some ion-exchange resins. *See also* anisotropic.

issuance cost *See* flotation costs.

issuer The organization that is incurring debt through issuance of bonds or other debt instruments. In the drinking water industry, it is generally the water utility, although it may also be another governmental entity such as a city or special financing authority. The issuer determines the need and timing for bonding, selects the financing team, and assumes the responsibility for repayment.

IT *See* information technology.

I* × *T Ultraviolet intensity *(I)* multiplied by time *(T)* (analogous to $C \times T$ for chemical disinfection). *See also* ultraviolet intensity.

itai itai disease A debilitating disease that affected postmenopausal women who lived along the Jinzu River basin in Japan. The symptoms included pain related to weak and deformed bones as well as kidney failure. The disease was first identified in the 1940s and is thought to have been caused by the ingestion of cadmium that was present at high levels in the Jinzu River. The women ingested rice that was contaminated with cadmium from the river water used to irrigate the rice. Intensive mining in the area resulted in cadmium release to the river. Cadmium levels in the river have been reduced, and no new occurrences of the disease have been reported.

iteration Any process of successive approximation used in numerical solution of mathematical equations, including algebraic equations and differential equations.

IUVA *See* International Ultraviolet Association.

IWEM *See* Chartered Institution of Water and Environmental Management.

IWSA *See* International Water Supply Association.

IX *See* ion exchange.

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J

J *See* joule *in the Units of Measure section.*

jacketed pump A pump equipped with jackets around the cylinders, heads, and stuffing boxes through which steam or heat from another source may be forced. These jackets permit the handling of such materials as pitch, resin, and asphalt that are solid when cold but melt on heating.

jacking A method of providing an opening ahead of and slightly larger than a pipe, into which the pipe is forced by means of horizontal jacks.

Jackson candle turbidimeter A device once used to determine turbidity in water. This type of turbidimeter consisted of a standard candle, a calibrated glass tube, and a supporting frame. It was used for many years, but it was not capable of reporting a turbidity less than 25 Jackson turbidity units. The device was included in the 16th edition of *Standard Methods for the Examination of Water and Wastewater* but was eliminated from the 17th edition in 1989. Jackson candle methods were replaced with nephelometric methods of measuring turbidity. *See also* nephelometric turbidity.

Jackson turbidity unit (JTU) *See in the Units of Measure section; see also* nephelometric turbidity unit *in the Units of Measure section.*

jar test A laboratory procedure for evaluating coagulation and rapid mix, flocculation, and sedimentation processes in a series of parallel comparisons. Dissolved air flotation can also be evaluated in jar tests if the jars are modified to permit the injection of dissolved air.

jar test apparatus An automatic stirring machine equipped with three to six paddles and a variable-speed motor drive. It is used to conduct jar tests in order to evaluate the coagulation and rapid mix, flocculation, and sedimentation processes. It may also be used to select powdered activated carbon doses for taste and odor control.

jaundice *See* icterus.

jejunum The section of the small intestine that lies between the duodenum and the ileum.

jet A stream of water under pressure issuing from an orifice, nozzle, or tube.

jet height The vertical distance to which a jet of water rises above the orifice from which it issues. Such height is always less than the head on the orifice because of air resistance and friction loss in passing through the orifice.

jet injection blending The blending of two or more fluid streams by use of a jet pump. The pump injects fluid under pressure into a flow stream prior to a high-velocity Venturi that implements mixing. This process is often used for injecting coagulant chemicals that require high-velocity gradients for proper mixing. *See also* jet pump; velocity gradient; Venturi principle.

jet pump A device that pumps fluids by converting the energy of a high-pressure fluid into that of a high-velocity fluid. It consists of a nozzle that discharges a jet of fluid at high pressure into a Venturi tube. The fluid to be pumped enters a chamber just ahead of the Venturi tube, where the high-velocity jet draws the fluid into the tube. *See also* eductor; ejector.

jetsam Floating discarded material.

jetted well A shallow well constructed by a high-velocity stream of water directed downward into the ground.

jetting (1) A method of well drilling in which the casing is sunk by driving while the material inside is washed out by a water jet and carried to the top of the casing. It is a very fast method of drilling water supply wells in certain types of soils. (2) A method of sinking piles by means of a water jet. (3) A method of inserting well points by means of a water jet. (4) A method of consolidating unconsolidated backfill by means of a water jet. Jetting is also called jet drilling. *See also* boil.

jetty (1) An obstruction built of piles, rock, or other material extending into a stream or into the ocean from the bank or shore, placed so as to induce scouring or bank building or to protect against erosion. (2) A similar obstruction to influence river, lake, or tidal currents or to protect a harbor. (3) A wharf or pier.

jet washing A method of well development or redevelopment that employs high-velocity, high-pressure water to clean the aquifer or formation outside the well screen.

jogging The frequent starting and stopping of an electric motor.

joining system Any of a variety of methods for connecting two separate components of a piping system together. Such systems include bell and spigot, threaded, coupling, and mechanical devices. It is also known as a connecting system.

joint (1) A surface of contact between two bodies or masses of material of like or different character or composition. (2) A connection between two lengths of pipe, made either with or without the use of a third part. (3) A length or piece of pipe.

joint clamp A repair mechanism that seals when a rubber gasket is pressed against both the bell and the

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pipe inserted in the bell. This type of repair is accomplished by placing a ring behind the bell and a follower ring behind the gasket and then compressing the gasket by applying force via bolts between the rings.

joint compound A synthetic compound made of sand and sulfur, plastic, or other materials and used in place of lead or rubber gaskets to produce watertight joints in pipes carrying fluids.

joint meter reading The practice of reading two or more utility meters by the same meter reader to reduce costs of the participating utilities.

Joint Powers Authority (JPA) A type of nonprofit organization frequently established as a separate entity by one or more cities or other public agencies for the specific purpose of borrowing funds for major capital programs with looser restrictions than are common for general obligation or revenue bonds. The Joint Powers Authority typically issues to the public certificates of participation that are equivalent to tax-exempt bonds, and it controls the resulting proceeds to pay for construction. *See also* certificate of participation.

joint spring A spring issuing from joints in a rock formation.

Jonval wheel A parallel- or axial-flow waterwheel.

joule (J) *See in the Units of Measure section.*

joulemeter An integrating wattmeter for measuring the energy in joules expended in an electric circuit or developed by a machine.

journeyman A person who has worked under direct supervision of others for a set period of time to learn a trade and is certified as competent to practice that trade.

JPA *See* Joint Powers Authority.

JTU *See* Jackson turbidity unit *in the Units of Measure section.*

judicial review A review of a final federal agency action by a federal court. Section 1448 of the Safe Drinking Water Act allows one or more parties to contest one or more provisions of a National Primary Drinking Water Regulation promulgated by the US Environmental Protection Agency by filing a petition for judicial review in the US District Court of Appeals for the District of Columbia.

junction A converging section of a conduit used to facilitate the flow from one or more conduits into a main conduit.

junior rights Water rights that are obtained more recently than older rights and therefore are junior in priority relative to the older, more senior rights. *See also* priority.

jute (1) A coarse, fibrous, rope-like material driven into a run joint to seal the inside so as to contain melted lead that is being poured into the joint. (2) To apply such a material.

juvenile water Water first entering the hydrologic cycle, such as water that enters from geothermal activity deep in the oceans.

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K

K *See* distribution constant; *see also* hydraulic conductivity.

K *See* kelvin *in the Units of Measure section.*

k *See* kilo *in the Units of Measure section.*

kaolin A special type of clay, usually high in aluminum content, sometimes used in water treatment.

Kaplan turbine A propeller-type turbine with adjustable blade or runner vanes.

karez A type of infiltration gallery common in the ancient world (ranging from Afghanistan to Morocco) and still in use today. Karezes are hand-dug by skilled workers using methods more than 3,000 years old, but otherwise they are equivalent to modern infiltration galleries. A karez is also known as a quanat, foggara, or falaj. *See also* infiltration gallery.

karotype The chromosomal complement of a cell nucleus. A normal karotype for humans is 23 chromosome pairs that have the distinct morphological characteristics (i.e., appearance) most commonly found in humans.

karst aquifer A type of aquifer formation characterized by carbonate rocks for which a significant portion of the porosity has developed from dissolution of the rocks. The Edwards Aquifer in Texas and the Mammoth Caves in Kentucky are examples of karst aquifers.

karst topography A land surface formed over limestone, dolomite, or gypsum and characterized by sinkholes, caves, and underground drainage.

katamorphic zone The zone of rock fracture, where materials break down. It is especially characterized by dissolution, decrease of volume, and softening of materials; these destructive processes result in degeneration. The zone is divided into the belt of weathering and the belt of cementation. *See also* aeration zone; anomorphic zone; weathering zone.

Kb *See* kilobase *in the Units of Measure section.*

KBEMS *See* knowledge-based energy management system.

KBS *See* knowledge-based system.

K_c *See* crop coefficient.

kelly In rotary well drilling, a rotating table used in large rotary drilling machines to transmit torque from the machine to the drill string. Torque from a drive table is applied to the square rod to cause the rotary motion. The drive table is chain- or gear-driven by an engine.

kelvin (K) *See in the Units of Measure section.*

Kemmerer sampler A vertical point sampler for a water–suspended-sediment mixture. A "messenger" is slid down a wire to trip the mechanism on the sampler to collect the sample.

Kennison flow nozzle A type of nozzle attached to the end of a pipe in order to measure flow when the pipe is not flowing full.

keratinocyte A cell in the epidermis of the skin that synthesizes keratin. Keratin is the main protein constituent of hair, nails, and other horny tissues. It also forms the organic matrix of teeth on which enamel is formed.

kernicterus A medical condition characterized by severe nervous system symptoms. It arises from high accumulations of bilirubin in the blood. It is also referred to as bilirubin encephalopathy. Kernicterus is produced when a chemical interferes with the elimination of bilirubin in the bile. This elimination process is one of the normal functions of the liver, and its interruption is one manifestation of liver toxicity. Kernicterus can come about because of inhibition of the conjugation reactions that allow bilirubin to be excreted, interference with the secretory mechanism that transfers the conjugated bilirubin into the bile, or interference with the flow of bile. *See also* bilirubin.

kerosene A mixture of liquid hydrocarbons obtained by distilling petroleum or bituminous shale and used as a fuel or a solvent for cleaning.

ketoacid A class of organic compounds that have both a ketone (R_1–CO–R_2) and carboxylic acid (COOH) functional group in the chemical structure. Some ketoacids are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. *See also* disinfection by-product; ozonation by-product.

ketone A class of organic compounds in which the carbonyl group (C=O) is attached to two alkyl (hydrocarbon) groups. In industry, ketones are used primarily as solvents. Some ketones are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. *See also* carbonyl; disinfection by-product; ozonation by-product; solvent.

key (1) A small, rectangular piece of metal used to prevent a pump impeller or coupling from rotating relative to the shaft. (2) A metal rod with a long shank used for operating valves that are located below ground level.

K_F *See* Freundlich adsorption constant.

kg *See* kilogram *in the Units of Measure section.*

KHP *See* potassium hydrogen phthalate.

kHz *See* kilohertz *in the Units of Measure section.*

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kill To render microorganisms unable to reproduce, grow, and, in the case of pathogens, infect. In contrast, with respect to viruses, the term *inactivation* is used. *See also* inactivation.

killer cell One of two different types of lymphocytes (white blood cells): the killer T cell, which is derived from the thymus, or the natural killer cells that are produced in bone marrow. The killer cells secrete chemicals that will spontaneously lyse virus-infected cells.

killer T cell A class of T-lymphocytes involved in cell-mediated immunity. *See also* killer cell.

kilo (k) *See in the Units of Measure section.*

kilobase (Kb) *See in the Units of Measure section.*

kilobyte *See in the Units of Measure section.*

kilocycle *See under* kilohertz *in the Units of Measure section.*

kilograin *See in the Units of Measure section.*

kilogram (kg) *See in the Units of Measure section.*

kilohertz (kHz) *See in the Units of Measure section.*

kiloliter *See in the Units of Measure section.*

kilopascal (kPa) *See in the Units of Measure section.*

kiloreactive volt-ampere (kvar) *See in the Units of Measure section.*

kilovolt (kV) *See in the Units of Measure section.*

kilovolt-ampere (kVA) *See in the Units of Measure section.*

kilowatt (kW) *See in the Units of Measure section.*

kilowatt-hour (kW·h) *See in the Units of Measure section.*

Kimura–Sourirajan model A series of mathematical equations that describe transport of a solvent (water) and any number of completely ionized solutes (cations and anions) with different valance through a reverse osmosis membrane system. The model defines the membrane as a barrier layer with preferential sorption for the water or repulsion of solutes. Thus, the model depends on the values of diffusion or permeability coefficient for different ions. The use of the model can predict the performance of different types of reverse osmosis membranes for any given water.

kinematic viscosity (ν) A convenient numerical factor of a fluid for use in engineering practice. It is calculated as follows:

$$\nu = \frac{\mu}{\rho}$$

Where:

ν = the kinematic viscosity
μ = the absolute viscosity of the fluid
ρ = the fluid density

In US customary units, kinematic viscosity is expressed in terms of square feet per second. In Système International units, it is expressed in terms of square meters per second. In the application of hydraulic engineering, kinematic viscosity is often used for determining the Reynolds number to classify the flow regimes and to evaluate the friction coefficient for flows in pipes and open channels. At 68° Fahrenheit (20° Celsius), the kinematic viscosity of water is 1.08×10^{-5} square feet per second (1×10^{-6} square meters per second).

kinematic viscosity coefficient The ratio of the coefficient of absolute viscosity of a fluid to the fluid's unit weight.

kinetic energy Energy possessed by a moving body of matter, such as water, as a result of its motion.

kinetic flow factor A standard for measuring the degree of turbulence or tranquility that prevails in a flowing stream.

kinetic friction coefficient A numerical quantity used as an index of the amount of force necessary to keep a body sliding at a uniform velocity on the surface of another body. It is equal to the ratio of (1) the horizontal force required to slide the body along a horizontal plane surface at a uniform velocity to (2) the weight of the body. It is expressed as a decimal. The coefficient may change with velocity.

kinetic head The theoretical vertical height through which a liquid body may be raised by virtue of its kinetic energy. It is equal to the square of the velocity divided by twice the acceleration due to gravity:

$$\text{kinetic head} = V^2/2g$$

Where (in any consistent set of units):

V = the velocity
g = the acceleration due to gravity

See also velocity head.

kinetic pump *See* velocity pump.

kinetics The study of the relationships between temperature and the motion and velocity of very small particles. Kinetic relationships influence the rate of change in a chemical or physical system and are used in particular to describe the dynamics and rates of chemical reactions.

Kirpich formula (T_c) An equation used for determining the relationship between rainfall and peak runoff, the time interval for surface runoff to reach the point of flow measurement from the upper reaches of a drainage basin. In equation form,

$$T_c = 0.00013\left(\frac{L^{0.77}}{S^{0.0385}}\right)$$

Where:

T_c = the time of concentration, in hours
L = the maximum length of travel of the water, in feet
S = the slope, equal to H/L

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H = the difference in elevation between the most remote point in the basin and the outlet, in feet

Kiwa The drinking water testing and research organization of the Netherlands. Kiwa also works in other sectors including energy, construction, and infrastructure.

kJ (kilojoule) *See under* joule *in the Units of Measure section.*

Kjeldahl nitrogen The combination of ammonia nitrogen and organic nitrogen in a water sample. Total Kjeldahl nitrogen is operationally defined by a method that involves digestion of a sample followed by distillation and determination of ammonia (NH_3) in the distillate. The name is derived from J. Kjeldahl, who in 1883 published a method for determining nitrogen in organic matter.

Kjeldahl nitrogen test A standard analytical method used to determine the concentration of ammonia nitrogen and organic nitrogen in a water sample. The Kjeldahl nitrogen test determines nitrogen in certain organic compounds, but it fails to account for nitrogen in the form of azide ($R(N_3)_x$), azine (–C=N–), azo (–N=N–), hydrazone (R_2C=N–NH_2), nitrile (–C≡N), nitro (NO_2–), nitroso (–NO or =NOH), oxime (R_2–C=N–OH), and semicarbazone (H_2N–(CO)–NHN=CR_2). *See also* total Kjeldahl nitrogen.

K_La *See* volumetric mass transfer coefficient.

Klebsiella A genus of lactose-fermenting bacteria belonging to the family Enterobacteriaceae.

Klebsiella oxytoca (K. oxytoca) A genus and species name for a lactose-fermenting bacterium belonging to the family Enterobacteriaceae. It is one of the coliform group of bacteria used as sanitary indicators for drinking water quality.

Klebsiella pneumoniae (K. pneumoniae) A genus and species name for a lactose-fermenting bacterium belonging to the family Enterobacteriaceae. It is one of the coliform group of bacteria used as sanitary indicators for drinking water quality.

kN (kilonewton) *See under* newton *in the Units of Measure section.*

knockout animal A test animal (e.g., a rodent) in which a gene has been removed to make the animal more or less sensitive to a particular chemical-induced adverse effect. *See also* transgenic animal.

knoll spring A spring occurring on the top of a small knoll or mound. It is produced, wholly or in part, by precipitation of mineral matter from the spring water or by vegetation and sediments blown in by the wind (a method of growth common in arid regions). A knoll spring is also called a mound spring.

knot *See in the Units of Measure section.*

knowledge-based energy management system (KBEMS) An expert system designed to manage and minimize energy usage and cost. *See also* expert system.

knowledge-based system (KBS) A set of computer programs that are designed to help people with the solution of tasks involving uncertainty and imprecision and that require judgment and knowledge. Typically the user is not expected to have expertise in the area of knowledge for which the system is designed.

Kolmogorov microscale A length scale indicating the size of eddies below which the kinetic energy of a fluid is dissipated by viscous forces. In equation form:

$$\eta = \left(\frac{\nu^3}{\varepsilon}\right)^{\frac{1}{4}}$$

Where:

η = Kolmogorov microscale, in feet (meters)

ν = kinematic viscosity, in feet squared per second (meters squared per second)

ε = energy dissipation per unit mass, in feet squared per second cubed (meters squared per second cubed)

Kolmogorov–Smirnov goodness-of-fit test A statistical procedure to determine the goodness of fit of a hypothesized distribution to an observed parametric data set.

K. oxytoca *See Klebsiella oxytoca.*

kPa *See* kilopascal *in the Units of Measure section.*

K. pneumoniae *See Klebsiella pneumoniae.*

KSCN *See* potassium thiocynate.

Kuch mechanism A mechanism describing the production of red water in distribution systems. Iron (Fe^{2+}) is released from corrosion scales on iron or steel pipe during times of water stagnation. This iron (Fe^{2+}) is oxidized to iron (Fe^{3+}), which then precipitates as ferric hydroxide ($Fe(OH)_3$), causing red water when flow is resumed.

Kutter formula A formula for determining the Chezy resistance factor. In US customary units, it is expressed as follows:

$$C = \frac{41.65 + \frac{0.00281}{S} + \frac{1.811}{n}}{1 + \left(41.65 + \frac{0.00281}{S}\right)\frac{n}{\sqrt{R}}}$$

and in Système International units, it is expressed as:

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$$C = \frac{23 + \frac{0.00155}{S} + \frac{1}{n}}{1 + \left(23 + \frac{0.00155}{S}\right)\frac{n}{\sqrt{R}}}$$

Where:

C = the Chezy resistance factor, in $\sqrt{\text{feet}}$ per second ($\sqrt{\text{meters}}$ per second)
S = channel slope (for uniform flow) or energy slope (for nonuniform flow), dimensionless
n = the Kutter roughness coefficient, dimensionless
R = hydraulic radius, in feet (meters)

See also Kutter roughness coefficient.

Kutter roughness coefficient The roughness coefficient in the formula published in 1869 by E. Ganguillet and W.R. Kutter for determining the Chezy resistance factor in the Chezy formula. *See also* Chezy resistance factor.

kV *See* kilovolt *in the Units of Measure section.*

kVA *See* kilovolt-ampere *in the Units of Measure section.*

kvar *See* kiloreactive volt-ampere *in the Units of Measure section.*

kW *See* kilowatt *in the Units of Measure section.*

kW•h *See* kilowatt-hour *in the Units of Measure section.*

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L

L *See* liter *in the Units of Measure section.*

labile Pertaining to a substance that is inactivated by high temperature or radiation; unstable.

laboratory A facility in which water is analyzed for constituents. Many environmental laboratories and larger water utility laboratories are divided into sections based on specialty: microbiology, inorganic chemistry, organic chemistry, and so on.

laboratory-fortified *See* spiked.

laboratory information management system (LIMS) Computer software designed to aid in the storage and retrieval of laboratory data. It can serve as a tool to boost productivity in use of instruments and personnel. The system allows information on a sample to be tracked from the time of reception in the laboratory to the time the sample is discarded. Data from laboratory analyses are entered either manually or automatically into the system. The data user can retrieve these data in a variety of ways. A LIMS also allows quality assurance and quality control information to be documented.

laboratory procedure A mode of conducting laboratory processes and analytical tests consistent with validated standard testing techniques.

laboratory study A laboratory-scale evaluation of whether a particular water is amenable to treatment with specific operations or processes. *See also* pilot-plant study.

Labs21 A voluntary program developed by the US Environmental Protection Agency, the Department of Energy, and the International Institute for Sustainable Laboratories to support the development of safe and energy- and water-efficient new or refurbished environmental laboratories. The program stresses a whole-building approach to these goals. The full name is Laboratories for the 21st Century.

lactation index A measure of the ability of a female experimental animal to provide nutritional support to her offspring during nursing. It is usually defined as the percentage of the offspring alive 4 days after birth (postpartum) that survive to the end of the lactation period (21 days in mice and rats).

lactose A disaccharide (4-β-galactosido-glucose) also known as milk sugar. When hydrolyzed by the enzyme β-galactosidase, it yields the monosaccharides glucose and galactose. Lactose is readily metabolized by coliform bacteria of the genera *Escherichia, Klebsiella, Enterobacter,* and *Citrobacter.*

lactose fermentation Fermentation that produces lactic acid as the primary product.

lactose negative Lacking the biochemical ability to hydrolyze or ferment lactose. This ability, which is easy to determine, is a key characteristic of the sanitary indicator group bacteria called the coliforms. The lactose fermentation ability is assessed under specified incubation time and temperature conditions and with the use of specific lactose-containing media.

lactose positive Having the biochemical ability to hydrolyze or ferment lactose.

lacustrine Related to, pertaining to, produced by, or formed in a lake or lakes.

lacustrine plain A plain originally formed as the bed of a lake from which the water has disappeared.

lacustrine zone A deep-water zone of a lake or reservoir system.

ladder dredge A continuous chain equipped with buckets and mounted on a scow. It is used to remove sediment from the bottom of a storage reservoir. A ladder dredge is also called a bucket dredge or chain bucket.

lag Any combination of factors that prevents a process from changing instantaneously.

lag growth phase The initial period following bacterial introduction to a food source, during which the population grows slowly as the bacteria acclimate to the new environment.

lagoon (1) Any large holding or detention pond, usually with earthen dikes, used to contain residuals while sedimentation and possibly biological oxidation occur. (2) A shallow, usually small body of water near or communicating with a larger body of water.

lagooning The placement of solid or liquid material in a basin, reservoir, or artificial impoundment for purposes of storage, treatment, or disposal.

laid length The length of pipe measured after that pipe is placed in position. The laid length includes such items as gaskets, space between ends of pipe in a coupling, and inserted bell-and-spigot joints.

lake An inland body of water, fresh or salt, of considerable size (usually more than 50 acres [about 200,000 square meters]) and occupying a basin or hollow on the earth's surface. It may or may not have a current or single direction of flow. *See also* pond.

lake aeration The process of adding air to water stored in lakes or reservoirs. The process may be either natural at the interface of the surface of the lake with the atmosphere or enhanced by addition of air or mixing energy to the lake.

lake mixing *See* destratification; lake overturn.

lake overturn The complete, wind-induced, top-to-bottom circulation of water in deep lakes occurring

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when the density of the surface water is the same as or only slightly greater than that at the bottom. It is also called lake turnover. *See also* destratification; thermal stratification.

lake wall A low ridge of material formed around lake perimeters on, or just above, the water level that is subject to freezing. The ice on the lake, freezing to the sand, gravel, and boulders on the shallow bottom near the shore, picks up this material, expands shoreward, deposits the picked-up material on the land upon melting, and repeats the process over a period of years.

λ *See* lambda *in the Units of Measure section.*

lambda (λ) *See in the Units of Measure section.*

Lamella® plate *See* inclined plate settler.

Lamella® separator *See* inclined plate settler.

laminar flow The movement of fluid in a particular direction in smooth, continuous, nonturbulent parallel layers that do not mix with each other.

laminar velocity That velocity at which, in a particular channel or conduit and for a particular fluid, laminar flow will always exist.

lamination A formation composed of individual lamina layered upon one another, each one a layer of geologic material that resembles a thin plate. A single geologic unit consisting of alternating layers of shale and sandstone—with each layer thin relative to the thickness of the entire unit and each layer cemented to adjacent layers—is an example of a lamination.

lamp envelope The exterior surface of an ultraviolet lamp, which is typically made of quartz.

lamp sleeve The quartz tube that surrounds and protects the ultraviolet lamp. The exterior is in direct contact with the water being treated, and there is typically an air gap (approximately 1 centimeter) between the lamp envelope and the quartz sleeve. *See also* quartz jacket.

LAN *See* local area network.

land application A disposal technique for residuals generated from water treatment processes. Settled solids, sometimes containing coagulant, can be applied to land as fill material under certain circumstances and within regulatory restrictions.

land batture (1) The land between the channel of a river and a levee that may be inundated at comparatively infrequent intervals. (2) That portion of river bank that is immediately above the shore and is submerged at times.

land disposal Application of raw or treated residuals or solid waste to soils, substrata, or both without production of usable agricultural products. *See also* land treatment.

land drain A drain for drawing off water from land. *See also* groundwater drain.

land drainage The removal of free water both from the land surface and from the soil of the root zone of plants.

landfill A land area upon which water treatment residuals can be applied between layers of earth. Water treatment residuals can be codisposed with other waste materials, such as solid waste, if a maximum water content in the material is not exceeded.

landform Multitudinous physical features that, when taken together, make up the surface of the earth. The natural processes involved include weathering, erosion, transportation, deposition, and consolidation.

land information system (LIS) A database describing physical or legal characteristics of land areas. A land information system is sometimes called a land records system. The most common forms of land information systems describe property ownership, land value, tax assessment, and property boundaries.

land pan An evaporation pan located on land.

land rights Rights or obligations in connection with the occupation or ownership of land. *See also* easement; leasehold; right-of-way.

landscape and irrigation water conservation ordinance An ordinance designed to minimize water waste associated with landscapes, lawns, and gardens. It may include water efficiency standards and requirements for turf and plant materials and irrigation systems and schedules.

landscape area The combination of irrigated area, nonirrigated planted area, water features, hardscape, and natural undeveloped area.

landscape coefficient A factor used to modify reference evapotranspiration and to calculate water requirements for a hydrozone. *See also* reference evapotranspiration.

landscape water requirement A measure of supplemental water needed to maintain the optimal health and appearance of landscape plantings and water features.

landscaping The grading, clearing, and decorative planting of vegetation to improve the natural beauty of a site and to stabilize the soil, thereby preventing runoff.

landslide A movement of a mass of earth, rock, or a mixture of both in a downward direction by sliding. Such sliding is usually along a layer or stratum of soft or slippery material, such as clay, that then becomes wet and loses its cohesiveness.

landslide flow A moderately rapid flowage of large masses of slippery earth material. It occurs along the edges of clay terraces in certain glaciated valleys and in some mountainous regions where shale bedrock occurs. It is also called earth flow.

landslide spring A spring occurring at the base of a landslide.

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land subsidence A decrease in land surface elevation caused by dewatering and subsequent compaction of the underlying soils as a result of sustained pumping of groundwater.

land treatment Irrigation performed using water treatment residuals (not water) on land. Additional treatment is provided by soil, microorganisms, and crops that are grown to use nutrients. Land treatment is rarely used with water treatment residuals. *See also* land application; land disposal.

land use (1) The culture of the land surface that has a determining effect on the broad social and economic conditions of a region and that determines the amount and character of runoff and erosion. Three general classes are recognized: crop, pasture or range, and forest. (2) An existing or zoned economic use of land, such as residential, industrial, agricultural, or commercial.

Langelier index (LI) *See under* Langelier saturation index.

Langelier saturation index (LSI) The most famous of the calcium carbonate ($CaCO_3$) saturation indexes, the formula for the Langelier saturation index is based on a comparison of the measured pH of a water (pH_a) with the pH the water would have (pH_s) if at saturation with $CaCO_3$ (calcite form) given the same calcium hardness and alkalinity for both pH cases. Many of the other indexes found in the water treatment and corrosion literature are merely approximations. Several versions of the LSI exist in the literature. The version presented here is the one developed by J.R. Rossum and D.T. Merrill for the quadratic equation form of the pH_s equation solution. This material has been updated using newer equilibrium constant and activity coefficient data. (Note that a simplified approximation equation was originally formulated by T.E. Larson and A.M. Buswell.) The basic formula for the Langelier saturation index is

$$LSI = pH_a - pH_s$$

It is interpreted in the following way: If LSI > 0, water is potentially scale forming (supersaturated with respect to $CaCO_3$). If LSI = 0, water is in equilibrium with $CaCO_3$, not tending to dissolve or precipitate it. If LSI < 0, water will potentially dissolve existing $CaCO_3$ deposits (undersaturated with respect to $CaCO_3$). The quantity pH_s is found from the computed hydrogen ion concentration at hypothetical saturation ($[H^+]_s$) by

$$pH_s = -\log_{10}([H^+]_s) - \log_{10} f_m$$

Where:

f_m = the activity coefficient for monovalent ions

The parameter $[H^+]_s$ is computed by the following quadratic equation:

$$[H^+]_s = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

Where:

$$A = 1 - \frac{[Ca^{2+}]K_2}{K_s}$$

$$B = K_2\left(2 - \frac{[Ca^{2+}]Alk}{K_2}\right)$$

$$C = \frac{K_w K_2}{K_s}[Ca^{2+}]$$

$[Ca^{2+}]$ = calcium concentration, in milligrams per liter as $CaCO_3$
Alk = alkalinity, in milligrams per liter as $CaCO_3$
K_2 = solubility constant
K_s = equilibrium constant
$K_w = [H^+][OH^-]$

See also Riddick index; Ryznar stability index.

langite ($Cu_4(SO_4)(OH)_6 \cdot 2(H_2O)$) A corrosion byproduct, blue-green to blue in color, associated with waters of a high sulfate activity and copper pitting corrosion.

Langmuir equation *See under* Langmuir isotherm; *see also* Freundlich isotherm.

Langmuir isotherm A relationship illustrating the equilibrium between an adsorbent surface and a solute. The graphical presentation illustrates the mass of solute per mass of adsorbent (typically activated carbon) as a function of the concentration of the solute in solution. In equation form,

$$q/Q = bC/(1+bC)$$

Where:

q = the number of moles of adsorbate per mass of adsorbent, in moles per gram
Q = the maximum number of moles adsorbed per mass of adsorbent, in moles per gram
C = the concentration of adsorbate, in milligrams per liter
b = an empirical constant, in liters per milligram

The mass adsorbed, q, is assumed to approach a saturating value, Q, when C becomes very large. The advantages of the Langmuir isotherm relative to other models of adsorption include its simplicity, its foundation in a model with some physical basis, and its ability to fit a broad range of experimental data. The Langmuir adsorption model incorporates an assumption that the energy of adsorption is the same for all surface sites and is not dependent on the degree of coverage. In reality, the energy of adsorption may vary because real

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surfaces are heterogeneous. In contrast to the Langmuir isotherm, the Freundlich isotherm attempts to account for this variation. *See also* Freundlich isotherm.

lantern ring A metal ring (usually bronze) that is installed over a pump shaft within the packing and is used to help distribute the lubricant for the packing against the rotating shaft.

lapse rate The rate at which atmospheric temperature decreases with altitude. The value is different for wet versus dry air masses.

large meter A water meter that is difficult to move and so is generally tested in place rather than taken to a meter shop for testing. Small meters are generally 5/8 inch to 2 inches, and meters larger than 2 inches are considered large meters. Système International units are not used for these designations.

large-volume gas chromatography–mass spectrometry (LVGC–MS) A technique where large sample volumes (on the order of tens to hundreds of microliters) are injected for separation and analysis by gas chromatography–mass spectrometry. This enables the shortening of sample preparation time by reducing the time needed to concentrate samples. A precolumn facilitates the removal of most of the solvent before the analytes are transferred to a standard gas chromatographic column.

large water system A public water system defined by the US Environmental Protection Agency as serving a population of more than 50,000 people.

Larson ratio (LR) An index developed to describe the corrosion process. Reactive anions, such as chloride (Cl^-) and sulfate (SO_4^{2-}), form strong acids in anodic pits, corroding the exposed metal, whereas bicarbonate (HCO_3^-) and other anions form weak acids and precipitate a protective scale. Rising index values (greater than 0.4) are increasingly corrosive, and falling index values are less corrosive. This index was developed by T.E. Larson. Its formula is

$$LR = \frac{[Cl^-] + [SO_4^{2-}]}{[HCO_3^-]}$$

Where the brackets indicate concentration in moles per liter.

LAS *See* linear alkyl sulfonate.

laser light-scattering *See* light scattering.

laser particle counter An instrument that uses a laser diode as a light source for the purpose of quantifying particles of various sizes. Different types of particle counters can detect light that is either scattered or blocked by a given set of particles.

laser turbidimeter A turbidimeter with a laser light source that is capable of detecting submicron particles as well as supramicron particles in water, exceeding the capability of the standard turbidimeters with tungsten lamp.

latency period A delay between exposure to a disease-causing agent and the appearance of manifestations of the disease, or the period from disease initiation to detection. This term is often used synonymously with *induction period. See also* incubation period; induction period.

latent energy *See* latent heat.

latent heat The amount of heat released or absorbed when a substance changes its physical phase with no change in temperature, e.g., the heat absorbed from surroundings when ice melts into liquid water at the freezing point or the heat released when a gas (steam) condenses into liquid water. The loss or gain of latent heat does not lead to a change in temperature for the melting ice or the condensing water. *See also* heat of fusion; heat of sublimation.

latent period *See* latency period.

lateral (1) Directed toward, coming from, or situated on the side. (2) A ditch, pipe, or other conduit entering or leaving a water main from the side. (3) A secondary conduit diverting water from a main conduit for delivery to distributaries.

lateral erosion The erosion of the sidewalls and side tributaries of the valley of a stream.

lateral floor A filter underdrain system consisting of parallel pipes (usually plastic or older earthenware designs) coming out of a central header and traversing the width of the filter, with a capped end. These pipes may have holes drilled in them to collect water and allow backwash water out, or nozzles may be screwed into the pipes for this purpose. The pipes must be rigidly fixed to the filter floor. They may be embedded in concrete or be packed around by stones and gravel. The nozzles and gravel must prevent sand entering the pipes. *See also* filter underdrain; nozzle floor.

lateral-flow spillway A spillway in which the initial and final flows are at approximately right angles to each other. *See also* side-channel spillway.

latex microsphere A spherical particle made of synthetic latex manufactured to be precisely of a certain micrometer or submicrometer size. These particles can be used for membrane system integrity testing. *See also* integrity testing.

latex sphere *See* latex microsphere.

latitude–longitude coordinate system A global coordinate system in which locations are expressed by geographical coordinates (the geodetic latitude and geodetic longitude) that depict angular measurements relative to the earth's ellipsoid.

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laundering weir A sedimentation basin overflow weir. It is a plate with V-notches along the top to ensure a uniform flow rate and avoid short-circuiting.

launders Sedimentation basin and filter discharge channels, consisting of overflow weirs (in sedimentation basins) and conveying troughs.

launder trough A trough in a basin designed for evenly distributing or collecting the flow to or from the unit.

launder wings Structures added to the sides of the backwash trough to divert air bubbles away from the edge of the backwash trough. This provides an air-free region for any sand that is disturbed by the air bubbles left in the bed after air scour to settle back into the filter during backwashing. Wings are also used to allow simultaneous combined air scour and water washing to take place with water passing over the washout trough, but without sand being carried over.

laurel tryptose broth (LTB) A medium for the detection of coliform organisms in water and wastewater.

lavage An irrigation (or washing) of an organ, typically the stomach or intestine.

law *See* public law.

lawn watering The application of water to vegetation and landscaping at a rate sufficient to promote good plant growth.

layer A graphic component of a geographic information system database. Each layer contains a set of homogeneous map features registered positionally with respect to other database layers through a common coordinate system. Data are separated into layers based on logical relationships and on the graphic portrayal of sets of features that are organized and stored by the geographical information system software in many, and typically proprietary, ways.

layer aeration *See* hypolimnetic oxygenation.

layered bed (1) A multimedia filter bed containing in the same vessel several different filter media (such as anthracite, sand, and garnet) with specific gravities that differ enough to maintain different layers even after backwashing. (2) A single ion-exchange bed made up of two or more resins that have bead sizes and densities different enough to maintain different layers after backwashing and that can be regenerated with the same regenerant. For example, a layered bed may have a bed of anion resin on top and cation resin below, with both layers regenerated by salt brine solution.

lb *See* pound *in the Units of Measure section.*

lb/d *See* pounds per day *in the Units of Measure section.*

lb/ft² *See* pounds per square foot *in the Units of Measure section.*

LC *See* lethal concentration; liquid chromatography.

LC_{50} *See* lethal concentration–50 percent.

LCA *See* life-cycle assessment.

LCCA *See* Lead Contamination Control Act.

LCD *See* liquid crystal display.

LC–MS *See* liquid chromatography–mass spectrometry.

LC–PB–MS *See* liquid chromatography–particle beam–mass spectrometry.

LCR *See* Lead and Copper Rule.

LD *See* lethal dose.

L/d *See* liters per day *in the Units of Measure section.*

LD_{50} *See* lethal dose–50 percent.

leach To dissolve out by the action of a percolating liquid.

leachate The soluble material dissolved or washed out during leaching.

leaching The dissolution of solids and chemicals into water flowing through a porous sample.

lead A control action used to compensate for lag in a process.

lead (Pb) A metallic element that has had various industrial uses, including in a gasoline additive, in solder and fusible alloys, and in radiation shielding. It is regulated in the distribution systems of public water supplies by the US Environmental Protection Agency at an action level of 0.015 milligrams per liter. Ninety percent of the samples collected at consumers' taps must be below the action level. In addition, it is regulated in air, gasoline, plumbing materials, foods, and house paints. *See also* Lead and Copper Rule; lead-free.

Lead and Copper Rule (LCR) A rule promulgated by the US Environmental Protection Agency on June 7, 1991 (*Federal Register*, 56(110):26460–26564) that set National Primary Drinking Water Regulations for lead and copper.

Lead and Copper Rule revisions Revisions to the LCR promulgated by the US Environmental Protection Agency on January 12, 2000 (65 FR 1950), that streamlined and reduced monitoring and reporting burdens, and address implementation problems and issues arising from legal challenges to the 1991 rule.

lead caulking The driving of lead into a pipe joint after that lead has been poured into the joint and cooled. The lead is tightened into the joint with (1) a blunt, elongated tool known as a caulking tool, which is placed against the lead and hit with a hammer, or (2) a similar tool used with either a pneumatic caulking gun or hammer. Forcing the lead into and all the way around the joint causes the lead to be pressed against the bell and spigot, creating a watertight seal. The recess in the bell keeps the lead from being forced out of the joint by internal pressure in the pipe. When a lead joint starts seeping, it can usually be sealed by recaulking, unless the lead has been forced out of the joint past the recess. *See also* caulking tool.

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Lead Contamination Control Act (LCCA) Public Law 100-572, which was passed in 1988 and amended the Safe Drinking Water Act to institute a program to eliminate lead-containing drinking water coolers in schools.

lead-free Meeting the conditions defined in Safe Drinking Water Act, Section 1417 for solder, flux, pipes, and fittings. To be considered lead-free, solder and flux can contain no more than 0.2 percent lead; pipes and fittings no more than 8.0 percent.

lead joint A bell-and-spigot joint in a water pipe sealed by pouring molten lead in the joint after juting (i.e., forcing jute into) the inside of the joint and then caulking the lead after cooling to complete the seal and stop leaks. *See also* jute; lead caulking.

lead line In hydrographic surveying, a rope, wire, or cable with a weight attached, used for measuring depths of water. A lead line is also called a sounding line.

lead pipe Water piping manufactured and produced from lead metal. Lead was used for service pipe in the past because of the ease of working with it and shaping it. It was sometimes used for small water mains up to 2 inches (5 centimeters) in size. Because of the hazard of lead poisoning, lead pipe can no longer be used. *See also* lead poisoning.

lead poisoning An illness resulting from an accumulation of lead in the body in toxic concentrations, sometimes as a result of the contamination of potable water by lead dissolved from service connections and metal vessels.

lead service *See* lead service line.

lead service line A water line constructed of lead material that was used for the small water line running from the water main to the customer cutoff at the meter box or to the cutoff for the building served. Lead service lines are no longer permitted. *See also* lead poisoning.

LEADSOL (lead solubility) A Fortran-language computer program widely used by the US Environmental Protection Agency in research studies on lead solubility in drinking water. The program computes equilibrium lead (Pb^{2+}) solubility at a specified ionic strength and 77° Fahrenheit (25° Celsius) as a function of pH and dissolved inorganic carbon (or alkalinity), orthophosphate, sulfate, and chloride concentrations.

leaf Any flat filter element that has or supports the filter septum.

leak An unintended hole or crack through which water escapes as from a pipe.

leakage (1) The uncontrolled loss of water from artificial structures as a result of hydrostatic pressure. (2) The uncontrolled loss of water from one aquifer to another. The leakage may be natural, as through a semi-impervious confining layer, or artificial, as through an uncased well. (3) The presence in treated effluent of the type of ions that the ion-exchange process was supposed to remove. Ion removal may be incomplete because of incomplete resin regeneration, excessive service rates, low temperatures, high concentrations of sodium, interfering total dissolved solids in the water being treated, or other factors. This type of leakage is also referred to as slippage. *See also* real losses; system leakage.

leakage current The unwanted flow of electric current through liquid passages rather than through membranes and cells.

leakage detector A device or appliance that detects leaks based on the audibility of water flowing through a leak. Most of these devices are marketed under descriptive trade names. *See also* waterphone.

leakage management The collective activities that provide water utilities with the capabilities to economically minimize real leakage losses. Specifically it covers the capability to detect, quantify, abate, and/or minimize water distribution system leakage. Leakage management also includes the means to prevent new leaks from occurring, such as leak surveys; use of district metered areas (DMA); and nightflow analysis, pressure management, system rehabilitation, and sound leak policies.

leak detection The precise locating of underground water leaks in a water system by the use of sounding or sonic devices where leakage is known or suspected. *See also* waterphone.

leak finder A device used for detecting leaks in liquid or gas pipelines. *See also* leakage detector; waterphone.

leak frequency map A map showing the different types or number of leaks throughout the distribution system. Colored pushpins are sometimes used to identify different leaks on a print of a comprehensive map.

Leaking Underground Storage Tank (LUST) Trust Fund A trust fund created by Congress in 1986 by amending Subtitle I of the Resource Conservation and Recovery Act. The fund has two purposes. First, it provides money for overseeing and enforcing corrective action taken by a responsible party, who is the owner or operator of the leaking underground storage tank (UST). Second, the trust fund provides money for cleanups at UST sites where the owner or operator is unknown, unwilling, or unable to respond, or which require emergency action. The trust fund is financed by a 0.1 cent tax on each gallon of motor fuel sold nationwide. The federal UST program receives approximately $70 million each year, of which an average of greater than 80 percent (approximately $56 million) is allocated for use in the administration, oversight, and

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cleanup of sites within the state and in Indian country. The remaining money has been used by US Environmental Protection Agency (USEPA) for negotiating and overseeing cooperative agreements, implementing programs on Indian lands, and supporting regional and state offices. To receive money from the trust fund, a state must enter into a cooperative agreement with the federal government to spend the money for its intended purpose. Trust fund money is divided among USEPA regional offices based on a formula that uses state data.

leak-noise correlator *See* digital correlator.

leak survey A systematic examination of a water system to find leaks.

leak survey map A modified sectional or valve map showing valves to be closed and areas to be isolated during a leak survey.

leak trigger theory An approach that uses the number of leaks in a length of pipe over a given time span and expands this number or extrapolates from it to obtain a maintenance cost that can be compared with a replacement cost to determine an economical point for starting a replacement project.

leaky aquifer An aquifer bounded by a low-permeability layer that can transmit water at sufficient rates to furnish some water to a well in the aquifer.

leasehold Rights to the use of land for which a consideration has been paid, as distinguished from ownership of the land.

least-cost design A facility design that complies with the intent of the specifications at the lowest possible cost.

least-cost planning A utility planning approach that emphasizes a balanced consideration of supply management and demand management options in identifying feasible least-cost alternatives for meeting future water needs. Compared with traditional planning, least-cost planning recognizes that water demand is malleable and that forecast demand does not have to be taken as a given for the planning process. *See also* demand management; supply management.

least-squares method A mathematical process used to determine a curve that matches up with observed data points as well as possible, so that the relationship between two or more variables can be approximated by the curve's mathematical formula. This method seeks to minimize the sum of the square of the distances (deviations) of the plotted available data (observations) from the fitted curve.

leather O-rings or gaskets used with piston pumps to provide a seal between the piston and the sidewall. *See also* O-ring.

LED *See* light-emitting diode.

left bank The bank of a stream to the left of an observer who is facing downstream.

legal water level That stage of a body of water where the shoreline defines the riparian boundaries, such as the normal high-water line on a lake.

Legionella A genus of bacteria of the family *Legionellaceae,* consisting of many serogroups and species.

Legionella pneumophila (L. pneumophila) A bacterial species that causes an acute pneumonia (Legionnaires' disease, named for a respiratory disease outbreak at a convention of the American Legion; also legionellosis) that is progressive and sometimes fatal, or a milder form of pneumonic illness (Pontiac fever) that is self-limited (i.e., heals on its own) with respiratory symptoms similar to influenza.

LEL *See* lower explosion limit.

length The greatest dimension along the perimeter in the measurement of a rectangular object.

length of dam The distance between end abutments measured on the top along the center line (axis) of a dam.

length units *See in the Units of Measure section.*

LEPA *See* low-energy precision application.

LEPC *See* Local Emergency Planning Committee.

lepidocrocite (γ-FeOOH) A polymorph of goethite. Lepidocrocite is a common corrosion by-product of iron-based distribution systems.

leptospirosis A worldwide zoonosis with tropical predominance and caused by *Leptospira interrogans,* a spirochete (helical bacterium) with numerous serovars. The reservoir of infection consists of wild and domestic animals. Bacterial entry into the body occurs through skin or mucosal abrasions, conjunctivitis, or inhalation of contaminated aerosols. The onset of disease is abrupt following an incubation period of 2–21 days. No strain-specific syndrome exists; however, typical symptoms include fever, abrupt-onset headaches, muscle pain (especially in the calves), coughing fits, conjunctivitis, lesions, meningitis, and kidney failure.

lesion A pathological or traumatic discontinuity or loss of function of a part as a result of damage induced by any chemical.

lethal Deadly; fatal.

lethal concentration (LC) A concentration of a chemical in air or water that will kill an organism. Air concentrations tend to be applied to all organisms, whereas those in water usually apply only to aquatic organisms. This term does not apply to ingestion, because in that case the amount (or dose) of a chemical taken in is considered important, not its concentration.

lethal concentration–50 percent (LC_{50}) The concentration of a chemical in air or water that is

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expected to cause death in 50 percent of test animals living in that air or water.

lethal dose (LD) A dose that would be expected to kill the exposed subject. This is an imprecise term. Estimating a dose that would be expected to kill a certain proportion of exposed individuals (e.g., lethal dose 50) is more precise. This term is most often used in relation to doses likely to be lethal in humans, for whom precise data are rarely available.

lethal dose–50 percent (LD_{50}) The dose of a chemical or other agent that causes death in 50 percent of the treated individuals. To be meaningful, both the dose and route of administration must be stated, as well as how long the test subjects were observed after treatment with the agent.

lethal time The time required for a particular dose to produce a lethal outcome. A more general term would be *latency period.* The lethal time is ordinarily inversely related to the dose administered.

letter of credit (LOC) An agreement by a bank to make a payment to the beneficiary if certain documents are presented to the bank. When the agreement obligates the bank to make principal and interest payments on bonds if the issuer is in default, a letter of credit can allow the issuer to obtain a higher credit rating.

leukemia A progressive and malignant disease of the organs responsible for producing blood cells (i.e., the bone marrow). It is marked by increased numbers of leukocytes and their precursor cells in the blood and bone marrow. It is frequently further characterized by the type of cell (myeloid, lymphoid, or monocytic) involved and the duration of the disease (acute or chronic). In humans, leukemia is primarily associated with benzene (C_6H_6) insults.

leukocytes Cells that are commonly referred to as white blood cells but are actually made up of several different cell types.

leukopenia A reduction in the normal number of leukocytes in the blood. The term is generally applied when the count of leukocytes falls below 5,000 cubic millimeters because of some chemical insult.

levee A dike or embankment, generally constructed on or parallel to the banks of a stream, lake, or other body of water, intended to protect the land side from inundation by floodwaters or to confine the stream flow to its regular channel.

levee grade (1) The slope of the crown of a levee along the center line. (2) The elevation of the top of a levee.

level basin A level area of land surrounded by earthen dikes that retain applied irrigation water until it infiltrates the soil.

level control A float device (or pressure switch) that senses changes in a measured variable and opens or closes a switch in response to that change. In its simplest form, this control might be a floating ball connected mechanically to a switch or valve, such as is used to stop water flow into a toilet when the toilet tank (reservoir) is full.

level of detection *See* limit of detection.

Lewis acid Any molecule or ion that can combine with another molecule or ion by forming a covalent bond with two electrons from the second molecule or ion. A Lewis acid is thus an electron acceptor (an electrophile). *See also* Lewis base.

Lewis base A substance that forms a covalent bond by donating a pair of electrons. Such a substance is also called a nucleophile. Neutralization results from a reaction between a Lewis base and a Lewis acid with the formation of a covalent bond. *See also* Lewis acid.

lewisite An oily, colorless chemical warfare agent that causes blistering of the skin and mucous membranes on contact. It has the chemical name 2-chlorovinylarsonous dichloride. A guideline for the maximum allowable amount of this chemical warfare agent in military drinking water has been developed by the National Research Council. *See also* National Research Council.

Leydig cell An epithelioid cell that is the endocrine (hormone-secreting) cell of the testis. Such cells are responsible for secreting a number of hormones, testosterone being the most abundant. Haloacetic acids were identified in a scientific study as having an adverse effect on hormones, but this finding has not been confirmed.

LFL (lower flammable limit) *See under* lower explosion limit.

L. fortunei *See Limnoperna fortunei.*

LGB *See* lissamine green B.

LHW (lower high water) *See* lower high water *under* tidal water level.

LI (Langelier index) *See* Langelier saturation index.

life cycle (1) The series of stages or changes undergone by an organism from fertilization, birth, or hatching to reproduction of the next generation. (2) The sequence of stages of a product from development through production, use, and final disposal.

life-cycle assessment (LCA) A tool of industrial ecology that tracks materials and energy from raw material acquisition, production, distribution, use, and disposal in order to understand industrial processes, find ways to improve them, justify claims of environmental friendliness, and define policy.

life cycle cost A method of expressing cost in which both capital costs and operations and maintenance costs are considered for comparing different alternatives. Typically, the amortized annual cost of the

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capital investment, based on a fixed interest rate and design period, is added to annual operations and maintenance cost to arrive at a total annual cost.

lifeline A rope or line attached to a person entering a confined space and by which the person can be raised or lowered.

lifeline rate A rate, applicable to usage up to a specified level, that is below the cost of service, providing below-cost pricing for basic necessary water requirements. It is often perceived as a means to assist low-income households in affordably meeting nondiscretionary water needs. *See also* water requirement.

life-span The length of an organism's existence, usually expressed as the mean value for the species. Life-span is considered an important variable in extrapolations of risk across species. Treatment periods in toxicological studies are generally considered to apply to the *portion* of the life-span involved in the testing, rather than the absolute time period involved. The life-span used is that of the strain that is being tested rather than the species as a whole, because the life-spans of inbred strains used in laboratory studies are usually significantly shorter than the normal life-spans (excluding predation) seen in wild strains. For example, a 2-year life-span of laboratory rodents is generally considered to be equivalent to a human life-span of 70 years.

lifetime exposure The total amount of exposure to a substance that a human would receive in a lifetime (usually assumed to be 70 years).

lift-and-turn valve A master control valve for operating and manually regenerating softeners and filters.

lift station A structure that contains pumps and appurtenant piping, valves, and other mechanical and electrical equipment for pumping water. A lift station is also called a pump station.

ligand A molecule, ion, or atom that is attached to the central atom of a coordination compound, chelate, or other complex. Ligands are also called complexing agents (e.g., in the case of ethylenediaminetetraacetic acid). *See also* chelating agent; ethylenediaminetetraacetic acid.

ligand binding site A site on one chemical that has a specific affinity for a group of other chemicals. In the biomedical sciences, the chemical containing the ligand binding site is usually a protein that functions as a receptor used in passing chemical signals between cells or from the exterior of the cell to its interior. Such sites are common targets for drugs and toxins. Chelating agents also have ligand binding sites with a high affinity for particular metals. Adsorption sites on materials such as activated carbon or resins could also be considered ligand binding sites.

light-emitting diode (LED) A semiconductor diode that emits light when current is passed through it. LEDs are commonly used in displays such as calculators and direct readout meters.

light extinction sensor *See* white light extinction sensor.

light intensity units *See in the Units of Measure section.*

light microscope A compound microscope that uses ordinary visible light to illuminate the specimen. The limit of resolution using visible light is about 0.2 micrometers. *See also* electron microscope.

light microscopy A technique that magnifies specimens up to 1,000 times by focusing light on the object with the help of a lens system and using another lens system to magnify the object. Details of the specimen may be enhanced by using methods such as staining, fluorescence, and filters.

light obscuration sensor A type of detector used in particle-counting instruments. Particles flowing past a detector block a light source of known intensity. The particle size is measured based on the decrease in light intensity at 180° from the light source. Light obscuration sensors (sometimes called light-blocking sensors) are able to measure a wide range of particle sizes, typically from 1 micrometer to greater than 100 micrometers.

light rain Rain that is falling at the time of observation with an intensity between a trace and 0.10 inches (2.54 millimeters) per hour, or 0.01 inches (0.25 millimeters) in 6 minutes.

light scattering A method commonly used for the absolute characterization of molecules and particles. Often with the help of lasers, the absolute molar mass and root mean square (rms) radius of synthetic polymers, biological molecules, and natural organic matter molecules can be determined. Separation of the molecules by high-performance liquid chromatography is necessary for complex mixtures. *See* high-performance liquid chromatography.

light speed *See under* speed of light *in the Units of Measure section.*

lignin An organic substance that, with cellulose, forms the chief part of woody tissue. *See also* fulvic acid; humic acid; tannin.

lignin sulfonate A commercially available reagent grade chemical that can simulate the ultraviolet (UV) absorbance spectrum of natural waters and be used to adjust UV transmittance during validation testing of UV reactors.

lignite-based activated carbon Activated carbon derived from combusting lignite, a brownish-black soft coal.

Lim Benyesh–Melnick pool The collective set of 8 pools, consisting of 42 equine antisera, used for typing

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enteroviruses. The pools have been designed such that a given antiserum appears within one pool, or in two or three pools. An unknown enterovirus may be identified (i.e., typed) based on its neutralization by the pool or pools containing its antiserum.

lime (CaO) A calcined chemical material, calcium oxide. Lime is used in lime softening and in lime–soda ash water treatment, but first it must be slaked to calcium hydroxide ($Ca(OH)_2$). Lime is also called burnt lime, calyx, fluxing lime, quicklime, or unslaked lime. *See also* hydrated lime; lime softening; slake.

lime and soda ash process *See* lime–soda ash softening.

lime and soda ash softening *See* lime–soda ash softening.

L

lime clarification The removal of water hardness and turbidity by adding lime to generate carbonate and hydroxide metal precipitates. The solids settle and are removed by manual or mechanical means, generating a clarified effluent with lower hardness and alkalinity than the source water. *See also* alkalinity; hardness.

lime recalcining The reuse of lime sludge by heating to drive off water and carbon dioxide (CO_2), leaving only the calcium oxide (CaO) plus some inert material. Some lime sludge must be wasted periodically to avoid a buildup of inert material. *See also* lime.

lime recovery The process of reclaiming lime by solubilizing magnesium through a carbonation of lime sludge and subsequently separating the solids by mechanical means (e.g., belt filter press or vacuum filter). Source water solids can be separated from the filter cake by flotation followed by lime recalcining of the dewatered calcium carbonate ($CaCO_3$) sludge. *See also* belt filter press; lime recalcining; vacuum filter.

lime scale Hard-water scale formed in pipes and vessels (generally more severe on the hot water side). It contains a high percentage of calcium carbonate ($CaCO_3$) or magnesium carbonate ($MgCO_3$).

lime slaker A mechanical device intended to add sufficient water to quicklime (CaO) to satisfy the latter's affinity for water and to form a slurry. The two basic types of lime slakers are paste (or pug mill) and detention. The paste-type slaker adds water as required to maintain a desired mixing viscosity of about 35 percent calcium hydroxide ($Ca(OH)_2$). The detention-type slaker adds water to maintain a desired ratio with the lime, producing a lime slurry of about 10 percent calcium hydroxide.

lime–soda ash method *See* lime–soda ash softening.

lime–soda ash softening A water treatment that makes use of lime softening followed by a reduction of noncarbonate hardness by the addition of soda ash (Na_2CO_3) to form an insoluble precipitate that is removed by filtration. This method of removing hardness by precipitation is sometimes used by municipalities, but it will leave 85 mg/L or more of residual hardness as calcium carbonate ($CaCO_3$). *See also* hot lime–soda softening; lime softening.

lime softened Pertaining to a water from which hardness has been removed by adding lime and precipitating the solids that are composed of metal carbonates and hydroxides.

lime softening The process of removing water hardness by adding lime to precipitate solids composed of metal carbonates and hydroxides. Clarification may or may not also occur.

limestone A sedimentary rock composed mostly of calcium carbonate ($CaCO_3$) and usually some magnesium carbonate ($MgCO_3$). *See also* calcite.

limestone contactor A treatment device consisting of a bed of limestone through which water is passed to dissolve calcium carbonate ($CaCO_3$). The addition of calcium carbonate to the water decreases corrosivity by increasing the pH, calcium concentration, and alkalinity of the water.

limited turf area A prescribed fraction of the landscape area to which turfgrass is restricted.

limiting factor A condition that tends to inhibit a biological, chemical, economic, physical, or social process.

limit of detection (LOD) The minimum concentration that can be detected by a particular analytical method. Limit-of-detection criteria depend on the context, and a different term may be used. For example, the US Environmental Protection Agency defines a method detection limit as the minimum concentration that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The limit of detection is also called the detection limit. *See also* limit of quantitation; method detection limit; practical quantitation level.

limit of quantitation (LOQ) The concentration level above which the quantification of a substance in a sample is reliable; the region between the limit of detection and the limit of quantification, where detection is reliable but quantification is not. *See also* limit of detection; method detection limit; practical quantitation level.

limit stop Any of several types of diaphragm valves for which adjustments can be made to control flow rates during various processes (backwash, fast rinse, or brine dilution) when brine is pumped in during batch regeneration of the resin in a portable ion-exchange tank.

limit switch setting The adjustment of a control device to specify when the device should stop an action, such as a valve operation or door opening at a predetermined location.

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limnetic Relating to or inhabiting the portion of a body of freshwater beyond the outer border of the littoral zone and to a depth that light penetrates.

limnetic community The area of open water in a freshwater lake providing the habitat for fish, phytoplankton, and zooplankton.

limnology The study of freshwaters, especially ponds and lakes, including their biological, geographical, and physical characteristics.

Limnoperna fortunei (L. fortunei) A freshwater mussel, commonly called the golden mussel, that is an invasive fouling species of water supply systems in Hong Kong, Korea, Taiwan, Japan, and most recently, South America. It is considered a significant invasion threat for North America, especially because, compared with the zebra mussel, *L. fortunei* exhibits a wider tolerance of ecological parameters. *See also* zebra mussel.

LIMS *See* laboratory information management system.

lindane ($C_6H_6Cl_6$) The legal label name for the γ-isomer of 1,2,3,4,5,6-hexachlorocyclohexane. The presence in drinking water of this pesticide is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.0002 milligrams per liter. *See also* pesticide.

line (1) An imaginary trace on the earth's surface. (2) The distance between two points. (3) A one-dimensional object. A line segment is a direct line between two points. Special forms of lines include: a string, a series of line segments; an arc, a locus of points forming a curve defined by a mathematical function; and a chain, a directed sequence of nonintersecting line segments or arcs with nodes at each end.

linear alkyl sulfonate (LAS) A synthetic detergent specially tailored for its biodegradability. Chemically, linear alkyl sulfonate ($R–C_6H_4–SO_4M$, where R is C_{10} or longer and the R group is normal or iso, and M is Na^+ or some other salt) is a straight-chain type of sulfonate, as opposed to a branch-chain sulfonate type detergent called alkylbenzene sulfonate that is known for its resistance to breakdown by microorganisms. *See also* alkylbenzene sulfonate.

linear differential transformer A device designed to produce an electric output proportional to the displacement of a movable core within the primary coil.

linear feet *See in the Units of Measure section.*

linearity A measure of how closely an instrument measures actual values of a variable through its effective range. This measure is used to determine the accuracy of an instrument.

linearization The modification of a system so that its outputs are approximately linear functions of its inputs.

linearized multistage (LMS) model A mathematical model in common use to approximate theoretical dose–response relationships for carcinogens. It is based on the assumption that a finite number of irreversible events are involved in the development of cancer. In the model's application to low-dose extrapolation, the assumption is made that the carcinogen being considered acts in an additive way to other causes of cancer in the population at risk. In general, this model implicitly assumes that the chemical or one of its metabolites is responsible for inducing a mutation. Because such an effect is irreversible, the damage is cumulative with dose. Thus, the probability of inducing cancer becomes linear at low doses. *See also* log-probit model; logit model; multihit model; multistage model; one-hit model; probit model; Weibull model.

linear-nonthreshold risk model A mathematical model used to estimate the risk of cancer following exposure to a substance over a period of time. This model assumes that exposure to even a small amount of a carcinogenic substance can theoretically result in an increased risk of cancer.

linear polarization A method used to estimate the metal corrosion potential of a fluid stream based on polarization resistance. The linear polarization instrument uses a probe with metal electrodes under a known electrical potential and measures the electrical current flow, considering both anodic and cathodic polarization characteristics, and relates the current flow to a metal corrosion rate (typically millimeters per year or mils per year).

linear polyphosphate Series of phosphate groups attached together in a linear manner by P-O-P linkages. Linear chain phosphates are used to control red water complaints associated with particulate iron and to prevent calcium carbonate deposition problems.

lined canal A canal for which the sides and bottom have been lined or covered with some watertight material to prevent leakage or erosion, improve carrying capacity, or minimize growth of vegetation.

liner A filled or unfilled thermoplastic or thermosetting resin layer, nonreinforced or reinforced, that forms the interior surface of the pipe.

line swabbing A method of well development that uses a tool that fits tightly in the well (similar to a brush) and forces water into the formation to remove fines and other blockages near the well.

line-to-line voltage For a polyphase circuit, the voltage between a pair of phase conductors, measured in volts.

line-to-neutral voltage For a polyphase circuit, the voltage between a phase conductor and the neutral conductor, measured in volts.

lin ft *See* linear feet *in the Units of Measure section.*

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lining (1) A protective covering over all or a portion of the perimeter of a conduit or reservoir, intended to prevent seepage losses, withstand pressure, or resist erosion. In the case of conduits, lining is also sometimes installed to reduce friction losses. (2) A physical method for controlling aquatic plants by placing a permanent lining, such as synthetic rubber, in a water body.

linuron ($C_6H_3Cl_2NHC(O)N(OCH_3)CH_3$) The generic name for the herbicide 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea. *See also* herbicide.

Linux An open-architecture computer operating system that is used in a variety of applications, including computer networks, stand-alone systems, and in embedded devices. It is freely available and is a popular alternative to proprietary systems.

lipid peroxidation An interaction of oxygen with double bonds present in fatty acids found in lipids. The process is accelerated in the presence of certain metals (e.g., iron, copper, manganese). Lipid peroxides are formed that are in themselves reactive chemicals and that continue to give rise to other reactive chemicals. Lipid peroxidation is thought to contribute to the toxicity of chemicals that induce oxidative stress. Examples include carbon tetrachloride (CCl_4) and paraquat ($(CH_3(C_5H_4N)_2CH_3)\bullet 2CH_3SO_4$) or ($CH_3(C_5H_4N)_2CH_3\bullet 2Cl$)).

lipids A group of organic compounds that make up fats and other esters that have analogous properties.

lipolytic Possessing the power to produce lipolysis, which is the decomposition or splitting up of fat.

lipophilicity The nonpolar character of a chemical substance.

lipopolysaccharide A major suprastructure of gram-negative bacteria that contributes greatly to the structural integrity of the bacteria. The lipopolysaccharide content could be used for rapid detection of bacteria in water.

lipoprotein A protein that is strongly associated with lipids through nonpolar interactions. Much of the time, these proteins are actually embedded in cell membranes. In many cases, the activity of the protein as an enzyme is dependent on the lipid.

liposome A spherical particle that is found in aqueous media and is formed as a lipid bilayer enclosing an aqueous compartment.

liquefaction The transformation to the liquid state. This term is more commonly used to refer to the changing of gases to liquids rather than the melting of solids to liquids.

liquid A substance that flows freely and takes the shape of its container. A liquid is characterized by free movement of the constituent molecules among themselves, but without the tendency to separate from one another as with gases. The terms *liquid* and *fluid* are often used synonymously, but *fluid* has the broader significance because it includes both liquids and gases. *See also* fluid.

liquid alum Liquid commercial-grade aluminum sulfate, $Al_2(SO_4)_3\bullet 14H_2O$, used as a coagulant chemical at water filtration plants. This chemical typically has a strength of 7.5 percent to 8.5 percent as Al_2O_3. *See also* alum; dry alum.

liquid chlorine Elemental chlorine converted to a liquid state by compression and refrigeration of the dry, purified gas. Liquid chlorine is shipped under pressure in steel containers. This term is also sometimes used to refer to hypochlorite (bleach, NaOCl) solutions. *See also* hypochlorite ion.

liquid chromatography (LC) A technique used in the analysis of organic compounds. It is a separation technique based on the partitioning of an analyte between a liquid mobile phase and a stationary phase, which is typically solid. Liquid chromatography is often practiced as high-performance liquid chromatography. Liquid chromatography techniques allow the analysis of organic compounds that may not be suited to gas chromatographic techniques. Examples include compounds that contain polar functional groups, are thermally unstable, or both. *See also* high-performance liquid chromatography.

liquid chromatography–mass spectrometry (LC–MS) A combined analytical technique that separates analytes in a liquid chromatograph and then in a mass spectrometer that detects the analytes by the masses of their ions. Technological advances have given these instruments a role as powerful tools in the identification of unknown compounds. *See also* electrospray ionization.

liquid chromatography–particle beam–mass spectrometry (LC–PB–MS) An instrumental technique used in the analysis of organic compounds. Such instruments are more commonly situated in research facilities and are not commonly found in water utility laboratories. The term *particle beam* refers to a type of interface between a liquid chromatograph and a mass spectrometer. One major advantage of a particle beam interface over earlier interfaces is that it produces electron impact spectra. This feature makes it easier to identify unknown compounds because spectral databases typically contain many electron impact spectra. One disadvantage of this type of instrument is an inability to completely ionize nonvolatile compounds at trace concentrations. *See also* electrospray ionization.

liquid crystal display (LCD) A common computer and information display device. It is made up of crystals that are laminated between two pieces of

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glass. The optical characteristics of the crystals change when voltage is applied across them. LCD displays consume very little power and are capable of full color and a pixel resolution of 920,000.

liquid limit *See* Atterberg limits.

liquid–liquid extraction (LLE) A class of separation techniques that can be used to isolate or purify a variety of organic and inorganic analytes. It is a commonly used sample preparation technique in water analyses, especially in the analysis of organic compounds. These techniques are based on the partitioning of compounds between two liquids. The trend in laboratory analyses is toward minimizing the use of organic solvents; therefore, many microextraction methods have been developed. Often the partitioning occurs in a separatory funnel or in a sample vial.

liquid–liquid extraction, continuous (CLLE) *See* continuous liquid–liquid extraction.

liquid oxygen (LOX) A form of oxygen for which the temperature is decreased to an extent that the oxygen is in liquid form. Oxygen in this form can be delivered and stored, thereby relieving the need for on-site generation. *See also* pure oxygen.

liquid residuals Residuals containing sufficient water (ordinarily more than 95 percent) to permit flow by gravity or pumping.

liquid scintillation counter An energy-sensitive instrument used in the analysis of radionuclides. A scintillation is a flash of light (photon) produced when an ionizing particle strikes a phosphor. A detector produces a signal that is proportional to the energy deposited in the detector. This behavior gives these instruments an ability to sort, identify, and quantify radiation from different sources. For example, a given instrument can determine the activity of tritium (^{3}H) and radon (^{222}Rn) in a given sample. In water samples, radon is the radionuclide most commonly determined with a liquid scintillation counter. *See also* scintillation cocktail.

liquids from dewatering processes *See* dewatering process liquids.

liquor A solution of one or more chemical substances (gas, solid, or liquid) in water.

LIS *See* land information system.

lissamine green B (LGB) A reagent used for the measurement of chlorine dioxide and chlorite ion in water.

list The text portion of a plat-and-list map. The list provides information about the size, make, direction to open, number of turns to open, date installed, date tested, and reference measurements for numbered valves and hydrants.

listing basin A small area in a field formed by plowing or with a special device (called a basin lister) to catch and divert water to ground storage in a semiarid region and to prevent erosion by water that would otherwise constitute surface runoff.

liter (L) *See in the Units of Measure section.*

liters per day (L/d) *See in the Units of Measure section.*

liters per minute (L/min) *See in the Units of Measure section.*

lithium hypochlorite (LiOCl) A dry powder consisting of a combination of lithium and chlorine put together in such a way that, when it is dissolved in water, active chlorine is released. The active chlorine content is usually about 35 percent.

litholitic Derived from rock or from the lithosphere. *See also* lithosphere.

lithology The science dealing with the mineral composition and structure of rocks, especially characteristics of structures that can be studied without high magnification. Lithology also deals with the character of a rock formation or of the rock found in a geological area or stratum, as expressed in terms of structure, composition, color, and texture.

lithosphere That part of the earth that is composed predominantly of rocks (either coherent or incoherent and including the disintegrated rock materials known as soils and subsoils), together with everything in this rocky crust.

litter (1) Vegetative material, such as leaves, twigs, and stems of plants, lying on the surface of the ground in an undecomposed or slightly decomposed state. (2) Solid waste from human activity deposited indiscriminately on land or water.

littoral *See* littoral zone.

littoral zone (1) That portion of a body of freshwater extending from the shoreline lakeward to the limit of occupancy of rooted plants. (2) The strip of land along a shoreline between the high- and low-water levels.

liver A large gland in the upper part of the abdomen that performs many diverse metabolic functions in a higher organism. In mammals, it has two sources of blood flow, one directly from the heart via the hepatic artery and a second from the complex set of vessels that carry newly absorbed materials from the gastrointestinal tract (stomach and intestines) via the portal vein. Consequently, the liver is the first internal organ through which blood flows from the intestine. In terms of toxicology, the liver is the organ most involved in the metabolism of drugs. This metabolism can inactivate an ingested toxic chemical from drinking water or produce reactive intermediates (during phase 1 metabolism) that interact with lipids, proteins, or nucleic acids to induce toxicity, genetic damage, or both, such as mutations or chromosomal abnormalities. Conversely, the liver is frequently involved in detoxification mechanisms (commonly catalyzed by proteins referred to as phase 2 enzymes). The general

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result of these metabolic reactions is to make a chemical more polar and easier to excrete by the kidney, bile, and intestine. The liver also plays important roles in control of lipid and carbohydrate metabolism and is involved in the metabolism of steroid hormones. It is also the organ that produces and secretes bile.

LLE *See* liquid–liquid extraction.

LLW (lower low water) *See* lower low water *under* tidal water level.

lm *See* lumen *in the Units of Measure section.*

L/min *See* liters per minute *in the Units of Measure section.*

LMS model *See* linearized multistage model.

ln *See* natural logarithm.

load Almost any quantity, e.g., of electrical power, of people served, or of water carried by a conduit.

load change Any change in the process that is imposed on it by changes in an external uncontrolled but related system.

load curve A curve that expresses the variation of the load on a water-pumping station or treatment plant over a given period of time, such as a day, week, month, or year. The load is usually plotted as the ordinate and time as the abscissa.

load factor The ratio of the average load carried by an operation to the maximum load carried, expressed as a percentage, during a given period of time. *See also* load.

loading The amount of a material carried in a moving medium such as water or air. The loading is also called the mass transport.

loading rate The flow rate per unit area (e.g., gallons per minute per square foot, cubic meters per minute per square meter) of a filter, adsorber, or ion-exchange unit through which water passes.

load shifting A treatment plant pumping plan in which treated water is pumped to the distribution system storage during electric off-peak hours (usually overnight) and pumping of treated water is minimized during peak hours to reduce plant electrical demand charges.

LOAEL *See* lowest-observed-adverse-effect level.

loam Soil that contains 7–27 percent clay, 28–50 percent silt, and less than 52 percent sand.

LOC *See* letter of credit.

local area network (LAN) A system for connecting computer hardware and software to provide shared access and data movement among multiple devices within close proximity.

Local Emergency Planning Committee (LEPC) A committee composed of members from entities that provide local emergency services, industries that handle hazardous materials, and government. This group reviews potential hazards and prepares plans to eliminate or respond to emergencies in the community.

localized corrosion Corrosion caused by action of local cells; i.e., galvanic cells arising because of nonuniformities between two adjacent areas at a metal surface exposed to an electrolyte.

local manual control A simple system of controlling equipment by direct human operation of switches and levers mounted on the equipment being operated.

local toxic effect An effect that occurs at the site of exposure; e.g., skin reactions to chemicals that are applied topically, lung irritancy induced by inhaled irritant gases, or tumors induced at the site of injection of a carcinogenic chemical.

locational compliance point A specified location designated in US Environmental Protection Agency regulations where compliance with a particular regulation or regulatory limit is required.

locational running annual average (LRAA) The average of any four consecutive quarterly averages of monitoring data at any particular sampling location. The US Environmental Protection Agency Stage 2 Disinfectants and Disinfection By-Products Rule sets limits on locational running annual averages for total trihalomethanes and sum of five haloacetic acids at monitoring sites that are most likely to have high disinfection by-product (DBP) concentrations.

locked-rotor current The current drawn by a motor the instant the power is turned on while the rotor is still at rest. It is also known as the motor-starting current or inrush current.

lockout The application of a lock to the energy sources for a piece of equipment to prevent that equipment from being accidentally energized while it is out of service.

lock-out-stop (LOS) switch An electrical switch designed to be locked in the off position to prevent operation of an electrical device. This is not necessarily a motor disconnect switch, which is used to ensure safe maintenance. An LOS need not open the power conductors to a load; it typically only disables the control circuit. *See also* lockout.

LOD *See* limit of detection.

lodestone *See* magnetite.

LOEL *See* lowest-observed-effect level.

loessial Referring to loess, a fine-grained, fertile soil deposited mainly by the wind.

log *See* common logarithm.

logarithm, common *See* common logarithm.

logarithm, natural *See* natural logarithm.

logarithmic scale A series of intervals (marks or lines), usually placed along one side and/or the bottom of a graph, that represents the range of values of the data

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and for which the marks or lines are varied logarithmically (as opposed to being equally spaced).

logarithmic transformation A mathematical operation to convert a given number to its logarithm. For example, the logarithmic transform *z* of the number *y* can be defined as $z = \log(y)$.

log boom A floating structure, usually of timber or logs, used (1) to protect the face of a dam or other structure built in or on the water from damage by wave action or by floating material being dashed against it by the waves, or (2) to deflect floating material away from such a structure. A log boom is also used to control spills in open water.

log credit Regulatory credit given to a water system for physical removal or inactivation of a microbial contaminant based on meeting regulatory performance criteria or based on demonstration of performance of treatment effectiveness by the water system. For example, a surface water system using conventional filtration treatment that meets the turbidity performance criteria of the Interim Enhanced Surface Water Treatment (IESWTR) is given a 2-log removal credit for *Cryptosporidium.*

logging, electrical *See* electrical logging.

log growth phase The period during which a bacterial population increases logarithmically with time. The growth rate of the population is a function of the cell division time only if an unlimited supply of food is available.

logical device The highest level of four levels of abstraction in device object modeling wherein each individual site is modeled as part of the Utility Communications Architecture (UCA) system. *See also* Utility Communications Architecture.

Logit dose–response model A model widely used in microbiology to assess microbial risk and to develop dose–response relationships for various types of infection. This type of model is useful in determining minimum infectious dose. The method applies a logarithmic transformation to convert the dose–response curve into a linear form. The logarithmically transformed response variable is calculated by:

$$\text{Response Logit} = \ln [P/(1 - P)]$$

Where P is the proportion of animals infected for a given dose (typically expressed in number of oocysts per milliliter).

The linear regression model for the dose–response curve is then defined as follows:

$$\text{Response Logit} = c + m \times \text{Log}_{10}(\text{Dose})$$

Where c and m are fitting parameters developed from the regression analysis.

logit model In toxicology, a tolerance distribution model that assumes a logistic (S-shaped) distribution of the natural logarithms of individual tolerances in the population. This model gives similar results to the log-probit model in the experimental range but gives a flatter tail at a low dose. As a consequence, it tends to predict higher risks at low doses. *See also* linearized multistage model; log-probit model; multihit model; multistage model, one-hit model; probit model; Weibull model.

log-logistic autoregression multivariate model Statistical model used to predict the expected percentage of positive coliform samples over the entire distribution system a week in advance. This model is applied in the same distribution systems as the AL.COL model. *See also* AL.COL model.

log-mean feed concentration In pressure-driven membrane-desalting processes, the average feed concentration in a concentrate-staged system, considering solute concentration effects throughout the system and varying membrane areas per stage:

$$\text{log-mean feed concentration} = \frac{C_f \ln(C_c/C_f)}{1 - (C_f/C_c)}$$

Where:

C_f = feed concentration, in milligrams per liter
C_c = concentrate concentration, in milligrams per liter

For reverse osmosis inorganic solute rejection calculations, the log-mean feed concentration is often preferred over the simple numerical averaging of the feed-concentrate concentration, because it more accurately defines the average system feed concentration. *See also* average feed concentration.

log-normal distribution A distribution of data in which occurrences of lower values are relatively more abundant compared to occurrences of higher values. Many natural water quality parameters are known to follow a log-normal distribution. A log-normal distribution can be mathematically described by the following equation:

$$f(x) = \frac{1}{x\sigma\sqrt{2\pi}} \exp\left[-\frac{1}{2\sigma^2}(\ln(x) - \mu)^2\right]$$

Where:

σ = population standard deviation
μ = population mean

log Pearson distribution A statistical distribution used in flood frequency analysis to determine the probability that a given flow will occur within a given time interval.

log-probit model In toxicology, a tolerance distribution model based on the concept that each individual has a threshold dose or exposure at which a toxic

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effect would be produced. The model assumes a normal distribution and includes location and scaling factors. The data are transformed $\log_{10}$ on a scale that is adjusted by adding whole integers to ensure that the values representing dose are expressed as positive numbers. These units are known as *probits.* This model is used traditionally in toxicology to estimate the lethal dose—50 percent and other dichotomous (i.e., all-or-nothing) responses. *See also* linearized multistage model; logit model; multihit model; multistage model, one-hit model; probit model; Weibull model.

log removal A shorthand term for $\log_{10}$ removal, used in reference to the Surface Water Treatment Rule and the physical–chemical treatment of water to remove, kill, or inactivate pathogenic organisms such as *Giardia lamblia* and viruses. A 1-log removal equals a 90 percent reduction in density of the target organism; a 2-log removal equals a 99 percent reduction; a 3-log removal equals a 99.9 percent reduction; and so on. *See also* common logarithm.

3-log removal A 99.9 percent removal or inactivation for *Giardia* cysts, as required by the Surface Water Treatment Rule under the US Environmental Protection Agency's Safe Drinking Water Act. *See also* log removal.

4-log removal The removal of 99.99 percent of a contaminant, usually microbes. *See also* log removal.

log removal value (LRV) A filtration removal efficiency value defined under the US Environmental Protection Agency Long Term 2 Enhanced Surface Water Treatment Rule for a target organism, particulate, or surrogate as the $\log_{10}$ feed concentration minus $\log_{10}$ filtrate concentration.

longitudinal dispersion Movement of a substance forward or backward along the direction of flow as a result of concentration gradients. *See also* Peclet number.

longitudinal epidemiologic study An analytical epidemiologic study in which the time sequence between exposure and disease status can be inferred; i.e., water exposure precedes onset of disease (in contrast to cross-sectional epidemiologic studies, in which disease may influence exposure; for example, disease may increase the need for fluid, thus leading to greater water exposure). Studies can be retrospective or prospective in time. In case-control or retrospective cohort (retrospective) studies, an inference is made about the current disease status of a study population and associated events or experiences in the past. A prospective cohort (prospective) study identifies exposed and unexposed populations and follows these populations to determine their future disease status. *See also* case-control epidemiologic study; cohort epidemiologic study; cross-sectional epidemiologic study; prospective study; retrospective analysis.

longitudinal flow A flow pattern in which water travels from the bottom to top (or vice versa) in either a cartridge-type or loose-media tank-type filtration system. Such flow generally produces greater contact time, higher unit capacity, more complete utilization of the medium, and a more uniform water quality. Longitudinal flow is also called axial flow.

longitudinal mixing Dispersion of a substance lengthwise in a stream as it moves downstream.

long pipe Generally, a pipeline for which the length is more than 500 times greater than the diameter. In such pipes, the loss of head caused by entrance into the pipe and by velocity head is negligible and usually disregarded.

long-run average cost The total cost of producing a product (e.g., water)—allowing for all factors of production to be changed as desired—divided by the number of units (e.g., 1,000 gallons) produced. In the field of economics, the long run is a period of time long enough so that all costs of production are variable, i.e., all forms of production can be changed, including the plant size, the process, the location, and so forth. By contrast, the short run is a period of time too short to alter all of the factors of production. In the long run, many plant sizes and processes might be devised to produce the required amount of product, each with varying average costs per unit. Each of these alternative plants, once committed, becomes a short-run operation, because all factors of production can no longer be changed. The goal in designing facilities and processes for the long run is to identify which plant configuration, from the array of alternatives evaluated, will minimize the short-run average cost for the expected level of output. *See also* short-run average cost.

long-run marginal cost A value determined by dividing the change in total cost associated with producing the next increment of product (such as the next 1,000 or 1 million gallons of water) by the amount of that increment. Since in the long run all costs are defined as variable, long-run marginal cost can be thought of as the change in total cost that results from small variations in the scale of the plant divided by the change in output associated with those changes in plant size. Each scale of plant also has its own short-run average and marginal cost curves. For the optimal plant scale, the short-run marginal cost is equal to the long-run marginal cost at the desired level of output.

Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) A rule promulgated January 14, 2002, by US Environmental Protection Agency (67 FR

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1812–1844) that requires small public water systems using surface water to meet strengthened filtration requirements. The LT1ESWTR requires systems to calculate levels of microbial inactivation to ensure that microbial protection is not jeopardized if systems make changes to comply with requirements of the Stage 1 Disinfectants and Disinfection By-products Rule (Stage 1 DBPR). This rule, which addresses subpart H systems serving fewer than 10,000 persons, is similar to the Interim Enhanced Surface Water Treatment Rule (IESWTR) established for larger systems.

Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) A rule promulgated January 5, 2006, by the US Environmental Protection Agency (71 FR 653–702) to reduce the possibility of disease incidence associated with *Cryptosporidium* and other pathogenic microorganisms in drinking water. The LT2ESWTR supplements existing regulations by targeting additional *Cryptosporidium* treatment requirements to higher-risk systems. This regulation also contains provisions to mitigate risks from uncovered finished water storage facilities and to ensure that systems maintain microbial protection as they take steps to reduce the formation of disinfection by-products. The LT2ESWTR applies to all systems that use surface water or groundwater under the direct influence of surface water.

long-term animal feeding study *See* carcinogenesis bioassay.

long-term single-element bench-scale test A membrane treatment study specified in the US Environmental Protection Agency's Information Collection Rule as promulgated in May 1996, whereby one spiral-wound membrane element (minimum element size 2.5 inches [6.4 centimeters] in diameter and 40 inches [1 meter] in length) with molecular weight cutoff less than 1,000 daltons is evaluated at 75 percent recovery while other operating parameters are held constant for at least 6,600 hours over the course of 1 year. The study is a continuous-flow test using one membrane element and concentrate recycle. *See also* Information Collection Rule.

long tube A tube inserted in an orifice that is more than three times longer than its diameter.

long-tube evaporator A distillation device in which long tubes for condensate or other steam are configured parallel to the steam flow direction. *See also* multiple-effect distillation; multistage flash distillation.

loop (1) The plumbing network designed to continuously circulate ultrapure-grade water in high-purity water systems between storage and disinfection modes so as to maintain microbiological cleanliness. (2) A plumbing connection used to bypass water around a particular location. It allows a water treatment device to be installed at that location, or it may be used when the treatment system is out of service for any reason. *See also* looping.

looped pooling A process of assigning one water allocation to a group of metered accounts in a looped system. A looped system involves a set of meters in service to the same irrigation main.

looping A distribution system design practice of configuring a piping system in a loop to allow continual flow-through of the treated water without dead ends in which the water can stagnate. Looping promotes good water quality and hydraulic pressure within a distribution system.

loop system *See* arterial-loop system.

loose apron A covering of loose stone or blocks laid on the berm of a river embankment to protect the embankment from erosion. The stone from the apron gradually fails as scour takes place; this process is called launching. *See also* riprap.

loose medium (loose media, pl.) A filter, adsorption, or ion-exchange medium (in a tank or bed) that can be expanded during backwashing and rinsing. The term *loose* is used to differentiate from a contained, or "fixed" medium in a tank or a fixed or compressed medium layer in a cartridge filter.

loose-rock dam A dam constructed of rocks without the use of mortar, usually dumped in place without any particular effort at packing, sorting, or arranging. Such a dam is also called a loose rock-fill dam.

LOQ *See* limit of quantitation.

losing stream A stream that loses water by seepage into the ground. A losing stream is also called an influent stream.

loss (1) The cost of a claim against a company. (2) The opposite of profit. Loss occurs when expenses exceed revenues in any accounting period. *See also* conveyance loss; water loss.

loss of head (1) The decrease in energy head between two points resulting from friction, bends, obstructions, expansions, or any other cause. It does not include changes in the elevation of the hydraulic grade line unless the hydraulic and energy grade lines parallel each other. (2) The difference between the total heads at two points in a hydraulic system.

loss-of-head gauge A gauge on a rapid granular filter that indicates the loss of head involved in the filtering operation and enables the operator to ascertain the need for filter washing. Some gauges are of the indicating–recording type.

loss-of-signal switch Protection for a control loop against overreacting when the loop is receiving no signal. This protection usually locks the control loop at the last value received. Most control signals are represented by a 4–20-milliampere or 1–5-volt

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signal, with 4 milliamperes and 1 volt representing the minimum value and 20 milliamperes and 5 volts representing the maximum value. If the control signal is lost altogether (0 milliamperes, 0 volts), the control loop must be protected by responding as though it were receiving a 4-milliampere, 1-volt signal.

LOS switch *See* lock-out-stop switch.

lost circulation The result of drilling fluid escaping from the borehole into a porous or fractured formation. This fluid loss increases the cost of the drilling operation because the drilling cuttings are not lifted to the surface but instead are forced into the borehole walls. The lost fluid and cuttings can damage the formation near the borehole, so that subsequent well development techniques are ineffective and the well cannot produce economic quantities of water.

lost-day rate *See* incident rate.

lost energy In hydraulics, the heat energy of water flowing in a waterway, produced by friction and lost through absorption in the stream and dissipation in the water or the walls of the waterway.

lost river In geology, a river that, because of acidity, or subterranean flow in karst areas, has lost its trunk, at first only during the driest season and later permanently. The remaining detached tributaries lose themselves in the arid ground.

lotic Pertaining to flowing water bodies, such as rivers.

low-consumption toilet A toilet designed to meet the American Society of Mechanical Engineers/ American National Standards Institute standard A112.19.6, Hydraulic Performance Requirements for Water Closets and Urinals, using 1.6 gallons (6 liters) or less of water per flush cycle.

low-dose linearity An assumption used in cancer risk assessment that almost any dose–response relationship for carcinogens becomes linear at low doses when background cancer rates are taken into account. This assumes that the carcinogen and the background cancer incidence occur by the same biological mechanism.

low duty of water An irrigation water requirement under which a given quantity of water will serve a relatively small area of land.

low-energy precision application (LEPA) A center-pivot agricultural irrigation system that applies water directly onto or near the soil by distributing it at low pressure from an overhead lateral pipeline through drop tubes and orifice-controlled emitters.

lower barrel The section of a hydrant that carries the water flow between the base and the upper section. It is usually buried in the ground with the connection to the upper section approximately 2 inches (50 millimeters) above ground line.

lower explosion limit (LEL) The lower end of a range in which a substance will be flammable at ambient temperatures. The value is usually represented as a percentage of the gas or vapor in air by volume.

lower flammable limit (LFL) *See* lower explosion limit.

lower main rod The lower part of the stem in a standard compression hydrant that attaches the main valve assembly to the upper stem and operating mechanism. It is equipped with a spring to ensure positive closure.

lower section The part of a dry-barrel hydrant that includes the lower barrel, the main valve assembly, and the base.

lower valve plate The portion of the main valve assembly in a standard compression hydrant that connects the valve to the lower main rod.

lowest-observed-adverse-effect level (LOAEL) An exposure, dose, or concentration that produces a minimal toxic response. The definition of what constitutes a minimal toxic effect is somewhat arbitrary, but such an effect is ordinarily viewed as a mild, reversible change that does not represent a severe health effect. Although the effect is mild, its relationship to a clearly recognized adverse effect must be recognized. The term has real meaning only when the effects of a chemical have been reasonably well characterized. It should not be applied to results obtained during a single noncomprehensive evaluation of toxic effects. The term has meaning in the derivation of standards only when it serves as the basis for calculating a reference dose. Ordinarily, the calculation of a reference dose from a lowest-observed-adverse-effect level requires additional safety factors relative to a no-observed-adverse-effect level that has been obtained under similar circumstances. *See also* benchmark dose; no-observed-adverse-effect level; reference dose.

lowest-observed-effect level (LOEL) The minimum dose or exposure that leads to some change in an organism. It differs from a lowest-observed-adverse-effect level in that the response has no clear relationship to the production of an adverse health effect. Although it identifies a particular dose level, it is usually not appropriate for use in establishing standards. *See also* benchmark dose; dose; lowest-observed-adverse-effect level; no-observed-adverse-effect level.

low-flow frequency analysis An analysis that uses raw hydraulic data to determine the probability that a particular low-flow design value will be the proper stream-flow-design value for estimating stream flow or impounding reservoir safe yield.

low-head drainage Drainage of water from irrigation lines at the low elevations in an irrigation circuit.

lowland Low-lying land, slightly undulated or flat, principally along coasts and in river valleys.

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low-pressure (LP) ultraviolet lamp A mercury vapor lamp that operates at an internal pressure of 2×10^{-5} to 2×10^{-4} pounds per square inch (0.133 to 1.33 kilopascals) and electrical input of 0.5 watts per centimeter, resulting in essentially monochromatic light output at 254 nanometers.

low-pressure high-output (LPHO) ultraviolet lamp A low-pressure mercury vapor lamp that operates under increased electrical input (1.5 to 10 watts per centimeter), resulting in a higher ultraviolet intensity than low-pressure ultraviolet lamps. It also has essentially monochromatic light output at 254 nanometers.

low-pressure membrane For pressure-driven membrane processes, a term sometimes used referring to microfiltration and ultrafiltration (as opposed to reverse osmosis and nanofiltration). It is also a term sometimes used for reverse osmosis and nanofiltration membranes that are designed for normal service at relatively low feed pressures (generally less than 200 or 250 pounds per square inch [137.9 or 187.4 kilopascals]). *See also* microfiltration; nanofiltration; reverse osmosis; ultrafiltration.

low-pressure reverse osmosis (LPRO) A reverse osmosis process utilizing membrane elements that maintain relatively high contaminant rejection characteristics and permeate fluxes while allowing for operation at reduced pressure.

low-pressure transient *See* pressure transient.

low-pressure ultraviolet (UV) irradiation Treatment with a monochromatic ultraviolet light at 254 nanometers generated by a low-pressure lamp. *See also* low-pressure ultraviolet light; ultraviolet light disinfection.

low-pressure ultraviolet light A low-intensity ultraviolet (UV) light generated by low-pressure ultraviolet lamps. The lamp operates with very low (vacuum) internal pressure and low temperature (110° Fahrenheit [43° Celsius]) and provides monochromatic radiation at 254 nanometers. Low-pressure lamps are often referred to as conventional lamps. *See also* ultraviolet light disinfection.

low-volume faucet A faucet that uses no more than 2.5 gallons per minute at 80 pounds per square inch, equivalent to 2.2 gallons per minute at 60 pounds per square inch; also referred to as a low-flow faucet.

low-volume showerhead A showerhead that uses no more than 2.5 gallons per minute at 80 pounds per square inch, equivalent to 2.2 gallons per minute at 60 pounds per square inch; also referred to as a low-flow showerhead.

low-volume toilet A toilet that uses no more than 1.6 gallons/flush; also referred to as a low-flow toilet.

low-volume urinal A urinal that uses no more than 1.0 gallon/flush; also referred to as a low-flow urinal.

low-water datum An approximation of the plane of mean low water that has been adopted as a standard reference plane for a limited area and is retained for an indefinite period, even though it may differ slightly from a better determination of mean low water from a subsequent series of observations.

low-water line The line to which the shore of a river, lake, or sea ordinarily recedes at low water.

low-water lunitidal interval The interval between the moon's meridian passage at a given place and the following low water at that place.

low-water regulation Adjustment of low stream flows to a desirable, necessary, or standard condition.

low-water-use landscape Use of plants (often native or adaptive noninvasive species) that are appropriate to an area's climate and growing conditions. *See* Xeriscape™.

low-water-use plants Plants that require less than 30 percent of reference evapotranspiration to maintain optimum health and appearance.

LOX *See* liquid oxygen.

LPHO ultraviolet lamp *See* low-pressure high-output ultraviolet lamp.

L. pneumophila *See Legionella pneumophila.*

LPRO *See* low-pressure reverse osmosis.

LPS endotoxin Also known as lipopolysaccharide, an outer coat of certain bacteria that stain as gram-negative and are endotoxic (potent stimulators of natural immunity).

LP ultraviolet lamp *See* low-pressure ultraviolet lamp.

LR *See* Larson ratio.

LRAA *See* locational running annual average.

LRV *See* log removal value.

LSI *See* Langelier saturation index.

LT1ESWTR *See* Long Term 1 Enhanced Surface Water Treatment Rule.

LT2ESWTR *See* Long Term 2 Enhanced Surface Water Treatment Rule.

LTB *See* laurel tryptose broth.

lubricant Usually a natural or synthetic oil or grease (sometimes gas) used to reduce friction and conduct heat away from bearings.

Lugol's iodine An aqueous solution of iodine and potassium iodide introduced into medicine in 1829 by the French physician Jean Lugol. In addition to the medical use, it is commonly used in plankton sample preservation and bacteria gram's stain. *See also* Gram's stain.

lumen (lm) (1) For a hollow-fiber membrane, the central bore of a fiber. (2) *See also* lumen *in the Units of Measure section.*

luminance units *See in the Units of Measure section.*

luminescent bacteria Among the most numerous unicellular inhabitants of sea waters. Morphologically

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and physiologically very similar to enteric bacteria, they are gram-negative bacilli and facultative anaerobes. Bioluminescence is one of the forms of a chemiluminescent reaction, the final product of which is visible light. Two common species of luminescent bacteria are *Photobacterium phosphoreum* and *Vibrio fischeri.*

luminous flux units *See in the Units of Measure section.*

lunar day The time of the rotation of the earth with respect to the moon, or the interval between two successive upper transits of the moon over the meridian of a place. The mean lunar day is approximately 24.84 solar hours in length, or 1.035 times as long as the mean solar day.

LUST Trust Fund *See* Leaking Underground Storage Tank Trust Fund.

lux (lx) *See in the Units of Measure section.*

LVGC–MS *See* large-volume gas chromotography–mass spectrrometry.

L'vov platform An adaptation of a graphite tube used in atomic absorption spectrophotometry. It was named for B.V. L'vov, a pioneer in the field, and is known generically as a stabilized temperature platform furnace. Such a tube contains a shelf onto which a sample is injected. The platform promotes even heating of the sample, which delays atomization of the analyte. This delay minimizes the nonspectral interferences common in graphite furnace work.

LW (low water) *See* low water *under* tidal water level.

lx *See* lux *in the Units of Measure section.*

lye *See* sodium hydroxide.

lymph node A collection point for drainage of tissues by the lymphatic system. The lymph is a clear watery fluid that may contain some red blood vessels but usually contains lymphocytes (white blood cells) and fat. The lymphatic system consists of a system of vessels that come from the blood vessels, converge in lymph nodes, and return to the blood vessels. Frequently, lymph nodes are sites at which metastasizing tumor cells collect. Therefore, lymph nodes are frequently biopsied at the time of cancer surgery to determine whether any signs of metastasis exist. They are examined in all chronic studies of potential drinking water carcinogens. *See also* metastasis.

lymphocyte Essentially a type of white blood cell. The term is applied most specifically to a mononuclear leukocyte that is 7–20 micrometers in diameter and that stains deep blue in the nucleus. A lymphocyte participates in humoral and cell-mediated immune responses. Lymphocytes are involved in inflammatory responses produced by many toxic chemicals. *See also* cell-mediated immunity; humoral immunity.

lymphoma Any neoplastic (i.e., cancerous) disorder of the lymphatic system, including Hodgkin's disease. Because benign lymphomas are relatively rare, the term used alone is usually taken to be synonymous with malignant lymphoma. Lymphoma is a frequent tumor in rodents used in toxicologic studies.

lymphosarcoma Any neoplastic (i.e., cancerous) disorder of the lymphatic system with the exception of Hodgkin's disease; a common tumor type. *See also* lymphoma.

lyngbyatoxin A toxin produced by *Lyngbya,* a type of cyanobacteria, that produces skin irritation on contact.

lyophilization An effective method for long-term preservation of bacteria and other microorganisms. It involves removing water from frozen microorganism suspensions by sublimation under reduced pressure.

lysed blood Blood that has gone through the lysis process, which disrupts the blood cell membrane. It usually refers to the destruction/decomposition of the blood cell.

lysimeter A structure containing a mass of soil and designed to permit the measurement of water draining through the soil. Water is applied by a sprinkling mechanism (rain simulator) that provides a rather uniform sprinkling of water to a prescribed area at prescribed rates and size drops (impact); an auxiliary apparatus consists of a rain gauge (either total or intensity) and a catchment basin or receptacles in which surface runoff rate or total flow is measured.

lysis A process of death of a living microorganism, causing the breakup of the cell wall and resulting in the release of protoplasm from the cell.

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M

M *See* molar *in the Units of Measure section.*

M *See* mega *in the Units of Measure section.*

m *See meta.*

m *See* meter *in the Units of Measure section;* milli *in the Units of Measure section.*

M^+ *See* molecular ion.

m^2 *See* square meter *in the Units of Measure section.*

m^3 *See* cubic meter *in the Units of Measure section.*

mA *See* milliampere *in the Units of Measure section.*

MAC *See* maximum allowable concentration; *Mycobacterium avium* complex.

MacConkey agar Selective growth medium used for growth of many enteric bacteria.

machine-banded pipe A pipe made of wooden staves held together in a machine and tightly wrapped with wire. It is made in definite lengths in a factory and joined in the field by couplings.

machine guard Shielding designed to prevent a person from coming into contact with moving parts of equipment.

macrobenthos The larger-than-microscopic animals and plants that are fixed or crawl on the bottom of a body of water.

macroinvertebrate Any larger-than-microscopic animal that has no backbone or spinal column.

macroorganism Any plant, animal, or fungal organism visible to the unaided eye.

macrophage Any of a family of phagocytic cells with a small, oval nucleus that occur in the walls of blood vessels and loose connective tissue. These cells are derived from monocytes. Normally immobile, they are activated by inflammation and engulf foreign material, including microbes and their remains.

macrophyte A large aquatic plant (as opposed to small algae such as phytoplankton).

macropore *See* transport pore.

macroporous resin Any of a special grade of ion-exchange resins that have a high resistance to oxidation and organic fouling and were developed to provide increased surface area for reactions with high–molecular-weight organic matter. Macroporous resins, which are produced in both anionic and cationic versions, contain high levels (12 percent or more) of divinylbenzene cross-linking, which reduces the swelling of the polymer resin in water.

macroreticular resin Any of a special grade of ion-exchange resins (either anionic or cationic) having a rigid polymer porous network that retains its porous structure even after drying. Macroporous, macroreticular, and fixed-pore ion exchangers are, in general, of the same grade and are less subject than other resins to organic fouling.

macroscopic Visible by the eye without the aid of a microscope.

macroscopic organism Any organism big enough to be seen by the eye without the aid of a microscope.

Madin–Darby canine kidney (MDCK) cell culture Cell line often used to detect infectious *Cryptosporidium* species.

MADM *See* moving average disaggregation model.

M. aeruginosa *See Microcystis aeruginosa.*

maghemite (γ-Fe_2O_3) A strongly magnetic dimorph of hematite. Brown in color, maghemite forms when iron minerals rust. It is sometimes found in drinking water distribution systems.

magnesia (MgO) Magnesium oxide that has been specially processed. Magnesia water treatment can be used to modify the pH of water.

magnesium (Mg) One of the elements that make up the earth's crust as components of many rock-forming minerals, such as dolomite. Magnesium and calcium dissolved in water constitute hardness. The presence of magnesium in water contributes to the formation of scale and the insoluble soap curds that typify hard water.

magnesium hardness The portion of total hardness caused by magnesium compounds, such as magnesium carbonate and magnesium sulfate.

magnetic affinity cell sorting *See* immunomagnetic assay.

magnetically impregnated ion-exchange resin *See* magnetic ion-exchange resin.

magnetically stabilized fluidized bed An upflow fluidized packed bed containing magnetic adsorbent or ion-exchange particles held in place by a magnetic field. The stabilized bed allows the use of fine particles in packed beds, prevents the mixing of fine particles or beads, and allows the passage of water containing suspended solids through the bed without filtering out the solids. *See also* magnetic ion-exchange resin.

magnetic field strength units *See in the Units of Measure section.*

magnetic flowmeter A flow-measuring device in which the movement of water induces an electrical current proportional to the rate of flow.

magnetic flux density units *See in the Units of Measure section.*

magnetic flux leakage A method of detecting pits in cast-iron and steel pipes. Magnets are designed to put a steady direct-current magnetic field into the pipe wall

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so that the field travels in the same direction as the pipe axis. If the field in the pipe wall is strong enough, a small amount of magnetic flux will exit the pipe whenever a corrosion pit or similar defect is detected.

magnetic flux units *See in the Units of Measure section.*

magnetic ion-exchange resin Micron-size ion-exchange resin particles or larger resin beads that contain encapsulated magnetic iron oxides that make the particles or beads magnetic. The magnetic properties facilitate the rapid separation of the fine particles from the solution after contact with water or wastewater. The magnetic properties of resin beads allow them be held in place in upflow magnetically stabilized fluidized beds that allow the passage of water or wastewater containing suspended solids without filtering out the solids. *See also* magnetically stabilized fluidized bed.

magnetic meter *See* magnetic flowmeter.

magnetic sector hybrid mass spectrometer A type of mass spectrometer named for the manner in which ions are separated within the mass analyzer. Ions are separated in a strong magnetic field so that ions of a certain mass-to-charge ratio reach the ion collector. Some magnetic sector instruments are capable of high-resolution mass spectrometry and are very expensive.

magnetic separation A physical treatment process for removing magnetic suspended solids from a liquid by applying a magnetic field.

magnetic stirrer A device used for mixing chemical solutions in the laboratory.

magnetite (Fe_3O_4 or $FeFe_2O_4$) The mineral name for the black, mixed ferrous–ferric iron solid of the formula Fe_3O_4, or $FeFe_2O_4$. The name is indicative of the frequent ability of grains of magnetite solid to be separable from other materials in a scale by the use of a magnet. Magnesium, zinc, manganese, and nickel often substitute for the ferrous iron in the crystal structure. Magnetite is found in layers in many corrosion deposits formed on iron pipe; a relatively high pH, low carbonate concentration, and reducing local environment favor its formation.

main A pipe that transports or distributes water from the supply system to the service lines of a water customer.

main extension Additional distribution piping connected to an existing conduit, line, or main that is already providing service.

main-line meter A water meter installed on a large main of the distribution system.

main rod A rod, made of two sections, that connects the standard compression hydrant valve to the operating nut.

main tapping The process of connecting a corporation cock to a water main, including drilling a hole, threading the pipe wall, and tightening the corporation cock. The tap may be made directly to the main or through a tap saddle or sleeve that goes around the pipe and has threads for the corporation stop to be attached. *See also* corporation cock.

maintenance Repairs and general upkeep necessary for the efficient operation of physical plants, property, and equipment. Maintenance is not to be confused with replacement or retirement.

maintenance cost The expenses of labor and materials related to upkeep necessary for efficient operation of physical property.

maintenance management system *See* computer maintenance management system.

main valve In a dry-barrel hydrant, the valve in the hydrant's base that is used to pressurize the hydrant barrel, allowing water to flow from any open outlet nozzle.

main valve assembly A standard compression hydrant subassembly including the lower main rod, upper valve plate, resilient hydrant valve, lower valve plate, cap nut, and bronze seat ring. The main valve assembly screws into a bronze subseat or directly into threads cut into the base.

major ions The following anions: bicarbonate (HCO_3^-), carbonate (CO_3^{2-}), chloride (Cl^-), and sulfate (SO_4^{2-}); and cations: calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), and sodium (Na^+).

makeup carbon Fresh granular activated carbon that must be added to a column adsorption system after a regeneration cycle or when deemed necessary to bring the total amount of granular activated carbon to specification.

makeup water Treated water added to the water loop of a boiler circuit or cooling tower to make up for the water lost by steam leaks or evaporation.

MAL *See* maximum allowable level.

malachite ($Cu_2(CO_3)(OH)_2$) Common internal corrosion by-product of copper plumbing in drinking water distribution systems. It is banded light to dark green in color.

MALDI–mass spectrometry A technique that uses soft ionization to allow the mass spectrometric analysis of biomolecules and large organic molecules, which tend to be fragile and fragment when ionized by more conventional ionization methods. "MALDI" is short for matrix-assisted laser desorption/ionization. *See also* mass spectrometry.

male end Obsolete term. Use *outside threaded connection* or *spigot end. See also* female end.

male fertility index In toxicity testing, the number of pregnancies that occur per number of confirmed couplings. This index is also referred to as the pregnancy ratio.

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male-specific bacteriophage An outdated term used to designate F-specific (male-specific) bacteriophages of *Escherichia coli.* These bacteriophages have their initial attachment point to the bacterial cell somewhere on the F pilus. The F pilus (sex pilus) is a short hair-like projection that is involved in bacterial mating. F-specific deoxyribonucleic acid bacteriophages and F-specific ribonucleic bacteriophages exist.

male-specific host *Escherichia coli* F-amp A strain of *E. coli* bacteria that contains the F-amp plasmid that codes for resistance to ampicillin and streptomycin. This strain is used in the detection of F+ ribonucleic acid coliphages. *See also* infectious male-specific F-specific ribonucleic acid coliphage.

male-specific phage serotype A subset of male-specific phages. F-specific ribonucleic acid coliphages are composed of serogroups I through IV. Serogroups I and IV are usually found in animal feces whereas serogroups II and III are typically isolated from human fecal material. Distinguishing human from animal fecal contamination may serve as a useful tool for determining the specific sources and associated risks of pollutants that degrade the quality of a water body. *See also* F-specific coliphage.

malignant Very dangerous or virulent, causing or likely to cause death.

M alkalinity *See* alkalinity test.

managed competition A process of limiting the number of individuals or companies allowed to be eligible for consideration or to bid to provide a service, product, or facility through establishment of prequalifying criteria, such as prescribed financial strength, specific expertise, or proven capability.

managed wetland A wetland that is actively managed by human intervention.

management The person or persons setting policy for and controlling and directing the affairs and operations of a water utility, business, or institution.

management efficiency In irrigation, a percentage or decimal fraction of the total water applied through irrigation, representing the portion beneficially applied through scheduling, maintenance, and repair of irrigation systems.

manager The person with responsibility of controlling and directing a utility, business, or institution or one of its major divisions.

manganese (Mn) An abundant element found naturally in the earth. Dissolved manganese is found in many water supplies. At concentrations in excess of 0.05 milligrams per liter, it causes black stains to plumbing fixtures, laundry, and other items in contact with the water.

manganese bacteria Bacteria capable of utilizing dissolved manganese as an energy source and depositing it as hydrated manganic hydroxide.

manganese dioxide (MnO_2) A dark brown or gray-black insoluble compound found in nature as pyrolusite or made synthetically. It is used as an oxidizing agent in water treatment and as a starting material for such permanganate compounds as potassium permanganate ($KMnO_4$). *See also* potassium permanganate.

manganese dioxide–based oxidizing medium A material that has a very high percentage of manganese dioxide and by surface contact the media has the ability to oxidize As III to As V. The surface of the manganese dioxide media is gradually exhausted during the oxidation of As III to As V, but usually can be regenerated and reused. This is one of a general class of solid-phase oxidants. *See also* solid oxidizing medium; solid-phase oxidant.

manganese dioxide–coated pumicite An oxidizing catalyst used to control iron and manganese. The manganese is sacrificial and thus disappears with time.

manganese greensand Greensand that has been processed to incorporate the higher oxides of manganese into its pores and onto its surface. Manganese greensand has a mild oxidizing power and is often used in the oxidation, precipitation, and removal of iron, manganese, hydrogen sulfide (H_2S), or a combination of these three. It is regenerated by solutions of potassium permanganate ($KMnO_4$). *See also* manganese; zeolite.

manganese removal The process of removing manganese from water. Manganese may have adverse health effects at elevated levels and, when oxidized, can form a black solid that can discolor fixtures and clothing.

manganese zeolite A synthetic gel zeolite (sodium alumino silicate) that has been converted to the manganese form by the same process used for manganese greensand and that is used for the same treatment applications as manganese greensand. Manganese zeolite is regenerated with potassium permanganate ($KMnO_4$). *See also* manganese; zeolite.

manganite (MnO(OH)) A form of manganese ore that consists of manganic hydroxide and is used in filters designed to control iron, manganese, or hydrogen sulfide (H_2S). It requires a very high backwash rate because of its very high density (specific gravity 4.3). It is similar to pyrolusite.

manhole *See* personnel access opening.

manifold A pipe with several branches or fittings to allow water or gas to be discharged at several points. In aeration, manifolds are used to spray water through several nozzles.

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man-made beta particle and photon emitters Radionuclides that emit beta particles and photons or gamma rays. They are regulated by the US Environmental Protection Agency in drinking water at 0.4 millirems per year. *See also* Radionuclides Rule.

man-made wetland *See* artificial wetland.

Manning formula A formula for determining the flow velocity in an open channel. In US customary units, the formula is

$$v = \frac{1.486}{n} R^{\frac{2}{3}} \sqrt{S}$$

In Système International units, the formula is

$$v = \frac{1}{n} R^{\frac{2}{3}} \sqrt{S}$$

Where:

v = the flow velocity, in feet per second (meters per second)
n = the Manning coefficient of channel roughness
R = the hydraulic radius, in feet (meters)
S = the channel slope (for uniform flow) or the energy slope (for nonuniform flow), dimensionless

The energy slope is calculated as $-dH/dx$, where H is the total energy, which is expressed as

$$H = z + y + \frac{v^2}{2g}$$

Where (in any consistent set of units):

z = elevation head
y = water depth
v = velocity
g = gravitational constant
x = distance between any two points

Manning roughness coefficient The roughness coefficient used in the Manning formula for determining the discharge coefficient in the Chezy formula. *See also* Chezy open-channel formula; Manning formula.

Manning tables Tabulations of sets of values that satisfy the Manning formula. *See also* Manning formula.

Mann–Whitney U test A nonparametric (distribution-free) statistical method used to evaluate epidemiological studies. The test explores whether the overlap between the two observed population distributions is less than would be expected by chance. It is also referred to as the Mann–Whitney rank sum test.

manometer An instrument for measuring pressure. Usually, a manometer is a glass tube filled with a liquid that is used to measure the difference in pressure across a flow-measuring device, such as an orifice or a Venturi meter. The instrument sometimes used to measure blood pressure is a type of manometer.

Mantel–Haenszel stratified analysis Statistical test used to evaluate epidemiological studies; tests for statistical significance from a contingency data table. It is used when controlling for confounding bias is necessary.

manual solution feed A method of feeding a chemical solution for small water systems such that the chemical is dissolved in a small plastic tank and transferred to another tank, from which it is fed to the water system using a positive-displacement pump.

map A two-dimensional representation of an area or surface for the purposes of delineating the relative locations of objects or attributes.

map projection A mathematical model used to transform positions on the surface of the earth, which is curved, onto a flat map surface.

map scale The ratio of units of linear measurement on the map to units of measurement on the earth. Scale is often stated as a representation fraction, such as 1:2,000, for which one part or unit of measurement on the map is equal to 2,000 parts or identical units of measurement on the earth. Scale can also be stated in specific measurement units, such as 1 centimeter = 100 meters, for which 1 centimeter on the map is equivalent to 100 meters on the ground.

marble test A laboratory test for calcium carbonate ($CaCO_3$) solubility whereby a water sample is analyzed for alkalinity concentration and then exposed to calcium carbonate powder for at least 3 hours, settled, filtered, and analyzed again. If the alkalinity content increases, decreases, or remains the same, then the sample is undersaturated with calcium carbonate (may be corrosive), supersaturated (may deposit protective scale), or at equilibrium (stable), respectively.

marginal cost The change in total (or variable) cost associated with producing the next unit of a product. In the water industry, the next increment of product evaluated is often the next 1,000 or 1 million gallons of water. This term is also often used to refer to the cost of the next increment of supply. The terms *marginal cost* and *incremental cost* are often used interchangeably in water industry practice. *See also* long-run marginal cost; marginal cost pricing.

marginal cost pricing Strictly speaking, the pricing of all water sales at the cost of the next increment of supply, so that water users can decide whether they wish to spend those marginal cost dollars on water or on other products also priced at the margin. Under ideal conditions (rarely achieved in the water industry), marginal cost pricing leads to the most efficient

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allocation of resources. In the water industry, this term is often applied to the practice of charging a higher price for each increment of water consumed based on the cost to produce that unit. For example, the primary source of water might be surface water, produced and sold for $1.00 per 1,000 gallons. To meet summer demand, remote wells might have to be operated at a cost of $1.20 per 1,000 gallons; in this case water use in excess of the average-month level (or some multiple of the average-month level—say 1.2 times the average, where the production break point is located) is billed at the higher rate. A third increment of supply could result in yet another marginal cost rate block.

margin of exposure In the US Environmental Protection Agency's proposed cancer guidelines, the means by which degrees of safety will be expressed for those compounds thought not to conform to the assumptions of the linearized multistage model. *See also* linearized multistage model; multistage model.

margin of safety (MOS) The range between levels of human exposure and those levels shown to produce a measurable toxic response. The concept has generally been applied to chemical exposures for which a toxic threshold exists or may reasonably be thought to exist (for all effects except cancer). *See also* linearized multistage model; multistage model.

marine environment An environment, including the adjacent shoreline and wetlands, where the salinity is greater than 5 parts per thousand (5,000 milligrams per liter) and is in direct contact with waters reaching an ocean.

marine salt An early chemical name for salt.

market basket analysis A regular sampling of foodstuffs for a variety of environmental contaminants. The US Food and Drug Administration conducts national market basket surveys as part of its ongoing Total Diet Study, sampling foodstuffs consumed by the average US family as a basis for estimating the range of exposures to a variety of environmental contaminants. Unfortunately, this approach is not a truly representative sampling of all segments of the US population.

MARS *See* multiple-address radio system.

marsh A tract of soft, wet land, usually vegetated by reeds, grasses, and occasionally small shrubs. *See also* swamp; tidal marsh; wetland.

Marsh funnel viscosity The number of seconds required for 1 quart (946 milliliters) of a given fluid to flow through a Marsh funnel. This value is used to determine proper viscosities for drilling fluids.

masonry dam A dam constructed of stone set in mortar or in concrete. Masonry may be qualified as rubble masonry, cyclopean masonry, or concrete masonry.

mass The quantity of matter contained in a particle or body regardless of its location in the universe. Mass is constant (unless relativity effects are considered), whereas weight is affected by the distance of a body from the center of the earth (or of any other planet or satellite). *See also* weight.

mass balance An accounting of all the masses of reactants and products in a reaction or all constituents in water being treated. For a given constituent in water entering a treatment process or blending in multiple flow streams, the mass of a constituent in water entering the system equals its mass exiting the system. The sum of each input stream constituent concentration multiplied by its flow rate equals the sum of the constituent concentrations multiplied by flow rates for all outputs from the process, assuming no mass accumulates in the system (i.e., the system is at steady state).

mass curve *See* mass diagram.

mass density units *See in the Units of Measure section.*

mass diagram A diagram, curve, or graph plotted with rectangular coordinates and representing a summation (integration) of all preceding quantities up to a point. Each ordinate value is equal to the sum of preceding terms in the series, with the corresponding abscissa value representing elapsed time or some other appropriate variable. Such diagrams are used extensively in storage and regulation studies pertaining to stream flow and water supply systems. A mass diagram is also called a mass curve. *See also* mass runoff; Rippl diagram.

mass loading The total amount of mass of a constituent flowing into a system.

mass media Means of communication that reach a large number of people, such as radio, television, newspapers, magazines, and Web sites.

mass movement A unit movement of a portion of the land surface, as in creep, landslide, earth flow, or subsidence.

mass runoff The total volume of runoff over a specified period of time. Successive summations are frequently plotted against time to produce a mass diagram. *See also* mass diagram.

mass spectrometer (MS) An instrument that can aid in the determination of molecular structure. In water analyses, mass spectrometers often serve as detectors after analytes are separated in a gas or liquid chromatograph. Several types of mass spectrometers are available; they are usually classified by the manner in which charged particles are separated within the instrument. For example, the most commonly available mass spectrometers are quadrupole ion trap, magnetic sector, and time-of-flight instruments. Many different configurations are available for specific applications.

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See also ion trap mass spectrometer; magnetic sector hybrid mass spectrometer; quadrupole mass spectrometer; time-of-flight mass spectrometer.

mass spectrometer, ion trap
See ion trap mass spectrometer.

mass spectrometer, magnetic sector hybrid *See* magnetic sector hybrid mass spectrometer.

mass spectrometer, quadrupole *See* quadrupole mass spectrometer.

mass spectrometer interface The linkage between a mass spectrometer and another instrument. Typically, the other instrument, such as a gas or liquid chromatograph, acts as a device to separate analytes. Interfaces are important devices because of the different environments the analytes encounter in each instrument. For example, analytes separated in a gas chromatograph are forced through a chromatographic column via a pressurized carrier gas. Analytes then travel into the vacuum of a mass spectrometer.

mass spectrometer–mass spectrometer (MS–MS) The combined use of two mass spectrometers, providing a powerful analytical technique. Ion fragments separated in the first mass spectrometer are directed into the second mass spectrometer for the purpose of further fragmentation and separation of masses. This technique is also called tandem mass spectrometry. Mass spectrometry/mass spectrometry (MS/MS) is the use of two or more analyzers separated by a region in which ions can be induced to fragment by transfer of energy. There are various methods for fragmenting molecules for tandem MS, including collision-induced dissociation (CID), electron capture dissociation (ECD), electron transfer dissociation (ETD), infrared multiphoton dissociation (IRMPD), blackbody infrared radiative dissociation (BIRD), and chemical ionization (CI).

mass spectrometry A method of chemical analysis in which compounds emerging from a gas chromatograph are fragmented and ionized by bombardment with a beam of electrons. An electromagnetic field separates the ions according to their individual mass-to-charge ratios into a characteristic mass spectrum for each molecule. Computer software analyzes the spectra and makes it possible to identify molecules even in cases of poor separation on the chromatography column, hence the advantage of mass spectrometry compared to selective chromatograph detectors. *See also* gas chromatography.

mass transfer The amount of molecules of a substance in motion to and across an interface from one phase to another, e.g., an amount (mass) of ozone (O_3) that transfers from air, across the air–water interface, and into water, or the amount of organic material that transfers from water to a solid adsorption surface. The rate and amount of mass transfer can be increased by (1) enlarging the interface boundary by increasing the area of the interface or by rapid renewal or clearance of the interface; (2) increasing the concentration difference (which is the driving force) across the interface boundary; (3) increasing the length of time (contact time) the interface boundary exists; or (4) any combination of these. *See also* Fick's law of diffusion.

mass transfer coefficient (MTC) A constant of proportionality that is specific to an individual compound and is used in a mass transfer expression to determine equilibrium conditions between two phases. Mass transfer coefficients are determined experimentally; the units will depend on the nature of the mathematical expression and the phase transfer.

mass transfer zone (MTZ) The place in an adsorption or ion-exchange bed where the concentration of adsorbate in solution is changing with depth. The concentration gradient corresponds to the gradual transition of the adsorbent or ion-exchange resin from fresh (or virgin) to spent (or exhausted). Aeration or air-stripping columns also have mass transfer zones as the gas or liquid changes from undersaturated to the equilibrium concentration with height. *See also* critical depth.

mass transport *See* loading.

mass units *See in the Units of Measure section.*

master meter A large instrument (meter) located upstream of other smaller meters and used for water accounting, billing purposes, or both. A utility that does not wholesale water would consider the large meter on the effluent of its treatment plant as a master meter. A wholesale customer that has a large meter at the point of system delivery would consider that to be the master meter.

master plan A facility plan that depicts the major facilities that will be needed for a system in the future based on the anticipated growth over a certain time span. The plan gives a layout of system additions, which can be constructed in increments to meet the demands of growth and demand.

matched precipitation rates Equal water delivery rates of sprinkler irrigation heads of varying arc patterns within an irrigation circuit. Matched precipitation rates are important to achieve a uniform distribution of water.

matching A technique used in epidemiologic studies to make the study group (those exposed to or having the disease being studied) and comparison group (the unexposed or control group) comparable with respect to certain characteristics. Several kinds of matching can be employed, including frequency matching (making sure the frequency distribution of a selected characteristic is similar in the groups being studied) or individual

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matching (making sure each individual selected for the comparison group is similar, for that chosen characteristic, to each individual enrolled in the study group). In epidemiologic studies, matching is a method used to prevent confounding bias for one or more selected characteristics. For example, if smoking is thought to be a cause of confounding bias in a case–control study, each control selected for inclusion in the study would be matched with a case according to the case's smoking status. For each case who smokes, a control who smokes would be selected; for each case who does not smoke, a control who does not smoke would be selected. Matching cases and controls in this way removes potential study problems caused by smoking's association with exposure or disease; thus, smoking will not result in confounding bias in that particular study. Matching for gender, race, or neighborhood is a common practice. However, matching for certain or several characteristics to prevent confounding bias in an epidemiologic study may not always be feasible. Other methods are available to assess and control confounding bias during the analysis. *See also* confounding bias.

material safety data sheet (MSDS) Information on the use, handling, and storage of specific chemicals or products. Material safety data sheets contain mandated types of information concerning physical characteristics, reactivity, required personal protective equipment, and other safeguards.

materials flow analysis (MFA) An industrial ecology tool that studies how material and energy flow through the life cycle stages on a macroscopic level. The result is an estimate or actual aggregation of data for a plant, corporation, region, or the entire world. This tool may provide insight into the effect of human activity on the earth.

mathematical model (1) In risk assessment, a model used to perform extrapolations from the effects at one dose to the effects at another dose. (2) Expressing a phenomenon with a mathematical equation for the purpose of predicting an outcome.

mathematics A branch of science in which shape, quantity, and dependence are studied. Two main areas of mathematics are pure mathematics, dealing with the intrinsic study of mathematical structure, and applied mathematics, dealing with the study of physical phenomena.

mating index In reproductive toxicity testing, the number of confirmed matings per number of females mated per male animal. This index is also referred to as the mating ratio.

matrix-assisted laser desorption/ionization *See* MALDI–mass spectrometry.

matrix diagram A method of organizing large amounts of information into sets of items to be compared. A matrix diagram shows the logical connecting point between any two or more items to illustrate relationships among them.

matrix effect An observation that the sample solution is affecting the performance of an analyte in a given analytical method. For example, solutes—other than the analyte—can have a positive or negative effect on the recovery of the analyte. When this phenomenon is observed experimentally, a matrix effect has occurred. Such observations are important because they can account for bias in an analysis.

matrix modifier A reagent used most commonly in graphite furnace atomic absorption spectrophotometry. The purpose of the matrix modifier is to delay atomization of the analyte metal as long as possible. This delay can result in a more intense signal from the analyte and can minimize interferences in a given determination.

mature river A stream with a slope that is so mild that the tractive forces are barely sufficient to carry debris delivered by the tributaries further downstream.

mature valley A stream valley that has reached a state of development at which cutting of the bottom has practically ceased. Such a valley has a flat bottom with a low gradient and numerous tributaries of considerable length.

Maui-type well A horizontal water collection tunnel that skims off freshwater. Such wells are common in Hawaii.

M. avium *See Mycobacterium avium.*

maximally tolerated dose (MTD) The highest dose rate at which an experimental animal may be treated without any observable toxic reactions. In the absence of specific signs of toxicity, a decrease in body weight relative to control animals is used as an index. In general, the body weight decrement should be less than 10 percent, although earlier guidelines allowed greater decrements of body weight.

maximum allowable concentration (MAC) A concentration of a chemical in a medium (e.g., air, water, or food) that cannot be legally exceeded. In essence, this term is the standard for that medium.

maximum allowable level (MAL) The maximum concentration of a contaminant in drinking water that a single product is allowed to contribute under NSF International/American National Standards Institute standard 60 and 61 and NSF International standard 61, section 9.

maximum available water The quantity of water that can be readily extracted by a plant and used for normal growth, represented as the difference between field capacity and wilting point.

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maximum computed flood The largest momentary flood discharge from a watershed believed possible based on a consideration of meteorologic conditions (such as probable maximum rainfall and snow cover) and geomorphic conditions (such as stream gradients or land slope).

maximum contaminant level (MCL) A value defined under the Safe Drinking Water Act Section 1401(3) as the maximum permissible level (concentration) of a contaminant in water delivered to any user of a public water system. Maximum contaminant levels are the legally enforced standards in the United States.

maximum contaminant level (MCL), primary *See* primary maximum contaminant level.

maximum contaminant level (MCL), secondary *See* secondary maximum contaminant level.

maximum contaminant level goal (MCLG) A federally nonenforceable, health-based goal established by the US Environmental Protection Agency under the Safe Drinking Water Act Section 1412(b)(4) for each contaminant regulated by a national primary drinking water regulation. The maximum contaminant level goal is set at the level at which no known or anticipated adverse effects on human health occur and for which an adequate margin of safety exists.

maximum-day demand (MDD) The volume of water consumption used on the highest-consumption day in a year.

maximum demand (1) In electricity, the maximum kilowatt load that occurs and persists for a full demand interval during any billing period, usually a month. (2) The maximum flow per hour or maximum flow per day for a water utility.

maximum discharge The maximum rate of flow that a stream, conduit, channel, pipe, pump, or other hydraulic structure is capable of passing. *See also* discharge.

maximum flood flow The maximum rate of floodwater discharge from a given drainage basin resulting from a rainfall of high intensity, melting of snow, breaking of log or ice jams, failure of a structure, or similar conditions causing maximum release.

maximum flow The greatest volume of influent to a treatment plant within a given time period.

maximum-hour demand (MHD) *See* peak-hour demand.

maximum mining yield The total volume of groundwater in storage in a particular source that can be extracted and used. *See also* groundwater safe yield.

maximum permissible concentration (MPC) The maximum level of radionuclides that an employee may be exposed to in an average 8-hour workday.

maximum probable precipitation Precipitation of a given amount and duration that can reasonably be expected to occur in a drainage basin.

maximum probable rainfall Precipitation as rain of a given amount and duration that can reasonably be expected to occur in a drainage basin.

maximum pumping rate (MPR) The maximum delivery rate of a pump during a specific demand period. The maximum pumping rate is most significant for systems with limited storage.

maximum residual disinfectant level (MRDL) A level of a disinfectant added for water treatment that may not be exceeded at the consumer's tap without an unacceptable possibility of adverse health effects. For chlorine (HOCl) and chloramines (NH_xCl_y, where x = 0–2, y = 1–3), a public water system will be in compliance with the federally proposed maximum residual disinfectant level when the running annual average of monthly averages of samples taken from the distribution system, computed quarterly, is less than or equal to the maximum residual disinfectant level. (That is, every 3 months, the average of the previous 12 monthly averages is assessed.) For chlorine dioxide (ClO_2), a public water system will be in compliance when no two consecutive daily samples taken at the entrance to the distribution system exceed the maximum residual disinfectant level. Maximum residual disinfectant levels will be enforceable in the same manner as maximum contaminant levels under Section 1412 of the Safe Drinking Water Act. Convincing evidence exists that addition of a disinfectant is necessary to control waterborne microbial contaminants. Notwithstanding the maximum residual disinfectant levels listed in Section 141.65 of the Disinfectants and Disinfection By-Products Rule (*Federal Register,* July 29, 1994), operators will be able to increase residual disinfectant levels of chlorine or chloramines (but not chlorine dioxide) in the distribution system to a level and for a time necessary to protect public health to address specific microbiological contamination problems caused by such circumstances as distribution system line breaks, storm runoff events, source water contamination, or cross-connections. *See also* Disinfectants and Disinfection By-Products Rule; maximum contaminant level; maximum residual disinfectant level goal.

maximum residual disinfectant level goal (MRDLG) A maximum level of a disinfectant added for water treatment and for which no known or anticipated adverse effect on human health would occur, allowing for an adequate margin of safety. Maximum residual disinfectant level goals are nonenforceable health goals and do not reflect the benefits of adding the chemical for the control of waterborne microbial contaminants. *See also* maximum residual disinfectant level.

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maximum running annual average (MRAA) The highest of any series of running annual averages.

maximum storage-replenishment rate analysis An analysis to determine whether a water system can adequately replenish storage facilities during low-demand periods. Such an analysis is also known simply as replenishment analysis.

maximum stream flow A stream's maximum rate of discharge during a specified period.

maximum sustained yield The maximum rate at which groundwater can be withdrawn perennially from a particular source. *See also* groundwater safe yield.

maximum THMFP *See* maximum trihalomethane formation potential.

maximum tolerated dose (MTD) *See* maximally tolerated dose.

maximum trihalomethane formation potential (maximum THMFP) The amount of trihalomethanes formed during a test in which a source or treated water is dosed with a relatively high (and possibly excessive) amount of chlorine (HOCl, typically in excess of what is required to achieve a reasonably low residual) and incubated (stored) under conditions that strongly encourage trihalomethane production (e.g., pH 9.2 or higher, warm water temperature, incubation time of 7 days or longer, or a combination of all three). This test is not a measure of the amount of trihalomethanes that would form under normal drinking water conditions, but rather an indirect measure of the amount of precursors in a sample. In regular testing for trihalomethane formation potential, precursors that can readily be converted to trihalomethanes will be converted. Under maximum trihalomethane formation potential conditions, "recalcitrant" precursors will yield trihalomethanes, or intermediate disinfection by-products initially formed will be converted to trihalomethanes, or both. Note that the maximum trihalomethane formation potential is not the same thing as the maximum trihalomethane potential. *See also* disinfection by-product precursor; maximum trihalomethane potential; trihalomethane; trihalomethane formation potential.

maximum trihalomethane potential (MTP) A value defined in the 1979 trihalomethane regulation (*Federal Register,* 44(231): 68624–68707) as the maximum concentration of total trihalomethanes that could be produced in a given water containing excess free chlorine (HOCl) after 7 days of incubation at a temperature of 77° Fahrenheit (25° Celsius). In the 1979 regulation, measurement of this parameter could be used in obtaining reduced monitoring requirements. This parameter was designed to measure the maximum amount of total trihalomethanes that could form in a distribution system—as opposed to the maximum trihalomethane formation potential, which represents the level of trihalomethane precursors in a water. The Disinfectants and Disinfection By-Products Rule bases criteria for reduced monitoring considerations on a sample collected in the warmest month at the longest detention time in the distribution system. *See also* maximum trihalomethane formation potential; trihalomethane.

maximum water density The density of water at 39.16° Fahrenheit (3.98° Celsius), i.e., 1.000000 grams per milliliter. Water becomes less dense at both higher and lower temperatures.

maximum water-holding capacity *See* field capacity.

MB *See* megabyte *in the Units of Measure section;* method blank.

MBAA *See* monobromoacetic acid.

MBAS *See* methylene blue active substance.

MBR *See* membrane bioreactor.

MCA *See* monochloroacetaldehyde.

MCAA *See* monochloroacetic acid.

McIlroy analyzer *See* EPANET model; pipeline network analyzer; series-parallel reducible network.

MCL *See* maximum contaminant level.

MCLG *See* maximum contaminant level goal.

m-ColiBlue24® test A test for drinking and ambient water approved by the US Environmental Protection Agency for the detection of total coliforms and *Escherichia coli.* Total coliform bacteria form red colonies and *E. coli* forms blue colonies.

M/DBP *See* microbial and disinfection by-products.

M/DBP agreement *See* microbial and disinfection by-products agreement.

MDCK cell culture *See* Madin–Darby canine kidney cell culture.

MDD *See* maximum-day demand.

MDL *See* method detection limit.

mean *See* arithmetic mean.

mean absolute percentage error An error value determined by one of the tests used to measure the goodness of fit in regression analysis. Calculating this value involves summing the absolute value of the deviation between the predicted value for a series of observations and the actual value and then dividing by the sum of the dependent variable. The mean absolute percentage error in water demand forecasting typically ranges between 3 percent and 10 percent when good forecasting data are available. Note that if the actual plus-or-minus deviations were summed, their sum would equal or be very close to zero and thus would not give any indication about the magnitude of the forecast errors (hence the use of absolute values).

mean annual precipitation The average over a period of years of the annual amounts of precipitation.

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mean annual runoff The average over a period of years of the annual amounts of runoff discharged by a stream.

mean depth The average depth of water in a stream channel or conduit, equal to the cross-sectional area divided by the surface width.

meander One of a series of regular, freely developing sinuous curves, bends, loops, turns, or windings in the course of a stream.

meander belt That part of the valley floor across which the stream shifts its bed naturally as its meanders shift their positions.

meander length The distance along the meander line between the corresponding points at the extreme limits of successive fully developed meanders.

meander line A curve that follows a body of water along the locus of the bank or shoreline at the elevation of mean or ordinary high water.

meander width The amplitude of swing of a fully developed meander, measured from midstream to midstream.

mean erosion rate (MER) The mean of all grid erosion values in a given area of study, described in units of mass/area.

mean flow The arithmetic average of the discharge at a given point or station on the line of flow for some specified period of time.

mean range of tide (1) The average difference between the heights of high and low water at any given place. (2) The difference in the elevations of mean high water and mean low water.

mean sea level (MSL) The mean plane about which the tide oscillates; the average height of the sea for all stages of the tide, measured from a fixed reference level.

mean seasonal average disaggregation model (MSADM) A conceptual model for use in disaggregating weekly water demands into daily values in which the demand for a particular day is assumed to be equal to a forecasted weekly demand multiplied by the percentage of weekly demand for that day as observed for a particular season (e.g., winter, spring, summer, and fall) in which the percentage is derived from an average of observed percentages over a corresponding 13-week season.

mean tide level The plane halfway between mean low water and mean high water in oceans and tidal rivers.

mean velocity The average velocity of a stream flowing in a channel or conduit at a given cross section or in a given reach. It is equal to the discharge divided by the cross-sectional area of the section or by the average cross-sectional area of the reach. Mean velocity is also called average velocity.

mean velocity gradient ($\overline{G}$) A measure of the intensity of mechanical agitation, or energy imparted to a volume of water, in rapid mixing and flocculation. It is defined as

$$\overline{G} = \sqrt{\frac{W}{\mu}}$$

Where:

$\overline{G}$ = mean velocity gradient in seconds^{-1}

W = the power input per unit volume of liquid, in foot-pound force per second per foot cubed (watt per meter cubed)

μ = the absolute viscosity of the liquid, in pound force second per foot squared (newton second per meter squared)

Often, though incorrectly, G is used to refer to mean velocity gradient. *See also* flocculation; velocity gradient.

mean velocity position (1) In flow with a free surface, the point on a vertical section at which the actual velocity is equal to the mean velocity. (2) The location of a point along a line or in a cross section where the actual velocity is equal to the mean velocity.

measured variable A factor (flow, temperature) that is sensed and quantified (reduced to a reading of some kind) by a primary element or sensor. *See also* process variable.

mechanical aeration The process of introducing air into a liquid by the mechanical action of paddle, paddle wheel, spray, or turbine mechanism.

mechanical aerator A mechanical device for the introduction of air into a liquid. *See also* mechanical aeration.

mechanical agitation *See* mechanical aeration.

mechanical analysis The operation of determining the distribution of grains of a granular material in accordance with size. The relatively large grains are separated by the use of sieves of various mesh sizes; the material that passes through mesh of one size and is retained on the sieve of the next smaller size is considered to be within one size range or bracket. The distribution is generally expressed in terms of a percentage by weight of materials within each specified size limit. Other methods are used for separating silt and clay.

mechanical control The application of artificial structures, such as terraces, dams, retards, or baffles, for the purpose of reducing erosion. Such control contrasts with vegetative control, in which ground cover is used for such purposes.

mechanical filter A pressure or gravity filter designed to physically separate and remove suspended solids from a liquid by mechanical (physical) means such as straining rather than by chemical means.

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mechanical filter respirator A type of respirator that protects against (i.e., filters out) airborne particles, such as dust and mist. It does not give protection from vapors, fumes, or gases.

mechanical flocculation A flocculation process in which mechanical devices, mixers, or stirrers are used to impart a gentle motion to coagulated water and thus cause formation of floc particles. *See also* end-around baffles; over-and-under baffles.

mechanical joint A flexible connection of two pipes or fittings with a gasket compressed by lugs and bolts.

mechanically cleaned screen A screen equipped with a mechanical cleaning apparatus for removing retained solids.

mechanical pipe joint Any form of flexible joint involving lugs and bolts.

mechanical rake A machine-operated mechanism used for cleaning debris from racks located at the intakes of conduits supplying water to hydroelectric power plants, water supply systems, or other uses.

mechanical scraping The pulling of a mechanical device with a cable from one entry point to another point to remove scale, rust, or a chemical buildup in a water main. The scraper can also be propelled with water flow. *See also* polypig; scraper; swab.

mechanical seal A mechanical device or assembly that forms a seal between a pump casing and a rotating shaft to prevent leakage along the shaft.

mechanical ventilation Equipment that exchanges the air in a room to remove airborne contaminants.

mechanism of action The entire causal chain of a chemical's impact on an organism's health, from molecular interactions of the chemical with the biological system to describing how the ultimate pathology has to be characterized. *See also* mode of action.

mechanistic equation A mathematical expression derived from an understanding of the underlying mechanics of a phenomenon. For example, if C is the concentration of a reactant that decays according to a first-order chemical reaction, the concentration at any given time t can be predicted by using the first-order chemical reaction model, $C = C_0e^{-kt}$, where C_0 is the initial concentration at time zero and k is the rate constant. In this example, the equation can be called a mechanistic model because it is derived from an understanding of the reaction mechanism.

MED *See* multiple-effect distillation.

media A selected group of materials used in filters and filter devices to form barriers to the passage of certain solids or molecules that are suspended or dissolved in water. The term *media* is commonly used to refer to ion-exchange resin products, granular filtration material, or granular adsorption material. *Media* is the plural form of *medium* and refers to more than one type of barrier material.

media interface The interface between two different layers of filtering material. Depending on the grain sizes and specific gravities of the materials in each layer, after backwashing a sharp delineation may be noticed at the interface of the layers, or, on the other hand, substantial intermixing of the two different filtering materials may occur. If a layer of small filtering material intermixes excessively with a layer of larger filtering material, the small grains may occupy pore spaces between the grains of large material. This can cause excessive clean bed head loss in the intermixing zone.

median A statistical term representing the middle value of a series of numbers when the numbers are arranged in order of their numerical quantity or value. Equal numbers of data points can be found that are greater than or less than the median. For example, in the sequence 1, 3, 4, 7, 8, 10, 12, the median is 7.

median stream flow The rate of discharge for which equal numbers of greater and lesser flow occurrences exist during a specified period.

median tolerance limit In toxicological studies, the concentration of pollutants at which 50 percent of the test animals can survive for a specified period of exposure, usually 96 hours. It is also called the lethal dose 50.

median toxic dose The dose at which 50 percent of test animals exhibit an adverse response. In general, this term is used to quantify the potency of a chemical for producing a nonlethal but clearly adverse effect on an organism.

media relations The methods and activities used to promote an informed public and a favorable image of an organization through good relations with print, broadcast, and electronic media.

mediation The process of using a third party to help resolve a dispute via a negotiated resolution.

Mediterranean climate A climate that occurs on the western shores of the populated continents, characterized by moderate temperatures throughout the year, an annual drought, and a rainy season.

medium *See* media.

medium-pressure (MP) ultraviolet lamp A mercury vapor lamp that operates at an internal pressure of 2 to 200 pounds per square inch (13.3 to 1,333 kilopascals) and electrical input of 50 to 150 watts per centimeter. This results in a polychromatic (or broad spectrum) output of ultraviolet (UV) and visible light at multiple wavelengths, including the germicidal range. The unique characteristic of these lamps is that they produce a high-intensity, broad-spectrum light source. Thus, these types of light produce UV doses

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similar to those produced by 6 to 16 low-pressure or conventional lamps.

medium-pressure ultraviolet (UV) irradiation Treatment with polychromatic ultraviolet light ranging from 185 to 1,367 nanometers generated by a medium-pressure lamp. The medium-pressure lamp operates with medium (nearly atmospheric) pressures and temperatures up to 1,500° Fahrenheit. *See also* polychromatic ultraviolet irradiation.

medium sand Sediment particles having diameters between 0.250 and 0.500 millimeters.

medium-size water system A water system that serves more than 3,300 and less than 50,000 people.

medium-specific concentration (MSC) A risk-weighted concentration limit based on the substance-containing medium (e.g., air, water, soil) and the exposure pathway (e.g., inhalation, ingestion).

medium test dust For particle analysis, a material used to create polydisperse suspensions that have relatively high concentrations of particles below and just above a 2-millimeter threshold.

medium-water-use plants Plants requiring 30 to 50 percent of reference evapotranspiration to maintain optimal appearance.

meg *See* megger; megabyte *in the Units of Measure section*; megohm *in the Units of Measure section.*

mega (M) *See in the Units of Measure section.*

megabyte (MB) *See in the Units of Measure section.*

megacolon Abnormally large colon; usually seen in children. It results from dilatation and hypertrophy.

megacycles *See* megahertz *in the Units of Measure section.*

megahertz (MHz) *See in the Units of Measure section.*

megaliter (ML) *See in the Units of Measure section.*

megaohm *See* megohm *in the Units of Measure section.*

megger (meg) An instrument used for checking the insulation resistance on motors, feeders, bus bar systems, grounds, and branch circuit wiring.

megohm *See in the Units of Measure section.*

melanoma A tumor that is made up of cells containing melanin. In common usage, the term is applied without qualification to malignant melanoma, a very aggressive tumor found in the skin. These tumors commonly arise from dark moles (nevi). Arsenic is associated with skin cancer, but squamous cell carcinomas, not melanomas, are generally formed.

melt water Water that is formed from the melting of snow, rime (white frost), or ice resulting from atmospheric processes.

membrane A natural or synthetic material that separates solids and liquids. Membranes used for water treatment are commonly synthetic organic polymers. In the case of pressure-driven membranes, the polymers are permeable to water (solvent) but reject solutes and/or particulate matter (depending on membrane type); for electrodialysis membranes, the polymers are designed to allow ions to pass but not water. *See also* electrodialysis; electrodialysis reversal; microfiltration; nanofiltration; reverse osmosis; ultrafiltration.

membrane, ion exchange *See* ion-exchange membrane.

membrane air-stripping A membrane process using a microporous, hydrophobic membrane that is permeable to volatile substances but not to water. The process is driven by a concentration gradient between water on one side of the membranes and air on the other side. Membrane air-stripping can be used for removing volatile organic chemicals.

membrane area The total active area of a permselective membrane.

membrane backflush The process of reversing the flow of water, gas, or both through a membrane from the filtrate side toward the feed side to remove retained substances. This process is typically applicable to microfiltration and some ultrafiltration membranes.

membrane biofilm reactor A biological wastewater treatment device or system that uses a membrane for solids–liquid separation and where the biomass is attached to the membrane surface rather than suspended in the process fluid. It is also called a membrane-immobilized biofilm system. This treatment technique has also been studied for the removal of perchlorate and nitrate from drinking water.

membrane biofouling *See* biofouling; membrane.

membrane bioreactor (MBR) A biological wastewater treatment device or system that combines a suspended growth bioreactor with a membrane for solids–liquid separation.

membrane bundle A grouping of hollow-fiber or hollow-fine membranes placed inside a pressure vessel.

membrane cartridge A spiral wound membrane element. *See also* membrane element.

membrane cleaning The process of removing unwanted substances from membranes by exposing them to one or more cleaning solutions. Typically, cleaning solutions are circulated through the membrane modules without the membranes being physically removed from the treatment unit.

membrane cleaning solution A special chemical solution prepared for membrane cleaning. Typically an acidic solution (e.g., citric acid) is used for carbonate scale and metal hydroxide removal, and alkaline solutions with detergents are used for organic foulant removal. Chelating agents and disinfectants are also commonly used.

membrane concentrate The reject from a membrane filter. Membrane concentrate can be passed through

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additional membranes to create more product water and higher reject concentrations, but ultimately the concentrate must be disposed of.

membrane configuration The arrangement of membranes in a module, e.g., in a spiral-wound, hollow-fiber, tubular, or plate-and-frame configuration.

membrane destructive analysis The process of disassembling a membrane element or module for diagnosis, testing, and removal of foulant, scale, or both such that, for practical purposes, the membrane module can no longer be reassembled and put back into service.

membrane disk filter A circular flat-sheet filtration membrane placed in a special housing. It commonly contains a small-diameter flat membrane with the appropriate composition used in laboratories for filtration or for water quality testing (e.g., one type is used for the silt density index test), or both.

membrane distillation A temperature-driven membrane-desalting process whereby a hydrophobic membrane is used for separation of water vapor, which passes through the membrane and condenses to form purified distillate.

membrane element Flat sheet membranes and spacers formed into a spiral-wound shape around a central permeate tube and wrapped in fiberglass or tape. One or more such membrane elements are placed inside pressure vessels for operation. *See also* membrane leaf.

membrane element autopsy The disassembly of a spiral-wound membrane element or module for diagnostic purposes, commonly to inspect for foulants, scale, or both and to collect samples for analysis. *See also* membrane destructive analysis.

membrane filter (MF) (1) A filtration device used to remove particulate materials (including microorganisms) from a sample of water or other fluid. Membrane filters are used either to ensure that the filtered fluid (filtrate) is free of specific-sized contaminants or to permit analysis of the particulates that were removed from the filtrate. Membrane filters are manufactured to specific nominal pore sizes and are made of a variety of materials depending on the intended application. Membrane filters used in bacteriological analyses are placed on culture media appropriate for detecting the bacteria of interest. (2) A microfiltration or ultrafiltration pressure-driven membrane that rejects particles and produces filtrate.

membrane filter (MF) method *See* membrane filter technique.

membrane filter (MF) technique A microbiological technique used for the analysis of water for the presence of specific bacteria. One of the more common membrane filter techniques is the analysis of water for coliform bacteria, including fecal coliforms and *Escherichia coli.*

membrane filtration Filtration using a microfiltration or ultrafiltration membrane. *See also* membrane filter.

membrane flushing The displacement and removal of concentrated substances from a membrane module following system shutdown.

membrane flux The rate of water passage through a membrane filter, expressed in units of volume per time per membrane area.

membrane flux retention coefficient For some pressure-driven membrane processes, a dimensionless factor that is equal to the fraction of initial productivity remaining after a period of operating time (accounting for membrane compaction). It can be multiplied with the permeate flow rate at a standard condition to calculate permeate flow rate at a given pressure, temperature, or time condition. *See also* compaction.

membrane fouling The loss of membrane flux as a result of material being retained on the surface of the membrane or within the membrane pores. Membrane fouling may be reversible or irreversible. Flux loss by reversible fouling can be recovered by periodic backflushing of the membrane surface. Flux loss by irreversible fouling cannot be recovered; ultimately the production capacity of the membrane becomes limited.

membrane fouling index An empirical measure of the plugging or fouling characteristics of membrane feedwater, or both. *See also* modified fouling index; silt density index.

membrane-immobilized biofilm system *See* membrane biofilm reactor.

membrane integrity The state of a membrane module such that no imperfections in the membranes or sealing components exist that could compromise the treatment process removal capability beyond rated limits.

membrane leaf For spiral-wound membrane elements, the combination of two flat membrane sheets arranged back-to-back with a permeate water carrier between them and sealed on three edges, forming an envelope shape. The open fourth side is attached to a permeate water collection tube. One or more leafs, separated by feed–concentrate spacers, are rolled into spiral-wound elements (modules).

membrane life The length of time a membrane performs well enough to remain in service. A membrane life is said to be over when the membrane has an insufficient treatment capability, requires cleaning too frequently, or for some other performance-related reason.

membrane module One or more membrane elements or a membrane bundle housed inside a pressure vessel. For hollow-fiber or hollow fine-fiber

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membrane products, a membrane module is sometimes called a permeator.

membrane packing density The number of hollow-fiber membranes or the total usable membrane area per unit volume of a membrane module.

membrane permeability coefficient For pressure-driven membrane treatment systems, a measure of the capability of a membrane to allow passage of water (solvent), sometimes expressed in (1) gallons per day of permeate per square foot of membrane area per pound-per-square-inch of net driving force or (2) grams per second per square centimeter per kilopascal. *See also* solvent (water) permeability coefficient.

membrane poisoning Absorption of ions of low mobility into a membrane, resulting in an inability to transport salt ions.

membrane posttreatment Chemical treatment of a membrane after it is manufactured to improve performance.

membrane pretreatment *See* pretreatment.

membrane process A treatment technique using a membrane technology.

membrane product posttreatment (1) The treatment of product water (i.e., permeate or filtrate) from a membrane system to produce finished water meeting quality requirements. (2) The treatment of waste concentrate (i.e., concentrate posttreatment).

membrane reactor A device for chemical reactions using catalysts that are contained on or in a membrane.

membrane reject The material retained or filtered out by the membrane. *See also* membrane concentrate.

membrane selectivity The ability of a membrane to allow passage of only cations, anions, or molecules of a certain size. *See also* dialysis; electrodialysis.

membrane shock treatment A process for disinfection or sterilization of a membrane using intermittent addition of a biocide for a short duration.

membrane softening Removal of water hardness ions (calcium, magnesium) by nanofiltration or, in some cases, by a combination of nanofiltration and reverse osmosis. *See also* nanofiltration; reverse osmosis.

membrane stack In an electrodialysis–electrodialysis reversal system, the vertical arrangement of multiple membrane cell pairs between electrodes.

membrane storage solution A chemical solution used for preventing biological growth and preserving a membrane while not in service. Such a solution is often used when membranes are taken out of service for an extended time period. In some cases, these solutions can be used to protect membranes from freezing.

memorandum of understanding (MOU) A document written to express principles, policies, and/or actions to be taken as agreed to by two or more parties. An MOU is commonly used by regulatory agencies to agree how certain activities will be conducted, to delineate responsibilities, and to express policies and/or principles. For example, the US Environmental Protection Agency and the Nuclear Regulatory Commission (NRC) have developed an MOU for the decommissioning and decontamination of NRC-licensed sites and to indicate the way in which those interactions will take place.

m-endo medium A type of selective culture medium used for detecting and recovering coliform bacteria from drinking water and other environmental water samples. *See also* coliform bacteria.

meningitis Inflammation of any or all of the meninges of the brain and spinal cord, usually caused by bacterial or viral infection.

meniscus The curved surface of a column of liquid (water, oil, mercury) in a small tube. When the liquid wets the sides of the container (as with water), the curve forms a valley. When the confining sides are not wetted (as with mercury), the curve forms a hill or upward bulge.

meq *See* milliequivalent *in the Units of Measure section.*

meq/L *See* milliequivalents per liter *in the Units of Measure section.*

MER *See* mean erosion rate.

mercury (Hg) A metallic element. All inorganic compounds of mercury are highly toxic by ingestion, inhalation, and skin adsorption. Most organic compounds of mercury are highly toxic. Mercury has many industrial uses, e.g., in amalgams, electrical apparatuses, thermometers, or mercury vapor lamps. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.002 milligrams per liter.

mercury gauge A gauge in which the pressure of a fluid is measured by the height of a column of mercury that the fluid pressure will sustain.

mercury intrusion porosimetry method A method of measuring the void volume of a bed of material by displacing the void space with liquid mercury. This method can be used with materials that have relatively large void spaces between their grains.

mercury vapor ultraviolet light The ultraviolet (UV) light given off as a result of an electron flow through an ionized mercury vapor between electrodes in a UV lamp. The mercury vapor UV wavelength that is most destructive to microorganisms in water is 254 nanometers.

merger A process of combining the physical components, managerial components, or both of two or more water systems to form one larger utility.

meromictic Of or pertaining to a lake for which the water is permanently stratified and therefore does not

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circulate completely throughout the basin at any time during the year.

merry-go-round A sequence of granular activated carbon columns, operated in series, in which the "lead" contactor is sequentially changed as its adsorptive capacity becomes exhausted. In other words, in a sequence of three contactors (labeled 1 through 3 in the initial sequence), column 1 is taken out of service after the granular activated carbon is completely exhausted (i.e., when the effluent concentration equals the influent concentration) and is regenerated. The second column then becomes the lead column, and the sequence becomes 2, 3, 1 after the first column is returned to service. The purpose of this arrangement is to make the most use of the adsorptive capacity of the granular activated carbon and thereby reduce the frequency of regeneration. If operated in parallel, each individual contactor would have to be regenerated at some specific target level, rather than at complete exhaustion. *See also* granular activated carbon; regeneration.

mesenteric lymph glands Lymph glands that are found in and around the mesentery, which is the membrane that connects portions of the intestines to the abdominal wall.

mesenteric veins Veins found in the peritoneal folds that connect the intestines to the dorsal abdominal wall.

mesh One of the openings or spaces in a screen or woven fabric. The value of the mesh is usually given as the number of openings per inch. This value does not consider the diameter of the wire or fabric; therefore, the mesh number does not always have a definite relationship to the size of the hole.

mesh screen A screen composed of woven fabric of any of various materials.

mesh size The particle size of granular media as determined by the US Sieve Series. Particle size distribution within a mesh series is usually given in the specifications of a particular granular medium, e.g., 10×40 granular activated carbon.

mesophile An organism whose growth temperature is in the range of 68° Fahrenheit to 104° Fahrenheit (20° Celsius to 40° Celsius).

mesophreatophyte A type of phreatophyte, a deep-rooted plant that gets its moisture from groundwater. A mesophreatophyte is a phreatophyte that is not resistant to alkali or drought.

mesophyte A plant that grows under medium or typical conditions of atmospheric moisture supply, as distinguished from one that grows under dry, desert, or very wet conditions.

mesopore A pore of intermediate size (2–50 nanometers).

meso-substituted porphyrins A group of heterocyclic organic compounds that has been reported to be able to inactivate viruses under irradiation with long-wavelength ultraviolet light.

mesotrophic Pertaining to reservoirs and lakes that contain moderate quantities of nutrients and are moderately productive in terms of aquatic animal and plant life.

messenger ribonucleic acid (mRNA) An organic compound that contains the information necessary for the synthesis of proteins that function as structural components or as enzymes in cells. *See also* ribonucleic acid.

***meta* (*m*)** A prefix meaning "beyond." This prefix is used in organic chemistry in naming disubstitution products derived from benzene in which the second substituent atom or functional group is located on the third carbon atom with respect to the first substituent atom. This arrangement is also called the 1,3-position. *See also ortho; para.*

meta-analysis The process of using statistical methods to combine the results of different studies. In epidemiology, a frequent application has been the pooling of results from a number of small, randomized, controlled clinical trials; however, more recently meta-analysis has been used to pool the results of observational epidemiologic studies. Meta-analysis refers to a collection of techniques whereby the results of two or more independent studies are statistically combined to yield a single statistic that is claimed to have important descriptive or inferential properties. Systematic biases of individual epidemiologic studies are not corrected when the studies are pooled to yield a single measure of risk. Two approaches are used to summarize the published research on a given subject. First, a synthetic or aggregative meta-analysis provides a summary estimate of an effect (such as the relative risk), a summary test of statistical significance for the studies, or both. Second, an analytic, comparative, or explanatory meta-analysis examines whether differences among the studies can explain the differences among their results.

metabolism The biotransformation of various chemicals by an organism. These chemicals may be normal substrates for pathways that yield energy or are used for biosynthetic purposes, but the term is also applied to the biotransformation of chemicals, such as drugs and other synthetic chemicals, that are foreign to biological systems.

metabolite The end product of the biotransformation of various chemicals by an organism.

metal An element that forms positive ions when its compounds are in solution and for which the oxides form hydroxides rather than acids with water. Most

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metals are crystalline solids with metallic luster, are conductors of electricity, and have rather high chemical reactivity. Some metals are quite toxic.

metal hydraulic shoring system A preengineered shoring system composed of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such a system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

metalimnion The middle layer in a stratified lake; another name for the thermocline.

metallic coagulant Various formulations of iron or aluminum, used for chemical coagulation.

metallothionein A low-molecular-weight protein that has a high content of cysteine ($HSCH_2CH(NH_2)COOH$), a sulfur-containing amino acid. The sulfhydryl groups in metallothionein bind various normal and toxic trace metals. Metallothionein is known particularly for its ability to bind cadmium. The cadmium–metallothionein complex becomes concentrated within the kidney and is largely responsible for the large accumulations of cadmium found within this organ after chronic exposure.

metal oxide semiconductor (MOS) A three-layered gate structure used in the manufacture of a field effect transistor. The configuration enables the device to have a higher power supply voltage fluctuation tolerance and to limit power use.

metal release Products of corrosion that do not remain attached to pipe walls but are released from the pipe to enter the water contacting the pipe. The forms of released metal may be dissolved (ionic), colloidal, particulate, or combinations of all three.

metal-rich lake sediments Bottom sediments in a lake or river containing high metal concentrations.

metal solvency The property of a metal that allows it to dissolve in water or another solution. Typical units for a metal dissolved in water are milligrams per liter or micrograms per liter.

metal uptake The absorption or incorporation of a metal by a water as the metal is released from a corroding surface.

metamorphic rock Rock that has been altered from its previous condition through the combined action of pressure and heat.

metamorphic water Water that has been associated with metamorphic rock during the rock's metamorphism.

metaphosphate A salt of a metaphosphoric acid that is sometimes used as a corrosion inhibitor in potable water systems. Metaphosphoric acids consist of oxoacids and phosphorus.

metastasis A process whereby tumor cells are shed from a tumor and migrate to and colonize other sites within the body. This is a sign of extreme malignancy because these tumor cells are able to avoid all the body's constraints on growth.

metastatic Pertaining to the transfer of disease from one organ or part to another not directly connected with it.

meteoric water Water that is in or derived from the atmosphere. This term is sometimes used to include all subsurface water of external origin, and sometimes to include only water derived by absorption, excluding especially connate ocean water. *See also* interstitial water.

meteorograph An instrument that automatically records on a single sheet the measurements of two or more meteorological elements, such as air pressure, temperature, humidity, or precipitation.

meteorological water Water that is in or derived from the atmosphere. *See also* meteoric water.

meteorologic elements (1) Six quantities that specify the state of the weather at any given time and place: air temperature, barometric pressure, wind velocity (direction and speed), humidity, cloudiness (types and amounts of clouds), and precipitation. (2) In addition to the preceding quantities, any of the various other meteorological phenomena that distinguish the particular condition of the atmosphere, such as sunshine, visibility, radiation, halos, thunder, mirages, or lightning.

meteorology The science concerned with the atmosphere and its phenomena.

meter An instrument for measuring some quantity, such as the amount or rate of flow of liquids, gases, or electric currents. *See also* meter (m) *in the Units of Measure section.*

meter, water *See* water meter.

meter box The housing or container that encloses a water meter when the latter is installed in a water system. It provides protection for the meter and access to it for reading.

meter coupling A service fitting placed on each side of a meter to connect the service line to the meter, allowing the meter to be easily set and removed. *See also* meter gasket.

metered system A system in which meters are used to measure the flow characteristics at all strategic points on main supply lines, pumping stations, reservoir outlets, connections to other political subdivisions, and at each consumer's service.

meter error The difference between an actual meter reading and a calibrated volume of water (or gas or electricity) put through the meter.

meter gasket A gasket that goes on each end of a meter, between the meter and the meter coupling. It seals when compressed by the meter coupling nut or flange against the meter. *See also* meter coupling.

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meter gear train A series of gears within a meter to transmit the pulsations of the disk or piston to the register.

metering The process of measuring and recording the quantity of water passing a given point in a system.

metering flume A flow-measuring device, such as a parshall flume, that is used to measure flow in an open channel.

metering pump A chemical solution feed pump that adds a measured volume of solution with each stroke or rotation of the pump.

metering system The equipment and processes to determine a customer's consumption of water.

meter interface unit (MIU) An electronic device responsible for communication between a utility office and a meter. The meter interface unit generally reads the meter when given a signal to do so and retransmits the information to the utility. It is used in automated meter reading and is a hand-held or automatically controlled device to extract the meter reading from the meter.

meter loss The amount of water (or gas or electricity) not accounted for because of a physical malfunctioning of the meter. Meter loss results in a direct loss of revenue for the utility.

meter pit The opening in a vault or enclosure that allows access to a meter and provides protection for it.

meter rate The charge for water based on the quantity used, as measured by water meters.

meter reader A person who visits commercial establishments and residences to read the water meters there, either in person or by remote sensing, for the purpose of determining the quantity of water used since the previous meter reading. This information is used to calculate the water bill. *See also* water bill.

meter reading The periodic noting or reading of the meter register that reflects the usage of water by a customer or the passage of water through the meter.

meter-reading system A setup by which a water meter register is accessed and the reading recorded. The system can be manual, with a person reading the register and recording the numbers or entering the numbers in a hand-held device; the reading may be recorded directly to a receiver by direct connection; or the system can be automated by using telephone lines or radio waves to transmit a recording signal back to a central processor or over radio waves to a mobile receiver.

meter setter A manufactured combination of meter couplings, stops, service pipe, and check valves that enables a meter to be installed merely by connecting the service line and customer plumbing line. A meter setter allows varying depths of services and meter heights with a standard spacing for the meter; it can be used to raise a meter from the initial set location.

meters per second per meter (m/s/m; s^{-1}) *See in the Units of Measure section.*

meter spud *See* meter coupling.

meter test bench Meter-testing equipment that allows a series of meters to be connected in a line. A measured volume of water at a certain rate of flow is allowed to flow through the meters. The accuracy of the meters can then be determined by comparing the known volume of water that passed through the meter with the amount registered on each meter.

meter vault The concrete structure or housing for a large meter, providing access for maintenance and reading.

methane (CH_4) A gaseous hydrocarbon that occurs in natural gas and coal gas as a result of decaying vegetation and other organic matter in swamps and marshes. Methane is flammable, as well as asphyxiating. *See also* hydrocarbon.

methane hydrate A mixture of methane and water that occurs in marine sediments and in permafrost regions. Typically, six water molecules surround a single methane molecule and many of those cages (clathrate) linked together form a crystal. Destabilization of it with uncontrolled release of large volumes of methane in oceans is a significant hazard. It is also a potential enormous energy resource. *See also* clathrate.

methane-oxidizing bacteria Bacteria that utilize methane as a sole source of energy and as a major carbon source. Also called methanotrophs, they are gram-negative, obligate aerobes and form resting states. Ubiquitous in freshwater, marine, and terrestrial environments, methanotrophs are relevant to processes that contribute to ozone depletion and global warming as well as ammonium oxidation and oxygen depletion that can potentially contribute to global nitrous oxide production. Well-characterized genera include *Methylomonas, Methylobacter, Methylococcus, Methylosinus,* and *Methylocystis.*

methanotroph *See* methane-oxidizing bacteria.

methemoglobin An oxidized form of hemoglobin that is incapable of reversibly binding oxygen. Therefore, this conversion by oxidation decreases the oxygen-carrying capacity of the blood. The conversion of hemoglobin to methemoglobin is responsible for the blue-baby syndrome produced by various oxidant chemicals, such as nitrite (NO_2^-) and chlorite (ClO_2^-). Excessive conversion of hemoglobin to methemoglobin produces anoxia in tissues and can be life-threatening. *See also* hemoglobin.

methemoglobin diaphorase *See* methemoglobin reductase.

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methemoglobinemia A condition of increased concentration of methemoglobin within the blood. This condition causes blue-baby syndrome.

methemoglobin reductase An enzyme responsible for reducing methemoglobin to hemoglobin. The major methemoglobin reductase is actually cytochrome b_5, which requires the reduced form of nicotinamide-adenine dinucleotide (NADH) as a cofactor.

method(s), standard *See* standard method(s).

method blank (MB) A sample, usually reagent water, that contains no analytes of interest and is passed through an analytical method. It is used to establish the zero calibration point as well as to ensure the method does not introduce interfering contaminants.

method detection limit (MDL) As defined by the US Environmental Protection Agency in 40 CFR Part 136 Appendix B for use in regulatory programs, the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. In practice, it is a value calculated from the absolute precision of replicate determinations. Many regulatory programs make use of the method detection limit. The concept and application of the method detection limit have been vigorously debated in recent years. The method detection limit is often mistakenly called the minimum detection limit. *See also* limit of detection; limit of quantitation; practical quantitation level.

method of images A modeling technique to simulate the effects of hydraulic boundaries on pumping wells by the use of image wells. *See also* image well.

method of standard addition A technique sometimes used in atomic absorption and other analytical methods to correct for certain nonspectral interferences without removing the interference. Calibration curves are constructed by spiking known amounts of the analyte into the sample. Determinations can then be made using the calibration curve constructed from the spiked sample matrix. One must use this technique with caution because it will not correct for all types of interferences.

methoxychlor ($Cl_3CCH(C_6H_4OCH_3)_2$) A generic name for 2,2-bis(p-methoxyphenyl)-1,1,1-trichloroethane, an insecticide whose presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.04 milligrams per liter.

methylation A chemical reaction in which a carboxylic acid group of an organic compound is converted into a methyl ester. This reaction is commonly used for modifying haloacetic acids (a group of disinfection byproducts) in order to make them more amenable to analysis by a method such as gas chromatography.

methyl bromide (CH_3Br) A soil and space fumigant. *See also* fumigant.

methyl-*tert*-butyl-ether (MTBE) ($(CH_3)_3COCH_3$) (1) An organic solvent with moderate polarity, fairly low boiling point, and fairly high vapor pressure. It has become more commonly used as a solvent in liquid–liquid extractions in water analysis laboratories, in part because of its use in specific analytical methods published by the US Environmental Protection Agency (USEPA). (2) Octane booster for unleaded gasoline. MTBE is a commonly used fuel oxygenate. MTBE has been detected in groundwater wells as a result of contamination from nearby leaking underground fuel tanks. Surface water supplies are also vulnerable to MTBE contamination, primarily through the use of recreational motorized watercraft. MTBE is highly soluble in water. It is not adsorbed by soil matter, nor does it volatilize readily. In addition, MTBE is not removed by conventional treatment techniques. The USEPA is looking into the development of a regulation for MTBE in drinking water and has included MTBE on its list of chemicals of concern on the Drinking Water Contaminant Candidate List (CCL). As an interim measure, the USEPA issued a Drinking Water Advisory that suggested limiting the amount of MTBE in water to 0.02 milligrams per liter to avoid tastes and odors.

methylene blue active substance (MBAS) A substance that reacts with methylene blue as part of an analytical method used to estimate the concentration of anionic surfactants. Methylene blue is a cationic dye that reacts with certain substances to form an ion pair. The ion pair is extracted into an organic solvent such as chloroform ($CHCl_3$). The intensity of the extracted blue color is proportional to the concentration of methylene blue active substances. *See also* ion pair.

methylene blue number The number of milligrams of methylene blue adsorbed by 1 gram of activated carbon in equilibrium with a solution of methylene blue that has a concentration of 1.0 milligram per liter.

methylene chloride *See* dichloromethane.

methyl ester (R–CO–O–CH_3) Any of a group of fatty esters derived from coconut and other vegetable oils. In addition, diazomethane ($H_2C{=}N^+{=}N^-$) is used to derivatize haloacetic acids, converting them into their corresponding methyl esters, so that they can be analyzed by gas chromatography. *See also* diazomethane; ester.

methyl glyoxal (CH_3COCHO) An aldoketone created during the reaction of ozone (O_3) with natural organic matter. *See also* aldoketone; ozonation by-product.

2-methylisoborneol (MIB) ($C_{11}H_{20}O$) A musty, camphor-smelling chemical produced by certain cyanobacteria and actinomycetes. This odorous compound can be perceived at low nanogram-per-liter

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concentrations. Removal at a treatment plant requires either ozone (O_3) oxidation or activated carbon adsorption. *See also* actinomycetes; cyanobacteria.

methyl isobutyl ketone (MIBK) ($(CH_3)_2CHCH_2COCH_3$) A solvent for paints and varnishes. *See also* solvent.

methyl orange ($(CH_3)_2NC_6H_4NNC_6H_4SO_3Na$) A pH indicator dye that can be used in water analysis. In aqueous solutions with pH less than 3.1, the color is red. Solutions for which the pH is greater than 4.4 are yellow in color.

methyl orange alkalinity A measure of the total alkalinity of an aqueous suspension or solution. It is measured by the quantity of standard sulfuric acid (H_2SO_4) required to bring the water to a pH value of 4.5, as indicated by the change in color of methyl orange. It is expressed in units of milligrams per liter of equivalent calcium carbonate ($CaCO_3$).

2-methylphenol ($CH_3C_6H_4OH$) The chemical name for ortho-cresol, a synthetic organic chemical derived by fractional distillation of crude cresol from coal tar. This chemical has various industrial uses, e.g., as a disinfectant, fungicide, or insecticide. *See also* coal tar; disinfectant; distillation; fungicide; insecticide; synthetic organic chemical.

methyl-red test A qualitative test for acid production. It is based on the use of a pH indicator, methyl red, to determine the hydrogen ion concentration present when an organism ferments glucose or other fermentable sugar.

methyl transferase Any of a group of enzymes that transfer methyl groups to biologically important substrates or to chemicals that are foreign to the body.

4-methylumbelliferyl-β-D-glucuronide (MUG) A fluorogenic compound used in microbiological media for the detection of *Escherichia coli* in drinking water or other environmental samples. It is the substrate for the enzyme β-glucuronidase, an enzyme common to most *Escherichia coli* strains. When 4-methylumbelliferyl-β-D-glucuronide is hydrolyzed by β-glucuronidase, methylumbelliferone is released and fluoresces with a blue color under long-wave (366-nanometer) ultraviolet light. *See also* β-glucuronidase; minimal medium.

metolachlor ($(CH_3)C_6H_3(C_2H_5)$-$N(COCH_2Cl)CH(CH_3)CH_2OCH_3$) The common name for the herbicide 2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide. *See also* herbicide.

metribuzin ($C_8H_{14}N_4OS$) The common name for the herbicide 4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4*H*)-one. *See also* herbicide.

metrication The conversion of values or expressions to metric (Système International) units.

metric benchmarking A process of systematically tracking multiple operations over a period of time and comparing internal performances against those of similar companies in the same industry.

metric system, metric units *See in the Units of Measure section; see also under* Système International d'Unités *in the Units of Measure section.*

metric ton *See in the Units of Measure section.*

MeV *See* million electron volts *in the Units of Measure section.*

MF *See* membrane filter; microfiltration.

MFA *See* materials flow analysis.

m-fecal coliform (FC) agar medium An agar used for the detection of fecal coliform bacteria by the membrane filtration technique.

MFI *See* modified fouling index.

MFLOPS *See* millions of floating point operations per second.

MF technique *See* membrane filter technique.

MG (also mil gal) *See* million gallons *in the Units of Measure section*.

mg *See* milligram *in the Units of Measure section.*

mgd *See* million gallons per day *in the Units of Measure section.*

mg/L *See* milligrams per liter *in the Units of Measure section.*

MHD (maximum-hour demand) *See* peak-hour demand.

MHHW (mean higher high water) *See* mean higher high water *under* tidal water level.

mho *See in the Units of Measure section.*

MHW (mean high water) *See* mean high water *under* tidal water level.

mHz *See* megahertz *in the Units of Measure section.*

mi *See* mile *in the Units of Measure section.*

mi^2 *See* square mile *in the Units of Measure section.*

MIB *See* 2-methylisoborneol.

MIBK *See* methyl isobutyl ketone.

MIC *See* microbially influenced corrosion.

micelle A unit or structure built up from complex molecules in colloids. It may have crystalline properties and is capable of increasing or decreasing in size without changing in chemical nature. The complex molecules have hydrophobic and hydrophilic characteristics.

Michaelis constant An apparent dissociation constant that can be determined by examining the effects of various concentrations of substrate on the rate of the substrate's conversion to product or the extent to which varying the concentrations of a ligand activates a response that is mediated by a receptor. *See also* dissociation constant.

Michaelis–Menten equation A mathematical expression to describe an enzyme-catalyzed biological reaction in which the rate of the reaction is described as a

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function of the concentration of the reactants. This equation is used in studies of enzyme kinetics and the study of any other saturable reaction; it takes the following general form:

$$v = \frac{V_{max}[S]}{K_m + [S]}$$

Where:

v = rate at any substrate concentration, in micromoles per liter per minute
V_{max} = maximum rate of enzyme activity at saturation, in micromoles per liter per minute
[S] = substrate concentration, in micromoles per liter
K_m = substrate concentration when rate is half the maximum (i.e., $v = 0.5\ V_{max}$), in micromoles per liter

The rates described by this equation are dependent on the amount of enzyme (or catalyst) present in the system and the temperature at which the reaction is taking place.

micro (µ) *See in the Units of Measure section.*

microaerophile A microorganism that grows best under reduced oxygen tension.

microbe *See* microorganism.

microbial activity The activities of microorganisms resulting in chemical or physical changes.

microbial and disinfection by-products (M/DBP) Referring to the group of regulations established by the US Environmental Protection Agency that regulate microbiological contaminants and disinfection by-products.

microbial and disinfection by-products (M/DBP) agreement An agreement between the US Environmental Protection Agency and stakeholders that expressed principles and provisions for the agency to consider in the development of the Stage 2 Disinfectants and Disinfection By-Products Rule and Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), which were published in December 2005.

microbial challenge test For a treatment process, such as a membrane filtration system or other filtration device, a test in which microbes (typically nonpathogenic microorganisms that are surrogates for targeted pathogenic microorganisms) are added (seeded) to the feedwater at a known concentration and the filtrate microbe concentration is monitored to determine the removal efficiency. *See also* integrity testing.

microbial disinfection kinetics The rate at which microbes are killed or inactivated in a disinfection system.

microbial film A gelatinous film of microbial growth attached to or spanning the interstices of a support medium. Such a film is also called biological slime. *See also* extracellular polymeric substance.

microbial growth The activity and growth of microorganisms, such as bacteria, algae, diatoms, plankton, and fungi.

microbially influenced corrosion (MIC) Corrosion that is initiated or accelerated by the presence of microbes and their metabolites. Sulfate-reducing bacteria are commonly associated with microbially influenced corrosion.

microbials Microbiological contaminants of any sort.

microbial toolbox A list of possible options available for surface water systems established by the US Environmental Protection Agency under the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), to enable surface water systems to achieve additional *Cryptosporidium* removal or inactivation credits under the proposed rule.

microbiocide A substance that kills or inactivates microorganisms.

microbiological Relating to microorganisms and their life processes.

microbiological analysis The use of various media, techniques, and equipment to determine the density or numbers of microorganisms in a sample.

microbiology The study of microscopic organisms and their processes.

microbiota Collectively, the microscopic animals and plants of a region or habitat.

microchemical Pertaining to chemical reactions involving very small quantities of material.

microclimate The local, frequently uniform weather of a specific habitat or place.

Micrococcus luteus (M. luteus) Bacterium commonly found on the human skin and mucosa. It produces an enzyme that degrades the compounds in sweat into ones that produce unpleasant odors. It can also be found in soil. The bacteria are oxidase-negative, catalase-positive, obligate, and aerobic gram-positive cocci and produce striking bright yellow colonies on most types of microbiological media. *M. luteus* is not considered pathogenic in healthy individuals but is associated with brain abscess, meningitis, pneumonia, arthritis, nosocomial bacteremia, peritonitis, and osteitis in immunocompromised or immunosuppressed individuals.

microcystin Most frequently occurring toxin in surface water supplies produced by *Microcystis* cyanobacteria.

microcystin-LR One of more than 50 microcystins, toxins produced by some cyanobacteria (blue-green algae). Microcystin-LR is a hepatotoxin produced by the cyanobacterium *Microcystis aeruginosa* and is

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one of the most common of the cyanobacterial toxins found in water. It has been responsible for poisoning of both humans and animals. The proposed guideline value for this toxin in water in Canada is 0.0015 milligrams per liter; no proposed guideline value exists in the United States at this writing.

Microcystis aeruginosa (M. aeruginosa) Common bloom-forming cyanobacteria found primarily in nutrient-enriched freshwaters and lower-salinity estuaries. During a bloom, they form thick mats, and in calm freshwater areas can look like green paint floating on the surface of the water. People and animals should avoid contact with water or drinking water containing high concentrations of *M. aeruginosa* because it produces natural toxins (microcystins) that are potent. The primary toxic effect of microcystins is on the liver. Ingestion of high doses of the toxin can result in severe liver damage and possibly death.

microdiameter-depth adsorption system (MIDDAS) A system using "microcolumn" adsorbers containing small adsorbent particles to predict the performance of fixed-bed adsorbers and develop information for scaleup and design. *See also* rapid small-scale column test.

microextraction A sample preparation method that involves the isolation of analytes using small quantities (on the order of milliliters) of solvent and sample.

microfilter Filtration device that removes micrometer-sized or larger particles. *See also* microfiltration.

microfiltration (MF) A pressure-driven membrane process that separates micrometer-diameter and submicrometer-diameter particles (down to an approximately 0.1-micrometer-diameter size) from a feed stream by using a sieving mechanism. The smallest particle size removed is dependent on the pore size rating of the membrane.

microfloc The initial floc formed immediately after coagulation, composed of small clumps of solids.

microflocculation A process that enhances the effectiveness of particle agglomeration and removal, typically associated with ozone (O_3) treatment. This flocculation phenomenon—in which larger but still microscopic particles are created by the collision of smaller particles—is a result of changes in surface chemistry resulting from ozonation; it can result in improved turbidity removal. *See also* flocculation; ozone.

microflora The microscopic plants present in a volume or area; the flora of a microhabitat.

microgram (µg) *See in the Units of Measure section.*

micrograms per liter (µg/L) *See in the Units of Measure section.*

microhm (µohm) *See in the Units of Measure section.*

micrometeorology The study of variations in meteorologic conditions over very small areas, such as hillsides, forests, drainage areas of rivers, or individual cities.

micrometer (µm) *See in the Units of Measure section.*

micromho *See in the Units of Measure section.*

micromhos per centimeter (µmho/cm) *See in the Units of Measure section.*

micromolar (µM) *See in the Units of Measure section.*

micromole (µmol) *See in the Units of Measure section.*

micron (µ) *See in the Units of Measure section.*

micron rating A measurement applied to filters or filter media to indicate the particle size for which any larger suspended solids will be removed. As used in the water treatment industry standards, it may be an absolute rating or a nominal rating. *See also* absolute filter rating; nominal filter rating.

micronucleus test A test for the ability of chemicals to damage chromosomes. It essentially involves detection of small remnants of nuclei containing damaged deoxyribonucleic acid that remain for short times after a cell containing chromosomal damage divides. This test is most frequently conducted in mice, where the number of micronuclei observed in polychromatic erythrocytes in the bone marrow is scored.

micronutrient A beneficial element that is needed only in trace amounts. The same element can sometimes be toxic in higher amounts. *See also* trace element.

microorganism A microscopic organism, either plant or animal, invisible to the naked eye. Examples are algae, bacteria, fungi, protozoa, and viruses.

microphyte A microscopic bacterium, plant, or smaller alga.

micropit A small-diameter hole made by a vacuum machine or boring machine to access a water main in order to repair it, inspect it, or obtain an elevation reading.

micropore *See* adsorption pores.

microporous membrane A microfiltration or ultrafiltration membrane with pores that treat water by sieving action.

MICROQL A generalized equilibrium chemistry modeling program that calculates chemical speciation in aqueous solutions. *See also* MINEQL.

microsand-ballasted clarification *See* sand ballasted flocculation–sedimentation.

microsand enhanced coagulation The use of small sand particles in a coagulation, flocculation, and sedimentation process to improve the settleability of the total particle mix. Particle settling may be hindered when higher coagulant dosages are used for improving organic removal in enhanced coagulation. Using microsand is one method to improve settling. After settling, the sand is separated from the residuals and is recycled

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to the process. *See also* enhanced coagulation; sand ballasted flocculation–sedimentation.

microsatellite polymorphisms Short segments of deoxyribonucleic acid (DNA), e.g., 2–6 base pairs, that have identical repeated sequences, e.g., CACACACA, and tend to occur in noncoding DNA. They have been utilized for genetic mapping and determining the amount of hybridization between closely related species. Microsatellite polymorphisms are also known as variable numbers of tandem repeats.

microscale modeling A mathematical description of a micrometer-scale system, such as fluid flow through a porous media, considering physical properties and interactions such as electrostatic, adhesion, roughness, friction, permeability, thermal effects, and other factors.

microscope An instrument used to observe materials and organisms too small to be seen with the unaided eye. Modern microscopes are of the compound variety because they have two sets of lenses, the ocular lenses and the objective lenses. Most laboratory microscopes have three objective lenses: low power, high power, and oil immersion.

microscope, brightfield *See* brightfield microscope.

microscope, electron *See* electron microscope.

microscope, fluorescence *See* fluorescence microscope.

microscope, light *See* light microscope.

microscope, phase contrast *See* phase contrast microscope.

microscope, scanning electron *See* scanning electron microscope.

microscope, transmission electron *See* transmission electron microscope.

microscopic Very small, generally with dimensions between 0.5 and 100 micrometers, and visible only by magnification with a microscope.

microscopic analysis The examination of water to determine the presence and amounts of plant and animal life, such as algae, diatoms, protozoa, and crustacea. Microscopic analysis is sometimes called microscopic examination.

microscopic particulate analysis (MPA) The use of any one of several methods to identify and size particles in water. Several versions of analytical methods are available that can identify *Giardia, Cryptosporidium,* algae, nematodes, and other microorganisms. Particles from large volumes of water are isolated onto a cartridge filter with a typical pore size of 1 micrometer. Microscopic particulate analyses are used to assess the performance of water filtration plants, as well as to help identify groundwater that may be under the influence of surface water.

microscopic particulate analysis particle counting *See* microscopic particulate analysis.

microscopy Use of a microscope to observe, investigate, measure, or evaluate samples.

microscopy, atomic force *See* atomic force microscopy.

microscopy, brightfield *See* brightfield microscopy.

microscopy, confocal laser scanning (CLSM) *See* confocal laser scanning microscopy.

microscopy, phase contrast *See* phase contrast microscopy.

microscopy, scanning electron *See* scanning electron microscopy.

microscopy, transmission electron *See* transmission electron microscopy.

microscreen A pretreatment device used to remove fine material such as filamentous algae. Screening media are typically stainless steel or polyester, and media openings are typically 20 to 30 micrometers.

microsiemens (µS) *See in the Units of Measure section.*

microsomal enzyme An oxidase that occurs in the diffuse membranous structures within most cells, but primarily in the liver. In a laboratory procedure, when the cell structure is disrupted with homogenization of the tissue, these membranes form small vesicular structures referred to as microsomes. The term *microsomal enzyme* is generally applied to a variety of enzymes that make up the so-called cytochrome P450 superfamily. Other drug-metabolizing enzymes, chemical-metabolizing enzymes, or both are also found in the microsomes. The enzymes are involved in the metabolism of chemicals that are foreign to the body, but they also participate in the metabolism of a variety of natural substrates, most notably steroids. The activities of these enzymes are included in a variety of in vitro assays for genotoxic effects, usually in the form of the so-called S-9 fraction, which is the supernatant liquid obtained following centrifugation of a tissue (usually liver) homogenate at 9,000 times gravity. *See also* genotoxic; microsome.

microsomal inducing agent A chemical or other agent that will increase the synthesis of microsomal enzymes. Most agents do not indiscriminately stimulate the synthesis of all microsomal enzymes, but rather selectively stimulate the synthesis of particular forms that have specificity for certain types of substrates. *See also* microsomal enzyme.

microsome A small vesicular structure that is created upon the laboratory homogenization of cells in a way that empties the cellular contents. Microsomes represent the smooth endoplasmic reticulum, which are membranous structures that are easily observed by electron microscopy. The subcellular fraction that is referred to as microsomes contains the bulk of the enzymes that are involved in the metabolism of foreign chemicals to which the body is exposed.

microsphere A submicron-size uniform latex particle. In drinking water research, microspheres are

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used as surrogates for particles that may be found in natural suspensions, such as microorganisms. Microspheres have been used in filtration and disinfection experiments to assess particle removal or disinfection efficacy.

Microsporidia Phylum of small, unicellular, obligate intracellular, spore-forming (with spores of about 1–4.5 micrometers) parasites that are widely distributed in nature and include more than 150 genera and numerous species. They have been recognized as pathogens of insects, fish, birds, and mammals, including humans, causing the disease microsporidiosis. This gastrointestinal tract infection is characterized by severe diarrhea, cachexia (general ill health and malnutrition), weight loss, and epigastric pain. Infections have been recognized in immunosuppressed patients (e.g., AIDS patients) and in immunocompetent patients. Species found in humans are *Encephalitozoon cuniculi; E. hellem; E. intestinalis* (*Septata intestinalis*); *Enterocytozoon bieneusi; Nosema connori; Pleistophora* spp.; *Trachipleistophora hominis;* and *Vittaforma corneum.*

Microsporidium A "catch-all" genus name for Microsporidia that have not yet been classified. *See also* Microsporidia.

microstrainer A mechanical device used to remove fine material and particles from water. *See also* microscreen.

microstraining A process that removes very small particles, typically 20 to 30 micrometers across, but sometimes as small as 1 micrometer, often algal-related, from a water source prior to treatment. A screen having small openings, often affixed to a rotating drum, is used for microstraining. The mechanical device is often called a microscreen.

microtubule Any of a variety of microscopic tubular structures found in the cytoplasm of many types of eukaryotic cells. Microtubules are polymers of the protein tubulin and are also called fibrils. They participate in a variety of structural and transport roles within cells. In particular, they are important in the formation of the spindle fibers of mitosis, which are responsible for separation of the chromosomes, an important task during cell division. They extend from the centriole to a special attachment point on each chromosome. They are composed primarily of protein, are contractile, and are involved in the motion of protoplasm (protoplasmic streaming) and transport. Thus, they are important components of cilia and flagella in microorganisms, and they transport organelles from sites of synthesis to functional sites. These proteins are the targets of the effects of various toxic chemicals, such as acrylamide ($CH_2CHCONH_2$) and n-hexane ($CH_3(CH_2)_4CH_3$), that produce a variety of toxicological responses. *See also* organelle.

microtunnel A small-diameter excavation from one entrance pit to another, normally completed with a lining to install water lines without disturbing the surface above the pipe.

microvilli A microscopic projection from the surface of a cell.

microwatt (µW) *See in the Units of Measure section.*

microwatt seconds per square centimeter (µW–s/cm^2) *See in the Units of Measure section.*

MIDDAS *See* microdiameter-depth adsorption system.

middleware Software that connects or provides a bridge between two otherwise separate applications.

midpoint The point at or near the middle of a scale or set of experimental data in scientific analyses.

midzonal lesion A lesion indicating that damage to the liver has occurred in the area between the central vein and the portal triad (i.e., portal artery, vein, and bile duct) and not immediately adjacent to either of these structures. *See also* centrilobular lesion; portal lesion.

mil *See in the Units of Measure section.*

mild slope (1) A conduit slope less than the critical slope for a particular discharge; a slope for which the depth of flow is greater than Belanger's critical depth and the velocity is less than Belanger's critical velocity. (2) A slope less than the friction slope. A mild slope is also called a flat slope. *See also* Belanger's critical velocity.

mile (mi) *See in the Units of Measure section.*

miles per hour (mph) *See in the Units of Measure section.*

milfoil An aggressive nonnative water weed that reproduces by a process called fragmentation. Easily spread between water bodies by boaters carrying plant fragments on their boats and trailers, the Eurasian watermilfoil (*Myriophyllum spicatum*) flourishes quickly and chokes out native species. Milfoil can cause problems such as restricting swimming, boating, and fishing; invading salmon spawning beds; and clogging irrigation intake pipes.

mil gal (also MG) *See* million gallons *in the Units of Measure section.*

milk dilution bottle *See* dilution bottle.

milk of lime The lime slurry formed when water is mixed with calcium hydroxide ($Ca(OH)_2$).

milli (m) *See in the Units of Measure section.*

milliampere (mA) *See in the Units of Measure section.*

milliequivalent (meq) *See in the Units of Measure section.*

milliequivalents per liter (meq/L) *See in the Units of Measure section.*

milligram (mg) *See in the Units of Measure section.*

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milligrams per liter (mg/L) *See in the Units of Measure section.*

millijoules per square centimeter (mJ/cm^2) *See in the Units of Measure section.*

milliliter (mL) *See in the Units of Measure section.*

millimeter (mm) *See in the Units of Measure section.*

millimicron (mμ) *See in the Units of Measure section.*

millimolar (mM) *See in the Units of Measure section.*

millimole (mmol) *See in the Units of Measure section.*

million electron volts (MeV) *See in the Units of Measure section.*

million gallons (mil gal) *See in the Units of Measure section.*

million gallons per day (mgd) *See in the Units of Measure section.*

millions of floating point operations per second (MFLOPS) A commonly used performance measurement of a computer's operational speed. A higher value corresponds to better performance.

millirem per year *See in the Units of Measure section.*

Mills–Reincke phenomenon The coincidence—first pointed out by Hiram F. Mills and J.J. Reincke in 1893–1894, each working independently—between an improvement in the quality of a water supply and a lowering of the death rate in a community from diseases not thought to be directly waterborne.

mils per year (mpy) *See in the Units of Measure section.*

min *See* minute *in the Units of Measure section.*

Minamata disease A severe neurologic disorder caused by alkyl mercury poisoning, usually characterized by peripheral and circumoral paresthesia, ataxia, dysarthria, and loss of peripheral vision, and leading to permanent neurologic and mental disability or death. Other symptoms include serious pain in the joints. The disease was prevalent between 1953 and 1958 among those who ate seafood from Minamata Bay, Japan, which contained an excess of alkyl mercury compounds coming from mercury used in a vinyl chloride plant on the bay. Fetuses were also affected. Other occurrences have been reported in Iran and in Native populations in Canada. *See also* itai itai disease.

MINEQL A family of equilibrium speciation and modeling computer programs that have evolved for the REDEQL family of programs, with modifications to enhance the efficiency and versatility of the code. MINEQL+ was a cooperative effort between the Procter & Gamble Corporation and Environmental Research Software and has an extensive user interface and output management facility. *See also* REDEQL.

mineral (1) An inorganic (nonliving) substance that occurs naturally in the earth, has a composition that can be expressed as a chemical formula, and has a set of characteristics (e.g., crystalline structure, hardness) common to all minerals. Examples of minerals are sulfur and salt. Certain organic substances, such as coal, are also sometimes referred to as minerals. The word *mineral* is also used to refer to matter derived from minerals, such as inorganic ions found in water and reported as mineral content. (2) In the water treatment industry, a naturally occurring inorganic cation exchanger formerly used in water softeners—as opposed to the synthetic organic resins used today for water softening.

mineral acid An inorganic acid, especially hydrochloric acid (HCl), nitric acid (HNO_3), and sulfuric acid (H_2SO_4).

mineral acidity Acidity in water caused by the presence of strong inorganic acids (such as hydrochloric acid [HCl], nitric acid [HNO_3], and sulfuric acid [H_2SO_4]), as opposed to weak acidity caused by such acids as carbonic acid (H_2CO_3) or acetic acid (CH_3COOH). Mineral acidity is usually expressed in water analysis as free mineral acidity.

Mineral Equilibrium *See* MINEQL.

mineral-free water Water produced by either distillation or deionization. This term is sometimes found on labels of bottled water as a substitute term for distilled water or deionized water.

mineralization The process of converting organic matter into a mineral or inorganic form. For example, complete oxidation of a chlorinated hydrocarbon results in carbon dioxide (CO_2), water (H_2O), and chloride ions (Cl^-) as the final by-products. Most water treatment oxidation practices, however, result in relatively minor mineralization of organic matter.

mineral salt A chemical compound formed by the combination of a mineral acid and a base. Minerals from dissolved rock exist in water in the form of dissolved mineral salts. An excess of mineral salts can give water a disagreeable taste or even be harmful to human health.

mineral spring A spring for which the water contains large quantities of mineral salts, either those commonly occurring in the locality or of a rare or uncommon character.

mineral water (1) Water that is naturally or artificially impregnated with mineral salts or gases (e.g., carbon dioxide, CO_2). (2) Bottled water that contains no less than 250 milligrams per liter total dissolved solids and originates from a protected groundwater source. *See also* bottled mineral water.

miner's salt Another name for mined rock salt.

minimal energy The difference between the potential energy of delivered water (for some unit of time) and the potential energy of the same quantity of water at the source.

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minimal medium A medium used in a test for total coliform analysis for compliance with the maximum contaminant level for total coliforms and *Escherichia coli* under the Safe Drinking Water Act. The ingredients of the minimal medium are *ortho*-nitrophenol-β-D-galactopyranoside (ONPG) and 4-methylumbelliferyl-β-D-glucuronide (MUG). *See also* 4-methylumbelliferyl-β-D-glucuronide; *ortho*-nitrophenyl-β-D-galactopyranoside.

minimize To limit impacts on a wetland by limiting the degree or magnitude of the activity affecting the wetland.

minimum annual flood The smallest of the annual floods during a period of record.

minimum bending radius The allowable deflection of the centerline of a pipe before damage occurs. The radius refers to an imaginary circle of which the pipe length would be an arc.

minimum bill rate A rate process whereby the charge to a customer for the initial block of water also recovers billing, collecting, and meter service costs.

minimum day The day during which the minimum-day demand occurs. *See also* minimum-day demand.

minimum-day demand The least volume per day flowing through the plant for any day of the year.

minimum detection limit (MDL) *See* method detection limit.

minimum flow (1) The flow occurring in a stream during the driest period of the year. It is also called low flow. (2) The least quantity of influent to a treatment plant within a given time period. *See also* maximum flow.

minimum fluidization velocity (V_{mf}) The minimum backwash velocity or rise rate needed to fluidize a given size media in a filter.

minimum hour The hour during which minimum-hour demand occurs. *See also* minimum-hour demand.

minimum-hour demand The least volume per hour flowing through a plant for any hour in the year.

minimum month The month during which the minimum-month demand occurs. *See also* minimum-month demand.

minimum-month demand The least volume of water passing through the plant during a calendar month.

minimum night flow (MNF) The amount of water flowing into a discrete zone or district metered area (DMA) during the period of lowest demand, typically between 2:00 A.M. and 4:00 A.M. For most nonindustrial areas, legitimate consumption is at the lowest proportion, and leakage is at the highest proportion, of the total flow during these hours. The MNF is one of several parameters assessed in a small zone or DMA via nighflow analysis to quantify amounts of existing leakage. *See also* nightflow analysis.

minimum reporting level (MRL) The lowest concentration of a given analyte that a laboratory feels confident reporting to data users. This value is often used within a laboratory but not in comparison to other laboratories (intralaboratory value). Calculation of the minimum reporting level has not been standardized.

mining groundwater The process of extracting groundwater from an aquifer in excess of the natural recharge rate. If mining is conducted long enough, the groundwater resource will be completely depleted. In certain parts of the world, no alternative exists, but proper management can make the resource last for decades or centuries. *See also* groundwater safe yield.

mining yield The amount of groundwater that can be economically withdrawn from an aquifer without regard to replenishment.

minor head loss The energy losses that result from the resistance to flow as water passes through valves, fittings, inlets, and outlets of a piping system.

MINTEQ A family of computer software programs, most developed by the US Environmental Protection Agency, that combine many of the computational features of the WATEQ programs with the more generalized equation-solving and modeling features of the MINEQL family of programs. The software programs perform a number of chemical equilibrium functions including the calculation of metal speciation and solubility equilibrium for water. *See also* MINEQL; WATEQ.

minute (min) *See in the Units of Measure section.*

MIO *See* Motility Indole Ornithine Medium.

MIOX *See* mixed oxidant.

MIPCOM *See* municipal infrastructure planning and cost model.

miscible Able to be mixed together or dissolved into each other to produce a homogeneous substance.

misclassification bias Bias in an epidemiologic study caused by the erroneous classification of an individual or a characteristic of the individual so that the individual is assigned to an incorrect category of exposure or disease. The probability of misclassification may vary among the groups under study (nonrandom misclassification) or may be the same (random misclassification). Random misclassification usually biases a study toward not observing an association or observing a smaller risk measure than may actually be present, whereas nonrandom bias can result in either higher or lower estimates of risk depending on the distribution of the misclassification error. In environmental epidemiologic studies, misclassification of exposure is often present, and assessing whether misclassification is random or not is important. Random misclassification bias is also called nondifferential misclassification bias by some

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epidemiologists, and nonrandom misclassification bias is also called differential misclassification bias.

misreplication A mistake in the synthesis of deoxyribonucleic acid (DNA) involving the insertion of an incorrect purine or pyrimidine base in the strand of DNA being synthesized.

missing value In statistics, a missing data point in a set of observations. Various statistical methods are available for estimating missing values.

mission The purpose, function, and goals of an organization.

mission statement A written document that specifies the mission of an organization or entity with an action plan to accomplish that mission.

mist Liquid particles that are suspended in the air by spraying or splashing.

mitigate To moderate or make less severe.

mitigation The act or process of avoiding, minimizing, rectifying, reducing, and compensating for impacts. Compensation covers creation, restoration, or enhancement of wetlands that were or will be lost.

mitigation banker A person or group of people, a corporation, a government entity, or a consortium that establishes and might also maintain and operate a mitigation bank. The banker might be different from the bank's sponsor. *See also* mitigation banking.

mitigation banking Wetland restoration, creation, or enhancement undertaken expressly to provide compensation credits for wetland losses caused by future development activities.

mitigation bank sponsor The entity that develops a mitigation bank. The bank's sponsor might be a different entity from the banker. *See also* mitigation banking.

mitochondria Subcellular organelles that are primarily responsible for aerobic metabolism of substrates to yield adenosine triphosphate ($C_{10}H_{16}N_5O_{13}P_3$), the common energy currency within the cell. The mitochondria also have roles in controlling ionic concentrations within the cytosol (especially calcium) in addition to the catabolism of carbohydrates, fats, and amino acids. *See also* organelle.

mitochondria-bearing Organisms carrying mitochondria within the cytoplasm of their cells.

mitogen A substance that increases the rate of cell division. Such chemicals are of interest primarily because they frequently can act as promoters of cancer.

mitosis The sequential differentiation and segregation of replicated chromosomes in a cell nucleus that precedes complete cell division.

MIU *See* meter interface unit.

mixed bed (1) The intermix of two or more filter or ion-exchange products in the same vessel during a service run. The most common use of a mixed bed is in ion-exchange systems having 40 percent cations to 60 percent anions in the resin bed, such as for a deionization polisher unit. (2) In filtration, an intermix of two or more media in a single tank, with each stratified into separate layers. *See also* multilayered bed.

mixed-bed ion exchange *See* mixed bed.

mixed-flow pump A centrifugal pump in which the head is developed partly by centrifugal force and partly by the lift of the vanes on the liquid. This type of pump has a single inlet impeller; the flow enters axially and leaves axially and radially.

mixed-flow turbine A reaction turbine in which the flow enters in a radially inward direction, changes to a direction parallel to the axis of the runner, and in some cases emerges in a more or less radially outward direction.

mixed-function oxidase An enzyme present in the endoplasmic reticulum of many cells that catalyzes reactions important in the metabolism of chemicals normally considered to be foreign to the body. The complex responsible consists of a reductase and a heme protein of the cytochrome P450 superfamily. *See also* cytochrome P450.

mixed media A combination of two or more media products in a single loose-media filtration bed where the products are intermixed rather than stratified in layers. An example is the intermixed use of calcite ($CaCO_3$) and magnesia (MgO) in pH modification or anthracite and sand in a filter for particle removal.

mixed-media filter A filter that contains media of differing sizes and densities that are intermixed as opposed to being in stratified layers.

mixed oxidant (MIOX) A disinfection solution generated electrochemically that is reported to have a superior disinfection efficiency than chlorine solution.

mixed-oxidant disinfection Disinfection in which a mixture of oxidants (composed of various chlorine- and oxygen-based compounds, such as ozone [O_3], chlorine dioxide [ClO_2], and short-lived free radicals) is used for disinfection. One technology for generating mixed oxidants uses an electrolytic cell that produces an aqueous mixed-oxidant solution consisting primarily of chlorine (HOCl) with smaller amounts of chlorine dioxide and ozone. *See also* disinfection; electrolytic cell; oxidant; radical.

mixing A process employing energy to create a homogeneous mixture from two or more components.

mixing basin (1) A basin or tank in which agitation is applied to water or sludge to increase the dispersion rate of applied chemicals. (2) A tank used for general mixing purposes.

mixing chamber A chamber used to facilitate the mixing of chemicals with liquid or of two or more liquids of different characteristics. It may be equipped with a

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mechanical device for accomplishing the mixing. *See also* mixing tank.

mixing channel A channel provided in a water treatment plant and having hydraulic characteristics or construction features such that chemicals, liquids, or both are thoroughly mixed upon passing through.

mixing tank A tank or channel designed to provide a thorough mixing of chemicals that are introduced into liquids or of two or more liquids that have different characteristics. *See also* mixing chamber.

mixing zone That part of a water body where mixing between the receiving waters and the effluent from a point source (e.g., an industrial discharge) takes place.

mixolimnion The upper zone or layer of a meromictic lake.

mixture Two or more elements, compounds, or both mixed together with no chemical reaction (bonding) occurring.

ML *See* megaliter *in the Units of Measure section.*

mL *See* milliliter *in the Units of Measure section.*

MLLW (mean lower low water) *See* mean lower low water *under* tidal water level.

M. luteus *See Micrococcus luteus.*

MLW (mean low water) *See* mean low water *under* tidal water level.

mM *See* millimolar *in the Units of Measure section.*

mm *See* millimeter *in the Units of Measure section.*

MMM *See* multimedia mitigation.

MMO (minimal medium *ortho*-nitrophenyl-β-D-galactopyranoside) *See under* minimal medium.

mmol *See* millimole *in the Units of Measure section.*

MMO-MUG (also ONPG-MUG) *See under* minimal medium.

MMO-MUG technique *See under ortho*-nitrophenyl-β-D-galactopyranoside, 4-methylumbelliferyl-β-D-glucuronide technique.

mμ *See* millimicron *in the Units of Measure section.*

M_n *See* number-average molecular weight.

mobile phase A component of chromatographic separation that transports analytes through the stationary phase. In gas chromatography, the mobile phase is often an inert gas, such as helium. In liquid chromatography, mobile phases can be a single liquid or a combination of several solvents. Differential interaction of the analytes with the mobile and stationary phases causes separation.

mobile water *See* free water.

mobilization A series of initiatives designed to address the fundamental causes of noncompliance with the Safe Drinking Water Act (SDWA) through a coordinated effort by the US Environmental Protection Agency, state drinking water programs, and organizations representing constituencies affected by the SDWA.

mode In statistics, the most frequently occurring number in a set of numbers. For example, in the set 1, 2, 4, 4, 4, 4, 6, 8, 10, the number 4 is the mode.

model A mathematical or physical representation of a real-world system, developed to study and understand the behavior of that system. Mathematical models can be used to predict the outcome of a process activity as a result of changes in the variables controlling the process. *See also* mathematical model.

model equation An organized representation of a mathematical model using mathematical symbols, chemical symbols, or both.

modeling The act of developing a mathematical or physical model.

model verification The process of comparing the prediction of a mathematical or physical model with the actual outcome of a real-world system.

mode of action A description of the biological processes a chemical modifies to induce an adverse health effect. *Mode of action* is a less specific term than *mechanism of action.* It is most commonly used to distinguish the effects of carcinogens such as chloroform ($CHCl_3$) that produce cell death and reparative hyperplasia from the effects of carcinogens such as aflatoxin ($C_xH_yO_z$, where x is typically 16 or 17, y is typically 10, 12, or 14, and z is typically 6, 7, or 8) that produce mutations (i.e., are genotoxic). *See also* carcinogen; genotoxic; mechanism of action.

moderate rain Rain that is falling at the time of observation with an intensity between 0.11 inches (0.28 centimeters) per hour and 0.30 inches (0.76 centimeters) per hour (i.e., between 0.01 inches [0.025 centimeters] and 0.03 inches [0.076 centimeters] in 6 minutes).

modified carbol fuchsin technique Method used for examination of fecal specimens.

modified coagulation/filtration (C-F or C/F) An arsenic removal process involving the addition of a coagulant such ferric chloride, ferric sulfate, or alum to precipitate the corresponding ferric or aluminum hydroxide, which strongly adsorbs arsenate (As(V)), the pentavalent form of arsenic. The process is considered "modified" because flocculation and sedimentation are not usually employed and pH is sometimes adjusted by adding acid to the mixer. The direct in-line dual or multimedia filter removes the metal hydroxide flocs with arsenic attached. Lower pH values (6.5–7.5) are more effective than higher pH (7.6–9) values for removing arsenic. The US Environmental Protection Agency considers modified coagulation/filtration to be a best available technology for arsenic removal.

modified fouling index (MFI) An empirical measure of the fouling characteristics of a membrane feedwater (in units of seconds per square liter) that is

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determined using the same equipment and procedures as the silt density index test, except that the filtrate volume is recorded every 30 seconds over the 15-minute filtration period. The index value is defined graphically as the slope of a curve relating inverse flow to cumulative volume in the cake filtration region and considers the resistance of filter and the deposited material (cake). *See also* silt density index.

modified Hom model A modified version of the Hom model describing the killing of microorganisms or the inactivation of viruses by a disinfectant. This version is used to describe inactivation during conditions in which the disinfectant is decaying according to a first-order rate, as denoted by the rate constant k^*. The following equation is a very good approximation of the resulting exact solution:

$$\ln(N/N_0) = -k'C_0^n t^m \left\{ \frac{m[1 - \exp(-nk^*t/m)]}{nk^*t} \right\}^m$$

Where:

N = the number of viable organisms at time t, in numbers per unit volume
N_0 = the original number of organisms, in numbers per unit volume
k' = the rate constant of killing or inactivation, in organisms killed or inactivated per unit time
C_0 = the initial concentration of the disinfectant, in milligrams per liter
t = the time of exposure, in minutes
m = a constant to take into account "shoulders" or tailing of the $[\ln (N/N_0)]$ versus time curve
n = the coefficient of dilution
k^* = the first-order rate constant for the disappearance of the disinfectant

See also Chick–Watson model; Hom model.

modified velocity The velocity as observed after corrections for drift and angularity have been made.

module *See* membrane module.

Mohr pipette A pipette with a graduated stem used to measure and transfer liquids when great accuracy is not required.

MOI *See* multiplicity of infection.

moiety (1) An indefinite portion of a sample; one of the portions into which something is divided. (2) A portion of a molecule, e.g., the phenolic moiety.

moisture (1) In hydrology, the amount of water contained in a sample. (2) The percentage by weight of water adsorbed on activated carbon.

moisture adjustment Adjustment of the observed precipitation in a storm via multiplication by the ratio of estimated maximum precipitable water over the drainage area under study to the actual precipitable water, calculated for a particular storm. This procedure is one step in determining the maximum probable precipitation for design purposes; it may lead to a statistically derived design flood.

moisture content The quantity of water present in sludge, usually expressed in terms of a percentage of wet weight.

moisture density The mass of water per unit volume of space occupied by soil, air, and water.

moisture equivalent The quantity of water retained by soil placed in a standardized apparatus when the water content is reduced by means of a constant centrifugal force (1,000 times gravity) acting for a specified period or until a state of capillary equilibrium with the applied force is attained. This value is expressed as a percentage of dry weight. In the reporting of a moisture equivalent, the details of the procedure should be stated.

moisture field deficiency The quantity of water that would be required to restore the soil moisture content to field moisture capacity.

moisture film cohesion In soil stabilization, the resistance of particles to separation as a result of the surface tension of the moisture film surrounding each particle.

moisture gradient The rate of change of the moisture content of soil with depth.

moisture-holding capacity *See* field capacity.

moisture penetration The depth to which moisture penetrates after an irrigation or rain, before the rate of downward movement becomes negligible.

moisture percentage The water content of semiliquid material, such as sludge, expressed as a ratio of the loss in weight after drying at 217.4° Fahrenheit (103° Celsius) to the original weight of the sample. *See also* soil water percentage.

moisture tension (1) A numerical measure of the energy with which water is held in the soil. When expressed as the common logarithm of the head in centimeters of water necessary to produce the suction corresponding to the capillary potential, moisture tension is called pF. (2) The equivalent "negative" or gauge pressure to which water must be subjected in order to be in hydraulic equilibrium, through a porous permeable wall or membrane, with the water in the soil.

mol *See* mole *in the Units of Measure section.*

mol. wt. *See* molecular weight.

molal concentration *See* molality.

molality A measure of concentration defined as the number of moles of solute per liter of solvent. Molality is not commonly considered in water treatment. *See also* molarity.

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molar *(M)* *See in the Units of Measure section.*

molar absorptivity A measure of the ability of an analyte to absorb light at a specified wavelength. A high molar absorptivity is crucial for the sensitivity of a colorimetric analysis. *See also* Beer–Lambert law; colorimetric analysis.

molar concentration *See* molarity.

molar energy units *See in the Units of Measure section.*

molar entropy units *See in the Units of Measure section.*

molar heat capacity units *See in the Units of Measure section.*

molarity A measure of concentration defined as the number of moles of solute per liter of solution.

molasses number A value calculated from the ratio of the optical densities of (1) the filtrate of a molasses solution treated with a standard activated carbon and (2) the activated carbon in question. It gives an indication of the volume of large pores in a given activated carbon compared to the standard activated carbon.

mold Multicellular filamentous fungi. *See also* fungus.

mole (mol) *See in the Units of Measure section.*

molecular diffusion A process whereby mobile compounds (dissolved or suspended in another compound) move from areas of high concentration to areas of low concentration. Molecular diffusion is described mathematically by Fick's first law of diffusion. *See also* Fick's law of diffusion.

molecular epidemiology The inclusion of biological markers (cellular, biochemical, or molecular alterations measurable in human tissues, cells, or fluids) in analytical epidemiologic studies. Biological markers may reflect subclinical health effects, define host susceptibility, or serve as indicators of exposure or dose. For example, serum (blood) cholesterol measurements are used in cardiovascular epidemiology, and the identifications of antibodies to various pathogens are used in infectious disease epidemiology. In cancer epidemiology, cellular alterations have been used to identify cancer precursors for screening tests, and deoxyribonucleic acid adducts are used in occupational and environmental epidemiologic studies.

molecular fingerprinting A technique for determining the likelihood that genetic material came from a particular individual or group. *See also* deoxyribonucleic acid fingerprinting.

molecular imprinting The process of polymerization of monomers with a template molecule that imprints structural information into resulting polymers. Molecular imprinting is applied in the fields of biotechnology, biochemistry, and pharmaceutical research.

molecular ion (M^+) A radical cation formed by the removal of an electron from an analyte in a mass spectrometer. The molecular ion's peak in a mass spectrum is important because it typically represents the molecular weight of the compound. A compound that forms a prominent molecular ion typically has one of the peaks with the highest mass-to-charge ratio. Aromatic compounds tend to have prominent molecular ions because of limited compound fragmentation within a mass spectrometer. Other compounds, such as branched hydrocarbons, tend to fragment extensively and can produce spectra with weak molecular ions.

molecular method A general term for techniques that involve analysis at the molecular level, including deoxyribonucleic acid purification techniques, deoxyribonucleic sequencing, polymerase chain reaction, and protein electrophoresis. *See also* deoxyribonucleic acid; electrophoresis; polymerase chain reaction.

molecular size An operational definition of the size of a material based on passage through one or several membrane filters of known molecular weight cutoff. For example, the ability of a molecule to undergo diffusion through a membrane, in general, is primarily a function of molecular size and secondarily of molecular shape. *See also* molecular weight cutoff.

molecular weight (mol. wt., MW) The sum of the atomic weights of the atoms in a molecule.

molecular weight cutoff (MWCO) In a pressure-driven membrane process, an approximate characterization of the membrane rejection capability, generally the smallest compounds (in terms of molecular weight) that are rejected. It is a nominal indicator of smallest molecular weight (size) of contaminant species that will not pass through a membrane material, measured in daltons.

molecular weight distribution Typically, an expression of the percentage of a complex mixture of organic substances having an apparent molecular weight greater or less than various molecular weight cutoffs (e.g., less than 500, 500–1,000, 1,000–5,000, 5,000–10,000, and greater than 10,000 daltons). *See also* apparent molecular weight; dalton *in the Units of Measure section;* molecular weight cutoff.

molecular weight fractionation The process of determining the distribution of the molecular weight or size of a heterogeneous mixture in liquid form by passing the mixture through a sequence of membrane filters with decreasing molecular weight cutoffs. The amount of a given attribute within a certain molecular weight range can be determined by difference.

molecule The smallest particle of an element or compound that retains all of the characteristics of the element or compound. A molecule is made up of one or more atoms. The helium molecule, for example, has only one atom per molecule. Oxygen molecules (O_2)

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have two atoms; ozone molecules (O_3) have three atoms. Molecules found in chemical compounds often have many atoms of various kinds.

moles per liter (mol/L) *See in the Units of Measure section.*

molinate (C_2H_5–S–CO–NC_6H_{12}) The common name for the herbicide *S*-ethyl hexahydro-1*H*-azepine-1-carbothioate. *See also* herbicide.

moling The use of a self-propelled hydraulic or pneumatic tool, called a gopher, to pull a service line underground without disturbing the surface except at the connecting points at each end of the pipe being installed.

mol/L *See* moles per liter *in the Units of Measure section.*

mollusk Any member of a large phylum (Mollusca) of invertebrate animals, such as clams or snails, with a soft, unsegmented body usually enclosed in a calcareous shell.

moment-of-force units *See in the Units of Measure section.*

momentum equation An equation stating, in any consistent set of units, that the impulse (force multiplied by time) applied to a body of water is equal to the momentum (mass multiplied by velocity) acquired by it. The concepts of momentum and impulse, along with energy, are basic to all dynamics.

monitoring (1) The process of tracking information needed to determine exposure limits or medical status. This information includes workplace conditions and employee medical conditions. (2) Routine observation, sampling, and testing of designated locations or parameters to determine the efficiency of treatment or compliance with standards or requirements.

monitoring, compliance *See* compliance monitoring.

monitoring and reporting (M/R) The monitoring and reporting requirements of the National Primary Drinking Water Regulations. *See also* National Primary Drinking Water Regulation.

monitoring light sensor An indicator light, electrically or electronically activated, attached to a sensor that is positioned in the effluent (product water) stream of a piece of water treatment equipment (deionizer, distiller, reverse osmosis unit, or electrodialysis unit) to detect and signal changes in water quality that might indicate an equipment malfunction. Some lights remain on while water quality is within the desired range and go out if the quality of the water falls into the unacceptable range. Other sensors use red and green light signals. *See also* sensor.

monitoring well A well drilled primarily for monitoring water levels or water quality in an aquifer. Such wells are distinct and different from production wells that are drilled to produce economic quantities of water for distribution to water users.

monitoring window A quartz disc that transmits irradiation from the interior of the ultraviolet (UV) reactor to the photodetector of a UV intensity sensor.

monoaldehyde A class of organic compounds that have one aldehyde (HC=O) functional group in the chemical structure (e.g., formaldehyde, CH_2O). Some monoaldehydes are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. *See also* aldehyde; formaldehyde.

monobromamine (NH_2Br) The brominated analog of monochloramine (NH_2Cl) that can be formed during the chloramination of bromide-containing water. *See also* bromamines.

monobromoacetic acid (MBAA) ($CH_2BrCOOH$) A haloacetic acid containing one bromine atom. It is formed during the chlorination of waters containing moderate amounts of bromide (Br^-), and it may also be formed during the ozonation of bromide-containing waters. *See also* disinfection by-product; haloacetic acid.

monochloramine (NH_2Cl) A chloramine species produced from the mixing of chlorine (HOCl) and ammonia (NH_3). Typically, monochloramine and a small percentage of dichloramine ($NHCl_2$) are formed. Monochloramine is used as a disinfectant, especially for distribution system residual maintenance. *See also* chloramines; dichloramine.

monochloroacetaldehyde (MCA) (CH_2ClCHO) A halogenated acetaldehyde where one hydrogen atom of acetaldehyde has been replaced by a chlorine atom. It is a disinfection by-product and detected in chlorinated water. It is not stable in chlorinated water and can be further chlorinated to dichloroacetaldehyde and trichloroacetaldehyde. *See also* disinfection by-product.

monochloroacetic acid (MCAA) ($CH_2ClCOOH$) A haloacetic acid containing one chlorine atom. Typically, dichlororoacetic acid ($CHCl_2COOH$) and trichloroacetic acid (CCl_3COOH), rather than monochloroacetic acid, are the principal haloacetic acids formed during chlorination of waters containing low amounts of bromide (Br^-). *See also* dichloroacetic acid; disinfection by-product; haloacetic acid; trichloroacetic acid.

monochlorobenzene (C_6H_5Cl) A volatile organic chemical with various industrial uses, including use as a solvent. It is also referred to as chlorobenzene. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.10 milligrams per liter. *See also* chlorobenzene; solvent; volatile organic compound.

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monochromatic (1) Having or consisting of a single color or hue. (2) In ultraviolet (UV) processes, light output at only one wavelength. For example, because low-pressure and low-pressure high-output UV lamps only significantly emit light at 254 nanometers, they are considered monochromatic UV light sources. *See also* low-pressure high-output ultraviolet lamp; low-pressure ultraviolet lamp.

monochromatic ultraviolet lamp An ultraviolet lamp that emits energy at only one wavelength. *See* monochromatic.

monochromator A device for isolating monochromatic or narrow bands of radiant energy, such as light, from the source. A monochromator is often used in chemical analysis.

monoclinal spring A contact spring occurring at the surface contact of a monoclinal formation. The water is derived from a pervious water-bearing stratum with a less pervious stratum underneath.

monoclonal antibody An antibody that is specific for a single antigenic determinant.

monocyte A leukocyte (white blood cell) that contains a single nucleus and is phagocytic (i.e., it will engulf foreign material).

Monod equation A mathematical expression first used by J. Monod in describing the relationship between the microbial growth rate and the concentration of a growth-limiting substrate. The relationship is expressed as

$$\mu = \mu_{max}\frac{S}{K_s + S}$$

Where:

μ = the microbial growth rate, in milligrams per liter per hour

S = the concentration of potentially limiting nutrient, in milligrams per liter

μ_{max} = the value of μ when the given nutrient is not limiting, in milligrams per liter per hour

K_s = the concentration of the given nutrient when $\mu = 0.5\mu_{max}$, in milligrams per liter

See also Michaelis–Menten equation.

monofilament A single synthetic fiber of continuous length, used in weaving filter cloths.

monofill An ultimate disposal technique for water treatment plant sludge in which the sludge is applied to a landfill dedicated to sludge disposal only (i.e., the landfill does not include municipal solid waste). The monofill is often lined to collect any leachate from the water treatment plant sludge for further processing. When filled, the monofill is "closed" by covering and seeding, as with a typical landfill closure.

monohalogen-substituted acetic acid (MXAA) Acetic acid with one halogen atom substituted for a hydrogen atom. *See also* disinfection by-product; haloacetic acid.

monomedia filtration A method of filtration in which particles are removed with a single media type. Monomedia filters are often deeper than conventional filters, up to 6 feet (1.8 meters), and use large-diameter media (from 1.2 to more than 1.8 millimeters in effective size) to reduce head loss. The deeper monomedia can provide additional storage for collected particles. Often used with ozone, monomedia configurations use anthracite or granular activated carbon as a result of their larger particle size compared to sand. *See also* effective size; granular media.

monomedium A filter media of a single particle type and size.

monomer A molecule of low molecular weight capable of reacting with identical or different monomers to form polymers.

monomictic Pertaining to a lake having a single period of free circulation or overturn per year, with consequent disruption of the thermocline. The lake may be either cold monomictic or warm monomictic.

mononuclear phagocyte *See* monocyte.

monosaccharide *See* algal polysaccharide.

monotrichous Having one flagellum at only one pole or end, as with certain bacteria.

monovalent *See* univalent.

monovalent ion An ion having a valence charge of 1. The charge can be either positive or negative, e.g., Na^+ or Cl^-.

monsoon A wind blowing with great persistence regularly at a definite season of the year and influenced by seasonal temperature contrasts between land and water masses.

Monte Carlo analysis A method of statistical analysis that involves selecting sample data in proportion to their true or estimated probability of occurrence through a random number generator and using that sample as input to some process (i.e., model) in order to estimate the probability of a particular output from the process. Although Monte Carlo analysis can be applied to a single variable, it is more commonly used to define the attributes of joint probability distributions and multivariate probability distributions. For example, one might wish to define the probability distribution (density function) of total water demand 20 years in the future as it is derived from a functional relationship of population forecasts, current and planned conservation programs, planned changes in water prices, and historical water use per capita. With estimated or known probability distributions for each of these input variables and an

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equation that links the separate input variables to total water demand, Monte Carlo software programs are available that combine the effects of the separate probability distributions into a single probability distribution around the forecast of water demand. This procedure is accomplished by taking hundreds (or thousands) of iterations of sample selections from each of the input variables and then combining them through the functional relationship until a combined distribution takes shape for the projected variable.

monthly flood The maximum flow occurring in a stream during a calendar month.

monthly user charges The charges made to the users of water service through the general water rate structures of the utility to pay for the utility's share of the cost of servicing the water service requirements.

Moody diagram A graphical representation of the relationship among the friction factor, Reynolds number, pipe roughness, and pipe size in pipe flow. The friction factor can be obtained if the other factors are known; this factor is used in the Darcy–Weisbach equation to calculate the head loss in pipe flow. *See also* Darcy–Weisbach formula.

moraine An accumulation of earth, usually with stones, carried and then finally deposited by a glacier.

Moraxella Aerobic, gram-negative cocci of the family Neisseriaceae that are oxidase- and catalase-positive and do not use glucose. *Moraxella* are constituents of the normal floral and commensal organisms in the upper respiratory tract but may also be isolated from the skin or genitourinary tract.

morbidity rate A measure of both the incidence and prevalence of disease. Use of this term should be avoided. The rate expresses the proportion of a population who are ill with a certain disease in a given period of time. However, one will not necessarily know whether the morbidity includes newly diagnosed cases of disease or all cases diagnosed during the time period. Another disadvantage is that the rate does not take into account such population characteristics as age, race, or gender. Unless standardized, morbidity rates should not be used to compare geographic areas or time periods. *See also* crude rate; incidence; incidence rate; prevalence; prevalence rate; rate difference; rate ratio; standardized mortality rate; standardized rate.

morbidity ratio The proportion of all infections that result in illness.

morning-glory spillway *See* glory-hole spillway.

morphology The biological study of the form and structure of living organisms; the structure and form of an organism, excluding its functions.

Morrill index The ratio of the time in which 90 percent of a unit volume of liquid passes through a tank to the time in which 10 percent of that unit volume passes through, t_{90}/t_{10}. *See also* dispersion index.

mortality A fatal outcome, death.

mortality rate A rate expressing the proportion of a population who die of a specific disease or of all causes during a stated period of time, usually a year. *See also* death rate.

mortgage bond A bond secured by a mortgage against specified properties of an equity, usually its public utilities or other enterprises. If such bonds are primarily payable from enterprise revenues, they are also called revenue bonds.

MOS *See* margin of safety; metal oxide semiconductor.

most advantageous section The cross section of a conduit of such shape and dimensions as to have the smallest wetted perimeter for a given area of cross section.

most probable number (MPN) An estimate of the density of microorganisms in a sample based on certain statistical formulas that are included in *Standard Methods for the Examination of Water and Wastewater* (APHA et al., 2005). Tables of most probable number values for combinations of positive and negative results obtained from the examination of multiple-portion decimal dilution sample aliquots in multiple-tube fermentation procedures are used to interpret the most probable number and the 95 percent confidence limits of a sample. The most probable number is commonly used to estimate the density of coliform bacteria in a water sample. *See also* multiple-tube fermentation test.

mother liquor (1) A residual brine, containing chiefly calcium and magnesium chlorides, obtained after the salt has been crystallized and removed from solution. This term is widely used when salt is produced by use of vacuum pan and gainer operations. In the solar salt evaporation process, the term *bittern* is often used instead. (2) A solution substantially freed from undissolved matter by a solid–liquid separation process, such as filtration or decanting.

motile Capable of self-propelled movement. This term is sometimes used to distinguish between certain types of organisms found in water.

Motility Indole Ornithine (MIO) Medium A medium used for identification of organisms on the basis of motility, ornithine decarboxylase activity, and indole production.

motor Any electromechanical device for converting electrical energy into mechanical energy. *See also* engine.

motor efficiency The ratio of power delivered by a motor to the power supplied to it during a fixed period or cycle. Electric motor efficiency ratings vary among manufacturers, usually in the range 88.9 to 90.0 percent.

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motor horsepower The horsepower equivalent of the electric power supplied to a motor. *See also* brake horsepower; water horsepower.

MotorMaster Program A software program, available free of charge from the US Department of Energy, which provides energy-efficient motor management and selection tools.

motor performance The efficiency of a drive mechanism as determined by comparing the energy required to drive the unit with the output of the unit. It is normally expressed as a percentage.

motor starter A specially designed switch assembly used to connect and disconnect electrical power from motors. Motor starters may be either manually or electrically operated. If they also contain current-limiting devices (fuses or circuit breakers), they are referred to as combination motor starters.

motor-starting current *See* locked-rotor current.

mottled Spotted or blotched. Teeth can become mottled if excessive amounts of fluoride are consumed during the years of teeth formation.

mottled tooth enamel Tooth enamel that has become discolored because of any of a variety of nutritional disorders and developmental defects. In connection with drinking water, the most common source of mottled tooth enamel is dental fluorosis, whereby excessive fluoride intake results in hypomineralization of the teeth. Mineralization of the tooth structure occurs because removal of the matrix proteins appears to be blocked by excessive fluoride. Thus, the period of a person's highest susceptibility to excessive fluoride is in the early maturation (childhood) stages.

mottling The staining of teeth caused by excessive amounts of fluoride in the water.

MOU *See* memorandum of understanding.

mound spring *See* knoll spring.

mouth (1) The exit or point of discharge of a stream into another stream, a lake, or the sea. (2) An opening resembling or likened to a mouth, such as an entrance or exit. (3) The end of a shaft, adit (horizontal mine), drift, entry, or tunnel emerging at the surface. (4) Part of an animal's body where food and liquid intake occurs.

movable bed (1) A streambed made up of materials readily transportable by the stream flow. (2) A bed made up of materials readily movable under the hydraulic conditions established in a tank or chamber.

movable weir (1) A temporary weir that can be removed from the river channel in times of flood. (2) The adjustable weir at the end of a sedimentation tank. *See also* overflow weir.

moving average disaggregation model (MADM) A conceptual model for use in disaggregating weekly water demands into daily values in which the demand for a particular day is assumed to be equal to a forecasted weekly demand multiplied by the percentage of weekly demand observed for the same day in the previous week.

moving average method A method of obtaining effective dose estimates that minimizes the number of animals used. It involves first range finding by administering the compound in relatively few animals and then moving up or down the dose scale depending on whether a positive or negative response was obtained. For example, in a lethal dose 50 determination, the dose given to a second group of animals would be increased if all animals survived when the first group was treated. On the other hand, if all the animals died, a single animal or a small group would be administered a second lower dose. Once the critical range is identified, more animals could be tested at additional doses spaced appropriately within that range. The number of animals finally employed would depend on how accurate an estimate of the effective dose is necessary. This procedure avoids the possibility that all doses were uniformly lethal or nonlethal in a larger experiment with a fixed number of animals. The statistical method applied to these data as they are developed is called Thompson's moving average interpolation.

moving bed A unique application of granular activated carbon in which a single activated carbon column can approach the efficiency of several columns in series. This is accomplished by the removal of spent activated carbon from one end of the granular activated carbon bed and the addition of fresh granular activated carbon at the other end with little or no interruption in the process.

moving vane A curved surface that moves in a given direction under the dynamic pressure exerted by an impinging jet or stream.

MPA *See* microscopic particulate analysis.

MPC *See* maximum permissible concentration.

mph *See* miles per hour *in the Units of Measure section.*

MPN *See* most probable number.

MPR *See* maximum pumping rate.

MP ultraviolet lamp *See* medium-pressure ultraviolet lamp.

mpy *See* mils per year *in the Units of Measure section.*

M/R *See* monitoring and reporting.

MRAA *See* maximum running annual average.

MRDL *See* maximum residual disinfectant level.

MRDLG *See* maximum residual disinfectant level goal.

mrem *See* millirem *in the Units of Measure section.*

MRL *See* minimum reporting level.

mRNA *See* messenger ribonucleic acid.

MS *See* mass spectrometer.

MS2 coliphage A ribonucleic acid virus that can replicate only within its bacterial host, *Escherichia coli.*

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MSADM *See* mean seasonal average disaggregation model.

MSC *See* medium-specific concentration.

MSDS *See* material safety data sheet.

MSF distillation *See* multistage flash distillation.

MSL *See* mean sea level.

M. spicatum (Myriophyllum spicatum) *See under* milfoil.

MS–MS *See* mass spectrometer–mass spectrometer.

m T7 medium A type of selective culture medium used for detecting and recovering injured coliform bacteria from treated water, disinfected water, or both. *See also* coliform bacteria.

MTBE *See* methyl-*tert*-butyl-ether.

MTC *See* mass transfer coefficient.

MTD *See* maximally tolerated dose.

MTF test *See* multiple-tube fermentation test.

MTP *See* maximum trihalomethane potential.

MTZ *See* mass transfer zone.

µ (mu) *See* micro *in the Units of Measure section;* micron *in the Units of Measure section.*

muck soil Organic soil derived from the decomposition of peat and containing 20 percent or more mineral material. *See also* peat soil.

mucoid Any of a group of organic compounds similar to the mucins or mucoproteins, descriptive of a bacterial colony that is very sticky or stringy.

mucopolysaccharide A structural component of bacterial cell walls. It is also called cell wall mucopolysaccharide, peptidoglycan, or murein. It is made up of N-acetylglucosamine and N-acetylmuramic acid, with a pentapeptide attached to each molecule of N-acetylmuramic acid. Bridges of amino acids cross-connect the pentapeptides, and each component of the entire cell wall structure is cross-linked by covalent bonds.

mucosal Referring to the mucus-secreting membrane that lines all body cavities that open to the outside.

MUD *See* municipal utility district.

mudball (1) A clump of granular media that stuck together during backwashing of a rapid granular filter, often caused by uneven distribution of backwash water. Because of their size—from that of a pea up to 1 or 2 inches (2.5 to 5 centimeters) or more in diameter—they sink during backwashing and become very difficult to remove. Surface wash or air wash is usually effective in preventing their formation. (2) A ball of sediment sometimes found in debris-laden flow and channel deposits.

mudball formation The formation of gelatinous, pseudo-spherical solids of varying diameter in filter media. Mudballs are often formed as a result of poor filter washing, absent or ineffective surface washing, or overdosing of polymeric filter aids. Mudballs must be removed to restore filter efficiency.

mud blanket A layer of flocculent material that forms on the surface of a slow granular filter. *See also* schmutzdecke.

mud cake A thin film of drilling fluid that forms on the wall of a borehole during drilling. It is similar to a filter cake. The development of a mud cake is usually a desirable phenomenon during the drilling of water wells. The mud cake is removed when the well is developed for water production.

mudleg A deliberately constructed low spot in instrument piping for collection of debris and sediment.

mud pot A hot spring of limited water flow in which the hot water mixes with clay and undissolved particles, forming a muddy suspension at the spring location.

mud valve A plug valve for draining out sediment, inserted in the bottom of a settling tank.

muff Fashioned after ear-muffs, muffs protect the wearer from excessive noise levels that could damage a person's hearing. Muffs are assigned different ratings to indicate the levels of noise for which they provide effective protection.

muffle furnace A high-temperature oven used to ignite and burn volatile solids. A muffle furnace is usually operated at temperatures near 1,112° Fahrenheit (600° Celsius).

MUG *See* 4-methylumbelliferyl-β-D-glucuronide.

µg *See* microgram *in the Units of Measure section.*

µg/L *See* micrograms per liter *in the Units of Measure section.*

mulch Any substance spread or allowed to remain on the soil surface to conserve soil moisture and shield soil particles from the erosive forces of raindrops and runoff.

multiattribute utility analysis A formal decision analysis technique that incorporates consideration of nonmonetary and monetary effects within a single analytical framework, wherein the relative importance of strategic goals is articulated, performance metrics relative to each goal are established, and total benefits associated with individual investments are estimated based on the established goals and performance metrics.

multicollinearity In multiple regression analysis, a condition present when two (or more) independent variables being analyzed to explain the outcomes of a dependent variable are highly correlated with each other. The result is that neither of the coefficients for the independent variables properly measures the independent variable's real causal impact on the dependent variable. The coefficients are said to be biased, leading to incorrect inferences. For example, in a time series forecasting regression model, rainfall and

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temperature are sometimes highly correlated with each other ($r > 0.8$). When this occurs and both variables are kept in the model, both variables will provide softened measures of their impact on water use. The weaker variable should be omitted or seasonal application of the variables (temperature in summer months, rainfall in winter months) might prove to be without significant multicollinearity.

multicomponent system An engineering system designed to have several components that function together to form the desired end product.

multieffect distillation *See* multiple-effect distillation.

multifilament A number of continuous fiber strands twisted together to form a yarn. Multifilaments are used in weaving filter cloths.

multifunctional medium A single filter or ion-exchange medium used to treat water for the removal of more than one constituent. Examples are activated carbon for chlorine removal and sediment filtration, calcite for pH modification and filtering of precipitated iron, or cation resin for reduction of dissolved iron (Fe^{2+}) and hardness removal.

multigas monitor A device used to monitor for explosive, toxic, and oxygen-deficient atmospheres. Some monitors can measure specific gases, such as chlorine.

multigeneration study An experiment to determine whether a chemical produces teratogenic or developmental toxicities beyond a single generation. The major concern addressed in these studies is whether a recessive mutation might be produced that would not be detected within the first set of offspring. In general, these studies are limited to two generations, primarily for economic rather than scientific reasons.

multihit model A model used to describe the risk from cancer based on age-specific hazard rates. Multihit models have been developed that allow carcinogenic risks to be calculated at lower doses based on the assumption that the chemical more or less nonspecifically affects a number of events within one or more stages of carcinogenesis. It makes the assumption that the "hits" (interactions of a carcinogen with a cell) fit a Poisson distribution. A multihit model is generally regarded as more restrictive than a multistage model in that it does not account well for dose–response relationships that are linear at low doses but curve upward at higher doses. *See also* beta-Poisson model; linearized multistage model; log-probit model; logit model; multistage model; one-hit model; Poisson distribution; probit model; Weibull–Gamma model; Weibull model.

multijet meter A current meter for which the velocity of the water passing through the meter causes a turbine wheel to rotate, providing a volume measurement.

multilayered bed A media bed in which more than one filter or ion-exchange medium is used in the same vessel, with each medium retaining its stratified position as a layer—even after specified backwashing is performed—because of differences in media densities.

multilevel intake A hydraulic structure by which water may be drawn into or through a dam from various levels at which intake works have been constructed. *See also* intake structure.

multilocus enzyme electrophoresis A laboratory technique for comparing the mobility of enzymes found in isolates of organisms as a means of subtyping the organisms. This technique has been used in epidemiologic studies of many bacterial and fungal diseases. *See also* subtyping.

multimedia filter A filtration device designed to use three or more different types of filter media. The media types usually used are silica sand, anthracite, and garnet sand. This type of filter can sometimes be operated at flow rates higher than 2 gallons per minute per square foot (5 meters per hour).

multimedia filtration *See* depth filtration.

multimedia mitigation (MMM) Actions taken to lower radon concentrations in indoor air by home remediation using technology that removes radon directly from indoor air, rather than indirectly by drinking water treatment. Under the US Environmental Protection Agency's proposed radon rule, primacy agencies that have an MMM program may allow water systems to meet an alternative maximum contaminant level (AMCL) for radon of 4,000 picocuries per liter.

multiobjective ratemaking Establishing water rates that meet several of the (sometimes conflicting) standard objectives for ratemaking: stable revenues, equity, affordability, promotion of water use efficiency, simplicity, and legal issues.

multiple-address radio system (MARS) A radio system in which a master radio communicates to a number of remote sites within a specified area of operation.

multiple-arch dam A buttress dam composed of series of inclined arches supported by buttresses or piers. The load is transferred from the arches to the foundation through the buttresses.

multiple-barrier approach The concept of using more than one type of protection or treatment in series in a water treatment process to control contamination and provide overall process reliability, redundancy, and performance. For example, to ensure the safety of drinking water, multiple barriers may include wastewater collection and treatment, protection of water sources, adequate treatment (including disinfection), adequate maintenance, the protection of water quality

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during storage and distribution, aggressive management, and adequate utility personnel training.

multiple correlation *See* multiple linear regression analysis.

multiple data management and acquisition system The acquiring of data from multiple sources including a computer maintenance management system (CMMS), supervisory control and data acquisition of real-time data (SCADA), and a laboratory information management system (LIMS). Once the data have been integrated, they can be displayed for operational use in a water treatment facility.

multiple-dome dam A buttress dam in which massive buttresses spaced far apart support a set or series of domes, arched horizontally and longitudinally, on which the water rests. The Coolidge Dam in Arizona is a multiple-dome dam.

multiple dosing tanks Two or more dosing tanks of equal capacity, each equipped with a dosing device to provide a capability for alternative dosing or rotation of the tanks. *See also* dosing tank.

multiple-effect distillation (MED) A desalting process in which heated saline water is fed as a thin film on one side of steam-heated tubes in one vessel, causing a portion of the water to vaporize. The hot vapors are introduced on the opposite side of tubes in the following vessel. As the vapors condense to form distillate (product water) in this following vessel, heat is released, aiding in vaporization of saline water on the other side of the tubes in that vessel. The process commonly uses four to eight vessels (effects) operating at successively lower pressures to lower the required boiling temperature point of the saline water.

multiple-effect evaporator A series of single-effect evaporators connected so that the vapor from one effect is the heating medium for the next.

multiple-hearth furnace A furnace consisting of several vertically stacked hearths used for regenerating granular activated carbon (GAC). Dewatered, exhausted GAC is fed into the top hearth and is dried by hot gases. The GAC gradually moves downward through the various hearths until it has been regenerated. This process is carried out in an oxygen-free environment to prevent combustion of the GAC. *See also* regeneration.

multiple-hearth incinerator *See* multiple-hearth furnace.

multiple linear regression analysis A statistical technique that relates one dependent variable with one or more independent variables. The dependent variable depends on or is explained by the independent variables. Multiple linear regression analysis is often referred to as least squares analysis (or something similar) because it mathematically solves for the linear relationship (regression line) between two or more variables that minimizes the sum of the squared deviations of each observation from the regression line. For example, the effect on seasonal runoff (a dependent variable) of such independent variables as antecedent precipitation, groundwater conditions, temperature, and snow depth may be determined through multiple linear regression analysis. The method calculates coefficients (slopes) that define the relationship between the dependent variable and each independent variable. The form of the relationship is typically

$$Y = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n + e$$

Where:

a = an intercept or constant

x_i = the value of the independent variable for the ith period

b_i = the coefficient that defines the relationship between the dependent variable and the ith independent variable

e = the residual or unexplained variation

Various measures are used to define the goodness of fit of the regression equation. *See also* coefficient of determination; *F*-ratio; regression analysis; standard error of the estimate; t-test.

multiple regression analysis *See* multiple linear regression analysis.

multiple sampler An instrument used for the simultaneous collection of several water-suspended sediment samples of equal or different volumes at each site.

multiple start times The presence of more than one irrigation cycle for a circuit in a given day. Some irrigation controllers can accept programming to allow this feature.

multiple-tray clarifier A clarifier consisting of a series of trays set one above the other to enhance the collection of suspended solids. It is sometimes equipped with individual sludge scrapers.

multiple-tube fermentation (MTF) *See* multiple-tube fermentation test.

multiple-tube fermentation (MTF) technique *See* multiple-tube fermentation test.

multiple-tube fermentation (MTF) test A microbiological test for estimating the density of bacteria in a sample. Although total coliform bacteria are often the target organisms, the test can be used to detect other bacteria if an appropriate culture medium is used. The test can be used with soil, water, or food samples. It uses a series of tubes (commonly three banks of 5 or 10 tubes each) of liquid culture medium (lactose or other sugar). Each tube receives an inoculum of sample, either as a multiple of 1 milliliter, or as a decimal dilution of the original sample. Following

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incubation for an appropriate length of time at an appropriate temperature, the tubes are examined for growth, usually indicated by a turbidity increase, a color change in the medium, a production of gas, or another easily observed characteristic. The combination of positive and negative tubes gives a most probable number, as well as a 95 percent confidence interval of the estimate when a table of most probable number values is consulted. *See also* most probable number.

multiple use Use of any resource for more than one purpose. Multiple land use could include grazing of livestock, wildlife production, recreation, watershed, and timber production, whereas a multiple-use reservoir could allow for recreational purposes, fishing, and water supply.

multiple-use reservoir *See* multipurpose reservoir.

multiplexed light scattering A way of organizing several detectors around a sample to simultaneously measure scattered light at different angles. The signals are combined, or multiplexed, at a main detector for data processing to characterize the sample.

multiplexor A device that splits a high-speed communication line into multiple channels supporting multiple devices and recombines multiple channels into a single high-speed channel. Multiplexors maximize the efficiency of a communication line by allowing multiple users to communicate on a single high-speed line.

multiplicity of infection (MOI) The average number of viruses or phage particles that can infect each bacterial cell.

multiplier A number noted on the meter face, such as 10× or 100×. The change in readings from a meter at different times must be multiplied by that number to provide the correct volume of water that passed through the meter in the period between readings.

multiport valve A master control valve used in a filter, deionizer, or water softener to control all the necessary steps in the regeneration process or the backwashing and rinsedown of filters.

multipurpose cadastre An integrated land information system containing legal information (e.g., property ownership or cadastre), physical information (e.g., topography, artificial features), and cultural information (e.g., land use, demographics) in a common and accurate reference framework. The reference framework is typically established with rigorous geodetic and survey control standards, such as the state plane and latitude–longitude coordinate systems. *See also* cadastre.

multipurpose reservoir A reservoir constructed and equipped to provide storage and release of water for two or more purposes, such as flood control, power development, navigation, irrigation, pollution abatement, and domestic water supply.

multipurpose riparian corridor A narrow tract of wetland, immediately adjacent to a river or creek, that provides a variety of functions and uses.

multistage Having more than one stage, as in a multistage pump having more than one pumping impeller.

multistage filtration The use of two or more stages of filtration to improve the efficiency of particle removal. In multistage filtration, a high-rate roughing filter is used in the first stage to remove large particles and reduce particle loading on subsequent filters. The subsequent filters are then used to provide a system with a very high particle removal efficiency.

multistage flash (MSF) distillation A desalting process in which a portion of heated saline water is vaporized (flashed) and condensed in each of several vessels (stages) to form distilled product water. Incoming saline water is heated by a steam heater and thereafter by condensing distillate in each following vessel. The process commonly uses 20 to 40 stages operating at successively lower pressures to lower the required boiling temperature point of the saline water.

multistage model The default (standard) methodology used by the US Environmental Protection Agency for estimating the probability of cancer produced by a chemical at low doses. This model was derived from the Armitage–Doll model, which assumes that cancer develops through a finite number of stages. Progression between stages is assumed to be rare but irreversible. Generally, the stages are produced by mutations in deoxyribonucleic acid sequences that participate in the control of the cell cycle. The transition rate between stages can be variable and can be directly or indirectly affected by the chemical. Some components of the response can also arise spontaneously. However, data are not generally available to estimate potential differential effects on various stages, nor are the mechanisms by which such effects are produced for particular chemicals understood. Therefore, the default methodology usually involves using an estimate of the upper 95 percent bound of some low level of risk based on data obtained from standardized bioassays of the chemical at high doses in experimental animals. *See also* linearized multistage model; log-probit model; logit model; multihit model; one-hit model; probit model; Weibull model.

multistage pump A pump that has more than one impeller. (A single-stage pump has only one impeller.)

multivalent (1) Polyvalent, having a chemical valence usually greater than 2. (2) Represented more than twice in the somatic chromosome number. (3) Having many values, meanings, or appeals. *See also* valence.

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multivariate analysis (1) In statistics, any analysis that allows the simultaneous study of two or more dependent variables. (2) In epidemiology, a technique for simultaneous study of the variation in several characteristics, events, or phenomena. Because independent variables are most frequently studied in epidemiology, the term *multiple-variable analysis* has been suggested as being more appropriate than *multivariate analysis. See also* regression analysis.

µM *See* micromolar *in the Units of Measure section.*

µm *See* micrometer *in the Units of Measure section.*

µmol *See* micromole *in the Units of Measure section.*

municipal contract operation Provision of services (e.g., water supply) by contractors, though the municipality retains ownership of all physical facilities.

municipal devolution Government restructuring leading to decentralization of authority and reduction of available funds.

municipal infrastructure planning and cost model (MIPCOM) A model that allows a planner to estimate a municipality's cost of services of a new development. Using this model, municipal officials, planners, engineers, and others can estimate the municipal infrastructure quantities associated with alternative community development scenarios. Important infrastructure quantity and cost issues can be addressed side by side with those of community size, complexion, and configuration. The end result is a more-informed decision based on the true costs of growth.

municipal sewage *See* municipal wastewater.

municipal softening A hardness reduction process performed at municipal central treatment plants. *See also* ion exchange; lime softening; lime–soda ash softening.

municipal utility district (MUD) A special entity authorized by a state government to provide water service, wastewater service, or both to a designated area. The district may authorize bonds to finance the water supply and water facility systems, with repayment from revenue received for the service provided.

municipal wastewater Wastes (mostly liquid) originating from a community; may be composed of domestic wastewaters and/or industrial wastewaters.

municipal water Water that is processed at a central plant to make it potable and then distributed to homes and businesses via water mains. Either public agencies or private companies can be involved in providing municipal water. This general term refers to the common source of water in most urban and suburban areas, as opposed to water obtained from separate proprietary sources such as private wells.

muriatic acid (HCl) Another name for hydrochloric acid.

µS *See* microsiemens *in the Units of Measure section.*

mushroom valve A valve consisting of a flat disk that raises and lowers without rotation about the valve opening. It is kept in position and on its path of travel by a rod or shaft attached to the disk at right angles to it and extending through the valve opening into a groove or hole that guides its movement. A mushroom valve is also called a poppet valve.

muskeg A bog, usually a sphagnum bog, frequently covered with grassy tussocks, growing in wet, poorly drained boreal (northern) regions, often in areas of permafrost. *See also* bog.

mustard agent *See* sulfur mustard.

mustard gas *See* sulfur mustard.

mutagen A material that induces genetic change. *See also* carcinogen; teratogen.

mutagenesis The process of producing a change in the base sequence of deoxyribonucleic acid (DNA) in a cell that is capable of reproducing in the organism. Somatic (i.e., nongerm cell) mutations can also occur, but these are not inheritable. Such mutations can, however, lead to chronic diseases such as cancer. A wide variety of tests are available to determine whether a chemical or one of its metabolites is capable of inducing a DNA change that can be passed on to the progeny of the affected cell. The most commonly applied assays are designed to detect point mutations (e.g., the Ames test, also called the *Salmonella*/microsome assay). Evaluating other genetic end points is also important, however, particularly clastogenic effects (e.g., breaks in chromosomes, changes in chromosome numbers, transfers of parts of chromosomes to one another). The basic mechanisms involved in these effects are potentially quite different, so conducting both types of tests is important in evaluating genotoxic effects. *See also* Ames test; codon; forward mutation; frame-shift mutation; genotoxic; germ cell; point mutation; reverse mutation.

mutagenic *See* mutagenesis.

mutagenic carcinogen A chemical or substance that causes cancer by causing permanent genetic changes in exposed cells.

mutagenicity *See* mutagenesis.

mutation An abrupt change in the genotype of an organism, not resulting from recombination. In a mutation, the base sequence of a nucleic acid molecule may undergo qualitative and quantitative alteration or rearrangement. *See also* mutagenesis.

mutual aid plan An important part of emergency preparedness that coordinates assistance from other utilities, contractors, and organizations to come to each other's aid during disasters or emergencies.

mutualism A necessary and beneficial interaction between two organisms living in the same environment.

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mutual water company A cooperative association that is organized to develop and distribute water and that is owned and operated by those receiving water from it.

µW *See* microwatt *in the Units of Measure section.*

MW *See* molecular weight.

MWCO *See* molecular weight cutoff.

MX *See* 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone.

MXAA *See* monohalogen-substituted acetic acid.

Mycobacterium A bacterial genus having members characterized as predominantly unicellular, unbranched or branched rods with high lipid content (20–40 percent). These bacteria are often termed acid-fast bacteria because they do not decolorize when rinsed with an acid–alcohol solution in the Gram stain procedure; therefore, their Gram reaction cannot be determined. Based on modern fatty acid analysis technique, however, these organisms have been shown to be gram-negative. The genus *Mycobacterium* includes species that are pathogens for warm-blooded animals and cold-blooded animals.

***Mycobacterium avium* complex (MAC)** A group of mycobacteria including *Mycobacterium avium* and *Mycobacterium intracellulare* that are acid-fast, rod-shaped bacteria 0.2–0.6 × 1.0–10.0 micrometers in size. *Mycobacteria* are aerobic, nonspore-forming, nonmotile bacilli. Members of the MAC are opportunistic human pathogens that can cause many symptoms throughout the body. *See also Mycobacterium.*

***Mycobacterium avium intracellulare* (MAI) complex** *See Mycobacterium avium* complex.

mycoplasmas Unusual bacteria that are smaller than ordinary bacteria (0.15–0.30 micrometers in size) and are the only prokaryotes that lack a cell wall and contain sterols. *See also* atypical bacteria.

mycotoxin A chemical substance produced by a fungus and having various adverse health effects. Most commonly, these toxins pose problems to humans when fungi are allowed to contaminate stored foods. The most widely recognized mycotoxins are the aflatoxins produced by *Aspergillus flavus* contamination of peanuts. *See also* aflatoxin.

Myer's flood scale A method of expressing the size of a flood (in cubic feet per second) as a numerical percentage of the hypothetical flood given by the product of the square root of the drainage area in square miles and the number 100. The numerical percentage rating is the value on Myer's flood scale.

myocarditis An inflammatory condition of the heart muscle (myocardium).

myositis Inflammation of a voluntary muscle; seen in trichinosis or *Sarcocystis* infections.

Myriophyllum spicatum *See* milfoil.

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N

N *See* normal; normality.

N *See* newton *in the Units of Measure section.*

n *See* nano *in the Units of Measure section.*

n *See* bromine incorporation factor for trihalomethanes.

***n*'(*x*/*y*)** *See* bromine incorporation factor for haloacetic acids.

N,N-diethyl-p-phenylenediamine (DPD) *See under* diethyl-p-phenylenediamine.

NA *See* not analyzed; not applicable; not available.

NAA *See* neutron activation analysis.

NADB *See* North American Development Bank.

NADPH–cytochrome P450 reductase *See* nicotinamide adenine dinucleotide phosphate–cytochrome P450 reductase.

NAE *See* National Academy of Engineering.

Naegleria fowleri (N. fowleri) A small free-living amoeba commonly found in soil, freshwater, wastewater, and wastewater biosolids. This organism causes an acute fulminating (rapidly occurring) disease of the central nervous system (CNS) called primary amoebic meningoencephalitis. The trophozoites of *N. fowleri* enter the body during water sport activities, make their way to the CNS, and cause an acute hemorraghic necrosis leading to destruction of the cerebral cortex. The disease is almost always fatal.

nameplate A durable metal plate found on equipment that lists critical installation information, operating conditions, and the serial number for the equipment.

nano (n) *See in the Units of Measure section.*

nanofiltration (NF) A pressure-driven membrane separation process that generally removes substances in the nanometer size range. Its separation capability is controlled by the diffusion rate of solutes through a membrane barrier and by sieving and is dependent on the membrane type. In potable water treatment, nanofiltration is typically used to remove nonvolatile organics larger than the 200–500 dalton molecular weight cutoff (e.g., natural and synthetic organics, color, disinfection by-product precursors) and multivalent inorganics (for softening). *See also* membrane; pressure-driven membrane.

nanometer (nm) *See in the Units of Measure section.*

nanoparticle A small, stable particle that consists of only a few atoms and measures less than 100 nanometers in diameter.

NAPL *See* nonaqueous phase liquid.

nappe The sheet or curtain of water overflowing a weir or dam. When freely overflowing any given structure, it has a well-defined upper and lower surface.

napthalene ($C_{10}H_8$) A synthetic organic chemical used as a moth repellent and fungicide, as well as in various industrial applications. *See also* fungicide; synthetic organic chemical.

narrow-base terrace A terrace similar to a broad-base terrace in all respects except the width of ridge and channel. The base width of a narrow terrace is usually 4 to 8 feet (1.2 to 2.4 meters). *See also* broad-base terrace.

narrows (1) A contracted part of a stream, lake, or sea. (2) A strait connecting two bodies of water. *See also* water gap.

NARUC *See* National Association of Regulatory Utility Commissioners.

NAS *See* National Academy of Sciences.

National Academies Name given to the collective group of private nonprofit advisory groups made up of the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, and the National Research Council.

National Academy of Engineering (NAE) A private organization in Washington, D.C., whose members are elected in recognition of their distinguished and continuing contributions to engineering. Along with the National Academy of Sciences and the Institute of Medicine, the National Academy of Engineering advises the federal government through the National Research Council, promotes understanding of the role engineering plays in technological fields, sponsors programs aimed at meeting national needs in the field, and encourages research. *See also* National Academies.

National Academy of Sciences (NAS) A private, nonprofit organization in Washington, D.C., whose members are elected in recognition of their distinguished contributions to science. The National Academy of Sciences was established by a congressional charter in 1863 to be the official adviser to any branch of the federal government on scientific and technological issues pertaining to public policy. Most of the science policy and technical work performed by NAS is carried out by its operational arm, the National Research Council. The National Academy of Sciences, with the National Academy of Engineering, the Institute of Medicine, and the National Research Council are collectively referred to as the National Academies. *See also* National Academies.

National Association of Regulatory Utility Commissioners (NARUC) A professional organization of state and federal regulatory commissioners

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headquartered in Washington, D.C., and having jurisdiction over transportation companies and public utilities.

National Association of Water Companies (NAWC) The association representing investor-owned and investor-operated water companies.

National Cancer Institute (NCI) One of the National Institutes of Health (NIH), the stated mission of which is to "lead a national effort to reduce the burden of cancer morbidity and mortality and ultimately to prevent the disease. Through basic and clinical biomedical research and training, NCI conducts and supports programs to understand the causes of cancer; prevent, detect, diagnose, treat, and control cancer; and disseminate information to the practitioner, patient, and public."

National Center for Environmental Assessment (NCEA) The US Environmental Protection Agency's national resource center for human health and ecological risk assessment. NCEA conducts risk assessments, carries out research to improve the state of the science of risk assessment, and provides guidance and support to risk assessors.

National Center for Environmental Research (NCER) The office within the US Environmental Protection Agency's (USEPA) Office of Research and Development responsible for dissemination of information and reports on USEPA research and for oversight of USEPA's extramural research.

National Center for Geographic Information and Analysis (NCGIA) A university research consortium dedicated to research and education in geographic information system technology. The center was established in 1988 with a grant from the National Science Foundation and is composed of research groups at the University of California at Santa Barbara, State University of New York at Buffalo, and the University of Maine at Orono.

National Centers for Water Treatment Technologies (NCWTT) Formed as a collaboration between the National Water Research Institute and the US Bureau of Reclamation to facilitate, coordinate, and integrate national research to develop and improve water supply, treatment, and reclamation applications by increasing access to and efficiently using water technology facilities.

National Committee for Digital Cartographic Data Standards A group sponsored by the federal government and composed of government, university, and industry representatives that proposed standards for the structure, content, terminology, and quality of digital cartographic data.

National Conference of State Legislatures (NCSL) A national organization of state legislatures and legislative staff, founded in 1975, that aims to improve the quality and effectiveness of state legislatures; ensure states a strong, cohesive voice in the federal decision-making process; and foster interstate communication and cooperation.

National Contaminant Occurrence Database (NCOD) A repository of information developed by the US Environmental Protection Agency (USEPA) that contains sample data for contaminants that are currently regulated and those that the USEPA may regulate. The database is linked with both the Unregulated Contaminant Monitoring program and the Drinking Water Contaminant Candidate List. *See also* Drinking Water Contaminant Candidate List; Unregulated Contaminant Monitoring program.

National Drinking Water Advisory Council (NDWAC) A 15-member council established by the 1974 Safe Drinking Water Act to advise, consult with, and make recommendations to the US Environmental Protection Agency (USEPA) administrator on matters relating to activities, functions, and policies of the agency under the act's terms. Members are appointed by the USEPA administrator; five are appointed from the general public, five from appropriate state and local agencies, and five from private organizations or groups with an active interest in water hygiene and public water supply. Meeting times and locations are announced in the *Federal Register* and usually include time for public statements.

National Drinking Water Clearinghouse (NDWC) NDWC is a public service organization (established in 1991) located at West Virginia University that collects, develops, and distributes timely drinking water-related information. Funded through the US Department of Agriculture's Rural Utilities Service, NDWC provides technical assistance to America's small and rural drinking water treatment plants and provides related educational materials to the communities they serve.

National Drinking Water Week A week in early May during which an alliance of government, nonprofit organizations, and drinking water purveyors encourages the public to celebrate the water cycle and to become involved in community activities relating to drinking water, wastewater, and other water-related environmental concerns.

National Drought Policy Act (NDPA) of 1998 Public Law 105-199, passed by Congress on July 16, 1998, establishing the National Drought Policy Commission (NDPC).

National Drought Policy Commission (NDPC) Established by the National Drought Policy Act in 1998, composed of 15 members representing all levels of government and other drought-impacted groups, and charged by Congress to provide advice

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and recommendations on the creation of an integrated, coordinated federal policy designed to prepare for and respond to serious drought emergencies. NDPC was given 18 months to complete its mission and so was dissolved after it published its recommendations in 2001.

National Electrical Code® (NEC®) A set of legally required rules designed to prevent unsafe installations of electrical systems. The National Electrical Code is developed by the National Fire Protection Association and is updated every 3 years. It is also referred to as NFPA 70.

National Electrical Manufacturers Association (NEMA) An association of companies that manufacture equipment used for the generation, transmission, distribution, control, and use of electric power. It develops product standards covering nomenclature, ratings, performance, testing, and dimensions of equipment used for electric power. It is one of the associations that participates in developing the National Electrical Code® and National Electrical Safety Code®.

National Environmental, Safety and Health Training Association (NESHTA) Formerly known as the National Environmental Training Association (NETA), a professional organization devoted to serving the environmental trainer and promoting better operation of water treatment and pollution control facilities.

National Environmental Education Foundation (NEEF) Chartered by Congress in 1990, a private nonprofit organization dedicated to advancing environmental education in its many forms. Since it was established, the foundation has become a leader in the development of new policies, grant-making approaches, and direct programming to advance environmental literacy in the United States.

National Environmental Justice Advisory Council (NEJAC) An advisory council to US Environmental Protection Agency (USEPA) that provides independent advice to the USEPA administrator on areas that may include, among other things, the direction, criteria, scope, and adequacy of the USEPA's scientific research and demonstration projects relating to environmental justice.

National Environmental Laboratory Accreditation Conference Former name of the NELAC Institute (known as TNI). *See also* NELAC Institute, the.

National Environmental Laboratory Accreditation Program (NELAP) The overall program of the NELAC Institute (TNI) that is used to assess and certify environmental laboratories. The objective of the program is to establish nationwide consistency among laboratories performing analyses for compliance with environmental regulations. *See also* NELAC Institute, the.

National Environmental Methods Index (NEMI) A database that allows comparison of analytical methods for an analyte in a variety of sample matrices. The database can be searched by analyte name, Chemical Abstracts Service number, or method number. Information includes instrumentation used, detection limits, accuracy and precision, and relative cost per analysis. NEMI was developed by the Methods and Data Comparability Board, which was chartered under the National Water Quality Monitoring Board. NEMI is funded by the US Environmental Protection Agency and the Water Resources Division of the US Geological Survey.

National Environmental Policy Act (NEPA) A federal law enacted in 1969 (42 USC Section 4321) that sets forth the goals and policies of the federal government directed at protecting and enhancing the quality of the nation's environment. Each federal agency must interpret and exercise its existing authority to achieve specified objectives for environmental preservation and enhancement.

National Environmental Services Center (NESC) Group of organizations operating out of the University of West Virginia that includes the National Small Flows Clearinghouse, the National Drinking Water Clearinghouse, the National Environmental Training Center for Small Communities, and the National Onsite Demonstration Program. NESC provides technical assistance and information about drinking water, wastewater, environmental training, and solid waste management to communities serving fewer than 10,000 individuals.

National Environmental Training Center for Small Communities (NETSC) An organization to assist small communities by providing training and training-related information and referral services in the areas of wastewater, drinking water, and solid waste.

National Fire Protection Association (NFPA) A nonprofit organization that serves as a center for information on fire protection and fire prevention. The association's more than 300 codes and standards are widely recognized by officials as the basis for laws and regulations. The association's Committee on the National Electrical Code updates the National Electrical Code® (NEC® or NFPA 70), the US standard for electrical wiring and equipment, every three years.

National Fluid Power Association (NFPA) An association located in Milwaukee, Wis., whose mission is to advance hydraulic and pneumatic motion control technology and deliver valued services to association members.

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National Geodetic Vertical Datum of 1929 (NGVD 29) A geodetic datum derived from a general adjustment of the first-order (highest accuracy) level (elevation) network of the United States and Canada. It was formerly called the Sea Level Datum of 1929.

National Geologic Map Database (NGMDB) A collection of digital data maintained and distributed by the US Geological Survey and organized based on the scale and format of the data. The database contains information on transportation, hydrography, boundaries, public land survey system, topography, land use and land cover, and geographic names. Two major types of data are produced: elevation data, distributed as digital elevation models, and planimetric and contour data, distributed as digital line graphs. The database was formerly known as the National Digital Cartographic Database (NDCDB).

National Governors Association (NGA) An organization of the governors of the 50 states, Guam, American Samoa, the Virgin Islands, the Northern Mariana Islands, and Puerto Rico, founded in 1908. The National Governors Association serves as a vehicle through which governors influence the development and implementation of national policy and apply creative leadership to state problems; it also keeps the federal establishment informed of the needs and perceptions of states, conducts research programs, and compiles statistics.

National Ground Water Association (NGWA) An association representing groundwater professionals and dedicated to the protection and proper development of groundwater. It was formerly called the National Water Well Association.

National Health and Environmental Effects Research Laboratory (NHEERL) The office within the US Environmental Protection Agency's Office of Research and Development responsible for conducting research on the relationships among human exposure to contaminants, internal dose, and health effects. It is located in Research Triangle Park, N.C.

National Historic Preservation Act (NHPA) A federal law passed in 1966 and amended in 2006 (16 USC Section 470) creating the Advisory Council on Historic Preservation to advise Congress and the President of the United States on historic preservation issues. The council is authorized to review and comment in writing on activities licensed or permitted by the federal government that may affect properties listed or eligible for listing on the National Register of Historic Places.

National Homeland Security Research Center (NHSRC) A research facility located in Cincinnati, Ohio, as part of a joint research effort by scientists at the US Environmental Protection Agency with research groups within the Department of Defense, the Department of Energy, and others to manage, coordinate, and support a variety of homeland security research and technical assistance efforts. Research focuses on developing ways to clean up contaminated buildings, protecting the nation's drinking water supply, and improve risk assessment techniques.

National Inorganics and Radionuclides Survey (NIRS) A survey conducted by the US Environmental Protection Agency in 1987 to characterize the occurrence of a variety of constituents in community groundwater supplies in the United States, its territories, and its possessions.

National Institute for Occupational Safety and Health (NIOSH) An organization formed under the Occupational Health and Safety Act in the Centers for Disease Control to study health and safety issues and recommend criteria for health and safety standards. The institute conducts research studies for which employers must submit data.

National Institute of Standards and Technology (NIST) A nonregulatory federal agency within the US Commerce Department, formerly known as the National Bureau of Standards and founded in 1901. NIST's mission is to develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life.

National Interim Primary Drinking Water Regulations (NIPDWR) The drinking water regulations set by the US Environmental Protection Agency under the 1974 Safe Drinking Water Act, based on the US Public Health Service's 1962 drinking water standards and additional health effects support that became effective in 1977.

National League of Cities (NLC) The oldest and largest national organization representing municipal governments throughout the United States. Its mission is to strengthen and promote cities as centers of opportunity, leadership, and governance. Working in partnership with the 49 state municipal leagues, the NLC serves as a resource to and an advocate for the more than 19,000 cities, villages, and towns it represents.

National Marine Fisheries Service (NMFS) The federal agency responsible for marine and coastal waters and adjacent wetlands that provide habitat, shelter, and food for marine life. The service provides consultation to the US Army Corps of Engineers during review of the Clean Water Act Section 404 permit applications that impact marine and coastal waters and adjacent wetlands.

National Oceanic and Atmospheric Administration (NOAA) An agency within the US Department of Commerce, the mission of which is to explore, map, and chart the global ocean and its living resources

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and to manage, use, and conserve those resources; to describe, monitor, and predict conditions in the atmosphere, ocean, sun, and space environment; to issue warnings against impending destructive natural events; to assess the consequences of inadvertent environmental modification over several scales of time; and to manage and disseminate long-term environmental information.

National Organics Monitoring Survey (NOMS) A national survey conducted by the US Environmental Protection Agency between 1976 and 1977 to determine the frequency of specific organic compounds in drinking water supplies.

National Organics Reconnaissance Survey (NORS) A national survey conducted by the US Environmental Protection Agency to determine the extent of the occurrence of trihalomethanes and other organic chemicals in the United States. It was completed in 1975.

National Pollutant Discharge Elimination System (NPDES) permit The regulatory agency document issued by either a federal or state agency that is designed to control all discharges of pollutants from point sources into US waterways. These permits regulate discharges into navigable waters from all point sources of pollution, including industries, municipal wastewater treatment plants, sanitary landfills, large agricultural feed lots, and return irrigation flows.

National Primary Drinking Water Regulation (NPDWR) A legally enforceable regulation that applies to public water systems as defined in Section 1401 of the Safe Drinking Water Act. It is also referred to as a primary standard. Primary standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health and are known or anticipated to occur in water. The regulations (1) apply to public water systems, (2) specify contaminants that may have any adverse effect on the health of persons, (3) specify for each contaminant a maximum contaminant level or treatment technique, and (4) contain criteria and procedures to ensure compliance.

National Priorities List (NPL) A list of sites chosen by the US Environmental Protection Agency for immediate attention under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, known as Superfund.

National Research Council (NRC) A council organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the academy's purposes of furthering knowledge and advising the federal government. Located in Washington, D.C., the National Research Council is the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The council is administered jointly by both of the academies and by the Institute of Medicine. *See also* National Academies; National Academy of Engineering; National Academy of Sciences.

National Risk Management Research Laboratory (NRMRL) A group of offices within the US Environmental Protection Agency's Office of Research and Development responsible for conducting and funding research in support of agency programs that are intended to reduce risk. It includes the Water Supply and Water Resources Division.

National Rural Water Association (NRWA) The association representing rural water and wastewater districts and systems, particularly those receiving funding from the Farmer's Home Administration.

National Safe Drinking Water Regulation *See* National Primary Drinking Water Regulation.

National Safety Council (NSC) An international organization started in 1913 to provide safety professionals of all fields with information expertise and safety assistance.

National Sanitation Foundation *See* NSF International.

National Science Foundation Network (NSFNET) A computer network funded by the National Science Foundation. It was a high-speed "network of networks" that played an essential part in academic and research communications. At its peak, it connected approximately 50,000 networks around the world. By 1995, all of its networks were transferred to commercial network providers and NSFNET was dissolved.

National Secondary Drinking Water Regulation (NSDWR) A US Environmental Protection Agency nonenforceable regulation for a contaminant that may adversely affect the taste, odor, or appearance of water. These effects may cause an adverse impact on the public welfare, e.g., by a substantial number of people discontinuing use of the water provided by a public water system. National Secondary Drinking Water Regulations establish secondary maximum contaminant levels.

National Society of Professional Engineers (NSPE) A society of professional engineers and engineers-in-training in all fields registered in accordance with the laws of states or territories of the United States or provinces of Canada, as well as qualified graduate engineers, student members, and registered land surveyors. The NSPE is concerned with social, professional, and ethical matters, as well as programs in public relations, employment practices, ethical considerations, education, and career guidance. It

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monitors legislative and regulatory actions of interest to the engineering profession.

National Spatial Reference System (NSRS) A network of physical geodetic control points, such as monuments or stone markers, in the United States maintained by the National Geodetic Survey to support global positioning system (GPS) navigation and surveying.

national standard hose coupling A fire hose coupling that has thread dimensions agreed on by several national associations and approved by the American Standards Association in 1925.

National Technical Information Service (NTIS) A self-supporting federal agency in the US Department of Commerce located in Alexandria, Va., that actively collects and disseminates scientific, technical, engineering, and business-related information generated by the US government and foreign sources. The National Technical Information Service's collection of information comprises millions of works, covering current events, business and management studies, research and development, manufacturing, standards, translations of foreign works, foreign and domestic trade, general statistics, and numerous other areas.

National Toxicology Program (NTP) A program responsible for the conduct of cancer bioassays in experimental animals. It is also responsible for disseminating toxicology information on chemicals to all government agencies and to the public. The program is part of the National Institute of Environmental Health Sciences and the Department of Health and Human Services.

National Voluntary Laboratory Accreditation Program (NVLAP) A program that certifies independent laboratories' competence to test national standards and publishes lists of certified laboratories for a number of analytes including asbestos in air monitoring.

National Water Research Institute (NWRI) A privately funded organization located in Fountain Valley, Calif., that funds drinking water research.

National Water Resources Association (NWRA) An association that promotes the development, control, conservation, and use of water resources in western states.

National Water Supply Improvement Association (NWSIA) A predecessor of the American Membrane Technology Association (AMTA). *See* American Membrane Technology Association.

National Water Well Association (NWWA) *See* National Ground Water Association.

National Wetlands Inventory (NWI) An inventory of wetlands in the United States conducted by the US Fish and Wildlife Service. In this inventory, a wetland is defined as lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substance is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

National Wildlife Federation (NWF) A federation of state and territorial conservation organizations and associate members. Located in Washington, D.C., the National Wildlife Federation encourages the intelligent management of the life-sustaining resources of the earth and promotes greater appreciation of these resources, their community relationship, and their wise use.

nationwide permit (NWP) A permit issued by the US Army Corps of Engineers that authorizes certain defined activities to occur in wetlands or waters of the United States without the need for a detailed individual review. Nationwide permits may be issued for categories of similar activities that individually and cumulatively produce minor environmental impacts.

native and adapted plant A plant indigenous to an area or from a similar climate that requires little or no supplemental irrigation once established.

native landscape A landscape composed of native plant communities.

native salt *See* halite.

natural algal growth Growth of simple plants that contain chlorophyll and require sunlight. Algae occur naturally in all surface waters and grow actively during all seasonal periods when adequate light, water temperature, and inorganic nutrients are available. In ponds, lakes, and reservoirs, massive blooms of planktonic algae are often observed during warm weather periods and may create taste-and-odor problems for water users. *See also* algal bloom; bloom.

natural environment The complex of atmospheric, biological, and geologic characteristics found in an area in the absence of artifacts or influences of a developed technological human culture.

natural estrogen A natural female hormone produced by plant, animal, and humans. Contaminants that could mimic or block the production of natural estrogen are referred to as estrogenic endocrine disruptors. Some of these compounds are reported to be present in natural and drinking water. *See also* estrogenic endocrine disruptors.

natural filtration The removal of particles or contaminants through in situ soil treatment. When contaminants are discharged into the ground, either by injection or by percolation, natural soil particles may remove

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these contaminants through filtration or adsorption prior to a location from which the water is recovered (e.g., through a well).

natural flow The flow of a stream as it occurs under natural, as opposed to regulated, conditions. *See also* regulated flow.

natural landscaping A landscaping design approach that aims to nurture or recreate a landscape as it would be found in nature, with little or no human intervention, such as the arranging of plants in a context that simulates their arrangement in nature, with primary or total dependence on rainfall to meet plant water needs. It may consist exclusively of native plants or incorporate a small number of low-water-use, nonnative exotic and ornamental plants.

natural logarithm (ln) A logarithmic function using the mathematical constant e as its base. The natural logarithm of a real number u is defined as v if the following mathematical condition is satisfied: $e^v = u$. In other words, $\ln u = v$. *See also* common logarithm.

natural logarithmic transformation A mathematical operation to convert a number to its natural logarithm. *See also* natural logarithm.

naturally developed well *See* natural strainer well.

naturally soft water Groundwater, surface water, or rainwater sufficiently free of calcium and magnesium salts that no "curd" (precipitated soap) forms and no calcium- or magnesium-based scale forms when the water is heated.

natural organic matter (NOM) A heterogeneous mixture of organic matter that occurs ubiquitously in both surface water and groundwater, although its magnitude and character differ from source to source. Natural organic matter contributes to the color of a water, and it functions as disinfection by-product precursors in the presence of such disinfectants as chlorine (HOCl). Humic substances (e.g., fulvic acid) represent a significant fraction of natural organic matter in surface water sources. *See also* disinfection by-product precursor; fulvic acid; humic material.

natural pollution The introduction of substances causing undesirable changes to the environment as a result of nonhuman-based activities, e.g., the dissolution of arsenic into groundwater from certain subsurface arsenic-containing rocks.

natural radioactive series A group of isotopes that includes all stages of an element's decay as it is transformed to its stable state. A natural radioactive element decays through a sequence of alpha and beta decays until a stable nucleus is achieved. The alpha particles, beta particles, and gamma rays emitted during the chain of decays are regulated in drinking water. *See also* Radionuclides Rule.

natural replacement The substitution of older, less efficient water fixtures (toilets, faucets, and so forth) with new, more efficient fixtures as the older fixtures break, wear out, or are replaced.

natural resources Those products and features of the earth that permit it to support life and satisfy people's needs. Land and water are natural resources, as are biological resources on the land and in the water, such as flowers, trees, birds, wild animals, and fish; as well as minerals, such as oil, coal, metals, stone, and sand. Some natural resources are renewable, such as solar, wind, and tidal energy; farmland; forests; fisheries; and surface water. Mineral and fossil fuels are examples of nonrenewable resources. Note that renewable resources may become nonrenewable if they are destroyed by bad management, e.g., farmland losing topsoil or denuding of watersheds.

Natural Resources Conservation Service (NRCS) An agency of the US Department of Agriculture that was formerly the Soil Conservation Service (SCS). It has national responsibility for helping farmers, ranchers, and other private landowners develop and carry out voluntary efforts to conserve and protect natural resources. Its key programs include conservation technical assistance, a natural resources inventory, a national cooperative soil survey, snow survey and water supply forecasting, a plant materials program, a small watersheds program, a flood prevention program, the Great Plains Conservation Program, the Resource Conservation and Development Program, a rural abandoned mine program, a water bank program, a Colorado River basin salinity control program, a forestry incentives program, and a farms-for-the-future program.

Natural Sciences and Engineering Research Council of Canada (NSERC) An educational council formed in 1978 as an offshoot of the National Science Council that provides university-based research in the form of scholarships, fellowships, and discovery grants. The NSERC provides a significant amount of all funds for natural science and engineering university research and development.

natural slope The greatest angle to the horizontal assumed by any unsupported granular semisolid or semifluid material. It is also called the angle of repose.

natural softening The replacement of hardness-causing minerals by sodium, potassium, or both as a result of the normal flow of water in the ground. *See also* hardness.

natural sparkling water *See* sparkling water.

natural strainer well A well that taps a water-bearing formation of imperfectly assorted and at least partly incoherent material and that has had its specific capacity increased by the withdrawal of much of the fine-grained part of such material in the immediate

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vicinity of the screened portion of the well. Such a well is also called a naturally developed well.

natural transformation A mechanism of deoxyribonucleic acid (DNA) exchange between bacteria whereby free or membrane-bound DNA is transferred from one bacterium to another with the use of sex pili. *See also* sex pili.

natural water Water as it occurs in its natural state, usually containing other solid, liquid, or gaseous materials in solution or suspension, in chemical equilibrium with the surroundings.

natural watercourse A surface or underground watercourse created by natural processes and conditions.

natural water table A water table in its natural condition and position, not disturbed by artificial additions or extractions of water.

natural well An abrupt depression in the land surface, not made by humans, that extends into the saturation zone but from which water does not flow to the surface except by artificial processes. It is distinguished from such features as ponds, swamps, lakes, and other bodies of impounded surface water that also extend into the saturation zone in that it has a smaller water surface, is deeper in proportion to its water surface area, and has steeper sides. Although it is not a well in a strict sense, the name has been firmly established as applying to such a feature.

navigable water Any stream, lake, arm of the sea, or other natural body of water that is actually navigable and that, by itself or by its connections with other waters, is of sufficient capacity to float watercraft for the purposes of commerce, trade, transportation, or even pleasure for a period long enough to be of commercial value; any water that has been declared navigable by the Congress of the United States.

NAWC *See* National Association of Water Companies.

NC data *See* noncensored data.

NCEA *See* National Center for Environmental Assessment.

NCER *See* National Center for Environmental Research.

NCGIA *See* National Center for Geographic Information and Analysis.

NCH *See* noncarbonate hardness.

NCI *See* National Cancer Institute.

NCOD *See* National Contaminant Occurrence Database.

NCSL *See* National Conference of State Legislatures.

NCWS *See* noncommunity water system.

NCWTT *See* National Centers for Water Treatment Technologies.

ND *See* not detected.

NDEA *See* nitrosodiethylamine.

NDMA *See N*-nitrosodimethylamine.

NDPA *See* nitroso-di-*n*-propylamine; National Drought Policy Act (1998).

NDPC *See* National Drought Policy Commission.

NDWAC *See* National Drinking Water Advisory Council.

NDWC *See* National Drinking Water Clearinghouse.

near the first service connection A designation used to indicate any of the 20 percent of all service connections in the entire system that are nearest the water supply treatment facility, as measured by water transport time within the distribution system.

nebulizer A device that reduces a liquid to a fine spray. For example, aqueous samples can be introduced into the flame of an atomic absorption spectrophotometer via a nebulizer. Nebulizer technologies such as crossflow pneumatic and Babington are used for inductively coupled plasma analysis. *See also* atomic absorption spectrophotometric method; Babington nebulizer; inductively coupled plasma spectroscopy.

NEC® *See* National Electric Code®.

neck (1) A narrow stretch of land connecting two larger areas. (2) A narrow body or channel of water between two larger bodies of water.

necropsy The process of taking tissue specimens from animals, usually from a controlled experiment, to be examined for pathological changes.

necrosis A process produced by exogenous influences (chemical or microbial) that causes the death of cells. Necrosis is in contrast to programmed cell death, apoptosis, which occurs naturally. *See also* apoptosis.

necrotizing fasciitis Inflammation and necrosis of the fascia.

needle A plank, usually made of timber or steel, set on end to close an opening for the control of water. In dams or control structures, a needle may be set in either a vertical or inclined position. *See also* needle dam.

needle dam A movable dam composed of upright pieces or needles, the lower ends of which bear against a sill on the river bottom and the upper ends of which bear against some form of bridge.

needle valve A valve with a circular outlet through which the flow is controlled by means of a tapered needle that extends through the outlet, reducing the area of the outlet as it advances and enlarging the area as it retreats.

needle weir A movable timber weir in which the wooden barrier consists of upright square timbers placed side by side against structural steel frames.

NEEF *See* National Environmental Education Foundation.

negative Having an electrical charge polarity associated with an excess of electrons or, equivalently, a deficiency of protons.

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negative (charge) metal oxide semiconductor (NMOS) A semiconductor incorporating a silicon gate structure that uses negative charges only.

negative charge An electrical potential inherent to an electron. Anions carry negative charges because they have more electrons than protons.

negative confining bed A confining bed that prevents or retards downward movement of groundwater even though the overlying water has sufficient head to produce a resultant downward pressure.

negative exponential model A model often used in drinking water for modeling disinfectant (e.g., chlorine, ozone) decays or microbial inactivation. It has the mathematical form

$$y = e^{-x}$$

Where:

y = the dependent variable (e.g., residual chlorine in milligrams per liter)

x = the independent variable (e.g., time in minutes)

negative head A condition that can develop in a filter bed caused by high head loss. When this occurs, the gauge pressure in the bed can drop to less than atmospheric, often resulting in the release of dissolved gases from the water and the formation of gas bubbles. Negative head is also called negative pressure.

negatively charged filter A filter that has a net negative charge at near-neutral pH values. Some negatively charged filters are composed of fiberglass or nitrocellulose. Virus adsorption to these filters usually requires that water be acidified to approximately pH 3.5, that divalent or trivalent cations be added (e.g., aluminum, Al^{3+}), or both.

negative pressure A gauge pressure less than the existing atmospheric pressure when the latter is taken as a zero reference.

negative pressure valve A valve that monitors drops in pressure and automatically closes prior to a negative pressure or vacuum being placed on a line or system.

negative sample In a multiple-tube fermentation or membrane filter test, any sample that does not indicate the presence of coliform bacteria.

negative well A shaft or well driven through an impermeable stratum to allow water to drain through to a permeable one. A negative well is also called an absorbing well, dead well, or drain well.

negotiated rate A water rate that is sometimes negotiated (downward) with major customers to allow for unique load characteristics, capital facilities provided by the user, technology-specific conditions (e.g., in the oil industry or Silicon Valley), load retention inducement (i.e., to keep a user from leaving the area or sinking a private well), or any other basis that is deemed fair. Rates for reclaimed water are frequently negotiated at less than the potable rates on the basis of facilities provided by the user or costs avoided by the supplier. *See also* economic development rate.

negotiated rulemaking An alternative to the traditional federal agency rulemaking process conducted under the authority of the Negotiated Rulemaking Act of 1990. A proposed rule is negotiated by an advisory committee whose membership includes a representative of each affected interest. Meetings of the committee are open to the public, and information is freely exchanged. New ideas and comments from the public can be offered to the advisory committee for consideration in its negotiations. The goal of committee deliberations is to reach a consensus on the language or issues included in a proposed rule. The negotiated rulemaking process may be initiated at the federal agency's discretion.

Negotiated Rulemaking Act (NRA) Public Law 101-648, enacted in 1990, that establishes a framework for the conduct of negotiated rulemaking and encourages federal agencies to use the process when doing so will enhance the informal rulemaking process.

NEJAC *See* National Environmental Justice Advisory Council.

NELAC (National Environmental Laboratory Accreditation Conference) *See* NELAC Institute, the.

NELAC certification *See* NELAC Institute, the.

NELAC Institute, the (TNI) A voluntary association of state and federal (US Environmental Protection Agency) agencies, with opportunity for input from the private sector, that establishes and promotes mutually acceptable performance standards for the operation of environmental laboratories. The components of accreditation include a review of personnel qualifications, on-site assessment, proficiency testing, and quality assurance/quality control standards. Such nationwide accreditation is meant to prevent laboratories that conduct business in more than one state from having to seek certification from each of the states. The NELAC Institute (known as TNI) is part of the National Environmental Laboratory Accreditation Program. *See also* National Environmental Laboratory Accreditation Program.

NELAP *See* National Environmental Laboratory Accreditation Program.

NEMA *See* National Electrical Manufacturers Association.

nematocide An agent that is destructive to soil nematodes. *See also* nematode.

nematode A roundworm belonging to the phylum Nematoda, characterized by a long, cylindrical, unsegmented body and a heavy cuticle. Many nematodes

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(hookworms and pinworms) are parasites of animals and plants.

NEMI *See* National Environmental Methods Index.

neonatal Balb-C mouse A newborn of an inbred strain of mouse. *See also* neonatal mouse infectivity assay.

neonatal CD-1/ICR mouse A newborn of an outbred strain of mouse. *See also* neonatal mouse infectivity assay.

neonatal mouse A newborn mouse. Newborn mammals are used in studying a variety of effects of chemicals and other agents during nursing. A specific use of the neonatal mouse is in studying chemical carcinogenesis. Because of their high rates of cell division, young animals can be more sensitive to chemical and physical agents that initiate cancer. The high rates of cell division quickly repair mutations induced by such agents, and the stimulus present for cell division causes the tumors to grow out quickly. On the other hand, the need to metabolize many carcinogens to reactive intermediates may make the neonatal animal less sensitive to a carcinogen, because the ability to metabolize the chemical to an active form is generally less well developed at this age.

neonatal mouse infectivity assay An assay that uses neonatal mice (newborn mice 4–6 days old). The neonatal CD-1/ICR mice, an outbred strain of mice, are inoculated with a numerated microliter dose of treated and untreated *Cryptosporidium parvum* oocysts. Infections in the mice are determined by examining formalin-fixed, slide-mounted, hematoxylin and eosin (H&E) stains of tissues of the terminal ileum. The ileum is the first region of the small intestine (gut) to be colonized by *Cryptosporidium parvum* and therefore harbors the greatest number of parasitic developmental stages of *Cryptosporidium.* The H&E slides are examined microscopically for evidence of parasites in the microvillous cells of the lining of the brush borders of the intestine. *See also* brush borders; hematoxylin and eosin stain; intestinal villous; neonatal CD-1/ICR mouse; terminal ileum.

neonate A newborn.

neoplasm An abnormal growth or tissue, as a tumor.

NEPA *See* National Environmental Policy Act.

nephelometer *See* nephelometric turbidimeter.

nephelometric turbidimeter An instrument that measures turbidity by measuring the amount of light scattered by particles in a water sample. It is the only instrument approved by the US Environmental Protection Agency to measure turbidity in treated drinking water. It operates by passing light through a sample and then measuring the amount of light deflected (usually at a 90° angle).

nephelometric turbidity A measure of turbidity in a sample as determined by an instrument called a nephelometric turbidimeter. *See also* nephelometric turbidimeter.

nephelometric turbidity units (ntu, NTU) *See in the Units of Measure section.*

nephrotoxicity Toxicity to the kidney.

Nernst equation An equation used to determine the effect of reactant and product concentration on electrochemical cell potential. Conversely, if the cell potential and the concentrations of all but one species are known, the equation can be used to determine the unknown concentration. The equation is applicable to reactions that take place in an electrochemical cell and in solution. In equation form,

$$E_{\text{red/ox}} = E^{0}_{\text{red/ox}} - \frac{RT}{zF}\ln Q$$

Where:

$E_{\text{red/ox}}$ = potential, in volts
$E^{0}_{\text{red/ox}}$ = standard potential (in volts), a constant that can be obtained from tables of standard reduction potentials
R = ideal gas constant (about 0.001987 kilocalories per degree-mole)
T = absolute temperature, in degrees kelvin
z = number of electrons transferred in the reaction
F = Faraday constant (23.060 kilocalories per volt)
Q = reaction quotient = {red}/{ox}
{red} = activity of the reductant
{ox} = activity of the oxidant

NESC *See* National Environmental Services Center.

NESHTA *See* National Environmental, Safety and Health Training Association.

Nessie curve analysis A technique for forecasting infrastructure repair and replacement expenditures based on how such assets wear out over their expected life spans.

Nesslerization A colorimetric technique used in the determination of ammonia (NH_3). The term is derived from Nessler reagent, which is prepared from an aqueous solution of mercuric iodide (HgI), potassium iodide (KI), and sodium hydroxide (NaOH). In this technique, laboratory personnel compare the intensity of a sample to the intensity of standard solutions by visually comparing the solutions or by using an absorption spectrophotometer.

Nessler tube A glass tube with a flat bottom used in some colorimetric analyses. A common Nessler tube can contain 50 milliliters. These tubes are often sold as matched sets to minimize differences between individual tubes. Lab personnel can visually compare

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samples and standards by looking directly down the length of the Nessler tube.

nested polymerase chain reaction The use of nested sets of polymerase chain reaction (PCR) primers for in vitro amplification of a specific target nucleic acid sequence. In a simple nested amplification protocol, the first round of amplification is performed with a single primer pair for 15 to 30 cycles and yields an amplification product; the amplification product from the first round is then transferred to a new reaction tube for the second round of amplification, which uses a second primer pair specific for the internal nucleic acid sequence amplified by the first primer pair. Following the second round of amplification for 15 to 30 cycles, the products are detected via an appropriate assay. Nested PCR is also called nested amplification. *See also* polymerase chain reaction.

NETA (National Environmental Training Association) *See* National Environmental, Safety and Health Training Association.

net available head The difference in pressure elevation between the water in a power conduit before it enters the waterwheel and the first free water surface in the conduit below the waterwheel.

net benefits The numerical difference between total benefits and total costs.

net demand The water demand that is expected to occur in the future after reductions for conservation, loss control optimization, and natural replacement. It represents the actual demand that should be experienced in the future at the premises of customers.

net depletion Total water consumed by irrigation or other uses in an area; equal to water withdrawn minus return flow.

net driving force *See* net driving pressure.

net driving pressure In a pressure-driven membrane treatment system, the hydraulic pressure differential across the membrane minus the osmotic pressure differential across the membrane. *See also* pressure-driven membrane.

net head The head available in a hydroelectric plant for production of energy after deduction of all losses caused by friction, eddies, entrance, unrecovered velocity head at the mouth of a draft tube, and so on, except those losses chargeable to the turbine. Net head is also called effective head.

Netherlands Waterworks Testing and Research Institute *See* Kiwa.

net peak flow The total flow at a peak minus the corresponding base flow; that part of the peak discharge that is attributable to direct runoff from precipitation.

net positive suction head (NPSH) A measure of the pressure at the suction side of the pump, including atmospheric pressure and vapor pressure of the liquid being pumped.

net present value (NPV) (1) The present value of benefits minus the present value of costs. (2) In the context of cash receipts or expenditures (cash flows) in future periods, a calculated value recognizing that a dollar in hand today is worth more than a dollar to be received in the future because the dollar in hand today has the ability to earn a return either as an interest-earning instrument in a financial institution or from an investment in a capital project. Future cash flows are therefore discounted by the expected return to derive the net present value. The net present value of n future values is given by the following formula:

$$\text{NPV} = \sum_{i=1}^{n} \frac{FV_i}{(1 + DR)^i}$$

Where:

n = the total number of time periods (e.g., number of years)
FV_i = the future value received in period i
DR = the discount rate, expressed as a decimal

For example, a single $100 expenditure that will be made 2 years from today can be shown to have a net present value of $87.34 if the long-term cost of capital is assumed to be 7.0 percent ($100/1.07^2 = $87.34). Net present value calculations are equally applicable to a constant amount or an uneven stream of cash flows over any number of periods.

net rainfall Rainfall minus infiltration and other deductions from surface runoff. Net rainfall is sometimes called excess rainfall.

net revenue requirement In water rate determinations, the difference between the total expenditures and the total revenue from nonrate sources. This difference is then the amount of net cost that must be recovered or paid for by water rates. Total expenditures include operations and maintenance, revenue-funded capital payments, and (when the utility method is used for defining rate requirements) a return on investment. The nonrate revenues include interest earnings on cash balances, various customer fees, and miscellaneous revenues.

net revenues available for debt service Operating revenues less operations and maintenance expenses but exclusive of depreciation and bond interest. Net revenue available for debt service, as thus defined, is used to compute coverage for revenue-bond issues. Under the laws of some states and the provisions of some revenue-bond indentures, net revenues available for debt service for computation of revenue-bond coverage must be computed on a cash basis rather than in conformity with generally accepted accounting

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principles. Sometimes indenture provisions permit nonoperating revenue and system-development-charge receipts to be included with operating revenue when one is determining net revenue available for debt service.

NETSC *See* National Environmental Training Center for Small Communities.

net water demand The amount of water needed to meet all requirements in a water service area; includes consumptive use, evapotranspiration of applied water (ETAW), irrecoverable losses from the distribution system, and outflow leaving the service area. It does not include water reused within a service area. It is also called net water use.

network (1) A data structure used to model relationships of interconnected linear features, such as roads and water distribution systems. (2) The structure of relationships among the activities, tasks, and events of a project. (3) A total computer system that integrates the functions of hardware and software, as well as the support provided by data communications. (4) A group of sampling locations connected by common objectives and methodologies. (5) A group of pipes in a distribution system.

network analysis The use of analytical procedures to evaluate movement (e.g., of water, sewage, vehicles, or electricity) through an interconnected system based on a number of criteria. Network analysis techniques are usually distinctive for the type of network being evaluated.

network analysis system A computer system used primarily for geographic or statistical analysis of relationships and flows that are dependent on how the segments and nodes in a system, such as a utility network, are connected.

network data model A data storage structure in which records of the same type are grouped in conceptual files, in owner-coupled sets reflecting one-to-many relationships, or in many-to-many relationships.

network diagram A schematic drawing showing the layout of a system.

networking (1) A method for distributing data process functions through communications facilities. (2) The design of networks.

network protocol A fixed set of rules specifying the format of data exchange between computers. A particular protocol defines how the individual bits are to be arranged in transmitting a message so that the message can be received and interpreted correctly by another node on the network.

network topology The arrangement or layout of the devices and communication lines in a computer network.

neural network *See* neural network model.

neural network learning capacity The capacity of neural networks to learn new information. If a neural network is provided with multivariate data sets with known outputs for each set for a given system, the neural network organizes itself internally so that it predicts the expected outcome for any other given input. *See also* neural network model.

neural network model A computer model that attempts to simulate the functioning of a human brain by observing and learning complex nonlinear relationships and using this knowledge to predict outcomes for unknown conditions. These models are developed by studying a set of historical data, including parameters known to influence the process. A neural network can be used for modeling, forecasting, and diagnosing. It is sometimes referred to as an artificial neural network (ANN) model.

neurocysticercosis Infestation of the brain with cysticerci, a form of larval tapeworm resembling cysticercus, but having the cyst small and almost devoid of fluid.

neurological effects Effects on the nervous system.

N. europaea *See Nitrosomonas europaea.*

neuropathy Pathological damage to neurons (nerves). Such pathology can involve different parts of the neuron or be relatively specific to certain types of neurons, depending on the agent or condition that gives rise to the damage. Examples of chemicals that are of some concern in this regard and could occur in drinking water are lead and acrylamide ($CH_2CHCONH_2$).

neurotoxicant A chemical that induces modifications of nervous system function that give rise to overt symptoms: modified functional activity of the nervous system, actual pathology (damage) to the nervous system, or both.

neurotoxic esterase An enzyme activity of unknown function that is inhibited by chemicals that give rise to a delayed neurotoxicity. Triorthocresyl phosphate and a variety of other organic phosphate compounds produce the effect. Many of these compounds also inhibit acetylcholinesterase, an inhibition activity common to the organophosphate pesticides; this activity can lead to acute neurotoxicity. The acute and delayed neurotoxicity are clearly separable entities, however. For example, not all organophosphate pesticides produce delayed neurotoxicity, and triorthocresyl phosphate is a relatively poor acetylchlolinesterase inhibitor. *See also* delayed neurotoxicity.

neurotoxicity A substance or force capable of exerting a destructive or poisonous effect on nerve tissue.

neurotoxin A substance that can damage nerve cells.

neutral (1) In electricity, a condition of being uncharged because of a balance between negative and positive charges. The condition of neutrality means that neither an excess nor lack of electrons exists.

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(2) In water chemistry, the midpoint (neutral) reading of 7.0 on the pH scale, indicating that the solution (water) producing the neutral reading will produce neither an acid nor alkaline reaction. A 7.0 reading on the pH scale means that an equal number of free hydrogen (acidic) ions (H^+) and hydroxide (basic) ions (OH^-) are in the sample.

neutral depth *See* normal depth.

neutralism A condition of minimal interaction between two species living in the same environment.

neutralization (1) A chemical reaction in which water is formed by mutual destruction of the ions that characterize acids and bases when both are present in an aqueous solution. Typically, the hydrogen and hydroxide ions react to form water ($H^+ + OH^- \rightarrow H_2O$), and the remaining product is a salt. Neutralization occurs with both inorganic and organic compounds. Neutralization can also occur without water being formed, as in the reaction of calcium oxide and carbon dioxide to form calcium carbonate ($CaO + CO_2 \rightarrow CaCO_3$). Neutralization does not mean that a pH of 7.0 has been attained; rather it means that the equivalence point for an acid–base reaction has been reached. (2) The process by which the cell-attachment protein of a virus is bound by an antibody, thereby inhibiting infection by the virus. *See also* equivalence point.

neutralize *See* neutralization.

neutralizer (1) An alkaline substance, such as calcium carbonate ($CaCO_3$, in the form of calcite) or magnesium oxide (MgO, in the form of magnesia), used to neutralize acidic waters; or an acidic substance, such as acetic acid (CH_3COOH) or dilute hydrochloric acid (HCl), used to neutralize alkaline waters. (2) A calcite or magnesia acid-neutralizing filter used to neutralize acidity, reduce free carbon dioxide (CO_2), or both in water and thereby raise the pH of acidic water.

neutron An uncharged elementary particle that has a mass approximately equal to that of the proton. Neutrons are present in all known atomic nuclei except the lightest nucleus (hydrogen). *See also* electron; proton.

neutron activation analysis (NAA) An instrumental technique that is used for measuring the concentrations of elements in a sample based on a measurement of induced radiation. A sample and standard of known weight of a given element are irradiated with neutrons. Neutron activation analysis can be a very sensitive technique for many elements. Because the neutrons must typically be generated in a nuclear reactor, the technique is unavailable to most analytical chemists.

neutron probe An instrument that measures soil moisture content by emitting "fast neutrons" from a radioactive source placed in the soil.

névé A granular mass, somewhat between snow and ice in form, that occurs in a snow field either as the result of compaction caused by the weight of overlying material or because of alternate thawing and freezing through the day and night of water trickling downward from the surface layers of snow to lower levels. As greater depths are reached, the material becomes more compact, eventually producing solid ice.

new route replacement of lead pipe The replacement of lead pipe with a pipe made of a different material in a location or trench away from the lead pipe. The lead pipe is then disconnected and the new bypass pipe connected. The lead pipe is then normally left in place, or it can be removed after service has been restored through the bypass pipe.

newton (N) *See in the Units of Measure section.*

Newtonian flow Flow of a fluid in which the viscosity is independent of shear rate, e.g., water or solutions of coagulants. *See also* non-Newtonian flow.

Newtonian fluid A simple fluid in which the state of stress at any point is proportional to the time rate of strain at that point. The proportionality factor is the viscosity coefficient. In equation form:

$$\tau = \mu \frac{du}{dy}$$

Where:

τ = shear stress, in pound force per square foot (newton per square meter)

μ = coefficient of viscosity, in pound force second per square foot (newton second per square meter)

$\frac{du}{dy}$ = rate of strain or velocity gradient, in seconds^{-1}

new water (1) Groundwater artificially brought to the surface or to the land that, without such diversion, would have run to waste or not have appeared in any known source. (2) Stream flow that has been induced by artificial means. *See also* developed water.

NF *See* nanofiltration.

***n* factor** A value of the roughness factor used in the Manning formula or Kutter formula. *See also* Manning formula; Kutter formula; roughness coefficient.

N. fowleri *See Naegleria fowleri.*

NFPA *See* National Fire Protection Association; National Fluid Power Association.

NFR (nonfilterable residue) *See under* suspended solids; total suspended solids.

N_{Ga} *See* Galileo number.

NGA *See* National Governors Association.

NGMDB *See* National Geologic Map Database.

NGO *See* nongovernmental organization.

NGVD 29 *See* National Geodetic Vertical Datum of 1929.

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NGWA *See* National Ground Water Association.

NHEERL *See* National Health and Environmental Effects Research Laboratory.

NHPA *See* National Historic Preservation Act.

NHSRC *See* National Homeland Security Research Center.

NiCad battery *See* nickel–cadmium battery.

niche (1) A closely delineated space that is occupied by a population in a biocenosis. (2) The role of a species or population in an ecosystem. *See also* biocenosis.

nickel (Ni) A metallic element used in alloys, in electroplated protective coatings, in alkaline storage batteries, and as a catalyst. Its presence in drinking water was regulated by the US Environmental Protection Agency under the Safe Drinking Water Act in 1974, but the maximum contaminant level was remanded in 1995. Many water supplies continue to monitor for this contaminant, and the US Environmental Protection Agency continues to study its health implications.

nickel–cadmium (NiCad) battery A small rechargeable battery used to power laptop or notebook computers and other low-voltage devices. To maintain performance, NiCad batteries must be completely discharged prior to being recharged, a process called a deep-cycle discharge and recharge.

nicotinamide adenine dinucleotide phosphate–cytochrome P450 (NADPH–cytochrome P450) reductase A flavoprotein enzyme that transfers reducing equivalents from nicotinamide adenine dinucleotide phosphate to cytochrome P450 to reduce the heme iron to the ferrous state. This transfer is an essential step in the function of the cytochrome P450 family of enzymes that participate in the metabolism of many chemicals that are foreign to the body. The enzyme is also referred to as nicotinamide adenine dinucleotide phosphate–cytochrome c reductase because cytochrome c is frequently employed in assays of the enzyme.

nightflow analysis A technique used to quantify leakage in a discrete zone of the water distribution network. By measuring flows into such a zone, the minimum night flow (MNF) can be observed, usually occurring between 2:00 A.M. and 4:00 A.M. when legitimate water consumption is at a minimum and leakage is at the greatest proportion of the total flow. Accounting for legitimate night consumption by customers (any residential consumption, 24-hour, industrial consumption, nighttime irrigation systems), nightflow analysis segregates legitimate consumption from network leakage. By continuously monitoring district metered areas (DMAs), leakage trends can be observed and leakage quantities gathered for inclusion in the annual water audit. *See also* minimum night flow.

95 percent confidence interval *See* box-and-whisker plot; confidence interval.

90th percentile The value of the variable in a set of data that is higher than 90 percent of the data in that set. The 90th percentile of a set of monitoring data is used in some regulations, including the Lead and Copper Rule, to determine compliance. It is calculated as follows: (1) The results of all samples taken during a monitoring period are placed in ascending order from the sample with the lowest concentration to the sample with the highest concentration. Each sample result is assigned a number, ascending by single integers beginning with the number 1 for the sample with the lowest contaminant level. The number assigned to the sample with the highest contaminant level is equal to the total number of samples taken. (2) The number of samples taken during the monitoring period is multiplied by 0.9. (3) The contaminant concentration in the numbered sample yielded by the calculation in step (2) is the 90th percentile contaminant level. If only 5 samples are collected per monitoring period, then the 90th percentile value is computed by averaging the highest and second highest concentrations.

90 percent values Values in the 90th percentile of a set of data, typically the value exceeded by 10 percent of the data in that set. *See also* 90th percentile.

NIOSH *See* National Institute for Occupational Safety and Health.

NIPDWR *See* National Interim Primary Drinking Water Regulations.

nipple A tubular pipe fitting usually threaded on both ends and less than 12 inches (30 centimeters) long. Pipe longer than this is regarded as cut pipe.

NIRS *See* National Inorganics and Radionuclides Survey.

NIST *See* National Institute of Standards and Technology.

nitrate (NO_3^-) An oxidized ion of nitrogen. Nitrifying bacteria can convert nitrite (NO_2^-) to nitrate in the nitrogen cycle. Sodium nitrate ($NaNO_3$) and potassium nitrate (KNO_3) are used as fertilizer. The presence in drinking water of the nitrate ion is regulated by the US Environmental Protection Agency at a maximum contaminant level of 10 milligrams per liter. *See also* fertilizer; nitrifying bacteria; nitrite; nitrogen; nitrogen cycle.

nitrate removal The process of removing nitrate (NO_3^-) from water. In drinking water, nitrate is typically removed by an ion-exchange process in which nitrate is exchanged for another monovalent ion (e.g., chloride, Cl^-) in a packed bed. Biological denitrification has also been suggested. *See also* biological denitrification; ion exchange.

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nitrification The process of formation of nitrate (NO_3^-) from reduced inorganic nitrogen compounds. Nitrification in the environment is carried out primarily by autotrophic bacteria and some chemoorganotrophic bacteria. *See also* autotrophic bacteria; denitrification.

nitrification inhibitor A chemical that slows down the conversion of ammonium ion (NH_4^+) to nitrate nitrogen (NO_3^-).

nitrifying bacteria Bacteria involved in the process of nitrification. The *Nitrosomonas* group of bacteria oxidize ammonia (NH_3) to nitrite (NO_2^-). The *Nitrobacter* group of bacteria oxidize nitrite to nitrate (NO_3^-). Both groups are chemolithotrophic organisms, found together in soils, that obtain energy for carbon dioxide (CO_2) fixation by aerobic oxidation of nitrite and nitrate. Some chemoorganotrophic bacteria—such as isolates of the genera *Vibrio, Bacillus, Mycobacterium,* and *Streptomyces*—can also oxidize ammonia to nitrite or nitrate.

nitrite (NO_2^-) An intermediate oxidized ion of nitrogen. Nitrifying bacteria can convert ammonia (NH_3) to nitrite (NO_2^-) to nitrate (NO_3^-) in the nitrogen cycle. Sodium nitrite ($NaNO_2$) is used in curing meats. The presence in drinking water of the nitrite ion is regulated by the US Environmental Protection Agency at a maximum contaminant level of 1 milligram per liter. *See also* ammonia; nitrate; nitrifying bacteria; nitrogen; nitrogen cycle.

nitrite-oxidizing bacteria (NOB) Gram-negative bacteria that catalyze the second step of aerobic nitrification, i.e., the oxidation of nitrite to nitrate. *Nitrobacter* and *Nitrospira* are found in most soil, freshwater, and marine habitats and in biological wastewater treatment plants. They are obligate chemolithoautotrophs and depend on carbon dioxide fixation for biosynthetic carbon.

Nitrobacter A genus of nitrifying bacteria. Members of this genus typically oxidize nitrite (NO_2^-) to nitrate (NO_3^-).

nitrobenzene ($C_6H_5NO_2$) A synthetic organic chemical used as a solvent and in various industrial applications. *See also* solvent; synthetic organic chemical.

nitrogen (N) A gaseous element (molecular formula N_2) that constitutes 78 percent of the atmosphere by volume and occurs as a constituent of all living tissues in combined form. Nitrogen is present in surface water and groundwater in the forms of ammonia (NH_3), nitrite (NO_2^-), nitrate (NO_3^-), and organic nitrogen. *See also* ammonia; nitrate; nitrite; organic nitrogen.

nitrogen cycle The conservation of nitrogen in nature through various forms, from living animal matter, to dead organic matter, to various stages of decomposition, to plant life, and again to living animal matter.

nitrogen fertilizer A plant nutrient that can cause algal blooms in sensitive water bodies but is also essential for the development of beneficial life forms. *See also* algal bloom.

nitrogen fixation The use of free nitrogen gas (N_2) in the formation of nitrogen compounds during some forms of biological activity.

nitrogenous Pertaining to chemical compounds (usually organic) that contain nitrogen in combined forms. Proteins and nitrates are nitrogenous compounds.

nitrogenous disinfection by-products *See* organic nitrogen–based disinfection by-products.

nitrogen–phosphorus detector A type of ionization detector that is specific to compounds containing nitrogen or phosphorus. Compounds eluting from a gas chromatograph are decomposed on an alkali bead; nitrogen- and phosphorus-containing compounds are preferentially ionized. The current generated is proportional to the concentration of the analyte.

***ortho*-nitrophenyl-β-D-galactopyranoside (ONPG) ($C_{12}H_{15}O_8N$)** A colorless organic compound that is a substrate for the enzyme β-galactopyranosidase produced by lactose-fermenting bacteria. When *ortho*-nitrophenyl-β-D-galactopyranoside is hydrolyzed by active lactose-fermenting bacteria, a yellow-colored compound (*ortho*-nitrophenol) is released, indicating the presence of the bacteria.

***ortho*-nitrophenyl-β-D-galactopyranoside ($C_{12}H_{15}O_8N$), 4-methylumbelliferyl-β-D-glucuronide ($C_{16}H_{16}O_9$) (MMO–MUG) technique** A test for detection of total coliforms and *Escherichia coli* in drinking water that uses the *ortho*-nitrophenyl-β-D-galactopyranoside, 4-methylumbelliferyl-β-D-glucuronide minimal medium. Total coliforms hydrolyze *ortho*-nitrophenyl-β-D-galactopyranoside to release *ortho*-nitrophenol, which gives a yellow color in the medium. Hydrolysis of 4-methylumbelliferyl-β-D-glucuronide by *E. coli* yields a compound (4-methylumbelliferone) that fluoresces when exposed to ultraviolet light (366-nanometer wavelength). *See also* minimal medium.

nitrosodiethylamine (NDEA) A volatile and clear yellow liquid used as an additive to gasoline and lubricants, as a stabilizer in plastics, and as a chemical reagent in research. It has been detected in drinking water at trace levels and is classified by the US Environmental Protection Agency as a probable human carcinogen.

***N*-nitrosodimethylamine (NDMA) ($(CH_3)_2N_2O$)** A synthetic organic chemical that is a known animal carcinogen and is classified as a probable human carcinogen. It has been used in rocket fuels, as a solvent, and as a rubber accelerator. In addition, it may be formed during drinking water treatment by the reaction

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of secondary amines (R_1–NH–R_2), nitrite (NO_2^-), and acid. *See also* amine; carcinogen; solvent; synthetic organic chemical.

nitroso-di-*n*-propylamine (NDPA) A synthetic chemical used in research that appears as a yellow liquid at room temperature. It is a by-product formed during the manufacture of some herbicides and plastics. It also forms in the stomach during the digestion of nitrite-treated foods or food containing certain amines. It has been classified by the US Environmental Protection Agency as a probable human carcinogen.

Nitrosomonas A genus of nitrifying bacteria. Members of this genus typically oxidize ammonia (NH_3) to nitrite (NO_2^-).

Nitrosomonas europaea (N. europaea) Gram-negative chemolithotroph that oxidizes ammonia to nitrite and lives in several places such as soil, wastewater, and freshwater. These bacteria play a central role in the availability of nitrogen to plants and thus in limiting carbon dioxide fixation. They are important in the treatment of industrial water and wastewater because they are the first step in oxidizing ammonia to nitrate. *N. europaea* is an attractive organism for use in bioremediation because of its ability to degrade a variety of halogen-substituted organic compounds, including trichloroethylene, benzene, and vinyl chloride.

NLC *See* National League of Cities.

nm *See* nanometer *in the Units of Measure section.*

NMFS *See* National Marine Fisheries Service.

NMOS *See* negative (charge) metal oxide semiconductor.

NMR *See* nuclear magnetic resonance.

N-nitrosodimethylamine
See under nitrosodimethylamine.

NOAA *See* National Oceanic and Atmospheric Administration.

NOAEL *See* no-observed-adverse-effect level.

NOB *See* nitrite-oxidizing bacteria.

noble Chemically unreactive, especially toward oxygen, or resistant to chemical action, such as corrosion caused by air, water, or (to a lesser degree) acids. Gold, silver, platinum, palladium, and mercury are said to be noble metals because they do not rust and are resistant to acid damage. Certain gases (e.g., helium, neon, radon) are called noble gases because they are inert (chemically inactive and stable).

noble metal A chemically inactive metal (such as gold); a metal that does not corrode easily and is much scarcer (and more valuable) than the so-called useful metals or base metals. *See also* base metal.

Nocardia Common soil organisms that can survive only in aerobic conditions and can result in foaming in diffused aeration processes. This genus of bacteria includes some pathogenic species that can cause opportunistic infections in immunocompromised people.

NODA *See* Notice of Data Availability.

node (1) A special type of point (zero-dimensional object) that serves as a topological junction or end point and may specify a geometric location. (2) Each computer in a network of computers. Each node has a unique address on the network.

node-pair reliability (NPR) Origin to destination point dependability.

Nodularia *A* halotolerant, filamentous, dinitrogen-fixing cyanobacterium. These cyanobacteria (e.g., *Nodularia spumigena)* and other members of this genus are planktonic, gas-vesiculate organisms that prevail in the southern parts of the Baltic Sea. Blooms are sporadic and typically hepatotoxic, resulting from the toxin nodularin.

nodularin A toxic substance produced by certain cyanobacteria.

NOEL *See* no-observed-effect level.

noise reduction rating (NRR) Rating given to hearing-protection devices to indicate the amount of noise reduction provided to the wearer.

NOM *See* natural organic matter.

Nomarski differential interference contrast A modification of the differential inference contrast method that that gives good rejection of out-of-focus interference. It provides an image of the gradient (i.e., spatial rate of change) of refractive index inhomogeneities in the sample. The technique essentially acts as a high-pass filter that emphasizes edges and lines. Out-of-focus refractive index changes will be blurred and have a shallow spatial gradient in the focal plane; they will therefore not contribute much to the contrast of the image. Nomarski microscopy is generally much more benign to living specimens than fluorescence microscopy, which can produce phototoxic effects.

nominal diameter An approximate measurement of the diameter of a pipe. Although the nominal diameter is used to describe the size or diameter of a pipe, it is usually not the exact inside diameter of the pipe.

nominal filter rating A filter rating indicating the approximate particle size for which a specified majority of such particles will not pass through the filter. It is generally interpreted as meaning that the filter will retain 85 percent of the particles of the size equal to the nominal filter rating.

nominal pipe size (NPS) The designation of a pipe based on the approximate size of its inside diameter, such as a 6-inch pipe or 24-inch pipe. The inside diameter of a pipe changes with the class of pipe and wall thickness, but all pipes near a certain diameter are referred to as that size of pipe. Note that only US customary units are used for nominal pipe sizes in the United States.

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nominal pore size For microporous, low-pressure membrane processes, the average size (diameter) of pores in the membrane. *See also* pore size.

nomograph A graph in which three or more scales are used to solve mathematical problems.

nomographic method A method that uses a graph or other diagram to solve formulas and equations.

NOMS *See* National Organics Monitoring Survey.

***trans*-2, *cis*-6-nonadienal** A taste- and odor-causing compound produced by algae in water. It gives a cucumber odor in drinking water.

nonaqueous phase liquid (NAPL) A liquid in contact or mixed in with water but having distinct boundaries and properties different from water. In a mixture of oil and water, oil is the nonaqueous phase liquid. In contrast, in a mixture of alcohol and water, the alcohol is dissolved in the water, and the distinct boundaries and properties do not exist.

nonartesian well A nonflowing well in which the water does not rise above the zone of saturation.

nonbinding arbitration A means of mediated conflict resolution such that if the arbitrator's decision is not acceptable to either party, that party may pursue other avenues of resolving the dispute.

nonbiodegradable carbon That portion of the carbon in water that cannot be mineralized by heterotrophic microorganisms. *See also* biodegradable organic carbon.

nonbiological surrogate Any nonbiological indicator analyte—physical or chemical—used as a surrogate for monitoring or measuring for a specific biological agent; for example, measuring removal of turbidity (or particle counts or sizing) during water treatment might be used as a nonbiological surrogate for assessing treatment removal of a biological agent that is not easily monitored, such as *Cryptosporidium parvum* oocysts. *See also* fluorescently labeled microsphere.

noncarbonate hardness (NCH) The hardness in excess of the carbonate hardness. In equation form,

$$\text{noncarbonate hardness} = \text{total hardness} - \text{alkalinity (carbonate hardness)}$$

when all are expressed as calcium carbonate ($CaCO_3$). *See also* carbonate hardness; hardness; total hardness.

noncensored (NC) data Data that include analytical results below the minimum detection level.

nonchlorine preoxidant An oxidant other than chlorine used to treat source water, e.g., ozone or potassium permanganate ($KMnO_4$). *See also* oxidant; ozone; potassium permanganate.

nonclogging impeller An impeller of the open, closed, or semiclosed type designed with large passages for passing large solids.

noncolloidal NOM A fraction of natural organic matter in dissolved or particular form.

noncommunity water system (NCWS) A public water system that is not a community water system. *See also* community water system; public water system; nontransient, noncommunity water system; transient, noncommunity water system.

noncompliance analysis The process of comparing data on water quality to desirable quality levels for specific uses. If a given value, usually a concentration, is greater than the prescribed value (or lower in the case of dissolved oxygen) or lies outside the prescribed range, then it is defined as a noncompliant value.

noncondensable Pertaining to gaseous matter that is not liquefied under the existing conditions.

nonconsumptive use Water that is drawn for use but is not consumed, such as water diverted for hydroelectric power generation. It also includes such uses as fishing and boating, where water is still available for other uses at the same location.

noncontributing area (1) In hydrology, a drainage area that, because of physical characteristics or topography, does not contribute surface runoff into a river system. (2) In a determination of drainage basin yields, an area that does not contribute either surface water or groundwater runoff.

nonconventional pollutant Any pollutant that is not listed in a statute or that is poorly understood by the scientific community.

nonculturable state A physiological state in which an organism cannot be grown on laboratory culture media used for its detection and enumeration. This condition can develop for some bacteria (including *Escherichia coli* and other enterics) that are exposed to adverse environmental conditions.

nondegradable Resistant to decomposition or decay by biological means, such as bacterial action, or by chemical means, such as oxidation, heat, sunlight, or solvents.

nondepositing velocity The water velocity that will maintain suspended sediment during movement.

nondetection The inability to detect an analyte because the signal from a detector is indistinguishable from the background signal.

noneroding velocity The water velocity that will maintain silt in movement and at the same time will not scour a stream or canal bed. This velocity depends on the material and age of the bed. *See also* safe velocity.

nonfilterable residue (NFR) *See* suspended solids; total suspended solids.

nonflammable Pertaining to materials that do not ignite or burn easily. This term is used as a rating for

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certain products, as shown on material safety data sheets, and certain clothes.

nonflowing well A well that does not discharge water at the surface except through the operation of a pump or other lifting device. Such a well is also called a pump well.

nonfunctional landscaping A built landscape, designed for aesthetics rather than to support a practical use or activity.

nongenotoxic Pertaining to a chemical, usually a carcinogen, for which experimental evidence exists to suggest that its toxic effects are not produced by direct interaction with deoxyribonucleic acid. This particularly poor (but widely used) terminology arises largely because mutation is recognized as an essential part of cancer. In those cases where the cancer is initiated by a chemically induced mutation, the response is considered linear at low doses. If, however, a chemical induces these mutations by some indirect effect (e.g., increasing cell turnover or damaging deoxyribonucleic acid as a result of inflammatory processes that occur only at high doses), the extra risk of cancer would not be predicted to be linear, and the chemical would be termed nongenotoxic. *See also* epigenetic carcinogen; genotoxic; genotoxic carcinogen.

nongovernmental organization (NGO) A nonprofit organization that is independent from government. NGOs usually are funded by charitable organizations and operate on the principles of altruism and voluntarism.

nongraphic data Digital representations of the characteristics, qualities, or relationships of map features and geographic locations, usually stored in conventional alphanumeric formats. The term *nongraphic* is often used to differentiate those data that do not describe the graphic images of the map features. Nongraphic data are often called textual data or attributes. They are related to geographic locations or graphic elements and are linked to them in the geographic information system through common identifiers or other mechanisms. Often, nongraphic data are managed separately from the graphic data because of their different characteristics or their maintenance and use in other systems. Nongraphic data are sometimes referred to as tabular data.

nonhardening salt A salt containing amounts of such agents as calcium chloride ($Ca(Cl)_2$) or magnesium chloride ($Mg(Cl_2)$) that becomes soft or liquid by attracting and absorbing moisture from the air and that prevents salt caking and bridging. *See also* bridging.

nonhealth hazard (1) A cross-connection or potential cross-connection involving any substance that generally would not be a health hazard but would constitute a nuisance, or be aesthetically objectionable, if introduced into the potable water supply. (2) Any contamination that would not be a health hazard but may or may not constitute a nuisance.

nonhydric soil A soil that has developed under predominantly aerobic soil conditions.

nonionic Not having an ionic charge.

nonionic flocculant A polyelectrolyte that has no net electrical charge, e.g., unhydrolyzed polyacrylamides.

nonionic polyelectrolyte A polyelectrolyte that forms both positively and negatively charged ions when dissolved in water.

nonionic polymer A polymer that has no net electrical charge.

nonionic resin An ion-exchange resin without exchangeable charged ions (e.g., chloride (Cl^-) or hydrogen (H^+)). A nonionic resin either can be a macroreticular, nonionic, acrylic ester type or—without ester cross-linking—could have a less polar structure and take the form of a polystyrene ($(C_6H_5CH{:}CH_2)_n$) backbone cross-linked with divinylbenzene ($C_6H_4(CH{:}CH_2)_2$). A nonionic resin is used to isolate and concentrate natural organic matter. The hydrophobic fraction, defined as the organic compounds adsorbed on the acrylic ester polymer resin at acidic pH, represents the most commonly used operational definition of aquatic humic substances. Organic solutes that do not adsorb on the acrylic ester polymer resin at acidic pH are defined as the hydrophilic fraction. The acrylic ester polymer and polystyrene divinylbenzene have been used in tandem for the isolation of both humic substances and hydrophilic acids. *See also* aquatic humic substance; hydrophilic; hydrophobic; natural organic matter; polymer; resin.

nonionic surfactant Any of a general family of surfactants for which the entire molecule remains associated in solution. Nonionic molecules orient themselves at surfaces not by an electrical charge, but having separate grease-solubilizing and water-soluble groups within the molecule.

nonisotopic gene probe A specific sequence of nucleic acid (deoxyribonucleic acid or ribonucleic acid) that has been labeled with a nonradioactive molecule or compound for detection after binding to its complementary sequence.

nonlinear dose response A pattern of frequency or severity of biological response that does not vary directly with the amount of dose of an agent.

nonlinear dose–response curve A graphical presentation of the relationship between degree of exposure to a chemical (dose) and observed biological effect or response. Although nonlinear, the curve may be S-shaped at the doses tested.

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nonlinear margin-of-exposure Terminology used to describe a threshold dose. A margin of exposure is determined by adjusting the threshold dose by the body weight of the protected individual, an uncertainty factor, and a relative source contribution.

nonlinear mode of carcinogenic action Chemicals, or other substances, that produce cancer once exposure has reached a certain threshold dose.

non-Newtonian flow Flow of a fluid having a viscosity that changes with increasing shear rate, e.g., solutions of flocculants. *See also* Newtonian flow.

nonoperating revenue Income of a utility that is not derived from normal operations, such as rents from nonutility facilities, interest on investments or on bank time deposits, and revenue for rendering nonutility services to others. It is also referred to as "other income" in financial statements.

nonparametric data set A set of data in which the individual observations do not follow a normal distribution. Many environmental observations fall in this category by having a significant number of observations that either are not detectable or are at much lower concentrations than the average (mean) value of all the observations. For example, a data set generated by conducting lead or copper corrosion experiments contains high concentrations of the constituents at the beginning of the experiments followed by a prolonged period of very low or nondetectable concentrations. *See also* normal distribution.

nonparametric test A statistical test of significance that is distinguished from parametric tests in that it is applicable with small samples for which the data are not equally spaced, need not be normally distributed, and do not require the population mean, standard deviation, or population proportion parameters that characterize parametric statistics. An example of a data set that requires a nonparametric test is a set of observations in which several of the reported values are indicated as not detectable. Some nonparametric tests (chi-square, for example) have a direct parametric counterpart. When the required assumptions apply, a parametric test will provide greater decision-making sensitivity and should be used; however, when the parametric assumptions are not met, nonparametric tests will avoid incorrect inferences and are clearly superior. In many situations, no parametric approach is available, so the nonparametric tests provide a basis for making statistical inferences that would otherwise not be possible. Frequently used nonparametric tests include the following: the chi-square test (contingency tables), runs test for sequential randomness, Wilcoxon ranked sum test, Mann–Whitney test, Kruskal–Wallis test for independent samples, Friedman test for matched samples, and Spearman's rank correlation test. Each test derives a statistical value from the input data that is then compared to a critical value for the test in order to determine statistical significance. *See also* chi-square distribution.

nonpathogenic Not disease-producing.

nonpoint pollution *See* nonpoint waste source.

nonpoint source (NPS) *See* nonpoint waste source.

nonpoint waste source (1) Waste material that enters a water body from overland flow rather than out of a pipe or channel. (2) An unconfined discharge of waste.

nonpolar organic compound An organic compound having an equal distribution of electrical charges. This type of natural organic matter is more hydrophobic, does not dissolve well in water, and can be easily removed by carbon adsorption processes.

nonporous membrane A membrane that acts as a solute barrier without distinct transmembrane openings and uses a diffusion-controlled mechanism for solute separation (as in reverse osmosis or nanofiltration pressure-driven membrane processes).

nonpotable *See* nonpotable water.

nonpotable reuse The use of reclaimed water for nonpotable purposes (i.e., not intended for direct human consumption). Such water is typically used for lawn watering, ornamental crop irrigation, industrial uses, and other purposes.

nonpotable use Water use for means other than drinking, cooking, or showering and bathing. Typical nonpotable uses include irrigation, maintenance, and some nonfood-producing industrial processes (e.g., cooling tower makeup). The level of treatment required for nonpotable water is less than for drinking water treatment. Treated wastewater can be a source for nonpotable water. Because most water consumption is for nonpotable uses, many water-deficient regions are determining that having separate, dual distribution systems (one each for potable and nonpotable water) is cost-effective and necessary to meet water demand. *See also* nonpotable reuse.

nonpotable water Water that may contain objectionable pollution, contamination, minerals, or infective agents and is considered unsafe, unpalatable, or both for drinking.

nonpurgeable dissolved organic carbon (NPDOC) The fraction of total organic carbon that cannot be removed by purging a sample with an inert gas.

nonpurgeable organic carbon (NPOC) That fraction of total organic carbon not removed after purging a sample with an inert gas. It is sometimes referred to as nonvolatile total organic carbon, but this is not a recommended term. *See also* dissolved organic carbon; particulate organic carbon; purgeable organic carbon; total organic carbon.

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nonreferee method An analytical method for testing drinking water featuring speed and practical usefulness rather than high accuracy. It is used for process control or general information rather than settlement of disputed test results.

nonrevenue water (NRW) Water that is used or lost from a system for which no payment is received.

nonrising-stem valve A gate valve in which the valve stem does not move up or down as the stem is rotated.

nonselective media Microbiological media used for the isolation of a variety of different organisms, unlike selective media, which inhibit the growth of specific microorganisms and allow others to proliferate.

nonsettleable matter *See* nonsettleable solids.

nonsettleable solids Very small, fine suspended solids, typically colloidal particles of less than 0.1 micrometer in diameter, that will not settle to the bottom of a vessel or water body when the water is calm and nonturbulent in what is considered a reasonable time of about 2 hours.

nonsignificant noncomplier (NSNC) A public water system that violates one or more National Primary Drinking Water Regulations but for which the violation is not serious, is infrequent, or is not persistent enough to meet the US Environmental Protection Agency's definition of a significant noncomplier. *See also* significant noncomplier.

nonsilting velocity The water velocity that will maintain silt in movement.

nonsporulating Does not produce spores.

nonstructural lining A protective lining of a water main that does not provide any structural strength, such as a paint or epoxy. *See also* epoxy lining.

nontransient, noncommunity water system (NTNCWS) A public water system that is not a community water system but that regularly serves at least 25 of the same people at least 6 months of the year. Examples of such systems include schools, factories, and hospitals that have their own water supplies. *See also* community water system; public water system; transient, noncommunity water system.

nontributary groundwater Underground water in an aquifer that neither contributes to nor draws from a natural surface stream to any measurable degree.

nonuniform Irregular.

nonuniform flow Flow in which the slope, cross-sectional area, and velocity change from section to section in the channel.

nonviable system A water system with technical, financial, or managerial weaknesses that may make it incapable of providing safe drinking water and complying with drinking water regulations on a continuing basis.

nonvolatile matter Material that is only slightly affected by the actions of organisms and is not lost upon ignition of dry solids at 1,022° Fahrenheit (550° Celsius) (e.g., sand, salt, iron, calcium, and other mineral materials). *See also* fixed matter; fixed solids; inorganic waste; volatile matter; volatile solids.

nonvolatile organic carbon (NVOC) *See* nonpurgeable organic carbon.

nonvolatile residue *See* nonvolatile matter.

nonwetland Any area that has sufficiently dry conditions that hydrophytic vegetation, hydric soils, wetland hydrology, or any combination of these is lacking. It includes upland as well as former wetlands that are effectively drained.

no-observed-adverse-effect level (NOAEL) The maximum dose or exposure of a chemical to which an animal or human has been exposed without an effect that is clearly detrimental to health being produced. This exposure level is the most common point of departure for calculating doses or concentrations of a chemical that can be considered safe. *See also* dose.

no-observed-effect level (NOEL) The maximum dose or exposure of a chemical at which no effect can be detected in an animal or human. Such effects need not be adverse; they simply represent physiological adaptation to an exposure. For example, the no-observed-effect level might refer to an effect on an enzyme activity that is not clearly involved in compromising health or producing overt pathology. *See also* dose.

normal (*N*) (1) A unit of measure for indicating a solution's normality. For example, the equivalent weight of sulfuric acid (H_2SO_4) is 49 (98 [the molecular weight] divided by 2 because two replaceable hydrogen ions are in the acid). Thus, a 1-normal (1*N*) sulfuric acid solution—a solution with a normality of 1—would consist of 49 grams of H_2SO_4 dissolved in each liter of solution. A 2*N* solution would contain 98 grams of H_2SO_4 per liter of solution. (2) A mean or average value established from a series of observations for purposes of comparison of some meteorological or hydrological event. (3) A straight line perpendicular to a surface or to another line. (4) Pertaining to a Gaussian statistical distribution for which the arithmetic and statistical means are equal. (5) Pertaining to hydrocarbon molecules that contain a single unbranched chain of carbon atoms, usually indicated by the prefix *n*- (e.g., *n*-hexane—$CH_3(CH_2)_4CH_3$). *See also* hydrocarbon; normal distribution; normality.

normal circumstance The soil and hydrology conditions that are normally present, without regard to whether the vegetation has been removed.

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normal depletion curve A graphical presentation of the mean of values obtained from a number of groundwater depletion curves.

normal depth (1) The depth of water in an open channel or conduit that occurs when, for a given flow, the velocity is uniform. It is the hypothetical depth under conditions of steady, uniform flow. Under uniform flow conditions, the water depth, flow area, discharge, and velocity distribution at all sections throughout the channel reach remain unchanged; the water surface line and the channel bottom are parallel to each other. Normal depth is also called uniform depth or neutral depth. (2) The depth of water measured perpendicular to the bed.

normal distribution A statistical distribution that is technically called the standard normal density function but is most frequently referred to as the bell curve. It is mathematically described by its probability density function:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{1}{2\sigma^2}(x-\mu)^2\right]$$

Where:

σ = population standard deviation

μ = population mean

x = individual datum value

The normal distribution can take on numerous flat or peaked, narrow or wide appearances, but it is always symmetrical when plotted as a function of the frequency of occurrence. In a normal distribution, the mean and the median are the same number. The shape of the distribution is determined by the mean and standard deviation of a sample taken from a population. All normal distributions are related in a way that makes it possible to use a table of probabilities for one standardized normal distribution to find probabilities for any other distribution in the normal family. The area under the normal distribution can be defined in terms of standard deviations from the mean of the population under consideration. A range of units of one standard deviation on both sides of the mean encompasses 68 percent of the area under the normal curve; two standard deviations include 95 percent of the area under the normal curve; and three standard deviations include virtually 100 percent of the area under the curve. The area under the curve is directly related to the probability of occurrence; hence, the normal curve has extensive applicability in large-sample theory for drawing inferences from sample data. A normal distribution is also called a Gaussian distribution.

normal erosion The erosion of land undisturbed by activities of humans or their agents.

normal flow (1) The flow that prevails for the greatest portion of the time; the mean flow or the average flow. (2) Flow at normal depth.

normal flow filtration The flow of the entire feedwater stream in one direction directly through the filter media. The flow is usually normal, or perpendicular, to the media surface area. *See also* crossflow filtration.

normality (*N*) The number of gram-equivalent weights of solute in 1 liter of solution. The equivalent weight of any material is the weight that would react with or be produced by the reaction of 7.999 grams of oxygen or 1.008 grams of hydrogen. Normality is a convenient unit for certain calculations of quantitative analysis. *See also* normal.

normalization For reverse osmosis and nanofiltration membrane processes, a technique whereby performance data are numerically adjusted to a constant set of conditions for comparison of membrane performance at varying times. The goal of normalization is to eliminate the effects of changing operating variables not related to the physical condition of the membrane, such as feedwater quality and temperature, feed pressure, and recovery. *See also* normalized (permeate) flow; normalized salt (solute) passage.

normalized (permeate) flow For reverse osmosis and nanofiltration membrane processes, the (permeate) flow rate through the membrane calculated by numerically adjusting the actual permeate flow rate to constant operating conditions. *See also* normalization.

normalized flux The normalized permeate flow divided by the membrane area. *See also* normalized (permeate) flow.

normalized head loss Head loss in an operating filter, with the data adjusted (normalized, or standardized) to a standard rate of filtration and a standard water temperature. When clean bed head loss data are normalized for flow rate and water temperature, data collected from different seasons and at different filtration rates can be compared.

normalized salt (solute) passage For reverse osmosis and nanofiltration membrane processes, the (solute) salt passage through the membrane calculated by numerically adjusting the actual salt (solute) passage to constant operating conditions. *See also* normalization.

normal moisture capacity *See* field capacity.

normal pressure (1) The pressure exerted by any substance against a surface in a direction perpendicular to that surface. (2) The mean atmospheric pressure at any place. (3) The pressure exerted most of the time in a fluid system.

normal solution A solution with a normality of 1. *See also* normal; normality.

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normal year A year during which the precipitation or stream flow approximates the average for a long period of record.

Norovirus Genus of viruses in the Caliciviridae family that cause most documented cases of acute nonbacterial gastroenteritis in humans. Formerly called round, structured viruses, human caliciviruses, and Norwalk-like viruses, the genus is subdivided into four genogroups and contains many species and strains, including the Norwalk virus.

NORS *See* National Organics Reconnaissance Survey.

North American Development Bank (NADB) An institution financed, established, and capitalized by the United States and Mexico that funds infrastructure projects located within the border region pertaining to municipal solid waste management, wastewater treatment, and potable water supply.

Norwalk virus The causative agent of a gastrointestinal outbreak among schoolchildren and their teachers in Norwalk, Ohio, in 1972. It is one of the viruses that belongs to the *Norovirus* genus (genotype 1) of the family Caliciviridae. The Norwalk virus causes severe gastroenteritis in humans, mostly children.

NOS *See* not otherwise specified.

nosocomial infection An infection acquired in a medical facility, e.g., a hospital. The infection can appear in a patient either before or after discharge. Infections among staff personnel are included.

nosocomial outbreak A disease outbreak that originates or was acquired from a hospital.

Nostoc Genus of cyanobacteria that forms amorphous sheets of gel-bound trichomes (chains of connected cells) in freshwater and moist terrestrial locations. Colonies range from microscopic to more than 8 inches (20 centimeters) in diameter. Some species are symbionts with fungi and plants such as bryophytes, cycads, and angiosperms. *Nostoc rivulare* has been associated with toxic blooms.

not analyzed (NA) A phrase entered into a table of data for a sample that was collected but for which a particular analysis was not performed. The phrase is used because a blank entry might wrongly imply that the parameter was not detected at that site. Because NA is also an abbreviation for "not available" or "not applicable," a footnote to the table should define the abbreviation when first used. *See also* not applicable; not available; not sampled.

not applicable (NA) A phrase used to indicate that a particular analysis is not applicable (or required) for a sample. The phrase is used because a blank entry might wrongly imply that the parameter was not detected at that site. Because NA is also an abbreviation for "not analyzed" or "not available," a footnote to the table should define the abbreviation when first used. *See also* not analyzed; not available.

not available (NA) A phrase used when an interim reporting of data is made and certain data are not yet available. The phrase is used because a blank entry might wrongly imply that the parameter was not detected at that site. Because NA is also an abbreviation for "not analyzed" or "not applicable," a footnote to the table should define the abbreviation when first used. *See also* not analyzed; not applicable.

notch An opening in a dam, spillway, or measuring weir for the passage of water.

notched weir A weir having a substantial width of crest broken at intervals by a notch of known hydraulic characteristics, usually a V-notch. *See also* broad-crested weir; V-notch weir.

not detected (ND) A phrase used in reporting test results to indicate that the substance being tested was not detected at or in excess of the detection limit by the equipment or method being used for the particular test. This term implies that trace amounts of this substance may be present at a level lower than the detection limit of the test equipment and method. *See also* limit of detection.

notice (1) A word used to call attention to information that is especially significant in understanding and operating equipment or processes safely. (2) A statement from a water utility to consumers about drinking water quality (e.g., a boil water advisory) or other water service parameter such as construction activity, reduced water pressure, or other temporary conditions. *See also* boil water advisory; notice of violation; public notification; warning.

Notice of Data Availability (NODA) A notice published in the *Federal Register* by a federal agency to update and inform the public and the regulated community about new information and/or data that will be considered in the development of final regulation.

notice of proposed rule making (NPRM) An official federal agency notice of a proposed rule that is published in the *Federal Register.*

notice of violation (1) An official notice issued by a primacy agency under the Safe Drinking Water Act to a public water system that the system is in violation of a National Primary Drinking Water Regulation. (2) An official statement delivered from a water utility to a water customer informing them that they have violated one or more of the local water utility regulations.

notifiable disease A disease required by statute to be reported to the appropriate public health authority when the diagnosis is made. In the United States, each state, as well as some localities, requires the reporting or notification of some 40 infectious diseases; the

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specific notifiable diseases are based on specific legislation in each jurisdiction.

not otherwise specified (NOS) A phrase used in shipping regulations for generic classes of substances to which a restriction applies and for which individual members are not listed in the regulations. The class of substance should also be identified by its technical name.

not quantitated (NQ) A phrase sometimes used when a parameter is detected at a trace level lower than the quantitation limit, depending on reporting requirements. Because detection of a signal lower than a quantitation limit may represent a false positive (the signal does not correspond to the analyte of interest), many laboratories simply report "not detected" instead of "not quantitated." *See also* not detected.

not reported (NR) A phrase used when data are being reported and a particular value does not meet quality assurance requirements (and that sample has not been reanalyzed or resampled). The phrase should be entered into the table of data for the corresponding sample because a blank entry might wrongly imply that the parameter was not detected at that site. *See also* quality assurance.

not sampled (NS) A phrase used when data are reported for a routine monitoring program and a particular location was not sampled. The phrase is entered into the table of monitoring data for that location because a blank entry might wrongly imply that the parameter was not detected at that site. *See also* not analyzed.

NOX *See Spirillum* NOX.

nozzle (1) A short, cone-shaped tube used as an outlet for a hose or pipe. The velocity of the emerging stream of water is increased by the reduction in cross-sectional area of the nozzle. (2) A short piece of pipe with a flange on one end and a saddle flange on the other end. (3) A side outlet attached to a pipe by such means as riveting, brazing, or welding.

nozzle aerator An aerator consisting of a pressure nozzle through which water is propelled into the air in a fine spray. A nozzle aerator is also called a spray aerator.

nozzle floor A filter floor designed for emplacement of filter nozzles, when nozzles are used in the underdrain system. A nozzle floor is one design that is used for filters employing air scour for media cleaning. *See also* filter underdrain.

nozzle jet The stream of water issuing from the end of a nozzle.

NPDES permit *See* National Pollutant Discharge Elimination System permit.

NPDOC *See* nonpurgeable dissolved organic carbon.

NPDWR *See* National Primary Drinking Water Regulation.

NPL *See* National Priorities List.

NPOC *See* nonpurgeable organic carbon.

NPR *See* node-pair reliability.

NPRM *See* notice of proposed rule making.

NPS *See* nominal pipe size.

NPS (nonpoint source) *See under* nonpoint waste source.

NPSH *See* net positive suction head.

NPV *See* net present value.

NQ *See* not quantitated.

NR *See* not reported.

NRA *See* Negotiated Rulemaking Act.

NRC *See* National Research Council; Nuclear Regulatory Commission.

NRCS *See* Natural Resources Conservation Service.

NRMRL *See* National Risk Management Research Laboratory.

NRR *See* noise reduction rating.

NRW *See* nonrevenue water.

NRWA *See* National Rural Water Association.

NS *See* not sampled.

NSC *See* National Safety Council.

NSDWR *See* National Secondary Drinking Water Regulation.

NSERC *See* Natural Sciences and Engineering Research Council of Canada.

NSF *See* NSF International.

NSF Environmental Technology Verification (ETV) Testing Program A program sponsored by US Environmental Protection Agency's (USEPA) Office of Research and Development (ORD) and conducted by NSF International to develop testing protocols and verify the performance of water treatment-related equipment and processes. NSF International entered into an agreement on October 1, 2000, with the USEPA to form a Drinking Water Systems (DWS) Center dedicated to technology verifications. With assistance through a USEPA grant, NSF manages an Environmental Technology Verification (ETV) Center that provides independent performance evaluations of drinking water technologies. Evaluations are completed using protocols developed with stakeholder involvement. ETV tests and reports are expected to accelerate a technology's entrance into the commercial marketplace by providing consumers with verified results of product evaluations. The ETV DWS Center also develops new protocols for other drinking water treatment system technologies, system components such as media, operation and maintenance devices, and pipe rehabilitation technologies. Additionally, the DWS Center conducts some tests under controlled

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laboratory conditions, to supplement the Center's field testing.

NSF International (NSF) A noncommercial, not-for-profit agency located in Ann Arbor, Mich., and devoted to research, education, and service. Services provided include development of consensus standards, voluntary product testing and certification with policies and practices that protect the integrity of registered trademarks, education and training, and research and demonstration, all relating to public health and the environmental sciences. NSF International was formerly called the National Sanitation Foundation.

NSFNET *See* National Science Foundation Network.

N_{Sh} *See* Sherwood number.

NSNC *See* nonsignificant noncomplier.

NSPE *See* National Society of Professional Engineers.

NSRS *See* National Spatial Reference System.

NTIS *See* National Technical Information Service.

NTNCWS *See* nontransient, noncommunity water system.

N_{total} *See* total nitrogen.

NTP *See* National Toxicology Program.

NTU *See* number of transfer units.

ntu *See* nephelometric turbidity unit *in the Units of Measure section.*

ν (nu) *See* kinematic viscosity.

nuclear energy Energy obtained from an atom in nuclear reactions.

nuclear magnetic resonance (NMR) A spectrometric technique used in the identification of organic compounds. Absorption of electromagnetic radiation depends on the characteristics of the atomic nuclei present in a compound. Proton (H-1) nuclear magnetic resonance and carbon-13 nuclear magnetic resonance are two versions of the technique, each with advantages in the elucidation of molecular structure. Although nuclear magnetic resonance spectrometry is a powerful analytical tool when used in conjunction with other techniques, the related instruments are typically present in research laboratories rather than water utility laboratories.

nuclear magnetic resonance geophysical log A geophysical method that measures the relative volume of bound and mobile fluid in a geologic matrix based on the measured response to an imposed, intermittent magnetic field. Permeability and pore size distribution can be determined through interpretation of nuclear magnetic resonance logs.

nuclear radiation Particulate and electromagnetic radiation emitted from atomic nuclei in various nuclear processes. The important types of nuclear radiation are alpha and beta particles, gamma rays, and neutrons. All types of nuclear radiation are ionizing radiation, capable of producing ions directly or indirectly by their passage through matter, including living tissue.

Nuclear Regulatory Commission (NRC) Governmental group that formulates policies, develops regulations governing nuclear reactor and nuclear material safety, issues orders to licensees, and adjudicates legal matters. The NRC is headed by five commissioners appointed by the President of the United States and confirmed by the Senate for five-year terms. One of them is designated by the president to be the chair and official spokesperson of the NRC. The chair is the principal executive officer of the NRC, responsible for conducting the administrative, organizational, long-range planning, budgetary, and certain personnel functions of the agency. The chair has ultimate authority for all NRC functions pertaining to an emergency involving an NRC license, and his or her actions are governed by the NRC's general policies.

nucleation The process of particles in solution beginning to adhere together following addition of a coagulant, usually with the aid of a catalyst. In some processes, precoagulated or settled sludge is returned or recycled to the point of coagulant addition to serve as the catalyst for the formation of new floc. *See also* nuclei seed addition.

nuclei *See* nucleus.

nucleic acid Any of numerous large acidic biological polymers that are found concentrated in the nuclei of all living cells. Nucleic acids contain phosphoric acid, sugar, and purine ($C_5H_4N_4$) and pyrimidine ($C_4H_4N_2$) bases. Two types are ribonucleic acid and deoxyribonucleic acid.

nucleic acid probe A segment of ribonucleic acid and deoxyribonucleic acid that has been labeled with an enzyme, antigenic substrate, chemiluminescent moiety, or radioisotope and that can bind with high specificity to a complementary sequence of nucleic acid. Many types of nucleic acid probes have been developed for detection of all types of microorganisms.

nuclei seed addition The addition of settled sludge or precoagulated solids to the mixing and coagulation process to serve as a catalyst for the formation of floc. *See also* nucleation.

nucleotide sequence database An electronic resource of deoxyribonucelic acid (DNA) and ribonucleic acid (RNA) sequences submitted from individual researchers, genome sequencing projects, and patent applications. Three well-known databases that exchange and update information daily are GenBank (USA), DNA Database of Japan (DDBJ), and the European Molecular Biology Laboratory–Nucleotide Sequence Database (EMBL-Bank). Sequence information can be accessed for free via the Internet.

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nucleus (1) The center of an atom, classically conceived as made up of positively charged particles called protons and uncharged particles called neutrons. (2) Organized and membrane-bound deoxyribonucleic acid. *See also* neutron; proton.

nuisance bacteria A common term for iron and sulfur bacteria, which are associated with water quality problems involving slime formation, colored water, and tastes and odors. The organisms in this group are morphologically and physiologically diverse and may be filamentous or single-celled, autotrophic or heterotrophic, and aerobic or anaerobic.

nuisance species Species of plants that detract from or interfere with a mitigation project, such as most exotic species and those indigenous species whose populations proliferate to abnormal proportions. Nuisance species may require removal through maintenance programs.

null hypothesis *See* hypothesis; statistically significant.

number-average molecular weight (M_n) The weighted average of the corresponding molecular weights of the individual components of natural organic matter (or some other heterogeneous mixture), as illustrated by the following equation:

$$M_n = \frac{\sum w_i(\mathrm{MW})_i}{\sum w_i}$$

Where:

w_i = the mass of the mixture's *i*th component
$(\mathrm{MW})_i$ = the molecular weight of the mixture's *i*th component

Although the measured value of such a basic compositional property is representative of the mixture as a whole, it is not necessarily representative of any component of the mixture. *See also* molecular weight; natural organic matter.

number of transfer units (NTU) Process design term used in sizing of air stripping towers that, when multiplied by the height of a transfer unit (HTU), is used to determine the required tower height. Dependent on the desired removal efficiency, the air–water ratio, and the Henry's constant; unitless. *See also* air-stripping; height of transfer unit; Henry's constant; Henry's law.

numerator The part of a fraction above the division line. A fraction indicates division of the numerator by the denominator. *See also* denominator.

numerical modeling A technique for mathematically simulating some physical, chemical, or statistical process. *See also* model.

nutating Oscillating or nodding back and forth. Some valve operators utilize a nutating gear motion to generate rotation. The drive gear nutates upon a driven gear with one less tooth, thus producing a rotation. The driven gear advances one tooth for each nutation of the drive gear.

nutating-disk meter An instrument for measuring the flow of a liquid. Liquid passing through a chamber causes a disk to nutate, or roll back and forth. The total number of rolls is then counted.

nutrient An element or compound essential as a raw material for an organism's growth and development. For example, carbon dioxide (CO_2), nitrogen, phosphorus, potassium, and numerous mineral elements are essential plant nutrients, as are water and oxygen.

nutrient cocktail A combination of specific growth substrates and inorganic chemicals that support or favor the growth of microorganisms.

nutrient pollution Contamination of water resources by excessive inputs of nutrients. In surface waters, excess algal production is the major concern. *See also* algal bloom.

NVLAP *See* National Voluntary Laboratory Accreditation Program.

NVOC *See* nonvolatile organic carbon.

NWF *See* National Wildlife Federation.

NWI *See* National Wetlands Inventory.

NWP *See* nationwide permit.

NWRA *See* National Water Resources Association.

NWRI *See* National Water Research Institute.

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O

o *See ortho.*

O_3 *See* ozone.

O&M *See* operations and maintenance.

O_3–bio process *See* ozone–biodegradation process.

object-oriented model A computer model that reflects real-world objects such as rivers or lakes by defining the attributes of the objects and the functions and procedures that relate the objects. For example, a reservoir is an object that has static attributes such as location and dynamic attributes such as the volume of water in storage. Releases and spills from the reservoir are functions and procedures that define the relationship between the reservoir and the next linear object, which is the downstream river reach.

obligate pathogen A pathogenic organism, such as a virus, that is unable to multiply outside a living host.

obligate plant species *See* obligate wetlands species.

obligate upland species A plant species that almost always occurs in uplands but that may rarely (less than 1 percent of the time) be found in wetlands (e.g., shortleaf pine).

obligate wetlands species A plant species that is nearly always found in wetlands. Its frequency of occurrence in wetlands is 99 percent or more.

OBr^- *See* hypobromite ion.

observation An act of watching the performance of an experiment or computer program. An observation is recorded to identify any change in the status of a variable.

observational epidemiologic study A study in which the investigator has no control over the assignment of exposure. The vast majority of epidemiologic studies are observational.

observation bias In epidemiology, systematic error or variation caused by the collection of information on disease in a noncomparable manner from exposed and unexposed groups (for experimental, cohort, or cross-sectional studies) or the collection of information on exposure in a noncomparable manner from cases and controls (for a case–control study). "Blindness" of study participants, investigators, or both and objectivity in obtaining information help minimize this bias. Observation bias is sometimes called information bias. *See also* case-control epidemiologic study; cohort epidemiologic study; cross-sectional epidemiologic study; experimental epidemiologic study.

observation well A well placed near a production well to monitor changes in the aquifer.

observed rate constant A kinetic constant of a biological or chemical reaction that is determined under a specific set of conditions. *Contrast with* intrinsic rate constant.

obsolescence The decrease in the value of assets as a result of economic, social, technical, or legal changes. This type of value reduction is an element of depreciation.

occasional storm A rainfall of an intensity that may be expected to occur once in 10 to 25 years. Such a storm is also called an extraordinary storm.

occlusion An absorption process by which one substance is taken in and retained in the interior rather than on the external surface of another substance, sometimes occurring by coprecipitation.

occupancy A customer service agent's productive time, i.e., when the agent is either engaged in a conversation or logged in and ready to receive a call.

occupational safety A condition of reduced or eliminated dangers, perils, and risks that threaten the safety of a worker performing responsibilities and duties, creating a safe working environment.

Occupational Safety and Health Act of 1970 Public Law 91-596, enacted December 1970. It is designed to prevent injury and death in industry and is administered at the federal level by the Occupational Safety and Health Administration.

Occupational Safety and Health Administration (OSHA) A federal agency in the Department of Labor that administers safety and health regulations and their enforcement.

Occupational Safety and Health Administration (OSHA) 300 log An empolyer log of occupational injuries and illnesses, on which the occurrence, extent, and outcome of each case are recorded during the year. It is required to be posted for employees to review during the month of February.

Occupational Safety and Health Administration (OSHA) 301 log A form required for every entry on the Occupational Safety and Health Administration 300 log. The 301 supplements the 300 log with greater detail about an event. A state's worker's compensation form or an insurance company report is an acceptable substitute, as long as it includes the same information as the federal 301 form.

Occupational Safety and Health Review Commission (OSHRC) A federal commission that reviews and decides the outcome of contested citations and penalties that are issued by the Occupational Safety and Health Administration.

ocean disposal A method of providing ultimate disposal of residuals (e.g., sludge) in which the residuals

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are discharged into an ocean environment. In general, the disposal is conducted under conditions where it has been determined that the practice will not adversely affect the environmental conditions surrounding the discharge location.

Ocean Dumping Act (ODA) A federal act that, as amended (33 US Code Sections 1401, 1445), regulates intentional ocean disposal of materials and authorizes related research. The act is administered by the US Environmental Protection Agency, US Army Corps of Engineers, National Oceanic and Atmospheric Administration, and the US Coast Guard.

oceanic climate A climate in which the meteorological phenomena are primarily influenced by the ocean. Such a climate is characterized by relatively high humidity and fairly uniform temperatures and is also called a marine climate.

ocean outfall Facilities for the discharge of waters (such as storm drainage, wastewater treatment plant effluent, or membrane treatment waste concentrate) into the ocean.

ocean water Seawater generally having a salinity of approximately 30,000–55,000 milligrams per liter total dissolved solids, depending on location.

OCl^- *See* hypochlorite ion.

OCR *See* optical character recognition.

OD *See* outside diameter.

ODA *See* Ocean Dumping Act.

odds ratio (OR) The odds (chance) of an exposed person having a given disease divided by the odds of an unexposed person having the disease. In case-control studies, the odds ratio is the odds of exposure among cases divided by the odds of exposure among controls. The odds ratio is equivalent to the rate ratio, especially if the disease is rare, e.g., cancer. *See also* case-control epidemiologic study; rate ratio.

odor A quality of something that stimulates the olfactory organ (i.e., its smell). Many compounds have a characteristic odor that serves as an effective means of identification.

odor control The elimination or reduction of odors in a drinking water supply by aeration, algae elimination, superchlorination, activated carbon treatment, and other methods. *See also* odor threshold concentration; threshold odor number.

odor test, 2 out of 5 A test designed to determine noticeable odor differences between water samples. The test requires only one to five persons with minimal training. The test can determine if a water sample really has an odor that consumers may notice. *See also* odor.

odor threshold *See* threshold odor.

odor threshold concentration (OTC) The concentration of a chemical compound in water at which the odor detection threshold is surpassed for 50 percent of a group of subjects. The odor detection threshold of a substance is defined as the concentration at which a subject gives a positive response in 50 percent of the cases in which the stimulus is presented. Thus, individual odor detection thresholds are evaluated, and from that data the odor threshold concentration of the compound (for the group of testers) is determined. Individuals differ appreciably in sensitivity to odors. Inter-individual differences in sensitivity show a range of 100 to 10,000 as indicated by threshold determinations. Small parts of the population are even odor-blind (anosmic) to certain compounds. Thus, odor threshold concentrations in the literature may differ depending on the test methods used and the sensitivity of the subjects. *See also* odor; threshold odor number.

odor unit (OU) *See* threshold odor number.

OEEI *See* Office of Energy and Environmental Industries.

OEI *See* Office of Environmental Information.

OEM *See* original equipment manufacturer.

***o*-ethyl *s*-2-diisopropylaminoethylmethyl phosphonothiolate (VX) ($C_{11}H_{26}NO_2PS$)** *See under* ethyl *s*-2-diisopropylaminoethylmethyl phosphonothiolate.

off-gas Air or vapor given off or expelled as a by-product or result of an operation or treatment process.

Office of Energy and Environmental Industries (OEEI) The principal resource and key contact point within the US Department of Commerce for American environmental technology companies. OEEI's goal is to facilitate and increase US exports of environmental goods and services by providing support and guidance to US exporters.

Office of Environmental Information (OEI) The office within the US Environmental Protection Agency responsible for information management and computer services.

Office of General Counsel (OGC) The US Environmental Protection Agency office responsible for the legal affairs of the agency.

Office of Ground Water and Drinking Water (OGWDW) The US Environmental Protection Agency office responsible for development and implementation of National Primary Drinking Water Regulations and the Public Water Supply Supervision program.

Office of Information and Regulatory Affairs (OIRA) The office within the Office of Management and Budget responsible for reviewing federal agency regulatory actions.

Office of Management and Budget (OMB) The agency of the executive branch of the federal government that has the following responsibilities: to assist

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the president in preparing the budget and in formulating the US government's fiscal program; to supervise and control the administration of the budget; to assist the president by clearing and coordinating department advice on proposed legislation and by making recommendations concerning presidential action on legislative enactments; to assist in developing regulatory reform proposals and programs for paperwork reduction; to assist in considering, clearing, and, where necessary, preparing proposed executive orders and proclamations; to plan and develop information systems that provide the president with program performance data; to plan, conduct, and promote evaluation efforts that assist the president in assessing program objectives, performance, and efficiency; and to keep the president informed of the progress of activities by US government agencies with respect to work proposed, initiated, and completed, together with the relative timing of work among the several agencies of the government, all to the end that the work programs of the executive branch agencies may be coordinated and that the moneys appropriated by Congress may be expended in the most economical manner.

Office of Pesticide Programs (OPP) The US Environmental Protection Agency office that regulates the use of all pesticides in the United States and establishes maximum levels for pesticide residues in food, thereby safeguarding the nation's food supply. In addition to regulatory functions, OPP's programs include providing information and coordination on issues ranging from worker protection to prevention of misuse of pesticides. OPP also participates in a variety of partnerships related to pesticide use.

Office of Pollution Prevention and Toxics (OPPT) The US Environmental Protection Agency office responsible for promoting the use of safer chemicals, processes, and technologies; promoting life-cycle management of environmental problems such as asbestos; advancing pollution prevention through voluntary action by industry; and promoting the public's right to know.

Office of Prevention, Pesticides, and Toxic Substances (OPPTS) The US Environmental Protection Agency office that protects public health and the environment from potential risk from toxic chemicals. OPPTS promotes pollution prevention and the public's right to know about chemical risks, evaluates pesticides and chemicals to protect human health and prevent environmental harm, and addresses emerging issues.

Office of Research and Development (ORD) The office within the US Environmental Protection Agency responsible for conducting and funding research to support agency regulatory programs.

Office of Saline Water (OSW) A governmental organization created in 1955 under the US Department of the Interior and abolished by merger with the Office of Water Resources Research in 1974. Its mission was to administer research and development programs in the area of desalination pursuant to the Saline Water Conversion Act. Its successor agency was the Office of Water Research and Technology (OWRT), the US Department of the Interior.

Office of Science Coordination and Policy (OSCP) The US Environmental Protection Agency office that provides coordination, leadership, peer review, and synthesis of science and science policy within the Office of Prevention, Pesticides, and Toxic Substances (OPPTS). Program areas under OSCP include biotechnology, endocrine disruptors, and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Scientific Advisory Panel (SAP).

Office of Water Research and Technology (OWRT) A US governmental organization created by the merger of the Office of Saline Water (OSW) and Office of Water Resources Research in 1974 under the US Department of Interior and abolished in 1982. Its mission was to administer research and development programs in the area of desalination. OWRT and its predecessor, OSW, were instrumental in much of the early development of desalination and membrane treatment technologies.

official statement A document that contains all the information about a bond issue that a potential investor is expected to need about the bond and the issuer. The preliminary official statement is issued before the sale; the final official statement is issued within 10 days after the sale and includes the prices at which the securities were offered to the public.

off-peak Pertaining to periods of time when customer demands for water are low.

off-peak power That part of the available load or energy that can be produced at off-peak hours outside the power load curve when the combined primary and secondary load has fallen to less than plant capacity.

off-peak rate A separate, lower-than-average unit charge applied to water delivered during off-peak periods.

offset (1) The difference between the actual value and the desired value (or set point), characteristic of proportional controllers that do not incorporate reset action. This type of offset is also called drift. (2) A combination of elbows or bends that brings one section of a line of pipe out of line with, but into a line parallel with, another section. (3) A pipe fitting in the approximate form of a reverse curve, made to accomplish the same purpose.

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offset bend Pipe fitting constructed in a long S-shape (reverse curve) to connect pipes that are not in alignment or to provide a slight alignment change when necessary to go past an obstruction. The use of two offset bends near each other will allow a change in alignment and place the pipe back on the original alignment after going under or around an obstruction.

offset error A small process error that results from proportional control action whenever a load changes.

off-site (1) Not on the same parcel as a wetland that has been adversely affected by a regulated activity. (2) Remote; not nearby.

off-site meter reading (OMR) A process whereby a meter reader, either walking or driving, obtains a reading from the vicinity of the water meter without directly contacting it.

offstream use Water withdrawn from surface or groundwater sources for use at another place.

OGC *See* Office of General Counsel.

ogee A reverse curve shaped like an elongated letter *S*. The downstream faces of overflow dams are often made to have this shape.

OGWDW *See* Office of Ground Water and Drinking Water.

OH^- *See* hydroxide ion.

ohm (Ω) *See in the Units of Measure section.*

Ohm's law A fundamental law of electricity that relates electromotive force to current and resistance. Ohm's law states that 1 volt of electromotive force will cause 1 ampere of current to flow through 1 ohm of resistance. It is written as

$$E = IR$$

Where:

E = electromotive force, in volts
I = current flow, in amperes
R = resistance, in ohms

O_3–H_2O_2 process *See* ozone–hydrogen peroxide process.

OID *See* original-issue discount bond.

oil Any of a wide range of viscous substances that are quite different in chemical nature. Oils derived from animals or from plant seeds or nuts are almost chemically identical with fats, the only difference being one of consistency at room temperature. Petroleum (rock oil) is composed of hydrocarbon mixtures comprising hundreds of chemical compounds. *See also* grease; hydrocarbon.

oil of vitriol Obsolete term for sulfuric acid (H_2SO_4).

oil well flooding *See* water flooding.

OIRA *See* Office of Information and Regulatory Affairs.

old river (1) A river in which all members are graded. (2) A stream system in which all channels, including wet weather rills, are subject to aggradation. It has a wide floodplain, broad meander belt, and gentle slopes.

old valley A stream valley that has reached the last stage of development. Such valleys have very wide, flat bottoms, low and more or less indistinct sidewalls, and stream channels that meander from side to side of the valley bottoms.

oleum A solution of sulfuric acid (H_2SO_4) and sulfur trioxide (SO_3) that is a form of fuming sulfuric acid. The term is used to describe a stage in the production of sulfuric acid.

olfactory fatigue A condition in which a person's nose, after exposure to certain odors, is no longer able to detect the odor.

oligodynamic action The bacteriostatic action exerted by very small amounts of heavy metals, such as copper, silver, and zinc, that deactivates bacteria and creates a hostile environment for the growth of bacterial colonies.

oligonucleotide A synthetically made, single strand of deoxyribonucleic acid, 10 to 25 bases in length, that is complementary to a specific sequence in the target organism's chromosome. An oligonucleotide is usually labeled with a radioactive or nonradioactive molecule and used as a probe for detecting organisms.

oligonucleotide probe A deoxyribonucleic acid or ribonucleic acid probe with fewer than 50 base pairs.

oligotrophic Pertaining to water bodies that are poor in such nutrients as phosphorus, nitrogen, and calcium but have abundant oxygen at all depths. Such waters support little growth of plankton. *Contrast with* eutrophic.

oligotrophic lake A deep, steep-sided lake containing little organic matter and a low level of nutrients. Because of its depth, low level of photosynthesis, limited bacterial action, and narrow littoral zone, the lake's hypolimnion possesses a high level of oxygen. *See also* hypolimnion.

oligotrophic water Water having a low level of nutrients and supporting little organic production.

oligotrophic water quality *See* oligotrophic water.

OM *See* organic matter.

OMB *See* Office of Management and Budget.

ombrometer A rain gauge.

Ω (omega) *See* ohm *in the Units of Measure section.*

ω (omega) *See* angular frequency.

omega (Ω) *See* ohm *in the Units of Measure section.*

omega (ω) *See* angular frequency.

OMR *See* off-site meter reading.

once-through operation A process operation without recycle, reuse, or recirculating flow streams. For example, with once-through cooling systems, the cooling water is used only one time before being discharged to waste.

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oncogene A gene that has been altered in expression or by mutation, resulting in disruption of normal control of cell division and thus giving rise to tumors. The corresponding normal genes are referred to as protooncogenes. Activation of oncogenes has been associated with a number of carcinogenic chemicals found in drinking water.

oncogenic Tending to cause the formation of tumors.

oncology The study of cancer.

1-bromo-1,1-dichloropropanone *See under* bromo-1,1-dichloropropanone.

1,4-dioxane *See under* dioxane.

one-hit model An extrapolation model that assumes a linear relationship between the probability of inducing pathology (e.g., cancer) and the dose of a chemical carcinogen. This model implicitly assumes that only a single irreversible change (hit, i.e., mutation) is necessary to produce cancer. Although this assumption may apply to certain tumors that arise in early childhood (i.e., have very short latent periods), it is not consistent with the development of most human cancers. *See also* linearized multistage model; log-probit model; logit model; multihit model; multistage model; probit model; Weibull model.

one hundred year (100-year) flood The flood with an average frequency of occurrence of once in 100 years, now usually the design flood for most federal and state water resource agencies.

1,1-dibromopropanone *See under* dibromopropanone.

1,1-dichloroethane *See under* dichloroethane.

1,1-dichloroethylene *See under* dichloroethylene.

1,1-dichloropropanone *See under* dichloropropanone.

1,1-dichloropropene *See under* dichloropropene.

1,1,1-dibromochloropropanone
See under dibromochloropropanone.

1,1,1-dichloropropanone
See under dichloropropanone.

1,1,1,3-tetrachloropropanone
See under tetrachloropropanone.

1,1,1-tribromopropanone
See under tribromopropanone.

1,1,1-trichloroacetone *See under* trichloroacetone.

1,1,1-trichloroethane *See under* trichloroethane.

1,1,1-trichloropropanone *See under* trichloropropanone.

1,1,3-tribromopropanone
See under tribromopropanone.

1,1,3,3-tetrabromopropanone
See under tetrabromopropanone.

1,1,3,3-tetrachloropropanone
See under tetrachloropropanone.

1,1,3-trichloropropanone
See under trichloropropanone.

1,1,2-trichloroethane *See under* trichloroethane.

1,1,2,2-tetrachloroethane *See under* tetrachloroethane.

one-tailed test A statistical procedure to determine the significance of the difference between the respective means of two data distributions. In a one-tailed test, the difference in only one direction (i.e., either greater or smaller) is considered. For example, a one-tailed t-test can be performed to determine whether ferric chloride ($FeCl_3$) is a better coagulant than alum ($Al_2(SO_4)_3 \cdot 14H_2O$) for turbidity removal. In a two-tailed test, differences in either direction are considered. For example, a two-tailed t-test can be performed to evaluate whether membrane units manufactured by one company are any different from those manufactured by another company with respect to *Giardia* removal. *See also* two-tailed test.

1,3-dichloropropane *See under* dichloropropane.

1,3-dichloropropanone *See under* dichloropropanone.

1,3-dichloropropene *See under* dichloropropene.

1,2-dibromo-3-chloropropane *See under* dibromo-3-chloropropane.

1,2-dichloroethane *See under* dichloroethane.

1,2-dichloroethylene *See under* dichloroethylene.

1,2-dichloropropanone *See under* dichloropropanone.

1,2-diphenylhydrazine *See under* diphenylhydrazine.

1,2,4-trichlorobenzene *See under* trichlorobenzene.

1,2,4-trimethylbenzene *See under* trimethylbenzene.

1,2,3-trichloropropanone *See under* trichloropropanone.

one-way analysis of variance A statistical procedure that compares the means of several normally distributed data sets to test the hypothesis that the data sets are statistically similar.

on-line turbidimeter A turbidimeter that continuously samples, monitors, and records turbidity levels in water. *See also* turbidimeter.

on–off differential control A mode of controlling equipment in which the equipment is turned fully on when a measured parameter reaches a preset value, then turned fully off when it returns to another preset value.

on-peak Pertaining to short periods of time when customer demands for water are high.

ONPG (*ortho*-nitrophenyl-β-D-galactopyranoside)
See under minimal medium; *see also under* nitrophenyl-β-D-galactopyranoside.

ONPG–MUG (also MMO-MUG) *See under* minimal medium.

on-site (1) On the same parcel at which a wetland has been adversely affected by a regulated activity. (2) At the same location where a given structure exists or activity is taking place.

on-site assessment A method of determining the capability and qualifications of a laboratory to perform specific environmental analyses. The term is used as an integral part of the National Environmental Laboratory Accreditation Program of the NELAC Institute (TNI). An assessment team would visit a laboratory

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and audit various aspects of the operation. Such an assessment would include a review of policies, procedures, records, analysts, analytical instruments, and supplies for the purpose of judging compliance with accreditation standards. *See also* National Environmental Laboratory Accreditation Program.

oocyst A structure that is produced by two coccidian protozoa (i.e., *Cryptosporidium*) as a result of sexual reproduction during the life cycle. The oocyst is usually the infectious and environmental stage, and it contains sporozoites. For the enteric protozoa, the oocyst is excreted in the feces. *See also Cryptosporidium.*

oocyte The germ cell within the ovary.

oogenesis The production of germ cells in a female. In humans this occurs prior to birth when primordial germ cells become segregated from somatic cells. Thus, the female is born with her full complement of germ cells. This is in contrast to the male, for whom sperm are produced throughout adult life. Oogenesis is important in evaluating reproductive toxicology.

opacity The capacity of matter to block the passage of light or other radiant energy, such as heat. One measure of opacity is the percentage of light transmission through a plume. Opacity is the opposite of transparency, and an object with a high degree of opacity is said to be opaque. For example, milk has much higher opacity than drinking water.

open architecture system A software program for computer operations that is open to the public and whose source code is public information. The benefit is that other software designers can develop applications that will run add-ons to that system. The opposite of open architecture is closed or proprietary software that cannot be adapted by others for add-ons because the source code is confidential.

open book method Cost-saving incentives in a design-build project, given to all parties when joint venture partners provide a guaranteed maximum price to the owner and savings are shared if actual costs of purchased equipment and subcontracts are lower.

open-bottomed well *See* open-ended well.

open centrifugal pump A centrifugal pump in which the impeller is built with a set of independent vanes.

open channel Any natural or artificial waterway or conduit in which water flows with a free surface.

open-channel constriction (1) Any obstruction that reduces the normal cross section of a channel. (2) In a general sense, any type of constriction in an open channel, whether natural or artificial, such as a dam, bridge, or culvert.

open-channel drainage Drainage accomplished by open channels or ditches.

open-channel flow Flow of a liquid with its surface exposed to the atmosphere. The conduit may be an open channel or a closed conduit flowing partly full.

open conduit In general, an open artificial or natural duct for conveying fluids.

open dumping Disposal of trash in an open area with incidental burning and without covering.

open-ended well A well in which the lower end of the casing at the bottom of the well is left open or unobstructed to permit entrance of water. The casing may have other openings. Such a well is also called an open-bottomed well.

open fire line A fire line or fire system that is connected to a distribution system and contains fire hydrants or fire hose connections through which water can easily be discharged from the system. These systems are usually metered.

open impeller An impeller without attached sidewalls.

open-loop control A computer-based form of control that advises the operator of system status and then sequences the operation of pumps and valves in response to the operator's commands.

open storage Uncovered storage of water in reservoirs that are not enclosed.

Open Systems Interconnection (OSI) model A structure for standard interfaces and communication protocols developed and promoted by the International Organization for Standardization. The model addresses low-level communications (e.g., physical and electrical interfaces, basic network protocols) as well as higher-level communications (e.g., network routing, error correction, communication between application software programs).

open trench replacement of lead pipe The removal and replacement of an existing lead pipe with an approved pipe material by excavation and backfill methods.

open well A well that is large enough to allow a person to enter it and descend in it to the water level. Wells of this class are generally dug wells 3 feet (1 meter) or more in diameter or width.

operant conditioning The process of reshaping the behavior of an animal by interactions with its environment. In behavioral toxicology, behavior can be conditioned by providing positive or negative reinforcement to encourage or discourage particular behavior. Interference with the acquisition or extinction of a particular behavioral pattern as a result of positive or negative reinforcement, respectively, is frequently used during tests for the ability of a chemical to interfere with learning.

operating cost The continuing costs involved in running a business, excluding capital costs of acquiring personal and real property required for the business.

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operating cycle (1) In filtration, the complete filter cycle consisting of filter service, backwash, and return to service. (2) In ion exchange, the cycle of service run, backwash and regeneration, slow rinse, fast rinse, and return to service. (3) In membrane processes, the cycle of service run, membrane cleaning, and return to service.

operating expense Expenses necessary for the daily running of an enterprise, rendering of service, and collection of revenue. Such expenses may include the daily costs of maintenance, labor, materials, chemicals, power, and depreciation.

operating floor (1) The floor in a rapid granular filter building on which the operating and indicating devices are generally installed. (2) The floor of a pumping station.

operating nut The end connection of a valve stem, usually a square nut that allows a valve key or operating handle to attach to the valve stem and transmit torque for opening or closing the valve.

operating pressure (1) The manufacturer's specified range of pressure—expressed in pounds per square inch (psi), pascals (Pa), or kilopascals (kPa)—within which a water-processing device or water system is designed to function. A range of 30 pounds per square inch (210 kilopascals) to 100 pounds per square inch (690 kilopascals) is often indicated. Operating pressure is also called working pressure. (2) In membrane systems, the pressure at which feedwater enters the system. It is also called feed pressure.

operating pressure differential The operating pressure range for a hydropneumatic system. For example, a system might operate such that, when the pressure drops to less than 40 pounds per square inch (275 kilopascals) the pump will come on and run until the pressure builds up to 60 pounds per square inch (415 kilopascals), at which point the pump will shut off.

operating reserve Funds set aside by water utilities, to allow for the following possibilities: seasonal variations in cash receipts (summer versus winter water sales); cool, wet weather that curbs irrigation water use in summer; unplanned expenditures stemming from natural disasters, major main breaks, and equipment breakdowns; and any other condition that might require a cash payment that is not provided for in the planned revenue for the budget year. Operating cash reserves are separate from reserves that are dedicated for specific purposes, such as connection charges used for capital improvements, capital replacement reserves, or moneys set aside for debt service. For most water utilities, operating cash reserves are targeted at 20 to 30 percent of total annual operating expenditures (excluding major capital programs and debt service).

operating revenue Revenue derived directly from the operations of the utility, either from the sale of water or from closely allied activities.

operating storage A tank or storage facility supplying a given area that is capable of storing water during hours of low demand for use when demand exceeds the system's pumping capacity to deliver water to the distribution area or district.

operating system (OS) The software that interacts directly with the processing unit to control all basic functions of a computer system, such as allocating memory and disk space; loading programs for execution; and controlling input–output operations, user access, and security. The operating system must reside in memory. Many different manufacturers and software companies have written operating system programs.

operating temperature The manufacturer's recommended feedwater or inlet water temperature for a water treatment system.

operational performance management system (OPMS) A process in which an organization, company, or utility identifies results desired to be achieved in such areas as customer service, human resources, organization, and finance, with tracking and monitoring to measure success.

operational salt efficiency *See* salt efficiency.

operation expense Costs incurred in operating source-of-supply facilities, pumping facilities, water purification facilities, and transmission and distribution facilities, as well as costs for customer accounting, customer services, administration, and general operations.

operations and maintenance (O&M) The ongoing process of carrying out activities necessary to fulfill the mission of an organization and to keep a system in such condition as to be able to achieve those objectives. Operations represent organized procedures for enabling a system to perform its intended function; maintenance represents organized procedures for keeping the system (equipment, plants, facilities) in such condition that it is able to continue performing its intended function.

operations and maintenance (O&M) cost *See* operations and maintenance expenditures.

operations and maintenance (O&M) expenditures All spending to operate and maintain all water treatment and supply facilities from the source of water through the distribution system. It includes labor, benefits, supplies, rent, utilities, furniture and other minor capital, vehicles, computers, travel, subscriptions, and all other line items of cost that are part of the utility's budget system. Although budgetary distinctions are made, for many utilities this category also includes customer service, computer operations, human resources,

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public relations, and executive offices expenditures. Some utilities separately classify some of the nonoperating departments as administrative and general expense and allocate part of it to line departments and to capital projects. Operations and maintenance expenditures include neither major capital programs that are funded from debt or from connection fees nor debt service.

operations and maintenance (O&M) manual Bound information, prepared for a particular system, that defines the equipment included in that system and its proper operation.

operator A person who operates the equipment of a water treatment plant.

operator certification Certification of operators of public water systems and wastewater treatment plants; asbestos specialists, pesticide applicators, hazardous waste transporters, and other such specialists as required by the US Environmental Protection Agency (USEPA) or a state agency implementing a USEPA-approved environmental regulatory program.

operator certification guidelines Guidelines established by the US Environmental Protection Agency Office of Ground Water and Drinking Water under the Safe Drinking Water Act to specify the primacy agency requirements for water system operator certification programs.

operator licensure *See* operator certification.

operator training An educational program for the instruction and development of water treatment plant operators.

operculum A lid or flap covering an aperture, such as the gill cover in some fish or the horny shell cover in snails or other mollusks.

OPMS *See* operational performance management system.

OPP *See* Office of Pesticide Programs.

opportunistic pathogen An organism that is considered nonpathogenic to immunologically competent individuals but can cause disease in individuals who are immunologically compromised because of existing illness or are immunosuppressed because of medical treatment, old age, or very young age.

OPPT *See* Office of Pollution Prevention and Toxics.

OPPTS *See* Office of Prevention, Pesticides, and Toxic Substances.

optical character recognition (OCR) The technology that recognizes and converts human-readable symbols or letters into a digital computer input. Scanners are based on this technology.

optical disc technology The equipment and knowledge that provide the capability to store data on optical disc drives, such as compact discs and laser discs. Optical drives have much greater storage densities than those of magnetic media and allow several gigabytes to be stored on a single disc. Most optical drives use a technique in which a laser burns small impressions on a disc surface. The drive reads data by sensing variations in the light reflected from this surface. Optical drives that can erase and rewrite to discs and can be used to store data, sound graphics, and full-motion video files are common. Optical disc technology is also called optical storage technology.

optical fiber An enclosed bundle of thin, transparent fibers of glass or plastic through which data are transmitted as pulses of light generated by lasers. Optical fibers are widely used in fiber-optic communications.

optical scanner A peripheral device that digitally encodes information in a raster form from hard-copy maps and documents by optically scanning an image consisting of line work, text, and symbols. The scanner senses variations in reflected light from the surface of the document. *See also* raster image.

optic atrophy Degeneration of the eye, associated with methyl mercury (CH_3Hg) poisoning.

optimal point of coagulation The point at which the best floc develops in the shortest time because of selected conditions of pH, mixing, and coagulant–floculant dose.

optimization of corrosion control For the purposes of the Lead and Copper Rule, the treatment that minimizes the lead and copper levels at users' taps while ensuring that the treatment does not cause the water system to violate any national drinking water regulation. *See also* Lead and Copper Rule.

optimized coagulation Coagulation that occurs under conditions—coagulant type, dose, and pH—that achieve the most effective removal of one or more of the following problems: turbidity, particulates, precursors, and disinfection by-products. Normally, optimized conditions are determined by running a series of different coagulant doses and pH levels, varying one parameter at a time. However, achieving optimized conditions for the removal of disinfection by-product precursors may not be practical in high-alkalinity waters. Therefore, the Disinfectants and Disinfection By-Products Rule requires the removal of disinfection by-product precursors by enhanced coagulation rather than optimized coagulation. *See also* coagulation; Disinfectants and Disinfection By-Products Rule; disinfection by-product precursor; enhanced coagulation; jar test.

optimized ribonucleic acid–polymerase chain reaction (optimized RNA–PCR) technology A ribonucleic acid-based polymerase chain reaction protocol that has been optimized in regard to sensitivity and specificity. It is sensitive enough to detect one deoxyribonucleic sequence and specific enough to detect the sequence of interest. It uses a

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ribonucleic acid strand and reverse-transcriptase (a molecule that allows synthesis of deoxyribonucleic acid and ribonucleic acid) to make a deoxyribonucleic clone that is in turn used for geometric amplification.

optimized RNA–PCR technology *See* optimized ribonucleic acid–polymerase chain reaction technology.

OR *See* odds ratio.

oral Of, through, or by the mouth.

oral–fecal transmission *See* fecal–oral transmission.

ORD *See* Office of Research and Development.

ordinary high-water mark That mark on the shore established by the highest nonflood water level and indicated by such physical characteristics as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that account for the characteristics of the surrounding areas.

ordinary storm A rainfall of an intensity that may be expected to occur with an average frequency of once in 5 to 10 years.

organelle A membrane-bound structure that forms part of a microorganism and performs a specialized function.

organic Of, relating to, or derived from living organisms (plants or animals); of, relating to, or containing carbon compounds. *See also* inorganic; organic compound.

organic acid (R–COOH) A carbon-containing acid, as opposed to an inorganic (mineral) acid. *See also* acid; amino acid; carboxylic acid; fatty acid.

organic adsorption The removal of organic chemicals by use of a solid adsorbent, such as activated carbon.

organic carbon Carbon derived from living organisms (plants or animals). *See also* dissolved organic carbon; inorganic carbon; total organic carbon.

organic carbon, dissolved *See* dissolved organic carbon.

organic carbon, total *See* total organic carbon.

organic cartridge An air-purifying filter used with a respirator that is designed to remove organic contaminants from inhaled air. *See also* chemical cartridge.

organic chemical A chemical having a carbon–hydrogen structure.

organic chloramines Organic compounds formed during the chlorination or chloramination of water containing organic nitrogen (e.g., N-chlorodimethylamine, $(CH_3)_2NCl$). Unlike inorganic chloramines (e.g., monochloramine (NH_2Cl), dichloramine ($NHCl_2$)), organic chloramines are not considered to be disinfectants. *See also* chloramines; organic compound; organic nitrogen.

organic compound A carbon-containing compound that is derived from living organisms, e.g., a hydrocarbon, alcohol, ether, aldehyde, ketone, carboxylic acid, or carbohydrate. *See also* alcohol; aldehyde; carboxylic acid; ether; hydrocarbon; ketone.

organic contamination Contamination of water, soil, and so on, with an organic compound, such as a volatile organic chemical or synthetic organic chemical. *See also* organic compound; synthetic organic chemical; volatile organic compound.

organic flocculation A method for concentrating viruses from water samples. Beef extract is the organic substance used to form flocs at a low pH (3.5). Viruses adsorbed to the flocs can be recovered by raising the pH to 9.0 in an eluting solution.

organic-free water Water that does not contain organic substances.

organic halogen A halogen-substituted (e.g., chlorine- or bromine-substituted) organic compound. Most disinfection by-products produced during chlorination are organic halogens. *See also* disinfection by-product; halogen; organic compound.

organic material *See* organic matter.

organic matter (OM) Material substances derived from living organisms (plants or animals). *See also* natural organic matter.

organic matter degradation The breaking down of organic matter into smaller structural units by hydrolysis, reduction, oxidation, or any combination of these, carried out either chemically or biologically.

organic nitrogen Nitrogen chemically bound in organic molecules, such as proteins, amines ($R_{3-x}NH_x$, where $x = 0$, 1, or 2), and amino acids (H_2N–R–COOH).

organic nitrogen–based disinfection by-products A group of disinfection by-products containing organic nitrogen. They are also referred to as nitrogenous disinfection by-products. Haloacetonitriles and *N*-nitrosodimethylamine are two typical examples. *See also* haloacetonitrile; *N*-nitrosodimethylamine; organic chloramines.

organic peroxide (R–O–O–R') Any organic compound containing a bivalent O–O group (i.e., the oxygen atoms are univalent). Such compounds are strong oxidizing agents. Some organic peroxides may be created during the reactions of ozone (O_3) with natural organic matter. *See also* hydrogen peroxide.

organics Organic compounds. *See also* organic compound.

organic substance A chemical substance of animal or vegetable origin and having carbon in its molecular structure.

organism Any individual animal or plant having diverse organs and parts that function together as a whole to maintain life and its activities.

organobromine compound Any organic compound containing bromine as a constituent. Some organobromine compounds are formed when bromine reacts

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with organic substances. Others are synthetic organic chemicals. *See also* bromine-substituted by-product; bromine-substituted organic; synthetic organic chemical.

organochloramine *See* organic chloramines.

organochlorine compound Any organic compound containing chlorine as a constituent. Some organochlorine compounds are formed when chlorine reacts with organic substances. Others are synthetic organic chemicals. *See also* chlorine-substituted by-product; chlorine-substituted organic; synthetic organic chemical.

organochlorine pesticide Any pesticide relating to or belonging to the chlorine-substituted hydrocarbon family.

organoclay A material consisting of bentonite, modified with cationic quaternary amines. Organoclay can be used for organic compounds and trace heavy metals removal in water. It can be used as filter medium or blended with granular activated carbon.

organogenesis The developmental process whereby cells differentiate into the phenotype associated with their function in particular tissues and form into organs.

organoleptic Affecting or employing one or more of the organs of special sense (e.g., sense of smell or taste).

organophilic An affinity for organic compounds; readily combining, absorbing, or dissolving in organic compounds.

organophobic Repelling, tending not to combine with, or incapable of dissolving in organic compounds.

organophosphorus pesticide A pesticide containing phosphorus as a constituent. Such chemicals damage or destroy cholinesterase, the enzyme required for nerve function in an animal body.

organotins A family of alkyl (C_nH_{2n+1}) tin compounds widely used as stabilizers for plastics (e.g., dibutyltin compounds—$(C_4H_9)_2SnX_2$, where X is an organic or inorganic group). *See also* inorganic; organic.

orifice An opening (hole) in a plate, wall, or partition. An orifice flange or plate placed in a pipe consists of a slot or a calibrated circular hole smaller than the pipe diameter. The difference in pressure between a point in the pipe upstream and a point at the orifice may be used to determine the flow in the pipe.

orifice box A stilling basin containing a submerged orifice used for measuring the flow of water or other liquids. *See also* orifice; stilling basin.

orifice feed tank A small tank into which a chemical solution is fed from a large chemical storage tank. An orifice feed tank is used for applying the chemical solution to water.

orifice flow Flow through an orifice. For such flow, the inlet is completely submerged, but discharge from the outlet may occur under free-flow conditions, partially or completely submerged, as in a conduit. *See also* sluice flow.

orifice meter A device or plate with an orifice smaller than the diameter of the pipe, installed between flanges to measure the flow of water in the pipe. The velocity is determined by measuring the drop in pressure as water flows through the smaller circular orifice in the plate. The rate of flow is based on the area and velocity for both the pipe and the orifice.

orifice plate A plate containing an orifice. In pipes, the plate is usually inserted between a pair of flanges, and the orifice is smaller in area than the cross section of the pipe.

orifice velocity The theoretical velocity (V) of water issuing from an orifice or other opening under a given head (H) when the effect of friction is eliminated.

$$V = \sqrt{2gH}$$

Where (in any consistent set of units):

g = the gravitational constant

H = head

orifice with full contraction An orifice placed so that filaments of water approach it freely from all directions.

orifice with suppressed contraction An orifice placed so that some filaments of water must approach it in a direction more nearly parallel to the direction of the jet. If the orifice is flush with a side or a bottom, the contraction on that side of the orifice is wholly suppressed. Rounding the inner edge also suppresses contraction.

original equipment manufacturer (OEM) The company that actually manufactured a component of a preassembled system. All mechanical and electrical systems are made up of components that are manufactured by other equipment manufacturers. Even large companies use components built by someone else and assembled into a complete system. Disk drives and monitors are two examples of such components used in brand-name computers.

original interstice An interstice created when the rock in which it occurs came into existence, as a result of the processes by which the rock was formed. Pores in sand or gravel and open pores in sandstone are typical. An original interstice is also called a primary interstice.

original-issue discount (OID) bond A long-term bond sold at a price below par (stated value) because the interest rate specified for the bond is lower than prevailing market rates. Buying a bond at a discount raises the effective interest rate earned by the investor. For example, a bond with a principal (par) of $100 and paying 5 percent interest per year ($5) might sell for

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$95, yielding an effective interest rate to 5.26 percent ($5 interest payment/$95 invested).

O-ring A round, circular, rubber-material gasket shaped like the letter *O* that is used to seal around round objects, such as the ends of two pipes between the bell and spigot; between a valve stem and valve bonnet; or between a fire hydrant stem and a fire hydrant bonnet. O-rings can vary both in diameter of the gasket and in circular length.

O-ring integrity In a membrane process, the proper seating of the O-rings in the system. *See also* integrity testing; membrane integrity.

ornithine decarboxylase An enzyme important for metabolism. The ability to metabolize the enzyme is a useful measure in differentiating coliform types.

orogeny The process or processes of mountain formation, especially the intense deformation of rocks by faulting and folding that, in many mountainous regions, has been accompanied by invasion of molten rock, metamorphism, and organic eruption.

orographic effect The lifting and cooling of air masses as they flow over mountains, leading to condensation and proportional changes in precipitation rate type (e.g., rain to mixed precipitation to snow) with increasing elevation.

orographic precipitation Precipitation caused by the interference of rising land in the path of moisture-laden wind. A horizontal air current striking a mountain slope is deflected upward, and the consequent dynamic cooling associated with the expansion of the air produces precipitation if the air contains sufficient aqueous vapor. *See also* orographic rainfall.

orographic rainfall Rainfall caused by the interference of rising land in the path of moisture-laden wind. *See also* orographic precipitation.

ORP *See* oxidation–reduction (redox) potential.

Orsat method A gas analysis method that uses a portable apparatus to determine mixtures of methane (CH_4), carbon dioxide (CO_2), carbon monoxide (CO), and molecular oxygen (O_2).

***ortho*- (*o*)** (1) A prefix meaning "straight ahead." This prefix is used in organic chemistry in naming disubstitution products derived from benzene (C_6H_6) in which the substituent atoms or functional groups are located on adjoining carbon atoms. It refers to the 1,2-position. (2) A prefix used in inorganic chemistry to mean the most hydrated form of an acid or its salt, in contrast to a less hydrated form that is indicated by the prefix *meta.* For example, H_3PO_4 is orthophosphoric acid; HPO_3 is metaphosphoric acid. *See also meta; para.*

***ortho*-dichlorobenzene** *See under* dichlorobenzene.

orthokinetic (shear) flocculation A method of agglomerating particles (i.e., making large particles) by the application of external energy to the fluid containing the particles. The agitation or mixing from the external energy results in both spatial and temporal variation in fluid velocity, thus promoting contact between particles that follow the fluid motion. *See also* differential settling; perikinetic flocculation.

***ortho*-nitrophenyl-β-D-galactopyranoside (ONPG)** *See under* nitrophenyl-β-D-galactopyranoside.

***ortho*-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine (PFBHA)** *See under* (pentafluorobenzyl) hydroxylamine.

orthophosphate (1) A salt that contains phosphorus as PO_4^{3-}. (2) A product of the hydrolysis of condensed (polymeric) phosphates. (3) A nutrient required for plant and animal growth. *See also* nutrient.

***ortho*-tolidine** *See under* tolidine arsenite test; tolidine reagent; tolidine test.

OS *See* operating system.

Osborne–Mendel rat A strain of rat used in experimental studies.

oscillation A periodic movement back and forth, or up and down.

Oscillatoria Genus of cyanophyta (cyanobacteria) commonly found in a variety of freshwater environments including hot springs and known for the gliding movement that it exhibits caused by the secretion of mucilage. Trichomes (chains of connected cells) have a bluish-green color and are straight with the apical end slightly bent and rounded, and some species have a small bulbous swelling at each end. *Oscillatoria* does not produce any spores or heterocysts.

OSCP *See* Office of Science Coordination and Policy.

OSHA *See* Occupational Safety and Health Administration.

OSHA 300 log *See* Occupational Safety and Health Administration 300 log.

OSHA 301 log *See* Occupational Safety and Health Administration 301 log.

OSHRC *See* Occupational Safety and Health Review Commission.

OSI model *See* Open Systems Interconnection model.

osmometry The measurement of osmotic pressure (the pressure produced by or associated with osmosis). *See also* osmosis; osmotic pressure.

osmosis A natural phenomenon whereby water (or some other solvent) diffuses from the lower-concentration side to the higher-concentration side of a permselective (semipermeable) membrane barrier in a process of equalizing concentrations on both sides.

osmotic pressure The pressure exerted on a solution as a result of osmosis. It is dependent on the molar concentration of the solutes and the temperature of the solution. An approximation of osmotic pressure for a natural water is 1 pound per square inch (6.9 kilopascals) per

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100 milligrams per liter total dissolved solids. *See also* osmosis.

osmotic water transport The transfer of water from compartments of lower solute concentration through a semipermeable membrane into compartments of higher solute concentration.

osteomyelitis Inflammation of the bone marrow.

osteosarcoma A tumor derived from cells involved in bone formation. This tumor was associated with fluoride in the National Toxicology Program's study of sodium fluoride (NaF).

OSW *See* Office of Saline Water.

OTA test *(ortho*-tolidine arsenite test) *See under* tolidine arsenite test.

OTC *See* odor threshold concentration.

otitis Inflammation of the ear.

OT test *(ortho*-tolidine test) *See under* tolidine test.

ounce (oz) *See in the Units of Measure section.*

ounce-inch (oz-in.) *See in the Units of Measure section.*

outbreak *See* common source epidemic; epidemic.

outcrop (1) That part of a geologic formation or structure that appears at the surface of the earth. (2) Bedrock that is covered only by surficial deposits, such as alluvium.

outfall A conduit through which a treated wastewater flows for ultimate discharge. Outfalls are typically associated with discharges to freshwater or ocean environments.

outflow The act of water moving as in a river.

outlet (1) The downstream opening or discharge end of a pipe, culvert, or canal. (2) An opening near the bottom of a dam for draining the reservoir. (3) In plumbing, a discharge opening for water from the water distributing system to a fixture, to atmospheric pressure (except into an open tank that is part of the water supply system), to a boiler or heating system, or to any water-operated device or equipment that requires water to operate but is not a part of the plumbing system.

outlet channel A channel provided to carry water out of or away from a reservoir, lake, or other body of surface water.

outlet control The mechanical means of controlling the relationship between the headwater elevation and the discharge, placed at the outlet or downstream end of any structure through which water may flow.

outlet hose nozzle The small type of hydrant outlet, usually 2.5 inches (62.5 millimeters) in diameter. It is often called a hose connection.

outlet zone The final zone in a sedimentation basin that provides a smooth transition from the settling zone to the effluent piping.

outlier A point in a graph or data set for which the value is suspiciously different from the others in the group. An outlier may result because of experimental errors or because of unexplained factors that are associated with an observation.

outlying station A remote location of unattended distribution system equipment, such as pumps and valves, controlled by a central station.

out-of-cycle regulations National Primary Drinking Water Regulations that may be established by the US Environmental Protection Agency Office of Ground Water and Drinking Water. These are on a different schedule from the 5-year cycle schedule specified by the Safe Drinking Water Act for regulation of new contaminants selected from the Drinking Water Contaminant Candidate List.

out-of-kind Pertaining to biological characteristics not closely approximating those of a wetland before it was adversely affected by a regulated or agricultural activity.

out-of-kind replacement In wetland restoration, the act of providing or managing substitute resources to replace the functional values of the resources lost. The substitute resources are physically or biologically different from those lost.

outside diameter (OD) The distance from the outside surface of a pipe or cylinder to the opposite outside surface, measured through the center. The outside diameter or dimension of pipe is critical in connecting two pipes or in selecting sleeves, fittings, and repair clamps to be installed on a pipe.

outside-in membrane filtration For hollow-fiber membrane processes, such as some types of microfiltration and ultrafiltration systems, filtration in which the feedwater is applied to the outside (or shell) side of the fibers, and the filtered filtrate/permeate, which passes through the membrane barrier, is collected on the inside (or lumen) of the fibers. *See also* lumen; microfiltration; ultrafiltration.

outsourcing A process or contractual arrangement in which a utility or company utilizes outside vendors or contractors to accomplish prescribed operational or maintenance work, or to design, build, or operate the facility.

outward-flow turbine A reaction turbine in which the water or steam enters the runners and flows radially outward away from the axis of the runner.

ova Mature female germ cells that develop into new organisms of the same species following fertilization. The singular form is *ovum.*

ovality The difference between the maximum and minimum inside measurements from pipe wall to pipe wall through the center point of a pipe for a given length of pipe.

oven A chamber used to dry, burn, or sterilize materials.

overall efficiency, pump *See* wire-to-water efficiency.

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over-and-under baffles A series of physical obstacles within or between unit processes that reduces short-circuiting by requiring the flow to pass over and under the obstacles (called baffles) sequentially. This arrangement often is used in multistage flocculation basins to ensure contact with the mixing devices in each stage. *See also* baffle; end-around baffles; flocculation.

over-and-under flow pattern A hydraulic regime in which a fluid is passed through a series of chambers or basins to reduce short-circuiting or promote particle contact. The basins are separated by baffles that have openings at the bottom or top, in an alternating fashion, to encourage the flow to traverse the cross-sectional area of the basins. *See also* over-and-under baffles.

overbank flow That portion of stream flow that exceeds the carrying capacity of the normal channel and overflows one or more adjoining floodplains.

overburden The soil, silt, sand, gravel, and other unconsolidated material that overlies bedrock in a given location.

overchute A flume to carry water, constructed transversely over a canal.

overdevelopment The act of exceeding the economic yield of groundwater from an aquifer. If the transmissibility of an aquifer is limited, excessive withdrawals in a restricted area may cause local drawdown sufficient to make it uneconomical to continue to withdraw water at that rate, even though the physical yield limit for the entire aquifer has not been reached. Such a condition is called local overdevelopment. *See also* mining groundwater.

overdraft (1) The withdrawal of water from a water supply in excess of the amount that a user has a legal right to take. (2) The withdrawal of water from an aquifer system in excess of the amount that natural replenishment can sustain without permanent adverse effects on the aquifer water quality or some other damage occurring.

overdraw Withdrawing from a bank savings, checking, or similar account more than is on deposit or exceeding authorized credit.

overfall dam A dam constructed with a crest to permit the overflow of water. Such a dam is also called a spillway dam.

overfall weir A device or structure over which water is allowed to flow or waste. *See also* overflow weir.

overfill (1) The part of a dam over which the water spills. (2) The overpouring water.

overflow (1) The water that exceeds the ordinary limits of a containing body, such as the stream banks, the spillway crest, or the ordinary level of a container. (2) To cover or inundate with water or other fluid.

overflow channel An artificial waterway provided to conduct away from the structure the water overflowing from a reservoir, aqueduct, or canal by way of an overflow device provided for that purpose. An overflow channel is also called a spillway channel.

overflowed land (1) Tidal marshes that are periodically submerged and uncovered by the rise and fall of the tides. Such marshes are also called tidelands. (2) River bottomlands or floodplains that are temporarily inundated during high stages of streams.

overflow level The maximum height that water or liquid will rise in a receptacle before it flows over the overflow rim. It is also known as flood level.

overflow rate A unit process attribute expressing the hydraulic surface loading rate on a treatment basin, such as a settling basin. The units of expression, volume per time per surface area (e.g., gallons per day per square foot or cubic meters per day per square meter) are equivalent to the units of velocity, thereby relating to the settling velocity of the "design" particle to be removed. Particles with settling velocities equal to or greater than the overflow rate will theoretically be removed, as will a fraction of the particles with settling velocities less than the overflow rate.

overflow rim The top edge of an open receptacle over which water will flow. It is also known as flood level rim. *See also* flood level rim.

overflow siphon An outlet installed to divert the liquid above the elevation of the overflow by means of a siphon.

overflow standpipe A pipe that is in a water tank and has the top open and lower than the top of the tank, with the bottom curving sideways and passing through the side of the tank. Water that reaches the top of the pipe overflows through the pipe and out of the tank rather than continuing to rise and place pressure on the top of the tank.

overflow stream In geology, a spillway from a standing water body; any effluent of a lake.

overflow tower A vertical outlet from a water conduit under pressure, inserted on summits to limit the pressure on the pipe by allowing water to be diverted when it reaches a given design elevation.

overflow weir A steel or fiberglass plate designed to evenly distribute flow out of a water treatment vessel. In a sedimentation basin, the weir is attached to the effluent launder. *See also* effluent launder.

overhead The general cost of operating a water utility or business.

overland flow Precipitation that gathers together and flows in small rivulets at shallow depths (3–30 millimeters). Overland flow eventually reaches defined channels and becomes streamflow.

overland runoff *See* overland flow.

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overlay (1) A computerized set, or layer, of data that can be superimposed on another layer. An example would be a digitized map with a superimposed layer showing piping systems, data on age and type of pipe, and installation and maintenance history. Many geographic information systems have multiple data overlays. (2) A method of detecting viruses. It involves the use of molten agar mixed with virus and host cells and poured onto an agar-containing petri dish.

overlay map (1) A transparent sheet containing data that is placed over a base map to indicate special features. It is commonly used to represent the growth of a water system through different decades and show the additional demands and facilities needed to keep up with that growth. The use of geographic information system (GIS) maps with different layers for the different decades has replaced overlays in most instances. (2) Software application that allows data to be entered on discrete layers of a map, allowing for features to be turned on and off.

overload relay A switch device used to sense an overloaded electric motor and disconnect it from the power source before the motor is damaged.

overlying use The use that occurs on top of an aquifer.

overpour head gate A canal head gate through which water passes from the river into the canal by discharging over the crest of a wall or the top edge of a gate or flashboards.

overpumping (1) The extraction by pumping of a quantity of water from a groundwater basin or aquifer in excess of the supply to the basin. Such pumping results in a depletion of the basin. (2) A procedure used in well development to create a high velocity of water entering the well screen. The high velocity is useful to suspend and clear away fine-grained materials from the well that would otherwise reduce the quality and quantity of water it produces. *See also* mining groundwater.

override The manual application of a device designed to supplement, correct, or stop the operation of an automatic device or process.

overrun To operate a filter or ion-exchange system beyond its predetermined exhaustion point. As a result, the filter or ion-exchange system is unlikely to be as effective as it should be, and it will probably need some regeneration to restore capacity (for ion exchange) or a cleansing, backwashing, or media or element replacement to reduce head loss and restore capacity (for a mechanical, adsorption, or neutralization filter).

overshot wheel A waterwheel operated by the weight of water falling into buckets attached to the periphery of the wheel.

overspray The application of water via sprinkler irrigation to areas other than the intended area.

overturn The phenomenon of vertical circulation that occurs in large bodies of water—also known as turnover. It is caused by the increase in density of water at temperatures greater or less than 39.2° Fahrenheit (4° Celsius), the temperature of maximum density. In the spring, as the surface of the water warms toward 39.2° Fahrenheit (4° Celsius), the water increases in density, becomes heavier, and tends to sink, producing vertical currents; in the fall, as the surface water cools toward 39.2° Fahrenheit (4° Celsius) and therefore becomes heavier, it also tends to sink. Wind also creates such vertical currents. *See also* destratification; thermal stratification.

over-year storage The accumulation of water in a reservoir during one or several years of greater-than-average supply, the holding of such water for 1 or more years, and the release of it for use during a period of years when the amount of source water supply is insufficient. Over-year storage is also called cyclic storage.

ovicide A chemical compound that kills or inactivates parasite ova. *See also* ova.

ovoid Lemon-shaped.

ovum *See* ova.

own product exclusion A business risk exclusion in which property damage to the named insured's own products arising out of such products or any part of such products is excluded from insurance coverage. *See also* policy exclusion.

OWRT *See* Office of Water Research and Technology.

OX *See* organic halogen.

oxalate–carbon equivalent A surrogate for assimilable organic carbon (AOC) that is based on the assumption that the growth of *Spirillum* NOX on oxalate as a defined medium is equivalent to the growth of *Spirillum* NOX on organic carbon in natural water. Oxalate ($OOCCOO^{-2}$) is a good carbon and energy substrate for *Spirillum* NOX; it is used as a reference growth substrate when *Spirillum* NOX is used in the AOC assay. Reporting AOC–NOX in terms of micrograms oxalate–carbon per liter assumes that the growth yield of *Spirillum* NOX on oxalate is equivalent to the growth yield on naturally occurring AOC in a water sample.

oxalic acid ($H_2C_2O_4$) A carboxylic acid compound that is commonly found in ozonated water as a disinfection by-product.

oxamyl ($(CH_3)_2N–CO–C(SCH_3):N–O–CO–NH–CH_3$) A common name for methyl *N'*-*N'*-dimethyl-*N*-[(methylcarbamoyl)oxy]-1-thiooxamimidate, a synthetic organic chemical used as an insecticide or nematocide. Its presence in drinking water is regulated by

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the US Environmental Protection Agency at a maximum contaminant level of 0.2 milligrams per liter. *See also* insecticide; nematocide; synthetic organic chemical.

oxbow lake An ancient meander that, following a flood and alluviation, formed a neck cutoff that became a lake because the river could not follow. *See also* alluvium.

oxic Pertaining to water that contains dissolved oxygen in solution. An oxic zone in a reservoir, lake, or treatment process is one in which a dissolved oxygen concentration can be measured. *See also* anoxic.

oxidant Any oxidizing agent; a substance that readily oxidizes (removes electrons from) something chemically. Common drinking water oxidants are chlorine (Cl_2), chlorine dioxide (ClO_2), ozone (O_3), and potassium permanganate ($KMnO_4$). Some oxidants also act as disinfectants. *See also* disinfectant; . *Contrast with* reducing agent.

oxidant demand The quantity of oxidant consumed in a specified time period by reaction with substances present in water that exert an oxidant demand (e.g., natural organic matter, ammonia (NH_3), and hydrogen sulfide (H_2S)). The oxidant demand for a given water varies with both contact time and temperature. *See also* chlorine demand.

oxidase Any plant or animal enzyme that acts as an oxidant.

oxidation (1) A process in which a molecule, atom, or ion loses electrons to an oxidant. The oxidized substance (which lost the electrons) increases in positive valence. Oxidation never occurs alone but always as part of an oxidation–reduction (redox) reaction. The reduced substance gains electrons and thereby decreases in positive valence. (2) In electrodialysis, a chemical reaction that occurs at an anode and results in the loss of electrons from the anodic material. (3) In ion exchange, a specific attack on the cross-linking of the copolymer of an ion-exchange resin by an oxidant (e.g., chlorine, hydrogen peroxide (H_2O_2), or ozone (O_3)) leading to degradation (loss of structure of resin beads) and shortening of the resin life. *See also* oxidation–reduction (redox) reaction.

oxidation by-product A compound that is formed during an oxidation reaction but is not related to the purpose of the oxidation. In water treatment, the most common oxidation by-products are formed at microgram-per-liter concentrations during disinfection by chlorination or ozonation. Many oxidation by-products are formed, but only some have been identified. *See also* disinfection by-product.

oxidation half reaction The electrical potential in volts (with the potential of the hydrogen electrode taken as zero volts) of an oxidation reaction (e.g., $NO_2^- + 2OH^- \rightarrow NO_3^- + H_2O + 2e^-$) at equilibrium and under standard conditions with unit activity of the reactants. *See also* reduction half reaction.

oxidation number The number of electrons that must be added or subtracted from an atom in a combined state to convert the atom to the elemental form. For example, in barium chloride ($BaCl_2 = Ba^{2+} + 2\ Cl^-$), the oxidation number of barium is +2 and of chlorine is –1. Many elements can exist in more than one oxidation state. *See also* oxidation state.

oxidation–reduction *See* oxidation–reduction chemistry; oxidation half reaction; oxidation–reduction potential; oxidation–reduction reaction.

oxidation–reduction (redox) chemistry The study of reactions in which electron transfers occur. *See also* oxidation; reduction.

oxidation–reduction (redox) couple *See* oxidation half reaction; reduction half reaction.

oxidation–reduction (redox) potential (pE) (ORP) The potential required to transfer electrons from the oxidant to the reductant, used as a qualitative measure of the state of oxidation in treatment systems. It is a dimensionless value. The more positive the value, the more oxidizing the solution; more negative values represent more reducing conditions. Aerobic waters in equilibrium with the atmosphere have a pE value of approximately +13. Anaerobic waters may have a pE of –4. Because electron activity varies with the pH of water, referring to graphs of pE as a function of pH is often useful. In this manner, the range of thermodynamically stable species can be illustrated. *See also* pH.

oxidation–reduction (redox) reaction A reaction in which electron transfers occur. Oxidation and reduction always occur simultaneously, and the substance that gains electrons (and is thus reduced) is termed the oxidant. *See also* oxidation; reduction.

oxidation state (1) For simple monatomic substances, simply the net charge on the atom. Thus, the oxidation states of the ferrous (Fe^{2+}) and ferric (Fe^{3+}) ions are +2 and +3, respectively. (2) For polyatomic species, a numeric value arbitrarily selected for each atom (based on some limited rules) so as to make the algebraic sum of the oxidation states equal to the net charge on the molecule or ion. Thus, in the case of the hypochlorite ion (OCl^-), with an oxidation state of –2 assigned to oxygen (which is done for all oxygen-containing compounds except for peroxides), the oxidation state of chlorine is +1.

oxidation treatment The process by which, through the action of living organisms in the presence of oxygen, organic matter is converted into a more stable form.

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oxidative dealkylation The removal of an alkyl group (C_nH_{2n+1}) as a result of oxidation. For secondary amines (R–NH–R), tertiary amines (R–N(R')–R''), and ethers (R–O–R'), the products are a simpler amine—primary amine (R–NH_2) or secondary amine (R–NHR)—and alcohol (R–OH), respectively, with the alkyl group leaving as an aldehyde (RCHO). Amine compounds (R_{3-x}–NH_x, where x = 0, 1, 2) or ether compounds (R–O–R') are metabolized by cytochrome P450 enzyme systems to produce the products in vivo. *See also* cytochrome P450.

oxidative deamination The removal of a primary amine (R–NH_2) from an alkyl chain through oxidation of the adjacent carbon. The products are an aldehyde (RCHO) and ammonia (NH_3).

oxidative dehalogenation The removal of a halogen from an organic compound by oxidation of the adjacent carbon–hydrogen bond. It is usually a two-step process, generating a haloalcohol (RX_n–OH, where X = Cl or Br) as an intermediate. The final products are an aldehyde (RCHO) and a haloacid (RX_n–COOH, where X = Cl or Br).

oxide-coated filter media *See* oxide-coated medium.

oxide-coated medium A granular medium or resin having a surface upon which is a layer of material that can participate in oxidation–reduction reactions. An oxide-coated medium is generated when the reduced form of a compound such as manganese dioxide (MnO_2), is deposited on the medium. Alternatively, the medium can be specifically designed with the reduced oxide coating in place to initiate the reaction with the water to be treated. *See also* greensand.

oxidizable salt A salt occurring in solution in groundwater—such as ferrous sulfate ($FeSO_4$), ferrous carbonate ($FeCO_3$), or the corresponding salts of manganese—that may be oxidized to other forms and is deposited from solution upon exposure either to air or to dissolved oxygen in surface water.

oxidize (1) To combine with oxygen. (2) To change a compound by increasing the proportion of the electronegative part or to change an element or ion from a lower to higher oxidation state. (3) To remove one or more electrons from an atom, ion, or molecule. *See also* oxidation; oxidation state.

oxidizing agent *See* oxidant.

oxidizing filter A type of filter used to change the valence state of dissolved molecules, making them insoluble and therefore filterable, e.g., a filter that oxidizes ferrous iron (Fe^{2+}), manganous manganese (Mn^{2+}), anionic sulfur (S^{2-}), or a combination of the three by the use of catalytic media (such as manganic oxides) and then filters the oxidized precipitates out of the water.

oxime (R–C(R')=N–OH) The final product of the reaction of hydroxylamine (H_2NOH) with aldehydes (RCHO) or ketones (R–CO–R') in which the initial addition to the carbonyl group (C=O) is followed by a subsequent dehydration. The formation of oximes is catalyzed by acids. Use of *ortho*-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine in the analysis of aldehydes and ketones yields a fluorinated oxime that can be detected by a gas chromatography electron capture detector. *See also* aldehyde; carbonyl; electron capture detector; ketone; *ortho*-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine.

oxime derivative *See* oxime.

ox-MX *See* (E)-2-chloro-3-(dichloromethyl)-butendioic acid.

oxoacid A class of organic compounds that have both a carbonyl (C=O) and carboxylic acid (COOH) functional group in the chemical structure. Some oxoacids are aldoacids and others are ketoacids. Some oxoacids (e.g., pyruvic acid, $CH_3COCOOH$; glyoxylic acid, OHCCOOH; ketomalonic acid, HOOCCOCOOH; and oxalacetic acid, $HOOCCOCH_2COOH$) are created during the reactions of oxidants used as disinfectants, particularly ozone (O_3), with natural organic matter. *See also* aldoacid; ketoacid.

oxychloride A synonym for hypochlorite. Both sodium hypochlorite and calcium hypochlorite are solid forms of chlorine and commonly used for water disinfection. *See also* chlorine.

oxychlorine residual The residual concentration of the sum of the oxychlorine species (e.g., chlorine dioxide (ClO_2), chlorite ion (ClO_2^-), and chlorate ion (ClO_3^-)). *See also* chlorine dioxide.

oxychlorine species ($Cl_xO_y^z$) A chemical that contains chlorine and oxygen atoms. Common oxychlorine species in drinking water include chlorine dioxide (ClO_2), the chlorite ion (ClO_2^-), and the chlorate ion (ClO_3^-). *See also* chlorate ion; chlorine dioxide; chlorite ion.

oxygen (O) A nonmetallic gaseous element. Molecular oxygen is O_2 and ozone is O_3. Atmospheric oxygen is the result of photosynthesis. *See also* ozone.

oxygen, dissolved *See* dissolved oxygen.

oxygenate A compound containing oxygen in a chain of carbon and hydrogen atoms. Adding oxygenate into gasoline can reduce vehicle emissions and is required in many states. Two common gasoline oxygenates are methyl-*tert*-butyl-ether and ethanol. *See also* methyl-*tert*-butyl-ether.

oxygenation capacity In treatment processes, a measure of the ability of an aerator to supply oxygen to a liquid.

oxygen deficiency A condition in which an atmosphere has less than 19.5 percent oxygen content.

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oxygen deficit The difference between the dissolved oxygen level at saturation and the actual dissolved oxygen concentration in water.

oxygen demand The quantity of oxygen used in the oxidation of substances in a specified time, at a specified temperature, and under specified conditions. *See also* biochemical oxygen demand; chemical oxygen demand.

oxygen depletion A state in which oxygen has been used up so that little or none is left.

oxygen saturation A condition in which a liquid of given chemical characteristics, in equilibrium with the atmosphere, contains the maximum quantity of dissolved oxygen at a given temperature and pressure.

oxygen supply apparatus *See* continuous air supply; self-contained breathing apparatus.

oxygen transfer (1) An exchange of oxygen between a gaseous and a liquid phase. (2) The amount of oxygen absorbed by a liquid compared to the amount fed into the liquid through an aeration or oxygenation device, usually expressed as a percentage. *See also* aeration.

oxyhalide An oxygen- and halogen-containing ion. This term is typically used to refer to the following disinfection by-products: chlorite ion (ClO_2^-), chlorate ion (ClO_3^-), and bromate ion (BrO_3^-). *See also* bromate ion; chlorate ion; chlorite ion.

oz *See* ounce *in the Units of Measure section.*

oz-in. *See* ounce-inch *in the Units of Measure section.*

ozonation The process of applying ozone (O_3) to a liquid for disinfection. *See also* ozone.

ozonation by-product A class of compounds formed when ozone (O_3) is used to disinfect water. Aldehydes (RCHO) and aldoacids (HOOCRCHO) are examples of these compounds; they are formed at microgram-per-liter concentrations. Many ozonation by-products are formed, but only some have been identified. *See also* disinfection by-product.

ozonator A device used to apply ozone (O_3) to a liquid. *See also* ozone.

ozone (O_3) An unstable gas that is toxic to humans and has a pungent odor. It is a more active oxidizing agent than oxygen. It is formed locally in air from lightning or in the stratosphere by ultraviolet irradiation; it inhibits penetration of ultraviolet light from the sun to the earth's surface. It also is produced in automobile engines and contributes to the formation of photochemical smog. For industrial applications, it is usually manufactured at the site of use. It serves as a strong oxidant and disinfectant in the purification of drinking water and as an oxidizing agent in several chemical processes. *See also* disinfectant; oxidant; oxidizing agent; ozonosphere.

ozone (O_3) by-product *See* ozonation by-product.

ozone (O_3) contactor A chamber or basin into which ozone is introduced for the purposes of providing contact with the water to be treated. Because ozone is highly reactive, the contactors are often designed with several chambers into which ozone can be introduced. *See also* ozone.

ozone (O_3) destruction The step by which a component unit of an ozonation system destroys all or some of the ozone present in the off-gas being vented.

ozone (O_3) enrichment A step in the ozonation process in which more ozone is added to a gas that previously contained ozone.

ozone (O_3) generator A mechanical device that produces ozone by applying an electric potential to oxygen. The carrier gas for oxygen can be in the form of either dry air or pure oxygen. *See also* ozone; pure oxygen.

ozone (O_3) half-life The period of time required for 50 percent of a given quantity of ozone to decompose at a specific temperature and pressure.

ozone (O_3) residual The concentration of ozone measured in treated water after its application, typically in units of milligrams per liter. *See also* ozone.

ozone-assisted coagulation A method to improve the coagulation process by using ozone to alter the surface charge on particles. This approach has been reported as a way to reduce coagulant dosages, and it typically works best in low-particle and low–organic content waters with relatively lower coagulant dosages. The dosages used for ozone under these applications may not be sufficient to provide the necessary degree of microbial inactivation, particularly for pathogen cysts such as *Giardia* and oocysts such as *Cryptosporidium.*

ozone–biodegradation (O_3–bio) process An advanced oxidation process in which ozone is added to the process stream to rupture organic molecules, making them more susceptible to biodegradation. This step in the process is followed by a biodegradation step, often a fixed microbial film reactor. *See also* advanced oxidation process; hydroxyl radical; ozone–hydrogen peroxide process; ozone–ultraviolet light process; pulsed ultraviolet light–hydrogen peroxide process; sonolysis; ultraviolet light–hydrogen peroxide process.

ozone chain decomposition cycle A series of complex ozone decomposition reactions involving free radicals. Because of the catalytic effect of free radicals on ozone decomposition, these reactions are commonly depicted as a cycle of reactions.

ozone–hydrogen peroxide (O_3–H_2O_2) process (peroxone process) An advanced oxidation in which hydrogen peroxide (H_2O_2) is added to a process stream followed by ozonation. This combination produces hydroxyl radicals (•OH) that are powerful oxidants. The hydroxyl radicals oxidize the contaminants in the

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process stream. This process is also called the peroxone process and is often used to oxidize taste-and-odor-causing compounds. *See also* advanced oxidation process; hydroxyl radical; ozone–biodegradation process; ozone–ultraviolet light process; pulsed ultraviolet light–hydrogen peroxide process; sonolysis; ultraviolet light–hydrogen peroxide process.

ozone–ultraviolet (O_3–UV) light process A process in which ultraviolet light is used together with ozone to oxidize compounds. The ultraviolet light in this advanced oxidation process catalyzes the decomposition of ozone to hydroxyl radicals (•OH), which are very strong oxidizing compounds. *See also* advanced oxidation process; hydroxyl radical; ozone biodegradation process; ozone–hydrogen peroxide process; pulsed ultraviolet light–hydrogen peroxide process; sonolysis; ultraviolet light–hydrogen peroxide process.

ozonide A compound that occurs as a by-product of ozonation.

ozonizer A device for producing ozone (O_3) from pure oxygen or air. It consists essentially of two electrodes between which a current of the dry gas is passed. High-voltage electric discharges pass through the air between the electrodes and cause ozone to form. *See also* ozonator.

ozonolysis (1) The oxidation of an organic material by ozone (O_3). (2) The use of ozone as a tool in analytical chemistry to locate double bonds in organic compounds.

ozonosphere A region in the upper atmosphere that contains a relatively high concentration of ozone (O_3) and absorbs certain wavelengths of solar ultraviolet radiation that are not screened out by other substances in the atmosphere.

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P

P *See* active power; delta *P.*

P *See* peta; poise *in the Units of Measure section.*

p *See* instantaneous power; *para;* probability value.

P17 *See Pseudomonas fluorescens* strain P17.

PA *See* polyamide.

Pa *See* pascal *in the Units of Measure section.*

PAC *See* powdered activated carbon.

pacing Use of the ratio type of feed-forward control for chemical injection.

package plant A single, compact unit that contains all of the unit processes necessary for treatment. Package plants are typically installed for small systems serving flows less than 1 million gallons per day (3,785 cubic meters per day).

packed bed A filter or ion-exchange bed for which the medium is completely retained so that no bed expansion can occur. No backwash step is used to restratify the media by grain size.

packed bed filter A water treatment unit in which a filtering medium is present with sufficient surface area to promote the removal of contaminants. Packed bed filters include simple rapid granular filters for physical removal of particulates (the granular material is the packing), as well as units with resins for contaminant adsorption or exchange. *See also* adsorption; resin.

packed column A unit designed to transfer contaminants from the liquid to the gaseous phase. The treatment unit, a hollow vertical column, contains packing material that provides surface area over which the liquid to be treated flows, allowing contact between a countercurrent airflow and the liquid and thereby promoting mass transfer. It is also called a packed tower. *See also* air-stripping; degasifier.

packed tower *See* packed column.

packed tower aeration (PTA) A process in which air is introduced into a packed column to promote the transfer of contaminants from the liquid to the gaseous phase. This process is actually misnamed because the contaminants are removed, or stripped, into the gaseous phase and expelled from the column. Thus, a more accurate term would be *packed tower stripping. See also* packed column.

packed tower stripping (PTS) *See* packed tower aeration.

packer In well drilling, a device lowered in the borehole or casing that swells automatically or can be expanded by manipulation from the surface at the correct time to produce a watertight joint against the sides of the borehole or the casing, thus entirely excluding water from higher horizons.

packer assembly An inflatable device used to seal a tremie pipe inside a well casing to prevent grout from entering the inside of the conductor casing. *See also* packer; tremie pipe.

packing (1) Specially prepared material placed in a stuffing box around a pump shaft. The packing prevents air from entering the pump and water from leaking from the pump along the shaft. (2) The material placed in a packed tower to provide a very large surface area over which water must pass to attain a high liquid–gas transfer.

packing gland The designed space between the body of a pump casing and pump shaft where packing material is placed to control the flow of water from the pump along the pump shaft. A follower with bolts in the gland is tightened to compress the packing until the desired amount of water from the pump is released to provide lubrication for the packing against the rotating shaft. *See also* gland.

packing material *See* packing.

pack joint A compression fitting or coupling for connecting service lines. The fitting contains a gasket material. Tightening of the end caps compresses the gasket material against the body of the fitting and service line, making a watertight seal. Some fittings contain a mechanical clamp to squeeze against the service line to prevent the fitting from being moved by pressure.

PACl *See* polyaluminum chloride.

paddle aerator A device, similar in form to a paddle wheel, that is used in aeration of water.

paddle wheel A waterwheel with paddles or strips of wood or other material attached to its periphery. Such a wheel may be constructed inside a tank, or it may be set in a moving stream or under a falling stream of water that causes the wheel to revolve and generate water power. It may also be used in a mechanical flocculator. *See also* flocculation.

paddle-wheel aerator *See* paddle aerator.

PAED *See* pulsed arc electrohydraulic discharge.

P. aeruginosa *See Pseudomonas aeruginosa.*

PAH *See* benzo(a)pyrene; polynuclear aromatic hydrocarbon.

PAHO *See* Pan American Health Organization.

PAHS *See* polyaluminum-hydroxysulfate.

paint A uniformly dispersed mixture having a viscosity ranging from a thin liquid to a semisolid paste and consisting of (1) a drying oil, synthetic resin, or other film-forming component, called the binder; (2) a solvent or thinner; and (3) an organic or inorganic

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pigment. Paints are used (1) to protect a surface from corrosion, oxidation, or other type of deterioration, and (2) to provide decorative effects.

palatability The degree to which water is significantly free of color, turbidity, taste, and odor, is of moderate temperature in summer and winter, and is well-aerated.

palatable Agreeable or pleasant, especially to the sense of taste. *See also* palatability.

P alkalinity *See* alkalinity test.

Palmer–Bowlus flume A device that is inserted into a pipe or channel to measure flow. The flume is designed with a raised floor elevation that creates higher velocity and thus lower surface elevations in the flume. For a given flume diameter, empirical relationships correlate the depth upstream of the flume to the flow rate.

Palmer–Bowlus meter *See* Palmer–Bowlus flume.

palustrine system The system of (1) all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, (2) all such wetlands that occur in tidal areas where salinity caused by ocean-derived salts is less than 500 milligrams per liter, and (3) wetlands lacking such vegetation but having the following characteristics: an area less than 20 acres (80,000 square meters); active-wave-formed or bedrock shoreline features; a water depth in the deepest part of the basin less than 6.5 feet (2 meters) at low water; and a salinity caused by ocean-derived salts that is less than 500 milligrams per liter.

PA membrane *See* polyamide membrane.

Pan American Health Organization (PAHO) An organization of governments of Western Hemisphere nations united to improve physical and mental health in the Americas. Located in Washington, D.C., the Pan American Health Organization coordinates regional activities combating disease, including exchanges of statistical and epidemiological information, development of local health services, and organization of disease control and eradication programs; encourages development in health systems and technology; provides consulting services; conducts educational courses on public health topics, such as environmental health, food and nutrition, and tropical diseases; and awards fellowships for training health services personnel.

pan coefficient The ratio of evaporation from a large body of water to that measured in an evaporation pan.

pancytopenia A blood disorder in which all the formed elements (i.e., red blood cells, white blood cells, platelets) of the blood are sharply depressed relative to normal. The extreme impact of such depressions is aplastic anemia. This type of response can be observed with high benzene (C_6H_6) exposures. *See also* anemia.

pandemic *See* epidemic.

P&ID *See* process and instrumentation diagram.

P&T method *See* purge-and-trap method.

pan evaporation A widely used method to determine the rate of evaporation from a body of water. Water level is monitored, generally in a National Weather Service Class A pan. Pan coefficients are used to calculate the ratios of evaporation between the body of water and the pan of water.

pannier A long wicker basket containing earth or stones, deposited on wire to serve the same purpose as a fascine, which is to prevent stream bank erosion. A pannier is also called a gabion. *See also* fascine.

paper chromatography A method for separating or purifying small amounts of mixtures for identification purposes by spotting the mixture at the bottom of a paper strip and allowing a solvent to move and distribute the components along the strip's path.

PAR *See* population attributable risk.

para (p) A prefix meaning "opposite." This prefix is used in organic chemistry in naming disubstitution products derived from benzene (C_6H_6) in which the second substituent atom or functional group is attached to the opposite carbon atom with respect to the first substituent atom. It represents the 1,4-position. *See also meta; ortho.*

parabolic weir A weir with a notch that is parabolic in shape, with the axis of the parabola vertical.

paracrine Pertaining to one cell affecting another through some signaling process—in contrast with the term autocrine, which applies to self-regulating cells.

***para*-dichlorobenzene** *See under* dichlorobenzene.

parallel misalignment A situation in which the axes of shafts are parallel but not concentric.

paralytic shellfish poisoning (PSP) An illness caused by eating shellfish contaminated with one of a group of toxins that are produced by harmful algae. The toxins, derivatives of saxitoxin, are accumulated in shellfish. Occurrence of paralytic shellfish poisoning is typically associated with "red tide," a marine algal bloom that creates a red tinge to the water.

parameter A water quality attribute. For example, the presence of certain bacteria, the hardness, and the level of sodium are all parameters.

parasitic bacteria Bacteria that live on other living organisms without serving any useful purpose for those organisms.

paratenic host Host of third-stage larvae that infect humans.

paratyphoid Any type of infectious intestinal disease with symptoms similar to typhoid.

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parcel A map feature depicting land ownership and rights. Parcel boundaries are usually described in narrative form on a deed as metes and bounds or as bearings and distances. In much of the United States, the descriptions may refer to the public land survey system townships, ranges, sections, and aliquot parts (half or quarter sections), which are not usually expressed in Système International units.

parcel identification number (PIN) A numbering scheme for identifying parcels of land. Parcel identification schemes range from using simple sequential numbers to using geocodes that also define locations by incorporating *x* and *y* coordinates for a parcel.

parenchyma The tissue characteristic of an organ, as distinguished from connective tissue.

parenchymal cell Any cell that is part of an organ in the body.

parent material Weathered rock material from which soil is formed.

paresthesia Localized numbness. Paresthesia can be produced by a variety of chemicals that have local anesthetic effects. It can also be a symptom of permanent sensory nerve damage induced by a chemical.

Pareto chart A graph showing the major causes of the problem under study in descending order.

Parkinson-like syndrome A constellation of diseases that produce symptoms commonly found with Parkinson's disease. In general, chemicals such as manganese destroy dopaminergic activity within the hippocampus region of the brain.

parshall flume A measuring flume with standard dimensions calibrated for determining the discharge of open channels by measuring the head a specific distance upstream and downstream from the critical area or sill. The surface level is measured in relationship to the bottom or floor level of the flume. The flow is calculated based on this depth or head and on the width of the flume. The downstream water depth does not affect the accuracy of the flow measurement until it exceeds approximately 60 percent of the upstream water depth.

partial diversion The taking or removing of water from one location in a natural drainage area and discharging it at another location in the same drainage area.

partial function outsourcing In some contracts where part of the work required for operation or maintenance within a utility is provided by contract by a private vendor or contractor.

partially suppressed contraction A reduction in the contraction occurring because of the presence of guiding walls that lead the flow to the opening.

partial pressure The pressure exerted by each gas independent of the others in a mixture of gases. The partial pressure of each gas is proportional to the amount (percent by volume) of that gas in the mixture.

partial vacuum A space condition in which the pressure is less than atmospheric.

participation agreement An agreement in which a developer or distributor pays for the cost of the distribution facilities (such as conduits, pump stations, or treated water reservoirs) required to provide service within that district from the nearest existing available source.

participation charge A contribution of capital required by a utility toward the development of water facilities and offered by those causing the incremental service demands.

particle A very tiny, separate subdivision of matter. Particles suspended in water can vary widely in size, shape, density, and charge. Colloidal and dispersed particles are artificially agglomerated by processes of coagulation and flocculation. *See also* coagulation; flocculation.

particle attachment Attachment of particles to filter grains in a granular media filter. Most of the particles in filter influent water are small enough to pass through the pores of the filter bed, so removal must occur by attachment rather than by physical straining. *See also* physical straining.

particle beam mass spectrometry (PBMS) The use of a particular type of interface in liquid chromatography–mass spectrometry. The interface consists of a nebulizer, a heated desolvation chamber, a set of skimmer lenses, and a probe inlet. The solvent must be removed from the liquid chromatography eluent prior to ionization of the sample compounds in the mass spectrometer source. Particle beam instruments can produce electron impact spectra in which analytes ionize into characteristic fragmentation patterns. This fragmentation improves the ability to identify compounds based on a comparison with large computerized databases of mass spectra. The use of such instruments is considered an improvement over older liquid chromatography–mass spectrometry interfaces; however, it still has a number of shortcomings relative to newer interfaces, such as electrospray. *See also* electrospray ionization; liquid chromatography; mass spectrometer interface; nebulizer; solvent.

particle count The results of a microscopic examination of water by a particle counter that classifies suspended particles by number and size. *See also* particle counter.

particle counter An instrument that measures and counts the particles within a given size range in a water sample. These instruments are used to optimize the performance of filters in water treatment plants.

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particle density The mass per unit volume of granular activated carbon, not including the voids between the particles and cracks larger than 0.1 millimeter. It is determined by immersion in mercury and then measuring the displacement of mercury.

particle filtration Filtration of particles having a diameter of 1 micrometer or larger. Particle filtration is typically handled by cartridge filters and media filters.

particle size The average volume or diameter of (1) the particles in a sediment or rock, (2) the grains of a particular mineral that make up a sediment or rock, or (3) the measure of particles in water as characterized by a particle counter.

particle size distribution A representation of the size distribution of a heterogeneous mixture of particles. The distribution is often given as a percentage of the mixture (based on mass) that is less than or equal to a given size.

particulate A very small solid suspended in water that can vary widely in size, shape, density, and electrical charge. Colloidal and dispersed particulates are artificially gathered together by the processes of coagulation and flocculation. *See also* coagulation; flocculation.

particulate matter Minute separate particles of inorganic matter, organic matter, or both. *See also* particulate; particulate organic carbon.

particulate organic carbon (POC) Organic carbon associated with particulates. In analytical terms, it is that portion of the organic carbon in water that is retained on a filter having a pore diameter of 0.45 micrometers or sometimes larger. For most drinking water sources, the particulate organic carbon fraction represents a very low percentage of the total organic carbon pool. However, some river systems—especially during storm events—may experience an increase in particulate organic carbon as a result of runoff. Conventional water treatment processes are generally efficient in removing particulate organic carbon. *See also* dissolved organic carbon; nonpurgeable organic carbon; particulate; purgeable organic carbon; total organic carbon.

partition coefficient A ratio of the molar concentrations of a solute distributed between two phases. It is often used as an expression of extraction efficiency. It is calculated by dividing the mass fraction of solute in the extraction phase by the mass fraction of the solute in the liquid phase remaining after the liquid has been mixed with the extraction phase.

partly submerged orifice An orifice with its bottom below the water discharge surface and its top above the water discharge surface.

partnering A systematic approach to overall project management that promotes a positive working environment among project participants.

Partnership for Safe Water A volunteer initiative by the US Environmental Protection Agency (USEPA), the Association of Metropolitan Water Agencies, the Association of State Drinking Water Administrators, the National Association of Water Companies, the American Water Works Association, and the Water Research Foundation to optimize water treatment to better protect the public from *Cryptosporidium* oocysts. The program began in September 1995 and commits participating water utilities to a four-phase self-assessment program for optimizing their operations. Phase I of the program consists of the agreement to participate and requires the water supplier to have met the Surface Water Treatment Rule for at least 6 months and to pledge to complete phases II and III of the partnership. Phase II consists of data collection, and Phase III consists of a comprehensive water treatment self-assessment package. Phase IV is a third-party assessment via the USEPA Composite Correction Program. *See also* Composite Correction Program.

parts per billion (ppb) *See in the Units of Measure section.*

parts per million (ppm) *See in the Units of Measure section.*

parts per thousand (ppt) *See in the Units of Measure section.*

parts per trillion (ppt) *See in the Units of Measure section.*

PAS *See* periodic acid–Schiff; polyaluminum sulfate; process assistance system.

Pa·s *See* pascal-second *in the Units of Measure section.*

pascal (Pa) *See in the Units of Measure section.*

pascal-second (Pa·s) *See in the Units of Measure section.*

pass For a membrane treatment process, a single treatment step or one of multiple membrane treatment steps producing a product stream. For example, a two-pass seawater reverse osmosis desalting system may include seawater reverse osmosis membranes in the first pass, producing permeate (product) that is then repressurized and further desalted by brackish water reverse osmosis membranes in the second pass, yielding a product water of even lower total dissolved solids. Sometimes a membrane system that contains more than one pass is referred to as a permeate-staged system.

passivating film A thin, protective corrosion control layer formed on the surface of a pipe or other material exposed to potable water in the presence of either certain water quality conditions or a corrosion inhibitor. Either may cause the pipe material and the potable supply to interact in such a way that metal

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compounds are formed on the pipe surface, creating a protective coating of less soluble materials.

passivation A corrosion control technique that causes the pipe materials to create metal/hydroxide/carbonate compounds that form a film on the pipe wall to protect the pipe. *See also* passivating film.

passive circuit A circuit without sources.

passive humoral immunity Immunity attained either naturally by an infant from its mother or artificially by inoculation with specific protective antibodies from immunized animals, convalescent hyperimmune serum, or immune serum globulin from humans.

passivity The phenomenon of an active metal becoming passive, i.e., the state of a metal when its behavior is more noble (resistant to corrosion) than predicted by theory.

Pasteur filter A domestic filter with a filtering medium of unglazed porcelain.

pasteurization A heat treatment process originally developed to preserve wine by killing bacteria that could cause the wine to become sour. Pasteurization is now most commonly associated with treating milk to destroy disease-causing organisms that can be transmitted by contaminated milk, including those that cause tuberculosis, Q fever, typhoid fever, paratyphoid fever, bacillary dysentery, diphtheria, scarlet fever, and foot-and-mouth disease. Pasteurization is not a sterilizing process because it does not kill all organisms present in the milk.

Pasteur pipette A small-diameter glass tube, generally unmarked or ungraduated, with a long tapered tip used for transferring small volumes of liquid culture suspension from one container to another.

patch test A quick test in which a 1-liter sample of filtered water from the treatment plant is filtered through a membrane filter having a 0.45-micrometer pore diameter and allowed to air dry after which the color is observed. Dried membranes are saved to document past performance. This can be used as a means of comparing filter performance from day to day.

P–A test *See* presence–absence test.

pathogen *See* infectious agent; pathogenic organism.

pathogenesis The postulated mechanisms by which an etiologic agent produces disease.

pathogenic Biologically harmful.

pathogenic bacteria Bacteria that cause disease in a host organism.

pathogenic *Escherichia coli* One of four recognized classes of enterovirulent *E. coli* (collectively referred to as the EEC group) that cause gastroenteritis in humans. Among these is the enterohemorrhagic (EHEC) strain designated *E. coli* O157:H7. *See also Escherichia coli* O157:H7.

pathogenicity The ability of an organism or condition to cause disease.

pathogenic organism An organism that can cause disease in a host. *See also* infectious agent.

pathology The study of disease.

path set A chain (sequence) of pipe segments connecting a demand node to a water supply source. A path set must be minimal, i.e., it cannot have any subsets that are also path sets.

pattern diagram A method of visually depicting the relative abundance or absence of dissolved compounds in a water sample.

pat test *See* wet-shake test.

pattiole *See* particle.

payback period The time it takes to be paid back for an investment, such as the time (months or years) it takes for an investment in a water efficiency device to be paid back to the investor in equivalent reduced water and sewer bills and/or other avoided costs as a result of water savings.

payloader A four-wheeled front-end loader used to load trucks with sand, gravel, or earth material from excavations, such as trenches for water lines.

payment in lieu of taxes A payment made to another governmental entity by a government-owned utility to replace taxes that would otherwise have been owed had the utility been a private business.

PBMS *See* particle beam mass spectrometry; performance-based measurement system.

PBPK modeling *See* physiologically based pharmacokinetic modeling.

PBS *See* phosphate-buffered saline.

PBT *See* performance-based training.

PC *See* polycarbonate.

PCB *See* polychlorinated biphenyl.

PCCP *See* prestressed concrete cylinder pipe.

PCE *See* tetrachloroethylene.

pCi *See* picocurie *in the Units of Measure section.*

pCi/L *See* picocuries per liter *in the Units of Measure section.*

PCP *See* pentachlorophenol; personal care product.

PCR *See* polymerase chain reaction.

PCU (platinum-cobalt color unit) *See under* color unit *in the Units of Measure section.*

PDD *See* peak-day demand.

PDM *See* pulse-duration modulation.

PDN *See* predischarge notification.

PDWR (Primary Drinking Water Regulation) *See under* National Primary Drinking Water Regulation.

PE *See* polyethylene; professional engineer.

Pe *See* Peclet number.

pE *See* oxidation–reduction (redox) potential.

P/E *See* precipitation/evaporation ratio.

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peak The highest load carried by an electric generating system or the maximum output of a water treatment plant during any specific period. *See also* peak demand.

peak day The day during which the peak demand for water occurs.

peak-day demand (PDD) The greatest volume per day flowing through a treatment plant for any day of the year.

peak demand The maximum momentary load (expressed as a rate) placed on a water treatment plant, distribution system, or pumping station. It is usually the maximum average load in 1 hour or less, but it may be specified as instantaneous or for some other short time period.

peak excursion evaluation An investigation under the Stage 2 Disinfectants and Disinfection By-Products Rule (Stage 2 DBPR) into the cause of a significant excursion caused by high total trihalomethanes and/or haloacetic acid concentrations in the distribution system.

peak flow Maximum flow.

peak hour The hour during which the peak demand for water occurs.

peak-hour demand (PHD) The greatest volume per hour flowing through a treatment plant for any hour in the year.

peaking costs Capital and operating costs incurred specifically to meet peak demands, e.g., the costs of increasing pipe or reservoir storage capacity to serve a particular area, or a capacity addition required to meet growing summer demand for an entire service area. Peaking costs are usually separated from base volume costs through a cost-of-service formula and are allocated to customer classes in proportion to the classes' peaking characteristics. *See also* base–extra-capacity approach to rate structure design; cost-of-service analysis; inclining block rate; marginal cost; peak-load pricing.

peak load *See* peak demand.

peak-load pricing A pricing scheme designed to charge utility customers a higher rate during peak periods of use. In the electric power industry, supply is engaged in increments to meet sales demands that vary during the day and over seasons of the year because electricity cannot economically be stored in significant quantities. Peak loads, therefore, determine the necessary capacity of the system. Increased prices during peak periods can eliminate or shift demand to nonpeak periods and thereby lower the required capacity. In the off-peak periods, costs should be related only to the production of product; in peak periods, capacity costs must also be recovered in the rate charged. A less pronounced situation (because of the limited opportunity for shifting demand to off-peak periods) can be found in the water industry, which has the capacity to store its product but only limited time-of-day usage information for peak-load pricing. Consequently, for this industry, pricing during peak periods reflects the cost of treatment, distribution lines, and local storage that are put in place to meet peak demands and are recovered entirely from the peak volumes. Avoided costs of additional capacity required to meet peak demands (rather than actual costs of facilities in place) are also used to price peak demands through the use of inclining block or conservation rate structures. *See also* cost of service; inclining block rate; marginal cost; peaking costs.

peak month The month in which the peak water demand occurs.

peak-month demand The greatest volume of water per calendar month passing through a treatment plant during a given year.

peak operating flow The maximum rate of flow under which a treatment unit is designed to properly function and produce a certain quality of product water.

Pearson's correlation matrix A matrix of correlation coefficients between pairs of dependent and independent variables. This type of matrix is calculated to determine the relative dependency of a dependent variable on a number of independent variables.

peat A dark brown or black residue that is produced by the partial decomposition and disintegration of sedges, mosses, trees, and other plants that grow in wet places such as marshes.

peat soil Organic soil that is formed by the accumulation in wet areas of partially decomposed remains of vegetation and that has less than 20 percent mineral material. *See also* muck soil; peat.

Peclet number (Pe) A dimensionless number that expresses the ratio of advective flux to diffusive or dispersive flux in a fluid system. Advective flux is the transport of mass by motion of the host fluid, whereas diffusive or dispersive flux is the transport of mass within the host fluid as a result of concentration gradients. High Peclet numbers are characteristic of diffusion-dominated systems.

pedogenic refractory organic matter (PROM) Refractory natural organic matter originating from soils (as opposed to that originating from aquatic media). *See also* aquagenic organic matter; natural organic matter; refractory organic matter.

peer review An independent, third-party review of the product, study, or report by experts who have not substantially contributed to its development.

PEG *See* polyethylene glycol.

PEL *See* permissible exposure limit.

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pelagic zone The open waters of a sea or lake, especially where the water is more than 65 feet (20 meters) deep.

pellet reactor A conical-shaped tank that is about half filled with calcium carbonate ($CaCO_3$) granules and in which softening takes place quite rapidly as water passes up through the unit.

pellet-softening process A softening process consisting of a conical tank in which the raw water and the lime are introduced tangentially at the bottom of the cone. The reactor is operated hydraulically to keep a bed of fine sand within the reactor fluidized. At elevated pH levels, the sand provides sites for the precipitation of the calcium carbonate to occur. As the calcium carbonate builds up on the sand grains, the sand increases in size and weight and eventually sinks to the bottom of the reactor. Periodically, the calcium carbonate pellets (residuals) must be removed from the reactor bottom, and sand must be added to replace the sand lost to the process. *See also* pellet reactor.

pellicular front The even front, developed only in pervious granular material, on which pellicular water depleted by evaporation, transpiration, or chemical action is regenerated by influent seepage.

pellicular water The film of water left around each grain of water-bearing material after gravity water has been drained off. It is also known as the water of adhesion. It is fixed water that can be extracted by root absorption and evaporation but cannot be moved by gravity or by the unbalanced film forces resulting from localized evaporation and transpiration.

pellicular zone The maximum depth from the natural surface down to which evaporation can have its effect. *See also* pellicular water.

Pelton turbine An impulse turbine mounted on a vertical or horizontal shaft and having curved vanes or buckets attached to its periphery that successively receive a jet from one or more nozzles. The jet, on striking the vane or bucket, is turned approximately 180° and leaves the runner with a low absolute velocity. The turbine speed is regulated by closing or deflecting the nozzle. A Pelton turbine is also called a Pelton wheel and is sometimes used as an energy recovery device in a seawater desalting reverse osmosis system.

Pelton wheel *See* Pelton turbine.

Pelton wheel turbine *See* Pelton turbine.

penetrant In well cleaning, any acid-type product that will penetrate the iron bacteria coating or barrier and allow the chlorine to then attack the bacteria.

penetrometer An instrument used to estimate a soil's compressive strength. Such an instrument is used to help determine the soil type of an excavation.

penstock The pipeline or conduit that carries water under pressure from the forebay or last free water surface to the turbines in a power-generating facility.

pentachlorophenol (PCP) (C_6Cl_5OH) A synthetic organic chemical used as a fungicide, bactericide, algicide, herbicide, and wood preservative. Unlike some chlorophenols, pentachlorophenol is not a disinfection by-product. Pentachlorophenol's presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.001 milligrams per liter. *See also* algicide; bactericide; chlorophenols; fungicide; herbicide.

***ortho*-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine (PFBHA) ($C_6F_5CH_2ONH_2$)** A derivatizing agent in the gas chromatographic determination of carbonyl compounds (i.e., aldehydes and ketones) in aqueous solution. The final product of the reaction of this hydroxylamine with a carbonyl compound is a fluorinated oxime. Fluorine-containing compounds can be detected with good sensitivity by use of an electron capture detector. *See also* carbonyl; derivatization; electron capture detector; oxime.

***ortho*-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine (PFBHA) ($C_6F_5CH_2ONH_2$) derivatization** A chemical reaction in which *ortho*-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine reacts with a carbonyl compound (i.e., aldehyde or ketone) in aqueous solution to form an oxime. This derivatization step is part of the analytical procedure for the detection of aldehydes and ketones in water. *See also* aldehyde; carbonyl; derivatization; oxime; *ortho*-(2,3,4,5,6-pentafluorobenzyl) hydroxylamine.

peplomer A projection extending from the outer surface of a virus envelope.

peptide Any of various natural or synthetic compounds containing two or more amino acids linked by the carboxyl group of one amino acid and the amino group of another.

peptide nucleic acid probe A synthetic deoxyribonucleic acid (DNA) analog to recognize and hybridize to complementary sequences in deoxyribonucleic acid and ribonucleic acid. They are useful in detecting specific nucleic acid sequences.

peptidoglycan Polymer found in bacterial cell walls. *See also* anaerobic bacterial spore.

P/E ratio *See* precipitation/evaporation ratio.

per capita Per person. For example, the total demand of a water treatment system divided by the number of people served provides an estimate of the per capita consumption.

per capita use rate An estimate of the water usage in a community, determined by dividing the total water used by the number of persons using it. It is the average amount of water used by a person within a given

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period of time. It is most commonly expressed in units of gallons (or liters) per capita per day.

percent (%) The fraction of the whole expressed as parts per 100.

percentage reduction The percentage of material removed from water by treatment. It is calculated by dividing the change in concentration through treatment by the concentration prior to treatment and then multiplying by 100 to obtain a percentage.

percentile A point on a frequency distribution indicating what percentage of values are less than or equal to the value being considered. For example, the tenth percentile is the point in a cumulative frequency distribution for which 90 percent of the observations are greater and 10 percent are lesser or equal. Someone who scored in the 78th percentile on a test would have a higher grade than all but 22 percent of those taking the test.

percentile data The percentile values that are obtained after data have been arranged in ascending or descending order so that percentiles can be calculated. Use of percentiles facilitates both the analysis of a large mass of data in a rapid fashion and an understanding of the frequency and magnitude of extremes or peaks in the data set.

percent recovery *See* recovery.

percent salt (or specific solute) passage *See* salt (or specific solute) passage.

percent salt (or specific solute) rejection *See* rejection.

percent saturation The amount or concentration of a substance that is dissolved in a solution divided by the amount or concentration that could be dissolved in the solution and multiplied by 100 to express as a percentage.

percent switch A feature of an irrigation controller that allows percent changes in the duration of programmed irrigation.

perched aquifer A small lens of unconfined groundwater separated from an underlying main body of groundwater by an impermeable unsaturated zone.

perched groundwater The water in a perched aquifer. *See also* perched aquifer.

perched spring A spring that has water from a perched aquifer as its source of supply. *See also* perched aquifer.

perched subsurface stream Vadose water that has concentrated in fractures or solution openings and flows toward the water table in a perched aquifer. *See also* vadose water.

perched water Groundwater occurring in a perched aquifer. *See also* perched aquifer.

perched water table The upper water surface of a perched aquifer. *See also* perched aquifer.

perchlorate (ClO_4^-) A salt or ester of perchloric acid ($HClO_4$), e.g., sodium perchlorate, $NaClO_4$. Sodium perchlorate has been used in explosives, in jet fuel, and as an analytical reagent. Perchlorate has been found in a number of drinking water sources as a result of probable contamination from the solid rocket industry. The US Environmental Protection Agency is looking into the development of a regulation for perchlorate in drinking water and has issued an Interim Health Advisory, suggesting that perchlorate concentration in drinking water not exceed 0.015 milligrams per liter. *See also* perchloric acid.

perchloric acid ($HClO_4$) A fuming, corrosive strong acid that is the most highly oxidized acid of chlorine and a powerful oxidizing agent when heated.

percolate To move or flow through a porous medium. *See also* infiltrate.

percolating water Water passing through soil or rocks under the influence of gravity but not necessarily flowing downward.

percolation The seeping of water through the soil without a definite channel.

percolation path The course followed by water moving or percolating through any permeable material.

percolation rate The rate of movement of water under hydrostatic pressure through the interstices of the rock or soil, except movement through large openings such as caves.

percutaneous absorption Permeation of the skin by a chemical.

perennial interrupted stream A stream that has perennial stretches with intervening interrupted or ephemeral stretches. *See also* ephemeral; perennial stream.

perennial periodic spring A periodic spring that discharges throughout all seasons of the year and during both dry and wet years.

perennial spring A spring that discharges continuously at all seasons of the year and during both dry and wet years.

perennial stream A stream that flows continuously at all seasons of the year and during both dry and wet years. Such a stream is usually fed by groundwater, and its water surface generally stands at a lower level than that of the water table in the locality.

perennial yield The amount of groundwater that can be withdrawn from an aquifer on a sustained basis without exceeding the natural replenishment rate. *See also* mining groundwater.

perfect fluid A fluid that is incompressible, has a uniform density, and offers no resistance to distorting forces.

perfluorooctylsulfonate (PFOS) A group of chemicals that are commonly used in leather surface treatments, paper protectors, and firefighting foams.

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These compounds have been detected in surface water and groundwater.

perforated baffle wall A wall that segregates unit processes, or chambers within a unit process, and allows flow to pass only through a series or matrix of holes (perforations) in the baffle wall. The perforations promote head loss that, in theory, uniformly distributes the flow into a basin or chamber, thereby minimizing short-circuiting.

perforated casing A well casing that permits the water to enter through holes that have been punched or cut in the casing.

perforated-casing well A well with a casing that has been perforated to allow the water to enter.

perforated launder A collection trough located at the water surface in a settling basin to allow the flow to be uniformly collected without adversely affecting particle settling. The trough has holes, or perforations, below the water surface to minimize upflow disturbances near the trough.

perforated plate A flat plate with a series of holes, used to control fluid flow distribution and sometimes to create backpressure or dissipate energy.

performance assessment A systematic evaluation of how well a water treatment plant, or individual treatment process, is meeting desired operational goals and outcomes.

performance-based measurement system (PBMS) As defined by the US Environmental Protection Agency, "a set of processes wherein the data needs, mandates, or limitations of a program or project are specified, and serve as criteria for selecting appropriate methods to meet those needs in a cost-effective manner." Under this system, laboratories are permitted to use any method that achieves the detection limits and meets other criteria specified for a particular program. Laboratories have to demonstrate that the method used meets the criteria. In contrast to methods in which every detail is specified, performance-based methods are developed to allow flexibility in terms of the details.

performance-based training (PBT) A training approach designed to transfer priority-setting and problem-solving skills to water system operators to improve the performance of a group of water treatment systems.

performance curve A plot of discharge quantity versus total dynamic head for a number of different head and discharge values for a given pump.

performance evaluation An assessment of the quality of data produced by a laboratory for a given analyte. Often this is done as part of a process of laboratory certification. *See also* performance evaluation sample.

performance evaluation (PE) sample A sample used to assess the quality of data a laboratory generates for a given analyte. Typically, these samples are furnished to the laboratory as a blind sample; i.e., the result is unknown to the laboratory being evaluated. Such samples are often used as part of a laboratory certification process for the purpose of demonstrating that the laboratory can successfully analyze the sample within limits of performance specified by the US Environmental Protection Agency.

performance metrics Standards by which performance can be measured, compared, and improved.

performance ratio In ozone treatment, the ratio of the measured performance of the ozone system to the required performance. For instance, when ozone is used for disinfection, a performance ratio of 1.2 signifies that the measured disinfection performance has a 20 percent safety factor over the required performance. The ratio is used in assessing ozone system optimization.

performance standard In wetland restoration, a set of specific goals to be reached to ensure that replacement wetlands reach functional maturity before credits are sold.

perigean tide A tide of increased range that occurs when the moon is in perigee (i.e., closest to the earth in its orbital path).

perikinetic flocculation The contact between particles that occurs as a result of random, or Brownian, motion. *See also* Brownian motion; differential settling; orthokinetic (shear) flocculation.

perimeter The distance around the outer edge of a shape.

perineum The portion of the body in the pelvis occupied by urogenital passages and the rectum, bounded in front by the pubic arch, in the back by the coccyx, and laterally by part of the hipbone.

period (*T*) (1) For a periodic signal (such as a sinusoidal time function), the minimum time interval after which the same characteristics of the signal recur. This interval is often measured in seconds. (2) The interval required for the completion of a recurring event. (3) Any specified duration of time. (4) A horizontal row of elements in a periodic table.

periodic acid–Schiff (PAS) A reaction that is the second most commonly used stain (after hemotoxylin and cosin) in diagnostic work. The stain is used to demonstrate the patterns and presence of polysaccharides including glycogen, starch, and cellulose. A staining procedure using PAS has been used to distinguish Microsporidia spores.

periodical Pertaining to detectable regular or irregular saturated soil conditions or inundation that (1) result from ponding of groundwater, precipitation, overland

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flow, stream flooding, or tidal influences and (2) occur such that hours, days, weeks, months, or even years pass between events.

periodic sample One of a series of grab samples taken at irregular intervals.

periodic spring A spring that has periods of relatively large continuous discharge at more or less regular and frequent intervals. *See also* ebbing-and-flowing spring.

periodic table A chart showing all the chemical elements arranged according to similar chemical properties. *See also* periodic table in the appendixes.

peripheral axonopathy Neuron damage that involves the axonal portion of the nerve. Peripheral nerves are those nerves that serve muscles and organs as opposed to nerves within the central nervous system. As a consequence of such damage, the muscle controlled by the nerve loses much of its tone and strength. In general, such effects are diagnosed by virtue of slowed conduction velocities in the peripheral neurons. They can be produced by such chemicals as acrylamide ($CH_2CHCONH_2$) and n-hexane ($CH_3(CH_2)_4CH_3$).

peripheral feed clarifier A settling unit for which the influent is fed from the perimeter and flows inwardly for collection. Peripheral feed clarifiers are typically fed through a surface launder or weir and are often circular. *See also* laundering weir.

peripheral flow Flow of a liquid parallel to the circumference or periphery of a circular tank or other circular structure. Such flow is also called circumferential flow.

peripheral neuropathy Degraded function of a peripheral nerve. This condition is generally associated with a specific pathology. With chemical exposures, the most common neuropathy appears to be the dying-back form, for which the axons of nerves degenerate. *See also* peripheral axonopathy.

peripheral pump A pump having an impeller that develops head by recirculating the liquid through a series of rotating vanes.

peripheral weir An outlet weir extending around the inside portion of the circumference of a circular settling tank, over which the effluent discharges.

periphyton Microscopic plants and animals that are firmly attached to solid surfaces under water, e.g., rocks, logs, and pilings. *See also* plankton.

periportal The region surrounding the branches of the portal vein and hepatic artery that supply blood to the acinus (the organizational unit of the liver). Blood from these vessels flows through the sinusoids that bathe the hepatocytes to the terminal hepatic vein (also known as the central vein). The bile ductules are observed in the same areas as the portal vein and hepatic artery when the liver is seen in an appropriate cross section. Collectively, these three vessels are referred to as the portal triad.

peristaltic pump A positive-displacement pump using a rotary head that squeezes a flexible tube to deliver the pumped liquid. The pump output is determined by the speed of the rotating head. *See also* positive-displacement pump.

peritoneal-dialysis effluent Fluid from the flushing of the peritoneal cavity.

peritonitis Inflammation of the membrane lining the walls of the abdominal cavity and enclosing the viscera.

perlite (1) A form of volcanic rock that, when processed, yields various grades of filter media. (2) The filter media so obtained.

permafrost Permanently frozen subsoil occurring wherever the temperature remains less than 32° Fahrenheit (0° Celsius) for several years. Permafrost is characteristic of arctic tundra.

permanent dam A dam that is fixed in position and intended for long service.

permanent hardness *See* noncarbonate hardness.

permanently absorbed water Water that passes downward beyond the root zone and finally reaches the saturation zone, where it becomes an increment to groundwater.

permanently flooded A water regime condition in which standing water covers the land surface throughout the year (but may be absent during extreme droughts).

permanent monitoring relief *See* alternative monitoring guidelines.

permanent partial disability A doctor's determination of permanent damage suffered to a portion of the body that will not recover its full abilities.

permanent snow line The line of lowest elevation or the lower limit of a snowfield at any locality on the earth's surface above which snow accumulates and remains on the ground throughout the entire year.

permanent software *See* firmware.

permanent stream A stream that flows throughout the year. *See also* perennial stream.

permanent total disability A doctor's determination that a worker's injuries will prevent the worker from being employed for life.

permanent water A watering place in the United States—such as a spring, well, or stretch of stream—where water can be obtained at all seasons of the year and during both dry and wet years.

permanganate *See* potassium permanganate.

permeability A measure of the relative ease with which water flows through a porous material. A sponge is very permeable; concrete is much less

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permeable. Permeability is sometimes called perviousness. *See also* permeability coefficient.

permeability coefficient A coefficient expressing the rate of flow of a fluid through a cross section of permeable material under a hydraulic gradient or pressure gradient. If the fluid is water, the permeability coefficient is the hydraulic conductivity. A standard coefficient of permeability used in the hydrologic work of the US Geological Survey, known as the Meinzer unit (not a Système International unit), is defined as the rate of flow of water at 60° Fahrenheit (15.6° Celsius), in gallons per day, through a 1-foot cross section under a hydraulic gradient of 100 percent. *See also* hydraulic conductivity.

permeability units *See in the Units of Measure section.*

permeable (1) Having communicating (i.e., connected) interstices of capillary or supercapillary size. (2) Having a texture or structure that permits water to move through perceptibly under head differences ordinarily produced in natural or engineered systems.

permeable confining bed A confining bed that produces artesian head in adjacent groundwater not by preventing percolation but by retarding it. Such beds are much more common than impermeable confining beds.

permeable rock A rock having a texture that permits water to move through it perceptibly under the pressure ordinarily found in subsurface water. Such a rock has communicating (i.e., connected) interstices of capillary or supercapillary size.

permeameter A device for measuring the permeability of soils or other material. It usually consists of two reservoirs or tanks connected by a conduit containing the material under investigation. Water is passed from one reservoir, under varying conditions of head, through the connecting conduit.

permeance *See* solvent (water) permeability coefficient.

permeate For a pressure-driven membrane treatment process, the portion of the feed solution that passes through the membrane. For potable water membrane treatment systems, the permeate is often referred to as the product flow stream.

permeate carrier tube For spiral-wound membrane elements, the perforated plastic pipe in the center of the element that is connected to the permeate spacers and carries the permeate flow out of the element. Typically, permeate adapters connect the permeate carrier tube outlets of elements installed in series in a pressure vessel and to the vessel end cap permeate outlet. *See also* permeate spacer; spiral wound.

permeate channel spacer *See* permeate spacer.

permeate flux The permeate flow rate per unit active membrane area. It is commonly expressed in units of gallons per day per square foot or cubic meters per hour per square meter. *See also* flux.

permeate spacer For spiral-wound membrane elements, a fine plastic mesh material placed inside the flat sheet membrane leaves to provide space for permeate flow stream and to channel the flow to the central permeate carrier tube. *See also* permeate carrier tube; spiral wound.

permeate staging For a pressure-driven membrane process, a membrane module arrangement for which the permeate from one stage is further processed in a following stage, usually with an additional pumping step prior to the following stage. *See also* array; hydraulic staging; pass.

permeation The passage of water and associated substances through a membrane or other porous medium. *See also* dialysis; leaching; percolation; reverse osmosis.

permeator A membrane treatment device for which hollow-fiber membranes are housed in a pressure vessel.

permissible dose The dose of a chemical that may be received by an individual without the expectation of a significantly harmful result. *See also* dose; no-observed-adverse-effect level.

permissible exposure limit (PEL) The maximum concentration of a substance that a worker may be exposed to in each 8-hour workday for 30 years and not experience related health problems.

permissible velocity The highest velocity at which water may be carried through a structure, canal, or conduit without excessive damage.

permit-required confined space A confined space that requires a checklist to be completed before employees may enter. *See also* confined space.

permitting authority The district engineer of the US Army Corps of Engineers or other such individual as may be designated by the secretary of the US Army to issue or deny permits under Section 404 of the Clean Water Act; or the state director (or delegated representative) of a permit program approved by the US Environmental Protection Agency under Section 404(g) and Section 404(h) of the Clean Water Act. A permit is required under Section 404 of the Clean Water Act to discharge dredged or fill material into the navigable waters of the United States.

permittivity units *See in the Units of Measure section.*

permselective material *See* permselective membrane.

permselective membrane A membrane used for separation of constituents in a fluid based on differences in one or more constituent properties, such as diffusion rate, solubility, electrical charge, or size and shape. A permselective membrane is also known as a semipermeable membrane.

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peroxidase Any of a family of enzymes capable of catalyzing the breakdown of peroxides. *See also* horseradish peroxidase.

peroxide Any compound containing two oxygen atoms united together into a bivalent –O–O– group. A peroxide readily releases abnormally active atomic oxygen and is therefore a strong oxidizing agent. Hydrogen peroxide (H_2O_2) is an example.

peroxisome A subcellular organelle (or microbody) that contains peroxidase, catalase, D-amino acid oxidase, and the capability for β-oxidation of fatty acids. β-oxidation of fatty acids in peroxisomes differs from that in mitochondria in that hydrogen peroxide (H_2O_2) is produced as an obligatory product.

peroxisome proliferator Any of a group of chemicals that is capable of increasing the numbers of peroxisomes in particular tissues. A rather diverse group of chemicals possesses this property, and most members of the class are capable of inducing tumors, particularly in the livers of rodents. Of particular interest in drinking water are the disinfection by-product trichloroacetic acid (CCl_3COOH) and the plasticizer di(2-ethylhexyl) phthalate ($C_6H_4(COOCH_2CH(C_2H_5)C_4H_9)_2$). Marked differences occur in the responses in different animal species to these chemicals, and the question of whether such chemicals would produce cancer in humans is very controversial.

peroxisome proliferator activated receptor (PPAR) Any of a family of proteins involved in the signal transduction pathway that leads to increased synthesis of peroxisomes and associated proteins. Although peroxisome proliferators are clearly necessary for the response, many of them appear not to interact directly with this type of protein; instead they seem to act by increasing the level of some endogenous factor. The peroxisome proliferator activated receptor interacts with other nuclear receptors that are important in development, including the retinoic acid receptor and thyroid hormone receptor. Despite the very weak activity of peroxisome proliferators to induce synthesis of peroxisomes in human and other mammalian cells, humans do possess the peroxisome proliferator activated receptors. This raises the possibility that the induction of peroxisomes may not be a prerequisite for the tumorigenic activity of these chemicals.

peroxone A combination of ozone (O_3) and hydrogen peroxide (H_2O_2).

peroxone process *See* ozone–hydrogen peroxide process.

persistence The tendency of a refractory, nonbiodegradable material to remain essentially unchanged after being introduced into the environment.

person An individual, corporation, company, association, or partnership; a municipality; or a state, federal, or tribal agency.

personal care product (PCP) A commercially available product used for personal care, such as shampoo, toothpaste, fragrances, cosmetics, and soaps. Some PCPs may contain compounds that are known or suspected to persist during wastewater treatment and may present potential human health and environmental risks as endocrine disruptors. *See also* pharmaceutical and personal care products.

personal protection equipment (PPE) Such equipment as hard hats, gloves, goggles, and steel-toed shoes used by workers to prevent potential injuries from workplace hazards.

personnel access opening The opening in a vault or caisson to allow maintenance and inspection personnel to enter and perform their duties. It was formerly called a *manhole.*

person-to-person spread The conveyance of an infectious disease from one person to another by direct transmission because of close proximity either within a family or with the population at large. *See also* transmission of infection.

perstraction Membrane-aided solvent extraction. *See also* extraction.

PERT *See* program evaluation review technique.

pervaporation A membrane process used primarily in industrial applications for separation of mixtures of dissolved solvents. In this process, transport through the membrane is induced by the difference in partial pressure between the liquid feed solution and the permeate vapor. Commonly, the permeate is under a vacuum produced by a vacuum pump or by a cooling and condensing of the permeate vapor.

pervious *See* permeable.

pervious bed A bed or stratum that contains voids through which water will move under ordinary hydrostatic pressure.

perviousness *See* permeability.

PES *See* polyethersulfone.

PE sample *See* performance evaluation sample.

pesticide Any substance or chemical applied to kill or control pests. *See also* algicide; herbicide; insecticide; rodenticide.

pesticide application certification A US Environmental Protection Agency regulatory requirement that pesticide applicators meet certain training and/or testing requirements before they use or supervise the use of pesticides labeled "restricted use." Certain pesticides may be applied only by or under the direct supervision of specially trained and certified applicators. Certification and training programs are conducted by states, territories, and tribes in accordance with national standards.

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Pesticide Environmental Stewardship Program A voluntary private and public partnership supported by the US Environmental Protection Agency and dedicated to reducing pesticide use and risk.

peta (P) *See in the Units of Measure section.*

PE tank *See* portable exchange tank.

pet cock A small valve or faucet used to drain a cylinder or fitting.

petition for review A legal action taken under Section 1448 of the Safe Drinking Water Act to contest one or more provisions of a National Primary Drinking Water Regulation issued by the US Environmental Protection Agency.

petri dish A shallow glass or plastic dish with vertical sides, a flat bottom, and loose-fitting cover, used for growing microbiological cultures.

petri factor A ratio used in collimated beam testing that is equal to the average intensity measured across the surface of a suspension in a petri dish divided by the intensity at the center of a petri dish. The petri factor is used to help calculate delivered ultraviolet dose. *See also* collimated beam test; ultraviolet dose.

petrochemical A product or component that arises primarily from the chemical processing of petroleum and natural gas hydrocarbons.

petroleum derivative A chemical substance derived from petroleum (e.g., a chemical formed when gasoline breaks down in contact with groundwater).

petrology A science that deals with the origin, history, occurrence, structure, chemical composition, and classification of rocks.

PF *See* power factor; protection factor.

pF A numerical measure of the energy with which water is held in the soil. It is expressed as the common logarithm of the head, in centimeters of water, necessary to produce the suction corresponding to the capillary potential. *See also* moisture tension.

PFBHA *See ortho*-(2,3,4,5,6-pentafluorobenzyl)-hydroxylamine.

PFBHA derivatization *See ortho*-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine derivatization.

P. fluorescens *See Pseudomonas fluorescens.*

PFOS *See* perfluorooctylsulfonate.

PFR *See* plug-flow reactor.

pfu *See* plaque-forming unit *in the Units of Measure section.*

pg *See* picogram *in the Units of Measure section.*

PGP *See* programmatic state general permit.

pH A measure of the acidity or alkalinity of a solution, such that a value of 7 is neutral; lower numbers represent acidic solutions and higher numbers, alkaline solutions. Strictly speaking, pH is the negative logarithm of the hydrogen ion concentration (in moles per liter). For example, if the concentration of hydrogen ions is 10^{-7} moles per liter, the pH will be 7.0. As a measure of the intensity of a solution's acidic or basic nature, pH is operationally defined relative to standard conditions that were developed so that most can agree on the meaning of a particular measurement. The pH of an aqueous solution is an important characteristic that affects many features of water treatment and analysis.

PhAC *See* pharmaceutically active compound.

phage *See* bacteriophage.

phagocyte Any cell that engulfs bacteria, other cells, or foreign material. Usually the material is digested within the phagocyte. Macrophages and polymorphonuclear lymphocytes (white blood cells) are examples of phagocytes.

pharmaceutical and personal care products (PPCPs) A very broad, diverse collection of thousands of chemical substances, including prescription and over-the-counter therapeutic drugs, fragrances, cosmetics, sunscreen agents, diagnostic agents, nutraceuticals, biopharmaceuticals, and many others. They are potential health and environmental risks that generally enter the environment in treated wastewater effluent or terrestrial runoff. *See also* personal care product.

pharmaceutical grade water The collective term for six types of water as defined by the *United States Pharmacopeia:* (1) purified water, (2) water for injection, (3) bacteriostatic water for injection, (4) sterile water for inhalation, (5) sterile water for injection (WFI), and (6) sterile water for irrigation.

pharmaceutically active compound (PhAC) Medicinal compounds that can enter the environment, for example, through animal feedlot operations, such as swine production, and through treated wastewater effluent.

pharmacodynamics The quantitative (i.e., kinetic) relationships between the amount of a chemical (or drug) at its active site within the body and the molecular, biochemical, and cellular and tissue responses the chemical produces within the body.

pharmacokinetic effect *See* pharmacokinetics.

pharmacokinetics The formal mathematical description of processes involved in the absorption, distribution, metabolism, and elimination of chemicals in an organism. In medicine, pharmacokinetic models are used to determine the required dosing regimen of a drug to maintain blood levels in the therapeutic range. In toxicology and risk assessment, pharmacokinetic models provide a means of adjusting external doses to an organism to the effective dose that is delivered to the site within the body at which the adverse effect is produced. With the inclusion of species-specific rate constants, pharmacokinetic models can be used for interspecies

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comparisons of effective doses of a chemical for a given external dose.

pharmacological antagonism A situation in which two chemicals act through the same receptor but one of the chemicals acts as an activator of the receptor (agonist) and the other acts as an antagonist. *See also* antagonism.

phase (1) A distinct state of matter. The three physical states are solid, liquid, and gas. In addition, colloids are said to be the dispersed phase and liquids are said to be the continuous phase. (2) An attribute of the type of electrical service being used. Water treatment utilities utilize three-phase power for 2 horsepower (1.5 kilowatts) and greater; single-phase power is used for smaller loads. (3) An indication of the time relationships of two or more alternating electrical currents' oscillations. Two or more signals with the same time relationships (i.e., matching peaks and valleys on a visual plot of the signal over time) are said to be in phase; if the timing is different, the signals are said to be out of phase. The phase in a circuit is determined by interaction among the resistance, inductance, and capacitance components of the circuit.

phase angle (θ) A measure of the progress of a periodic wave in time and space from a chosen instant or position. It is obtained by multiplying the phase by 360° or by 2π radians.

phase contrast microscope A modified light microscope that enhances the visibility of unstained objects that differ only very slightly from the background in terms of the refractive index.

phase contrast microscopy The examination of microorganisms using a phase contrast microscope.

Phase V Rule A rule promulgated by the US Environmental Protection Agency on July 17, 1992 (*Federal Register*, 57(138): 31776–31849), that set maximum contaminant level goals and National Primary Drinking Water Regulations for 18 synthetic organic chemicals (dichloromethane, 1,2,4-trichlorobenzene, 1,1,2-trichloroethane, dalapon, dinoseb, diquat, endothall, endrin, glyphosate, oxamyl, picloram, simazine, benzo(a)pyrene, di(2,ethylhexyl)adipate, di(2-ethylhexyl)phthalate, hexachlorobenzene, hexachlorocyclopentadiene, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin) and 5 inorganic chemicals (antimony, beryllium, cyanide, nickel, thallium).

phase I reaction An initial reaction of a chemical being metabolized by the body. Phase I reactions frequently result in the production of reactive intermediates that are capable of interacting with and altering the structure and function of such macromolecules as proteins, nucleic acids, or lipids that make up biological membranes.

Phase I Rule A rule promulgated by the US Environmental Protection Agency on July 8, 1987 (*Federal Register*, 52(130):25690–25717), that set maximum contaminant level goals and National Primary Drinking Water Regulations for eight volatile organic chemicals (trichloroethylene, carbon tetrachloride, 1,1,1-trichloroethane, vinyl chloride, 1,2-dichloroethane, benzene, 1,1-dichloroethylene, and *para*-dichlorobenzene).

phase II reaction A secondary reaction that tends to detoxify reactive metabolites produced by phase I reactions. Phase II reactions are frequently conjugation reactions with sulfate, glucuronides, glutathione ($C_{10}H_{17}O_6N_3S$), cysteine ($HSCH_2CH(NH_2)COOH$), or other biochemicals. Occasionally, however, further processing of metabolites produced by phase II reactions can lead to reactive metabolites, e.g., the cysteine conjugates that arise from processing of the glutathione conjugate of such chemicals as tetrachloroethylene ($Cl_2C{:}CCl_2$) or trichloroethylene ($CHCl{:}CCl_2$).

Phase II Rule A rule promulgated by the US Environmental Protection Agency on January 30, 1991 (*Federal Register*, 56(20):3526–3597), that set maximum contaminant level goals and National Primary Drinking Water Regulations for 26 synthetic organic chemicals (*ortho*-dichlorobenzene, *cis*-1,2-dichloroethylene, *trans*-1,2-dichloroethylene, 1,2-dichloropropane, ethylbenzene, monochlorobenzene, styrene, tetrachloroethylene, toluene, xylenes, alachlor, atrizine, carbofuran, chlordane, 1,2-dibromo-3-chloropropane, 2,4-dichlorophenoxyacetic acid, ethylene dibromide, heptachlor, heptachlor epoxide, lindane, methoxychlor, polychlorinated biphenyls, toxaphene, 2-(2,4,5-trichlorophenoxyl) propionic acid, acrylamide, epichlorohydrin) and 7 inorganic chemicals (asbestos, cadmium, chromium, mercury, nitrate, nitrite, selenium).

PHD *See* peak-hour demand.

phenanthroline method A colorimetric procedure used to determine the concentration of iron in water by using 1,10-phenanthroline ($C_{12}H_8N_2{\cdot}H_2O$) after the iron is reduced to the Fe^{2+} state with boiling hydrochloric acid (HCl) and hydroxylamine ($NH_2OH{\cdot}HCl$).

phenolic compound A hydroxy derivative of benzene (C_6H_6). The simplest phenolic compound is hydroxy benzene, C_6H_5OH (phenol).

phenolic endocrine disruptor Chemicals that mimic estrogen. *See also* endocrine disruptor; estrogenic endocrine disruptors.

phenolphthalein ($C_{20}H_{14}O_4$) An organic compound used as an acid-base indicator. Phenolphthalein solutions gradually change from colorless for a pH less than 8.3 to pink in solutions of pH greater than 10 and then to dark red.

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phenolphthalein alkalinity The alkalinity in a water sample as measured by the amount of standard acid required to lower the pH to a level of 8.3. If phenolphthalein is used, the solution changes from pink to clear at this pH. Phenolphthalein alkalinity is expressed in units of milligrams per liter as calcium carbonate ($CaCO_3$).

phenolphthalein indicator A chemical color-changing indicator used in several tests, including tests for alkalinity, carbon dioxide, and pH. The pH at which it changes color is 8.3.

phenospecies Species that look alike.

phenotype A cell characteristic that arises for a particular cell from expression of a particular protein or group of proteins. The phenotype may reflect properties that are determined by changes in expression seen during normal differentiation and development of a particular tissue, or it can reflect changes in the characteristics of the wild-type cell as the result of a mutation (i.e., a change in the genotype). For example, liver and kidney cells are of a different phenotype. Tumor cells have different phenotypes than the normal cells from which they are derived.

pH meter A sensitive voltmeter used to measure the pH of liquid samples.

pH of saturation (pH_s) The pH at which water is saturated with calcium carbonate ($CaCO_3$).

phosphatase inhibition assay A method for detecting microorganisms by exploiting their ability to inhibit the type-1 protein phosphatase.

phosphate A salt or ester of phosphoric acid (H_3PO_4). *See also* orthophosphate; phosphorus.

phosphate buffer The chemical(s) used to buffer water that is used in microbiological analyses of drinking water and other environmental water samples.

phosphate-buffered saline (PBS) Phosphate-buffered water used for washing bacteria in the microsuspension mutagenicity test method. *See also* phosphate buffer.

phosphate concentration The concentration of phosphates in drinking water or another source, normally presented in terms of phosphate ion (PO_4^{3-}) or phosphorus (P). The phosphate ion is a component of some corrosion inhibitors that are added to drinking water. Hence, the phosphate ion can be measured at the point of entry into the transmission system and at key locations within the distribution system to determine the adequacy of corrosion control.

phosphate inhibitors Chemicals used for reduction of lead and copper solubility and corrosion control in drinking water distribution systems. When applied at the proper pH, metal phosphate minerals having relatively low solubility are formed. Phosphate inhibitors include phosphoric acid and zinc orthophosphate.

phospholipid test A method for measuring the biomass attached to the surfaces of granular media. Phospholipids, or fat molecules, contained in the cell membranes are extracted and reacted with potassium persulfate reagent to release phosphate, which is derivatized to a color compound that can be measured spectrophotometrically.

phosphorus (P) An essential chemical element and nutrient for all life forms. It occurs in orthophosphate, pyrophosphate, tripolyphosphate, and organic phosphate forms. Each of these forms, as well as their sum (total phosphorus), is expressed in terms of milligrams per liter elemental phosphorus. *See also* nutrient.

phosphorus fertilizer A plant nutrient, composed of phosphorus, that can cause algal blooms in sensitive water bodies. *See also* algal bloom.

phosphorus removal The precipitation of soluble phosphorus from water by coagulation and subsequent flocculation and sedimentation.

photic zone The depth of water, whether in a lake, river, or ocean, that is exposed to sufficient sunlight for photosynthesis to occur.

photocatalysis The photochemically induced redox reactions in a solid-state metal oxide catalyst that generate hydroxyl radicals. The preferred catalyst is titanium dioxide, which is stable under various conditions and has a high potential to produce hydroxyl radicals. *See also* hydroxyl radical.

photochemical Pertaining to chemical reactions that depend on light.

photochemically driven reaction A chemical reaction (e.g., photosynthesis, photolytic decomposition, photochemical oxidation) in which absorption of radiant energy (photons) induces or modifies chemical changes. *See also* photochemical oxidation; photolytic decomposition; photosynthesis.

photochemical oxidation Changes in chemicals caused by light.

photodegradation The breakdown of a compound dispersed in the atmosphere or present on an exposed solid surface into simpler components by the action of solar radiation.

photodetector A device that produces an electrical current proportional to the ultraviolet light intensity at the detector's surface.

photodiode array detector An analytical instrument that uses a photodiode array (a group of small photoelectric-sensitive elements arranged on a semiconductor chip) to perform spectrophotometric analysis. As opposed to simpler detectors that can measure light absorption at a single wavelength only, a photodiode array detector can measure light absorption over a broad range of wavelengths in a single measurement. Commonly used in

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high-performance liquid chromatography, this detector is capable of simultaneously performing multiwavelength analyses of samples as they elute from the chromatography column.

photogrammetric digitizing A technique used to compile new maps from aerial photographs. It is similar to manual digitizing in its approach, but the table digitizer is replaced by a photogrammetric instrument, such as an analytical stereoplotter. Photogrammetric digitizing is most often used to record very precise and accurate digital planimetric features and elevation data from stereophotography.

photogrammetric mapping The process of compiling maps by measurement of controlled aerial photos.

photogrammetry The science of making reliable measurements by the use of photographs (usually aerial) in surveying and mapmaking.

photoionization detector (PID) A detector used in gas chromatography, typically for the analysis of aromatic compounds. A photoionization detector elicits an electrical signal from compounds with double bonds and can be fairly sensitive to conjugated double bonds, such as in aromatic compounds.

photolysis *See* photolytic decomposition.

photolytic decomposition Chemical decomposition that is driven by photons of sunlight or ultraviolet light.

photolyzed Pertaining to something that has undergone photolytic decomposition.

photometer An instrument used to measure the intensity of light transmitted through a sample or the degree of light absorbed by a sample.

photomultiplier tube Tube used to magnify the primary photocurrent by the ejection of several electrons for each electron striking a dynode. The magnification goes through several successive stages operating at increasingly higher voltages. These tubes are used in instruments like spectrophotometers and liquid scintillation counters.

P

photon The basic unit (quantum) of electromagnetic radiation. Light waves, gamma rays, x rays, and so on consist of photons. Photons are discrete concentrations of energy that have no rest mass and move at the speed of light. They are emitted when electrons move from one energy state to another, as in an excited atom. *See also* irradiation; radiation.

photon emitter A radionuclide that emits photons. Photon emitters and beta particles make up the radiological measurement of gross beta radiation that is regulated by the US Environmental Protection Agency. *See also* beta particle; gross beta particle activity; photon; radiological contaminant.

photooxidant An oxidant that participates in a photochemical reaction involving oxidation–reduction chemistry. *See also* oxidant; oxidation–reduction reaction; photochemically driven reaction.

photoreactivation A microbial repair process in which enzymes activated by light in the near ultraviolet (UV) and visible range (310 to 490 nanometers) split pyrimidine dimers, thereby repairing UV-induced damage. Photoreactivation requires the presence of light.

photosensitization The process of increasing the sensitivity of a cell or organism to the influence of light. Some drugs or chemicals are referred to as photosensitizers because they increase the adverse effects of ultraviolet light, visible light, or both. Two basic types of reactions can be produced: photoallergic or phototoxic. In humans, such effects most often involve the skin or the eyes.

photosynthesis The synthesis of complex organic materials, especially carbohydrates, from carbon dioxide (CO_2), water, and inorganic salts under the following conditions: with sunlight as the source of energy, with the aid of a catalyst such as chlorophyll, and with the simultaneous liberation of oxygen.

photosynthetic bacteria Bacteria that obtain their energy for growth from light by photosynthesis.

phototaxis The movement of an organism in response to a source of light, whether to or away from the light.

phototoxicity Biological damage caused by photon-driven chemical reactions. Phototoxic reactions are divided into two broad classes: those that are dependent on reactions with oxygen (i.e., photodynamic reactions) and those that do not require oxygen. The former generally result in the formation of reactive free radicals that are responsible for the damage. In the latter case, the chemical facilitates the reaction of a photon with cellular biochemicals. The methoxypsoralens, certain polycyclic aromatic hydrocarbons, and selected drugs are chemicals known to induce various types of phototoxicity. *See also* free radical.

photovoltaic Pertaining to the process by which some materials convert incident light to an electromotive force.

photovoltaic cell A device used to convert light energy to electrical energy. In such a cell, light falling on a semiconductor surface releases electrons to a collector electrode, so that the output current produced by the cell is very nearly proportional to the intensity of illumination.

photozone of seawater The region in the ocean into which light will penetrate.

phreatic Pertaining to that layer of soil or rock in which a water table exists.

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phreatic cycle A period of rise and succeeding period of decline for a water table. The most common kinds of phreatic cycles are daily, annual, and secular.

phreatic decline A downward movement of the water table.

phreatic divide *See* groundwater divide.

phreatic fluctuation *See* phreatic cycle.

phreatic line The upper boundary of (1) the water table in soils or (2) seepage water in earth dams, levees, and dikes. It is the line of atmospheric pressure, and it lies between the capillary zone and the saturation zone.

phreatic rise An upward movement of the water table.

phreatic surface A surface that represents the position to which water would rise in wells anywhere in an unconfined aquifer. A water-table contour map is a method of depicting the phreatic surface of an unconfined aquifer.

phreatic water Water beneath the water table in an unconfined aquifer.

phreatic water discharge Discharge of water from the saturation zone directly onto the land surface, into a body of surface water, or into the atmosphere by means of springs, wells, infiltration galleries, or infiltration tunnels and other subterranean channels. Such discharge is also called groundwater discharge.

phreatic wave A wavelike movement of the water table in the direction of the latter's slope. It assumes the form of a groundwater mound or ridge. It is produced by a considerable addition of water to the water table in a relatively short time and over a relatively small area, and it flattens out as it progresses to lower levels. A phreatic wave is also called a groundwater wave.

phreatophyte A type of plant with very long roots and extensive root systems that draws its water from the water table or other permanent groundwater supplies. Examples of phreatophytes are willows and salt cedars. Excessive phreatophyte growth is undesirable in areas where water is scarce because these plants can consume large quantities of water.

pH Redox Equilibrium Equation (PHREEQC) A general-purpose equilibrium chemistry modeling computer program developed by the US Geological Survey. This flexible program can be used to perform calculations for aqueous speciation and solid saturation, as well as to model precipitation, dissolution, oxidation–reduction, titration, and mixing reactions.

PHREEQC *See* pH Redox Equilibrium Equation.

pH_s *See* pH of saturation.

pH shock A short-term depression of pH levels caused by a sudden influx of acid runoff into a water body. The acid runoff could result from an intense rainfall of low pH or from meltwater. A pH shock is also called an acid shock.

phthalate ($C_6H_4(COOR)_2$) Any of a class of synthetic organic chemicals with various industrial uses, including use as a plasticizer. The compound di(2-ethylhexyl) phthalate (C_6H_4 ($COOCH_2CH(C_2H_5)C_4H_9)_2$ is regulated by the US Environmental Protection Agency. *See also* di(2-ethylhexyl) phthalate; plasticizer; synthetic organic chemical.

***p*-hydroxy-phenyl-acetic acid** *See under* hydroxy-phenyl-acetic acid.

phylogeny The study of comparative evolutionary relationships among organisms.

physical adsorption The accumulation or concentration of substances (adsorbate) at a surface or interface with another substance (adsorbent) by physical attraction and interaction.

physical analysis An examination of a sample for parameters that represent the collective properties of the sample. For example, in the examination of water, examinations of appearance, conductivity, turbidity, temperature, and color represent physical analyses.

physical–chemical treatment Treatment of water by unit processes other than those based on microbiological activity. Unit processes commonly included under this heading are precipitation with coagulants, flocculation with or without chemical flocculants, filtration, adsorption, chemical oxidation, air-stripping, ion exchange, membrane treatment, and several others.

physical protection system (PPS) An integrated network of people, procedures, and equipment to protect assets of facilities against trespass, theft, vandalism, sabotage, or other action threatening facility operation or the health and safety of employees, the public, or the environment. A PPS incorporates detection, delay, and response.

physical stability A measure of the ability of an ion exchanger or filter medium to resist breakdown caused by the physical forces to which the exchanger or medium is subjected during use. Such forces include crushing, attrition, or forces caused by high temperatures.

physical straining Removal of particles in a granular media filter bed caused by the inability of a particle to pass through a pore space in the bed that is smaller than the particle itself.

physical treatment Any water treatment process involving only physical means of solid–liquid separation, e.g., centrifugation, clarification, distillation, filtration, flocculation solely by agitation, and heat treatment.

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physiognomy The general outward appearance of a community as determined by the life form of the dominant species, e.g., grassland, forest.

physiographic balance A condition of equilibrium between surface topography and vegetal cover on the one hand, and precipitation and the accompanying processes of erosion on the other. It is said to exist in a given locality when topography and cover have become so adjusted to precipitation and erosion that changes in the topography and cover are imperceptible over a considerable period of time, even though they might be taking place.

physiographic province Terrain having a pattern of natural relief features or landforms—including drainage, geomorphological characteristics, and topography—that differs significantly from that of adjacent zones. It is also called a *physiographic region.*

physiological antagonism A circumstance in which chemicals or drugs activate different physiological systems to produce opposing effects. For example, many of the effects of chemicals that activate the parasympathetic nervous system (a portion of the autonomic nervous system that uses acetylcholine as the major neurotransmitter) are counteracted by chemicals that activate the sympathetic system (a portion of the autonomic nervous system that uses catecholamines as neurotransmitters). A simpler example may be the antagonistic effects of stimulants and depressants. *See also* antagonism.

physiologically based pharmacokinetic (PBPK) modeling A very particularized way of modeling how a chemical, its metabolites, or both are handled within the body. These models contain specific information on blood flows, as well as transfer rates (frequently described by the partition coefficients) of each chemical species between the external environment (e.g., air concentration) to the blood plasma and tissues. They can also include kinetic parameters related to the metabolism and excretion of each chemical form from the body and any specialized binding of the chemical within each compartment. Many believe these models provide a more accurate basis than other models for extrapolating exposure and dose information across species. These models are very data-intensive, however, relative to the compartmental models that have frequent application in the use of drugs. *See also* biologically based dose–response modeling; compartmental model.

phytofiltration The use of plant root systems to concentrate, adsorb, or precipitate metals and organic contaminants from a groundwater or wastewater stream. Aquatic wastewater treatment systems, such as constructed wetlands, are an example of one type of phytofiltration system.

phytometer A device for measuring transpiration, consisting of a vessel containing soil in which one or more plants are rooted and sealed so that water can escape only by transpiration from the plant. *See also* lysimeter.

phytoplankton Collectively, all the microscopic plants that live suspended in the water of aquatic habitats and are unattached.

PI *See* propidium iodide.

pi (π) The ratio of the circumference of a circle to the diameter of that circle, approximately equal to 3.14159, or about $^{22}/_{7}$.

pica Abnormal craving for clay, paint, chalk, or other substances not fit for food.

PICl *See* polyiron chloride.

picloram ($C_6H_3O_2N_2Cl_3$) A common name for 4-amino-3,5,6-trichloropicolinic acid, a systemic herbicide that has been used as defoliant. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.5 milligrams per liter. *See also* defoliant; herbicide.

pico *See in the Units of Measure section.*

picocurie (pCi) *See in the Units of Measure section.*

picocuries per liter (pCi/L) *See in the Units of Measure section.*

picogram (pg) *See in the Units of Measure section.*

picornavirus The smallest of the ribonucleic acid viruses. The picornaviruses are subdivided into nine genera: *Enterovirus, Cardiovirus, Rhinovirus, Aphthovirus, Hepatovirus, Parechovirus, Erbovirus, Kobuvirus,* and *Teschovirus.* These viruses are very diverse and include many human pathogens, such as the virus that causes the common cold and the virus responsible for polio.

picosecond (ps) *See in the Units of Measure section.*

picture element *See* pixel.

PID *See* photoionization detector.

PID control *See* proportional integral derivative control.

piedmont alluvial deposit A series of alluvial fans built up by streams originating from a mountain range.

piedmont alluvial plain A series of alluvial fans that merge into one another. A piedmont alluvial plain is also called a compound alluvial fan.

piestic interval The difference in altitude between two isopiestic lines (lines of equal pressure).

piezometer An instrument for measuring pressure head in a conduit, tank, or soil by determining the location of the free water surface.

piezometric head The elevation of water (with respect to a datum) plus the pressure head expressed in units of length; above a datum, the total head at any cross section minus the velocity head at that cross section. It is equivalent to the elevation of the water surface in open-channel flow, and it gives the elevation of the

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hydraulic grade line at any point. *See also* pressure head.

piezometric map A map showing, by means of isopiestic lines, the shape of the piezometric surface of an aquifer.

piezometric surface A surface that represents the position to which water would rise in wells anywhere in an aquifer. A groundwater-level contour map is a method of depicting the piezometric surface of an aquifer. *See also* isopiestic line.

piezometric surface map A contour map of the imaginary surface to which the water in an artesian aquifer will rise. Such a map is also called a pressure surface map.

piezometric tube A tube open at both ends, with one end that is placed into a liquid flow system (e.g., an aquifer or pipeline) to measure the static water level in the system. The height of water in the tube measures the energy in the liquid caused by pressure (pressure head) and elevation (elevation head). *See also* piezometer.

PIF *See* pipe importance factor.

pig *See* polypig.

pigging The process of forcing an in-line scraper or polypig through a water line by the force of moving water or flush water to remove scale, sand, and other foreign matter from the interior surface of the pipe.

pilot filter A small tube containing the same media as plant filters and through which flocculated plant water is continuously passed, with a recording turbidimeter continuously monitoring the effluent. The amount of water passing through the pilot filter before turbidity breakthrough can be correlated to the operation of the plant filters under the same coagulant dose.

pilot hole A test well.

pilot plant A small-scale treatment process designed to simulate a full-scale treatment unit or sequence of units. It operates at a lower flow and is used to evaluate the impact of variations in operating criteria on treatment performance. A pilot plant is operated in a continuous-flow manner but uses sufficiently small quantities of water that the effluent can be wasted, thus providing the distinct benefit of simulating the process without being required to generate a potable water for consumption.

pilot-plant study Evaluation, on a scale larger than laboratory scale but smaller than full scale, of the amenability of water to treatment by particular operations or processes.

pilot-plant test data Information regarding water quality and operating parameters obtained from a small scale, continuous-flow unit constructed to simulate the behavior of a full-scale treatment unit.

pilot project An undertaking of a special unit of work or research (as in a school, laboratory, or plant) organized and carried out as a trial unit for experimentation, testing, or seeking a solution to a specific problem.

pilot valve The control mechanism on an automatic altitude or pressure-regulating valve.

PIN *See* parcel identification number.

pin The male end of a pipe or fitting that matches with the female end of another pipe or fitting.

pinch point An area on equipment or a point in a procedure where an employee may have a portion of clothes or body caught between two pieces of equipment or between equipment and the working surface.

pipe A conduit that diverts or conducts water from one location to another.

pipe bedding The surface, material, or both on which pipe rests in a ditch.

pipe break model A model that computes release rate, based on the thermodynamic and physical properties of the fluid being released. The model also considers such factors as storage pressure, temperature, and the size of the hole through which the fluid is released.

pipe class The working pressure rating, including allowances for surges, of a specific pipe for use in water distribution systems. This term is used for cast-iron, ductile-iron, asbestos–cement, and glass pipe, as well as some plastic pipe.

pipe corrosion The destruction of a pipe as a result of a chemical reaction with its surroundings. Pipe corrosion is generally a physicochemical interaction between a pipe's material and its environment that results in an alteration of the pipe material's properties. Internal pipe corrosion refers to destruction associated with the inside of the pipe, which is in contact with the substance being conveyed, e.g., potable water. Internal pipe corrosion may be uniform over the surface or it may form pits and tubercles. External pipe corrosion refers to destruction from the outside of the pipe toward the interior. External pipe corrosion is often associated with stray current or certain soil conditions. *See also* tubercle.

pipe coupon *See* coupon.

pipe cutter A mechanical tool with rolling blades that indent a pipe as the tool rotates around and cuts the pipe. Such a tool is used for cast-iron pipe, with a smaller cutter used for copper tubing.

pipe diameter The nominal or commercially designated inside diameter of a pipe, unless otherwise stated. *See also* inside diameter.

pipe finder An instrument for locating underground metal water pipes by magnetic attraction or electronic detection.

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pipe fitting A set of connections, appliances, and adjuncts designed to be used in connecting pipes. Examples are elbows and bends to alter the direction of a pipe; tees and crosses to connect a branch with a main; plugs and caps to close an end; and bushings, diminishers, or reducing sockets to couple two pipes of different dimensions.

pipe gallery (1) Any conduit in which pipes are to be located, usually of a size to allow a person to walk through. (2) A gallery provided in a treatment plant for the installation of the conduits and valves and for a passageway to provide access to them.

pipe gauge A number that defines the thickness of the sheet used to make steel pipe. The larger the number, the thinner the pipe wall.

pipe grade The slope or fall of the pipe in the direction of flow.

pipe importance factor (PIF) A single (combined) measure of pipe age, break rate, reliability, and geometry (topology). It measures a pipe's contribution to source-to-node reliability. This term is also defined as the rate at which source-to-node reliability improves as the reliability of the pipe improves.

pipe-lateral system A filter underdrain system using a main pipe (header) with several smaller perforated pipes (laterals) branching from it on both sides. *See also* filter bottom.

pipeline A collection of pipes jointed to provide a conduit through which fluids flow.

pipeline network analyzer An analog computer invented by Malcom S. McIlroy for predicting the behavior of complex water, gas, or other distribution networks under specified demands. Each pipeline segment was represented by a "fluistor," a special light bulb the current-voltage characteristic of which follows the Hazen–Williams flow-headloss formula. Dozens of these machines, some capable of handling networks of a thousand or more pipes, were installed in the 1950s and 1960s before digital computers became powerful enough to solve such problems. It has also been called a fluid network analyzer. *See also* Hardy Cross method; Hazen–Williams formula; series-parallel reducible network.

pipe loop An experimental apparatus consisting of several feet of pipe complete with joints, elbows, and connections for flow-through testing of corrosion and corrosion control.

pipe mass loss Amount of mass of metal pipe lost during corrosion over time.

pipe offset A casting in the form of a reverse curve, designed for the continuation of a line of pipe parallel to its beginning. *See also* offset.

pipe-related liabilities Any of a number of risks assumed by a water utility or district associated with a water distribution system including age of pipe, pipe material, maintenance practices, pressure, corrosion, and other factors.

Piper trilinear diagram A graphical method for showing the content of major ions in water by plotting the percent equivalents of anions and cations along the sides of two triangles and using a rhombus (equilateral parallelogram) to represent the total ionic constituents.

pipe saw (1) A pneumatically or hydraulically powered tool that is self-propelled on a chain or rollers and has a saw blade that saws the pipe as the machine goes around the pipe. Such a tool is used to cut large-diameter cast-iron and ductile-iron pipe. (2) A handheld gasoline-powered saw that rotates a grinding blade at high speed and will saw or grind pipe. The pipe can be rotated or the saw can be moved all the way around the pipe. This type of saw can be used for ductile-iron, large cast-iron, steel, and concrete pipe.

pipe schedule A classification in a sizing system of arbitrary numbers that specifies the inside diameter and outside diameter for pipe. This term is used for steel, wrought-iron, and some types of plastic pipe. It is also used to describe the strength of some types of plastic pipe.

pipe stiffness A measure of the amount of force required to deflect the diameter of a pipe ring a given unit amount.

pipe-to-soil potential An electrical potential (driving force expressed in volts) that any two connected metals develop when in contact with a common medium, such as soil. Traditionally, pipe-to-soil potential is the potential measured between an underground metal, such as pipe, and a copper–copper sulfate electrode.

pipette A slender glass or plastic tube (sometimes graduated) used to measure and transfer small volumes of liquids (usually less than 25 milliliters). *See also* volumetric pipette.

piping (1) The action of water passing through or under a dam and carrying some of the finer soil material to the surface at the downstream toe. Such action may result in excessive leakage or even failure because the increased porosity of the material caused by removal of the fines allows an increase in the velocity of the water; in turn more and larger-sized material is removed. (2) The result of such action. (3) The system of pipes, incorporated fittings, and appurtenances that is provided to carry any fluid in a structure or plant. (4) The installation or laying of a system of pipes.

piping system A system of pipes, fittings, and appurtenances within which a fluid flows.

***p*-isopropyltoluene** *See under* isopropyltoluene.

piston A sliding metal cylinder or disk that reciprocates in a tubular housing to move water or apply force to water.

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piston meter A positive-displacement type water meter generally used for pipeline sizes of 2 inches (50 millimeters) or less, in which the flow is registered by the action of an oscillating piston.

piston pump A reciprocating pump in which the cylinder is tightly fitted with a reciprocating piston.

piston-type pump *See* piston pump.

pitless adapter A tube with a waterproof cap that is attached to a well casing above the frostline to protect the well discharge pipe and pump from freezing. The tube permits power wiring to enter but is otherwise waterproof.

pitometer A device operating on the principle of the Pitot tube, principally used for determining the velocity of a flowing fluid at various points in a water distribution system and to ascertain waste, leakage, or clogging of pipes.

pitometer survey A survey conducted with a pitometer to determine the velocity of flow of water flowing at various points in a distribution system and to ascertain waste, leakage, or clogging of pipes.

Pitot-integrating tube A flow element that consists of a rod extending through the pipe, with a number of holes (up to eight) on the upstream side of the rod that sample and average the velocity-induced pressure across the pipe cross section. The pressure is proportional both to the velocity of the fluid in the pipe and to a corresponding flow rate in the pipe. *See also* Pitot tube.

Pitot tube A device for measuring the velocity of flowing fluid by using the velocity head of the stream as an index of velocity. One type of Pitot tube consists essentially of an orifice that is held so as to point upstream and that is connected with a tube in which the impact pressure caused by the incoming water's velocity head may be observed and measured. A Pitot tube may also be constructed to have both an upstream and a downstream orifice; or it may have an orifice pointing upstream to measure the velocity head or pressure and piezometer holes in a coaxial tube to measure the static head or pressure. In either of these latter cases, the difference in pressure is the index of velocity.

pitting corrosion Highly localized corrosion resulting in deep penetration at only a few spots.

pixel The smallest indivisible element that makes up an image. In raster processing, data are represented spatially on a matrix of grid cells by picture elements, which are assigned values for image characteristics or attributes. The higher the resolution, the higher the picture's element count for a given area. *See also* raster image.

pK_a The negative common logarithm of the equilibrium constant (K) for the dissociation of an acid. The weaker an acid, the larger its pK_a. Thus, at 77° Fahrenheit (25° Celsius), for sulfuric acid (H_2SO_4, a strong acid), the pK_a is approximately –3.0; for acetic acid (CH_3COOH, a weak acid), the pK_a equals 4.76; and for boric acid (H_3BO_3, a very weak acid), the pK_a equals 9.24. When pH equals pK_a, the acid is 50 percent deprotonated. *See also* acid; dissociation.

pK_x A common logarithmic equilibrium constant for which x is replaced by an appropriately descriptive letter (e.g., pK_a for acid).

PL *See* public law.

placebo An inert preparation to act as a control in an experimental test. It has no physiological effect other than psychological on the person receiving the treatment.

placeholder A requirement included in a proposed regulation that may be replaced by a different requirement defined at a later date.

placental barrier The cellular and basement membranes that prevent a free diffusion of chemicals from the mother's blood to the fetal circulation. It is not an absolute barrier. Its structure differs significantly in different species and during different times in pregnancy. Up to six layers of cells may be present, and placentas are classed according to the number of layers present.

placental transfer The rate at which a chemical or other agent moves from the maternal blood into the fetus.

plague An acute, infectious, and contagious disease of rodents and humans, caused by a short, thick, gram-negative bacillus, *Yersinia pestis.*

plain angle units *See in the Units of Measure section.*

plain sedimentation The sedimentation of suspended matter without the use of chemicals or other special means.

plain settling tank A tank or basin in which water containing settleable solids is retained for a sufficient time, and in which the velocity of flow is sufficiently low, to remove by gravity a part of the suspended matter. *See also* sedimentation basin.

plan and profile drawings Engineering drawings showing depth of pipe, pipe location (both horizontal and vertical displacements), and the distance from a reference point.

planimetric map A map that shows the horizontal position on the earth's surface of natural and cultural physical entities, such as roads, buildings, and water bodies that are visible, identifiable, and able to be compiled into map features through photogrammetric or surveying procedures.

plankton (1) Small, usually microscopic, plants (phytoplankton) and animals (zooplankton) in aquatic systems. The chief constituents of phytoplankton are unicellular algae. Zooplankton consist of protozoa,

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small crustaceans, and various invertebrates' larvae. They are used as food by higher aquatic life forms such as fish. (2) The aggregate of passively floating, drifting, weakly motile organisms in a body of water. *See also* periphyton; phytoplankton; zooplankton.

planktonic Pertaining to plankton.

planktonic larvae The free-living, sexually immature form of plankton, these communities of microscopic organisms drift passively or swim weakly near the surface of oceans, ponds, and lakes.

planned indirect reuse *See* indirect reuse; planned reuse; water reuse.

planned reuse Water reuse implemented by a prepared system that was designed in advance (e.g., golf course irrigation with treated wastewater) rather than unintentional reuse (such as using a water body contaminated with wastewater as a drinking water source).

plant community The plant populations existing in a shared habitat or environment.

plant factor For a water treatment plant, the quantity of the production output over a given period of time divided by the plant's rated capacity, usually expressed as a percentage. A plant factor is sometimes also referred to as a plant operating factor.

plant hydraulic capacity The level of flow into a plant in excess of which the system will be hydraulically overloaded.

planting plan A two-dimensional plan drawn to scale that shows the layout of landscape plantings and plant specifications.

plant operating factor *See* plant factor.

plant optimization In the context of the Partnership for Safe Water, the continuous effort to improve filtered water quality and plant performance so that filtered water turbidity and particle counts (if the latter are measured) are as low as the plant can reasonably attain through the efforts of the operating staff. *See also* Partnership for Safe Water.

plant-scale study A full-scale evaluation of whether or not a particular water is amenable to treatment with particular operations or processes.

plant tap A water-sampling site upstream of the entrance to the distribution system but downstream of treatment.

plant water requirement The amount of irrigation needed to replace moisture depleted from the soil around plant roots as a result of evapotranspiration.

plan view A diagram or photo showing an object or facility as it would appear when one is looking down on it from above. *See also* elevation view; isometric view.

plaque A clear circular zone seen in a bacterial lawn resulting from in vitro virus infection.

plaque-forming units *See in the Units of Measure section.*

plasma (1) Any of several types of high-energy discharges of hot (3,000–10,000 kelvin) ionized gas. Plasma is applied in certain spectroscopic instruments for the analysis of metals. For example, an inductively coupled plasma is energized by a radio frequency coil and resulting magnetic field. The plasma is often cooled with large volumes of an inert gas such as argon. The plasma makes a very good atomizer for metals analysis and can be a powerful instrument when interfaced with atomic emission or mass spectrometric detectors. (2) The fluid portion of the blood in which the particulate compounds are suspended.

plasma membrane The lipid structure that separates the contents of a cell from the cell's external environment. Such membranes serve the purpose of excluding materials from the cell and provide a means of maintaining cellular contents, including various substrates, at a sufficient concentration to maintain normal physiological function.

plasma protein A protein found in the blood. The two major classes found in mammalian blood are albumin and globulins. As observed in therapeutics and toxicology, plasma proteins bind certain chemicals. Such binding serves as a buffer, preventing rapid diffusion of chemicals to cells where they produce their effects but also serving to limit the rate at which chemicals are removed from the body (i.e., the protein acts as a temporary sink for the chemicals). Thus, chemicals that are heavily bound to plasma proteins will have their initial or peak effects blunted, but the duration of the chemical effects might well be prolonged as a result.

plasma sparker system *See* sparker pressure pulse.

plasma water The aqueous phase of the blood. *See also* plasma.

plasmid A cytoplasmic, autonomously replicating chromosomal element found in bacteria. *See also* antibiotic resistance.

plasmid deoxyribonucleic acid (plasmid DNA) A circular strand of deoxyribonucleic acid (DNA) that can exist in the cytoplasm of a bacterial cell and replicate independent of bacterial genomic DNA. Genes encoded in the plasmid strand are accessory genes, such as antibiotic resistance genes, and are not needed by the organism for survival under normal conditions.

plastic Any high-molecular-weight polymer material (usually synthetic) that during its manufacture or processing can be extruded, molded, cast, drawn, or laminated into objects of all sizes and shapes by application of heat or pressure, by chemical

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condensation, or by casting during polymerization of monomers, and that can retain the new shape under conditions of use. *See also* polymer.

plastic fluid A fluid, in laminar flow, that requires a minimum shear stress (called the yield stress) before velocity gradients can be established.

plasticity index The unique numerical difference between the plastic and the liquid limits of a soil or sludge. Within this range of water content, the material exhibits plastic behavior. The plastic index, along with a material's liquid limit, will typically determine if a material can be used for a specific application, such as fill material.

plasticizer An organic compound added to a high-molecular-weight polymer to facilitate processing, increase the flexibility, and increase toughness of the final product by internal modification of the polymer molecule. Among the more important plasticizers are nonvolatile organic liquids and low-melting solids (e.g., phthalate, adipate). *See also* adipate; phthalate; polymer.

plastic limit *See* Atterberg limits.

plastic media Media that are made of plastic and are used within a packed bed or packed tower process. The media promote mass transfer or serve as attachment points for microorganisms. They are often in the shape of hollow spheres with varying geometric patterns to increase their surface area. *See also* packed bed filter; packed tower aeration.

plastic pipe An identification used for nonmetallic pipe manufactured from different polymers, such as polyvinyl chloride, $(CH_2{:}CHCl)_n$; polyethylene, $(H_2C{:}CH_2)_n$; or polybutylene, $(C_4H_8)_n$.

plastic soil A soil that is easily molded and shaped without cracking or losing volume.

plat The graphic representation of a specific ground area showing surface structures as well as water facilities located within the area.

plat-and-list map method A method of preparing valve and hydrant maps. *Plat* is the map position, showing mains, valves, and hydrants. *List* is the text portion, which provides appropriate information for items on the plat. *See also* list; plat.

plate Any flat-surface filter element. Plates are usually found in horizontal plant filters.

plate-and-frame filter press A mechanical device used to dewater sludge. The square plates are fitted with a filter fabric into which sludge is introduced, and the plates are pressed together, in accordion fashion, to dewater the sludge. After the pressing cycle, the plates are opened and the dewatered sludge cake falls into a hopper. In some instances the dewatered sludge may have to be manually dislodged from the filter fabric. Although somewhat labor-intensive, plate-and-frame filter presses can achieve a very high solids content in the dewatered sludge, potentially up to 50 percent.

plate-and-frame membrane configuration A type of membrane arrangement in which flat sheets of pressure-driven membranes are placed between porous separation plates. The arrangement is designed for a pressure-differential driving force across the membrane.

plate count An enumeration of bacteria in a sample. An appropriate volume of sample, or diluted sample, is placed in a sterile petri dish with a culture medium. The sample is then incubated at an appropriate temperature for some specified time period (usually 24 hours to 48 hours, but some types of samples and media are incubated for several days to several weeks). Each bacterial colony that develops is considered to have developed from 1 colony-forming unit, which may be a single viable cell or a clump of viable cells. All colonies on the plate are counted and adjusted for dilution, and the colony count recorded in colony-forming units per milliliter. *See also* heterotrophic plate count.

platelet A disk-shaped cell lacking a nucleus. Such cells are found in the blood of mammals and play an important role in the coagulation (clotting) of blood.

platelet aggregation The process by which platelets accumulate rapidly at the site of injury within blood vessels. The platelets attach to exposed collagen fibers and, through an active process, recruit the adhesion of other platelets to initiate a clot. During this process, a factor is exposed on the membrane of the platelet that augments thrombin formation, further accelerating clot formation.

plate press *See* plate-and-frame filter press.

plate screen A screen composed of one or more perforated plates through which a liquid flows. *See also* perforated baffle wall.

plate settler *See* inclined plate settler.

platform furnace *See* L'vov platform.

platform scale A weight-measuring device typically used for relatively heavy objects. The scale is located at grade elevation so that the object to be weighed can be rolled into place and does not have to be lifted. A truck scale is an example of a platform scale.

plating media Specific growth substrates, in a solid form, that meet the nutritional needs required to culture microorganisms.

platinum–cobalt (Pt–Co) color unit *See under* color unit *in the Units of Measure section.*

platinum–cobalt method A procedure used to determine the amount of color in water by comparing the colors of standards made up with specified platinum–cobalt solutions to the color in the sample.

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playa (1) A lake bed found in arid or desert regions in the lowest part of an enclosed valley with centripetal or inward drainage; a bolson. The lake is usually dry, except after heavy rainstorms, when it may be covered by a thin sheet of water that quickly evaporates. (2) A shore, strand, beach, or bank of a river.

playa deposit A deposit of sedimentary material laid down in a playa.

PLC *See* programmable logic controller.

pleated membrane Flat sheet membrane folded into pleats and placed in a filter housing. Often, pleated membranes are packaged as a cartridge that can be installed in a cartridge filter. *See also* cartridge; cartridge filter; membrane.

plenum The space under a filter floor where filtered water is collected before it exits through the header and where air or water or both can be introduced and then flow upward through the filter nozzles into the filter bed.

plerotic water Subsurface water occupying the saturation zone, from which wells and springs are fed. In a strict sense, this term refers only to water below the water table. Plerotic water is also called groundwater or phreatic water.

ploidy The number of copies of chromosome complements that are contained in a cell.

plotter A peripheral device that allows a computer to produce hard copies of graphics. Plotters differ from printers in that plotters use pens to draw continuous lines rather than a series of dots. Most plotters have the capability of using larger sheets than standard printers as well.

PLSS *See* public land survey system.

plug (1) A fitting for the bell end of cast-iron pipes to close the opening. (2) A fitting that has an exterior pipe thread and a projecting head by which the fitting is screwed into the opening of another fitting. (3) The movable part of a tap, cock, faucet, plug, or valve. (4) A clogging of a pipe. (5) A specific quantity, or "chunk," of water moving through a containing structure. *See also* plug flow.

plug cock A shutoff valve in which the liquid passageway is a hole in a rotatable plug fitted into the valve body. Rotation of the plug through a right angle stops or starts the flow.

plug flow A flow regime in which no longitudinal dispersion (mixing in the direction of flow) occurs. The input, or plug, travels through a pipe or unit process in such a fashion that the entire mass or volume is discharged at exactly the theoretical hydraulic retention time of the unit (calculated as volume of the vessel divided by the flow rate). *See also* hydraulic detention time; longitudinal dispersion; plug.

plug-flow reactor (PFR) A reactor in which the hydraulic behavior is such that the residence time of a given input, or plug, is exactly equal to the theoretical hydraulic retention time. *See also* hydraulic detention time.

plug-flow sampling A technique of collecting samples in which grab samples are taken at downstream intervals in a flowing stream so that the same plug of water is always being sampled.

plugging In a membrane treatment process, the depositing of solids in the membrane module, causing a physical flow restriction that negatively affects performance.

plugging factor An empirical measure of the plugging characteristics of membrane feedwater based on passing the water through a membrane filter test apparatus containing a 0.45-micrometer pore diameter filter (commonly a cellulosic type) in a dead-end filtration mode at a constant feed pressure (typically 30 pounds per square inch [207 kilopascals]) for a specified duration (typically 15 minutes) and observing the flow rate decline. The plugging factor is calculated based on the measured time required for 500 milliliters of filtrate to pass through the filter at the beginning of the test filtration period and the time for collection of 500 milliliters of filtrate at a later time. It is computed as [1 – (initial time in seconds/final time in seconds)] × 100, expressed as a percentage.

plug valve A valve in which the movable control element is a cylindrical or conical plug, in contrast to a flat disk.

plumbing (1) The pipes, fixtures, and other apparatuses inside a building for bringing in the water supply and removing liquid and waterborne wastes. (2) The installation of the foregoing pipes, fixtures, and other apparatuses.

plumbing fixture A receptacle that receives water and discharges wastewater into a drainage system (e.g., a sink or toilet).

plumbing system A building's distributing pipes for water supply; fixtures and fixture traps; soil, waste, and vent pipes; building drain and building sewer; and stormwater drainage pipes; along with the associated devices, appurtenances, and connections within and adjacent to the building.

plumbosolvation The actual dissolution of lead into drinking water, as opposed to the electrochemical deterioration of the lead-bearing material.

plume The pattern formed as polluted water extends downstream from the pollution source (analogous to smoke drifting downwind from a smokestack).

plunger pump A reciprocating pump having a plunger that does not come in contact with the cylinder walls but enters and withdraws from the cylinder through

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packing glands. Such packing may be inside or outside the cylinder, according to the design of the pump. The packing is in the casing rather than around the plunger or piston.

pluripotent stem cell A primitive stem cell that has not yet committed to a final developmental pathway and can still give rise to several different cell types. Stem cells are believed to be important in carcinogenesis because cancer is assumed to evolve only from stem cells in which a mutation has been inserted or in which control over the rate of division has been lost. *See also* stem cell.

plutonic water Water derived from deep in the earth's magma by volcanic activity.

pluvial index An indicator of the total rainfall that may be expected to be exceeded during a given period, such as 1 day or 2 days, in a given locality during a given number of years. *See also* rainfall index.

pluviometric coefficient The ratio of the actual mean rainfall in a particular month to a calculated mean rainfall, expressed as a percentage and based on the assumption that the annual rainfall is evenly distributed throughout the year.

PMOS *See* positive (charge) metal oxide semiconductor.

PMP *See* probable maximum precipitation.

PMR *See* proportional mortality ratio.

PNAH *See* polynuclear aromatic hydrocarbon.

pneumatic Powered or moved by air pressure or compressed air.

pneumatic controller A device for controlling the mechanical movement of another object (e.g., a valve stem) by variations in pneumatic pressure connected to the controller.

pneumatic ejector A device by which a material is ejected or educted into a pipe through reduced air pressure created by a Venturi. *See also* Venturi.

pneumatic hammer *See* water hammer.

pneumatic pumping Pumping by means of an air-lift pump.

pneumatic system A system in which air pressure is used as the primary motive force.

pneumatic tank A pressurized holding tank that is part of a closed water system (such as for a household well system) and is used to create a steady flow of water and avoid water surges created by the pump turning on and off.

PNOM *See* polar natural organic matter.

POC *See* particulate organic carbon; purgeable organic carbon.

pocket spring A spring located at the lower edge of a deposit of pervious material filling an irregular depression of the bedrock.

pocket storage The volume of water, expressed as a depth for the entire water surface of the area, that is required to fill natural depressions, large or small, to their overflow levels. Pocket storage is also called depression storage.

POE *See* point of entry.

pOH A measure of a solution's hydroxide ion (OH^-) concentration.

poietin Any of a variety of hormones that control the numbers of various cell types found in the peripheral blood (e.g., the numbers of red blood cells or white blood cells).

point dilution method A technique for measuring water discharge by adding a known concentration of a tracer compound at one location and measuring the concentration of that tracer at a downstream location. A simple mixing calculation allows an estimate to be made of the total discharge between the two points based on how much the tracer was diluted.

point gauge A sharp-pointed rod attached to a graduated staff or vernier scale, used for measuring the elevation of the surface of water. The point is lowered until the tip barely touches the water and forms either a streak (in flowing water) or a meniscus jump (in still water). A point gauge can also be used in a still well, and it can operate on an electric current with a buzzer or light activated by contact with the water.

point mutation A change in the base sequence at a single site on deoxyribonucleic acid. Point mutations usually represent deletions or base-pair substitutions. Deletions are particularly destructive if they cause a number of bases not divisible by three to be lost. In this case, the mutation is referred to as a frame-shift mutation. *See also* frame-shift mutation; mutagenesis.

point of application The location, in relation to other processes, where a specific treatment chemical is introduced.

point of diminishing returns The point at which additional increments of coagulant result in an "insignificant" removal of disinfection by-product precursors. A requirement in the Disinfectants and Disinfection By-Products Rule states that surface water systems using conventional treatment must enhance their coagulation processes to remove disinfection by-product precursors. Because some waters contain natural organic matter that is less amenable to removal by coagulation than for typical surface waters, a utility can perform a series of jar tests to determine a point of diminishing returns that can be employed in requesting alternative performance criteria. The rule establishes a protocol for determining the point of diminishing returns for a particular source water. *See also* Disinfectants and Disinfection By-Products Rule; disinfection by-product precursor; enhanced coagulation; natural organic matter; Stage 2 Disinfectants and Disinfection By-Products Rule.

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point of disinfectant application The point where disinfectant is applied and where water downstream of that point is not subject to recontamination by surface water runoff.

point of entry (POE) The location at which a product to be delivered, such as potable water, enters the delivery system, such as a distribution system.

point-of-entry (POE) treatment Water treatment at the inlet to an entire building, house, or facility. (Outside faucets at the location may be excepted from such treatment.)

point-of-entry (POE) treatment device A treatment device applied to the drinking water entering a house or building for the purpose of reducing contaminants in the drinking water distributed throughout that house or building. *See also* Water Quality Association.

point of take (1) The location or point at which water leaves the distribution system and enters a private system or another system. This point is normally the meter or property line. (2) The location at which a water system receives water, which might be a lake, river, reservoir, conduit, pipe, or meter.

point of use (POU) The location at which a product, such as potable water, reaches the end user.

point-of-use (POU) treatment Water treatment at a single outlet or limited number of water outlets in a building, but for less than the whole building or facility. Point-of-use treatment is often used to treat water for drinking and cooking only.

point-of-use (POU) treatment device A treatment device applied to a small subset of a building's taps (usually one) for the purpose of reducing contaminants in drinking water at those taps. *See also* Water Quality Association.

point-of-zero charge *See* zero point of charge.

point rainfall The rainfall rate at a single station, in contrast to the average rate for a region.

point source (PS) A discharge that comes out of the end of a pipe—as opposed to runoff or a discharge from a field or similar source, which is called a nonpoint source. *See also* nonpoint waste source.

point-source emitter A drip-irrigation component that delivers water from a single orifice at a predictable rate, usually measured in gallons or liters per hour.

poise (P) *See in the Units of Measure section.*

poised river A river or stream that, as a whole, maintains its slopes, depths, and channel dimensions without any raising or lowering of its bed. Such a river condition may be only temporary from a geologic point of view, but it may be accepted as having considerable stability for practical engineering purposes.

Poiseuille's Law *See* Hagen–Poiseuille equation.

poison *See* toxicant.

Poisson's effect (ratio) The property of a material that causes a change in its dimensions because of a force applied perpendicular to the plane of the dimension change. It is expressed as the ratio of lateral strain to load direction strain.

Poisson distribution In statistics, a frequency distribution for a population that is randomly dispersed and for which the mean and the variance are equal. *See also* arithmetic mean; variance.

polar Having distinct positively and negatively charged ends.

polarity reversal In an electrodialysis reversal membrane process, the periodic change in electrode polarity of the electrodes, whereby the demineralizing compartments become concentrate compartments and the concentrate compartments become demineralizing compartments. *See also* electrodialysis reversal.

polarization (1) The concentration or depletion of ions in the thin boundary layer adjacent to an ion-rejecting membrane. (2) In the electrodialysis process, the point at which the current density is great enough to dissociate water molecules, forming hydrogen ions (H^+) and hydroxide ions (OH^-). *See also* concentration polarization.

polarize (1) To make something polar. (2) To disrupt the corrosion process by developing a barrier on an anodic or cathodic surface.

polar natural organic matter (PNOM) The natural organic matter fraction having an unequal distribution of electrical charges. This type of natural organic matter is more hydrophilic, can be better dissolved in water, and is hard to remove by coagulation or carbon adsorption processes. *See also* hydrophilic.

polarography An electrochemistry technique, generally performed in aqueous solutions, whereby current is measured as a function of potential applied to an electrolytic cell.

polar organic by-product A disinfection by-product that is a polar organic compound. Polar compounds have a positive and negative charge in separate positions on the molecule. An example of a polar organic by-product is a compound with a carboxyl (COOH) group, such as haloacetic acids (CX_3COOH, where X = Cl, Br, or H, or a combination) or carboxylic acids (R-COOH). *See also* disinfection by-product; organic compound.

polar organic compound A compound with a molecular structure composed of one or more functional groups that make the structure unbalanced in terms of electron placement. Polar organic compounds are characterized by high water solubility, and they are generally difficult to extract from water.

polar solvent A solvent for which the molecules are polarized. In other words, the electrostatic charge is relatively positive on one side of the molecule and,

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consequently, relatively negative on the other because of an unequal sharing of electrons in the covalent bonding between the atoms. Polar solvents separate the structural units of the solute by surrounding each ion with a cluster of solvent molecules pointing opposite charges toward the positive or negative solute ions. Water and methanol (CH_3OH) are examples of highly polar solvents.

polar turfgrass pesticides Pesticides used to kill weeds, insects, and fungi on lawns or golf courses having an unequal distribution of electrical charges. These types of pesticides are more hydrophilic and can be better dissolved in water. *See also* hydrophilic.

pole One end of a magnet: the north or south pole.

pole shader A copper bar circling the laminated iron core inside the coil of a magnetic starter.

police power The ability to enforce laws.

policy exclusion An exclusion commonly contained in a comprehensive general liability insurance policy that purports to restrict coverage to a policyholder for certain types of liabilities incurred as a result of an alleged failure of the policyholder's products or work, which liabilities would otherwise be covered under the basic insuring language of the policy. Examples of policy exclusions include business risk exclusion, failure-to-perform exclusion, impaired property exclusion, own-product exclusion, and sistership exclusion.

poliovirus A member of the genus *Enterovirus.* It is responsible for an acute infectious disease involving the central nervous system.

polished water *See* intrinsic water.

polisher A treatment stage placed at the end of other treatment to bring the water to a more highly conditioned and more perfect state, e.g., a mixed bed of ion-exchange media installed as the final treatment step in the deionization process to remove last traces of undesirable ions.

polishing filter A filter installed for use after the primary water treatment stage to remove any traces of undesirable matter or to "polish" the water. *See also* polisher.

polling A technique of monitoring several instruments over a single communications channel with a receiver that periodically asks each instrument to send current status.

pollutant Dredged spoil, solid waste, incinerator residue, wastewater, garbage, wastewater biosolids, munitions, chemical wastes, biological materials, or radioactive materials not covered by the Atomic Energy Act; heat; wrecked or discarded equipment; or rock, sand, cellar dirt, or industrial, municipal, or agricultural waste discharged into water.

pollution (1) A condition characterized by the presence of harmful or objectionable material in water. (2) The presence in a natural body of water of any material that diminishes the optimal economic use of the water body by the population it serves and that has an adverse effect on the surrounding environment.

pollutional index A criterion by which the degree of pollution of a stream or other body of water may be measured, such as bacterial density, plankton level, benthos level, biochemical oxygen demand, or dissolved oxygen concentration.

pollutional load The quantity of material that is carried in a body of water and exerts a detrimental effect on some subsequent use of that water.

pollution control The implementation of a program to reduce or eliminate substances that contaminate another substance (e.g., air, water, soil) after the contamination is verified by comparison with a standard.

pollution plume A mass of water that contains undesirable concentrations of some pollutant. Water at the periphery of the mass may also contain the pollutant but at acceptable concentrations and so would not be considered part of the plume. Plumes are often elliptical or teardrop shaped, with the long axis aligned with the direction of flow.

polyacrylic acid ($(H_2C{:}CHCOOH)_x$) A major chemical component of some types of scale inhibitors (antiscalants). Polyacrylic acid–based scale inhibitor is sometimes added during pretreatment for membrane desalting systems.

polyaluminum chloride (PACl) ($Al(OH_x(Cl)_y(SO_4)_z$, with *y* typically from 1.5 to 2.5 and *z* from 0 to 1.5) A hydrolyzed form of aluminum chloride ($AlCl_3$) that is used for coagulation, typically in low-turbidity cold waters. As a result of its polymeric form, lower dosages can be used compared to metal coagulants. *See also* coagulant; coagulation.

polyaluminum hydroxychloride A hydrolyzed form of aluminum chloride that includes water of hydration. It is used for coagulation. As a result of its polymeric form, lower dosages can be used compared to metal coagulants. *See also* coagulant; polyaluminum chloride.

polyaluminum-hydroxysulfate (PAHS) A hydrolyzed form of aluminum sulfate (aluminum-to-hydroxide ratio = 1.5) that includes water of hydration. It is used for coagulation, typically in low-turbidity waters. As a result of its polymeric form, lower dosages can be used compared to metal coagulants. *See also* coagulant; coagulation.

polyaluminum sulfate (PAS) ($Al(OH)_x(Cl)_y(SO_4)_z$, with *y* typically from 1 to 2.5 and *z* from 0 to 1.5) A hydrolyzed form of aluminum sulfate ($Al_2(SO_4)_3$) that is used for coagulation, typically in low-turbidity waters. As a result of its polymeric form, lower

P

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dosages can be used compared to metal coagulants. *See also* coagulant; coagulation.

polyamide (PA) A polymer in which amide linkages (CONH) occur in its molecular structure. Nylon is a common synthetic polyamide. *See also* polyamide membrane.

polyamide membrane A membrane with polyamide-based barrier-layer composition. Such membranes are commonly used for hollow-fiber membrane permeators or for thin film composite flat-sheet membranes formed into spiral-wound elements. *See also* flat-sheet membrane; hollow-fiber membrane.

polyaromatic hydrocarbon *See* polynuclear aromatic hydrocarbon.

polybutylene ($(C_4H_8)_n$) A thermoplastic polymer, such as butyl rubber, of butylene liquefied petroleum gas—isobutene, butene-1, or butene-2. Polybutylene is manufactured in various degrees of elasticity, strength, and stability. It is used for films, coatings, pipes, tubing, fittings, and many other services. *See also* plastic; plastic pipe.

polycarbonate (PC) ($(–C_6H_4C(CH_3)_2C_6H_4OCOO–)_n$) A thermoplastic polymer resin that is a linear polyester of carbonic acid (H_2CO_3). Polycarbonate is a transparent, nontoxic, noncorrosive, heat-resistant, high-impact-strength plastic. It is generally stable but may be subject to attack by strong alkalies and some organic hydrocarbons. It can be molded, extruded, or thermoformed, and it is commonly used for numerous services, such as nonbreakable windows, household appliances, tubing, piping, and cartridge filter sumps. *See also* plastic; plastic pipe.

polychlorinated biphenyl (PCB) ($C_{12}X_{10}$, where two or more of the substituent atoms are chlorine and the remainder are hydrogen) Any of a class of aromatic compounds containing two benzene nuclei with two or more substituted chlorine atoms. These compounds are highly toxic. Because of their persistence and ecological damage via water pollution, their manufacture was discontinued in the United States in 1976. Their presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.0005 milligrams per liter. *See also* aromatic hydrocarbon.

polychromatic (1) Having or consisting of more than one color or hue. (2) In ultraviolet (UV) processes, light energy output at several wavelengths such as with medium-pressure UV lamps. *See also* medium-pressure ultraviolet lamp.

polychromatic ultraviolet (UV) irradiation Treatment using ultraviolet light with multiple wavelengths generated by medium-pressure mercury ultraviolet lamps. Low-pressure mercury ultraviolet lamps emit a single wavelength at 254 nanometers, and medium-pressure mercury ultraviolet lamps emit over a range of wavelengths ranging from 185 nanometers to 1,367 nanometers. See also medium-pressure ultraviolet irradiation; ultraviolet light disinfection.

polyclonal antibody An antibody that is more tolerant of minor changes in the antigen, resulting in less specificity. This is in contrast to monoclonal antibody. *See* monoclonal antibody.

poly(diallyldimethylammonium chloride) (polyDADMAC) A widely used cationic polymeric coagulant of relatively low molecular weight (<500,000) and cyclic structure. It is in a class called polyquaternary amines. Each monomer unit contains a nitrogen atom bound to four carbon atoms and carries a positive charge. It is typically used to increase the rate of aggregation of negatively charged particles by an adsorption and surface charge neutralization mechanism.

polydispersity A measure of the range of molecular weights of the components of natural organic matter in a water sample. For example, a sample with low polydispersity contains substances that occupy a narrow size fraction and do not possess molecular weights that vary by orders of magnitude. *See also* molecular weight distribution; natural organic matter.

polyelectrolyte A complex polymeric compound, usually composed of synthetic macromolecules that form charged species (ions) in solution. Water-soluble polyelectrolytes are used as flocculants; insoluble polyelectrolytes are used as ion-exchange resins. *See also* coagulant; polymer.

polyelectrolyte flocculant A polymeric organic compound used in water treatment to induce or enhance the flocculation of suspended and colloidal solids and thereby facilitate sedimentation or the dewatering of sludges.

polyethersulfone (PES) A hydrophilic, noninonic and flexible polymer plastic material that is widely used to make various water treatment and life science membranes. *See also* membrane.

polyethylene (PE) ($H_2C{:}CH_2$) A tough thermoplastic polymer ($(–CH_2CH_2–)_x$ of ethylene ($CH_2{:}CH_2$) that resists chemicals and absorbs very little moisture. Polyethylene can vary from soft and flexible to hard and rigid depending on the pressures and catalysts used during manufacturing. Low-density polyethylene has a melting point of about 240° Fahrenheit (115° Celsius) and a tensile strength of 1,500 pounds per square inch (10,345 kilopascals); high-density polyethylene melts at 270° Fahrenheit (135° Celsius) and has a tensile strength of 4,000 pounds per square inch (27,580 kilopascals). Polyethylene is commonly used for tubing and piping, food packaging, garment

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bags, molded plastic products, and pressure drinking water pipe. *See also* plastic; plastic pipe.

polyethylene encasement An 8-mil (0.2-millimeter) polyethylene film placed around gray or ductile cast-iron pipe to prevent corrosion.

polyethylene glycol (PEG) A linear, hydrophobic, nonionic, and flexible polymer. Its nonionic macromolecules are widely used to determine the pore size distribution of various membranes.

polyethylene loose wrap *See* polyethylene encasement.

polyethylene sleeves *See* polyethylene encasement.

polyethylene wrap *See* polyethylene encasement.

polygon (1) A closed, two-dimensional figure with three or more sides and intersections. (2) An enclosed geographic area, such as a land parcel or political jurisdiction.

polygon overlay A software function that generates derivative polygons based on the union, intersection, or subtraction of polygons in multiple geographic information system data layers. *See also* polygon.

polyhalogen-substituted anisole A halogenated methoxybenzene compound. For trichlorophenol analysis, it is common to convert trichlorophenol to its methyl ester, trichloroanisole, which can be easily separated and analyzed using gas chromatography. *See also* methyl ester.

polyiron chloride (PICl) A prepolymerized, hydrolized form of iron used as a coagulant. *See also* polyaluminum chloride.

polymer A synthetic organic compound with high molecular weight and composed of repeating chemical units (monomers). Polymers may be polyelectrolytes (such as the water-soluble flocculants epichlorohydrin-dimethylamine and poly(diallyldimethylammonium chloride)), water-insoluble ion-exchange resins, or insoluble uncharged materials (such as those used for plastic or plastic-lined pipe). *See also* coagulant; plastic pipe.

polymer aging A process in which a polymer is stored in a diluted form and slowly mixed to allow the polymer to develop certain characteristics that are required for its intended purpose. Polyelectrolyte polymers typically are aged in day tanks, in which the concentrated polymer is mixed with dilution water and is gradually fed over the course of 1 to several days. *See also* day tank; polymer.

polymerase chain reaction (PCR) An assay or protocol that allows exponential amplification (cloning) of a specific deoxyribonucleic acid sequence from the original sequence (template).

polymer bridging A flocculation mechanism in which previously formed particles are connected by a polymer, thus creating a larger particle that can more readily be removed by physical processes (e.g., settling). *See also* bridging; polymer.

polymer coagulant Any of a group of coagulants that are polymeric in nature and of varying molecular weights and charges. A polymer coagulant is used to destabilize particles in suspension for subsequent removal by physical processes. Most polymer coagulants that are used as the primary, or sole, coagulants are positively charged.

polymeric sludge The material produced as a result of adding a polymer to a raw water, and subsequent coagulation and sedimentation. Polymeric sludge contains the hydrolyzed floc formed by polymer's reaction with the raw water and the particulate matter removed by the process.

polymyxin B Antibiotic and cyclic polypeptide that causes direct membrane damage by a detergent-like action.

polyneuropathy A disease that involves several nerves (as opposed to a single nerve).

polynomial equation A mathematical equation in which various exponential forms of the independent variable appear simultaneously. For example, $y = ax + bx^2 + cx^3$ is a polynomial equation.

polynuclear aromatic hydrocarbon (PAH, also PNAH) (C_xH_y) A complex aromatic ring system built up by fusing two (or more) rings—usually of the benzenoid type (C_6H_6)—to one or more common sides. For example, naphthalene ($C_{10}H_8$) is a fusion of two rings; anthracene ($C_{14}H_{10}$) and phenanthrene ($C_{14}H_{10}$) are fusions of three rings; pyrene ($C_{16}H_{10}$) and naphthacene ($C_{18}H_{12}$) are fusions of four rings; and benzopyrene ($C_{20}H_{12}$) is a fusion of five rings.

polyoxyethylene (20) sorbitan monooleate *See* polysorbate 80.

polyphosphate Any of a broad family of inorganic phosphorus compounds that are commonly referred to as molecularly dehydrated phosphates or condensed phosphates, including hexametaphosphate, tripolyphosphate ($P_3O_{10}^{5-}$), and pyrophosphate ($P_2O_7^{5-}$), among others. Unlike orthophosphate (PO_4^{3-}), for which four oxygen atoms always surround a single central phosphate, polyphosphates are arranged as polymeric chains or occasionally rings that vary in their phosphorus-to-oxygen ratio and chain length with different commercial formulations. Inorganic polyphosphates may be protonated like weak acids when they are not coordinated with metal ions, and they tend to break down (hydrolyze) into orthophosphate groups plus molecules of shortened chain length over time and under extreme temperature and pH conditions.

polypig A flexible polyurethane cleaning swab that is flushed through a distribution line with water to

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scrape, remove foreign matter, and assist in flushing and cleaning water mains. *See also* scraper.

polyploidy A condition in which a cell contains more than two full sets of homologous chromosomes (e.g., triploid, three sets; tetraploid, four sets). This condition is not necessarily abnormal in certain tissues (e.g., the liver), but it may result in observable anomalies if such cells do not normally appear in a particular tissue or organism.

polypropylene ($(C_3H_6)_n$) A thermoplastic polymer of propylene resembling polyethylene and used for making molded and extruded plastic products, such as water pipe, tubing, and fittings. *See also* plastic; plastic pipe; polyethylene.

polyquarternary amine The monomer building block of the coagulant polymers epichlorohydrin-dimethylamine and poly(diallyldimethylammonium chloride). It is a nitrogen atom bound to four carbon atoms and carries a positive charge. *See also* epichlorohydrin-dimethylamine; poly(diallyldimethylammonium chloride).

polysaccharide *See* algal polysaccharide.

polysilicate surface film Substance associated with inhibiting corrosion pitting of copper pipes in drinking water distribution systems.

polysorbate 80 The generic name for polyoxyethylene(20) sorbitan monooleate. In general, polysorbates are nonionic surfactants obtained by esterification of sorbitol ($C_6H_8(OH)_6$) with one or three molecules of a fatty acid (e.g., oleic acid ($CH_3(CH_2)_7CH{:}CH(CH_2)_7COOH$)) under conditions that cause splitting out of water from the sorbitol, leaving sorbitan. Polysorbates are used as surfactants, emulsifying agents, dispersing agents, foaming and defoaming agents, and so on. Polysorbate 80 is used in bacterial media to disperse microorganisms that would grow in clumps. *See also* esterification; fatty acid; nonionic; surface-active agent.

polystyrene ($(C_6H_5CH{:}CH_2)_n$) Polymerized styrene. Polystyrene forms the skeletal structure of many ion-exchange resin beads.

polystyrene microsphere *See* microsphere.

polystyrene resin The most common type of resin used in ion-exchange processes.

polystyrene sulfonate (PSS) A water-insoluble polymer commonly used as a cation-exchange resin for water softening. *See also* resin; water softener.

polysulfone (PSU) ($(–C_6H_4SO_2C_6H_4OC_6H_4C(CH_3)_2C_6H_4O–)_n$) A synthetic thermoplastic polymer. Derivation is from the condensation of bis-phenol A ($((CH_3)_2C(C_6H_4OH)_2)$) and dichlorophenyl ($(Cl_2C_6H_3)$) sulfone. (A sulfone is an organic compound containing an $–SO_2$ group.) *See also* polysulfone membrane.

polysulfone membrane A composite membrane with a polysulfone-based barrier layer composition.

polytetrafluoroethylene (PTFE, or TFE) ($(C_2F_4)_n$) A fluorinated polymer used for labware and as a nonstick coating. *See also* polymer.

polyunsaturated Pertaining to a fat or oil that is based at least partly on fatty acids having two or more double bonds per molecule. *See also* fatty acid.

polyurea Urea ($CO(NH_2)_2$) that is used in the preparation of plastics, resins, and so on. *See also* polyurea membrane.

polyurea membrane A composite membrane with a polyurea-based barrier layer composition.

polyurethane foam filter A prefilter that could be used when clarification does not provide the desired level of turbidity removal. This type of filter is constructed of flexible open celled foams of polyether polyurethane. Because the material is flexible, the bed depth and porosity can be varied by altering the degree of mechanical compression of the filter. *See also* fuzzy filter.

polyvinyl alcohol (PVA) ($(–CH_2CHOH–)_x$) A water-soluble synthetic polymer made by alcoholysis (a chemical reaction between an alcohol and another organic compound, analogous to hydrolysis) of polyvinyl acetate $(–CH_2CH(OOCCH_3)–)_x$. *See also* polymer.

polyvinyl chloride (PVC) ($(–H_2CCHCl–)_x$) An artificial polymer made from vinyl chloride monomer ($CH_2{:}CHCl$) and frequently used in pipes, sheets, and vessels for transport, containment, and treatment in water facilities. *See also* polymer.

polyvinyl chloride (PVC) pipe A type of pressure pipe for water distribution manufactured from polyvinyl chloride compound. This type of pipe is found in plumbing and irrigation systems.

polyvinylidene fluoride (PVDF) A highly crystalline unreinforced fluoropolymer with good mechanical and thermal properties and excellent chemical resistance. It is commonly used as pipe fittings, disc filters in laboratory, and membrane for water and wastewater treatment.

poly wrap A thin, loose plastic sheet or bag that is placed around ductile-iron pipe or iron fittings to separate the material from the surrounding soil, providing corrosion protection for the pipe or fitting.

pond A body of water of limited size, either naturally or artificially confined, and usually smaller than a lake.

ponded stream A section or stretch of stream flowing through an area that has been warped upward or uplifted at a geological period subsequent to the time when the stream channel was originally established.

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pool (1) A small and rather deep body of relatively quiet water, as a pool in a stream. (2) A small body of standing or stagnant water; a puddle.

pool cushion A pool of water maintained at the toe of an overflow dam or other structure to receive and spread the impact of water that falls with high velocity over the structure.

pooled sample result Statistical method that estimates the analytical result of one sample based on the result of the aggregate of many samples. If a large number of samples are to be analyzed for one or more analytes and it is expected that only a few samples will have analyte concentrations above a specified level *(C),* testing costs may be reduced by pooling or combining equal volumes of several samples and analyzing the resulting mixture. If the concentration of a mixture is less than *C/n,* where *n* is the number of samples pooled, then the concentration of the analyte in any one of the samples must be less than *C.* Hence only one analysis, instead of *n,* has to be performed. If the analyte concentration in the pooled sample exceeds *C/n,* then it may be necessary to analyze each of the individual samples. The method of analysis must be sensitive enough so that $n \times$ detection limit $< C/n$.

pooling A process whereby water allocations from several different irrigation accounts are reassigned to better fit actual watering needs.

pool spring A spring that occurs as a pool of water in the bottom of a surface depression.

poorly buffered Having minimal ability to resist changes in pH.

poorly drained Pertaining to a condition in which water is removed from the soil so slowly that the soil is saturated periodically during the growing season or remains wet for long periods (greater than 7 days).

poppet valve *See* mushroom valve.

population In ecology, a group of individuals of the same type, particularly of the same species, within a community. Populations have certain characteristics not shown by either individual organisms or the community as a whole. Characteristics of a population include age distribution, birth and death rates (natality and mortality, respectively), density (size in relation to unit space), dispersion (distribution of the individuals within the area), growth rate, and sex ratio.

population at risk A population subgroup that is more likely to be exposed to a chemical, or is more sensitive to a chemical, than is the general population.

population attributable risk (PAR) The fraction of the disease burden (e.g., cancer) that could be eliminated if an exposure were absent.

population-based fee An annual operating fee determined by the size of the population being served by a community water system.

pore A very small open space in a rock or granular material. *See also* interstice.

pore diffusion The mechanism by which molecules pass through a pore in a medium for subsequent removal by adsorption. This term is typically associated with diffusion through granular activated carbon pores, in which the limiting step in adsorption may be associated with the ability of a molecule of a given size to pass through (or be excluded by) a pore of similar, or smaller, size. *See also* adsorption; granular activated carbon.

pore size The diameter of openings through a porous membrane that allows passage of water and precludes passage of particles larger than the size of the porous openings, typically measured in micrometers; commonly used to distinguish particle removal capability of low-pressure microfiltration and ultrafiltration membranes. Often average pore size is called nominal pore size and maximum pore size is called absolute pore size. *See also* microfiltration; ultrafiltration.

pore space An open space in rock or granular material. *See also* interstice.

pores per linear inch (ppi) *See in the Units of Measure section.*

pore velocity The fluid velocity in each pore of a porous medium. *See also* actual groundwater velocity.

pore volume The volume of the internal void spaces in a granule that are smaller than 0.1 millimeter across and large enough to allow access to helium. It is measured as the difference in the volumetric displacement by a measured quantity of granules in mercury as compared to the same measurement in helium at standard conditions.

pore water Water in interstices of granular permeable rocks, as in sedimentary and alluvial deposits.

porosity The ratio of void volume to bulk volume in a sample of rock, sediment, or filter pack material.

porous Full of pores through which water, light, and so on may pass.

portable exchange (PE) tank A tank containing up to 2 cubic feet (0.06 cubic meter) of ion-exchange products or filter media, rented to homeowners or business clients with the bed fully regenerated and ready for use. Portable exchange tanks do not have the valving controls required for regeneration. Upon exhaustion (as indicated by predetermined calendar days, a meter, or a monitoring device), the tanks are returned to a central regeneration plant, where the resin or other media in each tank are reprocessed and restored for reuse. Portable exchange tanks may be available with water-softening or deionization resins, mixed ion-exchange media, manganese zeolite, activated alumina, or activated carbon. Portable

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exchange tanks are used for both household and commercial applications.

Portable Operating System Interface for UNIX (POSIX) An IEEE standard for operating systems aimed at ensuring that programs are transportable between different hardware platforms using the UNIX operating software.

portal lesion Necrotic damage to the liver in the area surrounding the portal vein.

portfolio management A strategic planning process aimed at achieving a balanced array of investments that will mitigate uncertainties and maximize the probability of achievement of potential returns. Investments typically include a mix of fixed-return, or low-volatility, investment instruments (such as bonds or blue-chip stocks) and investments that have variable rates of return (and higher volatility) in order to minimize risk and maximize return.

portland cement A type of hydraulic cement usually made by heating a mixture of limestone and clay and pulverizing the resulting product. Portland cement is the most common type of cement in general use.

POS *See* preliminary official statement.

positive Having an electrical charge polarity associated with an excess of protons (or, equivalently, a deficiency of electrons).

positive (charge) metal oxide semiconductor (PMOS) A metal oxide semiconductor incorporating a silicone gate structure that uses only positive charges.

positive bacteriological sample A water sample for which a positive total coliform result is obtained by the use of any of the approved total coliform analytic techniques specified under the US Environmental Protection Agency's Coliform Rule, promulgated June 29, 1989, or any such techniques approved subsequent to promulgation of the rule. *See also* Total Coliform Rule; total coliform test.

positive charge The electrical potential associated with a proton. A cation is an atom that has lost one or more electrons, leaving it with more protons than electrons; hence, cations carry positive charges.

positive chemical ionization *See* chemical ionization.

positive confining bed A confining bed that prevents or retards upward movement of groundwater so that the underlying water has a higher static level than the overlying water, creating an upward pressure. Artesian head is maintained by confining beds of this class. *See also* permeable confining bed.

positive-displacement meter A quantity meter that captures definite volumes of water in a chamber with a piston or disk and discharges the water, counting operations as the water passes through the meter.

positive-displacement pump A pump in which a measured quantity of water is collected or entrapped and forced to the discharge side by a reciprocating piston, gear, or rotary vane.

positive head The energy possessed per unit mass of a fluid caused by the fluid's elevation above some datum. Positive head is also called elevation head.

positively charged filter A filter that has a net positive or only slight negative charge at pH values near neutrality. Such filters may be composed in part of asbestos or aluminum hydroxide gels. They adsorb viruses in water at pH values near neutrality without the need for special water treatment.

positive rotary pump A type of displacement pump consisting essentially of elements rotating in a pump case in which they closely fit. *See also* rotary pump.

positive routine sample A positive control sample that is run concurrently with test samples on a routine basis (e.g., every 20 samples) to ensure that quality assurance/quality control criteria have been achieved in a laboratory analysis.

positive sample In the context of a multiple-tube fermentation or membrane filter test, any sample that contains coliform bacteria.

positron A particle having a mass equal to that of an electron but with an opposite charge of equal magnitude.

POSIX *See* Portable Operating System Interface for UNIX.

possible precipitation For a given area, the depth and duration of precipitation that can be reached but not exceeded under known meteorological circumstances.

postammoniation The addition of ammonia (NH_3) to a treated water containing free chlorine (HOCl), following the final treatment process in a plant, to produce a chloramine (NH_xCl_y, where $x = 0–2$, $y = 1–3$) residual. *See also* chloramines.

postchloramination The application of chloramines (NH_xCl_y, where $x = 0–2$, $y = 1–3$) to water after filtration. Postchloramination can be used for secondary disinfection after primary disinfection has been accomplished with a stronger disinfectant (e.g., chlorine (HOCl), ozone (O_3), or chlorine dioxide (ClO_2)). *See also* chloramination.

postchlorination (1) The application of chlorine (HOCl) to water after filtration. (2) The application of chlorine subsequent to any treatment. The treatment should be specified, e.g., postsedimentation chlorination.

postdisinfection The addition of a disinfectant following the final treatment process in a plant, often following filtration.

post hydrant A fire hydrant that rises above the sidewalk surface.

postozonation The addition of ozone (O_3) following the final treatment process in a plant, often following

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filtration, to provide disinfection. Recently, however, a more accepted treatment practice is to follow ozone with a granular medium, such as a filter, that is biologically active in order to remove biodegradable compounds produced during ozonation. *See also* biologically active filter.

posttreatment An additional treatment step following a primary treatment process, such as permeate posttreatment for corrosion control or disinfection following membrane desalting.

potable Safely drinkable.

potable reuse The reuse of reclaimed water for potable purposes. *See also* direct reuse; indirect reuse.

potable water Water that is safe and satisfactory for drinking and cooking.

potable water approval An approval status conferred on a water supply by a regulatory agency, signifying that the treated drinking water meets applicable standards for potable water.

potamology The branch of hydrology that pertains to streams; the science of rivers.

potassium (K) An alkali metal. It is an essential element in plant growth and in animal and human nutrition. Potassium occurs in all soils. *See also* alkali metals.

potassium acid phthalate *See* potassium hydrogen phthalate.

potassium chloride (KCl) A colorless potassium salt that can be used as a regenerant in cation-exchange water softeners.

potassium cycle The use of potassium chloride (KCl) salt instead of sodium chloride (NaCl) salt in the regeneration of cation ion-exchange water softeners. The potassium ion (K^+) becomes the exchangeable ion rather than the sodium ion (Na^+).

potassium ferrioxalate actinometry A method to measure light intensity through photochemical transformation of potassium ferrioxalate. This method is commonly used to measure the ultraviolet dose or intensity. *See also* chemical actinometer.

potassium hydrogen phthalate (KHP) ($HOOCC_6H_4COOK$) An analytical standard used for total organic carbon analysis (2.1254 grams of anhydrous potassium hydrogen phthalate per liter of solution equals 1.00 milligram of carbon per milliliter). Potassium hydrogen phthalate is also used as a standard for chemical oxygen demand analyses. (It has a theoretical chemical oxygen demand of 1.176 milligrams of oxygen per milligram.) *See also* chemical oxygen demand; total organic carbon.

potassium iodide actinometry A method of measuring the 254-nanometer radiation for germicidal ability. Irradiation results in the formation of triiodide, which can be measured to estimate the amount of energy absorbed by the potassium iodide solution.

potassium permanganate ($KMnO_4$) A substance in the form of dark purple crystals used as an oxidant in drinking water treatment. Potassium permanganate is used for taste-and-odor control and for iron and manganese removal. Unlike other oxidants, potassium permanganate has not been associated with the production of disinfection by-products. *See also* disinfection by-product; oxidant.

potassium thiocynate (KSCN) A chemical reagent that reacts with ferric iron to form a red color. It is commonly used in water analysis because of this property.

potency The amount of material necessary to produce a given level of a deleterious effect.

potential (1) Electrostatic potential, the gradient (derivative) of which gives the electric field strength. (2) Velocity potential, the gradient of which gives the velocity in a fluid flow. (3) Gravitational potential, the derivative of which yields the gravitational force. (4) The work required to move a unit mass against a unit force from one specified point to another, yielding force in a mechanical field. (5) In soil water, a quantity synonymous with *head.* It is what makes water move through soil, as a voltage difference causes an electric current to flow through a resistance. Head equals the elevation of any point in question with respect to an arbitrary datum plus the pressure of water in the soil pores per unit weight of water (i.e., assuming that the velocity of flow is small and that the water is not changing temperature). Below the water table (piezometric surface), the pressure head (the second term in the preceding sentence) is positive. Going down *X* feet or meters into the soil below the water table, the elevation head decreases by *X* feet or meters, but the pressure head increases by *X* feet or meters (pressure per unit weight = *X*); thus, no change in head occurs in a geostatic sense, and the groundwater does not flow. Above the water table (capillary zone), the pressure head is negative and is equal (in absolute value) to the distance from the piezometric surface to the point in the capillary zone in question times the unit weight of water. Above the capillary zone, in the vadose zone, where the soil becomes unsaturated, the pressure begins to be controlled by suction, or a negative pressure in the pore water caused by the formation of air bubbles with high surface tension. (6) The possibility of the creation of disinfection by-products when a disinfectant reacts with precursor organic matter. *See also* formation potential; precursor.

potential cross-connection Any arrangement of pipes, fittings, or devices that indirectly connects a potable

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water supply to a nonpotable source. It is also known as an indirect cross-connection. *Contrast with* cross-connection.

potential-determining ion A charged species that establishes the electrostatic attraction or repulsion among suspended particles. *See also* coagulant.

potential energy Energy possessed by a body of matter as a result of its position or condition.

potential evaporation The evaporation that would occur under given climatic conditions if unlimited moisture were available to evaporate.

potential evapotranspiration The evapotranspiration that would occur if unlimited soil moisture were present.

potential head The height of any particle of water above a specified datum. Potential head is also called elevation head.

potentiation The effect of one chemical to increase the effect of another chemical.

potentiometer An instrument in which electrical potential (voltage) is measured. It is a variable resistor of electricity that measures voltage.

potentiometrical procedure Any laboratory procedure that measures a difference in electric potential (voltage) to indicate the concentration of a constituent in water.

potentiometric surface A surface that represents the level to which water will rise in a tightly cased well. If the head varies greatly with depth, then multiple potentiometric surfaces may exist. The water table is a particular potentiometric surface for an unconfined aquifer.

pothole A depressional wetland commonly found in the upper Midwest (North and South Dakota and western Minnesota), as well as a similar wetland found elsewhere.

POTW *See* publicly owned treatment works.

POU *See* point of use.

pound (lb) *See in the Units of Measure section.*

pounds per day (lb/d) *See in the Units of Measure section.*

pounds per square foot (lb/ft^2) *See in the Units of Measure section.*

pounds per square inch (psi) *See in the Units of Measure section.*

pounds per square inch absolute (psia) *See in the Units of Measure section.*

pounds per square inch gauge (psig) *See in the Units of Measure section.*

Pourbaix diagram A diagram showing thermodynamically stable species of a metal as a function of potential (relative to the standard hydrogen electrode and pH).

pour plate A bacterial culture method in which an aliquot of sample is placed in a petri dish and melted; tempered agar growth medium poured in, mixed, and allowed to solidify; and the plate then incubated at an appropriate temperature.

powdered activated carbon (PAC) Activated carbon composed of fine particles and providing a large surface area for adsorption. Powdered activated carbon is typically added as a slurry on an intermittent or continuous basis to remove taste-and-odor-causing compounds or trace organic contaminants and is not reused. *See also* granular activated carbon.

power *See* active power; apparent power; complex power; exponent; instantaneous power; reactive power.

power capacity of a stream The total hydroelectric power that, according to estimates, can be developed on a stream during a stipulated portion of the time, such as 50 percent of the time. The term is generally used in studies of prospective hydroelectric power, and it is flexible in the application. In estimates of power capacity, the feasibility of storage, proportion of total runoff and of total fall that can be used, and other factors must be taken into consideration.

power factor (PF) For sinusoidal signals, the cosine of the voltage phase angle minus the current phase angle:

$$PF = \cos(\theta_v - \theta_i)$$

Where:

PF = the power factor
θ_v = the voltage phase angle, in radians
θ_i = the current phase angle, in radians

power function A mathematical equation in which several independent variables appear as a multiplicative term and the independent variables contain different exponents. For example, $y = ab^m c^n d^o$ is a power function.

power head An actuating mechanism at the power end of a deep-well pump that transmits the power for lifting the water.

power plant A facility designed to produce electricity from an energy source, such as fossil fuel (e.g., burning coal), wind, solar energy, or hydroelectric energy.

power pump A pump that requires energy other than manual energy for its operation.

power quality The characteristics of power with respect to its suitability for use. For example, transient or time-varying conditions—such as power surges or harmonics—that cause problems with the operation of electrical equipment would indicate power of poor quality. These problems can originate with the electric utility (as in the case of voltage sags) or the end user (as with harmonics from variable frequency drive), but in either case they degrade the power quality.

power relay *See* control relay.

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power requirement The rate of energy input needed to operate a piece of equipment, a treatment plant, or other facility or system. The form of energy may be electricity, fossil fuel, hydroelectric power, or some other form or combination of forms.

power site Any site where a power plant has been built, is being built, or is contemplated.

power spectral density (PSD) A term that describes how the power (or variance) of a time series is distributed with frequency. It is also known as the squared modulus of the Fourier transform of the time series, scaled by a proper constant term.

power units *See in the Units of Measure section.*

POX *See* purgeable organic halogen.

POXFP *See* purgeable organic halogen formation potential.

PPAR *See* peroxisome proliferator activated receptor.

ppb *See* parts per billion *in the Units of Measure section.*

PPCPs *See* pharmaceutical and personal care products.

PPE *See* personal protection equipment.

ppi *See* pores per linear inch *in the Units of Measure section.*

ppm *See* parts per million *in the Units of Measure section.*

PPS *See* physical protection system.

ppt *See* precipitate. *See also* parts per thousand *in the Units of Measure section;* parts per trillion *in the Units of Measure section.*

PQL *See* practical quantitation level.

practical quantitation level (PQL) The lowest concentration that can be quantified within specified limits of precision and accuracy during routine laboratory operations. The practical quantitation level is intended to represent the lowest concentration achievable by good laboratories under practical and routine laboratory conditions. Practical quantitation levels are set by the US Environmental Protection Agency based on interlaboratory studies and applications of statistics. They are usually set at a level between 5 and 10 times the minimum detection limit. *See also* limit of detection; limit of quantitation; method detection limit.

practical quantitation limit *See* practical quantitation level.

practical turf area A landscape design and management concept promoting turf only in those areas of the landscape that are functional, as well as the efficient management of supplemental irrigation required for those areas.

PRD-1 phage A bacterial virus that infects *Salmonella typhimurium,* also known as a bacteriophage. *See also* bacteriophage.

preaeration The use of an aeration device, such as a packed tower aerator or tray aerator, prior to a sequence of treatment processes to (1) increase the dissolved oxygen concentration in the water, (2) reduce the concentration of a contaminant by transferring it from the liquid to the vapor phase, or (3) oxidize a dissolved contaminant so that it can be removed by subsequent physical removal process. Preaeration has historically been used for taste-and-odor removal, as well as oxidation of iron and manganese prior to filtration.

preammoniation Chloramination in which ammonia (NH_3) is added before the chlorine (Cl_2). This order of chemical addition minimizes free chlorine contact time in order to control the formation of disinfection by-products. *See also* chloramination; disinfection by-product.

prechloramination Chloramination of source water prior to other unit processes (e.g., before coagulation). The location where the chloramine (NH_xCl_y, where $x = 0–2$, $y = 1–3$) is added should be specified to avoid confusion, e.g., source water chloramination, prefiltration chloramination. *See also* chloramination.

prechlorination Chlorination of source water prior to other unit processes (e.g., before coagulation). The location where the chlorine (Cl_2) is added should be specified to avoid confusion, e.g., source water chlorination and prefiltration chlorination. *See also* chlorination.

precipitable water The total water vapor contained in an atmospheric column of unit cross-sectional area, expressed in terms of depth of water of the same cross-sectional area.

precipitate (ppt) (1) A substance separated from a solution or suspension by a chemical reaction. (2) To form such a substance.

precipitated iron *See* ferric iron.

precipitation (1) The total measurable supply of water received directly from clouds as rain, hail, or sleet, usually expressed as depth in a day, month, or year (i.e., daily, monthly, or annual precipitation, respectively). (2) The process by which atmospheric moisture is discharged onto a land or water surface. (3) The process by which small particles settle out of a liquid or gaseous suspension by gravity. (4) The process of particle formation during a chemical reaction. (5) In the context of corrosion, the shifting of chemical equilibrium to cause the formation of a solid protective coating, usually calcium carbonate ($CaCO_3$) on interior pipe surfaces.

precipitation/evaporation (P/E) ratio The ratio of monthly precipitation to monthly evaporation, used in evapotranspiration studies.

precipitation gauge A device for catching and measuring the depth of precipitation. *See also* rain gauge.

precipitation mass curve A graph showing accumulated precipitation as a function of time. *See also* mass diagram.

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precipitation oscillation The long-term changes in average precipitation (such averages being taken as the mean of a period of 50 to 100 years) that occur over periods ranging from less than 1 year to more than several thousand years. Although no actual measurements exist of the precipitation over such periods, evidence based on studies of tree rings, geological deposits, and changes in vegetation indicates that such changes do occur.

precipitation rate The amount of precipitation occurring in a unit of time, generally expressed in inches per hour or centimeters per hour.

precipitative softening A unit process by which the dissolved minerals in water, particularly calcium and magnesium, are removed during lime (CaOH) softening (which causes a pH increase) through the formation of a precipitate. For the Disinfectants and Disinfection By-Products Rule, precipitative softening can be used for the removal of disinfection by-product precursors (a process referred to as enhanced softening). *See also* Disinfectants and Disinfection By-Products Rule; disinfection by-product precursor; enhanced softening; ion exchange; lime softening; precipitate.

precision A measure of the agreement among replicate measurements. *See also* accuracy; bias.

precoat A very fine granular filter medium, such as diatomaceous earth, applied (usually by slurry) to a retaining membrane or fabric surface prior to a service run. At the end of each service run, the precoat medium is rinsed off and disposed of prior to application of a new precoat to the filter septum.

precoat filtration A process designed to remove particulates by applying the water to be treated to a membrane or fabric coated with a very fine granular medium, such as diatomaceous earth. *See also* diatomaceous earth; precoat.

precoating The process of applying a precoat to a support surface called a septum. *See also* precoat.

precursor A compound or mixture that can be converted to a specific substance. For example, upon disinfection, disinfection by-product precursors are converted to disinfection by-products. *See also* disinfection by-product precursor.

precursor compound *See* precursor.

precursor limited Pertaining to a situation in which the concentration of precursor material in a solution (e.g., water) is limiting. For example, during chlorination of effluent from granular activated carbon treatment, the concentration of disinfection by-product precursors is the limiting factor to disinfection by-product formation. *See also* disinfection by-product precursor.

predator–prey interaction A natural process controlling living populations. In every society or community of organisms in its natural state, predators survive by eating prey.

prediction An act of attempting to foretell values of dependent variables from known values of independent (or predictor) variables.

predictive equation A mathematical equation used for developing predictions of dependent variables for known values of independent variables.

predischarge notification (PDN) Notification to the US Army Corps of Engineers prior to discharge of fill material, as required under a Clean Water Act Section 404 Nationwide Permit.

predisinfection Application of a disinfectant prior to a treatment step. This term typically refers to source water disinfection. Better usage is to specify where the disinfectant is added, e.g., source water disinfection, prefiltration disinfection.

preformed chloramine A concentrated solution of chloramine (NH_xCl_y, where $x = 0–2$, $y = 1–3$) formed outside of the treatment train. Preformed chloramines are added to the water directly, rather than separately adding the chlorine (Cl_2) and ammonia (NH_3) to the water. *See also* chloramines.

preliminary filter A filter used in a water treatment plant for the partial removal of turbidity prior to final filtration. Such filters are usually of the rapid type, and their use allows final filtration at a more rapid rate or reduces or eliminates the necessity of other preliminary treatment of the water. A preliminary filter is also called a contact filter, contact roughing filter, roughing filter, or primary filter.

preliminary official statement (POS) A document issued before the sale of bonds that contains all the information that a potential investor is expected to need about a security and the issuer, except the final price of the bonds. *See also* official statement.

preliminary treatment Any physical, chemical, or mechanical process used before the main water treatment processes. Preliminary treatment can include screening, presedimentation, and chemical addition. It is also called pretreatment, although this term is often confusing.

preloaded granular activated carbon Granular activated carbon (GAC) that has been exposed to selected substance(s) prior to being used to study the adsorption of some target substance. This preloading allows the investigation of the impact of the preloaded substance(s) on the removal of the target substance. GAC is often preloaded during competitive adsorption studies.

preloading A method of applying a compound to a unit process prior to putting the process into service. For example, granular activated carbon can be preloaded with natural organic matter to determine the

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latter's impact on the removal of specific synthetic organic compounds. Preloading can be deliberate, as in the preceding example, or accidental, as in an attempt to adsorb a specific organic compound on granular activated carbon in the presence of naturally occurring background organic matter.

premarking facilities The process of painting personnel access openings, valves, and so on with distinct symbols or patterns so that the facilities can easily be identified in aerial photography and captured during photogrammetric compilation.

premise piping Piping that is located on the property of the water customer and is designed to serve the needs of that particular customer or group of customers. Premise piping includes all or part of the service line (depending on local utility regulations) and home or building plumbing. It does not include a water transmission or distribution line that crosses a customer's property on an easement.

premises isolation The prevention of backflow into a public water system from a user's premises by installation of a suitable backflow prevention device at the user's connection.

preneoplastic lesion A group of cells, usually clonal in origin, that are recognized as being precursors to tumors. However, such groups of cells do not inevitably lead to tumors.

preoxidation Application of an oxidant prior to a water treatment step. Better usage is to specify where the oxidant is added, e.g., source water oxidation or prefiltration oxidation.

preozonation Application of ozone (O_3) prior to a water treatment step. This term is typically used to refer to source water ozonation (whereas *intermediate ozonation* and *postozonation* are used to refer to ozonation of settled and filtered water, respectively). *Source water ozonation* is a better term. *See also* ozonation.

prepatent period The time from infection to when parasites are seen in diagnosis.

preplumbed installation An installation that allows domestic water treatment equipment to be installed easily because the necessary bypass and valves are already in place. An example would be a new home that already has all of the plumbing needed for installing a water treatment device.

prescreen testing contaminant A contaminant included on Unregulated Contaminant Monitoring Rule (UCMR) List 3. These contaminants are Lead-210, Polonium-210, cyanobacteria, echoviruses, coxsackie viruses, *Helicobacter pylori*, Microsporidia, caliciviruses, and adenoviruses. These contaminants needed additional research and development of analytical methods before UCMR requirements could be established. The UCMR requires monitoring at a minimum number of vulnerable systems for List 3 contaminants at 5 systems per state and the maximum at 25 systems per state. It is at the state's discretion exactly how many they will include. The final number of systems for the prescreening survey will be 200, taken from across the country, and they will be selected at random from those systems provided by each state.

prescriptive Pertaining to water rights that are acquired by diverting water and putting it to use in accordance with specified procedures. These procedures include filing a request (with a state agency) to use unused water from a stream, river, or lake.

presedimentation A preliminary treatment process used to remove gravel, sand, and other gritty material from the source water before the water enters the main treatment plant. This treatment is usually performed without the use of coagulating chemicals.

presedimentation impoundment A large earthen or concrete basin used for sedimentation of source water prior to further treatment. Such a basin is also useful for storage and for reducing the impact of source water quality changes on water treatment processes.

presence–absence method *See* presence–absence (P–A) test.

presence–absence reporting For drinking water compliance monitoring, the reporting of coliform bacteria test results as "coliforms present" or "coliforms absent," regardless of whether the results were obtained from a quantitative procedure (such as the membrane filter test or the most probable number test) or the original presence–absence test. *See also* presence–absence test.

presence–absence test (P–A test) A qualitative microbiological test indicating the presence or absence of coliform bacteria in water. A standard 100-milliliter sample volume is inoculated into a bottle of presence–absence medium, the inoculated medium is incubated for 24 to 48 hours, and the results are recorded. Any amount of gas, acid, or both constitutes a positive presumptive test and requires confirmation. Acid production from lactose fermentation is indicated by a distinct yellow color in the medium; if gas is also being produced, gentle shaking of the bottle results in foaming of the medium. Bottles of inoculated medium that do not change color, do not produce gas, or both are considered as indicating an absence of coliform bacteria. *See also* presence–absence reporting.

preservation *See* preserved wetland.

preservation, sample *See* sample preservation.

preservative In water treatment, a substance added to a water sample to maintain certain constituents in the form in which they are found in the water body, e.g., dissolved metals in solution.

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preserved wetland A specified wetland area for which prohibition in perpetuity of specific uses and activities is established in a binding legal agreement.

presettling A process of sedimentation applied to a liquid before some other treatment.

press filter *See* filter press.

pressure The force pushing on a unit area. Water pressure is normally measured in pounds per square inch, kilopascals, or feet or meters of head.

pressure aquifer *See* confined aquifer.

pressure class The maximum sustained pressure for which a pipe is designed.

pressure-compensating emitter A drip-irrigation emitter designed to deliver water at a consistent flow rate under a range of operating pressures.

pressure control A switch that operates based on changes in pressure. Such a switch is usually a diaphragm pressing against a spring. When the force on the diaphragm overcomes the spring pressure, the switch is actuated (activated).

pressure correction factor For some pressure-driven membrane processes, a dimensionless coefficient that is dependent on net driving pressures across the membrane. This factor can be multiplied by permeate flow at a standard condition to calculate the permeate flow rate at a given net driving pressure condition.

pressure decay test *See* air pressure–hold test.

pressure differential The difference in pressure between two points in a water system. The difference may be caused by a difference in elevation, a pressure drop resulting from water flow, or both.

pressure differential meter Any flow-measuring device that creates and measures a difference in pressure proportional to the rate of flow. Examples include the Venturi meter, orifice meter, and flow nozzle.

pressure-driven membrane A membrane that uses a pressure differential across the membrane, from the feed side to the permeate or filtrate side, as the driving force.

pressure drop (1) A decrease in water pressure that occurs as the water flows. Pressure drop may occur for several reasons: internal friction between the molecules of water, external friction between the water and the walls of the piping system, or rough areas in the channel through which the water flows. (2) The difference between the inlet and outlet water pressure during water flow through a water treatment device, such as water conditioner. This type of pressure drop is abbreviated ΔP and is measured in pounds per square inch or pascals gauge pressure. *See also* delta *P;* head loss.

pressure energy Energy associated with a body because of the body's location in a pressure system, usually with respect to atmospheric pressure.

pressure filter (1) An enclosed vessel having a vertical or horizontal cylinder of iron, steel, wood, or other material containing granular media through which liquid is forced under pressure. (2) A mechanical filter for partially dewatering sludge. *See also* filter press; plate-and-frame filter press.

pressure filtration A filtration process in which the media are completely enclosed and the operation takes place under pressure via pumping of the water to be treated. Pressure filtration is often used in applications for which insufficient elevation is available to support gravity filtration, such as in industrial settings or swimming pool filters.

pressure gauge A device having a metallic sensing element for registering the pressure of solids, liquids, or gases. The device may be graduated to register pressure in any units desired. *See also* piezometer.

pressure gradient The change in pressure over some selected distance. The units are pressure units per length.

pressure granular filter A granular filter placed in a cylindrical steel pressure vessel. The water is forced through the medium by pumping.

pressure grouting The placing of grout (a watery mixture of either portland cement and water, or of various organic chemicals, that hardens in place) under pressure in void spaces in a structure, in soil or rock adjacent to a structure, or in and around underground pipes to strengthen the structure or make it more watertight.

pressure head A measurement of the amount of energy in water caused by water pressure.

pressure hold test *See* air pressure–hold test.

pressure intensity *See* pressure.

pressure loss *See* head loss; pressure drop.

pressure management Methods to optimize pressures in a water distribution network to minimize losses and surge impacts, while maintaining adequate service levels, including firefighting flows. *See also* fixed and variable area discharge path model; step testing.

pressure–momentum curve A curve derived from calculations of flow in an open channel and showing the variation of the sum of the forces caused by pressure and momentum flux with depth of flow.

pressure pipe Pipe used to distribute potable water throughout a utility's service area for firefighting and domestic purposes.

pressure potential The amount of work a unit mass of fluid could perform against pressure forces to change from its current position to an arbitrary reference position.

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pressure rating The maximum long-term operating pressure a manufacturer recommends for a given product. It is also known as design pressure.

pressure reducer A control valve that opens to allow flow if the downstream pressure is less than a certain value and that closes when the set pressure is reached. A pressure reducer ensures that the downstream pressure does not become too high. It is used on house services where the distribution pressure is high and in other situations that require reductions from higher-pressure planes to lower-pressure planes.

pressure-reducing valve A flow valve used to allow water to flow from a higher-pressure plane to a lower-pressure plane so as not to exceed a set maximum pressure in the lower-pressure plane.

pressure-regulating valve (PRV) A valve designed to maintain a set pressure on the downstream side of the valve regardless of pressure changes on the source side.

pressure regulator A device for controlling pressure in a pipeline or pressurized tank, such as a pressure-regulating valve or a pump drive-speed controller. *See also* regulator.

pressure relief cone The depression in the piezometric (potentiometric) surface of a confined aquifer that forms around a well through which water is being extracted at a given rate. This cone is analogous to the pumping depression cone in the water table of an unconfined aquifer that forms around a well through which water is being extracted. *See also* cone of depression.

pressure relief valve A valve that opens automatically if the water pressure exceeds a certain level.

pressure sand filter *See* pressure filter.

pressure strainer A device that is used in a pressure pipe and has two or more isolated compartments holding removable screens or strainers. Such a device is removable so that screens can be made accessible for cleaning without interfering with the flow.

pressure surface An imaginary surface that everywhere coincides with the static level of the water in an aquifer. *See also* isopiestic line; piezometric surface.

pressure surface map A contour map of the imaginary surface to which the water in an artesian aquifer will rise. Such a map is also called a piezometric surface map.

pressure-swing adsorption A process that uses an adsorbent (e.g., zeolite) to separate individual components of a gas mixture. The process employs a sequencing batch control to alternately pressurize and depressurize the vessels that contain the adsorbent. Pressure-swing adsorption can be used to separate oxygen from air to form pure oxygen. *See also* pure oxygen; zeolite.

pressure tank A tank that is used in connection with a water distribution system for a single household, for several houses, or for a portion of a larger water system; is airtight and holds both air and water; and in which the air is compressed and the pressure is transmitted to the water.

pressure test A measurement of pressure with a pressure gauge at a point in the distribution system. When no flow is occurring in the system, the pressure is the static pressure; pressure during flow is called residual pressure. Measuring the static pressure and residual pressure at a fire hydrant while measuring the flow of another fire hydrant nearby allows one to determine the amount of fire flow available at the flowing hydrant at various residual pressures. Usually the flow is determined for a residual pressure of 20 pounds per square inch (137.8 kilopascals), which is the minimum desired pressure during fire flow.

pressure transient A short-lived pressure wave in a distribution system that can result in hydraulic surges. These waves, having both a positive and negative amplitude, can produce negative pressures that last only seconds and may not be observed by conventional pressure monitoring.

pressure-type vacuum breaker *See* pressure vacuum breaker assembly.

pressure units *See in the Units of Measure section.*

pressure vacuum breaker (PVB) assembly A backflow protection device to prevent water from being drawn back into a water supply when the line is closed. The assembly opens to the atmosphere, thus preventing a vacuum in the line, such as an irrigation line.

pressure vessel A device designed to contain pressure, such as a housing used for pressure filters or membranes.

pressure zone An area within a distribution system of a domestic or municipal water supply in which the pressure in the mains is maintained within certain specified limits.

pressure zone map A graphic presentation of an area that shows boundaries and lines indicating a certain pressure at specific ground elevations. An estimated pressure can then be extrapolated from the contours for any spot on the map. A pressure zone map is also known as a water-gradient contour map.

pressurized membrane system A pressure-driven membrane process that has membranes located inside pressure vessels and uses pressurized feedwater for the process driving force. Also, a type of low-pressure membrane system, such as some types of hollow-fiber microfiltration and ultrafiltration systems, in which the hollow-fiber membranes are placed in pressure vessels and the filtered water is collected either on the

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outside or the inside of the fibers and the transmembrane pressure is created by a feed pump. It is also referred to as an encased membrane system for some types of microfiltration and ultrafiltration systems. *See also* hollow-fiber membrane; microfiltration; ultrafiltration.

pressurized-tank toilet A toilet that flushes by using pressure from the waterline entering a pressurized plastic vessel inside the tank. It is also known as a flushometer-tank toilet.

prestressed Pertaining to pipe that has been reinforced with wire strands (which are under tension) to give the pipe an active resistance to loads or pressures on it.

prestressed concrete cylinder pipe (PCCP) A pipe made with a steel cylinder either lined or embedded in structural concrete, wrapped by prestressing wire, and coated in portland cement mortar or concrete. *See also* concrete pressure pipe.

prestressed concrete pipe A type of reinforced concrete pipe placed in compression by a highly stressed, closely spaced helical wire winding. The reinforcement increases a concrete pipe's ability to withstand tension forces.

presumptive test The first major step in the multiple-tube fermentation test. This step presumes (indicates) the presence of coliform bacteria based on gas production in a nutrient broth after incubation. *See also* completed test; confirmed test.

presystemic elimination The process by which a substance is metabolized or immediately secreted back into the bile by the liver before it reaches the systemic circulation. The extent to which this occurs is frequently referred to as the first-pass effect. Presystemic elimination is particularly marked for certain chemicals that are introduced to the body via the gastrointestinal tract.

pretreated Pertaining to water that has received pretreatment.

pretreatment One or more actions or processes occurring immediately before water enters a downstream treatment unit process. Better usage is to specify the type of subsequent treatment, e.g., presedimentation or prefiltration.

prevailing wind Wind that regularly comes from the same compass point or direction, most frequently observed during a given period (e.g., day, month, season, or year).

prevalence The number of people in a population who have a disease, illness, or infection at a given point or period in time. Prevalence depends on how many people have become ill in the past and the duration of their illness. Whereas incidence measures the rate at which new illness occurs, prevalence measures the residual of such illness at a given time. *See also* incidence.

prevalence index (1) A weighted average measure of the sum of the frequency of occurrences of all species along a single transect. (2) The average of the prevalence index of all sample transects through the study area.

prevalence rate The number of people with a disease, illness, or infection (i.e., the existing number of cases) at a particular time divided by the total population at risk at that time.

prevalence study An epidemiological study that examines the relationships between diseases and exposures as they exist in a defined population at a particular point in time.

preventive maintenance program A specific, ongoing plan to inspect, monitor, and service—at scheduled and specified intervals—equipment, motors, pumps, valves, vehicles, and so on to ensure efficient operation of such equipment and prolong its productive life.

previously disturbed soil Soil that has been excavated, exhumed, or worked on prior to the present excavation.

Price current meter A wheel-like current meter with a series of conical cups fastened to a flat framework through which a pin extends. The pin sits in the framework of the meter, and the cups are rotated around it in a horizontal plane by the flowing water. The number of revolutions is registered by an acoustical or electrical device. The velocity of the water may be computed based on the number of revolutions.

price elasticity (of demand) The degree of responsiveness of the demand for a good (such as water or oil) relative to a change in its price.

pricing signals Rate structures that encourage water conservation by drawing the customers' attention to the cost associated with water usage.

primacy Having the primary responsibility for ensuring that a law is implemented, as well as the authority to enforce that law and related regulations.

primacy agency The agency that has the primary responsibility for administering and enforcing regulations.

primacy state A state that has adopted regulations no less stringent than US Environmental Protection Agency's (USEPA) and that has met USEPA's requirements to be delegated the primary responsibility for administering and enforcing those regulations.

primary In electrical systems, the high-voltage side of a step-down transformer. *See also* secondary.

primary cell A cell taken directly from living tissue and used to start a cell culture. *See also* cell culture.

Primary Drinking Water Regulation (PDWR) *See* National Primary Drinking Water Regulation (NPDWR).

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Primary Drinking Water Standard *See* National Primary Drinking Water Regulation (NPDWR).

primary element (1) The part of a pressure differential meter that creates a signal proportional to the water velocity through the meter. (2) A hydraulic structure used to measure flows. In open channels, weirs and flumes are primary elements or devices. In pipes or pressure conduits, Venturi meters and orifice plates are the primary elements.

primary enforcement responsibility (primacy) The acceptance by a state, tribe, or territory, of the responsibility for enforcing a federal regulation, such as the Safe Drinking Water Act requirements. US Environmental Protection Agency primacy requirements must be met in order for primacy to be granted and retained.

primary instrument The main instrument used for an analytical method. If there is a dispute of the results, a secondary instrument can be used to confirm or refute the original results.

primary instrumentation Sensors that are used to measure process variables such as flow, pressure, level, and temperature.

primary interstice *See* original interstice.

primary maximum contaminant level Maximum contaminant levels for various water quality indicators that have been established to protect public health.

primary opening *See* original interstice.

primary power Power that is developed at a hydroelectric power plant and is always available and dependable for carrying a given load. Its amount is governed by the minimum amount of water available at any time, including that derived from storage. Primary power is also called firm power.

primary production Production of biomass by green plants, whether on land or in water.

primary sedimentation The first of a sequence of settling steps (typically two steps) designed to remove large particles. Primary sedimentation can be conducted with or without the use of coagulants.

primary treatment A level of treatment associated with the removal of particles, typically by settling, with or without the use of coagulants. Dissolved contaminants are not significantly removed in primary treatment.

primary wastewater treatment Removal of settleable solids from wastewater by sedimentation.

prime To fill a pump casing or siphon with water to remove the air. Most pumps must be primed before start-up or they will not pump any water.

prime mover A source of power, such as an internal combustion engine or an electric motor, designed to supply force and motion to drive machinery, such as a pump.

primer A short synthetic strand of deoxyribonucleic acid (DNA) used in polymerase chain reaction technology. The synthetic strands of DNA bind to their complementary sequences on the original double-stranded DNA sequence. Two primers are used in polymerase chain reaction technology, one upstream and one downstream of the target sequence. This bracketing of the target sequence determines the length of clones (copies of the target sequence).

priming (1) The first filling with water of a canal, reservoir, or other structure built to contain water. (2) The action of filling a pump casing or siphon with water to remove the air and allow the pump or siphon to start.

primitive water Water that has been trapped in the interior of the lithosphere (in either molecular or dissociated condition) since the formation of the earth. *See also* interstitial water.

principal isotope *See* isotope.

prior appropriation A doctrine of water law that allocates the right to use water on a first-come, first-served basis.

prioritization matrix A diagramming tool that a decision maker uses to prioritize issues, product service characteristics, tasks, and so forth based on known weighted criteria.

priority The status of a water user when water rights are based on the doctrine of prior appropriation. Under this doctrine, those who have been using the water longer have higher priority (i.e., greater rights to use the water) than parties who started using the water more recently.

priority contracting The process of signing agreements with other utilities or outside contractors prior to disasters or emergencies for services, products, or both, allowing the signer to be first to receive those products or services in times of disaster.

prism (1) The liquid, mobile volume of water flowing in a specified segment of a stream. (2) A piece of glass for dividing light into individual wavelengths.

pristine Unchanged by civilization; fresh and clean.

pristine watershed A water basin or valley that is clean and unchanged by civilization.

privately owned water utility A public water system owned by one or more private investors. *See also* investor-owned water utility.

private use of water The use of water solely by those entities directly associated with the agency engaged in the development and distribution of that water.

private utility An enterprise owned by private individuals or by a corporation and operated for the purpose of rendering utility service.

private water Streams or other bodies of surface water that are not publicly owned. *See also* public water.

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private water supply A water supply not available to the general public because it is located on or has outlets on private property to which the public does not have access or legal right of entry. *See also* individual water supply; privately owned water utility.

privatization The sale to private investors of government-owned equity in nationalized industry or other commercial enterprises. *Contrast with* contract operation and management.

probabilistic model A model that assigns a probability or likelihood of occurrence to events or data within a population, as expressed by a ranked numerical value or an estimate of best case, worst case, or most likely case. As opposed to a deterministic model, the outcome of a probabilistic model is not a fixed outcome but a distribution of outcomes.

probability *See* probability value.

probability (*p*) value The probability that a difference at least as large as the measured difference between two groups under study could have arisen at random, assuming the groups were drawn from the same population and the measured characteristic obeys the normal probability distribution. For example, the statement $p < 0.05$ means that at most, one chance in twenty exists that a difference as big as that observed would have occurred if the null hypothesis (that the groups represent no real difference) were true. Investigators may set their own values, but $p < 0.05$ is frequently used to assess statistical significance. *See also* confidence interval; hypothesis; normal distribution; statistically significant.

probability distribution A graphical distribution that is based on a frequency distribution (also called a histogram) and that reflects the frequency of actual sample data falling into selected intervals of occurrence (e.g., 0 to 2.0, 2.1 to 4.0, 4.1 to 6.0). In frequency distributions, the highest frequency usually falls near the center of the range of actual values, near the mean. A frequency distribution can, however, have many shapes, e.g., symmetrical (normal) or with the distribution skewed (tailing) to the right or left; concentrated near the mean or spread out; or high peaked or relatively flat. The probability distribution concept derives from the inference that large or repeated samples of data will generate relatively consistent recurring patterns or frequency distributions that can be interpreted to show the expected frequency (probability) of occurrence for any of the data values, individually or cumulatively. A number of different types of probability distributions are frequently used in business, social science, medicine, and engineering applications, e.g., the normal distribution, binomial distribution, Poisson distribution, and the gamma distributions that include the exponential and chi-square distributions. Probability distributions are also referred to as density functions. *See also* chi-square distribution; normal distribution; Poisson distribution.

probability plot A form of graphical representation of data in which one of the axes follows a particular probability distribution.

probable carcinogen A chemical for which the weight of available scientific evidence would suggest that the chemical poses a carcinogenic hazard for humans. This is a qualitative judgment, not a quantitative one. The meaning of the term somewhat depends on the agency making the determination (e.g., the International Agency for Research on Cancer or the US Environmental Protection Agency [USEPA]). Once the USEPA makes such a determination, it regulates the chemical as a carcinogen. Frequently, such a determination has resulted in the assignment of a letter or number ranking to summarize the weight of evidence. The evidence considered includes epidemiological data to suggest that the chemical produces cancer in exposed human populations. Negative epidemiological data, however, are not generally considered helpful unless the study had sufficient power to detect relatively small increases in cancer risk by virtue of a very high exposure or an unusually large and well-defined population to study. The ability of the chemical to induce cancer in more than one species of experimental animal is most frequently the critical determination. The evidence is further strengthened if the chemical produced tumors at multiple sites in experimental animals and particularly if it produced tumors at sites in the animal at which the background rate of cancer was particularly low. Certain in vitro data will heighten the concern that the chemical is capable of inducing cancer in humans, but rarely can that information alone be the basis of indicting the chemical as a human carcinogen. In particular, strong evidence that the chemical can induce point mutations in deoxyribonucleic acid or damage chromosomes at less than cytotoxic doses adds significantly to other evidence that the chemical is capable of inducing cancer in vivo. *See also* point mutation.

probable maximum precipitation (PMP) The best judgment of meteorologists of the realistic upper limit of precipitation that can occur at a location. This value is used in the design of large dam spillways.

probe method *See* electrode method.

probing In subsurface investigations, the act of pushing or driving a rod down through the soil as far as it will penetrate with the equipment at hand. *See also* sounding.

probit model In toxicology, a model for which the response values on a dose–response curve are expressed

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in terms of standard deviations. If the data are normally distributed, this type of model has the benefit of rendering a linear dose–response curve, which facilitates comparisons of curves produced by different chemicals. Conventionally, 5 is added to all the standard deviations to avoid negative numbers (i.e., otherwise the mean would be zero). *See also* beta-Poisson model; exponential model; linearized multistage model; log-probit model; logit model; multihit model; multistage model; one-hit model; Weibull–Gamma model; Weibull model.

problem area wetland A wetland that is difficult to identify because it may lack indicators of wetland hydrology, hydric soils, or both, or because its dominant plant species are more typical of nonwetlands.

problematic peak Under the US Environmental Protection Agency's Stage 2 Disinfectants and Disinfection By-Products Rule (Stage 2 DBPR), a single distribution system sample total trihalomethanes (TTHM) or sum of five haloacetic acids (HAA5) result that exceeds the maximum contaminant level (MCL) value, and that may result in MCL noncompliance based on locational running annual average (LRAA) or running annual average (RAA), and/or may represent a significant excursion.

procarcinogen A chemical that can be modified by chemical reaction or by enzymatic action to become a chemical that is capable of initiating cancer. Most generally, metabolism of the procarcinogen results in the formation of a reactive chemical that interacts with the pyrimidine or purine bases found in nucleic acids. Binding of the chemical to these bases results in the misreading or misrepair of the deoxyribonucleic acid template and, following cell division, a cell containing a mutation.

process and instrumentation diagram (P&ID) A plan schematically illustrating the manner in which the components of a unit process, or group of unit processes, interrelate and how the process will be controlled. Process and instrumentation diagrams include such information as monitoring devices (e.g., flowmeters), alarms, and control devices (e.g., switches). Standards for process and instrumentation diagrams are issued by the International Society of Automation. *See also* International Society of Automation.

process assistance system (PAS) A computerized tool that helps operators assess treatment process problems and make treatment decisions.

process control The use of industrial control computers to monitor and control such plant facilities as pump stations, regulating valves, reservoirs, and filter plants as well as to coordinate and maintain telemetry, radio, and communications equipment.

process decision program chart A procedure to map out conceivable contingencies and events that may occur in any implementation plan and to identify feasible countermeasures.

process error The difference between the controlled variable and the controller set point. It is also known as deviation.

process flowchart A visual representation of all the steps in a process under study. It is a tool that helps develop a clear and common vision of all the elements in a process.

process lag A time delay in a process response to an adjustment. Process lag is caused by the inertia of the process. A contributing factor, along with dead time, is the time required for a controlled variable to respond to a change in value of the final control element.

process safety management Implementation of an Occupational Safety and Health Administration program designed to protect workers and communities from exposure to extremely hazardous chemicals in the workplace. A review of the entire chemical storage, handling, mixing, and feeding process is conducted and evaluated.

process train An independent treatment process or group of processes in series. Commonly, multiple trains are placed in parallel in a treatment facility to subdivide the overall treatment capacity or for some other purpose.

process variable A physical or chemical quantity that is usually measured and controlled in the operation of a water treatment plant or industrial plant. *See also* measured variable.

process water Water used in a manufacturing or treatment process or in the actual product manufactured. Examples include water used for washing, rinsing, direct contact, cooling, solution makeup, chemical reactions, or gas scrubbing in industrial and food-processing operations. In many cases, water is specifically treated to produce the quality of water needed for the process.

Proctor compaction test The standard compaction test used to determine the moisture–density relationship of a soil. In the test, a cylindrical mold of standard volume is filled in three layers of the test material with each layer of the soil being compacted with a standard compactive energy. The bulk density is determined by weighing the mold, and a small portion of the soil is taken for moisture content determination. From these measurements, the dry density is calculated. The test is repeated over a wide range of moisture contents, and a curve is plotted showing the moisture–density relationship of the soil. From this curve, the maximum dry density and the optimum moisture content are determined.

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prodromal Showing the symptom of the onset of a disease.

product In chemistry, a substance resulting from a chemical reaction. The products of a reaction are shown on the right-hand side of a chemical equation. *See also* reactant.

product channel spacer *See* permeate spacer.

production rate The amount of product water the system produces per minute or (especially for reverse osmosis) per 24-hour period.

productivity (1) In biology, the rate of production of biomass resulting from a biological activity in a given area or volume. (2) In business, the ability to bring into existence—by intellect, creative ability, or a work program—goods and services that have exchange value. (3) As a measure of filter performance, the total number of gallons of water produced per square foot of filter area during a filter run (cubic meters of water per square meter of filter area). Net productivity is determined by subtracting the volume of water used to backwash the filter from the total water production to determine net water production, and then calculating the volume produced per unit area.

product staging In reverse osmosis, the practice of using some of the product water from the first stage of treatment as feedwater for the second stage.

product stewardship The act of responsibly assessing the environmental impact of a product to ensure that the product is used properly and does not damage the environment. *See also* ecology.

product water Water that has passed through a water treatment plant, i.e., water for which all the treatment processes are completed or finished. This water is the product from the water treatment plant and is ready to be delivered to the consumers. It is also called finished water.

product water dispensing rate That amount of product water available from the full-open dispensing outlet of a water treatment unit for a specified period of time.

professional engineer (PE) A person registered to practice engineering in one or more disciplines in accordance with the laws of a state or territory of the United States.

proficiency testing (PT) A program of providing environmental samples to a laboratory for analysis. This term is equivalent to the term *performance evaluation* in current laboratory certification programs. The respective compositions of proficiency testing samples are unknown to the analyst, and the results must be reported to the sample provider. *See also* NELAC Institute, the (TNI); performance evaluation.

profile (1) A vertical section of the surface of the ground, underlying strata, or both along any fixed line. (2) A graphical representation of elevation plotted as a function of distance. (3) In open channel hydraulics, a plot of water surface elevation as a function of channel distance; the hydraulic grade line. (4) A longitudinal section along a pipeline, conduit, or stream.

program evaluation review technique (PERT) A time–event network analysis system in which the various events in a project or program are identified, with a planned time established for each. These events are placed in a network diagram showing the relationships of each event to the other events.

programmable logic controller (PLC) A control device used for sequential control of processes or functions. Older programmable logic controllers did not possess the control capability of current units, which are indistinguishable from digital computers. Programmable logic controllers are easily configured or programmed and have a full range of control and data display functions, including erasable programmable read-only memory. *See also* remote terminal unit.

programmable read-only memory (PROM) chip A computer chip manufactured, configured, or customized for a special application or need. Once such a chip's memory is programmed (or "burned"), it cannot be changed.

programmatic state general permit (PGP) A general permit that is issued by the US Army Corps of Engineers (USACE) to a state delegating certain general wetland permitting authority. Programmatic state general permits operate in conjunction with state and local regulatory programs and are intended to reduce unnecessary duplication resulting from federal and state or local programs. The USACE issues programmatic state general permits for dredge and fill activities only where existing state, regional, or local programs provide the same or higher levels of environmental protection as the federal regulatory program provides. The USACE maintains control over the aspects of Clean Water Act Section 404 permitting that are not covered by a general permit.

Programming in Logic (Prolog) A high-level computer language used mainly for artificial intelligence applications. It manipulates knowledge rather than numbers.

progressive cavity pump A positive-displacement pump using a screw or auger to lift liquids, usually sludge or wastewater. It is a low-lift, high-volume, wide-range-of-flow, nonclogging pump.

projected savings An estimate of the amount of water that will not be used because both customers and suppliers are implementing efficiency practices.

project flood The design flood chosen for a particular water resources project.

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project yield The water supply attributed to all features of a water supply project, including integrated operation of units that could be operated individually.

prokaryote A cellular organism such as cyanobacterium for which the nucleoplasm is not surrounded by a membranous envelope.

proliferation The growth or production by multiplication of parts, as in budding or cell division.

Prolog *See* Programming in Logic.

PROM *See* pedogenic refractory organic matter; programmable read-only memory chip.

PROM chip *See* programmable read-only memory chip.

prometon ($(H_7C_3HN)_2C_3N_3OCH_3$) The common name for the herbicide 2,4-bis(isopropylamino)-6-methoxy-*s*-triazine. *See also* herbicide.

promoter *See* tumor promoter.

promoter region A sequence within deoxyribonucleic acid to which a transcription factor can bind to increase the synthesis of a particular messenger ribonucleic acid. This binding ordinarily increases the rate of synthesis of the protein coded for by the messenger ribonucleic acid.

promotion (1) Advancement in rank, position, or the next higher stage or grade, usually accompanied by an increase in honor, pay, prestige, and other rewards. (2) In oncology, the process by which a chemical provides a selective advantage to cells that have been initiated for cancer. This selective advantage (i.e., an increase in the rate of cell division or a decrease in the rate at which these populations of cells die relative to normal cells) accelerates the development of tumors. *See also* tumor initiator.

promulgate To announce final federal agency action on a rulemaking by publication of the final rule in the *Federal Register;* to publish officially.

propagate (1) To transmit or spread from place to place. (2) To cause to increase or multiply.

propanone The IUPAC (International Union of Pure and Applied Chemistry) name for acetone.

propeller meter A meter that measures flow rate by measuring the speed at which a propeller spins as an indication of the velocity at which the water is moving through a conduit of a known cross-sectional area.

propeller pump A centrifugal pump that develops most of its head by the propelling or lifting action of the vanes on the liquids. Such a pump is also called an axial-flow pump.

propeller-type impeller An impeller of the straight axial-flow type.

propeller-type turbine A turbine of the axial-flow type that is fitted with a runner having large blades similar to those of the propeller of ship, and that makes use of both the kinetic and pressure energy of the water.

prophylaxis Measure necessary to preserve health and prevent the spread of disease**.**

propidium iodide (PI) A reagent to enable the measurement of the deoxyribonucleic acid (DNA) content of microorganism cells. It intercalates in the DNA helix and fluoresces strongly red. It has the advantage that it is excited by 488-nanometer light and can be used on most common flow cytometers, or instruments for cell counting.

proportional Having or occurring in the same ratio. For example, the fractions 1/2 and 2/4 are proportional to each other.

proportional action A type of control mode that varies the controller's output in proportion to the error of the controlled variable. *See also* proportional integral derivative control.

proportional band The gain of a proportional action controller. It is defined as a percentage of the controlled variable's change that will cause the output to change from minimum to maximum (100 percent).

proportional control *See* proportional action.

proportional counter A radiation detection instrument suitable for determining alpha activity at the alpha operating plateau, as well as beta plus alpha activity and a little gamma activity at a higher operating voltage. A proportional counter is extremely sensitive for making low-level radiation measurements because the sample may be introduced into the gas-flow counting chamber for radioassay.

proportional flowmeter Any flowmeter that diverts a small portion of the main flow and measures the flow rate of that portion as an indication of the rate of the main flow. The rate of the diverted flow is proportional to the rate of the main flow.

proportional integral derivative (PID) control Control based on the deviation between the actual output and desired output according to the proportion of deviation, the integral of deviation, and the derivative of deviation. *See also* derivative action; integral action; proportional action.

proportional limit The greatest stress a material can sustain for a short time without causing permanent deformation. It is defined by the point at which the stress–strain curve deviates from linearity. For composite materials, this point is called the apparent elastic limit because it is an arbitrary approximation on a nonlinear stress–strain curve. *See also* stress–strain curve.

proportional mortality rate *See* proportional mortality ratio.

proportional mortality ratio (PMR) The ratio of the number of deaths observed in the study population to the number of deaths expected in the study population, generally multiplied by 100 for convenience in making

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comparisons. In the proportional mortality ratio, the expected number of deaths in the study population (usually age, time, and cause specific) is computed on the basis of the proportion of that cause of death in the standard or general population. This ratio is used frequently in occupational epidemiology when a standard mortality ratio cannot be computed. Empirically, in occupational studies, the interpretation of a proportional mortality ratio is similar to the interpretation of a standard mortality ratio. *See also* standardized mortality ratio.

proportional weir A special type of weir in which the discharge through the weir is directly proportional to the head of the water being discharged.

proposed rulemaking A formal proposal issued by a federal agency for a rule announced via publication in the *Federal Register*.

propping agent A granular material, such as sand, that is used to keep conduits formed by hydraulic fracturing from collapsing. Propping agents are required to prevent the fractures from collapsing when the pressure is released. *See also* hydraulic fracturing.

proprietary floor A filter floor of proprietary or patented design.

prospective study An epidemiological study that examines the development of disease in a group of people determined to be free of the disease at present.

protean (1) Very changeable; taking on different shapes and forms. (2) Any of a group of insoluble derived proteins that are the first products of the action of water, dilute acids, or enzymes on proteins.

protection factor (PF) The ratio of airborne contaminant concentration in the environment to the concentration in air that has passed through a respirator.

protective coating A covering on one material of another material that has greater resistance to corrosion.

protective system Engineered procedures, shielding, or both established or set up to protect workers in an excavation from cave-ins or from material breaking off the sides of a trench or adjacent structures.

protein Any of numerous naturally occurring, extremely complex substances that consist of amino acid residues joined by peptide bonds, containing the elements carbon, hydrogen, nitrogen, oxygen, usually sulfur, and occasionally other elements (such as phosphorus or iron). Many essential biological compounds (e.g., enzymes, hormones, or immunoglobulins) contain proteins.

protein code The amino acid sequence of a functioning protein. The building blocks of proteins are amino acids, and it is the amino acid sequence and its length (i.e., number of amino acids) that determine the protein's function.

proteolysis Hydrolysis of proteins or peptides into simpler compounds.

protist A diverse group of eukaryotic microbes, meaning their deoxyribonucleic acid (DNA) is enclosed in a nucleus inside the cell. They include slime molds, algae, sporozoans (apicomplexans), zooflagellates, and several other eukaryotes that are not plants, animals, or fungi. Protists live in water, moist soil, and larger organisms. Most are unicellular and have flagella or cilia at some time in their life cycles. Most are aerobic in their metabolism. All can reproduce asexually, and many form resistant cysts at some point in their life cycles.

protocol (1) The plan, including the methodology, of a scientific study or experiment. (2) A set of formats and procedures governing the exchange of information between systems. (3) A set of rules that define a function. In synchronous communications, blocks of information are structured to adhere to a particular protocol understood by devices on the network. A network protocol is a fixed set of rules specifying the format of data exchange. A protocol defines how the individual bits are to be arranged in transmitting a message so that the message can be received and interpreted correctly by another device or node on the network.

proton One of the three classical elementary particles of an atom (along with neutrons and electrons). The proton is a positively charged particle located in the nucleus of an atom. The number of protons in the nucleus of an atom determines the atomic number of that element. *See also* electron; neutron.

proton-conducting membrane A synthetic membrane that passes positively charged protons (hydrogen ions). It can be used in hydrogen analyzers, fuel cells, and other devices.

proton nuclear magnetic resonance (proton NMR) An absorption spectrometric technique used in the characterization of organic compounds. It is based on the absorption of radio frequency radiation by protons in the presence of a magnetic field. This technique allows a nuclear magnetic resonance spectrum—a plot of the absorption frequency versus intensity—to be generated. The peak area of the plot is proportional to the number of protons in the compound; the pattern of peaks in the spectrum depends on the chemical environment of protons in a compound.

protoplasm Cell material inside the cell membrane. Protoplasm is composed largely of proteins along with significant quantities of fats and carbohydrates; it is responsible for all the metabolic activities of the cell.

prototype (1) A natural or full-scale version of a device or system that previously had only been simulated by a

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model. (2) A trial version of a product for testing before a final version is brought to market.

protozoa Small, one-celled organisms, including amoebae, ciliates, and flagellates.

protozoan conjugation A process of sexual reproduction in which ciliate protozoans of the same species temporarily couple and exchange genetic material.

protozoan cyst An environmentally stable life-cycle stage of protozoan parasites. Such cysts are excreted through feces into the environment. *See also* cyst; *Giardia;* oocyst.

provisional oral reference dose A draft or preliminary oral reference dose that may be subject to revision by the US Environmental Protection Agency prior to final adoption.

proximate carcinogen The form of a carcinogen (usually an electrophilic or radical cation intermediate) that actually reacts with the purine and pyrimidine bases within nucleic acids to initiate the carcinogenic response.

Prussian blue A blue paste or liquid (often supported on a paper, such as carbon is supported on carbon paper) used to show an area of contact between two pieces of equipment. The Prussian blue rubs off at the points of contact. For example, Prussian blue is used to determine whether gate valve seats fit properly.

PRV *See* pressure-regulating valve.

prymnesin Marine toxin produced by poisonous fish.

PS *See* point source; trichloronitromethane (chloropicrin).

ps *See* picosecond *in the Units of Measure section.*

PSAT *See* Pumping System Assessment Tool.

PSD *See* power spectral density.

pseudocholinesterase Any of a broad class of nonspecific enzymes that catalyze the hydrolysis of the esteratic bond in acetylcholine. These enzymes are found in high concentrations within the blood. The term *pseudocholinesterase* was given to these enzymes to differentiate them from the true cholinesterases found in nerves and red blood cells that are actually responsible for terminating the action of acetylcholine. Pseudocholinesterases can play an important role in terminating the activity of a number of chemicals that have similar properties to acetylcholine.

Pseudomonas A genus of aerobic bacteria belonging to the family Pseudomonadaceae, characterized as gram-negative motile rods with either monotrichous (having a single flagellum at one end of the cell), amphitrichous (having a tuft of flagella at one end of the cell), or lophotrichous (having a single flagellum or a tuft of flagella at each end of the cell) polar flagellation.

Pseudomonas aeruginosa (P. aeruginosa) A gram-negative, aerobic, motile bacterial species, 1.5 to 3 micrometers long by 0.5 micrometers wide, that often produces a bluish green, soluble diffusible pigment called pyocyanin and a yellowish green fluorescent pigment. This organism is found in a variety of environments, generally aquatic, and is pathogenic for humans. It has been associated with infections of wounds and burns, middle-ear infections (swimmer's ear), endocarditis, pneumonia, meningitis, gastrointestinal infections, and generalized systemic infection.

Pseudomonas fluorescens (P. fluorescens) A gram-negative, aerobic, motile bacterial species that is commonly found in aquatic environments and produces a diffusible yellowish green fluorescent pigment. The numerous strains of *Pseudomonas fluorescens* do not appear to be pathogenic to humans.

***Pseudomonas fluorescens* strain P17** A bacterial strain used in bioassay procedure for determining the concentration of assimilable organic carbon in drinking water. *See also* assimilable organic carbon.

pseudopod Projections of cell membranes that move a cell.

psi *See* pounds per square inch *in the Units of Measure section.*

psia *See* pounds per square inch absolute *in the Units of Measure section.*

psig *See* pounds per square inch gauge *in the Units of Measure section.*

psittacosis A disease caused by a bacterium *Chlamydophila psittaci,* found in bird droppings.

PSP *See* paralytic shellfish poisoning.

PSS *See* polystyrene sulfonate.

PSU *See* polysulfone.

psychrometer An instrument or hygrometer used to determine the relative humidity and vapor tension of the atmosphere. It usually consists of two thermometers, with one bulb left dry and the other encased in cloth or a cloth wick that can be saturated with water. Evaporation from the wet bulb causes the temperature to fall to less than that of the air. The relative humidity and the vapor pressure can be determined based on this temperature difference and specially prepared psychrometric tables.

psychrophilic bacteria Bacteria whose optimal temperature for growth is 54° to 64° Fahrenheit (12° to 18° Celsius).

psychrophilic range The optimal temperature range for growth of psychrophilic bacteria, generally accepted as 54° to 64° Fahrenheit (12° to 18° Celsius).

PT *See* proficiency testing.

PTA *See* packed tower aeration.

Pt–Co (platinum–cobalt) *See under* color unit *in the Units of Measure section.*

PTFE *See* polytetrafluoroethylene.

PTS *See* packed tower stripping.

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public The people constituting a community, state, or nation.

Public Health Security and Bioterrorism Preparedness and Response Act of 2002 Public Law 107-188, passed in 2002, that required measures to be implemented to improve the ability of the United States to prevent, prepare for, and respond to bioterrorism and other public health emergencies. Title IV of the law, Drinking Water Security and Safety, amended The Safe Drinking Water Act to require community drinking water systems serving populations of more than 3,300 persons to conduct assessments of their vulnerabilities to terrorist attack or other intentional acts and to defend against adversarial actions that might substantially disrupt the ability of a system to provide a safe and reliable supply of drinking water. The requirements of the act assign the US Environmental Protection Agency and water utilities responsibilities to enhance water sector security and to develop response measures for potential threats to the nation's water supplies and systems.

public information Information that is disseminated through various communications media to attract public notice or to educate the public at large.

public landscape Public street medians, parks, recreational facilities, and landscapes next to a public facility.

public land survey system (PLSS) A reference scheme for recording property ownership by township, range, section, and aliquot parts (half or quarter sections) in the United States. The public land survey system was laid out during the settlement of the country, dividing land areas into townships of 36 1-square-mile sections.

public law (PL) A bill or joint resolution (other than for amendments to the US Constitution) passed by both houses of the US Congress and approved by the president of the United States. Bills and joint resolutions that are vetoed by the president but overridden by Congress also become public law.

publicly owned treatment works (POTW) A wastewater treatment facility owned by a municipality or local government authority.

publicly owned water utility A water system owned by a municipal or quasi-municipal (e.g., special district) government.

public notification Disclosure to the public of when and how public water systems are in violation of the Safe Drinking Water Act, as per the requirements set October 27, 1987 (*Federal Register*, 52(208):41534,41550), by the US Environmental Protection Agency. For an acute violation, public notification is required by TV and radio within 72 hours, a general circulation newspaper within 14 days, and by mail or hand delivery within 45 days. If no newspaper of general circulation is available, posting or hand delivery is required. Notification by mail or hand delivery is repeated quarterly as long as the system is in violation. *See also* consumer confidence report. *See also* revised public notification rule.

public outreach A systematic attempt to provide services beyond conventional limits, as to particular segments of a community.

public participation Those occasions when the public takes part in, shares in, and influences the outcome of issues, events, or policy decisions. Open forums, public meetings, surveys, and task forces are among the methods used to provide the opportunity for public participation.

public perception A group's attitude or understanding of an issue based on what is observed or thought.

public relations The methods and activities used to promote a favorable relationship between an organization and the public.

public relations monitoring (1) Periodic monitoring of the effects of a public relations program or campaign implemented for a specific audience or population and performed while the program is under way. (2) Monitoring for the sake of being able to assure the public that something is being done to protect their health.

public trust doctrine A judicial doctrine under which the state holds its navigable waters and underlying beds in trust for the public and is required or authorized to protect the public interest in regard to such water sources. All water rights issued by the state are subject to the overriding interest of the public and the exercise of the public trust by state administrative agencies.

public use of water The use of water that is provided by an agency engaged in the development and distribution of water and is offered—up to the full capacity of the agency's water system—to all consumers who can be served under that system and who may apply for this service.

public utility A business enterprise in the form of a public service corporation that performs an essential public service and is regulated by the federal, state, or local government.

public water Water that is open to public recreational use.

public water supply *See* public water system.

public water system (PWS) As defined in Section 1401(4) of the Safe Drinking Water Act, a system for providing to the public water for human consumption through pipes or other constructed conveyances, if such system has at least 15 service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. Such a system includes (1) any collection, treatment, storage, and distribution facilities under control of the operator of such system and

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used primarily in connection with such system, and (2) any collection of pretreatment storage facilities not under such control but that are used primarily in connection with such system. A public water system is either a community water system or a noncommunity water system. On Aug. 5, 1998, the US Environmental Protection Agency published guidance regarding interpretation of the definition of *public water system (Federal Register,* 63:41939–41946). *See also* community water system; noncommunity water system; transient, noncommunity water system.

public water system inventory A listing maintained by the US Environmental Protection Agency that categorizes all public water systems in the United States that are subject to Safe Drinking Water Act regulations.

Public Water System Supervision (PWSS) Program The US Environmental Protection Agency program that implements and enforces Safe Drinking Water Act regulations in the United States through designated state agencies.

public water use The use of water to support public facilities, such as public buildings and offices, parks, golf courses, picnic grounds, campgrounds, and ornamental fountains.

public works Structures for public use, such as dams, airports, and buildings, paid for by government funds.

puddle A small pool of water, usually a few inches in depth and from several inches to several feet in its greatest dimension.

puddle clay Clay with certain adhesive properties that make it suitable for use in forming a watertight lining or backing for a reservoir embankment or other structure used to hold back water.

puddled core An earth dam core constructed of puddle clay, compacted clay, or other fine material. *See also* impervious core.

pull through A method of installing pipe inside another pipe or casing by means of cables and machines to move the pipe.

pulmonary test A medical test required by Occupational Safety and Health Administration's respiratory standard and given to employees before they are allowed to wear respirators on the job. This test measures the volume of air that a person's lungs can bring into the body.

pulse bed *See* moving bed.

pulsed arc electrohydraulic discharge (PAED) A technology for water treatment in which the rapid discharge of stored electrical charge across a pair of submerged electrodes generates pulsed electrohydraulic discharges. This experimental technology may be a viable method for treating microorganisms, algae, volatile organics, nitrogenous municipal waste compounds, and some inorganics. The technology may be potentially more effective and less expensive that ultraviolet treatment.

pulsed blanket clarifier A sludge-blanket clarifier that operates with controlled pulsing that creates and maintains the sludge blanket in a homogeneous suspension.

pulsed electric field An experimental disinfection treatment process in which the water being treated is passed through a strong electric field. The electric field can cause electroporation (physical disruption of membranes) of pathogens, leading to the death of the organism. *See also* electroporation.

pulsed sludge-blanket clarifier *See* pulsed blanket clarifier.

pulsed ultraviolet (UV) irradiation *See* high-intensity pulsed ultraviolet light treatment; pulsed ultraviolet light.

pulsed ultraviolet (UV) light Ultraviolet light produced by a system in which capacitors build up and release electricity in pulses to xenon flash tubes. With each pulse, the flash tubes give off high-intensity, broadband ultraviolet radiation. *See also* high-intensity pulsed ultraviolet light treatment.

pulsed ultraviolet (UV) light–hydrogen peroxide (pulsed UV/H_2O_2) process An advanced oxidation process in which pulsed ultraviolet light and hydrogen peroxide are used to create hydroxyl radicals that oxidize contaminants. *See also* advanced oxidation process; hydroxyl radical; ozone–biodegradation process; ozone–hydrogen peroxide process; ozone–ultraviolet light process; pulsed ultraviolet light; sonolysis; ultraviolet light–hydrogen peroxide process.

pulse-duration modulation (PDM) An analog type of telemetry-signaling protocol in which the time that a signal pulse remains on varies with the value of the parameter being measured.

pulsed UV/H_2O_2 process *See* pulsed ultraviolet light–hydrogen peroxide process.

pulsed-wave, broadband ultraviolet (UV) technology *See* pulsed ultraviolet light.

pulse-field gel electrophoresis A laboratory analytical method used in epidemiological studies for bacterial identification.

pulse-power plasma generator *See* sparker pressure pulse.

pulse sensor clearance The gap or distance over which the sensor in an instrument or meter will pick up the pulse signal. For a magnetic sensor, a pulse or signal that has to travel more than this distance will not be sensed or detected.

pumicite A stable, natural, glassy aluminum silicate mineral derived from volcanic ash that is used as a water treatment filtration medium. *See also* manganese dioxide–coated pumicite.

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pump A mechanical device for driving fluid flow, for raising or lifting a fluid, or for applying pressure to a fluid.

pumpage The total quantity of liquid pumped in a given interval, usually 1 day, 1 month, or 1 year.

pump amperage The electrical current flow, at a given voltage, that must be applied to a pump to produce a certain flow at a specific head. This current flow is expressed in amperes.

pump bowl The submerged pumping unit in a well, including the shaft, impellers, and housing.

pump capacity The amount or rate of flow a pump can deliver. Pump capacity varies with the head or pressure and is usually expressed at a point near the highest efficiency. *See also* rated capacity.

pump center line An imaginary line through the center of a pump.

pump characteristics curve A graphic representation of the performance of a pump in relation to the rate of flow against the total head, with the efficiency of the pump shown at points along the curve. These curves are generally established from actual run tests of the pumps. The shutoff head at which the pump will no longer deliver water and the rated capacity at the most efficient point are included with the curve. From these curves, a range of heads and delivery amounts can be determined, allowing one to select a pump for a specific pump application and for the most efficient operating range.

pump curve *See* pump characteristics curve.

pumped storage Water pumped by a power plant into a reservoir during off-peak periods of plant operation. Such water is later used to develop hydroelectric power during periods of peak demand. The reservoir is usually at a considerable elevation above the power plant; thus, the stored water provides a high head, so only a relatively small amount of storage space is needed. This method of supplying peak power often results in a considerable improvement in the load factor of the main plant and a consequent savings in equipment costs. *See also* pumped-storage plant.

pumped-storage plant A hydroelectric power plant in which peak-load power capacity is produced by water pumped into storage reservoirs during off-peak periods by using the plant's turbine-driven generators as motor-driven pumps. The power needed for pumping is obtained from the system when excess power-producing capacity is available; it would be wasted were it not used for this purpose. *See also* pumped storage.

pump efficiency The ratio of the pump output (i.e., water horsepower) to the pump horsepower, expressed as a percentage. If the motor is included with the pump as a unit, then the ratio of the pump output to the horsepower required by the motor gives a wire-to-water efficiency. One must know the efficiency of the motor to calculate the pump efficiency to determine the wire-to-water efficiency. *See also* wire-to-water efficiency.

pumper outlet nozzle The large type of hydrant outlet, usually 4.5 inches (11.4 centimeters) in diameter, suitable for the attachment of a large-diameter fire hose. Such an outlet is often called a pumper connection. It was formerly called a steamer connection because of its use with steam fire engines.

pump horsepower *See in the Units of Measure section.*

pump house A shelter for housing a small water pump.

pumping The application of force to a liquid to move or pressurize the liquid or to lift it from a lower elevation to a higher elevation.

pumping depression area The surface area overlying the area of influence or pressure relief cone created by a pumping operation. *See also* area of influence; pressure relief cone.

pumping depression cone The depression, roughly conical in shape, produced in a water table or other piezometric surface by the extraction of water from a well at a given rate. *See also* cone of depression; cone of influence; drawdown; pressure relief cone.

pumping groundwater level The depth to water in a production well as observed when the well is being pumped. The difference between this depth and the static (nonpumping) depth to water is called the drawdown. Typically the measurement is made after 1 hour of pumping during which the specific capacity of the well is measured. *See also* cone of depression; drawdown.

pumping head The sum of the static head and friction head on a pump discharging a given quantity of water.

pumping level The elevation at which the water level stands in a well when the well is being pumped at a given rate.

pumping line The discharge pipe from a pump.

pumping sampler An apparatus for sampling a water–sediment mixture by withdrawing it through a pipe or hose. The intake of the pipe or hose is placed at the desired sampling point.

pumping station *See* pump station.

Pumping System Assessment Tool (PSAT) A computer software program available from the US Department of Energy that aids management in evaluation of pumping operations with respect to parameters such as efficiency, energy usage, inventories, maintenance, and reporting.

pumping trough A hydrodynamic barrier to seawater intrusion in coastal areas created by operating a line of wells near the coast to extract brackish water from

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an aquifer. These wells are designed to stabilize the location of a saltwater wedge in the aquifer.

pumping water level (pwl) The vertical distance from the centerline of the pump discharge to the level of the free pool of the upper-level storage or water supply tank while water is being drawn from the tank.

pump kilowatts *See in the Units of Measure section.*

pump output The flow rate times the total head—with the product expressed in units of horsepower or kilowatts—that a pump will deliver to water at a specific pressure or head. Pump output is also known as water horsepower or water kilowatts. *See also* kilowatt *in the Units of Measure section;* water horsepower.

pump overall efficiency *See* wire-to-water efficiency.

pump packing The material placed in the designed space between the pump housing and the pump shaft to prevent excessive loss of water along the pump shaft. The packing is inserted in rings and is compressed by a follower gland with bolts to reduce leakage. A small amount of water provides lubrication of the packing against the rotating shaft, preventing overheating and wear of the shaft.

pump performance The measurement of pump efficiency based on the comparison of the output or discharge energy compared to the input energy expressed as a percentage.

pump pit A dry well or chamber, below ground level, in which a pump is located.

pump primer A vacuum pump attached to the suction end of a pump, used for priming the pump automatically.

pump priming The act of filling a pump casing with water to replace the air and provide a liquid to which the pump may apply a force. Pumps for which the suction side is set below the water level are said to have a positive suction head and can be primed by venting the top of the pump casing, allowing water to replace the air.

pump rod The line of rods of a reciprocating well pump, connecting the piston in the working barrel with the power head.

pump scheduler A program to help select pumping operations to maximize energy savings or runtime on equipment.

pump setting A measure of the energy added to a system by a pump. It is equal to the height of the pump head above the pump location or, for a well pump, the total length of the discharge column.

pump slip The percentage of water that is taken into the suction end of a pump but is not discharged because of clearances in the moving unit.

pump stage The number of impellers in a centrifugal pump; e.g., a single-stage pump has one impeller, and a two-stage pump has two impellers.

pump station A structure containing relatively large pumps and appurtenant piping, valves, and other mechanical and electrical equipment for pumping water. A pump station is also called a lift station. *See also* pump house.

pump strainer A device placed on the inlet of a pump to strain out suspended matter that might clog the pump.

pump stroke The lineal distance traveled by the piston or plunger of a reciprocating pump through one half of its cycle of movement.

pump submergence The vertical distance of a pump inlet or suction below the water level in a pump pit or afterbay.

pump valve An opening through which water enters or leaves the cylinders of a displacement pump.

pump-valve cage A casting containing a number of ports for water valves on the suction end of a reciprocating pump.

pump well A well that does not discharge water at the surface except through the operation of a pump or other lifting device. A pump well is also called a nonflowing well.

purchased water system A water system that purchases water from another water system and generally provides only distribution and minimal treatment.

pure culture *See* axenic culture.

pure oxygen An oxygen source that is at least 90 percent oxygen. Pure oxygen for process applications is either produced on-site or shipped in liquid form.

pure water A term that has no real meaning unless the word *pure* is defined by some standard, such as for, say, reagent grade water, distilled water, deionized water, reverse osmosis treated water, or activated carbon adsorption treated water. *See also* reagent grade water.

purgeable organic carbon (POC) The fraction of total organic carbon removed from an aqueous solution by gas stripping under specified conditions. Purgeable organic carbon is also referred to as volatile organic carbon, which includes the carbon content of chemicals that are volatile under the specified stripping conditions of the test. *See also* dissolved organic carbon; nonpurgeable organic carbon; particulate organic carbon; total organic carbon; volatile organic compound.

purgeable organic halogen (POX) A surrogate measurement of the total quantity of purgeable (fairly volatile) halogen-substituted organic material in a water sample. It is the volatile fraction (under conditions of the test) of the total organic halogen. The presence of purgeable halogen-substituted organic molecules in source water is typically caused by the presence of volatile organic chemicals (e.g.,

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industrial solvents), whereas in finished water it is typically caused by the presence of volatile disinfection by-products (e.g., trihalomethanes). *See also* disinfection by-product; halogen-substituted organic material; surrogate measurement; total organic halogen; volatile organic compound.

purgeable organic halogen formation potential (POXFP) The amount of purgeable organic halogen (POX) formed during a test in which a source or treated water is dosed with a relatively high amount of disinfectant (normally chlorine) and is incubated (stored) under conditions that maximize purgeable organic halogen production. This value is not a measure of the amount of purgeable organic halogen that would form under normal drinking water treatment conditions, but rather an indirect measure of the amount of purgeable organic halogen precursors in a sample. If a water has a measurable level of purgeable organic halogen prior to the formation potential test (e.g., from volatile organic chemicals in the water being tested), then the formation potential equals the POX concentration measured at the end of the test minus the initial value $((POX_t) - (POX_0))$. *See also* disinfection by-product formation potential; purgeable organic halogen.

purge-and-trap Method commonly used with gas chromatography–mass spectrometry, involving the isolation of analytes via aspiration of a sample with an inert gas and trapping of the analytes in a small volume on a carbon column. The carbon is baked to release the analytes for separation and detection.

purge-and-trap gas chromatograph (GC)–mass spectrometry (MS) *See* gas chromatography; mass spectrometry; purge-and-trap method.

purge-and-trap method (P&T method) A combination of isolation techniques used in the analysis of volatile organic compounds. Typically, an inert gas is bubbled through a water sample to purge volatile analytes into the headspace. Analytes are then adsorbed from the gaseous phase onto a solid trap. Compounds are then desorbed onto the head of a chromatographic column for separation and subsequent analysis.

purge water The water used in cleaning and disinfecting a water line or water storage facility. It is purged, wasted, and replaced with clean, potable water.

purification The act of removing objectionable matter from water by natural or artificial methods.

purified water A *United States Pharmacopeia* grade water that is produced from water meeting US Environmental Protection Agency standards for potable water, has microbiological content under control, and is free of foreign substances. *United States Pharmacopeia* grade water has various stipulated ions and gases removed, and it has a 1.0-megohm-centimeter resistivity measurement.

purveyor, water *See* water purveyor.

push joint A type of gasket joint in bell-and-spigot pipe. The gasket is placed in a groove in the bell end and is sealed when compressed against the pipe and bell. This compression occurs when the spigot end of the pipe is inserted or pushed into the bell.

push well A tubular well pushed approximately horizontally into a water-bearing stratum or under the bed of a lake or stream. A push well is also called a horizontal well.

pustule A slight, inflamed elevation of the skin filled with pus.

put The right of a bondholder to redeem the bond at a specified price prior to maturity. Investors might choose to do this if interest rates increase after the bond was issued. Bond terms generally restrict the dates and conditions under which this can be done.

putative carcinogen A chemical that is thought to be responsible for the induction of cancer.

putrefaction Biological decomposition of organic matter associated with anaerobic conditions, resulting in the production of ill-smelling and bad-tasting products.

putrescibility The relative tendency of organic matter to undergo decomposition in the absence of oxygen.

PVA *See* polyvinyl alcohol.

***p*-value** *See* probability value.

PVB assembly *See* pressure vacuum breaker assembly.

PVC *See* polyvinyl chloride.

PVC pipe *See* polyvinyl chloride pipe.

PVDF *See* polyvinylidene fluoride.

pwl *See* pumping water level.

PWS *See* public water system.

PWSS Program *See* Public Water System Supervision Program.

pycnometer A device for measuring densities of liquids, consisting of a container of known capacity that is filled with the liquid and weighed. The difference in mass compared to the mass of the empty container indicates the density.

Pyrex® A brand name for glass products manufactured from borosilicate glass. It has excellent thermal properties because of its high softening point and low coefficient of expansion. Its maximum recommended working temperature is 500° Celsius.

pyrimidine dimer A dimer product found in deoxyribonucleic acid (DNA) chains damaged by ultraviolet irradiation, most frequently thymidine dimers. They consist of two adjacent pyrimidine nucleotides, usually thymine nucleotides, in which the pyrimidine residues are covalently joined by a cyclobutane ring. These dimers stop DNA replication.

pyrochromatogram A chromatogram generated from the pyrolysis of a sample. Such a chromatogram

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illustrates the fragments produced upon rapid heating of complex molecules.

pyrogen A substance (often of unknown origin) that produces fever when introduced into the human body. Because they are chemically and physically stable, pyrogens are not necessarily destroyed by conditions that kill bacteria.

pyrolusite (MnO_2) *See* manganese dioxide.

pyrolysis The destructive distillation of organic compounds in an oxygen-free environment, converting the organic matter into gases, liquids, and char.

pyrolysis gas chromatography–mass spectrometry (pyrolysis GC–MS) A technique of introducing components of a sample to a gas chromatograph–mass spectrometer. It involves rapid heating of a sample so that the sample decomposes, and the products are analyzed by a combined gas chromatograph–mass spectrometer. High-molecular-weight substances have been analyzed by this technique.

pyrolysis GC–MS
See pyrolysis gas chromatography–mass spectrometry.

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Q

Q *See* reactive power.

QA *See* quality assessment; quality assurance.

QALY *See* quality-adjusted life year.

QA/QC *See* quality assurance and quality control.

QC *See* quality control.

QNB *See* 3-quinuclidinyl benzilate.

quadrant An arc of 90 degrees, a quarter of a circle.

quadrupole mass spectrometer A device used in the detection and identification of compounds. A quadrupole type of mass spectrometer is a fairly compact instrument and is commonly interfaced with a gas or liquid chromatograph. The term *quadrupole* refers to the four parallel metal rods that act as a filter for ions formed in the ion source portion of the mass spectrometer. Alternating radio frequency and direct current fields on the rods allow separation of ions by permitting only substances of a certain mass-to-charge ratio to pass entirely through the quadrupole. This type of device might better be called a quadrupole filter.

quagga mussel A bivalve (*Dreissena bugensis)* that multiplies rapidly in freshwater and can clog intake pipes. It has been identified in the Great Lakes and is similar in appearance to the zebra mussel. *See also* zebra mussel.

qualification test A set of tests and verifications performed to validate the conformance of water treatment equipment to a specific standard.

qualified right A water right that is not absolute but must be shared with others.

qualitative Pertaining to kind, type, or direction, as opposed to size, magnitude, or degree.

qualitative assay A test measurement resulting in a nonnumerical result (e.g., positive versus negative, presence versus absence).

quality The presence of value for the customer; the degree of excellence that a thing possesses.

quality-adjusted life year (QALY) A year of potential life adjusted based on a consideration of the quality of life at various ages. In epidemiology, an adverse effect of exposure is sometimes measured in terms of the number of years of potential life lost, a public health measure of the premature deaths that may result from exposure. The method of calculation assigns equal value to each year of life lost, but it has often been proposed that an indicator of the quality of life should be considered because certain years of life may be more valuable than others, both to the individual and to society. This requires that the years of potential life lost be adjusted. However, epidemiologists have neither reached a general agreement on which years of life are more valuable nor devised an accepted standard for weighting those years in the calculation of years of potential life lost. Because the measure of a quality-adjusted life year can vary from investigator to investigator, knowing how the quality has been determined in calculating quality-adjusted life years lost is important.

quality assessment (QA) A process of measuring and evaluating quality. Often this assessment involves evaluating such information as control charts, replicate measurements, spiked samples, and standard reference materials. *See also* certified reference material; control chart; spiked sample.

quality assurance (1) An overall system of management functions designed to provide assurance that a specified level of quality is being obtained. It can be thought of as being composed of quality control (QC) and quality assessment (QA). (2) The management of products, services, and production or delivery processes to ensure the attainment of operational performance, product, or both in keeping with quality requirements. *See also* quality assessment; quality assurance and quality control; quality control.

quality assurance and quality control (QA/QC) Monitoring, inspection, and evaluation of a product, facility, or service to compare with preset standards to determine if acceptable.

quality circle A small group of people, usually from similar units and organizational levels, who meet regularly for the purpose of improving productivity, morale, product, profit, and quality of performance.

quality control (QC) A system of functions carried out at a technical level for the purpose of maintaining and documenting quality. It includes such features as personnel training, standard operating procedures, and instrument calibrations.

quality design team In total quality management, a small group of people—working at any and every appropriate level—that formulates, communicates, promotes, and guides the process; plans organizational activities; and approves principal staff improvement teams. *See also* total quality management.

quality indicator The ratio of the effective energy and the minimal energy used during the same unit of time. It shows the entire efficiency of the water supply system.

quality system The overall program of quality assurance policies and quality control procedures used by a laboratory. Quality systems are in place to ensure

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that analyses are of high and documented quality. This term is used in NELAC Institute standards. *See also* NELAC Institute, the.

quanat A type of infiltration gallery common in the ancient world (ranging from Afghanistan to Morocco) and still in use today. Quanats are hand-dug by skilled workers using methods more than 3,000 years old, but otherwise they are equivalent to modern infiltration galleries. A quanat is also called a karez, foggara, or falaj. *See also* infiltration gallery.

quantification The measurement of the quantity of a substance. This term is preferred over *quantitation.*

quantitation The measurement of the quantity of a substance. The term *quantification* is preferred.

quantitative Pertaining to size, magnitude, or degree.

quantitative assay A test measurement resulting in a numerical result.

quantity-of-electricity units *See in the Units of Measure section.*

quantity-of-heat units *See in the Units of Measure section.*

quarterly user charges The charges made to the users of water service through the general water rate structures of the utility for the utility's share of the cost of servicing the water service requirements.

quartile confidence interval In statistics, an interval or range that is estimated to enclose one quarter of the values that a particular random variable might assume. A quartile represents one quarter of a population or sample. The four quartiles are reported as lower, second, third, and upper for a population or sample.

quartz jacket A clear, pure, fused quartz tube used to protect the high-intensity ultraviolet lamps in ultraviolet systems. It usually retards less than 10 percent of the ultraviolet radiation dose. A quartz jacket is also called a quartz sleeve or lamp sleeve.

quartz sleeve *See* quartz jacket.

quaternary amine (R_4N^+) A class of organic compounds of nitrogen that may be considered as derived from the ammonium ion (NH_4^+) by replacing all four of the hydrogen atoms with alkyl groups. *See also* strong acid cation exchanger.

quaternary ammonium salt ($R_4N^+X^-$) A type of organic nitrogen compound in which the molecular structure includes a central nitrogen atom joined to four organic groups (R) as well as to an acid radical (X). An ammonium salt in which the nitrogen atom shares its four valence electrons with carbon atoms is usually formed by the reaction between a tertiary amine (R–N(R')–R") and an alkylating agent (R"'X). They are all cationic surface-active coordination compounds and tend to be adsorbed on surfaces. Quaternary ammonium salts have many industrial uses, including use as a disinfectant, cleanser, and sterilizer. Cationic quaternary ammonium compounds adsorb on the cell walls of microbes and react chemically with the negative charges carried by the cell walls. Quaternary ammonium salts provide the exchange sites on certain anion-exchange resins. *See also* strong base anion exchanger.

quench To cool a material suddenly or halt a process or reaction abruptly.

quenching agent A substance used to inhibit a chemical reaction. For example, ascorbic acid ($C_6H_8O_6$) can be used as a reducing agent to quench the chlorine (HOCl) present in a treated water sample.

query To selectively retrieve data from a database. Having a computer list all items at a particular location that have not been replaced in the last year is an example. Most queries are accomplished with structured query language.

questionnaire (1) A form used for information gathering, inviting open-ended feedback from either a targeted or random group. It has a question-and-answer format and may allow for comments. The compiled results provide information on a range of opinions but have no statistical validity. (2) A formally developed set of questions used to solicit information about the individuals in a study for use in epidemiologic analyses. Information is collected to help assess various exposures, risk factors, and confounding characteristics. The questionnaire is usually developed by a survey statistician and is designed to collect information in an unbiased manner. Objectivity is sought in obtaining information; i.e., objective (closed-ended) answers rather than subjective (open-ended) answers are solicited. A questionnaire can be either self-administered or administered by a trained interviewer, but it must be administered in a consistent fashion according to established guidelines. Whenever possible, interviewers are unaware of the exposure or disease status of a study participant, and study participants are unaware of the associations being studied. Most often the actual study participants are questioned, but sometimes information about individuals in the study must be obtained from a spouse or another individual familiar with the study participant.

queue A temporary holding place for data. The data are usually processed on a "first-in–first-out" basis. A computer print queue is a good example. The print buffer stores, or queues, the data, which are then, in a job-by-job order, output to a printer.

quicklime (CaO) Another name for calcium oxide (CaO), which is used in water softening and stabilization. *See also* lime.

quick-operating valve A valve that has a revolving plug and a lever attached to it to facilitate sudden opening or closing.

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3-quinuclidinyl benzilate (BZ, or QNB) An organic compound can be used as a chemical warfare agent. It affects both the peripheral and central nervous systems.

quorum-sensing The phenomenon by which the accumulation of signaling molecules enables a single cell to sense the behavior of other bacteria in its environment (cell density). This mechanism enables bacteria to coordinate their behavior.

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S

S *See* complex power.

S *See* siemens *in the Units of Measure section.*

|*S*| *See* apparent power.

s *See* second *in the Units of Measure section.*

S-9 fraction The supernatant liquid produced after a cell homogenate is spun in a centrifuge at a force 9,000 times that of gravity. Typically this preparation is made from the liver of a rodent that has been pretreated to induce enzymes that metabolize chemicals to reactive intermediates. It is incorporated into a variety of in vitro tests (e.g., the Ames test). *See also* Ames test.

SAB *See* Science Advisory Board.

sabotage (1) In an industrial setting, any deliberate act, not involving toxicological release, that could have an unacceptable impact on operations. (2) Toxicological sabotage is a deliberate act involving hazardous materials stored, produced, or used at a facility to adversely affect the health and safety of employees, the public, or the environment.

SAC *See* spectral absorption coefficient.

saccharolytic Possessing the capability for chemically splitting sugar.

SAC exchanger *See* strong acid cation exchanger.

sacrificial anode An anode made of suitable metal placed in a water heater tank or water storage tank to protect the tank from corrosion.

sacrificial anode system A cathodic protection system in which the driving voltage for the protective current is generated by a galvanic corrosion cell, with the protected structure serving as the cathode.

saddle (1) A steel or concrete structure used for supporting a pipe or penstock laid above the surface of the ground. (2) A depression in a ridge. (3) An assembly of circumferential metal straps on a pipe where a connection is to be installed.

safe Pertaining to a condition of exposure under which a "practical certainty" exists that no harm will result for exposed individuals.

safe bearing capacity The load, usually expressed in tons per square foot (kilograms per square meter), that a given soil or foundation can safely support without appreciable settlement or movement.

safe drinking water Water that does not contain harmful bacteria or toxic materials or chemicals. Water may have taste and odor problems, color, and certain mineral problems and still be considered safe for drinking. *See also* potable water.

Safe Drinking Water Act (SDWA) Public Law 93-523, enacted Dec. 16, 1974, establishing Title XIV of the US Public Health Service Act, codified generally as 42 US Code 300f-300j-11. It required the US Environmental Protection Agency to set national primary (health-related) drinking water regulations that were the first to apply to all public water systems, as defined by the act, in the United States. *See also* Safe Drinking Water Act Amendments of 1986; Safe Drinking Water Act Amendments of 1996.

Safe Drinking Water Act Amendments of 1986 Public Law 99-339, which was enacted June 16, 1986, amending Title XIV of the US Public Health Service Act, commonly known as the Safe Drinking Water Act. It required the US Environmental Protection Agency to regulate a list of 83 specific contaminants, to regulate an additional 25 contaminants every 3 years, to specify criteria for deciding when filtration of surface supplies is required, to require certain water systems using groundwater to use disinfection, and additional provisions, including new programs for wellhead protection and sole source aquifer. *See also* Safe Drinking Water Act; Safe Drinking Water Act Amendments of 1996; wellhead protection.

Safe Drinking Water Act Amendments of 1996 Public Law 104-182, which made substantial revisions to the Safe Drinking Water Act, including elimination of the 1986 requirement that 25 contaminants be regulated every 3 years; addition of a new process for listing and regulating new contaminants; revision of the standard-setting process to include consideration of costs and benefits and competing health risks; addition of new programs for source water assessment, local source water petitions, and source water protection grants; mandatory regulation of filter backwash water recycle, radon, and arsenic; revision of requirements for unregulated contaminant monitoring and a national occurrence database; creation of a new state revolving loan fund for drinking water; new provisions regarding small system variances, treatment, technology, and assistance centers; and development of capacity development and operator certification guidelines by the US Environmental Protection Agency. *See also* Safe Drinking Water Act; Safe Drinking Water Act Amendments of 1986.

Safe Drinking Water Act Rules Regulations developed and promulgated by the US Environmental Protection Agency under the authority of the Safe Drinking Water Act.

Safe Drinking Water Hotline A US Environmental Protection Agency telephone hotline that provides

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assistance and regulatory knowledge to the regulated community (public water systems) and to the public on the regulations and programs developed in response to the Safe Drinking Water Act Amendments of 1986. Hours are from 10:00 A.M. to 4:00 P.M. Eastern time, Monday through Friday. The phone numbers are (800) 426-4791 or (703) 412-3330.

Safe Drinking Water Information System (SDWIS) A computerized information system established and maintained by the US Environmental Protection Agency that contains information on public water systems and compliance with National Primary Drinking Water Regulations.

safety Averting or not causing injury, danger, or loss.

safety audit A review of hazards in the environment or workplace, with a view toward reducing them to an acceptable level.

safety belt A safety device, rarely used now. It was a belt used to secure a person who was performing an activity and who required fall protection. This type of belt was phased out by regulations beginning in 1997. *See also* safety harness.

safety can A container used for safe storage of such flammables as gasoline. Such a can has a spring-loaded cap to allow release of internal pressure upon exposure to high temperatures. Laid on its side, this can should not leak more than 3 drops per minute.

safety factor (1) A numerical factor by which a dose or exposure that is known to produce minimal effects or no effect in an experimental situation (usually involving experimental animals or humans) is multiplied to help prevent adverse effects in a more susceptible species or individual. Safety factors are frequently applied to the determination of "safe" doses or exposures to chemicals. In general, however, the term *uncertainty factor* is favored, because it more precisely indicates why these factors are used. (2) An amount of water added to demand projections to protect against unforeseen changes in water demand and supply. *See also* lowest-observed-adverse-effect level; no-observed-adverse-effect level; uncertainty factor.

safety harness A harness worn by employees requiring fall protection to distribute the shock of a fall evenly on the body. In contrast, a safety belt directs all of the fall energy to the waist of the wearer. *See also* safety belt.

safety program A set of written procedures and guidelines that instruct workers on how to carry out their job duties safely and avoid hazards.

safety shoes Shoes that have steel toes and are shanked to prevent damage to the foot. Such shoes must meet ASTM F2412, Standard Test Methods for Foot Protection.

safety shower A shower that delivers a drenching flow to the user. A safety shower is usually located near hazardous chemicals.

safety switch Generally, a switch that disables or disconnects a circuit, piece of equipment, or particular control function. Some safety switches, however, cause the functions to freeze in the last setting. Although most safety switches are of the circuit breaker type, some are contained in the software of a control program that requires inputs from other circuits. If the input is not received, the equipment is shut down or remains at the last setting that was received. A safety switch is also called a disconnect switch.

safety valve A valve that automatically opens when prescribed conditions, usually of pressure, are exceeded in a pipeline or other closed receptacle containing liquids or gases. A safety valve prevents such conditions from being exceeded and causing damage.

safe velocity The fluid velocity that will maintain solids in movement and, at the same time, will not scour the conduit in which the fluid is being carried. *See also* noneroding velocity.

safe yield, groundwater *See* groundwater safe yield.

safe yield, impounding reservoir *See* impoundment safe yield.

safe yield, river *See* river safe yield.

salimeter A hydrometer that measures the percentage of salt as sodium chloride in brine or other salt solutions. A 100 percent reading on a salimeter is about 26.4 percent salt by weight at 60° Fahrenheit (15.5° Celsius). Some use the term *salinometer* to refer to a salimeter but the two devices are different; a salinometer measures electrical conductivity, not density. *See also* salinometer.

saline Pertaining to or containing salt.

saline–alkaline soil A soil with the exchangeable sodium percentage greater than 15, the pH usually 8.5 or lower, and the conductivity of the saturation extract greater than 4 millimhos per centimeter at 77° Fahrenheit (25° Celsius).

saline contamination Contamination of water by intrusion of salt water. *See also* saline water intrusion.

saline soil A nonalkaline soil with the conductivity of the saturation extract greater than 4 millimhos per centimeter at 77° Fahrenheit (25° Celsius), the exchangeable sodium percentage less than 15, and the pH usually less than 8.5.

saline solution Usually, any solution with the total dissolved solids ranging from 15,000 to 30,000 milligrams per liter (e.g., a solution of sodium chloride (NaCl) at this concentration), and usually also containing other salts. Saline solution may also be called saline water.

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saline spring A spring in which the water contains a considerable quantity of sodium chloride (NaCl) or other common minerals.

saline water Water containing relatively high concentration of salts or dissolved solids, generally at least 1,000 milligrams per liter total dissolved solids. *See also* brackish water; brine.

saline water intrusion The movement of saline groundwater into a formerly freshwater aquifer as a result of pumping in that aquifer. Saline water intrusion typically occurs in coastal areas where the source of saline water is the nearby ocean. Passive saline water intrusion refers to the slow intrusion caused by a general lowering of the freshwater potentiometric surface. Active saline water intrusion refers to a much more rapid intrusion caused by a lowering of the freshwater potentiometric surface below the local mean sea level.

salinity (1) The relative concentration of dissolved salts in water. (2) The total dissolved solids in salt water after all carbonates and organic matter have been oxidized and all bromide and iodide have been replaced with chloride. This type of salinity is usually reported in grams per kilogram or parts per thousand. Salinity in parts per thousand empirically is equal to 0.03 plus the value of 1.805 multiplied by chlorinity in parts per thousand. *See also* chlorinity; chlorosity.

salinity wedge *See* saltwater wedge.

salinization The process of salts accumulating in soil.

salinometer An instrument for determining the salt concentration (salinity) of brine water by measuring the electrical conductivity of the solution. A salinometer is sometimes called a salt gauge. *See also* salimeter.

sal marina The Spanish name for sea salt.

Salmonella A genus of enteric bacteria belonging to the family Enterobacteriaceae. *Salmonella* are gram-negative, rod-shaped, nonspore-forming, facultative anaerobes that are morphologically indistinguishable from the coliform bacteria. Most species are actively motile by means of peritrichous flagella. All members of the *Salmonella* group are pathogenic to some degree in humans, primarily causing gastrointestinal illnesses ranging from mild to severe (typhoid fever is an example of the latter). They may also cause disseminated systemic infections. The natural hosts for these organisms are lower animals (both warm- and cold-blooded), especially rodents and birds, that provide a reservoir for human disease. *See also* typhoid fever; waterborne disease.

***Salmonella* microsome test** A mutagenesis test designed to detect reverse mutations induced by chemicals in one or more tester strains of *Salmonella* bacteria. *Salmonella* microsomal or S-9 fractions are frequently added to the incubation to enable detection of chemicals that have to be metabolically activated to induce mutations. The enzymes that mediate such metabolism in mammals are most often found in the endoplasmic reticulum. Upon homogenization of tissues, the endoplasmic reticulum is reduced to vesicular structures referred to as microsomes. *See also* Ames test; microsome; reverse mutation; S-9 fraction.

Salmonella typhimurium (S. typhimurium) A type of bacteria that causes food poisoning in humans. This bacteria is also used to test the mutagenic potential of chemicals.

salmonellosis *See* waterborne disease.

salometer *See* salimeter.

salt A compound resulting from acid–base mixtures.

salt (or specific solute) passage For a pressure-driven membrane treatment process, the fraction of feedwater salt or specific solute that passes through the membrane and becomes part of the permeate (product). In equation form,

$$\text{salt (or specific solute) passage (\%)} = \frac{C_p}{C_f} \times 100$$

Where:

C_p = permeate concentration, in milligrams per liter

C_f = feedwater concentration, in milligrams per liter

It is also equal to 100 percent minus the percentage salt or specific solute rejection.

salt-affected soil Soil that has been adversely modified for the growth of most crop plants by the presence of certain types of exchangeable ions or soluble salts. Soils having an excess of salts, exchangeable sodium, or both, fit in this category.

saltation The transportation of clastic (broken or fractured) sediments in air or water by intermittent leaps or bounds.

salt balance The condition that occurs when the amount of salts added to the soil through irrigation and the amount removed by leaching are equal.

salt block Evaporated salt or fine rock salt that is mechanically compressed into dense blocks, weighing about 50 pounds (23 kilograms) each, that are sometimes used in residential water softeners.

salt cake Sodium sulfate (Na_2SO_4) that is only 90–99 percent pure (i.e., contains 1–10 percent substances other than sodium sulfate). Salt cake is made by heating rock salt with sulfuric acid (H_2SO_4), producing muriatic acid (HCl) and salt cake.

salt dosage *See* regeneration level.

salt efficiency The hardness removal capacity of a water softener unit, calculated as the milligrams (grains) of hardness removed divided by the kilograms (pounds) of salt that is used to achieve that amount of

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hardness reduction. Operational salt efficiency refers to the performance, in terms of salt efficiency, of a water softener under conditions of actual or simulated long-term use (6 months or more) in a household where the amount of water usage typically varies from day to day.

salt flotation A method by which one can concentrate parasites either through sedimentation or by flotation. Concentration is specifically designed to allow recovery of protozoan cysts, coccidian oocysts, Microsporidian spores, and helminth eggs and larvae.

salt flux *See* solute (salt) flux.

salting out The act of decreasing the solubility of a solute by addition of a salt. This phenomenon has been applied in analytical chemistry as a way to increase the extraction efficiency of certain analytes. For example, liquid–liquid extraction methods for the analysis of haloacetic acids (CX_3COOH, where X = Cl, Br, or H in various combinations) in water recommend the addition of large amounts of salt to improve the extraction efficiency.

salt mass transfer coefficient *See* solute (salt) permeability coefficient.

salt method A method of measuring the discharge of water flowing through closed passages under pressure. A salt solution of known strength is injected at a known rate into the water at one point, and samples are taken of the water at a downstream point and analyzed. Knowing the quantity of salt in the solution, the solution's rate of injection, and the quantity of salt in the resulting mixture, one can compute the quantity of discharge by a mass balance. This method is frequently used in measuring water flow through hydraulic turbines. *See also* dilution method.

salt passage correction factor For some pressure-driven membrane processes, a dimensionless coefficient that is dependent on the net driving pressure and concentration gradient across the membrane. This factor can be used to calculate salt passage for a given net driving pressure and concentration gradient by multiplication with salt passage at a standard condition.

salt permeability coefficient (constant) *See* solute (salt) permeability coefficient.

salt rejection *See* rejection.

salt splitting An ion-exchange process in which neutral salts in water are converted to their corresponding acids or bases. A strong base anion-exchanger resin (R) can convert a salt solution to caustic (i.e., base), e.g.,

$$NaCl + ROH = RCl + NaOH$$

A strong acid cation exchanger can convert a salt to acid, e.g.,

$$NaCl + HR = NaR + HCl$$

salt-splitting capacity test A test that measures the performance of a used ion-exchange resin to determine the capacity of the used resin versus the standard rated capacity of the resin when fresh. This allows a calculation of the degree of exhaustion of the resin.

salt spring A saline spring.

salt transport coefficient *See* solute (salt) permeability coefficient.

salt-velocity method A means of measuring water velocity by injecting salt at one point and observing the time required for the salt solution to reach another point. *See also* salt method.

salt water Water containing relatively high concentration of salts or dissolved solids, usually over 1,000 milligrams per liter. *See also* ocean water; saline water.

saltwater encroachment The invasion of a body of freshwater by a body of salt water. *See also* saline water intrusion.

saltwater intrusion The movement of salt water into a body of freshwater, either surface water or groundwater. *See also* saline water intrusion.

saltwater system A system of water mains, separate from the regular distribution system, that conveys salt water for fighting fires.

saltwater underrun The more rapid movement of the ocean water along the bottoms of tidal estuaries, making the bottom water saltier than the top water. *See also* saltwater wedge.

saltwater wedge A salinity intrusion that occurs in certain tidal waterways and has the distinguishing characteristic of being a stratum of salt water underflowing a stratum of comparatively fresh water. The thickness of the stratum of salt water is greatest at the entrance and least at some point upstream, giving the stratum a wedge shape. *See also* saline water intrusion; saltwater underrun.

salvaged water That part of a particular stream or other water supply that, as a result of artificial work is not lost from the supply and therefore is retained within the supply and made available for use. Salvaged water is already in the area and is saved and restored to the usable supply within the area by artificial means.

salvage water right A legal right to appropriate and use waters that would otherwise go to waste.

SAMP *See* special area management plan.

sample (1) A fraction of a population or material tested or analyzed in order to determine the composition, nature, or properties, or a combination of all three. (2) To collect a sample.

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sample bottle A wide-mouth glass or plastic bottle used for taking microbiological and chemical water samples.

sample point A location or apparatus in a water distribution system that will allow a water sample to be collected for testing.

sample preservation Treatment given to a sample to maintain its original composition.

sampler A person or device that collects a portion of a substance for the purpose of analysis.

sample split Part of a larger sample.

sampling (1) A process of collecting a portion of a substance for analysis. A goal of sampling is to obtain a portion of the substance that is representative of the whole. (2) In statistics, a selection of a subset of the entire population of subjects or products for analysis such that the measured values obtained collectively represent the entire population within certain confidence limits. In general, a method of selecting individual samples in an unbiased way must be found. The most common approach is to randomly select the samples for analysis.

sampling iron A metal frame used during the collection of water samples from rivers and lakes. A sampling iron is designed to hold sampling bottles of different sizes.

sampling vertical A vertical line from the bottom of a water body to the surface, along which one or more samples are collected.

SANCHO model A computer model to simulate the behavior of chlorine (HOCl), biodegradable organic carbon, and biomass in distribution system pipes. This model can predict the spatial fluctuations of the modeled parameter under a steady-state condition.

sanctuary Territory set apart and maintained in a natural state for the preservation of plants and animals.

sand (1) A soil particle between 0.05 and 2.0 millimeters in diameter. Chemical composition does not influence the definition, only size. (2) Any one of five soil separates: very fine sand, fine, medium, coarse, or very coarse.

sand ballasted flocculation–sedimentation A flocculation and sedimentation process that is enhanced by the use of sand. During the flocculation process, the sand attaches to other particles, often formed through the addition of coagulants. These particles then settle rapidly in the sedimentation process. The sand is then recovered from the residuals and is recycled to the beginning of the process. *See also* microsand enhanced coagulation.

sandbar A ridge of sand built up to the surface or near the surface of a river or along a beach.

sand barrier A layer of gravel around the curb of a dug well.

sand boil The violent washing action in a granular water filter caused by an uneven distribution of backwash water.

sand drying bed A device used to separate water and solids in residuals. The residuals are applied to the surface of a layer of sand, ranging in depth between 6 and 9 inches (15 and 23 centimeters), supported by 12 inches (30 centimeters) of a gravel underdrain system. The dewatering process occurs by two mechanisms: (1) gravity drainage through the sludge cake and sand filter, and (2) air drying from the surface of the sludge cake by evaporation. Sand drying beds are simple to operate but require large land areas to provide effective dewatering. *See also* residuals drying bed.

S&DSI *See* Stiff-and-Davis stability index.

sand ejector A portable device for transporting sand by water under pressure.

sand filter The oldest and most basic filtration process, which generally uses two grades of sand (coarse and fine) for turbidity and particle removal. A sand filter can serve as a first-stage roughing filter or prefilter in more complex processing systems. *See also* granular media; slow sand filter.

sand gate A sluice gate used for sluicing out sand and sediment collected at a sand trap in an irrigation canal.

sand grain bridging The formation of bridges by sand grains during well construction and development. Such bridging can result in inefficient wells and damage to pumps when the bridges break and sand particles pass through the pump.

San Dimas flume A special form of flume for measuring the flow of debris-laden water in open conduits.

sand interceptor A detention chamber designed to remove sand from a conduit.

sand pump A long cylindrical tube fitted with a valve at the bottom and open at the top, used for raising the mud that accumulates in the bottom of a boring during the sinking process. A sand pump is also called a shell pump or sludger.

sand-pump dredge *See* suction dredge.

sandstone Sedimentary rock, usually consisting of quartz sand united by some cement, such as silica (SiO_2) or calcium carbonate ($CaCO_3$).

sand trap An enlargement of a conduit carrying untreated water that allows the water velocity to slow down so that sand and other grit can settle.

sand washer *See* sand-washing machine.

sand-washing machine A device used for washing the sand in a slow sand filter, as well as the sand from a rapid granular filter. *See also* slow sand filter.

sandy Containing a large fraction of sand. This term may be applied to any one of the soil classes that contains a large percentage of sand.

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sanitary drinking fountain A drinking fountain that delivers water in a stream in such a manner that (1) the individual drinks from the stream without coming in contact with the equipment, and (2) the unused water flows only into the waste basin.

sanitary engineering *See* environmental engineering.

sanitary landfill A dedicated location for disposal of solid waste. After it reaches a specified elevation, the landfill is decommissioned and a cover material, such as soil or grass, is placed on the surface.

sanitary seal Any device or system that creates a protective union between two mechanical or process system elements.

sanitary sewer A sewer that transports only wastewaters from domestic residences and/or industries, no stormwater runoff, to a wastewater treatment plant.

sanitary survey An on-site review of a water utility's water source, facilities, equipment, and operations and maintenance records for the purpose of evaluating the system's adequacy in producing and distributing safe drinking water.

sanitation The improvement of environmental conditions favorable to health; measures designed to prevent disease through an environmental health program that includes provisions for safe food and drinking water, satisfactory quality of indoor and outdoor air, proper collection and treatment of domestic and industrial wastewater, and proper management of industrial and agricultural runoff and solid and hazardous wastes.

SAN trimer *See* styrene-acrylonitrile trimer.

Sapporo virus Species of virus of the family Caliciviridae and the genus *Sapovirus.* It is associated with worldwide sporadic outbreaks of gastroenteritis in humans, particularly children. Formerly called Sapporo-like virus, it is named after the first recorded outbreak in human infants in Sapporo, Japan, in 1977, and it contains multiple strains.

saprophyte An organism living on dead or decaying organic matter. Saprophytes help the natural decomposition of organic matter in water.

saprophytic Living on dead or decaying matter.

saprophytic bacteria Bacteria that live on dead or decaying organic matter.

SARA *See* Superfund Amendments and Reauthorization Act.

sarin (GB) A clear, colorless, tasteless, and highly toxic chemical that affects the nervous system (a nerve agent). It can be used as a bioweapon and has the chemical name methylphosphonofluoridic acid, (1-methylethyl) ester. A guideline for the maximum allowable amount of this chemical warfare agent in military drinking water has been developed by the National Research Council. *See also* National Research Council.

SAR transfer *See* sodium adsorption ratio transfer.

SASW *See* spectral analysis of surface waves.

satellite management Operations and maintenance services provided through contracts with one or more other water systems.

satellite management agency (SMA) A person or entity approved by a regulatory agency to own or operate public water systems on a regional or countywide basis without the necessity for a physical connection between systems.

saturable kinetics A feature of a chemical process when that process is independent of the substrate concentration (i.e., of zero order). This term is commonly used in toxicology when a process's capacity for clearing a compound by a metabolic or excretory pathway is exceeded. Doses of an administered toxic compound that exceed these capacities will produce exaggerated responses relative to lower doses. However, if a metabolite is responsible for the effect rather than a toxic compound, the metabolite will flatten (i.e., make less exaggerated) the relationship between external dose and the measured response. *See also* reaction order.

saturate (1) To fill all the empty spaces between soil particles with a liquid. (2) To form a solution of the highest possible concentration under a given set of physical conditions in the presence of an excess of the solute. (3) To fill something to capacity.

saturated (1) Pertaining to a material that can absorb no more of a second material. Saturated soil has its void spaces completely filled with water, so any water added will run off and not soak in. (2) Pertaining to a chemical in which all available valence bonds of an atom (especially carbon) are attached to other atoms. The straight-chain alkanes ($R–CH_2–R'$) are typical saturated compounds. *See also* alkane; unsaturated; valence.

saturated air Air containing as much water vapor as possible at a given temperature and pressure. *See also* relative humidity.

saturated liquid A liquid that contains as much of a solute as it can retain in the presence of an excess of that solute at a given temperature.

saturated rock A rock that has all its interstices or void spaces filled with water.

saturated soil A soil sample for which all the pore space is occupied by some liquid. Typically, the liquid is water, but it could be some other liquid or a mixture of liquids. In the latter case, a modifier is usually added to the term, e.g., a gasoline-saturated soil.

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saturated solution A solution that contains the maximum amount of the dissolved substance (solute) that it can normally hold at this temperature. *See also* supersaturated.

saturated zone The portion of the subsurface where the pore space is completely occupied by water at or in excess of atmospheric pressure.

saturation The condition of a liquid when the liquid has taken into solution the maximum possible quantity of a given substance at a given temperature and pressure.

saturation capacity The maximum capacity of an ion-exchange column, usually expressed in terms of kilograms of exchanged material per cubic foot of exchange resin (kilograms per cubic meter).

saturation extract The extract from a sample of soil that has been saturated with water.

saturation index (SI) A numerical value obtained by calculation from a water analysis. Such an index is intended to make predicting the scale-forming or scale-dissolving tendencies of water possible. *See also* Langelier saturation index; Riddick index; Ryznar stability index.

saturation line A horizontal line on a cross section of an earth dam, dike, or levee that marks the uppermost limit of water flow through the dam and subsoil. Material below the line of saturation will be saturated with water. *See also* phreatic line.

saturation pH The pH at which a water is saturated with a compound, normally calcium carbonate ($CaCO_3$).

saturation point The point at which a solution can no longer dissolve any more of a particular chemical. Precipitation of the chemical will occur beyond this point.

saturation zone That portion of the lithosphere in which the functional interstices of permeable rocks are saturated with water under hydrostatic pressure.

saturator (1) A piece of equipment that feeds a sodium fluoride (NaF) solution into water for fluoridation. A layer of sodium fluoride is placed in a plastic tank and water is allowed to trickle through the layer, forming a constant-concentration solution that is fed to the water system. A saturator can also be used for feeding lime ($Ca(OH)_2$). (2) In the dissolved air flotation (DAF) process, a pressure vessel used to produce clarified or filtered water saturated typically at 60 to 80 pounds per square inch (420 to 560 kilopascals). When the high pressure is released on entry to the DAF clarifier, a fine cloud of air bubbles forms.

sausage dam A low dam constructed of cylinders of loose rock formed by wire wrapping. The cylinders are laid in either a horizontal or a vertical position. Such dams are not impervious and are used primarily to reduce erosion or retard debris flows.

SAV *See* submerged aquatic vegetation.

saxitoxin A neurotoxin produced by planktonic algae (dinoflagellates primarily) including *Alexandrium tamarense, Gymnodinium catenatum,* and *Pyrodinium bahamense.* Filter-feeding mollusks ingest the algal species, thereby concentrating the toxins that they produce. When people consume these contaminated shellfish, they quickly succumb to the effects of the toxin, a syndrome known as paralytic shellfish poisoning (PSP). Symptoms of PSP are predominantly neurological and include tingling, burning, numbness, drowsiness, incoherent speech, and respiratory paralysis. Saxitoxin is reported to be one of the most toxic nonprotein substances known. The LD_{50} (lethal dose–50 percent) in mice is approximately 8 micrograms per kilogram, which suggests that a single dose of 0.2 milligram would be lethal for the average-weight human. *See also* lethal dose–50 percent; paralytic shellfish poisoning.

Saybolt standard unit (SSU) *See in the Units of Measure section.*

SBA exchanger *See* strong base anion exchanger.

SBIR *See* Small Business Innovation Research.

SBJPA *See* Small Business Job Protection Act.

Sc *See* Schmidt number.

SCADA *See* supervisory control and data acquisition.

scale A coating or precipitate deposited on surfaces. Examples include oxide flakes forming on metal surfaces, carbonate (CO_3^{2-}) precipitates depositing in piping systems or water heaters, sulfate (SO_4^{2-}) scale precipitating in desalting systems, or silica (SiO_2) scale forming in boilers. Waters that contain carbonates or bicarbonates (HCO_3^-) of calcium or magnesium are especially likely to cause scale when heated. Scale is also called hard water scale.

scale inhibitor *See* scale prevention compound.

scale prevention compound A chemical additive that prevents the formation and buildup of a scale that can be caused by supersaturation of a compound in the bulk water. For example, the addition of sodium polyphosphate ($Na_{n+2}P_nO_{3n+1}$) can reduce precipitation and scaling associated with supersaturation of calcium carbonate ($CaCO_3$) in potable water. Scale prevention compounds are often used to prevent scaling in boilers. They are also called scale inhibitors or antiscalants.

scaling The deposition of scale on a surface. *See also* scale.

scanning A technique for capturing and converting analog data to digital form. A scanner uses an optical laser or other electronic device to scan an existing map and convert its images into digital format. Most scanners produce digital data in raster image format, recording a value of dark (e.g., representing a line or

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symbol) or light (no line or symbol) for each grid cell or picture element (pixel) of the scan. *See also* pixel; raster image.

scanning electron microscope (SEM) A type of electron microscope that operates at a much lower voltage than a transmission electron microscope and for which the electron beam operates as a probe by being deflected across the surface of the specimen by deflection coils within the bore of the final lens. The whole scanning electron microscope can be regarded as a slow-scan TV system with the microscope column acting as a very high-resolution camera tube and the specimen as the camera tube target. *See also* transmission electron microscope.

scanning electron microscopy The practice of using a scanning electron microscope.

scatter diagram A graphical depiction of the relationship between one variable and another, used to screen for possible cause-and-effect relationships.

scattering The change in direction of light propagation caused by interaction with a particle.

scavenger A polymer matrix or ion exchanger that is used specifically to remove organic species from the feedwater before the water is to pass through a deionization process.

scavenger well A well that pumps brackish water from beneath a freshwater lens to control saline water intrusion.

scavenging A process in which free radicals are consumed or inactivated by a radical scavenger. *See also* free radical; radical; radical scavenger.

SCBA *See* self-contained breathing apparatus.

SCD *See* soil conservation district.

SCDWAP *See* Small Community Drinking Water Assistance Plan.

scenario planning A strategic planning tool involving the characterization of the business environment within which a utility will most likely operate over time as well as potentially favorable and unfavorable changes that may affect business performance; used for the development of a business strategy affording appropriate consideration of prevailing risks.

SCFM (also scfm) *See* standard cubic feet per minute *in the Units of Measure section.*

schedule, pipe *See* pipe schedule.

schema The set of characteristics of computer files that contain nongraphic attributes. The schema holds information such as the names of data elements, the size of element fields in bytes or columns, the data element format (e.g., alpha, integer, binary), and other data required by the software to process attribute data.

schizogonic stage Asexual reproduction of apicomplexan parasites resulting in many merozoites.

Schlumberger array *See* dipole array.

Schmidt number (Sc) A dimensionless quantity that expresses the relationship between mass diffusivity and momentum diffusivity. The Schmidt number is often used in determining behavior in mass transfer in binary systems between phases.

schmutzdecke The layer of solids and biological growth that forms on top of a slow sand filter, allowing the filter to remove turbidity effectively without chemical coagulation. *See also* biofilm; slow sand filter.

Science Advisory Board (SAB) An independent advisory board of scientists and engineers initially established in 1973. Congress provided statutory authorization for the Science Advisory Board in 1978 under the Environmental Research, Demonstration, and Development Authorization Act (42 US Code Section 4365). The Science Advisory Board reviews and provides advice and comments on the scientific adequacy of proposed criteria, documents, standards, limitations, or regulations issued by the US Environmental Protection Agency (USEPA). The Safe Drinking Water Act requires the USEPA to request comments from the Science Advisory Board before proposing any maximum contaminant level goal or National Primary Drinking Water Regulation.

scientific notation A means of expressing any number as a number between 1 and 10 (excluding 10 itself) multiplied by a power of 10. For example, 1,300,000 would be 1.3×10^6; 0.065 would be 6.5×10^{-2}.

scintillation cocktail A solution used in the analysis of radionuclides. These solutions can be prepared in the laboratory or purchased commercially. They are often composed of one or more organic solvents containing a scintillator. A method for the determination of radon in water makes use of a scintillation cocktail as both an extraction solvent and a medium containing a scintillator. Particles from the radioactive decay of radon interact with a scintillator that then emits photons. Those photons are then detected in a liquid scintillation counter. *See also* scintillator.

scintillation counter, liquid *See* liquid scintillation counter.

scintillator A substance that produces flashes of photons upon interaction with radioactive particles. A liquid scintillator is typically an organic compound dissolved in an organic solution (scintillation cocktail). Radioisotopes, such as radon-222, carbon-14, and tritium emit beta particles that interact with the scintillator, which in turn emits photons. These photons are detected and counted by an instrument, such as a liquid scintillation counter. *See also* scintillation cocktail.

SCM *See* supply chain management.

scolex The knoblike anterior end of a tapeworm. Suckers or hooklike parts that in the adult stage serve as

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organs of attachment to the host on which the tapeworm is parasitic.

scoop wheel A type of pump consisting of a series of flat vanes revolving in a curved channel. A scoop wheel is practically a reverse undershot waterwheel and is used for drainage pumping.

scour (1) The action of a flowing liquid as it lifts and carries away the material on the sides or bottom of a waterway, conduit, or pipeline. (2) The enlargement of a flow section of a waterway through the action of the fluid in motion carrying away the material composing the boundary. *See also* scouring velocity.

scouring sluice An opening in a gate-controlled dam through which accumulated silt, sand, and gravel may be ejected.

scouring velocity The minimum velocity necessary to dislodge stranded material from the boundary of a waterway, conduit, or pipeline by a fluid in motion.

scraper (1) A device for insertion in pipelines that is pushed or hauled through by some method or device (such as water pressure, rope, or cable) to remove accumulated organic or mineral deposits. Scrapers are used principally in pipes too small for access by persons and are of various designs and sizes. (2) A device used in the bottom of a sedimentation tank to move settled sludge to a discharge port. (3) A blade used to separate accumulated sediment from filter or screen surfaces. *See also* polypig; squeegee.

screen (1) A device with openings, generally of uniform size, used to retain or remove suspended or floating solids in flowing water to prevent them from entering an intake or passing a given point in a conduit. The screening element may consist of parallel bars, rods, wires, grating, wire mesh, or perforated plate, and the openings may be of any shape, although they are usually circular or rectangular. (2) A sieving device used to segregate granular material, such as sand, crushed rock, and soil, into various sizes. *See also* surface screen; well screen.

screen chamber A chamber in which screens are installed.

screen copy device A device used to generate a small-format hard copy of a geographic information system display screen.

screened well A well into which water enters through one or more screens.

screening A pretreatment method using coarse screens to remove large debris from the water to prevent clogging of pipes or channels leading to the treatment plant and to protect pumps.

screening procedures for compliance monitoring Analytical methods developed by the US Environmental Protection Agency to be used as screening procedures in the monitoring of regulated and/or unregulated contaminants.

screenings (1) Material removed from liquids by screens. (2) Broken rock, including the dust, of a size that will pass through a given screen, depending on the character of the stone.

screenings dewatering The removal of a large part of the water content of waste screenings by draining or by mechanical means.

screenings shredder A device that shreds screenings.

screening survey contaminant A contaminant that was included on Unregulated Contaminant Monitoring Rule (UCMR) List 2. This included contaminants for which analytical methods existed or had recently been established. Monitoring of List 2 chemical contaminants occurred at small public water systems (PWSs) selected for the screening survey in 2001, and at large PWSs selected for the screening survey in 2002. Monitoring of the List 2 microbiological contaminant occurred at large and small PWSs selected for the screening survey in 2003. List 2 contaminants are 1,2-diphenylhydrazine; 2,4,6-trichlorophenol; 2,4 dichlorophenol; 2,4-dinitrophenol; 2-methylphenol; Alachlor ESA; diazinon; disulfoton; diuron; fonofos; linuron; nitrobenzene; prometon; RDX; terbufos; and *Aeromonas.*

screen size *See* mesh size. *See also* geographic information system.

screw conveyer A device that axially transports liquid–solid mixtures by means of a rotating screw-type shaft that progressively moves the mixture between the screw threads along the interface between the screw and a conveyor belt.

screwed pipe A pipe provided with threaded ends and connected by threaded couplings.

screw-feed pump A pump with either horizontal or vertical cylindrical casing, in which a runner with radial blades like those of a ship's propeller operates. *See also* horizontal screw pump; vertical screw pump.

screw impeller The helical impeller of a screw pump.

screw pump A special type of rotary positive-displacement pump in which the fluid is carried between screw threads on one or more rotors and is displaced axially as the screws rotate. Because screw pumps employ a low internal velocity, they offer a number of advantages in applications where liquid agitation is objectionable or where the specific gravity, viscosity, or both of the fluid to be pumped are relatively high.

SCS (Soil Conservation Service) *See under* Natural Resources Conservation Service.

S-curve hydrograph A graph showing the summation of the ordinates of a series of unit hydrographs

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spaced at unit rainfall duration intervals. Such a graph represents the hydrograph of a unit rate of rainfall excess indefinitely continued. If the ordinate values of an S-curve are a percentage of the total unit hydrograph volume at any given time, with the abscissa in units of time, the S-curve is known as a summation graph.

SDE *See* simultaneous distillation extraction.

SDI *See* silt density index; sludge density index.

SDS *See* simulated distribution system; sodium dodecyl sulfate.

SDS-DBP *See* simulated distribution system disinfection by-product concentration.

SDSS *See* simulated distribution system sample.

SDS-THM *See* simulated distribution system trihalomethane concentration.

SDWA *See* Safe Drinking Water Act.

SDWIS *See* Safe Drinking Water Information System.

SDWR (Secondary Drinking Water Regulation) *See under* National Secondary Drinking Water Regulation.

S. dysenteriae *See Shigella dysenteriae.*

S_e *See* standard error of the estimate.

SEA *See* size exclusion analysis.

seal Packing gland material or a mechanical device that fits around a pump shaft and prevents either air intake to the pump or water leakage.

sea level In general, the surface of the sea used as a reference for elevation; a curtailed form of the term *mean sea level.*

sea-level datum A determination of mean sea level that has been adopted as a standard datum for elevation. The sea level is subject to some variations from year to year; however, because the permanency of any datum is of prime importance in engineering work, a sea-level datum should, in general, be maintained indefinitely after adoption even though it may differ slightly from later determinations of mean sea level based on a longer series of observations. The sea level used for the US Coast and Geodetic Survey level net is officially known as the sea level datum of 1929 (the year refers to the last general adjustment of the net). The datum itself can be considered to be an approximation based on observations of the tide at various tide stations along the coasts of the United States over a number of years. *See also* mean sea level; National Geodetic Vertical Datum of 1929.

season A division of the year generally determined by some annually recurrent natural phenomenon, such as the state of vegetation or the meteorological conditions.

seasonal Related to, characteristic of, or depending on the season or seasons.

seasonal analysis Analysis of seasonal water use by a water utility. Monthly water consumption, particularly for single-family residential accounts, tends to follow a highly consistent pattern from year to year. In areas that have snowy winters, winter consumption represents indoor water use, and summer consumption in excess of winter use is primarily used for irrigation. Spring and fall consumption reflect the lower irrigation requirements during periods of moderate temperatures. Rainfall will affect water consumption primarily during summer months but also during hot weather in the spring and fall. A very useful method of quantifying the seasonal pattern of water use is to calculate a seasonal index. Most statistical programs use a moving average method to determine the seasonal influence of each month. The most frequently used method is to compute a centered 13-month moving average of the time series data that is centered on the middle, i.e., the seventh month. Because the 13 months exceed the period of a year, the seasonal or monthly pattern is removed in the average. Then each month is expressed as a ratio with respect to the moving average, and the ratios for all the January data, all February data, and so on are averaged to derive a typical index (or ratio with respect to the average) for each month. The sum of all the monthly ratios equals 12. The seasonal index can be used for seasonally adjusting water sales—removing the influence of season (by dividing actual sales by the index)—or for forecasting future monthly sales (by multiplying the moving average by the index).

seasonal application efficiency The sum of the evapotranspiration of applied water and the leaching requirement divided by total applied water; expressed as a percentage.

seasonal depletion Withdrawal of groundwater or surface water from a source at a rate in excess of the rate of supply during a given season, but not in excess of the average supply over a secular cycle. (Withdrawal at a rate in excess of the average rate of supply over a secular cycle is termed *cyclic depletion.*)

seasonal excess-use charge A charge for use above preestablished levels, used during a period or periods of peak water use. Seasonal charges attempt to match charges for water use with the higher cost of providing water for peak periods.

seasonal index *See* seasonal analysis.

seasonal rate A seasonally based water rate, with the summer rate higher than the winter rate, sometimes established either to recover the additional cost associated with peak summer water production or as an inducement for customers to conserve during the peak-use season. The summer rate can be applied to all summer water use or only for summer use in excess of winter use. The latter approach is preferred by most rate economists because it allows for a relatively large summer surcharge (e.g., to induce

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conservation) without driving down the winter rate simply to maintain annual revenues at the same level as before the change. Seasonal rates can also include an inclining block design. *See also* inclining block rate; revenue-neutral rate.

seasonal recovery The general rise of the elevation of the water table caused by the addition of water during or after the wet season. *See also* seasonal depletion.

seasonal storage Storage of water in a reservoir during that portion of the year when an excess or surplus occurs in the source of supply.

seasonal water table A water table that rises and falls substantially with the seasons as a result of either natural causes (seasonal rainfall or fluctuations in the levels of nearby rivers) or human activity (seasonal irrigation). *See also* water table.

seat The portion of a valve that the disk compresses against to achieve valve shutoff.

seawater *See* ocean water; salt water.

seawater intrusion The invasion of a body of freshwater by seawater. Both coastal surface water and groundwater can be impacted by seawater intrusion. Seawater intrusion in surface water supplies is common during drought, high-tide, or low-river-flow conditions. *See also* saline water intrusion.

SEB *See Staphyloccocal enterotoxin* B.

SEBST *See* single-element bench-scale test.

Secchi disk A circular metal plate, 8–12 inches (20–30 centimeters) in diameter, that is painted in black and white quadrants. A Secchi disk is used to measure the clarity of water and determine visible light extinction coefficients.

second (s, sec) *See in the Units of Measure section.*

secondary Pertaining to the low-voltage side of a step-down transformer. *See also* primary.

secondary carcinogen A chemical that requires metabolism to produce cancer. Generally, such chemicals are metabolized to a reactive form that interacts covalently with nucleophilic centers in deoxyribonucleic acid.

secondary containment *See* containment protection.

Secondary Drinking Water Regulation (SDWR) *See* National Secondary Drinking Water Regulation.

Secondary Drinking Water Standard *See* National Secondary Drinking Water Regulation.

secondary instrumentation Instruments that respond to and display information from primary instrumentation.

secondary interstice An opening in rock developed by processes that affected the rock after it was formed.

secondary maximum contaminant level (SMCL) A nonenforceable numerical limit set by the US Environmental Protection Agency for a contaminant on the basis of aesthetic effects to prevent an undesirable taste, odor, or appearance that would have an adverse impact on the public welfare. *See also* National Secondary Drinking Water Regulation.

secondary opening *See* secondary interstice.

secondary soil Soil developed through the action of weathering and other processes on materials, originating from previously existing soils and rock debris that have been eroded from their former locations and redeposited by the transporting agents. *See also* transported soil.

secondary treatment Level of treatment of wastewater in which biological and chemical processes are used to remove most of the organic matter and suspended solids. Disinfection is often part of secondary treatment. *See also* nonpotable water; tertiary treatment.

secondary wastewater treatment *See* secondary treatment.

second feet *See in the Units of Measure section.*

second-foot day *See in the Units of Measure section.*

section (1) A view of something as it would appear if cut through by an intersecting plane. (2) *See also in the Units of Measure section.*

sectionalizing valve A large valve installed in a pipeline to shut off flow in a section of the pipeline for the purpose of inspection or repair. Such valves are usually installed in the main pipelines.

sectional map A map that provides a detailed picture of a portion (section) of the distribution system. It reveals the locations and valving of existing mains, locations of fire hydrants, and locations of active service lines.

Section 7 Endangered Species Act (ESA) consultation A requirement of the Endangered Species Act that all federal agencies must consult with the National Marine Fisheries Service for marine and anadromus species, or the US Fish and Wildlife Service for freshwater and wildlife, if they are proposing an "action" that may affect listed species or their designated habitat. *Action* is defined broadly to include funding, permitting, and other regulatory actions. For local governments, any project that requires a federal permit or receives federal funding is subject to Section 7. Each federal agency is to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

sector gate A roller type of crest gate in which the roller is constructed as a sector of a cylinder instead of as a complete cylinder (i.e., the roller has a cross section that resembles a piece of pie).

secular cycle A period of time that includes a group of years during which the precipitation is, in general, considerably greater than average, as well as a group

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of years during which it is, in general, considerably less than average.

Security and Emergency Management System (SEMS) Designed for water utilities serving fewer than 10,000 people, a software program that can be used to generate a vulnerability assessment and has the added feature of automatically generating an emergency response plan based on vulnerability assessment answers.

Security Self-Assessment Guide for Small Systems Serving Between 3,300 and 10,000 A vulnerability assessment guide targeted at small community drinking water systems to help complete vulnerability assessments required under the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (Bioterrorism Act). *See also* Public Health Security and Bioterrorism Preparedness and Response Act of 2002.

sedentary soil Soil formed in place without removal from the site of the original rock from which it was formed. Sedentary soil is also called residual soil.

Sedgwick–Rafter cell A special microscope cell used in the Sedgwick–Rafter method. It is about 50 millimeters long, 20 millimeters wide, and 1 millimeter deep. It holds 1 milliliter of sample to allow counting of the organisms. *See also* Sedgwick–Rafter filter; Sedgwick–Rafter method.

Sedgwick–Rafter filter A cylindrical funnel used as a filter for concentrating organisms in the Sedgwick–Rafter method for the quantitative determination of organisms that are microscopic but larger than bacteria in water. *See also* Sedgwick–Rafter method.

Sedgwick–Rafter method A method for the quantitative determination of organisms in water that are microscopic but larger than bacteria. This method involves a low-magnification (less than 200 times) microscopic examination of water. A Sedgwick–Rafter cell is often used in the quantification of phytoplankton in water. *See also* Sedgwick–Rafter cell; Sedgwick–Rafter filter.

sediment (1) Solid material settled from suspension in a liquid. (2) Mineral or organic solid material that is being transported or has been moved from its site of origin by air, water, or ice and has come to rest on the ground surface either above or below sea level. (3) Inorganic or organic particles originating from weathering, chemical precipitation, or biological activity. (4) Any solid-phase settling out of a liquid phase, e.g., deposits in rivers and lakes or sludge in clarifiers.

sedimentary rock Consolidated rock formed from material that was either deposited in layers from suspension or precipitated from solution.

sedimentation A treatment process using gravity to remove suspended particles.

sedimentation basin A basin or tank in which water is retained to allow settleable matter, such as floc, to settle by gravity. A sedimentation basin is also called a settling basin, settling tank, settler, or sedimentation tank.

sedimentation compartment That portion of a water treatment tank used as a settling tank; the settling section of a chemical flocculation and sedimentation unit.

sedimentation sludge The material produced as a result of adding a coagulant such as alum, ferric, or polymer to a raw water, and subsequent coagulation and sedimentation. Sedimentation sludge contains the hydrolyzed floc formed by coagulant's reaction with the raw water and the particulate matter removed by the process. It is also called clarifier sludge. *See also* sludge.

sedimentation tank *See* sedimentation basin.

sedimentation test A test in which a soil sample and a jar of water are used to determine the soil's composition and characteristics for excavations.

sediment concentration The ratio of the weight of the sediment in a water–sediment mixture to the total weight of the mixture. The sediment concentration is sometimes expressed as the ratio of the volume of sediment to the volume of mixture. It is dimensionless and is usually expressed as a percentage for high values of concentration and in parts per million for low values.

sediment discharge Usually the mass, but sometimes the volume, of sediment passing a stream transect in a unit of time.

sediment discharge curve A graphical presentation of the relationship between the stage of a river and the sediment discharge.

sediment erosion Detachment of sediment particles by water, wind, ice, or gravity.

sediment load The quantity of sediment that passes a cross section of a stream or river in a specified period of time.

sediment source area That area of a drainage basin that yields a large amount of eroded material.

sediment station A river section where samples of suspended load are taken either each day or periodically.

sediment transport curve A graph showing the relationship between the water discharge, in cubic feet (meters) per second, and the amount of sediment in transport in a stream channel, in tons (kilograms) per day.

sediment trap A device, often a simple enlargement in cross-sectional area, placed in a conduit to arrest, by deposition, the sand or silt carried by the water. A sediment trap usually includes a means for ejecting

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the settled material. A sediment trap is also called a sand trap. *See also* sand trap.

sediment yield The total amount of suspended sediment and bed load outflow from a drainage basin, usually expressed in terms of mass or volume per unit time.

SEDMOD *See* spatially explicit delivery model.

seep (1) A more or less poorly defined area where water oozes from the earth in small quantities. (2) To appear or disappear, as water or other liquid, from a poorly defined area of the ground surface. (3) *See also* seepage.

seepage The slow movement of water or other fluid downward through unsaturated soil, rocks, artificial structures, or other porous media. It is to be distinguished from percolation, which is the predominant type of movement of water in saturated material.

seepage area An area where discharged groundwater appears at the ground surface, often a sizable area. Water in seepage areas may pond and begin to move as a current of flowing water.

seepage boil A concentrated outcropping of seepage landward of a levee or downstream of a dam.

seepage face The rock or soil face at which a seepage area occurs.

seepage spring A spring in which the water discharges from numerous small openings in permeable material. A seepage spring is also called a filtration spring.

seepage velocity The velocity of water flowing in a porous medium, obtained by dividing the total discharge by the product of the cross-sectional area and porosity. *See also* actual groundwater velocity; pore velocity.

seep water Water that has passed through or under a levee or dam.

segmental degeneration A neuropathologic condition characterized by loss of myelin from neurons (nerve cells) but with the axon (the portion of the nerve that carries electrical signals away from the cell body of a nerve) largely spared.

segmented transition In uniform communications architecture, a strategy used by a utility when it has a strong economic incentive to add a new high-level automated system to one specific area.

seiche An oscillation of the water surface of a lake or other large landlocked body of water as a result of unequal atmospheric pressure, wind, or other cause that sets the surface in vibration. The amplitude of the oscillation may be 1 foot (30 centimeters) or more, and the period may reach several hours. *See also* storm surge.

seize-up A mechanical condition that occurs when an engine overheats and a part expands to the point where the engine will not run. Seize-up is also called freezing.

select backfill Backfill material of a specified quality, often imported from a different location to meet a particular specification.

selected ion monitoring The operation of a mass spectrometer in which the intensities of several specific ion beams are recorded rather than the entire mass spectrum.

selection bias In epidemiology, systematic error caused by differences in characteristics among those selected for study. Selection bias occurs only as a result of poor study design, and it must be prevented because it cannot be controlled during the analysis. Preventing selection bias requires exposed and unexposed groups to be selected by the investigator without knowledge of disease, or cases and controls must be selected without knowledge of exposure.

selective adsorption A method used in gas chromatography to separate organic compounds so that their concentrations can be determined.

selective ion electrode A device used in the electrochemical analysis of specific ions in solution. For example, pH (i.e., hydrogen ion), fluoride, and calcium can be determined in water by the use of electrodes designed for the particular ion.

selective ion exchanger An ion-exchange medium that shows selectivity, e.g., a chelating ion-exchange resin that will remove only gold ions from solution. *See also* selectivity.

selective ion probe *See* selective ion electrode.

selective mass analysis A technique using an ion trap detector in mass spectrometry where ions are confined in a radio-frequency field and then ejected in a detector in a controlled way such that scanning on the basis of mass-to-charge ratio is possible. *See also* ion trap detector.

selective media Microbiological media that inhibit the growth of specific microorganisms, allowing certain other microorganisms to proliferate.

selective membrane A sheet of material that is preferentially selective to the passage of either cations or anions in solution.

selective toxicity Adverse effects that apply to specific organisms. This concept has been used in the development of various pesticides and drugs to disrupt metabolic pathways so as to render the target organism uniquely sensitive to the substance's toxic effects. For example, penicillin displays selective toxicity to bacteria because it inhibits the synthesis of the cell wall; animals do not synthesize cell walls, so penicillin is not toxic to animals.

selectivity (1) The relative capacity of an ion-exchange resin to remove different ions of similar charge (i.e.,

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co-ions). (2) For pressure-driven membrane processes, the relative permeability of a solute through the membrane. (3) The ability of an analytical test method for a microorganism to encourage growth of the target organism while retarding the development of nontarget organisms.

selectivity band The respective region or zone within an ion exchanger or adsorption medium bed where individual ions or substances accumulate and are removed from the water in the order of their individual respective preferences for the medium. Because different substances each have different affinities or selectivity preferences for the treatment medium, they are removed in different zones of the medium bed. The removal zone for the ion or substance with the lowest selectivity moves downward through the bed most quickly, and the zone for the highest selectivity substance moves downward through the bed least quickly. *See also* chromatographic behavior; mass transfer zone; selectivity.

selenite broth A selective enrichment medium used for the growth–isolation of *Salmonella.* It is very inhibitory for most Enterobacteriaceae.

selenium (Se) A nonmetallic element that occurs in certain soils. This inorganic chemical has various industrial uses, including in electronics and as a trace element in animal feed. Selenium is regulated in drinking water by the US Environmental Protection Agency at a maximum contaminant level of 0.05 milligrams per liter.

self-backwashing filter A filter whose hydraulic design allows backwashing with the filtered water from operating filters without pumping. Filtered water effluent weirs are located at an elevation higher than the surface of the backwash gullet, allowing the filtered water to flow upward through the filter being backwashed by gravity. *See also* gullet.

self-cleansing velocity The minimum velocity in a water supply intake necessary to keep solids in suspension, thereby preventing them from depositing and from subsequently creating a nuisance in the form of stoppages.

self-closing faucet A faucet that automatically shuts off water flow after a designated amount of time, usually seconds.

self-contained breathing apparatus (SCBA) A full-face respirator connected to a tank that contains a 30- or 60-minute air supply of grade D air. *See also* grade D air.

self-insured Risk management strategy whereby management of an organization agrees to assume all replacement costs or repairs of structures in the event that they are destroyed or damaged. Cost savings are realized if the avoided cost of the premiums of insurance to an outside organization is greater than the cost of actual replacement or repair. *See also* risk management.

self-limiting Limiting itself, as in a disease that clears without treatment.

self-maintaining system An ecosystem that can perform all of its natural ecological functions without human intervention or dependence on engineered structures.

self-regulation The regulatory paradigm whereby an industry or facility ensures compliance with best practices and best technology, or applies other means to meet an expected standard of performance, without enactment of a formal regulation or regulatory requirement.

seltzer water *See* bottled sparkling water; soda water.

SEM *See* scanning electron microscope.

SEMI *See* Semiconductor Equipment and Materials International.

semiarid Neither entirely arid nor strictly humid, but intermediate, with a tendency toward an arid character. This term may be applied to dry farming country in which many crops grow without irrigation, but in which far better yields result from irrigation. *See also* semihumid.

semiarid climate A climate characterized by 10 to 20 inches (25 to 50 centimeters) of annual rainfall.

semiautomatic control A form of system control equipment in which many actions are taken automatically but some situations require human intervention.

semibatch reactor A reactor in which one of the reactants is added continuously but the other component was added in the initial batch of water. For example, in a semibatch ozone reactor, ozone (O_3) is continuously added to a static volume of liquid.

semibolson A topographic basin that has an inward-flowing drainage system, is more or less longitudinal in shape, and is drained by an intermittent stream.

semiconductor A material that can be easily forced to carry electricity only under certain circumstances. Semiconductors are the foundation of modern electronics.

Semiconductor Equipment and Materials International (SEMI) An association that represents the microelectronic, display, and photovoltaic industries. It has set the accepted standards for electronics-grade purified water.

semiconfined aquifer *See* leaky aquifer.

semidiurnal Having a duration of approximately one half of a tidal day. The predominating type of tide throughout the world is semidiurnal, with two high waters and two low waters each tidal day.

semihumid Neither entirely arid nor strictly humid, but intermediate, with a tendency toward a humid

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character. Sufficient moisture to raise all crops may be present, but irregularity of precipitation during the year makes providing irrigation facilities essential to raising better crops. *See also* semiarid.

semihydraulic-fill dam An earth dam for which, during construction, some of the material was transported to the dam by some means other than water and some of it was moved into place by the action of water.

semimechanistic model Predictive model for future outcomes that combines aspects of both mechanistic and empirical models. Mechanistic models are generally used for predicting the results of reactions that are well known and can be described by first order rate equations. Other reactions remain largely unknown and so are modeled empirically based on experimental observations. *See also* empirical equation; mechanistic equation.

seminal vesicle A structure that secretes seminal fluid, the fluid that provides nutrients to sperm and serves as a carrier for sperm upon ejaculation.

semiperched Pertaining to an overlying body of groundwater that has a greater pressure head than an underlying body of water but is not separated from the underlying body by unsaturated rock.

semiperched water Groundwater that has a greater pressure head than an underlying body of groundwater from which the first type of groundwater is not completely separated hydraulically. Semiperched water can occur in layered aquifer systems where an upper aquifer is in contact with a lower aquifer and the lower aquifer has less water pressure than the upper aquifer. In such cases, the upper aquifer is said to be semiperched. The upper aquifer can have greater water pressure because its net recharge exceeds that of the lower aquifer. *See also* semiperched water table.

semiperched water table The upper surface of a body of semiperched water. This is the water table of the hydraulically connected underlying water, too. *See also* semiperched water.

semipermanent snow line The line of lowest elevation or the lower limit of a snow field at any locality on the ground surface above which snow accumulates and remains on the ground continuously for a considerable portion of the year.

semipermeable membrane *See* permselective membrane.

semivariable costs Those water utility costs that are not completely fixed with respect to treated water volume but that do not vary directly with volume, either. Examples are indirect labor, overtime premiums, portions of chemical and energy costs, and costs that are reassigned to meet peak demands. In the short run, most of the costs of operating and maintaining a water utility are fixed; i.e., they do not vary with the volume of water produced. Examples are facility rent or debt service, leases, insurance, supplies, and so forth. In most utilities, labor is also a fixed (or programmed) cost for a given scope of work. A few costs vary directly with volume, such as some chemicals and some pumping power costs. *See also* long-run average cost.

SEMS *See* Security and Emergency Management System.

senescent Having aged or grown old, in a physiological sense. This term is used to describe the aging process of cells or whole organisms.

sensitive subpopulation A population that is at increased risk of some adverse health event or outcome after exposure to a contaminant in drinking water, compared to the general population.

sensitivity (1) The smallest amount of a chemical or microorganism that can be discriminated from a blank value with a specified degree of reliability. (2) The responsiveness of an organ or organism to external stimuli. (3) In analytical testing, the lowest practical detection level (not necessarily the minimum detection level). (4) In terms of a test method for a microorganism, the likelihood that the test result will be positive when the target organism is present. (5) The capacity of a detector to respond to a class of compounds or a specific analyte. In some methods, sensitivity is defined as the concentration of an analyte that produces a specific detector response. *See also* limit of detection; limit of quantitation; method detection limit; practical quantitation level.

sensitivity analysis An analysis of the sensitivity of the dependent variable in a mathematical expression as a function of variations in the value of any independent variables or coefficients associated with the independent variables. For example, in the expression $Y = ax_1 + bx_2$, a sensitivity analysis would determine how much the value of Y is affected by changes in the values of a and b or by changes in the values of x_1 and x_2. In hydraulics, a sensitivity analysis might be conducted to determine the effect of small changes in the assumed values for known heads, consumptions, and pipe or pump characteristics on a hydraulic model's solutions.

sensitivity control A measure of the smallest change in input that a device can detect and react to.

sensitivity level The lowest concentration that can be detected and quantified by a test method. *See also* limit of detection; limit of quantitation; method detection limit; practical quantitation level; sensitivity.

sensitization The initial exposure of an individual to an antigen. This exposure stimulates the synthesis of antibodies that will precipitate an immune response with subsequent exposures. This term is most

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frequently applied to circumstances in which the secondary exposure leads to hypersensitivity reactions. Sensitization also appears to be involved in autoimmune disorders that appear after chronic exposures to certain toxic chemicals.

sensor An instrument that measures (senses) a physical condition or variable of interest. Floats and thermocouples are examples of sensors. A sensor is also called a primary element.

separation line In a solids-contact unit, the interface of the clarified liquid and the sludge blanket.

separation process An operation—possibly including more than one unit process—in which the various components of a mixture are isolated. Some important separation processes are evaporation, distillation, drying, gas adsorption, sedimentation, solvent extraction, pressure extraction, adsorption, and filtration.

separation technique Any of a variety of analytical and preparatory techniques for the purpose of distinguishing between solutes or solvent. Extraction, chromatography, and distillation are three examples of separation techniques.

separator In desalting, a device designed to remove entrapped droplets from a vapor stream. A separator is also called a demister entrainment unit. *See also* spacer.

sepralator A spiral-wound membrane element or cartridge used in crossflow membrane systems.

sepsis The presence of pathogenic organisms or their toxins in the blood or tissues.

septage The liquid and semisolid contents removed by pumping from a septic tank.

septic Pertaining to a condition produced by bacteria in water when all oxygen supplies are depleted. If this condition is severe in a body of water, the bottom deposits produce hydrogen sulfide (H_2S), the deposits and water turn black and give off foul odors, and the water will have a greatly increased chlorine demand.

septicemia A systemic disease associated with the presence and persistence of pathogens or their toxins in the blood.

septicity A condition characterized by growth of anaerobic organisms.

septic system An on-site system designed to treat and dispose of domestic wastewater. A typical septic system consists of a tank that receives wastes from a residence or business and a system of tile lines or a pit for disposal of the liquid effluent that remains after the solids settle out in the tank.

septic tank A tank (usually underground) into which the solid matter of household wastewater flows and is held to settle and for some degree of decomposition by bacteria. Septic tanks are common in rural areas where no municipal wastewater system is available. A proper septic tank facility must also include an adequate tile field for disposal of the liquid. *See also* tile field.

septum (1) Any permeable material that supports filter media. (2) The lining of a bottle cap that can be pierced to draw a sample. (3) The covering on an inlet port to a chromatograph or other piece of analytical equipment that can be pierced to inject a sample.

sequent depths The depths before and after a hydraulic jump. Sequent depths are also called conjugate depths.

sequential composite sample A sample obtained either by continuously pumping water from the liquid stream being sampled or by mixing equal volumes of water collected from the liquid stream being sampled at regular time intervals.

sequential control Process control implemented via a series of discrete steps.

sequential disinfection Treatment of a process stream using separate, consecutive processes to achieve microbial inactivation goals. For example, a period of free chlorine contact followed by chloramine treatment, or ultraviolet treatment followed by free chlorine disinfection.

sequential inactivation *See* sequential disinfection.

sequential inactivation kinetics The dynamics and rates at which organisms are rendered nonviable or noninfectious following the application of two or more types of disinfection or treatment in sequence.

sequester To keep a substance (e.g., iron or manganese) in solution through the addition of a chemical agent (e.g., sodium hexametaphosphate) that forms chemical complexes with the substance. In the sequestered form, the substance cannot be oxidized into a particulate form that will deposit on or stain fixtures. Sequestering chemicals are aggressive compounds with respect to metals, and they may dissolve precipitated metals or corrode metallic pipe materials. *See also* complexation; hexametaphosphate; sodium hexametaphosphate.

sequestering A chemical reaction in which certain chemicals (sequestering or chelating agents) "tie up" other chemicals, particularly metal ions, so that the chemicals no longer react. Sequestering agents are used to prevent the formation of precipitates or other compounds.

sequestering agent (1) A chemical that forms complexes with metallic ions in solution so that the metallic ions may no longer be precipitated. For example, calcium soap precipitates are not produced from hard water treated with sodium hexametaphosphate. (2) Any agent that prevents an ion from exhibiting its usual properties because of close combination with an added

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material. *See also* hexametaphosphate; sequester; sodium hexametaphosphate.

sequestration *See* sequestering.

serial correlation A statistical condition in which errors for different periods of time series data are correlated. Serial correlation is very common in time series analyses, such as those dealing with monthly water consumption. A tendency exists for errors (residuals) in one period to be correlated with errors in preceding periods. If these patterns are predictable (i.e., if they can be defined with a regression coefficient just like any other explanatory variable), then a coefficient should be determined for the serial correlation effect because including that coefficient will make the coefficients of the other independent variables more true to their actual causal influences. The standard test used to determine whether serial correlation exists in a time series is the Durbin–Watson test. The computed value of the Durbin–Watson test can range from 0, indicating extreme positive serial correlation, to 4.0, indicating extreme negative serial correlation. A Durbin–Watson value of 2.0 indicates no serial correlation. Generally, it is desirable for the Durbin–Watson value to be within a range of 1.7 to 2.3. The effect of serial correlation is usually demonstrated either by including the dependent variable as an independent variable lagged by one or more periods or by including an autoregressive variable as an independent variable. *See also* autocorrelation; autoregressive term; Durbin–Watson test.

serial filtration The arrangement of two or more filtering steps, one following the other, in order to remove increasingly finer particulates at each stage and to provide for filtration of all sizes of suspended solids. Cartridge-style units often employ this method, using depth prefilters (compressed fibers) followed by surface filtration with a micromembrane cartridge element.

series-parallel reducible network A system used in distribution flow analysis similar to electrical current analysis to model distribution flows for design purposes. *See also* Hardy Cross method; Hazen–Williams formula; pipeline network analyzer.

series resistance Restrictions that are in line with each other that decrease flow. This is also applicable in electrical energy.

serious violation An Occupational Safety and Health Administration's classification assigned to a workplace hazard that is deemed dangerous to a worker's well-being.

seroepidemiologic study A study based on serological testing of a change in the serum level of specific antibodies. Through such a study, asymptomatic infections and carriers can be detected in addition to clinical cases.

serological group Related organisms distinguished by their antigenic properties.

serological typing *See* serotype analysis.

serology The medical science that deals with serums. Serums are clear, yellowish fluids obtained by separating whole blood into its solid and liquid components; the fluid from the tissues of immunized animals, used especially as an antitoxin; and watery fluid from animal tissue, such as that found in edema.

serotype analysis An analysis in which microorganisms can be identified based on serological procedures that detect the presence of specific characteristic antigens. Such an analysis can be performed for any microorganism for which specific antibodies can be produced. Serotype analysis is used to identify particular groups within a large group of closely related organisms, such as bacteria in the genus *Salmonella.*

serotyping A method of identifying microorganisms using serological procedures that detect the presence of specific characteristic antigens.

serpentine flow A back-and-forth pattern used in disinfection or chlorine contact basins for water and wastewater treatment and also in some flocculation basins. Serpentine flow basins, properly designed, can attain a very close approximation to plug flow. *See also* end-around baffles.

Serratia Genus of enteric bacteria that are *ortho*-nitrophenyl-β-D-galactopyranoside- and Vogues Proskauer-positive, oxidase-negative, gram-negative bacilli. Found in the environment and present in the gastrointestinal tract of both humans and animals, they are mainly responsible for nosocomial infections.

Sertoli cell A cell that mechanically supports developing spermatids and is thought to be involved in providing metabolic signals that trigger critical steps in the development of sperm.

serum The aqueous phase remaining in a blood sample following clotting. *See also* plasma; plasma water.

Servais method A method for evaluating the biologic stability of drinking water. The principal steps are sterilization of a sample of water, inoculation thereof by an autochthonous bacterial population, and measurement of the reduced concentration of the degraded organic carbon during the incubation period, caused by oxidation of the organic carbon by heterotrophic bacteria. This method may be used to evaluate water samples taken from source water, from different stages of water treatment, and from distribution systems.

server A computer or a device attached to a network that manages network resources for all users on the network. Servers may perform narrowly limited functions or may be able to execute numerous

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programs simultaneously. Common examples of servers include file servers that provide common information and database capabilities to users on the network, as well as print servers that allow multiple users to share printers and reduce overall costs. Other examples include Web servers, fax servers, list and mail servers, news servers, and so on.

service The small water line—including such components as the meter, corporation stop, curb stop, and meter couplings—that allows the movement of water from a water main to or into a building.

service age The period of time between the date when a new physical unit of property was put into service and the date when the physical unit is studied for decommissioning or rehabilitation. *See also* service life.

service area The geographic area served by a water utility's distribution system.

service box A valve box used with a corporation cock or curb cock.

service charge A fixed monthly charge that most utilities incorporate as part of their rate structures. This charge is intended to recover the costs of meter reading and servicing, accounting, billing and collection, customer service, and any other costs that the utility believes are directly related to the customer, as contrasted with the costs of producing and distributing water. Service charges are almost always allocated based on meter size or number of equivalent meters. Sometimes monthly service charges are added to the cost to provide service by water consumption block and are then identified as a fixed monthly minimum charge or a standby charge. *See also* base–extra-capacity approach to rate structure design.

service clamp (1) A clamp used to repair a pinhole or leak on a service line. (2) A full-circle repair clamp with an outlet tap for a corporation stop, used for repairing a leak on a water line near a service connection.

service connection That portion of the service line from the utility's water main to and including the curb stop at or adjacent to the street line or the customer's property line, including valves and fittings but not the curb box.

service factor A number less than or equal to 1.0 that takes into consideration the variables and degree of safety involved in a design. The service design factor is multiplied by test values to obtain design allowables. It is the reciprocal of design factor.

service flow The rate at which a given water-processing system can deliver product water, expressed in gallons (liters) per minute. The rating may be for intermittent peak flow or constant flow.

service life The period of time between the date when a new physical unit of property was first put into service as a part of the property and the date when the unit was retired, or is anticipated to be retired, from service. *See also* service age.

service line The pipe and all appurtenances that run between the utility's water main and the customer's place of use, including fire lines.

service line sample A 1-liter sample of water that has been collected in accordance with Section 141.86(b)(3) of the *Code of Federal Regulations* and was standing for at least 6 hours in a service line prior to sampling.

service meter A water meter installed on a consumer's service line.

service outlet A device for releasing water at a dam for downstream uses.

service pipe The pipeline extending from the water main to the building served or to the consumer's system.

service pipeline *See* water service pipe.

service protection *See* containment protection.

service reservoir A reservoir supplying a given district and capable of storing water during hours of low demand for use when demands exceed the capacity of the treatment plant(s) providing water to the district.

service run That portion of the operating cycle of a water-processing system during which the water is actually being treated. The other portion of the cycle is regeneration or cleaning. For example, that portion of the cycle in which the hard water supply is passed through a regenerated and rinsed bed of ion-exchange material, thereby producing softened water, is a service run.

service unit Typically, a portable exchange tank. *See also* portable exchange tank.

sessile Pertaining to animals (e.g., Asiatic clams) that live attached to a substratum, such as the shell of another animal or a rock.

set The direction of a current of water.

***S*-ethyl-di-*N*,*N*-propylthiocarbamate**
See under ethyl-di-*N*,*N*-propylthiocarbamate.

set point The position at which a process controller is set. The set point is the same as the desired value of the process variable.

set-point operation A method of controlling ultraviolet (UV) reactors that uses validated reactors that operate within acceptable flow ranges, without control of lamp intensity output. The validation determines a minimum UV irradiance sensor set point that must be maintained to ensure adequate dose delivery. It is also called flow-based method.

setting A point or instruction for a controller, operator, or transmitter at which an action is to occur or specific rate is to be maintained. Examples include a fully open or closed valve position that triggers a limit switch to stop the travel of a valve operator; a level in a tank that causes a pump to come on or turn off; or a

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chemical feed rate to be maintained at a certain flow of water. The setting may be fixed or variable based on changing conditions, such as the positions of a valve based on a certain flow rate through the valve.

setting tee *See* hydrant tee.

settleability The tendency of suspended solids to settle.

settleability test A determination of the settleability of solids in a suspension by measuring the volume of solids settled out of a measured volume of sample in a specified interval of time, usually reported in milliliters per liter.

settleable solids The material settling out of a suspension within a defined period of time. *See also* settleability test.

settling *See* sedimentation.

settling basin *See* sedimentation basin.

settling chamber A chamber in which water containing settleable solids is retained to allow a part of the suspended matter to be removed by gravity, e.g., the settling portion of a combination flocculating–settling tank. *See also* sedimentation basin.

settling solids Solids that settle in a tank or chamber constructed for the purpose of removing this fraction of suspended solids. *See also* settleable solids.

settling tank *See* sedimentation basin.

settling time The time necessary for the removal of suspended or colloidal substances by gravitational settling, aggregation, or precipitation.

settling tube (1) A tall, vertical, transparent tube used to simulate the settling behavior of aqueous suspensions of particulates in the full-scale settling tanks used in water treatment. (2) An inclined tube placed in a settling tank (as part of a bank of such tubes) to improve solid–liquid separation. *See also* tube settler.

settling velocity The velocity at which subsidence and deposition of the settleable suspended solids in water will occur. *See also* standard fall velocity; Stokes's law.

settling zone The zone in a sedimentation basin that provides a calm area so that the suspended matter can settle.

severity rate *See* incident rate.

sewage *See* wastewater.

sewage treatment plant (STP) *See* wastewater treatment plant.

sewer An underground system of conduits (pipes and/or tunnels) that collects and transports wastewaters or runoff, or both. Gravity sewers carry free-flowing liquids; pressurized sewers carry pumped wastewaters under pressure.

sewerage system The network of sewers that carries wastewater from point of origin to point of treatment.

sex pili Thin filaments consisting of two protein fibers protruding from the surface of gram-negative bacteria.

SFBW *See* spent filter backwash water.

SFC *See* supercritical fluid chromatography.

SFE *See* supercritical fluid extraction.

shading A physical method for controlling aquatic plants by limiting the amount of sunlight reaching the bottom of the water body.

shaft A cylindrical piece of metal connected to rotating machine parts to transmit power or motion for such equipment as an electric motor or centrifugal pump.

shaft bearing Corrosion-resistant bearing that fits around the shaft on a butterfly valve to reduce friction when the shaft turns.

shaft spillway *See* glory-hole spillway.

shale A fissile rock formed by the consolidation of clay, mud, or silt. Shale has a finely laminated or stratified structure and is composed of minerals essentially unaltered since deposition.

shallow-depth sedimentation A modification of the traditional sedimentation process using inclined tubes or plates to reduce the distance the settling particles have to travel to be removed. *See also* inclined plate settler; tube settler.

shallow injection well (Class V) underground injection rule A US Environmental Protection Agency rule promulgated December 7, 1999 (64 FR 68546-68573), setting requirements for large-capacity cesspools and motor vehicle waste disposal wells, two types of Class V wells. New and existing large-capacity cesspools and new motor vehicle waste disposal wells were banned nationwide. Existing motor vehicle waste disposal wells were banned in groundwater protection areas and other state-designated sensitive groundwater areas. However, owners and operators of existing motor vehicle waste disposal wells could seek waivers from the ban and apply for permits that would allow them to continue operating their wells, provided the waste meets drinking water standards at the point of injection.

shallow-water deposit A deposit on the bed of the ocean made in water of a depth of about 100 fathoms (600 feet; 300 meters) or less.

shallow well A well sunk in easily penetrated ground to a point that is below the water table but usually less than about 30 feet (10 meters) in depth.

sharp-crested weir A weir having a crest—usually consisting of a thin plate (generally metal)—so sharp that the edge over which the water passes is only a line.

sharp-edged orifice An orifice with sharp edges, such that the water passing through touches only the line of the edge. Such an orifice is also called a standard orifice.

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sharps Objects that can puncture or cut the skin, such as needles, glassware, and scalpels, and that have come in contact with bodily fluids in laboratory, dental, or medical settings.

shear forces Forces acting on floc and particles attached to filter media grains. Flocs and particles that are attached to filter media grains in an operating filter are able to withstand the existing shear forces that would tear them away from the filter grains at that moment. However, if the interstitial velocity within the filter bed is increased, the shear forces increase, and the previously attached flocs may be detached from the filter grains. Shear forces increase when the rate of filtration is increased and as the pores of the filter bed are filled with flocs, leaving a smaller cross-sectional area for water flow and, thus, increasing the interstitial velocity.

shear gate A pivoted gate, without guides, that is closed by water pressure and seating lugs that force the gate against a seat. This type of gate closes in one direction only and is generally used on drain outlet pipes.

shearing action The action of water flowing at high rates that splits and separates particle agglomerations and prevents the formation of floc deposits during the coagulant feed and filtration process. This action may also tear away from the filter grains any previous deposits or suspended matter.

shear stress Component of the stress field that is applied tangentially to the face of a material, and so creates angular distortion.

shear vane *See* vane shear.

sheet erosion The gradual uniform removal of a section of ground surface without the formation of rills or gullies. This type of erosion may occur when water flows in a sheet down a sloping surface and removes material from the surface.

sheet flow Flow in a relatively thin sheet of generally uniform thickness.

sheeting *See* sheet piling.

sheet pile A structural element of timber, concrete, or steel of rectangular sheet shape rather than circular or square that is driven, jetted, or otherwise embedded on end into the ground to support a load or compact the soil.

sheet piling The portion of a shoring system that keeps the earth in place.

shellfish Any aquatic animal with a shell, as a shelled mollusk or crustacean, especially an edible one, such as a clam, lobster, or shrimp.

shell pump *See* sand pump.

shelter (1) A small housing providing protection against the elements. (2) A louvered box having openings on all sides and bottom to permit free flow of air and fitted with instruments to measure some condition, such as temperature, humidity, or air quality.

Sherwood number (N_{Sh}) The ratio of the actual mass transfer across the water boundary (as measured by the mass transfer coefficient) to the theoretical mass transfer across the water boundary (as calculated by the diffusion coefficient), divided by the thickness of the liquid film. In equation form,

$$N_{Sh} = \frac{k_L}{D \times d}$$

Where:

N_{Sh} = the Sherwood number, dimensionless
k_L = the mass transfer coefficient across the liquid boundary, in length per time
D = the diffusion coefficient, in length squared per time
d = the thickness of the "stagnant" water boundary, in length

Ideally, the Sherwood number should be 1, but 1.5 is more common.

Shewhart control chart A process control chart used to illustrate statistical quality control. The concept was developed in the 1930s by Walter A. Shewhart. Although these graphs can be of several varieties, a typical Shewhart chart is a plot of a series of replicated measurements compared with a mean value and control limits.

shield A structure built on-site in accordance with Occupational Safety and Health Administration's No. 1926.650 excavation standard or by manufacturers that specialize in excavation safety systems. Shields are able to withstand the forces that are imposed by the surrounding earth to prevent cave-ins and thereby protect workers.

shielding (1) The separation and insulation of metal parts of a pipe joint by means of a special fitting that will not conduct electric current. The fitting prevents corrosion caused by galvanic action between two different metals. (2) A protective cover or barrier that prevents transmittance of heat or radiation to or from a component of water treatment equipment.

shield system *See* shield.

Shigella A genus of gram-negative, nonmotile, nonspore-forming, rod-shaped, facultatively anaerobic bacteria belonging to the family Enterobacteriaceae. Commonly found in water contaminated with human or primate fecal material, these organisms cause bacillary dysentery. *See also* waterborne disease.

Shigella dysenteriae (S. dysenteriae) Specific species of *Shigella* causing gastroenteritis in humans. Symptoms include abdominal pain; cramps; diarrhea; fever; vomiting; and blood, pus, or mucus in stools.

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Shigella sonnei (S. sonnei) A bacterial species that causes dysentery. This species may be waterborne and is characterized by slow lactose fermentation. *See also Shigella;* waterborne disease.

shigellosis An acute enteric disease characterized by diarrhea, fever, nausea, and sometimes vomiting, cramps, and tenesmus (urge to defecate). Although some cases have watery diarrhea, typically stools contain blood and mucus. The infectious dose of the bacteria responsible is low for humans; 10–100 bacteria are known to have caused disease. In outbreaks, secondary attack rates can be as high as 40 percent. The only significant reservoir of the pathogen is people. Mild and asymptomatic infections occur, and illness is usually self-limiting, lasting 4 to 7 days. The illness can also be severe; the severity of illness and the case fatality rate depend on age and nutrition of host and *Shigella* serotype. *Shigella sonnei* and *Shigella fexneri* are frequently identified as etiologic agents for waterborne outbreaks in the United States; occasionally *Shigella boydii* is identified. *Shigella dysenteriae* accounts for most isolates from developing countries and is often associated with serious illness; case fatality rates are as high as 20 percent. Worldwide, 600,000 deaths are estimated per year to be caused by shigellosis, primarily in children under 10 years of age. *See also* waterborne disease.

shim A thin steel plate, sometimes wedge-shaped, used to level pumps and motors by raising the base or feet.

Shipek sampler A device used to collect samples of the top layer of bottom sediments that are undisturbed.

shock load The arrival at a water treatment plant of source water containing unusual amounts of algae, colloidal matter, color, suspended solids, turbidity, or other pollutants.

shooting flow Flow with a mean velocity greater than the critical velocity and depth less than critical depth. For this type of flow, the Froude number is greater than 1 and the velocity is greater than the speed of a gravity wave. Shooting flow is also called supercritical flow. *See also* Froude number; gravity wave.

shore The land bordering any body of water. This term is sometimes used to represent the bank of a stream.

shoreline The line along which the land surface meets the water surface of a lake, sea, or ocean. Strictly speaking, it is not a line but rather a narrow strip or area embracing that part of the land surface that comes in contact with wave action both above and below the surface of the water. The term does not apply on tidal flats or marshes that are inundated by the tides; it applies essentially to strips where the land surface has an appreciable slope toward the water. *See also* coastline.

shoring A mechanical, metal hydraulic or timber system that is able to withstand the forces that are imposed by the surrounding earth to prevent cave-ins and thereby protect workers. A shoring system is composed of wales, sheeting, cleats, uprights, and crossbraces. *See also* metal hydraulic shoring system; timber shoring system.

shoring jack A hydraulic jack that is placed between sheeting and extended to brace against the faces of an excavation to prevent cave-ins.

shoring system *See* shoring.

short circuit *See* short-circuiting.

short-circuiting A hydraulic condition in a basin in which the actual flow time of water through the basin is less than the design flow time (i.e., less than the tank volume divided by the flow).

short nipple A nipple with a length only a little greater than that of its two threaded lengths, or somewhat longer than a close nipple. A short nipple always has some unthreaded shoulder between the two threads. *See also* close nipple.

short pipe Usually, a pipeline for which the length is less than 500 times the diameter. In such pipes, the effects of entrance and velocity head may be significant and should be considered.

short-run average cost The total cost of producing a product (water) with existing facilities divided by the number of units produced. In economics, the short run is a period of time too short to alter all of the factors of production. By contrast, in the long run, all factors of production can be changed. *See also* long-run average cost.

short-run marginal cost The change in total (or variable) cost associated with using existing facilities to produce the next increment of product, such as the next 1,000 or 1 million gallons of water. The term *incremental cost* is often used to mean the same thing as the short-run marginal cost. Short-run costs contrast with long-run costs in that, in the long run, all costs are variable, including those for the plant scale and the technology employed. *See also* long-run marginal cost.

short-term exposure limit (STEL) The maximum exposure concentration that a worker can be exposed to in a continuous 15-minute period, with a maximum of four exposure periods per day and at least 60 minutes between each exposure period. This limit is not to exceed the standard time-weighted average for that particular hazard. These limits are set by the Occupational Safety and Health Administration. *See also* time-weighted average.

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short-term test A biological test that can be used to screen for effects of chemicals that may be beneficial or harmful. In toxicology, short-term tests are developed to be predictive of particular adverse health effects. The most frequently applied short-term tests in toxicology are mutagenesis tests. Such tests are used to determine whether a chemical produces mutation in bacteria. Positive results suggest, but do not prove, that such chemicals may produce cancer. Unfortunately, such tests predict only carcinogenic effects of mutagenic chemicals. Other mechanisms are now known to be important with a variety of chemical carcinogens that are associated with drinking water. *See also* Ames test.

shortwave ultraviolet *See* germicidal ultraviolet.

shot drill A core drill for which the cutting edge consists of a short length of steel tube with one or more notches. Under the weight of the drill rod, the shot—chilled steel balls about 1/16 inch (1.6 millimeters) in diameter—is fed down with the water inside the drill rods, rolls under the bit, and wears out an annular ring similar to that cut by a diamond drill. Shot drills are limited to vertical holes.

shoulder ditch A ditch constructed above a cut slope to convey surface water runoff and reduce erosion or cutting of the slope. *See also* berm ditch.

shrink fit *See* interference fit.

shrub Usually, woody vegetation greater than 3 feet (1 meter) but less than 20 feet (6 meters) tall, including multistemmed, bushy shrubs and small trees and saplings. (Woody seedlings less than 3 feet [1 meter] tall are considered part of the herbaceous layer.)

shrub wetland A wetland area dominated by woody vegetation less than 20 feet (6 meters) tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions.

shrunk joint A joint secured in place by shrinking of a larger pipe on a smaller one.

shutoff A valve that can close off the source of water or a section of a distribution system in a water system.

shutout The closing of valves in a water distribution system to isolate and stop flow to a certain area or section of a water main. The shutout may be made using one valve for a dead-end system, two valves on a single main, or multiple valves when a connection is involved.

shutter (1) A type of flashboard that swings open by water pressure. (2) A swinging crest gate that may be opened quickly under water pressure. *See also* flashboard.

shutter weir A movable weir consisting of a row of large panels hinged at the bottom and inclined slightly downstream toward the top when the weir is closed.

SI *See* saturation index; *see also* Système International d'Unités *in the Units of Measure section.*

Siamese connection *See* fire department connection.

SIC codes *See* standard industrial classification codes.

side-channel spillway A spillway in which the initial and final flow are approximately at right angles to each other. The water, after passing over the spillway weir or ogee crest, is carried away by a channel running essentially parallel to the crest. A side-channel spillway is also called a lateral-flow spillway.

side contraction A contraction of the nappe, or reduction in width of water overflowing a weir, brought about by the detachment of the sides of the nappe or jet of water while the water passes over the sides of the weir.

side-flow weir A diverting weir constructed on the side of a channel or conduit, usually at right angles to the centerline of the main channel. *See also* overfall weir; overflow weir.

siderite ($FeCO_3$) The mineral name for the ferrous carbonate solid. Siderite is frequently found in layers of corrosion deposits on cast-iron pipes, as well as in encrustations in groundwater well screens and pumps. It is a member of the calcite structural group of minerals that includes calcium carbonate ($CaCO_3$), magnesium carbonate ($MgCO_3$), and manganese carbonate ($MnCO_3$). Formation of ferrous carbonate usually requires high inorganic carbonate concentrations and a near-neutral to alkaline pH, as well as a relatively low oxidation–reduction potential in the local environment.

side slope The slope of the sides of a canal, dam, or embankment. Typically, the horizontal distance is named first, with "1.5 to 1" (or, frequently, "1H:1") meaning a distance of 1.5 units horizontal to 1 unit vertical.

sidestream filtration system A rapid sand or high-efficiency cartridge that draws water from a cooling tower basin, filters out particulates, and returns the filtered water to the cooling tower, enabling the system to operate more efficiently while using less water.

sidestream ozone addition Introduction of ozone into a process stream via an injector. The pressurized process stream flows through a Venturi-type injector. The resulting pressure difference between the inlet and outlet sides of the Venturi creates a vacuum that allows the ozone to be drawn into the process stream through an injection port. *See also* eductor.

sidewall (1) The vertical, curved, or inclined wall that supports the arch or top of a masonry conduit. (2) The wall at the side of a structure.

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side water depth (SWD) The depth of water measured along a vertical interior wall.

siemens (S) *See in the Units of Measure section.*

sieve analysis An analytical procedure used to determine the particle size distribution of filtering granular materials.

sievert (Sv) *See in the Units of Measure section.*

sigma (σ) *See* standard deviation; surface tension.

$\sigma_{\bar{x}}$ *See* standard error of the mean.

signal conditioning The act of processing the form or mode of a signal so as to make it intelligible to or compatible with a given device, such as a data transmission line.

signal processing A method of data analysis in which mathematical operations are performed on signals to extract more information. For example, an ultraviolet spectrum obtained for a liquid sample may have a number of interferences associated with a solvent. Subtraction of the spectrum of the pure solvent from that of the samples gives the spectrum solely caused by the solutes of the liquid sample.

signal-to-noise (S/N) ratio The ratio of the electronic signal of a detector produced by an analyte to the signal when no analyte is present. Increasing the signal-to-noise ratio will usually result in a lower detection limit and more accurate quantitation.

signal transduction The conversion of a signal to different modalities. For example, the electrical signal of a neuron is converted to a chemical signal at a synapse between two nerves. Interactions at the postsynaptic site can generate a second electrical signal, or they can initiate processes within a cell to activate enzymes that generate secondary signals (which are frequently referred to as second messengers). This cascade of events eventually triggers a response on the part of the targeted cell.

significant digits *See* significant figures.

significant figures Digits that may be interpreted as accurate in a number. Significant figures are used because all instruments have limitations in terms of how precisely they can provide an accurate measured value. For example, if experimental or mathematical conditions dictate that the number 28,645 must be rounded off to two significant figures, the number will be expressed as 29,000 (where the 2 and the 9 are the significant figures). If the number 0.0046783 must be rounded off to three significant figures, it will be expressed as 0.00468.

significant noncomplier (SNC) A community water system; nontransient, noncommunity water system; or transient, noncommunity water system that has serious, frequent, or persistent National Primary Drinking Water Regulation violations. The criteria that classify a system as a significant noncomplier are set by the US Environmental Protection Agency for each regulated contaminant. *See also* community water system; nonsignificant noncomplier; nontransient, noncommunity water system; transient, noncommunity water system.

silica (SiO_2) A common name for silicon dioxide. Silica occurs widely in nature as sand, quartz, flint, and diatomite. It has various industrial uses, including in the manufacture of glass and ceramics and in water filtration. *See also* activated silica.

silica sand A filtering material commonly used in granular media filters.

silicates A group of compounds containing oxygen and silica (SiO_2). Silicates are considered anodic corrosion inhibitors, combining with the free metal released at the anode site of corrosion activity and forming an insoluble metal–silicate compound. Silicates can also be used to sequester soluble iron and manganese present in source waters to help prevent oxidation and the formation of red and black water.

siliceous gel zeolite *See* gel zeolite.

sill (1) The base on which a supporting structure, such as a bent of a trestle, rests. Usually a sill is made of wood or concrete and rests directly on the ground surface. (2) The timber, steel, or concrete base, located at the bottom of a lift-gate opening, on which the gate rests when closed. (3) The timber, steel, or concrete base, affixed to the crest of a dam or spillway, to which gates or flashboards are attached or against which they are supported. (4) A low concrete or masonry dam in a small mountain stream, designed to retard the downward cutting of the stream in relatively soft rock or unconsolidated material. (5) A low wall used on an apron or in a stilling basin to assist in energy dissipation and in controlling the water currents within and leaving the stilling basin. (6) An intrusive sheet of igneous rock of an approximately uniform thickness and a much greater lateral extent, forced between level or gently inclined beds. (7) A structure built underwater across deep pools of a river, with the aim of correcting the depth of the river.

sill cock *See* hose bib.

silt Detritic sedimentary rock that has noncemented grains of particle size between fine sand and clay (i.e., between 0.002 and 0.05 millimeters in equivalent diameter).

siltation The accumulation of silt (small soil particles having a diameter between 0.002 and 0.05 millimeters) in an impoundment.

silt density index (SDI) An empirical measure of the plugging characteristics of membrane feedwater based on passing the water through a membrane filter test apparatus containing a 0.45-micrometer pore diameter filter (commonly a cellulosic type) in a deadend

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filtration mode at a constant feed pressure (typically 30 pounds per square inch [207 kilopascals]) for a specified duration (most commonly 15 minutes) and observing the flow rate decline. The silt density index is calculated based on the measured time required for collection of a 500-milliliter filtrate sample at the beginning of the test filtration period (t_i) and the time for collection of a 500-milliliter filtrate sample at a later time (t_f). For a test period T, the SDI value (which is dimensionless) is calculated as follows:

$$SDI_T = \frac{1 - \frac{t_i}{t_f}}{T} \times 100$$

Where:

t_i = initial time to collect a 500-milliliter sample, in seconds

t_f = final time to collect a 500-milliliter sample, in seconds

T = filtration test period, in minutes

See also membrane fouling index; modified fouling index.

silting *See* siltation.

siltstone A very fine-grained, consolidated rock composed predominantly of particles of silt grade.

silt stop (1) A device placed at the outlet of a water storage tank to prevent silt or sediment from reaching the consumer. (2) A device or barrier that prevents silt from being washed from a construction site into a storm drain or drainage structure.

silver (Ag) A metallic element that has various industrial uses, e.g., in the manufacture of photographic chemicals and in electronic equipment, table cutlery, jewelry, and dental amalgams. It is regulated in drinking water by the US Environmental Protection Agency.

silver-impregnated filters Point-of-use water treatment device containing activated carbon impregnated with silver ions, which have a bacteriocidal effect on water.

silver or copper ionization The production of silver or copper ions by release from a solid medium such as silver-impregnated activated carbon or brass granules. The released ions are reported to have biocidal properties.

silvex ($Cl_3C_6H_2OCH(CH_3)COOH$) A generic name for 2-(2,4,5-trichlorophenoxy)propionic acid. Silvex is an herbicide and plant growth regulator whose presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.05 milligrams per liter. *See also* herbicide.

simazine ($ClC_3N_3(NHC_2H_5)_2$) A generic name for 2-chloro-4,6-bis(ethylamino)-*s*-triazine, an herbicide whose presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.004 milligrams per liter. *See also* herbicide.

similitude A condition that exists when the attributes of a model and prototype unit are equal. For example, geometric similitude exists between model and prototype if the ratios of all corresponding dimensions in the model and prototype are equal. Hydraulic similitude is difficult to achieve.

simple electrolyte Any compound, such as a coagulant, that forms charged species (ions) in solution. *See also* polyelectrolyte.

simple surge tank A surge tank that does not have a restricted orifice to create a head differential between the conduit and the tank.

Simple Tools for Effective Performance (STEP) guides A series of workbooks available from the US Environmental Protection Agency to help owners and operators of community and nontransient noncommunity water systems serving 3,300 and fewer people learn about the strategic planning process and appropriate water treatment technologies.

simple water budget A water budget used in landscaping on the premise that no change in water storage in the soil occurs. It is used to determine the amount of water required to irrigate landscape plants to prevent wilting. The irrigation amount is determined as the product of a reference evapotranspiration rate, the irrigated area, and a conversion factor. *See also* reference evapotranspiration.

simplex Term related to data transmission whereby data can be transmitted in one direction only through a single channel or circuit. *Compare with* full duplex; half duplex.

simulate To reproduce the action of some process, usually on a smaller scale.

simulated distribution system (SDS) *See* simulated distribution system test.

simulated distribution system (SDS) test A type of test in which a treated water is dosed with a typical treatment plant level of the disinfectant normally applied and is incubated (stored) under conditions that simulate disinfection by-product production in a distribution system. The pH, temperature, and contact time should match the values found in the actual distribution system. This test does not measure the amount of disinfection by-product *precursors* in a sample; that parameter is measured in a disinfection by-product formation potential test. However, an SDS test should predict the disinfection by-product concentration at a consumer's tap if the water's time of travel to that tap

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is the same as the contact time in the test. *See also* disinfection by-product; disinfection by-product formation potential; uniform formation conditions.

simulated distribution system disinfection by-product (SDS-DBP) concentration The amount of disinfection by-products formed during a test in which a treated water is dosed with a typical treatment plant level of disinfectant (normally but not always chlorine) and is incubated (stored) under conditions that simulate disinfection by-product production in a distribution system. The pH, temperature, and contact time should match the values found in the actual distribution system. The SDS-DBP level is not a measure of the amount of disinfection by-product *precursors* in a sample; that parameter is measured in a disinfection by-product formation potential test. However, the SDS-DBP concentration should be similar to the disinfection by-product concentration at a consumer's tap if the water's time of travel to that tap is the same as the contact time in the test. *See also* disinfection by-product; disinfection by-product formation potential; uniform formation conditions.

simulated distribution system sample (SDSS) A total trihalomethane and/or total haloacetic acid formation potential sample tested under the conditions of distribution system temperature, disinfectant residuals, and residence times, in order to simulate a specific water distribution system.

simulated distribution system trihalomethane (SDS-THM) concentration The amount of trihalomethanes formed during a test in which a treated water is dosed with a typical treatment plant level of disinfectant (normally but not always chlorine) and is incubated (stored) under conditions that simulate trihalomethane production in a distribution system. The pH, temperature, and contact time should match the values found in the actual distribution system. The SDS-THM concentration is not a measure of the amount of trihalomethane *precursors* in a sample; that parameter is measured in a trihalomethane formation potential test. However, the SDS-THM level should predict the trihalomethane concentration at a consumer's tap if the water's time of travel to that tap is the same as the contact time in the test. *See also* trihalomethane; trihalomethane formation potential; uniform formation conditions.

simulated water quality Water quality values generated by a computer simulation of a treatment process or a physical simulation of a distribution system. Computer simulations of a treatment process use predictive equations to determine the changes in water quality. Physical simulation of a distribution system involves holding a batch of finished water for an equivalent time (compared to the distribution system) under conditions similar to that expected within the distribution system.

simulation An act of reproducing the effects of a system by conducting mathematical manipulation of predictive equations or by using a physical model intended to represent the system on a smaller scale.

simulation model *See* simulation program.

simulation program A computer program that has a collection of various equations describing different processes of a system. A simulation program can be used to study the approximate effects of changing certain operating conditions on the outcome of the system.

simultaneous distillation extraction (SDE) An analytical technique for extracting and concentrating trace organic compounds. A water sample and a solvent are heated separately and are then condensed together. The steam and steam-distillable organic compounds mix with the solvent vapor. The condensate separates into two phases; from each phase the solvent and extracted organic compounds are recovered for subsequent concentration and analysis. *See also* organic compound; solvent.

sinc function A function composed of trigonometric terms and four parameters that is used to approximate the seasonal fluctuation associated with daily time series of water demand data.

single-action pump A reciprocating pump in which the suction inlet admits water to only one side of the plunger or piston and the discharge is intermittent.

single-arch dam A curved masonry dam that depends principally on arch action for stability. A single-arch dam is also called an arch dam.

single-centrifugal pump A centrifugal pump in which the suction inlet admits water to one side of the impeller.

single check valve A directional flow control valve; not an approved backflow because of its unreliability. *See also* air gap; backflow prevention; double check valve; double check valve assembly.

single-effect evaporator An evaporator in which the liquid is subjected to only one evaporating step. *See also* evaporator; multiple-effect evaporator.

single-element bench-scale test (SEBST) A membrane treatment study specified in the US Environmental Protection Agency's Information Collection Rule as promulgated in May 1996, whereby two spiral-wound membrane elements (minimum element size 2.5 inches [6.4 centimeters] in diameter and 40 inches [1 meter] in length) with molecular weight cutoffs less than 1,000 daltons are evaluated at 75 percent recovery while other operating parameters are held constant for 4 weeks during each quarter of 1 year. The study for each membrane is a continuous-flow test using a single

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element and concentrate recycle. *See also* Information Collection Rule.

single-family structure A building that was constructed as a residence for one family and is currently used as either a residence or a place of business.

single-main system A water system for which one main supplies both potable and firefighting water.

single-pan balance A balance used to make quick, accurate mass measurements. The material to be weighed is placed on the pan, and counterweights, located on arms (beams) beneath the pan, are adjusted to balance the material, thus indicating the weight. A single-pan balance is also known as a beam balance.

single-phase circuit An electric circuit energized by a single voltage source. An alternating current single-phase circuit usually consists of two conductors.

single-phase power Alternating current power in which the current flow peaks in each direction only once per cycle.

single-phasing (of a motor) The loss of a power phase to an electrical motor in a three-phase power supply. This condition will cause the motor to be underpowered and to overheat.

single point of failure (SPOF) A point in a system at which if a failure occurs, there is no redundancy to compensate for it.

single probe A probe, usually 4–4.5 feet (1.2–1.4 meters) in length, used to measure the resistivity of soil around the tip or point of the probe.

single-stage pump A pump that has only one impeller. (A multistage pump has more than one impeller.)

single-stage recirculation A process used in a multiple (2–6) membrane reverse osmosis system in which a portion of the concentrate stream is split off and routed back to the inlet and mixed with the feedwater. This approach increases the flow across the membrane without increasing the amount of feedwater and increases the overall recovery rate. The pump capacity will affect the amount of water to be recirculated and the recovery rate. *See also* recirculation.

single-stage system A reverse osmosis system in which the water is passed through the membrane(s) only once by a single high-pressure pump.

single-stranded deoxyribonucleic acid (ssDNA) *See* deoxyribonucleic acid.

single-stranded ribonucleic acid (ssRNA) *See* ribonucleic acid.

single-stroke deep-well pump A reciprocating, power-driven, deep-well pump having a single pump rod connecting the reciprocating mechanism to the power head with the cylinder plunger.

single-suction impeller An impeller with one suction inlet.

single-suction pump A centrifugal pump in which water enters from only one side of the impeller. It is also known as an end-suction pump.

sink (1) A depression in the land surface, especially one having a central playa or saline lake with no outlet. (2) One of the hollows in limestone regions, often connected to a cavern or subterranean passage, so that waters running into it are lost. (3) In hydromechanics, a theoretical singular point in the fluid medium at which fluid matter is annihilated at a constant rate; an infinitesimal orifice or exit; a negative source. (4) A place into which anything flows; e.g., ice is a heat sink. *See also* sinkhole.

sinker bar A heavy bar of round iron that makes up the mass in a string of well-boring tools.

sinkers Material that is heavier than water and readily drops to the bottom during clarification or sedimentation processes of water and wastewater treatment.

sinkhole A depression in local topography that connects to an underlying aquifer or underground watercourse. Sinkholes can become very large; entire homes have been lost when a sinkhole suddenly increases in size following large recharge events when the unconsolidated material in the sinkhole is washed into the aquifer.

sintered glass A material made of powdered glass heated to the extent that the glass particles have bound together. The powdered glass is not heated enough to melt.

sintering The process of heating small metal particles to a temperature prior to melting to cause the particles to bind or weld together. *See also* sintered glass.

sinuosity The ratio between the thalweg length and the linear distance through the air between two points on a river. *See also* thalweg.

sinusoidal signal A physical quantity (e.g., voltage or current) that is varying in time as

$$A\sin(\omega t + \theta) \text{ or } A\cos(\omega t + \theta)$$

Where:

A = the amplitude or maximum amplitude of the quantity, in volts or amperes depending on the signal

ω = the angular frequency, in radians per second

t = the time, in seconds

θ = the phase angle of the sinusoidal time function, in radians in both US customary and Système International units

siphon (1) A hydraulic process in a closed system in which a low enough pressure created at the siphon discharge permits a fluid to flow upward and be transferred across a higher elevation as long as the ultimate discharge point is at a lower elevation than the

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hydraulic grade of the system at the siphon starting point. For example, a siphon will transport water up and over the edge of a container as long as the discharge point is below the water surface in the container and the system is closed (i.e., no air gaps occur in the siphon). (2) To create such a condition.

siphonage The movement of liquid from a higher to a lower level by action of a siphon. Shutting off and draining a distribution main can create conditions for siphonage to occur from either a building or leak in the same shutout. *See also* siphon.

siphon spillway An enclosed spillway that uses the operating principle of a siphon. The top of the spillway inlet or air vent is constructed at the elevation at which spilling from an impoundment is to cease, and the top of the inside of the spillway tube is placed at the maximum elevation the water in an impoundment is to attain. When the water level in an impoundment somewhat exceeds the elevation of the spillway crest, the air is exhausted in the tube, siphoning begins, and the discharge through the spillway is greatly accelerated. When the water level in the impoundment falls below the top of the inlet or air vent, the siphon is broken and discharge ceases. Siphon spillways have several advantages. First, because siphon spillways have such a large capacity for a small rise in water level, their use allows a considerable reduction in the length of the spillway. Second, a siphon spillway can be constructed around a dam or through a dam without deep excavations. Third, a siphon spillway allows for a rise in the water level in an impoundment prior to discharging water.

sistership exclusion *See* policy exclusion.

site area The total area of a development site, including building footprints, roadways, and parking areas.

site characterization A review of a facility's physical, operational, procedural, and legal assets and constraints. It is conducted to help identify a facility's strengths and vulnerabilities.

16S ribosomal ribonucleic acid (rRNA) targeted probe *See under* ribosomal ribonucleic acid (rRNA) targeted probe.

size exclusion analysis (SEA) An analytical technique to determine the molecular weight and molecular weight distribution of a sample. The method involves the separation of molecules according to molecular size. *See also* molecular size; molecular weight distribution.

size exclusion chromatography A high-performance liquid chromatographic technique for separating analytes based on their molecular weights via the use of resin beads containing pores of defined sizes. Analytes enter the pores they can fit in and the smaller the analyte, the more likely it will spend more time in the pores. Thus, the larger analytes elute first. *See also* high-performance liquid chromatography.

skeletal fluorosis A condition of brittle bones that arises from excessive deposition of fluoride in bones. The skeletal changes that occur consist of combined osteosclerosis and osteomalacia.

skeletonization The practice of deleting certain minor pipes and facilities from a system model. Ideally, this creates a manageable model that decreases execution time without a loss of overall accuracy in model performance.

skewness *See* skewness of data.

skewness of data A statistical condition in which the data in a distribution are not symmetrical about the mean value. If more data points have larger values than smaller values, the database is called positively skewed or skewed to the right. If more data points have smaller values, the data set is said to be skewed to the left or negatively skewed.

skid A device that supports one or more objects. *See also* rack.

skimmer well A type of infiltration gallery, common on volcanic islands, for which the pumps are designed to produce very little drawdown so as not to mix the underlying salt water with the freshwater lens.

skimming (1) The process of diverting water from the surface of a stream or conduit by means of a shallow overflow in order to avoid diversion of sand, silt, or other debris or material carried as bottom load. (2) The process of diverting water from any chosen elevation in a reservoir by means of outlets at different elevations or by any other skimming device in order to obtain the most palatable drinking water.

skimming weir A weir on a tank or reservoir with an adjustable crest elevation to afford a means of restricting the depth of overflow so that a layer of water of limited depth is removed or skimmed off. *See also* overflow weir.

skin absorption The passage of a chemical through the skin. In general, polar chemicals pass through the skin very poorly, but uncharged, lipophilic chemicals can readily pass through the skin as long as they are applied to the skin in a solubilized form.

skin of water The thin layer of water at the free surface that, because of the different molecular conditions that exist at this interface, is denser and develops a somewhat membranous character, allowing it to resist slight upward or downward pressures. *See also* surface tension.

slack water (1) In tidal waters, the state of a tidal current when the current's velocity is at a minimum, especially the moment when a reversing current changes direction and its velocity is zero. The

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relation of the time of slack water to the tidal phases varies in different localities. In some cases slack water occurs near the times of high and low water, whereas in other localities the slack water may occur midway between high and low water. (2) In streams, a place where very little current exists.

slake To add water to quicklime (calcium oxide, CaO) to form calcium hydroxide ($Ca(OH)_2$) that can then be used in a softening or stabilization process. *See also* quicklime.

slaked lime *See* hydrated lime.

slaker The part of a quicklime feeder that mixes the quicklime (CaO) with water to form hydrated lime [calcium hydroxide, $Ca(OH)_2$].

sleeve (1) A pipe fitting for uniting two pipes of the same nominal diameter in a straight line. (2) A tube into which a pipe is inserted.

Slichter method A method of measuring the velocity of groundwater flowing through granular material, developed by Charles S. Slichter. It consists essentially of driving sets of perforated pipes into the material at known distance intervals, charging the groundwater passing the upstream pipe with a strong electrolyte (ammonium chloride, NH_4Cl, is very suitable), and noting the time involved in the passage of the charged water to another perforated pipe downstream by determining the electrical resistance of the water in the latter pipe at intervals of time. When the resistance is plotted against time, the point of inflection of the resulting curve is taken as the time of passage between the pipes, and the velocity is computed by dividing the distance between the two pipes by the time of passage. The method is repeated for multiple pipes across the cross section of granular material.

slickens The thin layer of extremely fine silt deposited after a general flood over the valley of a large, silt-bearing river, such as the Nile, Sacramento, or Mississippi rivers.

slide gate A device on a dam to control the release of water.

sliding gate A gate valve, or any type of gate, that slides directly on its bearings or seats while opening or closing without the use of rollers or other devices to reduce friction.

sliding-panel weir A movable timber weir in which the barrier consists of wooden panels that slide in grooves and are placed between pairs of immovable frames.

slime (1) Any of numerous substances of viscous organic nature that are usually formed from microbiological growth and that attach themselves to other objects, forming a coating. (2) The coating of biomass (humus, schmutzdecke, sluff) that accumulates on the top of slow sand filters. *See also* biofilm; schmutzdecke; slow sand filter.

slip (1) In a pump, the percentage of water taken into the suction end that is not discharged because of clearances in the moving unit. (2) In geology, a movement that dislocates a rock or soil mass.

slip-fitting The jointing of a bell and spigot connection with the use of a rubber-type gasket in the bell to seal the joint when the spigot is inserted into the bell.

slip joint An inserted joint in which the end of one pipe is slipped into the flared or swaged end of an adjacent pipe.

sliplined water main A part of a water distribution system in which a smaller size pipe is pushed or pulled into an existing pipe and then connected at each end to the original pipeline. The method is used to avoid excavating the old water main.

slip lining treatment of lead pipe The placement of a smaller size pipe of a different material in a lead pipe with the lead pipe used as a casing.

slipoff slope A meandering stream's bank that is not eroded by stream action and is being built up gradually.

slippage *See* leakage.

slope The ratio of vertical distance to horizontal distance, or "rise over run." *See also* grade; side slope.

slope area discharge measurement A determination, by indirect measurement during a field survey, of the peak discharge of a reach of channel, as well as the high-water marks, usually after a flood has passed. Discharge is usually computed by the Manning formula, modified to account for nonuniform flow. *See also* Manning formula.

slope-discharge curve A graph of discharge in a stream as a function of the slope of the water surface. The slope of the water surface is determined as the ratio of the difference in water elevation at two gauges to the distance between the two gauges. A slope-discharge curve is also called a slope-discharge diagram.

slope gauge A gauge used to determine the slope of a water surface. *See also* sloping gauge.

slope wash The process by which erosional debris are removed from sloping surfaces by natural runoff of water that is not concentrated in well-defined channels.

sloping A means to protect workers from cave-in during an excavation by angling the sides of the excavation. Sloping prevents the faces of the excavation from sloughing off and burying the workers. The slope of the sides depends on the type of soil in which the excavation is being performed. *See also* natural slope.

sloping-benching A series of steps intended to provide protection to workers from a cave-in during an excavation. This arrangement prevents the faces of the excavation from sloughing off and burying the worker.

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The number of benches depends on the type of soil in which the excavation is being performed.

sloping gauge A staff gauge that is used to indicate the elevation of the water surface in a stream channel, conduit, reservoir, or tank and is graduated to such a scale that the graduations represent vertical distances above a specific datum plane. Such a gauge is usually installed on a flat sloping bank where increased accuracy in reading the gauge is desirable. A sloping gauge is also called an inclined gauge or slope gauge.

sloping wave A translatory wave or decrease in depth of the water surface in an open channel caused by a sudden change in conditions of flow. This wave is usually discernible only as a lowering of the water surface, and it acts in accordance with the same principles that apply to an abrupt wave. *See also* hydraulic jump.

slot A narrow opening.

slot opening The size of the holes in a well screen that lets water pass from an aquifer into a well.

slotted lateral pipe An underdrain lateral pipe that has many tiny openings that appear as though the pipe had been partially cut around the perimeter with a hacksaw. *See also* filter underdrain.

slough (1) A small muddy marshland or tidal waterway that usually connects other tidal areas. (2) A tideland or bottom land creek; a side channel or inlet, as from a river or a bayou. This type of slough may be connected at both ends to a parent body of water. (3) To shed, cast off, drop off, separate from, or become detached. In reference to biofilms developed on materials in contact with drinking water, biofilm material that sloughs from granular filtration media, or from the surfaces of distribution pipes and storage tanks, may result in increased densities of bacteria (including coliforms) in the water.

sloughing The process of shedding, casting off, dropping off, separating, or detaching. Biofilms or other types of films applied to or developed on a surface may become detached by a process of sloughing because of physical or chemical action. Sloughing of aquatic biofilms usually occurs because of the shearing action of turbulent water flow.

slow rinse In ion exchange, that portion of the rinsing stage that usually follows the introduction of the regenerant and during which the rinse water (deionized, decationized, softened, or untreated water) passes through the resin at the same flow rate as the regenerant. *See also* fast rinse.

slow sand filter A filter for the purification of water in which water, without previous treatment, is passed downward through a filtering medium consisting of a layer of sand 24 to 40 inches (0.6 to 1 meter) thick. The filtrate is removed by an underdrainage system, and the filter is cleaned by scraping off the clogged sand and eventually replacing the sand. A slow sand filter is characterized by a slow rate of filtration, commonly 3–6 million gallons per day per acre of filter area (0.1–0.2 meters per hour). Its effectiveness depends on the biological mat, or schmutzdecke, that forms in the top few millimeters. *See also* schmutzdecke.

slow sand filtration (SSF) The use of a slow sand filter. *See also* slow sand filter.

slow start A technique used to reduce the peak and duration of the turbidity spike when a filter is placed into service after having been backwashed. In the slow start, the filter is brought into service at a fraction of the full filtration rate, and the rate is gradually increased using small, incremental rate increases and multiple rate increase steps. This reduces the magnitude of each individual rate increase and, thus, has the potential to cause fewer disturbances to any floc or particles that may be deposited in the filter bed.

SLR *See* surface loading rate.

sludge One of the residuals produced during water treatment. Sludge is the accumulated solids separated from water during processing. The solids include the precipitated chemicals and other materials removed from the raw water. Water treatment sludge is typically a liquid containing solids. In water treatment, sludge is produced as a result of a number of different processes: coagulation/sedimentation (producing a coagulant or a sedimentation sludge), softening (producing a lime or softening sludge), or as a result of settling without the addition of a chemical, such as occurs in presedimentation (producing presedimentation sludge). Sludge is categorized either by the process that produces it or by the predominant chemical used in the process. *See also* alum sludge; coagulant sludge; ferric (or iron) sludge; polymeric sludge; sedimentation sludge; softening sludge.

sludge bed *See* residuals drying bed.

sludge blanket *See* sludge-blanket clarifier.

sludge-blanket clarifier A type of clarifier designed to maintain a zone in which sludge accumulates and concentrates. Sludge blankets are often associated with the region in a settling basin in which sludge deposits and collects. Unlike a solids contact basin, a sludge-blanket clarifier operates in such a way that a blanket of suspended particles is created, and water is passed upward through this blanket, which provides an additional filtration step. That is, as flocculated water passes through the sludge blanket, influent flocs attach to the flocs present in the sludge blanket, promoting efficient clarification. Solids are captured by the floc in the blanket; when the floc becomes sufficiently heavy, it drops to the bottom of the clarifier

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where it is recirculated. *See also* solids-contact basin; upflow clarifier; upflow coagulation; upflow contact clarifier.

sludge blowdown The removal of sludge from a sedimentation basin, thickener, or other type of settling tank to maintain the proper level of settled solids in the basin.

sludge cake Semidry solids composed of sludge with little or no free water, typically after being mechanically or nonmechanically dewatered. Sludge cakes typically contain solids concentrations of 20 to 25 percent, and sometimes higher. *See also* residuals dewatering.

sludge collector A mechanical device for removing sludge from the bottom of a settling tank.

sludge compartment A separate compartment for sludge incorporated into a settling process.

sludge concentration *See* residuals concentration.

sludge conditioning *See* residuals conditioning.

sludge density index (SDI) A measure of the degree of compaction for 1,000 milliliters of sludge after settling in a graduated container takes place for 30 minutes. This index is expressed in units of milliliters per gram. It is also called the sludge volume index.

sludge dewatering *See* residuals dewatering.

sludge disposal *See* residuals disposal.

sludge dryer *See* residuals dryer.

sludge drying bed *See* residuals drying bed; sand drying bed.

sludge filter *See* residuals filter.

sludge index *See* sludge density index.

sludge lagoon *See* residuals lagoon.

sludge moisture content *See* residuals moisture content.

sludge pressing The process of dewatering sludge by subjecting it to pressure, usually within a cloth fabric through which the water passes and in which the solids are retained. *See also* belt filter press; plate-and-frame filter press.

sludge processing *See* residuals processing.

sludge solids *See* residuals solids.

sludge thickener A tank or other piece of equipment designed to concentrate water treatment sludges. The principal mechanism is gravity settling of sludge solids.

sludge thickening A process of removing water from accumulated solids prior to dewatering. Thickened sludge has a solids concentrations ranging from less than 2 percent to 5 or 6 percent. Sludge is often thickened by less mechanically intensive processes than in dewatering, such as the use of settling tanks, to reduce the volume to be treated in more mechanical and cost-intensive (but less land-intensive) dewatering processes. It is also known as residuals thickening.

sludge volume index *See* sludge density index.

sludge wasting The process of removing sludge from a unit process.

sludge zone The bottom zone of a sedimentation basin. This zone receives and stores the settled particles.

slug (1) A temporary, abnormally high concentration of an undesirable substance that appears in the product or distributed water. For example, a slug of iron rust might appear because of the shearing action of a high-demand flow that loosens a previously deposited iron precipitate. (2) *See also in the Units of Measure section.*

slug dose A single applied addition of a material to a process. In tracer testing, a slug dose of the tracer chemical may be added; the hydraulic characteristics of the basin being evaluated are determined based on the mass of tracer recovered in the effluent over time. *See also* bolus dose.

sluggish stream A stream in which the peaks of a flood form more slowly than usual because of the decrease in the slope as the stream system ages or as the flow is reduced or retarded by withdrawal or storage in upstream reaches.

slug method A method of disinfecting new or repaired water mains in which a high dosage of chlorine is added to a portion of the water used to fill the pipe. This slug of water is allowed to pass through the entire length of pipe being disinfected.

slug test An aquifer test, conducted in wells, in which a known volume of tracer (the "slug") is added to the groundwater to determine hydraulic properties of the aquifer or overlying soils. *See also* auger hole test.

sluice (1) A conduit for carrying water at high velocity. (2) An opening in a structure for passing debris. (3) To cause water to flow at high velocities for wastage, for such purposes as excavation or ejecting debris.

sluice flow That part of the total discharge that flows through sluices. Sluice flow is also called orifice flow.

sluice gate A gate used for sluicing. Such a gate is constructed to slide vertically and is fastened into or against the masonry of dams, tanks, or other structures.

sluiceway (1) An opening in a diversion dam, usually adjacent to the head gate. A sluiceway may consist of an open panel in the dam or a gate near the base of the dam. (2) A culvert or controlled drainage opening in a levee or dam.

sluicing The operation of moving earth, sand, gravel, or other material by means of flowing water.

slump A type of landslide involving the downward slipping of a mass of rock or unconsolidated material of any size, moving as a unit or as several subsidiary units, usually with backward rotation.

slurry A mixture of liquid and solids that can be pumped and transported by liquid-handling equipment. Drilling mud and wet concrete are examples of slurries.

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slurry recirculation unit A center-feed clarifier with flocculation zones built into a central compartment. A motor-driven impeller can recirculate within the reactor up to five times the source water inflow rate, allowing a specified slurry concentration to develop. The recirculation allows a higher slurry concentration to be obtained, thus dampening source water quality or hydraulic loadings that can cause floc carryover or operational difficulty in maintaining proper slurry concentrations.

slush ice An unfrozen mixture of water and ice.

SMA *See* satellite management agency.

small-bore piping Copper or stainless-steel pipe with a diameter of 0.5 inch (13 millimeters). Such pipe is commonly found in pump-assisted hot water central heating systems.

Small Business Innovation Research (SBIR) A highly competitive program under the National Institute of Standards and Technology Office of Technology Partnerships that encourages small businesses to explore their technological potential and provides the incentive to profit from technology commercialization.

Small Business Job Protection Act (SBJPA) Act passed in 1996 that became Public Law No. 104-188. The act covers a broad range of subjects from child adoption to water supply. It made significant changes in the rules governing worker employment status, and Sec. 1613 covers treatment of contributions in aid of construction.

Small Community Drinking Water Assistance Plan (SCDWAP) An initiative under the US Environmental Protection Agency's 2001 drinking water small systems assistance strategy to protect public health, reduce compliance costs, and improve water systems sustainability.

smallpox A highly contagious, febrile disease caused by a virus. Symptoms include fever and skin pustules. It can be used as a bioweapon.

Small Systems Technology Initiative A program developed by the US Environmental Protection Agency's Office of Drinking Water to promote the use of drinking water treatment technologies for small systems (those serving fewer than 3,300 people).

small water system A public water system serving fewer than 3,300 people.

SMCL *See* secondary maximum contaminant level.

SMCRA *See* Surface Mining Control and Reclamation Act.

Smith–Hieftje background correction An instrumental technique of compensating for interferences in atomic absorption spectrophotometry. The technique measures the difference between signals obtained from a hollow cathode lamp before and during a high-current pulse. This technique can be used for analytes in which the spectral line is in either the ultraviolet or visible region.

smooth nozzle A nozzle in which the internal diameter is gradually reduced from its large end to its small end.

SMP *See* soluble microbial product.

SMR *See* standardized mortality ratio.

SMSA *See* standard metropolitan statistical area.

SMV *See* Snow Mountain virus.

snake (1) A fiber yarn rope that is placed around a pipe joint and covered with mud to hold molten lead being poured into a joint until the lead solidifies. A vee is formed in the rope on the top side of the pipe to allow the lead to be poured into the joint. (2) A flexible wire with a cutter, sometimes used to clear clogged pipes.

SNARL *See* suggested no-adverse-response level.

SNC *See* significant noncomplier.

snow (1) Precipitation of water from the atmosphere in the form of branched hexagonal crystals or stars, often mixed with simple ice crystals. Snow falls more or less continuously from a solid cloud sheet. These crystals may fall either separately or in coherent clusters forming snowflakes. (2) The accumulation of fallen snow.

snow bin A large box used to measure the depth of snowfall. The box is usually 5 to 10 feet (1.5 to 3 meters) square, protected against eddying air currents along the top of its sides by screens, and lined with some waterproofing material. The snow is allowed to melt, with such melting sometimes being aided by means of rock salt sprinkled in the bottom of the bin or by a heating apparatus, such as an electric lamp, heating element, or a coal oil lamp installed in the box. The melted snow drains into a measuring tank.

snow board A flat board, usually about 18 by 24 inches (0.45 by 0.6 meters) and covered with white flannel, used to measure the depth of snowfall. The board is laid horizontally on the ground or snow surface; the white surface reflects the radiant heat of the sun and is very similar in texture to snow. The depth of snowfall is measured directly as the snow is caught on the board.

snow course A line on a drainage area, laid out and permanently marked, along which the snow is sampled at definite distances or stations at appropriate times during a snow survey to determine the snow's depth, water equivalent, and density.

snow cover The accumulated snow and ice on the surface of the ground at any time. *See also* snowpack.

snowfall (1) The rate at which snow falls, usually expressed in terms of inches (centimeters) of snow depth per 6-hour period. (2) The actual depth of snow on the ground after a snowstorm. (3) A snowstorm.

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snowfield (1) An area, usually at high elevation or in polar latitudes, where snow accumulates and remains on the ground during the entire year. (2) An unbroken expanse of snow.

snow gauge A device for measuring snow depth. *See also* snow scale.

Snow Mountain virus (SMV) Strain of viruses isolated from an outbreak of acute gastrointestinal illness that occurred at a ski resort near Granby, Colo., in 1976. It has been positively associated with both waterborne and foodborne disease outbreaks, and airborne spread by aerosolized droplets from infected persons is suspected, as well. It belongs to the *Norovirus* genus (genotype 2) of the Caliciviridae family.

snowpack A field of naturally packed snow that provides a steady supply of water and is also useful in furnishing water power. This term is used in the mountain regions of western United States. Snowpack is also called snow storage or, sometimes, snow cover.

snow residuum Accumulated snow on the ground surface at the end of any period, or that snow's water equivalent.

snow ripening The process, occurring during early stages of melting, by which snow crystals tend to become granular, spaces between the crystals become filled with water, and the water content of the snow tends to become uniform at all depths. When the snow becomes still more dense and begins to lose water, it is sometimes said to be overripe.

snow sample A core taken from the snow mantle on a snow course by a snow sampler during the course of a snow survey. From this core, the depth, water equivalent, and density of the snow mantle may be determined.

snow sampler A device used in securing snow samples, consisting essentially of a set of light, jointed, metal tubes for taking samples and a spring scale graduated to read directly the corresponding depth of water contained in the snow sample.

snow sampling The process or operation, in connection with a snow survey, of observing the depth and determining the density or water content of snow existing at given times at given locations or along given snow courses on a drainage basin.

snow scale A device, usually a rod, bearing markings so that snow depth can be read directly from a distance without the snow cover being disturbed.

snow stake A wooden stick, either driven into the ground or held upright by guy wires, used in regions of deep snowfall to indicate the depth of snow. The depth is read directly from graduations marked on the stake. *See also* snow scale.

snow storage Storage of water on a drainage basin in the form of snow and ice.

snow survey The process or operation of determining the depth, water content, and density of snow at various selected points on a drainage basin in order to ascertain the amount of water stored in the form of snow so that subsequent runoff can be forecasted.

snow trap An opening made in a dense forest to allow snow to fall to the ground, thus trapping the snow.

S/N ratio *See* signal-to-noise ratio.

soap The water-soluble reaction product of a fatty acid ester (RCOOR') and an alkali (usually sodium hydroxide, NaOH) that produces suds when used with water for washing or cleaning purposes. Some soaps are mild disinfectants. Common soaps, such as sodium and potassium soaps, are soluble but can be converted to insoluble calcium and magnesium soap curds (bathtub ring) by the presence of hardness ions in the water. *See also* hardness.

SOC *See* synthetic organic chemical.

social costs of open-cut trenching The disruption of residential, business, or industrial areas and the loss of business while repairing or installing pipelines and conduits.

Society for Epidemiologic Research An association of epidemiologists and biostatisticians that sponsors the *American Journal of Epidemiology.*

socket pipe In pipe fitting, a cast-iron pipe that is provided with a socket at one end and a spigot at the other. The sockets of wrought pipes are couplings and are screwed over the ends on the outside diameter.

soda ash (Na_2CO_3) A common name for commercial sodium carbonate.

soda water Water that has been impregnated with carbon dioxide (CO_2) so that it will be effervescent when not under pressure. Soda water is the same thing as seltzer water and sparkling water. *See also* bottled sparkling water.

sodium (Na) A metallic element found abundantly in compounds in nature but never existing alone. Sodium compounds are highly soluble and do not form curds when used with soaps or detergents. Many sodium compounds are used in the water treatment industry. Notable are the uses of sodium chloride (NaCl) as a regenerant in the cation-exchange water-softening process and sodium hypochlorite (NaOCl) as a disinfectant.

sodium adsorption ratio (SAR) transfer An expression of the relative activity of sodium ions in exchange reactions with soil, indicating the sodium or alkali hazard to soil. It is calculated from the following expression:

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$$SAR = \frac{[Na^+]}{\sqrt{0.5([Ca^{2+}] + [Mg^{2+}])}}$$

Where:

$[Na^+]$ = sodium ion concentration
$[Ca^{2+}]$ = calcium ion concentration
$[Mg^{2+}]$ = magnesium ion concentration

All concentrations are expressed in milliequivalents per liter. This term is used in guidelines for the interpretation of the quality of water for irrigation. In addition, interactions between soil ions and dissolved organic carbon may be characterized by the value of the sodium adsorption ratio. Calcium is able to act as a bridge between organic matter and clay and produce insoluble organic matter complexes, thereby increasing the retention capacity of the soil. When calcium-based ameliorants are applied to soil, the added calcium will change the sodium adsorption ratio of the solution in contact with the soil, thereby reducing clay dispersion, which will reduce the desorption of ions and molecules from these surfaces.

sodium aluminate ($Na_2Al_2O_4$) A substance sometimes used as an auxiliary coagulant for the removal of fine turbidity and color in soft, low-pH water. *See also* coagulant.

sodium aluminosilicate The chemical name for gel zeolite. *See also* gel zeolite; zeolite.

sodium arsenite ($NaAsO_2$) A salt used in testing for residual chlorine. It is also known as sodium metaarsenite.

sodium azide A reagent used for preserving samples for total organic carbon measurements.

sodium bicarbonate ($NaHCO_3$) A substance that can be added to drinking water to increase alkalinity and provide additional buffering intensity. It is generally supplied as a powder and is used as part of a corrosion control strategy or in the coagulation treatment process. It is also called baking soda.

sodium bisulfite ($NaHSO_3$) A chemical additive used as a disinfectant, preservative, and dechlorination or reducing agent.

sodium borohydrate regeneration An in situ chemical regenerant for granular activated carbon that has been exhausted for the removal of perchlorate. *See also* perchlorate.

sodium bromide (NaBr) A salt of sodium and bromine. When chlorine is applied to a water solution of NaBr, gaseous bromine (Br_2) is released.

sodium carbonate (Na_2CO_3) A salt used in water treatment to increase the alkalinity or pH value of water or to neutralize acidity. It is also called soda ash.

sodium chloride (NaCl) The chemical name for common table salt. Sodium chloride is also widely used for regeneration of ion-exchange water softeners and in some dealkalizer systems. *See also* common salt.

sodium cycle The cation-exchange water-softening process in which sodium ions in the resin are exchanged for hardness ions in the water. Sodium chloride (NaCl) is commonly used for resin regeneration.

sodium dodecyl sulfate (SDS) An ionic detergent that is commonly found in household products such as toothpaste, shampoo, and shaving foams.

sodium fluoride (NaF) A dry chemical used in the fluoridation of drinking water. It is commonly used in saturators.

sodium hexametaphosphate A substance that has a molecular ratio of 1.1 parts of sodium monoxide (Na_2O) to 1 part of phosphorus pentoxide (P_2O_5), with a guaranteed minimum of 76 percent P_2O_5. Several specialized compositions are available. In general, it is used as a sequestering, dispersing, and deflocculating agent. It is soluble in water and insoluble in organic solvents. It is also called sodium polyphosphate or glassy sodium phosphate. *See also* hexametaphosphate; sequestering agent.

sodium hydrosulfite ($Na_2S_2O_4$) A crystalline salt that is a strong reducing agent and the main ingredient in several resin cleansers used to clean iron-fouled ion-exchange resin beds.

sodium hydroxide (NaOH) A strong caustic chemical used in treatment processes to neutralize acidity, increase alkalinity, or raise the pH value. It is also known as caustic soda, sodium hydrate, lye, or white caustic.

sodium hypochlorite (NaOCl) A substance, commonly known as liquid bleach, that is used for disinfection as an alternative to chlorine gas, especially where safety concerns over storage of the gas exist. When the hypochlorite is added to water, it hydrolyzes to form hypochlorous acid (HOCl), the same active ingredient that occurs when chlorine gas (Cl_2) is used. *See also* chlorine; hypochlorous acid.

sodium hyposulfite ($Na_2S_2O_4$) A strong reducing agent. *See also* sodium metabisulfite.

sodium metabisulfite ($Na_2S_2O_5$) A dry commercial form of sodium bisulfite. *See also* sodium hydrosulfite.

sodium montmorillonite clay A material commonly referred to as bentonite or bentonite clay. It is commonly added to low turbidity water to enhance coagulation and flocculation. *See also* bentonite.

sodium 2-(parasulfophenylazo)-1,8-dihydroxy-3,6-naphthalene disulfonate (SPADNS) method A colorimetric method for the determination of fluoride in water. It is based on the reaction of fluoride with zirconium and the sodium 2-(parasulfophenylazo)-1,8-dihydroxy-3,6-naphthalene disulfonate (SPADNS)

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reagent. The intensity of the dye complex is inversely proportional to the concentration of fluoride.

sodium pyrophosphate ($Na_4O_7P_2$) White or colorless and water-soluble polyphosphate. Sodium pyrophosphate is often used in water softeners and detergents and is used to control iron precipitation in drinking water distribution systems.

sodium silicate (Na_2SiO_3) A caustic solution of silica used in water treatment to prevent corrosion or, after a treatment known as activation, to assist coagulation. *See also* activated silica.

sodium silicofluoride (Na_2SiF_6) A dry chemical used in the fluoridation of drinking water. It is derived from hydrofluosilicic acid.

sodium thiosulfate ($Na_2S_2O_3 \cdot 5H_2O$) A reducing agent used to remove residual chlorine from solution. *See also* reducing agent.

sodium tripolyphosphate (STP or STPP) ($Na_5P_3O_{10}$) A water-soluble chelating agent for certain metals in solution. It is also called sodium triphosphate or pentasodium tripolyphosphate.

soft In water, having low hardness (low concentrations of calcium, magnesium, or both). *See also* hard water; hardness; soft water.

softened water Any water that has been processed in some manner to reduce the total hardness to a lower value, expressed as calcium carbonate ($CaCO_3$) equivalent. *See also* hard water; zero soft water.

softener S*ee* water softener; water softening.

softening *See* water softening.

softening membrane A membrane that softens water; typically a nanofiltration membrane. *See also;* membrane; nanofiltration.

softening sludge The material produced as a result of the softening process in water treatment. Softening sludge contains the precipitated solids formed by lime, caustic soda, or soda ash's reaction with the raw water, the particulate matter, and the hardness in the raw water. *See also* sludge.

softening uniform formation conditions (SUFC) Test conditions used to determine the expected level of disinfection by-products in a distribution system that are the same as the uniform formation conditions (24 ± 1 hour incubation, 20.0 ± 1.0° Celsius temperature, 1.0 ± 0.4 milligrams chlorine residual/liter) except that the pH is 9 ± 0.2 pH units to better represent the conditions in the distribution system following precipitate softening treatment. *See also* uniform formation conditions.

soft scale Scale that dissolves under acidic conditions. It is mainly composed of calcium carbonate and magnesium hydroxide. *See also* scale.

soft water Water having a relatively low concentration of calcium and magnesium ions. Generally, soft water exhibits a hardness within the range of 0 to 75 milligrams per liter (0 to 4.4 grains per gallon) as calcium carbonate ($CaCO_3$). *See also* hard water.

soil The unconsolidated, naturally occurring mineral or organic material on the immediate ground surface, capable of supporting plant growth. It extends from the surface to 6 inches (15 centimeters) below the depth at which properties produced by soil-forming processes can be detected. These properties differ from those found in the underlying unconsolidated material, and they consist of the interactions among living organisms, climate, and other natural processes acting on soil and soil parent material.

soil air The gases in the interstices of the aeration zone that open directly or indirectly to the surface and hence are connected with the atmosphere. Soil air is also called ground air or subsurface air.

soil alkalinity The pH value of soil extract. The soil is alkaline when the pH is greater than 7.0 and acidic when less than 7.0.

soil amendment Organic and inorganic materials added to soils to improve texture, nutrients, moisture-holding capacity, and infiltration rates.

soil and rock deposit classification The classification of a soil and rock deposit by a competent person as either type A, type B, or type C on the basis of such properties as unconfined compressive strength, whether the soil is fissured, whether the soil has previously been disturbed, and so on. *See also* type A soil; type B soil; type C soil.

soil box A device used to determine the resistivity of a confined volume of soil. Such boxes are manufactured by several companies; however, one can be constructed conveniently. A soil box measures 4 cm × 4 cm × 4 cm and two of the opposite sides are of stainless steel.

soil classification The process of identifying soil types based on different characteristics in the excavation, as required by the Occupational Safety and Health Administration's 1926.650 excavation standard.

soil colloid Soil particles that constitute the physical fraction of soils generally considered as being less than 2 micrometers in diameter. These particles are usually clay minerals, although other minerals may also be present with diameters less than 2 micrometers. These particles are mainly composed of silica (SiO_2), alumina (Al_2O_3), iron oxide (most commonly Fe_2O_2), and combined water.

soil conditioning Alteration of the physical nature of a soil by addition of solid agents to improve water movement.

soil conservation district (SCD) A local government entity within a defined water or soil protection area that provides assistance to farmers and other local residents in conserving natural resources, especially

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soil and water. This type of entity is also called the soil and water conservation district in some areas.

Soil Conservation Service (SCS) *See* Natural Resources Conservation Service.

soil corrosion Corrosion of underground materials resulting from soil conditions.

soil creep The slow movement, usually over relatively short distances, of a mass of soil acting under the force of gravity. This term is usually applied to movement that is much smaller in magnitude and extent than a landslide.

soil discharge As applied to groundwater, the direct discharge of water through evaporation. The water discharged is, for the most part, lifted by capillarity from the zone of saturation nearly to the surface, where evaporation takes place.

soil erodibility A measure of the soil's susceptibility to raindrop impact, runoff, and other erosional processes.

soil horizon A layer or section of the soil profile, more or less well defined, occupying a position approximately parallel to the soil surface and having characteristics that have been produced through the operation of soil-building processes.

soil improvement The addition of soil amendments (additives) to planted areas.

soil infiltration rate The maximum rate at which a soil, in a given condition at a given time, can absorb water.

soil moisture Pellicular water in the soil zone. It is divided into available and unavailable moisture—the former being water easily abstracted by roots of plants, the latter being water held so firmly by adhesion and other forces that it cannot usually be absorbed by plants rapidly enough to produce growth. *See also* pellicular water.

soil moisture content The volumetric water content of a soil sample; the ratio of water volume in a sample to total volume of the sample.

soil organic matter The organic fraction of the soil. It includes plants and animal residues in various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population. Soil organic matter is commonly considered to be those organic materials that accompany the soil after passage through a 2-millimeter pore diameter sieve.

soil pipe A standard type of bell-and-spigot cast-iron pipe of limited strength.

soil porosity The percentage of the soil (or rock) volume that is not occupied by solid particles, including all pore space filled with air and water. The total porosity may be calculated from the following formula:

$$n = \left(1 - \frac{\gamma_d}{\gamma_w G}\right) \times 100$$

Where:

n = the percent of pore space

γ_d = the unit weight (weight per unit of volume) of the soil after all free water has been removed from the pores of the soil (γ is the universal symbol in soil mechanics for unit weight or weight density; the subscript d symbolizes dry)

γ_w = the unit weight of water (62.4 pounds per cubic foot in US customary units, 9.81 kilonewtons per cubic meter [Système International units])

G = specific gravity of the solid particles in the soil

soil priming The amount of saturation locally required to produce runoff.

soil profile The layer-like arrangement of soil horizons, often with differing colors, consistencies, and textures formed by natural weathering processes in soil material.

soil resistivity An indication of difficulty with which a soil conducts electrical current; the average electrical resistance of a volume of soil.

soil salinity *See* saline–alkaline soil.

soil saturation The filling of all the pore space in a soil with water. Soil below the depth of the water table is said to be saturated. *See also* duration of inundation.

soil-saving dam A dam, usually small, constructed to impound or retard surface runoff temporarily and bring about deposition of a substantial portion of the soil being carried away by stormwater runoff. Such a dam is also called a detention dam.

soil sealant A chemical or physical agent that plugs porous soils and prevents leaching or percolation.

soil solution The aqueous liquid phase of the soil and its solutes, the latter consisting of (1) ions dissociated from the surfaces of the soil particles and (2) other soluble materials.

soils report A report by a soils engineer indicating soil type(s), soil depth, uniformity, infiltration rates, and pH for a given site.

soil structure The arrangement of soil particles into aggregates.

soil tank A tank filled with soil and used for measuring evaporation and evapotranspiration. A soil tank is also called a lysimeter or vegetation tank. *See also* lysimeter.

soil texture The proportions of soil particles (sand, silt, and clay) in a soil profile.

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soil water Water in the aeration zone, immediately below the surface of the ground. Such water may be discharged into the atmosphere in appreciable quantities by plant transpiration or soil evaporation.

soil water percentage The percentage of water in soil based on the weight of material oven dried at 230° Fahrenheit (110° Celsius). It is the ratio, expressed as a percentage, of (1) the weight of a given volume of soil under specified conditions minus the weight of such soil after it has been dried in an oven at a temperature of 230° Fahrenheit (110° Celsius) until its weight becomes constant, to (2) the weight of such volume of oven-dried soil.

soil water table The upper surface of a body of soil water.

soil-water zone The portion of the unsaturated zone where plants can use soil water in their metabolic processes.

SOK *See* state-of-the-knowledge report.

solar distillation A desalting process in which distillation takes place in a device that uses solar energy as the heat source (i.e., a solar still). This process is also called solar humidification. *See also* solar still.

solar energy Energy imparted from the sun.

solar humidification *See* solar distillation.

solar irradiation The use of the sun's energy to initiate or catalyze a reaction.

solar salt Common salt that is produced by solar evaporation in shallow ponds or lagoons and is used in water softener regeneration.

solar still A device used for solar humidification or solar distillation, consisting of a saline water basin under a transparent cover that allows solar energy to pass through, resulting in a temperature rise and evaporation followed by the subsequent condensation of vapors and collection of the distillate.

solder A metal or metallic alloy that is melted and used to join metallic surfaces. Many solders contain lead and tin. Historically, 50:50 tin–lead solder was used to join copper piping. The US Environmental Protection Agency now requires that low-lead solders be used when the solder is exposed to potable water.

solenoid A magnetically operated mechanical device (electric coil). Solenoids can operate small valves or electric switches.

solenoid shutoff valve An electrical device operated by a magnetic coil to make a valve either open or close to allow or shut off water flow. This type of valve is used extensively for flow control and direction on many water-processing systems.

sole source aquifer (1) The single water supply available in an area. (2) A US Environmental Protection Agency designation for a water source requiring protection.

solid Matter that is in its most highly concentrated form (i.e., the atoms or molecules are more closely packed than in gases or liquids) so it is more resistant to deformation. The normal condition of the solid state is a crystalline structure (the orderly arrangement of the constituent atoms of a substance in a framework called a lattice). All solids can be melted by heat and thereby converted into a liquid.

solid angle units *See in the Units of Measure section.*

solid chlorite ion system System using a packed bed of solid sodium chlorite embedded with inert stabilizing components to produce chlorine dioxide. Dilute, moist chlorine gas and air are continuously passing through the bed where they react with chlorite ion. Because chlorine and air are continuously passing over the solid bed, the generated chlorine dioxide is swept off the bed and carried through to a holding tank. The chlorine feed onto the bed can be controlled so that minimal unreacted chlorine is able to pass through the bed. This system controls the production of chlorine dioxide via the delivery of the chlorine gas. This system has been commercialized.

solid–liquid separation Any process for removing suspended solids from water.

solid oxidizing medium A filter medium (anthracite, greensand, sand, or other mineral) coated with manganese oxides that first adsorb and then oxidize Fe(II) and Mn(II). Such media are also used to oxidize other water contaminants such as arsenite (As(III)) to arsenate (As(V)) for easier removal by subsequent adsorption or ion-exchange processes. *See also* manganese dioxide–based oxidizing medium; solid-phase oxidant.

solid-phase extraction A technique in which analytes are isolated from solution by adsorbing onto a solid matrix. The matrix is often a chromatographic material coated onto resin beads or a membrane filter. Analytes are typically desorbed from the solid matrix with an elution solvent. *See also* solid-phase microextraction.

solid-phase extraction disk A disk, similar in size and shape to standard filter paper but made of various hydrophobic compounds, that is used to adsorb (extract) organic compounds from a water sample. The disk is then extracted (desorbed) with a solvent, such as methylene chloride (CH_2Cl_2), for subsequent analysis. Use of such a disk serves as a substitute for liquid–liquid extraction to lessen the volume of waste solvents generated. *See also* liquid–liquid extraction.

solid-phase microextraction (SPME) A separation technique used in the analysis of organic compounds. Analytes are adsorbed onto the stationary phase of a small section of a fused silica fiber. Analytes can be desorbed into an organic solvent or directly into an instrument for further analysis.

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solid-phase oxidant A material in which the oxidant is immobilized on the surface of the medium. In some instances, the oxidant can be regenerated and reused after exhaustion. One example is a manganese dioxide–based solid-phase oxidant. *See also* solid oxidizing medium.

solid-phase separation cartridge A small-diameter cartridge containing a solid-phase extraction resin for sample preparation. The compactness makes it convenient for small-volume samples and automated operation. *See* solid-phase extraction.

solids Matter suspended or dissolved in water. In addition, the terms *dissolved solids* and *suspended solids* are used to refer to nonfilterable residue and filterable residue, respectively. Different categories of solids are defined based on the analytical method of determination. *See also* dissolved solids; fixed solids; settleable solids; suspended solids; total solids; volatile solids.

solids, suspended *See* suspended solids.

solids, total *See* total solids.

solids, volatile *See* volatile solids.

solids concentrator As solids are removed in the blanket and clarification zone, blanket volume increases and some solids must be removed to maintain stable conditions. A zone of sludge concentrators collects and concentrates excess solids. As these excess solids increase the volume of the blanket, they spill over into the concentrators. When the concentrator is full, thickened sludge is withdrawn through sludge removal headers usually on a timed basis by automatically controlled sludge valves.

solids-contact basin A unit process in which both flocculation and particle separation occur. Coagulated water is passed upward through a solids blanket, allowing flocculation and particle separation to take place in a single step. The solids blanket is typically 6 to 10 feet (2 to 3 meters) below the water surface, and clarified water is collected in launder troughs along the top of the unit. Solids are continually withdrawn from the solids blanket to prevent undesired accumulation. *See also* launder trough.

solids-contact clarifier *See* solids-contact basin.

solids-contact process A process combining coagulation, flocculation, and sedimentation in one treatment unit, in which the flow of water is vertical. *See also* solids-contact basin.

solids disposal Any process for ultimate disposal of residuals by incineration, landfilling, soil conditioning, or other means.

solids flux The application of solids per unit time and area, typically expressed in units of pounds per square foot per second (kilograms per square meter per second). Solids flux is a design criterion frequently used in sedimentation to define the limiting amount of solids that can be applied to a given area in a specified time to permit the necessary thickening to take place or to govern the underflow of solids in the bottom of a clarifier.

solid sleeve (1) A pipe fitting for uniting two pipes of the same nominal diameter in a straight line. (2) A tube into which a pipe is inserted.

Solid Waste Disposal Act (SWDA) Public Law 89-272, Title II, enacted in 1965, which focused on research, demonstrations, and training. It provided for the federal government to share with the states the costs of making surveys of waste disposal practices and problems, as well as the costs of developing waste management plans. The Solid Waste Disposal Act was so extensively amended by the Resource Conservation and Recovery Act of 1976 (Public Law 94-580) that it is commonly referred to by the latter act's title rather than by its own official title. The Solid Waste Disposal Act–Resource Conservation and Recovery Act and amendments are codified in 42 US Code 6901–6991k.

solubility The ability or tendency of one substance to blend uniformly with another. Solids vary from 0 to 100 percent in their degree of solubility in liquids, depending on the chemical nature of the substances. To the extent that they are soluble, solids lose their crystalline form and become molecularly or ionically dispersed in the solvent to form a true solution. Liquids and gases are often said to be miscible in other liquids and gases rather than soluble. *See also* miscible; solvent.

solubility coefficient *See* gas solubility coefficient.

solubility product constant (K_{sp}) In a saturated solution at a specified temperature, the equilibrium constant of the dissolution reaction of a solid in water. For example, if solid B_mA_n dissolved in water, it would become m B^{x+} and n A^{y-} ions (where x and y are the valence of the ions). In this case, K_{sp} would equal $[B^{x+}]^m[A^{y-}]^n$. If the solid were $Mg(OH)_2$, then $x = 2$, $y = 1$, $m = 1$, and $n = 2$; hence, K_{sp} would be $[Mg^{2+}]^1[OH^{1-}]^2$, or more commonly $[Mg^{2+}][OH^-]^2$. *See also* equilibrium constant; saturated; solubility.

solubilization To treat a material so that it becomes more readily dissolved.

soluble microbial product (SMP) Water-soluble byproducts of biodegradable organic matter metabolism that are released by biomass attached to filter media during biologically active filtration (biofiltration). SMPs can significantly affect the quality of effluents and overall organic matter removal in biological treatment processes.

solute A substance dissolved in a solvent.

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solute (salt) flux For a membrane separation process, the solute (salt) mass passing through the membrane in the permeate per unit area and time. Solute (salt) flux is commonly expressed in pounds per square foot per second (grams per square meter per second).

solute (salt) mass transfer coefficient *See* solute (salt) permeability coefficient.

solute (salt) permeability coefficient A factor describing the flow of solute (salt) through a membrane for a diffusion-controlled, pressure-driven membrane process, such as reverse osmosis. The coefficient is dependent on the specific membrane type and characteristics. It is equal to the solute (salt) flow rate through a unit area of membrane (the solute or salt flux) divided by the solute (salt) concentration gradient across the membrane. It is typically expressed in units of feet or meters per second, depending on the system of units used. Sometimes this term is referred to as the solute (salt) transport coefficient or solute (salt) mass transfer coefficient. In equation form,

$$B = F_s/(C_1 - C_2)$$

Where:

B = solute permeability coefficient, in feet per second (meters per second)
F_s = solute flux, in pounds per second per square foot (grams per second per square meter)
$C_1 - C_2$ = solute concentration gradient across the membrane, in pounds per cubic foot (grams per cubic meter)

solute transport The movement of a given dissolved constituent in a fluid, or from one phase to another. Solute transport can describe the movement of a contaminant in groundwater, or it can describe the movement of a contaminant from a liquid to a solid phase (e.g., granular activated carbon adsorption).

solute transport coefficient *See* solute (salt) permeability coefficient.

solution A mixture in which one or more substances (solutes) are dissolved into another substance (solvent), usually a liquid, in such a way that the solute is equally distributed (homogeneous) throughout the solvent in the form of either molecules (as in a sugar solution) or ions (as in a salt solution).

solution channel An opening in solid rock created by the dissolution, usually by water, of material that formerly occupied the opening and the carrying away of the material in solution. A solution channel is also called a solution opening.

solution diffusion model For some pressure-driven membranes (e.g., a reverse osmosis membrane), a mathematical model that describes the transport of solvent (water) and solute (salt) through a permselective (semipermeable) membrane. For a membrane type with given solvent permeability, solute permeability characteristics, and membrane thickness, the solvent flux is directly proportional to the net driving force across the membrane, and the solute flux is directly proportional to the concentration gradient across the membrane. *See also* net driving pressure.

solution feeder A feeder for dispensing a concentrated chemical solution to water at a rate that is controlled manually or automatically.

solution opening *See* solution channel.

solvent A liquid substance that dissolves another substance (the solute) to form a solution.

solvent (water) mass transfer coefficient *See* solvent (water) permeability coefficient.

solvent (water) permeability coefficient A factor describing the flow of solvent (water) through a membrane for a pressure-driven membrane process such as reverse osmosis. The coefficient is dependent on the specific membrane type and characteristics. It is equal to the solvent (water) flow rate through a unit area of membrane (the solvent flux) divided by the net driving pressure across the membrane. This term is sometimes referred to as permeance, solvent (water) transport coefficient, or solvent (water) mass transfer coefficient. In equation form,

$$A = \frac{F_w}{\text{NDP}}$$

Where:

A = solvent permeability coefficient, in gallons per day per square foot per pound per square inch (cubic meters per hour per square meter per kilopascal)
F_w = solvent flux, in gallons per day per square foot (cubic meters per day per square meter)
NDP = net driving pressure (hydraulic pressure differential across the membrane minus the osmotic pressure differential across the membrane), in pounds per square inch (kilopascals)

solvent (water) transport coefficient *See* solvent (water) permeability coefficient.

solvent flux *See* flux; flux rate (solvent, water).

soman (GD) A clear, colorless, tasteless nerve agent that is easily absorbed through inhalation. It has the chemical name O-Pinacolyl methylphosphonofluoridate. A guideline for the maximum allowable amount of this chemical warfare agent in military drinking water has been developed by the National Research Council. *See also* National Research Council.

somatic (1) Of or pertaining to the body. (2) Pertaining to any of the cells of an organism that become

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differentiated into the tissues, organs, and so on; pertaining to nonreproductive cells or tissues.

somatic bacteriophage A bacteriophage that attaches to receptor sites on the bacterial cell surface, as opposed to an F-specific or male-specific bacteriophage that attaches only to bacteria that have F-pili. *See also* male-specific bacteriophage.

somatic coliphage A bacteriophage that infects *Escherichia coli* bacteria via attachment to receptor sites on the bacterial cell surface. *See also* somatic bacteriophage.

somatic phage host *Escherichia coli C* A strain of *Escherichia coli* bacteria used for the detection of somatic coliphages. *See also* somatic coliphage.

sonication A method of enhancing the breakdown of a substance in a solvent by exposing the sample to ultrasonic waves.

sonic flowmeter A device for measuring flow rates across fluid streams by either Doppler-effect measurements or time-of-transit determination. In both types of flow measurement, the displacement of the portion of the flowing stream carrying the sound waves is determined, and the flow rate is calculated from the effect on sound wave characteristics.

sonic leak detection A method of detecting leaks using stethoscopes or listening horns placed against fire hydrants or on the ground above a pipe. *See also* acoustic emission technology; waterphone.

sonic logging A geophysical logging technique that determines the properties of a formation by measuring its response to high-energy sound waves.

sonic sensing *See* acoustic sensing.

sonolysis An advanced oxidation process in which oxidation of a chemical or pollutant is catalyzed by ultrasonic sound waves. It is also known as ultrasonically catalyzed oxidation. *See also* advanced oxidation process; hydroxyl radical; ozone–biodegradation process; ozone–hydrogen peroxide process; ozone–ultraviolet light process; pulsed ultraviolet light–hydrogen peroxide process; ultrasound; ultraviolet light–hydrogen peroxide process.

sonoscope *See* waterphone.

SOP *See* standard operating procedure.

sorbent A solid material, such as activated carbon or ion-exchange resin, that is used to concentrate dissolved compounds. *See also* activated carbon; adsorbent; adsorption; ion-exchange resin.

sorption A surface phenomenon involving absorption, adsorption, or a combination of the two. This term is often used when the specific mechanism is not known. *See also* absorption; adsorption.

sounding (1) In hydrography, the process of measuring the depth of water with a lead line or by other means. (2) In subsurface investigations, the act of pushing or driving a rod down through the soil as far as it will penetrate with the equipment at hand. Such soundings are most useful in soft materials to determine the depth of a solid stratum. This type of sounding is also called probing. (3) The act of seeking and discerning leak noise generated from pressurized water piping systems.

sounding line In hydraulic surveying, a rope, wire, or cable with a weight attached, used for measuring depths of water. A sounding line is also called a lead line.

sounding rod A portable staff gauge for measuring the depth of a liquid in a vessel or stream. For deep, quickly flowing streams, a sounding wire is used. It is sometimes called a sounding stick.

sounding tube A pipe or tube used for measuring the depths of water.

sounding wire A flexible wire with weight attached at the bottom, used for determining the depth of water. A sounding wire is also called a lead line or log line.

sour brine Brine that contains a high concentration of calcium, magnesium, or other substances that would interfere with the brine's use or reuse for effective regeneration of exhausted ion-exchange resin.

source contribution *See* relative source contribution.

source meter A water meter that records the total volume of water withdrawn from a surface water or groundwater source, the total volume purchased from a wholesale supplier, or the total flow into a facility (e.g., for water treatment).

source-of-funds analysis An analysis often undertaken when major expenditures are planned in a utility to determine "who pays," especially if new capacity is planned. The purpose of the analysis is to match revenue requirements with the available sources of funds. For new capacity, the concept of "growth pays for growth" is often used, in which case connection charges are established or increased to pay for the portion of new facilities constructed to serve new demand. Major capital programs are usually funded from debt (rather than directly from rates), and the debt service is paid for from rates for facilities serving existing customers or from connection charges for facilities serving new customers. The source-of-funds analysis is usually confined to rates, debt (with many alternatives), and connection charges, but it could also be applied to the rate structure to determine how, for example, to pay for new peak capacity.

source of infection The person, animal, object, or substance from which an infectious agent passes to a host. *See also* reservoir of infection.

source–pathway-receptor approach A process for evaluating exposure of a chemical or transmission of a disease.

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source-to-node connectivity An event or condition that ensures that a water demand node is connected to a source of water supply, i.e., receives water from a supply source.

source-to-node reliability The probability that at least one minimal path set is available from the supply source to a water demand node. This term is also defined as the probability that at least one path set is available to supply water from a water supply source to a water demand node. *See also* path set.

source water The supply of water for a water utility. Source water is usually treated before distribution to consumers, but some groundwaters are of such a quality that they can be distributed untreated. This term is preferred over *raw water*.

Source Water Assessment Program (SWAP) A US Environmental Protection Agency program established by the 1996 Safe Drinking Water Act amendments, requiring states to develop a comprehensive program to identify the areas that supply public tap water, inventory contaminants and assess water system susceptibility to contamination, and inform the public of the results.

sp. *See* species.

spacer For a membrane treatment unit, a material that is designed to allow controlled fluid flow and is used to separate membrane layers, such as a feed-concentrate or permeate spacer for spiral-wound membrane or a concentrating compartment or demineralizing compartment spacer for an electrodialysis membrane stack.

spadable residuals Residuals that can readily be forked or shoveled from a drying bed. Such residuals are ordinarily less than 75 percent moisture.

SPADNS method *See* sodium 2-(parasulfophenylazo)-1,8-dihydroxy-3,6-naphthalene disulfonate method.

span The scale or range of values across which an instrument is designed to measure. *See also* range.

sparge To agitate a liquid by diffusion of compressed air or gas through a pipe.

sparger A perforated pipe or porous fitting on a pipe in an aerator or ozone (O_3) contact compartment through which the air or ozone-containing air is introduced into the water. A sparger allows for the diffusion of the air or ozone into the water.

sparingly soluble salt A salt that is relatively insoluble in water and may precipitate when moderately concentrated even at ambient temperatures. For membrane desalting processes, the concentrations of sparingly soluble salts—such as calcium carbonate ($CaCO_3$), calcium sulfate ($CaSO_4$), strontium sulfate ($SrSO_4$), and barium sulfate ($BaSO_4$)—are commonly evaluated and provisions made to avoid their precipitation in the system.

sparker pressure pulse Pulsed electrical energy dissipated in water as an electric field and/or converted into other energy forms such as light or pressure waves. The fast-rise, short-duration, high-voltage electric fields have been tested with mixed results for their ability to control zebra mussels. It is also known as a pulse-power plasma generator or a plasma sparker system.

sparkling bottled water *See* bottled sparkling water.

sparkling water Carbonated water for which the carbon dioxide (CO_2) content comes from the same source as the water itself. *See also* bottled sparkling water.

spark source mass spectrometry (SSMS) A type of mass spectrometry in which ions representative of the sample material are produced by a pulsed radio frequency spark source. A spark between the conducting sample electrodes is produced by application of a pulsed radio frequency. Sample electrodes may be made directly from the sample material if that material is a conductor or semiconductor, whereas nonconducting materials must be mixed with pure conductors, such as silver or graphite, and compressed. Ions produced in the source are accelerated into the analyzer portion of the mass spectrometer. This technique offers high sensitivity and comprehensive elemental coverage, as well as linear response for many elements. For example, this technique has been used to analyze the boron content of different steel samples. *See also* mass spectrometry.

spatial (1) Pertaining to an object, dataset, or activity that has a geographic component or is related to a location in a coordinate system. Spatial analysis and spatial modeling are based on geographical relationships of data. (2) In biology or ecology, pertaining to the occurrence of or relationships among microorganisms, plants, or animals living in the same habitat, as in the spatial distribution of a particular species.

spatial analysis The use of analytical techniques associated with the study of the locations of geographical entities together with their spatial dimensions.

spatial demand allocation The process of assigning water demand to geographic areas represented by nodes or points in the system. Water demand may be an instantaneous flow rate or a hydrograph representing demand over a period of time, such as 24 hours. Demands for nodes are input data for distribution system modeling. *See also* initial distribution system evaluation.

spatial disaggregation strategy A methodology for taking the demand at a given node for a given geographic area and reassigning the demand to the original customer classes within the same area (i.e., breaking the total into its parts).

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spatial heterogeneity Irregular distribution of particles or organisms within a given space or population.

spatially explicit delivery model (SEDMOD) A tool for analyzing the impact of spatial processes such as landscape structure or drainage area on the dynamics of point and nonpoint sources. The model uses a geographic information system database in compiling spatial information.

spatial variation Changes in water quality characteristics among various locations in a water body or among water bodies.

SPC (standard plate count) *See under* heterotrophic plate count.

SPCS *See* State Plane Coordinate System.

special A specific section of pipe constructed for a special purpose or location that meets specifications but is not of a standard length or standard shape. A special may have nonstandard connection outlets or degree of bend. *See also* pipe fitting.

special aquatic site A geographic area, large or small, possessing special ecological characteristics in terms of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values.

special area management plan (SAMP) A type of comprehensive plan authorized by the Coastal Zone Management Act amendments of 1980, providing for natural resource protection balanced against reasonable economic growth. Special area management plans are developed by the US Army Corps of Engineers, often in coordination with state and local planning efforts, and they identify areas either suitable for development or in need of protection.

special casting Any of numerous fittings of various shapes and materials made to serve specific purposes.

speciation The chemical makeup of a group of compounds. For example, for disinfection by-products, the speciation may be limited to chlorine-substituted by-products or may alternatively include a mixture of chlorine- and bromine-substituted species.

species (sp., spp.) A group of related individuals with common chromosomic number and structure, hereditary morphology, physiological characteristics, and way of life, separated from neighboring groups by a barrier that is generally sexual in nature and occupying a definable geographic area. Members of the same species are capable of reproduction producing offspring of the same species. The term is abbreviated sp. (singular) and spp. (plural).

species composition The kinds and numbers of species occupying an area.

species difference The presence in different animal species of varying degrees of sensitivity to the effects of a chemical, physical, or biological agent. Such differences can be related to differences in the metabolism of a chemical or by different species, or they may simply reflect differences in intrinsic sensitivity. *See also* selective toxicity.

species diversity The number and relative abundance of species in an area.

species population Similar organisms residing in a defined space at a certain time, taken as a group.

specific absorption The capacity of water-bearing material to absorb water after the free water has been removed. Specific absorption is equal to the specific yield of the material, except in cases when such material has suffered compaction from the burden of overlying material after groundwater has been removed, in which case allowance must be made for the effect of such compaction. *See also* free water; specific yield.

specific activity As pertaining to an enzyme, the activity of the enzyme per milligram of total substrate. Specific activity is a measure of the purity of the enzyme. It is defined as the amount of product formed by the enzyme in a given amount of time under given conditions per milligram of enzyme.

specifications Precise standards of performance for construction work, materials, and manufactured products. Specifications make it possible to express expected values when work or items are purchased or contracted for, and they provide means of determining conformance with expectations after purchase or construction.

specific attribute test A test to perform paired comparisons to evaluate odor of a sample with respect to a standard that has odor at the level that consumers could detect. It is also referred to as attribute rating test. It is an efficient, focused, cost-effective method that treatment plant personnel can use to monitor raw and treated water for specific odorants and to maintain the finished water's odor below a target concentration.

specific capacity A measurement of the well yield per unit length of drawdown. *See also* drawdown.

specific capacity test A testing method for determining the adequacy of an aquifer or well by measuring the specific capacity. *See also* specific capacity.

specific conductance The conductivity of a solution as measured using a standard cell with a width of 1 centimeter. Specific conductance is expressed in units of micromhos or microsiemens at 77° Fahrenheit (25° Celsius). *See also* conductivity.

specific discharge The discharge per unit area. This value is often used to define flood magnitudes. In porous media and filtration, specific discharge is the discharge per unit area of the filter or porous media.

specific energy (1) The energy with regard to the channel bed as a datum, or the energy measured above the channel bed. In equation form,

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$$E = Y + \frac{V^2}{2g}$$

Where (in any consistent set of units):

E = the specific energy
Y = water depth
V = mean velocity in a channel
g = gravitational constant

(2) The total energy per unit weight of a substance. *See also* critical velocity.

specific energy units *See in the Units of Measure section.*

specific entropy units *See in the Units of Measure section.*

specific flux *See in the Units of Measure section.*

specific gravity (sp gr) *See in the Units of Measure section.*

specific heat (sp ht) (1) The ratio of the heat capacity of a substance to the heat capacity of water; or the quantity of heat required for a 1° temperature change in a unit mass of material. Specific heat is commonly expressed in units of calories per gram per degree Celsius or British thermal units per pound per degree Fahrenheit. (2) The quantity of heat required to increase the temperature of a unit mass of granular activated carbon through a given interval of temperature, divided by the corresponding quantity for water.

specific humidity The ratio of the mass of water vapor to the total mass of the mixture of air and water vapor.

specific ion meter A sensitive voltmeter used to measure the concentration of specific ions, such as fluoride, in water. Electrodes designed specifically for each ion must be used.

specificity (1) A quality of being specific, such as host specificity. (2) In the context of an analytical test method for a microorganism, the ability of the method to select and distinguish the microorganism under consideration from all others in the same environment (sample).

specific level The level of the water surface in a river at any particular site for a given discharge. The specific level may change with time, depending on changes in the river section at the site.

specific productivity For pressure-driven membrane processes like reverse osmosis, the permeate production rate divided by the net driving pressure. Specific productivity is commonly expressed in units of gallons per day per day per pounds per square inch or cubic meters per second per kilopascal. It is commonly temperature corrected, in which case it is sometimes called the temperature-corrected specific productivity. *See also* net driving pressure; permeate; specific flux; temperature correction factor.

specific resistance (SR) (1) A measure of the resistance of a sludge to dewatering under specified conditions. (2) The capacity for resisting the flow of electrical current. In the case of liquids, such as water, specific resistance is the resistance of a 1.0-cubic-centimeter cube, which is the resistance offered by the liquid between two electrode plates 1 centimeter square and placed 1 centimeter apart. Specific resistance is the reciprocal of specific conductance and is expressed in units of ohm-centimeters. One hundred milligrams per liter of sodium chloride (NaCl) dissolved in water causes a specific resistance of 4,716 ohm-centimeters, whereas a 1,000-milligrams-per-liter solution of NaCl in water results in a specific resistance of 500 ohm-centimeters. *See also* specific conductance.

specific resistance to filtration (SRF) A measure of the filterability of a sludge, based on the amount of time required for the sludge to pass through a filter paper with a known pore opening size under a specific applied pressure.

specific retention The quantity of water retained against the pull of gravity by rock or earth after the material has been saturated and allowed to drain completely to a remote body of mobile water by way of continuous capillary interstices. Specific retention is expressed as the ratio of the volume of water that the rock or earth material will retain against gravity to the volume of the material itself. The sum of specific yield and specific retention is the porosity of the sample. *See also* porosity; specific yield.

specific speed A speed or velocity of revolution, expressed in revolutions per minute, at which the runner of a given type of turbine would operate if it were so reduced in size and proportion that it would develop 1 horsepower under a 1-foot head (not a Système International unit). This quantity is used in determining the proper type and character of turbine to install at a hydroelectric power plant under given conditions.

specific ultraviolet absorbance (SUVA) The ultraviolet absorbance at 254 nanometers (measured in units of reciprocal centimeters) divided by the dissolved organic carbon concentration (in milligrams per liter). Typically, a specific ultraviolet absorbance less than 3 liters per meter-milligram corresponds to largely nonhumic material, whereas a specific ultraviolet absorbance in the range of 4–5 liters per meter-milligram corresponds to mainly humic material. Because humic materials are more easily removed through coagulation than nonhumic substances, higher specific ultraviolet absorbance values should indicate a water that is more amenable to enhanced coagulation. *See also* dissolved organic carbon;

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enhanced coagulation; humic material; ultraviolet absorbance at 254 nanometers.

specific volume units *See in the Units of Measure section.*

specific weight Weight of a substance per unit volume. It is equal to the density times the gravitational constant.

specific weight units *See in the Units of Measure section.*

specific well yield The maximum rate at which a well will yield water under a stipulated set of conditions, such as a given drawdown, pump and motor, or engine size. Specific well yield may be expressed in terms of cubic meters per second, gallons per minute, cubic feet per second, or similar units.

specific year flood A stream flow that is equaled or exceeded, on the average, once in a designated period, e.g., 10 years, 50 years, or 100 years. *See also* flood frequency.

specific yield The quantity of water that a unit volume of permeable rock or soil, after being saturated, will yield when drained by gravity. Specific yield may be expressed as a ratio or as a percentage by volume. The sum of specific yield and specific retention is the porosity of the sample. *See also* porosity; specific retention.

spectral absorption coefficient (SAC) The ultraviolet absorbance of a sample divided by the spectrophotometer cell path length. Ultraviolet absorbance measurements are typically reported in units of reciprocal centimeters. *See also* spectroscopy; ultraviolet absorbance.

spectral analysis of surface waves (SASW) A method for inspecting prestressed concrete cylinder pipe in which controlled impacts on the pipe generate surface waves that are detected by several geophones and the waves are separated into different frequency components.

spectral ultraviolet (UV) absorbance The determination of ultraviolet absorbance over a range of wavelengths (e.g., 200 to 400 nanometers).

spectrograph An instrument for photographing or producing a representation of a spectrum.

spectrometer An instrument for measuring some function of power or other physical quantity (e.g., mass or energy), with respect to spectral position within a spectral range. Unlike the spectroscope, the spectrometer tends to make use of electronic detectors. *See also* spectroscopy.

spectrometry The branch of physical science treating the theory and practice of the measurement of spectra.

spectrophotometer A spectrometer with associated equipment, so designed that it furnishes the ratio, or a function of the ratio, of the radiant power of two beams as a function of spectral position. The two beams may be separated in time, space, or both. *See also* spectrometer.

spectrophotometry The science of using a spectrophotometer. *See also* spectrophotometer.

spectroscope An optical instrument used for the visual identification of emission lines. The spectroscope consists of a monochromator arranged near an exit slit, which is replaced by an eyepiece that can be moved along the vocal plane. The wavelength of an emission line is determined by centering the line on the eyepiece and observing the angle between the incident and dispersed beams.

spectroscopy (1) The branch of physical science treating the theory and interpretation of spectra. (2) A technique used in chemical analyses that is based on the principle that many substances, when crossed by a beam of light, allow a unique and well-defined fraction of that light to pass or emit a well-defined fraction of radiation when returning from an atomic vapor state to their fundamental state. The characteristic wavelength pattern of the absorbed or emitted light can be used to identify the particular substance with great certainty. The quantity of the light absorbed or emitted is proportional to the concentration of the substance. Spectroscopy is one of the most frequently used analytical methods for water analysis. *See also* atomic absorption spectrophotometric method; emission spectroscopy.

spectrum A representation of electromagnetic radiation over a range of wavelengths.

speed coefficient The ratio of the linear velocity of the runner periphery of a waterwheel to the orifice velocity of the water under a prescribed head. *See also* orifice velocity.

speed of light *See in the Units of Measure section.*

speed units *See in the Units of Measure section.*

spent filter backwash water (SFBW) Water containing particulate matter discharged from a filter during backwashing. During backwashing, water is forced back through the filter to clean it. This water (SFBW) contains the material that the filter had removed from the process water, which can include particles, floc, microbes, precipitated metals, and organic material.

spent washwater *See* spent filter backwash water.

sperm *See* spermatozoon.

spermatid An intermediate cell in the development of sperm. It is derived from a secondary spermatocyte by fission (meosis) and develops into a spermatozoon.

spermatocyte An intermediate cell in the development of sperm. It is derived from spermatogonia and develops into a spermatid.

spermatogenesis The orderly process of producing sperm, beginning with the development of spermatogonia and proceeding through primary and

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secondary spermatocyte and spermatid stages before production of mature spermatozoa.

spermatogonia The stem cell for sperm, found attached to the basal lamina of the seminiferous tubule.

spermatotoxic Causing the death of mature spermatozoa.

spermatozoon A mature male germ cell; the specific output of the testes.

spermhead abnormality A change in the structure of the head of sperm. Because a normal spermhead has well-defined genetic determinants and a complex structure, production of spermhead abnormalities can be used as the basis of a short-term in vivo test for genotoxic chemicals. The effects can be differentiated from simple spermatotoxic effects by the timing of the appearance of the abnormalities following exposure. This timing corresponds to the stage of spermatogenesis in which the effect is produced. If the effects are delayed relative to exposure, the effect is likely to reflect a genotoxic effect. *See also* genotoxic.

S. petersenii *See Synura petersenii.*

sp gr *See* specific gravity *in the Units of Measure section.*

sphagnum Soft moss found mainly in bogs on the surface.

sphericity A measure of the bead roundness or "whole bead" count of beads in an ion-exchange resin product or other bead-form absorbent or filter medium.

sp ht *See* specific heat.

spicule A small needle-like structure or part, such as one of the silicate or calcium carbonate processes supporting the soft tissue of certain invertebrates.

Spiegler-Kedem-Katchalsky model *See* Kimura–Sourirajan model.

spigot The end of a pipe, fitting, or valve that is inserted into the bell end.

spiked Pertaining to a sample fortified with a known amount of a substance to evaluate the accuracy (recovery) of an analytical method as part of a laboratory quality assessment and quality control program. The term *fortified* (or *laboratory-fortified*) is more commonly used to refer to a spiked sample.

spiked integrity monitoring For membrane processes, integrity monitoring using the addition of a substance in the feed stream; typically at a relatively large known concentration, and measuring its presence or absence or its concentration in the filtered water stream. *See also* direct integrity testing; integrity testing; microbial challenge test.

spiked sample A sample to which a known amount of a substance has been added.

spill An intentional or unintentional release of compounds into the environment or workplace.

spill-resistant pressure vacuum-breaker backsiphonage-prevention assembly (SVB) A backflow assembly containing an independently operating, internally loaded check valve and an independently operating, loaded air-inlet valve located on the discharge side of the check valve. The assembly is to be equipped with a properly located resilient-seated test cock, a properly located bleed/vent valve, and tightly closing, resilient-seated shutoff valves attached at each end of the assembly. This assembly is normally used on systems such as lawn sprinklers to protect from backsiphonage pressure.

spill water Water released from an impoundment because the impoundment lacks sufficient storage capacity.

spillway A device used to release water from a dam.

spillway channel An artificial waterway provided for conducting away from the structure the water overflowing from a reservoir, aqueduct, or canal by way of an overflow device. A spillway channel is also called an overflow channel.

spillway chute An open conduit conducting water, usually at supercritical velocity, from a reservoir to the waterway downstream from a dam. A spillway chute is also called a spillway trough.

spillway dam A dam constructed with a crest to permit the overflow of water. A spillway dam is also called an overfall dam.

spillway lip That part of the spillway crest where overflow starts.

spillway trough *See* spillway chute.

spillway tunnel A tunnel used as an outlet channel for a spillway.

spiral riveted pipe Steel pipe made from sheets of steel curved into a cylindrical shape with the edges riveted together to form a seam around the pipe.

spiral welded pipe Steel pipe made from sheets of steel curved into a cylindrical shape with the edges welded together. The seams may form a spiral running around the circumference of the pipe with welding along the seam.

spiral wheel An axial-flow turbine modified with runner blades having helical surfaces and usually mounted on a horizontal or slightly inclined shaft.

spiral wound Having a construction configuration very common for one style of reverse osmosis membrane and cartridge filter element. In reverse osmosis membranes, the membrane sheets are assembled in layers around a perforated mandrel product water tube, with coarse mesh spacer screens between the layers, to form a complete module element. In cartridge filter elements, the filtration material, such as fiber cord, is continuously wound around a perforated mandrel core tube.

spiral-wound cartridge *See* membrane element; spiral wound.

spiral-wound membrane *See* spiral wound.

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Spirillum A genus of bacteria characterized as rigid, helical cells (1.4–1.7 micrometers in diameter by 14–60 micrometers in length) that are aerobic or microaerophilic, gram-negative, motile by means of large bipolar tufts of flagella, and found in stagnant, freshwater environments.

***Spirillum* NOX (NOX)** A bacterial strain used in a bioassay procedure to estimate oxalate ($OOCCOO^{-2}$)–carbon equivalents of the assimilable organic carbon concentration in a water sample. *See also* assimilable organic carbon; oxalate–carbon equivalent.

***Spirillum* sp.** Any species of bacteria belonging to the genus *Spirillum.*

splash goggles Safety goggles with shatterproof lenses designed to provide a tight covering around the eyes to protect them from chemicals and flying particles.

spline interpolation The construction of a smooth curve by fitting simple curves represented by mathematical formulas to connect a series of points. (If the simple curves are line segments, the process is called linear interpolation.)

split addition The multiple addition of a coagulant, flocculant, or both at several locations along a flow path to achieve cumulative benefits.

split-case pump A centrifugal pump with the suction and discharge ports parallel but on opposite sides of the pump. The pump is split along the shaft so that the top half of the casing can be removed.

split electrolytic cell An electrolytic cell in which the anode and cathode are separated by a diaphragm or membrane.

splitless injector *See* split–splitless injector.

split-phase motor *See* squirrel-cage induction motor.

split sample A single sample that is separated into at least two parts such that each part is representative of the original sample.

split–splitless injector A device that is commonly used on a gas chromatograph and allows two types of injection techniques. The split injection technique allows a portion of a sample to be directed to the gas chromatographic column and the remainder of the sample sent to waste. The splitless injection technique directs the entire sample onto the chromatographic column.

split-stream treatment *See* split treatment.

split-tee fitting A special sleeve that is bolted around a water main to allow a wet tap to be made. It is also known as a tapping sleeve. *See also* tapping sleeve.

splitter box (1) A division box that splits the incoming flow into two or more streams. (2) A device for splitting and directing discharge from a head box to two separate points of application.

split treatment A water treatment scheme whereby a portion of the potential feedwater to a treatment process bypasses the process and combines with the product water from the treatment process, producing a blended product water. Split treatment generally is considered when treating all of the water with a specific process would have negative affects (such as increased corrosivity) or when product water quality goals can be met without treating all of the water with the process and the bypass would reduce overall production costs. Split treatment is typically used in ion-exchange softening, such that one train will be designed for virtually complete hardness removal and the output will then be blended with bypass water to meet finished water hardness goals.

SPME *See* solid-phase microextraction.

SPOF *See* single point of failure.

spoil Excavated material such as soil from the trench of a water main.

spontaneous abortion Also known as a miscarriage or stillbirth; refers to the natural loss of a fetus.

spore A propagative unit that is typically unicellular, is often uninucleate, and may be formed with (sexually) or without (asexually) a change in ploidy. Most types of nonmotile spores are dormant and are more resistant to environmental change than are vegetative cells. The principal groups of spore-forming bacteria are those in the genera *Bacillus* and *Clostridium.* Bacterial spores are asexual; are formed within the vegetative cell (one spore per cell); and are much more resistant to heat, desiccation, and many bactericidal chemicals than are vegetative cells. Some spores can behave as gametes. *See also* cyst; gametogenesis; ploidy; sporocyst; sporozoite.

spore removal surrogate technique In drinking water treatment, the use of indigenous *Bacillus* spores, or of *Bacillus subtilis* spores added as a spike, to evaluate the effectiveness of the coagulation, flocculation, and filtration process for removal of particulates from drinking water. Spore removal is used as a surrogate for the removal of specific parasite cysts or oocysts (*Giardia* and *Cryptosporidium*) because detecting the spores is simpler than the sample processing and analysis for the parasite cysts or oocysts.

spore strip A filter paper strip inoculated with viable *Geobacillus stearothermophilus* spores and used to demonstrate adequate sterilization. The strips are autoclaved along with a typical waste load and inoculated into a recovery medium. If the medium remains clear after incubation and its color does not change, the test is considered satisfactory. Growth is indicated by a color change and turbidity within the broth. In such cases, the autoclave run would be considered a sterilization failure.

sporocyst A cyst structure enclosing one or more sporozoites of organisms that are intracellular

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parasites of invertebrate and vertebrate animals, and in the case of malaria, in white and red blood cells of vertebrates.

sporogonic state, sporogony The production of spores resulting from sexual fusion of gametes prior to multiple fission, characteristic of certain protozoans.

sporont Parasitic cells with thickened membranes seen prior to becoming sporoblasts.

Sporozoa Term used to describe a group of parasitic protozoa that are not motile. It formerly referred to a class of organisms that included all parasitic protists, but modern taxonomy no longer recognizes that class. Instead, parasitic protozoa that are characterized by a lack of organelles of locomotion and by the production of spores at the end of their life cycle are now included in the phylum Apicomplexa. *See also* Apicomplexa; organelle.

sporozoite A motile individual contained within a spore of an organism of the Apicomplexa phylum.

sporulation Producing or releasing spores.

spot flushing The removal of water from a specific location or area by flowing water from a hydrant blowoff or service connection.

spp. *See* species.

Sprague–Dawley rat A strain of albino rat commonly used for toxicological studies.

spray aerator An aerator consisting of a pressure nozzle through which water is propelled into the air in a fine spray. A spray aerator is also called a nozzle aerator.

spray dryer An evaporator that is used to concentrate and dry solids. Commonly, feedwater (such as salt water) is atomized and sprayed with a hot gas (air) stream into a drying chamber, where evaporation and drying of the solids takes place; a filter then separates the solids from the gas stream. A spray dryer is sometimes used in zero-discharge wastewater treatment facilities and for concentrate disposal in some small-scale desalting systems. *See also* zero discharge.

spray head A sprinkler irrigation nozzle installed on a riser that delivers water in a fixed pattern. Flow rates of spray heads are high relative to the area covered by the spray pattern.

spray tower A tower built around a spray aerator to keep the wind from blowing the spray and to prevent the water from freezing during cold temperatures.

spreader A wood, timber, concrete, or masonry plate or wall set, with its upper edge level, in a channel or ditch. A spreader is intended to spread the flow evenly over the channel floor. A spreader is also called a sill.

spreading (1) The process by which a small amount of a liquid, as a drop, when placed on a solid that it wets, will spread out as a film. (2) A process of diverting water from streams when the supply exceeds the demand, and carrying it—either by means of ditches or by allowing it to flow broadly—to areas of absorbent material, where it sinks to the zone of saturation.

spring A concentrated discharge of groundwater appearing at the ground surface as a current of flowing water.

spring breakup Fragmentation of the ice cover on water bodies, pieces of which are carried by currents.

spring-fed intermittent stream A stream, or stretch of a stream, that flows only at certain times when it receives water from springs. As with most intermittent streams, the intermittent character of spring-fed intermittent streams is generally caused by fluctuations of the water table such that stream channels stand a part of the time below the water table and a part of the time above it.

spring line (1) The theoretical center of a pipeline. (2) The guideline for laying a course of bricks.

spring tide The tide as it occurs when its range is a maximum, on the days following the new and full moon.

spring water Water obtained from an underground formation from which water flows naturally to the surface, or would flow naturally to the surface if it were not collected underground. *See also* spring.

sprinkle In meteorology, a light rain of scattered drops.

sprinkler system In fire protection, a network of overhead piping provided with systematically spaced sprinkler heads and connected to a suitable water supply, arranged so that actuation of fusible elements in the heads or other heat-sensitive devices causes the system to discharge water over a fire starting at any point.

spur (1) An obstruction of stone, timber, brushwood, or earth constructed from the bank of a channel and projecting into the channel to train the flow. (2) A similar structure for protecting the seashore from erosion.

spur terrace A short terrace used to collect or divert runoff.

SQL *See* Structured Query Language.

squamous cell carcinoma A malignant tumor derived from squamous cell epithelium (a particular cell in the skin).

square foot (ft^2) *See in the Units of Measure section.*

square inch ($in.^2$) *See in the Units of Measure section.*

square meter (m^2) *See in the Units of Measure section.*

square mile (mi^2) *See in the Units of Measure section.*

squeegee The metal blades attached to the scraper mechanism in a tank bottom.

squirrel-cage induction motor The most common type of induction electric motor. The rotor consists of a series of aluminum or copper bars parallel to the shaft,

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resembling a squirrel cage. It is also known as a split-phase motor.

SR *See* specific resistance.

sr *See* steradian *in the Units of Measure section.*

SRB *See* sulfate-reducing bacteria.

SRF *See* specific resistance to filtration; state revolving loan fund.

ss *See* stainless steel.

ssDNA Single-stranded deoxyribonucleic acid. *See also* deoxyribonucleic acid.

SSF *See* slow sand filtration.

SSMS *See* spark source mass spectrometry.

S. sonnei *See Shigella sonnei.*

ssRNA Single-stranded ribonucleic acid. *See also* ribonucleic acid.

SSU *See* Saybolt standard unit *in the Units of Measure section.*

stability (1) The ability of any substance to resist change. (2) The ability of an engineering structure, such as a dam or retaining wall, to resist movement when loads are applied to it. (3) The ability of an ion-exchange product or filter medium to withstand physical and chemical degradation in cycle-after-cycle operations. (4) The resistance of a density-stratified or thermally stratified body of water to mixing or overturning. *See also* thermal stratification.

stability index A numerical value that indicates the degree to which waters may cause scale or corrosion. *See also* Langelier saturation index; Riddick index; Ryznar stability index.

stabilization A water treatment process intended to reduce the corrosive or scale-forming tendencies of water.

stabilization tank A basin used in water treatment to adjust the pH of the water being treated. Following lime softening, for example, the pH typically is adjusted downward (i.e., stabilized) to an acceptable range for distribution and consumption. *See also* recarbonation.

stabilize (1) To produce a water that is exactly saturated with calcium carbonate ($CaCO_3$). (2) To prevent soil movement or the overturning of a structure. *See also* Langelier saturation index; Riddick index; Ryznar stability index.

stabilized channel An earth channel or canal in which, over a period of time, no appreciable erosion or deposition of silt or sediment occurs.

stabilized temperature platform furnace An instrument that furnishes the conditions needed to provide a consistent analytical process in atomic absorption spectrophotometry. Examples of these features include an L'vov platform, matrix modification, and background correction. These conditions minimize nonspectral interferences and allow many types of samples to be treated in a similar manner. *See also* atomic absorption spectrophotometric method; L'vov platform.

stable Resistant to change.

stack In demineralization, a basic electrodialysis operating unit consisting of membranes, separator, electrodes, and other appurtenances necessary to make a complete operating unit.

staff gauge A graduated scale (vertical unless otherwise specified), on, e.g., a plank, metal plate, pier, or wall, used to indicate the height of a liquid surface above a specified point or datum plane.

STAG *See* State and Tribal Assistance Grant.

stage (1) The elevation of a water surface above its minimum or above or below an established low-water plane or datum of reference. (2) One of many steps in the operation of an evaporator, filter, compressor, or pump, each of which is operated at different conditions of pressure. Such a stage is also called an effect. *See also* electrical stage; gauge height; hydraulic staging; regulatory stage.

stage, electrical *See* electrical stage.

stage, hydraulic *See* hydraulic staging.

stage, regulatory *See* regulatory stage.

stage–area curve A graphical representation of the relationship between reservoir depth and reservoir surface area.

stage–discharge curve A graphical representation of the relationship between surface water storage levels and surface water releases from a body of water or wetland.

stage–discharge relation The relation between gauge height and discharge of a stream or conduit at a gauging station. This relation is shown by the rating curve or rating table for such station.

Stage 1 DBPR *See* Stage 1 Disinfectants and Disinfection By-Products Rule.

Stage 1 Disinfectants and Disinfection By-Products Rule (Stage 1 DBPR) US Environmental Protection Agency regulations for disinfectants and disinfection by-products promulgated Dec. 16, 1998 (63 *Federal Register* 69390–69475), focused on reducing the levels of disinfectants and disinfection by-products in treated drinking water. It set maximum residual disinfectant levels for chlorine, chloramines, and chlorine dioxide and set maximum contaminant levels (MCLs) for two groups of organic disinfectant by-products, trihalomethanes and haloacetic acids, and for two inorganic disinfection by-products, chlorite and bromate. The maximum residual disinfectant levels were set at 4.0 milligrams per liter (as Cl_2) for chlorine and chloramines and 0.8 milligrams per liter (as ClO_2) for chlorine dioxide. Regulated for the first time under this rule, the MCL of the sum of five

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haloacetic acids (HAA5) was set at 0.060 milligrams per liter as a running annual average. The MCL for the sum of four trihalomethanes (THMs) was set at 0.08 milligrams per liter, for chlorite at 1.0 milligrams per liter, and for bromate at 0.01 milligrams per liter. Compliance with these MCLs is determined by the running annual average of the monitoring results from all compliance sites within a distribution system. A treatment technique was also mandated for total organic carbon (TOC).

stage treatment Any treatment in which similar processes are used in series or stages.

Stage 2 DBPR *See* Stage 2 Disinfectants and Disinfection By-Products Rule.

Stage 2 Disinfectants and Disinfection By-Products Rule (Stage 2 DBPR) US Environmental Protection Agency (USEPA) regulations, promulgated Jan. 4, 2006 (71 *Federal Register* 388–493), intended to set limits on peak and average levels of disinfection by-products (DBPs) in drinking water supplies, and so reduce the risk of potential reproductive and developmental health effects and cancer. USEPA's Stage 2 DBPR requires compliance with a total trihalomethane maximum contaminant level (MCL) of 0.08 milligrams per liter and a total haloacetic acid MCL of 0.06 milligrams per liter, both based on a locational running annual average at the new Stage 2 DBPR sampling sites identified by the initial distribution system evaluation. This rule maintained the same levels of MCLs for these two groups of organic disinfectant by-products but changed how compliance with the rule was calculated. Under Stage 2, monitoring data at each location must meet the MCL, based on the locational running annual average.

Stage 2 Federal Advisory Committee Act (FACA) agreement An agreement developed by a FACA committee that resulted in the Stage 2 Disinfectants and Disinfection By-Products Rule (Stage 2 DBPR) and Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The FACA committee, consisting of 21 members representing various stakeholder groups, was convened in March 1999. The FACA committee collected, developed, and evaluated new information that became available after the Stage 1 Disinfectants and Disinfection By-Products Rule was published. During the final days of discussions in September 2000, the FACA committee reached agreement on formal recommendations, expressed in an Agreement in Principle, published in the *Federal Register* (65 FR 83015–83024).

stagnation A condition that occurs when water is motionless, or nearly motionless, and does not flow in a stream or move in a lake. Similar no-flow or low-flow conditions can occur in a finished water storage reservoir or in a distribution system piping network.

stainless steel (ss) A chromium alloy steel (usually 10 to 25 percent chromium) that is resistant to rusting and corrosion. Austenitic stainless steel contains 16 percent or more chromium and 7 percent or more nickel, as well as 2 percent silicon for stress-corrosion-resistant stainless steel. Ferritic stainless steel contains chromium and cannot be hardened by heat treatment. Martensitic stainless steel contains chromium and can be hardened by heat treatment.

stainless-steel band A full-circle water main repair band made from stainless steel and placed around the main to repair holes or leaks. A gasket material, attached to the inside of the band, is pressed against the water main to form the seal as the band is tightened by bolts connected to each end of the band. The stainless steel provides a measure of protection against corrosive soils.

stake dam A dam composed of brush held in an advantageous place by staggered rows of stakes, used to retard the velocity of surface water flow on a slope.

stakeholder A group, organization, person, or agency who has an interest in, decision-making responsibility for, or authority over a process and who is affected by or will benefit from the outcome of a process.

stale water Water that has not flowed recently and may have picked up tastes and odors from distribution or storage facilities.

standard (1) A recommended practice in the manufacturing of products or materials or in the conduct of a business, art, or profession. Such standards may or may not be used as (or called) specifications. (2) A document that specifies the minimum acceptable characteristics of a product or material, issued by an organization that develops such documents (e.g., an American Water Works Association standard). (3) A numerical contaminant limit set by a regulatory agency (e.g., a US Environmental Protection Agency maximum contaminant level). *See also* standard method(s).

standard, analytic *See* analytic standard.

standard addition, method of *See* method of standard addition.

standard atmospheric pressure *See* standard pressure.

standard bioassay for carcinogens *See* carcinogenesis bioassay.

standard biochemical oxygen demand Biochemical oxygen demand as determined under a standard laboratory procedure for 5 days at 68° Fahrenheit (20° Celsius), usually expressed in milligrams of oxygen per liter.

standard cell potential (ΔE^0) The voltage measured in an electrochemical cell under standard conditions (i.e., 1-molal concentration—which is essentially the same as 1 molar—for all dissolved materials; 1 atmosphere

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(101.3 kilopascals) pressure for gases; and the most stable form of solids at 77° Fahrenheit (25° Celsius). When a cell operates under standard conditions, its ΔE^0 depends only on the chemical nature of the reactants and products. The standard cell potential can be taken as a quantitative measure of the tendency of reactants in their standard states to form products in their standard states. In short, ΔE^0 represents the driving force of the chemical reaction. For example, in a zinc–copper cell, the relevant equations are as follows:

$$Zn^{2+} + 2e^- = Zn,\ E^0 = -0.76 \text{ volt}$$
$$\text{or } Zn = Zn^{2+} + 2e^-,\ E^0 = +0.76 \text{ volt}$$
$$Cu^{2+} + 2e^- = Cu,\ E^0 = +0.34 \text{ volt}$$
$$Zn + Cu^{2+} = Cu + Zn^{2+},\ \Delta E^0 = 1.10 \text{ volts}$$

standard compression hydrant A type of dry-barrel hydrant in which the main valve closes upward with the water pressure, creating a positive seal. *Compare with* eddy hydrant.

standard cubic feet per minute (SCFM) *See in the Units of Measure section.*

standard deviation A measure of the dispersion of a data series about its mean. The standard deviation is calculated as the square root of the squared deviations of all values in the series from the mean of the series. The more spread out the distribution of the values included, the higher the standard deviation. If the data series (e.g., persons, firms, farms, trees, or some other series) includes the totality of items in the data series (population data), the standard deviation is denoted as σ and is given by the following formula:

$$\sigma = \sqrt{\frac{\sum (x_i - \bar{x})^2}{N}}$$

Where:

x_i = the value of the *i*th item in the data set
$\bar{x}$ = the mean of the data set
N = the population size of the data set

If the data are drawn from a sample of the population, the standard deviation is usually denoted as S and is given by the formula

$$S = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n - 1}}$$

Where:

x_i = the value of the *i*th item in the data set
$\bar{x}$ = the mean of the data set
n = the sample size of the data set

The $(n - 1)$ term in the denominator reflects the loss of one degree of freedom resulting from the use of sample data rather than whole-population data. In the context of probabilities, the standard deviation enables taking account of the variation in a data series, thereby helping in drawing sound conclusions from the available information. For example, in a normal probability distribution (a bell-shaped frequency curve), one standard deviation on each side of the mean value encompasses about 68 percent of the area under the curve—i.e., there is a 68 percent probability in repeated samples that the true mean value will lie within ±1 standard deviation of the sample mean. Similarly, a 95 percent probability exists that the true mean is within ±2 standard deviations of the sample mean; and the probability that the true mean is within ±3 standard deviations is virtually 100 percent. The standard deviation is often called the standard error because its derivation stems from deviations (or errors) from a predicted or estimated mean. *See also* normal distribution; standard error of the estimate; standard error of the mean; *see also* frequency distribution; probability distribution; standard error of the coefficient.

standard electrode potential (E^0) A measure of the tendency of a given half-reaction (e.g., a metal losing electrons to become an ion or an ion accepting electrons to become a metal) to proceed for a reactant or product in its standard state. The standard cell potential is the sum of the two half-cell potentials, one associated with each of the half-reactions in the cell. It is also referred to as the standard half-cell potential. *See also* standard cell potential.

standard error *See* standard deviation.

standard error of the coefficient A statistical measure of the dispersion around regression analysis coefficients. In regression analysis, a coefficient is calculated for each independent variable included in the analysis. Each coefficient is derived from the best fit given by the method of least squares. Because each coefficient is presumed to be from a random sample and unbiased, each coefficient has a probability distribution around it. In a normal probability distribution (i.e., a bell curve) the area under the curve is directly related to the number of standard errors above and below the mean value. The mean ±1 standard error encompasses about 68 percent of the area under the curve; 2 standard errors equates to about 95 percent, and 3 standard errors equates to 100 percent of the area under the curve. These percentages of area under the curve reflect the probability that, in repeated samples, the true population mean will be included within the probability range defined by the number of standard errors about the population mean. *See also* frequency distribution; probability distribution; standard deviation; t-test.

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S

standard error of the estimate (S_e, $S_{Y.123...}$) A statistical measure of the dispersion of regression analysis point estimates. In regression analysis, point estimates are made of the dependent variable for any given values of the independent variables. The point estimates are made from sample data and consequently have a probability distribution around them. If the errors are randomly distributed (with a mean of zero and a constant variance over the range of independent variable values), the actual dependent variable values will fall within a probability range defined by the point estimate plus or minus a number of standard errors that relate to selected probabilities. One standard error relates to about 68 percent probability, 2 standard errors to about 95 percent probability, and 3 standard errors to virtually 100 percent probability. The general formula for computing the standard error of the estimate in multiple regression is as follows:

$$S_{Y.123...} = \sqrt{\frac{\text{unexplained variation}}{\text{number of degrees of freedom}}}$$

Where:

$S_{Y.123...}$ = the error of the forecast of the dependent variable Y when independent variables 1, 2, 3, ... are used to make the forecast

Unexplained variation is the sum of the differences between the point estimates derived from the regression and the actual values of Y given the independent variable values. Unexplained variation is equal to $\Sigma(Y_i - Y')^2$, which is the sum of the squared differences between the actual values of the dependent variable (Y_i) and the forecasted value (Y'). The number of degrees of freedom is calculated as the total sample size less the number of coefficients estimated in the analysis. Therefore, the larger the sample size, the better the estimate of the population standard error. The general formula for the standard error of the estimate with two independent variables would be

$$S_{Y.12} = \sqrt{\frac{\sum(Y_i - Y')^2}{n - 3}}$$

where n is the sample size (of number of observations in a regression analysis). Note that, with two independent variables, three degrees of freedom are lost because one degree of freedom is lost for each independent variable and one for the estimate of the intercept term, the constant in $Y = a + bx_1 + cx_2$. An additional degree of freedom would be lost for each additional independent variable that might be added.

standard error of the mean ($\sigma_{\bar{x}}$) A statistical value computed by dividing the standard deviation of a sample drawn from a population by the square root of the sample size. This value provides an estimated standard deviation for the distribution of repeated sample means that could be drawn from a population—hence the term *standard error of the mean.* The formula is as follows:

$$\sigma_{\bar{x}} = \sqrt{\frac{\sigma_x}{n}}$$

Where:

$\sigma_{\bar{x}}$ = the estimated standard deviation of the mean of sample means

σ_x = the standard deviation of the sample taken

n = the number of observations

standard fall diameter The diameter of a sphere that has a specific gravity of 2.65 and has the same standard fall velocity as the particle in question.

standard fall velocity The average rate of fall that a particle would attain if falling alone in quiescent distilled water of infinite extent and at a temperature of 75.2° Fahrenheit (24° Celsius). *See also* fall velocity; settling velocity; Stokes's law.

standard fire stream A stream of water delivered at a rate of 250 gallons per minute (0.016 cubic meters per second) from a 1⅛-inch (28.6-millimeter) smooth nozzle.

standard free energy (G^0) The Gibbs free energy of a reactant or a product in its standard state. *See also* Gibbs free energy; standard free-energy change.

standard free-energy change (ΔG^0) The free-energy change that accompanies the conversion of reactants in their standard states to products in their standard states. If ΔG^0 for a chemical reaction is negative, the reactants in their standard states will be converted spontaneously to products in their standard states. If ΔG^0 is positive, this conversion will not be spontaneous; however, the corresponding reverse reaction will be. When ΔG^0 is positive, some products can be formed, but not in concentrations as great as for the standard state. *See also* Gibbs free energy; standard cell potential.

standard industrial classification (SIC) codes Four-digit codes established by the US Office of Management and Budget and used to classify nonresidential facilities (e.g., industrial, commercial, and institutional) by the type of activity for which they are used.

standardization (1) The procedure necessary to bring a preparation to a specified or known concentration, e.g., preparation and adjustment of a standard solution in volumetric analysis. (2) The process of comparing an instrument or device with a standard to determine the relationship between results obtained

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with the instrument or device and those obtained with the standard. *See also* rating.

standardize (1) In wet chemistry, to find out the exact strength of a solution by comparing it with a standard of known strength. This information enables one to adjust the strength of the solution by adding more water or more of the substance dissolved. (2) To set up an instrument or device to read a standard. This procedure allows one to adjust the instrument so that it reads accurately or to apply a correction factor to the readings.

standardized monitoring framework A compliance monitoring framework developed by the US Environmental Protection Agency (USEPA) and intended to standardize monitoring cycles. It is based on a 9-year compliance cycle. Each 9-year cycle consists of three 3-year compliance periods. All compliance cycles and periods are based on a calendar year. The framework was first applied in the USEPA's Phase II Rule. *See also* Phase II Rule.

standardized mortality rate A summary measure of the death rate that a population would have if it had a standard age structure. Morbidity can also be expressed in this manner. The standardized mortality rate is also called the age-adjusted death rate.

standardized mortality ratio (SMR) The ratio, multiplied by 100, of the number of deaths observed in the study population to the number of deaths (usually age, time, and cause specific) expected if the study population had the same specific rates as the standard or general population. This concept is used frequently in occupational epidemiology. A standardized mortality ratio of 175 indicates that mortality is 75 percent greater than would be expected. Morbidity can also be expressed in this manner. *See also* proportional mortality ratio.

standardized rate A weighted averaging of a characteristic-specific rate, e.g., the crude mortality rate, according to a standard distribution of age or other selected characteristics of the population. Standardization is necessary when one is comparing crude rates for two or more populations that differ with respect to a characteristic (confounding variable), such as age, that independently influences the risk of death. Adjustment methods are classified as either direct or indirect. *See also* crude rate.

standardized rate ratio A rate ratio in which both rates in the ratio (i.e., both the numerator and denominator rates) have been standardized to the same population distribution.

standard method(s) (1) An assembly of analytical techniques and descriptions commonly accepted in water and wastewater treatment. (2) A shorthand way of referring to *Standard Methods for the Examination of Water and Wastewater*, published jointly by the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF). (3) Validated methods published by professional organizations and agencies covering specific fields or procedures. The publishers include, among others, APHA, American Public Works Association, American Society of Civil Engineers, American Society of Mechanical Engineers, ASTM International, AWWA, National Institute of Standards and Technology, American National Standards Institute, US Public Health Service, WEF, and the US Environmental Protection Agency.

standard metropolitan statistical area (SMSA) A land area classification that was introduced in the United States to provide an appropriate unit for statistical descriptions. Both a city and its surrounding areas are included in an SMSA because of extensive interactions between these areas. To qualify as a standard metropolitan statistical area, an area must meet certain criteria with respect to size, population density, and social and economic interactions and conditions. The US Bureau of the Census sets these criteria.

standard monitoring Initial monitoring required by the Safe Drinking Water Act.

standard National Weather Service gauge A rain gauge developed and used at regular and cooperative stations of the National Weather Service. It consists of a circular collector, 8 inches (203 millimeters) in diameter, with a funnel-shaped bottom that drains into a cylindrical brass measuring tube. The tube has a cross-sectional area equal to one tenth that of the collector plus the area of the measuring stick, so that 1 inch (25.4 millimeters) of rainfall on a collector will fill the measuring tube to a depth of 10 inches (254 millimeters).

standard National Weather Service pan A land evaporation pan developed and used by the National Weather Service. It is circular in shape, 4 feet (1.2 meters) in diameter, 10 inches (254 millimeters) in depth, and set on a framework of timbers laid crosswise with the top 12 inches (305 millimeters) from the ground. The water surface in the pan is maintained during the course of observation between 1.5 and 2.5 inches (38.1 and 63.5 millimeters) from the top of the pan.

standard operating procedure (SOP) A set of instructions or guidelines directing personnel to take certain actions under certain conditions.

standard orifice *See* sharp-edged orifice.

standard plate count (SPC) Obsolete term. *See* heterotrophic plate count.

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standard pressure Atmospheric pressure at sea level under standard conditions of temperature, 273.1 kelvin. *See also* atmospheric pressure.

standard pumper-connection fire hydrant A standard fire hydrant with two hose connections and a 4-inch (10-centimeter) outlet for connection to a pumper truck that can take suction from the fire hydrant and pump water to increase pressure for firefighting.

standard reference material *See* certified reference material.

standard sample An aliquot of finished drinking water that is examined for the presence of coliform bacteria. *See also* coliform bacteria.

standard short tube A tube with a diameter about one third its length. Such a tube is also called a standard tube.

standard solution A solution with an accurately known concentration, used in the laboratory to determine the properties of unknown solutions.

standard temperature and pressure (STP) A standard set of conditions used in developing certain relationships in chemistry: A temperature of 273.1 kelvin (0° Celsius) and a pressure of 101.3 kilopascals (1 atmosphere).

standard test conditions A set of specified variables that are fixed for performance testing or comparison, e.g., for factory testing of reverse osmosis membranes at a constant feedwater quality, temperature, pressure, and recovery to measure permeate flow rate and salt rejection or salt passage at a specified operating time.

standard tube *See* standard short tube.

standby generation Electrical generation equipment used for emergency situations or other specifically defined times (e.g., peak demand periods) to minimize electrical demand charges.

standby plant An electric power plant that is maintained in a condition to produce power in case of emergencies, such as breakdowns occurring in the regular generating stations or transmission lines.

standby service Service provided occasionally under certain defined conditions, such as in the event of failure of the customer's normal water supply system. Fire protection is another form of standby service.

standing crop The biota present at a selected point in time in an environment.

standing sample A 1-liter sample collected from the kitchen or bathroom cold-water faucets of targeted sample sites, representing water standing in the interior piping for at least 6 hours. Standing samples will often contain higher levels of a contaminant that has been picked up because of prolonged exposure to a pipe wall or faucet. A standing sample is also known as a first-draw tap sample by the US Environmental Protection Agency. *See also* first-draw residential lead sample.

standing water level The water level in a nonpumping well, whether the well is within or outside the influence area of pumping wells. If the well is outside the influence area, this term is equivalent to *static water level;* if the well is within the influence area, the standing water level is one elevation on the pumping depression cone. *See also* circle of influence; cone of depression; drawdown; well cone of influence; zone of influence.

standpipe A high tank, usually small in diameter compared to height, for holding water. This water is used to maintain pressure in a water supply system and as storage for fire protection.

standpipe mixing system (1) The process of mixing chlorine or other chemicals in source water prior to treatment to achieve longer retention times. This can be in a raw water line, standpipe, or elevated reservoir if available. (2) The process of adding additional chlorine or chemicals in a standpipe or elevated storage to provide further disinfection and prevent regrowth in the distribution system.

stannous chloride ($SnCl_2 \cdot 2H_2O$) White in color, water-soluble crystalline solid used chiefly as a reducing agent.

***Staphyloccocal enterotoxin* B (SEB)** An infectious disease agent caused by bacteria. It can be used as a bioweapon.

start-action notice A notice that initiates work on a rule or related action and establishes a work group within the US Environmental Protection Agency (USEPA). The office within the USEPA developing the rule, referred to as the lead office, prepares the start-action notice at the outset of its effort to develop a regulation. The notice provides brief, descriptive information about the rule to be developed, alerts other agency offices to the lead office's intention to develop a rule, and serves as the mechanism for reaching internal agreement on the necessary review steps for the new rule.

starter A device used to start up large motors gradually to avoid severe mechanical shock to a driven machine and to prevent disturbance to the electric lines (which would cause dimming and flickering of lights).

starting head loss *See* clean bed head loss.

startup The activity associated with initiating the operation of a unit process or treatment facility.

state (1) The agency of the state government that has jurisdiction over public water systems. During any period when a state has not been delegated primary enforcement responsibility, the designation *state* will refer to the regional administrator of the US

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Environmental Protection Agency. (2) The characteristics or description of a system. As associated with thermodynamics, on a macroscopic scale, the state of a system is determined when it can be accurately characterized or described (to the limits of experimental measurement ability) in terms of all of the properties of thermodynamic interest. Measurable properties of matter that describe the macroscopic state of a system are called state variables (e.g., pressure, temperature, volume, density, refractive index, and magnetic susceptibility). Time-dependent processes taking place within a system characterize a transient state. Time-independent processes can be either dynamic or static. If dynamic, they characterize a steady state. If static, they characterize an equilibrium state. Equations of state (e.g., the ideal gas law) describe a quantitative relationship that exists between intensive (mass-independent) system parameters (e.g., pressure, temperature) and the extensive (mass-dependent) system parameters (e.g., volume, number of moles of a substance). *See also* state function.

State and Tribal Assistance Grant (STAG) Grant funds administered by US Environmental Protection Agency that are used to enhance the capacity of states and tribes to carry out compliance assurance activities within their respective jurisdictions. The projects selected cover a wide range of activities that enable states/tribes to demonstrate compliance assurance and enforcement outcomes from their activities while serving as models for other states/tribes.

state function A system property that has some definite value for each state and is independent of the manner in which the state is reached.

Statement 34 A set of requirements for local and state government accounting designed to improve financial reporting and indicate how the entity is performing as a steward of publicly owned assets. It also requires recording of all capital assets, with depreciation shown as an expense or development of an asset management plan that demonstrates the condition level the organization is trying to achieve for its capital assets. *See also Basic Financial Statements—and Management's Discussion and Analysis—for State and Local Governments.*

state of the art The most advanced level of development of a device, procedure, process, technique, or science at any particular time.

state-of-the-knowledge (SOK) report A report prepared to summarize all of the available information on a specific topic.

State Plane Coordinate System (SPCS) A system of *x–y* coordinates for each state maintained by the National Geodetic Survey and commonly used in geographic information system technology in the United States. One of two map projections—Transverse Mercator (for states with a north–south orientation) or Lambert Conformal (for states with an east–west orientation)—is usually used to define one or more specific zones for each state. The geographic extent of the zones is limited to a distance of 158 miles (254 kilometers) (east–west in the Transverse Mercator or north–south in the Lambert Conformal) to limit the amount of distortion that accumulates because of the curvature of the earth. *See also* geographic information system.

state revolving loan fund (SRF) A mechanism whereby federal funds are provided to states to capitalize a state loan for the purpose of providing low-interest loans. For example, a state revolving loan fund was established under the federal Clean Water Act and the federal Safe Drinking Water Act whereby the federal government provided capitalization grant money to states to provide low-interest loans to communities for constructing wastewater treatment facilities and water treatment facilities, respectively. In general, states must meet specific US Environmental Protection Agency requirements to receive capitalization grants for these revolving loan funds and provide a specified percentage of matching funds. *See also* Drinking Water State Revolving Fund.

state water quality certification A certification issued by a state water quality agency under Section 401 of the Clean Water Act.

static Fixed in position; resting; without motion.

static discharge head The difference in height between the pump centerline and the level of the discharge free water surface.

static groundwater level The level of groundwater in a well when the well pump is not operating and the water level is not changing (i.e., the level at equilibrium). Depending on aquifer properties, it might take anywhere from several minutes after shutoff to many days after shutoff to reach this level.

static head When water is not moving, the vertical distance from a specific point to the water surface. *See also* dynamic pressure head; static pressure.

static mixer A device designed to produce turbulence and mixing of chemicals with water by means of fixed sloping vanes within the unit, without the need for any application of power. The energy required is a function of the head loss through the unit.

static pressure When water is not moving, the vertical distance from the specific point of interest to the water surface. The static pressure is the static head multiplied by the specific weight of water. *See also* dynamic pressure head; static head.

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static suction head The difference in elevation between the pump centerline and the free water surface of the reservoir feeding the pump. In the measurement of static suction head, the piezometric surface of the water at the suction side of the pump is higher than the pump; otherwise, static suction lift is what is being measured. *See also* static suction lift.

static suction lift The difference in elevation between the pump centerline and the free water surface of the liquid being pumped. In a static suction lift measurement, the piezometric surface of the water at the suction side of the pump is lower than the pump; otherwise static suction head is what is being measured. *See also* static suction head.

static system A system or process in which the reactants are not flowing or moving.

static water depth The vertical distance from the centerline of the pump discharge down to the surface level of the free pool while no water is being drawn from the pool or water table.

static water level (SWL) The water level in a well measured when no water is being taken from the aquifer by pumping.

static water system A water system in which, at the moment, water is not moving.

stationary phase A substance that remains in place during chromatographic separations. Typically, stationary phases are bonded to particles or to the interior wall of capillary tubes. Stationary phases interact with analytes and a mobile phase to allow analytes to be separated. A number of mechanisms, such as adsorption or ion exchange, can account for the interaction between analytes and the stationary phase. *See also* gas chromatography; high-performance liquid chromatography.

stationary surface washer A stationary system used to clean the media surface in a filter. Unlike a rotary surface washer, a stationary surface washer is a fixed pipe grid with small holes that produce high-velocity water or air jets to clean the media surface at the beginning of a backwash cycle. *See also* rotary surface washer.

station rating curve A curve showing the relationship between gauge height and discharge of a stream or conduit at a given gauging station. A station rating curve is a graphical representation of a rating or discharge table.

statistical analysis A set of techniques used to analyze a set of observations from a population in order to draw inferences about the population.

statistically significant Pertaining to a situation in which, at a specified confidence interval and for a valid null hypothesis, an observed difference or association is not likely a result of chance alone. *See also* confidence interval; hypothesis; probability value.

statistical power The probability, at a specified confidence level, that the null hypothesis will be rejected when it is false or that a study will demonstrate a statistically significant result when a difference or an epidemiologic association actually exists in the population. *See also* hypothesis; statistically significant.

statistical significance test A statistical procedure to test the null hypothesis. An estimate is made of the probability of the observed difference or epidemiologic association under conditions of the null hypothesis in an experiment or random sample of a given size. From this estimate, the statistical significance can be stated, usually as a *p* (for probability) value. Statistical significance does not mean the association is of biological significance or that bias or systematic error was not present. Neither does it mean that random error or chance can be completely ruled out as the explanation for the observed result. Most epidemiologists feel that strict reliance on statistical significance testing is not appropriate. *See also* bias; confidence interval; hypothesis; probability value.

statistics A branch of mathematics dealing with the collection and analysis of data with a view toward drawing inferences on the population from which the data are collected.

stator (1) The nonrotating or stationary part of an alternating current electrical motor. (2) A fixed baffle in a mixing chamber or vessel to help promote the mixing of a solution.

Stauwerke gate An automatic crest gate operated by counterweights placed either above or below the water surface.

steady flow A type of flow in which the properties of flow do not vary with time. Equilibrium flow to a well is a type of steady flow. *See also* steady uniform flow.

steady nonuniform flow A flow in which the quantity of water flowing per unit of time remains constant at every point along the conduit but the velocity varies along the conduit because of changes in the hydraulic characteristics.

steady operating flow rate The flow rate in gallons (liters) per minute at which a water-processing filter or ion exchanger will deliver its rated capacity. For water softeners, this flow is based on delivering softened water from an incoming source water having 342 milligrams per liter (20 grains per gallon) total hardness as calcium carbonate ($CaCO_3$).

steady state A condition in which the input energy equals the output energy. This term may apply to any continuous physical, chemical, or biological process.

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steady-state analysis A pipe network analysis that assumes that consumptions, supplies, storage-tank levels, and certain other variables are unchanging for one specific point in time.

steady uniform flow A flow in which the velocity and the quantity of water flowing per unit of time remain constant. *See also* steady flow.

steam distillation extraction *See* simultaneous distillation extraction.

steamer outlet nozzle *See* pumper outlet nozzle.

steam power Any type of energy or power generated or developed through the use of a steam engine. This term is commonly applied to electrical energy or power generated by the use of steam engines or turbines to drive electric generators.

steam pump A pump operated by a steam engine, in which the steam and water cylinders placed in the same machine are considered a single unit.

steam turbine A prime mover in which the pressure or motion of steam on vanes is used for the generation of mechanical power.

steam vacuum pump A displacement pump in which steam admitted to the cylinder is condensed by a stream of water, creating a vacuum that serves to draw the water into the cylinder. When the cylinder is full, or nearly so, steam under full boiler pressure is admitted, forcing the water out through the outlet valve.

steel An iron-base alloy malleable under certain conditions, containing up to 2 percent carbon, and having varying qualities of hardness, elasticity, and strength according to composition and the type of heat treatment given to the alloy.

steel bolted tank A cylindrical tank that is constructed with curved steel plates bolted together, with gasket material between plates at the bolted areas.

steel pipe Pipe manufactured out of rolled steel sheets or plates with welded longitudinal or spiral seams. For water applications, the interior can be lined and a coating applied to the exterior for corrosion protection.

steep slope (1) A conduit slope greater than the critical slope for a particular discharge; the slope for which the depth of flow is less than Belanger's critical depth and the velocity is greater than Belanger's critical velocity. (2) A slope greater than the friction slope. *See also* Belanger's critical velocity.

steering committee A standing group within the US Environmental Protection Agency (USEPA), with representation from each assistant administrator and the Office of General Counsel, that coordinates and integrates the USEPA's regulatory development activities. The committee's key functions are to approve start-action notices; to charter and monitor the progress of staff-level work groups, especially regarding cross-media or interoffice problem solving; and to ensure, when appropriate, that significant issues are resolved or elevated to top agency management. USEPA's regional offices participate in steering committee activities through regional regulatory contacts who coordinate reviews in their regions and facilitate rule-related activities for the regional administrators.

STEL *See* short-term exposure limit.

stem cell A cell that still possesses the capability of differentiating. Stem cells are generally nondifferentiated cells that do not yet possess all of the characteristics of the functional cell of an organ. *See also* stromal cell.

stemflow Rainfall or snowmelt fed to the ground down the trunks or stems of plants.

step dose Any of the doses applied under conditions such that the chemical is fed continuously at progressively larger or smaller dosages. One can use a step dose in tracer testing to determine the hydraulic characteristics of the basin being evaluated by comparing the amount of time required for the concentration of the tracer in the effluent to reach a specified percentage of the influent concentration.

STEP guides *See* Simple Tools for Effective Performance guides.

step testing The measurement of water flow in successive sections of a water supply network. A large increase in water flow between successive readings suggests that a leak may exist in the last section closed down. Both pressure and flow are monitored during step testing as leakage rates are impacted by the change in pressure that occurs as sections of the test grid are closed. A modified step test is often performed by gradually closing a valve on the input supply main and measuring successive pressure reductions in the zone. The data gathered in this test allows calculation of the N1 exponent of the fixed variable area discharge (FAVAD) path model, which gives a measure of the pressure management potential existing in the zone or district metered area (DMA). *See also* fixed and variable area discharge path model; pressure management.

stepwise multiple linear regression analysis A statistical procedure to develop a regression equation consisting of several independent variables to predict dependent variables. The independent variables are entered into the equation one at a time in order of their relative importance in terms of explaining the dependent variable. *See also* multiple linear regression analysis.

stepwise regeneration The process of regenerating ion-exchange resin beds several times with the same regenerant but at a higher concentration each time. This method is usually used to avoid calcium sulfate ($CaSO_4$) precipitation when sulfuric acid (H_2SO_4) is

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employed as a regenerant for cation bed units of deionizer systems being used to decationize unsoftened feedwater.

steradian (sr) *See in the Units of Measure section.*

stereoplotter A device used in photogrammetric mapping to digitize the horizontal position and elevation of selected points and features visible in aerial photographs.

sterilization The process of destroying all forms of microbial life on and in an object by physical or chemical means. *See also* disinfection; pasteurization.

sterilize To apply physical treatment (heat, ultraviolet irradiation, gamma irradiation, or filtration) or chemical treatment to kill or remove all life forms in a liquid, in or on a material, or on a surface. *See also* disinfection; pasteurization.

sterilized water *See* bottled sterile water.

sterol A group of predominantly unsaturated solid alcohols of the steroid group, such as cholesterol and ergosterol, present in the fatty tissues of plants and animals. Sterols in water could be used as biomarkers to evaluate wastewater or fecal contaminations.

Stiff-and-Davis stability index (S&DSI) An index, generally applicable to waters with total dissolved solids greater than 10,000 milligrams per liter, that indicates whether a water is in equilibrium with calcium carbonate ($CaCO_3$).

$$S\&DSI = pH_a - pH_s$$

Where:

pH_a = the actual pH of the water
pH_s = the pH of saturation, the pH of the water if it were saturated and at equilibrium with calcium carbonate

The pH_s value is calculated based on the concentrations of calcium and alkalinity, as is the pH_s of the Langelier index, as well as a specified constant that is dependent on ionic strength and temperature. Stiff-and-Davis stability index values greater than, less than, or equal to zero indicate the tendency of a water to deposit calcium carbonate, dissolve it, or be at equilibrium with it, respectively. They are used for scale-control calculations, such as for reverse osmosis membrane concentrate streams. *See also* Langelier saturation index; Riddick index; Ryznar stability index.

stiffness class The nominal stiffness of a specified pipe.

stilling basin A structure or excavation that reduces the velocity or turbulence of flowing or falling water.

stilling well A pipe, chamber, or compartment with one or more comparatively small inlets connected with a main body of water. The purpose of a stilling well is to dampen waves or surges while permitting the internal water level to rise and fall with the major fluctuations of the main body of water. A stilling well is used with water-measuring devices to improve the accuracy of measurement.

still water A portion of a stream or basin in which no apparent current exists.

stirred sludge volume index A measure of the settling characteristics of a solid suspension determined by evaluating the settled volume of the suspension after a prescribed time for a given initial concentration. The suspension is slowly stirred by a mechanical apparatus; the container is often a cylindrical column, such as a graduated cylinder. The index is expressed in milliliters of settled sludge per gram of solids in suspension.

stochastic Pertaining to actions for which the results occur from probabilistic events.

stochastic process A process involving a random variable dependent on a parameter, usually time.

stoichiometric Pertaining to the proportions in which chemicals combine to form compounds, as well as the mass relations in chemical reactions.

stoichiometric equation A symbolic representation of a chemical equation in which the proportions of various constituents are also represented.

stoichiometry The mathematical and theoretical study of how elements combine in predetermined quantities to form compounds.

Stokes's law A formula for calculating the rate of fall of particles through a liquid medium. In the laminar flow region, the rate at which a spherical particle will fall when suspended in a liquid medium varies directly with the square of the particle's diameter, the density of the particle, and the viscosity of the fluid. In equation form,

$$V_s = \frac{g(\rho_s - \rho)d^2}{18\mu}$$

Where (in any consistent set of units):

V_s = the settling velocity
g = the gravitational constant
ρ_s = the density of the particle
ρ = the density of the fluid (water)
d = the diameter of the particle
μ = the absolute viscosity

stomacher A mechanical, electric motor–driven device used for thoroughly mixing a food or environmental sample with sterile water or other diluting fluid prior to analysis of the sample.

stoney gate A crest gate used in connection with very large openings in hydraulic structures, such as spillways on dams. This type of gate is carried by a set of rollers that travel vertically in grooves in masonry piers and are independent of the gate and piers. The gate moves vertically by rolling along the rollers; this

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design eliminates friction caused by water pressure to a great extent, and it reduces the power required to open and close the gate.

stop box A receptacle that provides access to the service shutoff valve located on a service line, usually between the main and the meter. Quite often the stop box is located on the property line or between the curb and the sidewalk. A stop box is also referred to as a curb stop or valve box. *See also* curb stop and box.

stopcock A small valve for stopping or regulating the flow of a fluid through a pipe or burette.

stop gate (1) A hand-placed gate, usually made of metal, used to divert or block flow in an open channel. (2) A form of lock gate that is raised vertically.

stop log A log, plank, cut timber, or a steel or concrete beam fitting into end guides between walls or piers to close an opening in a dam or conduit to the passage of water. Stop logs usually are handled or placed one at a time.

stopped flow experiment A frequently used rapid kinetics technique. It involves the mixing of two (or possibly more) small-volume solutions using a high-efficiency mixer. It allows the resultant mixture to enter and pass through a measurement flow cell in very short time (milliseconds) and into a stopping syringe. *See also* kinetics.

stop plank A removable plank (usually wooden, but sometimes steel) that is placed in a groove or rack to block off the flow of a liquid from one compartment or channel to another.

stop valve A large valve installed in a pipeline to shut off flow in a section to permit inspection or repair. Such valves are usually installed in the main lines. A stop valve is also called a sectionalizing valve.

storage The impounding of water, in either surface reservoirs or underground reservoirs, for future use. Storage differs from pondage and regulation of stream flow in that the latter refer to more or less temporary retention of the water, whereas storage involves retention for much longer periods.

Storage and Retrieval of US Waterways Parametric Data (STORET) A repository of waterway parametric data, including information on ambient, intensive survey, effluent, and biological water quality of the waterways within and contiguous to the United States. This program was first developed by the US Public Health Service in 1964 to collect and disseminate basic information on chemical, physical, and biological quality of the nation's waters. The US Environmental Protection Agency now manages the program, which is available on the agency's Web page.

storage capacity The maximum volume of water available for use from a water storage tank, e.g., the amount available from a reverse osmosis or distiller water storage tank.

storage capacity curve A curve expressing the relationship between the volume of a space and the upper level of elevation of the material occupying the space. In the case of a reservoir, the curve depicts the relationship between the water surface elevation in the reservoir and the volume of water below that elevation. A storage capacity curve is also called a capacity curve.

storage coefficient (1) For surface waters, a coefficient devised by Allen Hazen to express the relationship of storage capacity in a reservoir to the mean annual flow of a stream above the dam forming the reservoir. The coefficient is the ratio of reservoir storage capacity to the annual water volume entering the reservoir. A reservoir with a large storage coefficient (greater than 1) can store multiple years' worth of flow, whereas one with a small coefficient must pass some fraction of the inflow over the dam every year. (2) For groundwater, the volume of water released from storage per unit decline in peizometric head per unit area of aquifer. In the US customary system, the storage coefficient would be the volume of water (in cubic feet) released from storage in a vertical column of aquifer having a base of 1 square foot when the piezometric surface falls 1 foot. In the Système International, it would be the volume of water (in cubic meters) released from storage in a vertical column of aquifer having a base of 1 square meter when the piezometric surface falls 1 meter. The value of this storage coefficient is approximately equal to the specific yield in an unconfined aquifer. *See also* specific yield.

storage equation An axiom stating that the volume of inflow equals the volume of outflow plus or minus the change in storage. The storage equation is also called the continuity equation.

storage gallery A water-collecting gallery that is located in a water-bearing formation and can be used for either conveying or storing groundwater.

storage lagoon Lagoon used to store water treatment residuals before dewatering or ultimate disposal, typically on the site of the water treatment plant.

storage ratio The ratio of the net available storage of an impounding reservoir to the annual mean flow of the stream feeding it. Usage of the term must be limited to large reservoirs.

storage reservoir A reservoir in which surface water is retained for a considerable period of time. *See also* impounding reservoir; reservoir.

storage tank A compartment used to accumulate the product water from a water treatment unit so that sufficient quantity, pressure, or both are available for

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intermittent periods of higher-flow-rate water use. A storage tank is also called a clearwell.

STORET *See* Storage and Retrieval of US Waterways Parametric Data.

storm Usually, an occurrence of such phenomena as rain, snow, hail, and wind, although windstorms may be described in accordance with the material that is carried in suspension in the air, such as dust or sand. This term is often used in connection with a meteorologic phenomenon that is either unusual or of great magnitude, rate, or intensity.

storm center The center of the area covered by a storm, especially the place of lowest pressure in a cyclonic storm or the place where wind velocities approach zero.

storm distribution pattern The manner in which the depth of rainfall varies from station to station throughout an area.

storm drain The pipe or piping system that carries stormwater or runoff to a stream or outfall.

storm drainage Surface movement of water resulting from storms.

storm drain outfall The large pipeline that carries runoff and rainwater from small collector storm drains to streams, lakes, or oceans.

storm flow That portion of the precipitation that leaves the drainage area in a comparatively short time on or near the surface after the occurrence of precipitation. Storm flow is also called excess rainfall or surface runoff.

storm overflow Some portion of flow caused by stormwater.

storm runoff That portion of the total runoff that reaches the point of measurement within a relatively short time after the occurrence of precipitation. Storm runoff is also called direct runoff.

storm seepage The rainfall that infiltrates into the surface soil and moves away from the area on which it falls through the upper soil horizons at a rate much in excess of normal groundwater seepage. *See also* infiltration; subsurface runoff.

storm surge A rise or piling up of water against the shore, produced by wind stress and atmospheric pressure differences in a storm. *See also* storm tide; wind tide.

storm tide A wind tide caused by storm winds, as in the case of abnormally high or low water in tidal bays and rivers as a result of winds and freshwater runoff. *See also* wind tide.

stormwater Water that is collected as runoff from a rainfall event. Separate collection facilities and piping are often designed to prevent stormwater from overloading sanitary wastewater collection systems.

stormwater runoff That portion of the rainfall over a given area that finds its way to natural or artificial drainage channels.

stovepipe well casing A well casing made of two thin sheets of steel, one fitting closely over the other for half its length. When casing segments are fitted together in several lengths, a double-thickness casing is formed, which is jacked into the borehole. The material at the bottom of the hole is removed by a sand bucket or bailer. This method of well driving is called the California stovepipe method and is used for wells of reasonable depth in relatively loose soil with few boulders.

STP *See* sodium tripolyphosphate; standard temperature and pressure.

STP (sewage treatment plant) *See* wastewater treatment plant.

STPP *See* sodium tripolyphosphate.

straightening vanes Horizontal vanes mounted on the inside of fluid conduits to reduce swirl ahead of a flowmeter.

straight-flow pump A pump in which the suction and discharge pipes and the pump are all in line, with the water not changing flow direction as it passes through.

straightway valve A valve through which the fluid passes without deviation. Such valves offer the least resistance to flow.

strain The deformation per unit length, measured in inch per inch (millimeter per millimeter). True strain is given by the integral of (dL/L) evaluated from L_0 to L. This results in the expression $\ln[L/L_0]$ (ln is the natural log), where L_0 is the initial length and L is the total length. For engineering calculations, the strain is typically calculated as the deformation divided by the original length. *See also* engineering strain; true strain.

strain difference A difference in the response of a different strain of the same species to a stimuli or insult. Such differences are genetically determined but may have multiple determinants (i.e., multiple genes could contribute to such differences).

strainer A filtration device in which particles are separated from a fluid stream by sieving. The removal rate is dependent on the size and shape of the strainer openings and the physical characteristics of the particles.

strainer head A perforated device inserted in one type of underdrain of a rapid granular filter, through which the filtered water is collected and through which the wash water is distributed when the filter is washed. A strainer head is also called a filter head. *See also* filter bottom.

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strainer system A network system equipped with strainers to collect filtered water in the underdrain of a rapid granular filter.

strainer well A tube well in which a strainer is interposed at the level where water-bearing strata must be tapped to prevent sand and debris from entering the well.

strain F334 of rats A type of rat strain used in experimental laboratory studies.

strain gauge A device that uses a change in the electrical resistance of a wire under strain to measure pressure.

strategic goals The set of specific utility performance attributes that define the utility's vision of its desired future. They may be used to galvanize organizational focus.

strategic investments Those resource allocations (e.g., available funds, staff resources) that will yield substantial advances toward achievement of the utility's strategic goals. Strategic investments include resources allocations that (1) create a new customer service that enhances value to the customer; (2) fundamentally change the ways a utility delivers service to a customer, thereby enhancing value; or (3) provide a mechanism for managing a utility's monetary and nonmonetary risks.

strategic load management The use of certain techniques by water utilities to alter the level or pattern of demand to improve overall system efficiency. Strategic load management includes methods that affect the level and timing of peak and off-peak water use.

strategic objectives (1) The principal vehicle by which utilities may assess their market position and define their response to market conditions; a bridge between strategic goal-setting and tactical development of annual capital and operating budgets. (2) A limited number of well-defined performance metrics used to indicate relative degrees of accomplishment of the utility's strategic goals.

strategic plan The umbrella under which all other master plans, budgets, and business activities are compiled. It includes customer satisfaction, employee development, regulatory compliance, financial management, facility development, and water supply and quality. A strategic plan enables utilities to assess their market position and define their response to market conditions.

strategic planning A phase of the annual utility planning cycle in which strategic goals are translated into specific, prioritized work plans for implementation by the utility's operating units. Strategic planning is the near- and long-term planning of capital investments, water treatment research, customer services, and governmental and community affairs.

strategic quality planning A process of using multilevel, multidisciplinary, multifaceted teams to change, challenge, and improve an organization as a whole.

stratification (1) The formation of separate mixing layers in a body of water, usually characterized by different temperature regimes and usually called thermal stratification. (2) Collectively, the existence of beds or laminae. Such stratification is also called lamination. (3) The layering of granular media on the basis of grain size during backwashing (fluidization). (4) An arrangement into classes, groups, or strata. (5) An arrangement or deposition of sedimentary material in layers; of sedimentary rock in strata marked by change in color, texture, dimension of particles, and composition. (6) A method of analyzing epidemiologic data to assess and control confounding bias. The population sample is separated for analysis into smaller groups based on specified criteria, such as age, gender, or other characteristics. For example, in a study of the possible association of bladder cancer and drinking water exposure, an appropriate analysis would be to stratify on smoking status to determine whether risks differ for smokers and nonsmokers. *See also* bedding; hydraulic classification; hypolimnion; mixolimnion; thermocline.

stratified bed A bed in which two ion exchangers of different classes and different densities have been placed in the same column (bed), e.g., a weak base anion resin on top of a strong base anion exchanger or, in cation-exchange systems, a weak acid on top of a strong acid resin. *See also* hydraulic classification.

stratified data Data that are grouped (or stratified) according to specified criteria for the purpose of analyzing how the criteria may affect the data. In epidemiology, health effects of interest are studied among various groups or strata (e.g., age, gender, or smoking status) to determine the risks of disease in each stratum (e.g., are risks greater among the elderly or young, males or females, smokers or nonsmokers?). Stratified data are commonly used to assess and control confounding bias. *See also* confounding bias.

stratum A layer that is characterized by certain unifying attributes, characteristics, or properties distinguishing it from adjacent layers.

straw man A document issued by the US Environmental Protection Agency (USEPA) to the public that presents initial thoughts and concepts for a new rule for discussion. A straw man rule is not a formal proposal; it merely serves to initiate public discussion on issues associated with a regulation under development by the USEPA.

stray current Direct electrical current traveling through the earth around an existing underground structure. When the current uses a water main as the path of

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travel and exits, metal from the main will be removed. Thus, the current will cause pitting, corrosion, or both. *See also* stray current corrosion.

stray current corrosion Corrosion that is caused by stray currents from some external source.

streak line A locus of the temporary location of all particles that have passed through a given point.

stream A course of running water usually flowing in a particular direction in a definite channel and discharging into some other stream or body of water. In the law of water rights, an important distinction exists between a stream and water that appears on the surface in a diffused state with no permanent source of supply or regular course for any considerable time. Surface water may at times collect and flow through a land depression or gully, but a stream usually flows even though it may be dry temporarily. *See also* channel; river.

stream adjustment The natural process involving the changes in the courses of streams, extending over long periods of time, by which such courses develop definite and sustained relations to the rock structure in which they are located. This process involves a continued tendency on the part of the streams to seek out and erode channels in rocks of weaker structure.

stream aggradation *See* aggrading river.

stream banks The side slopes of a natural channel between which the normal flow of a stream is confined. *See also* shore.

streambed The bottom of a stream below the usual water surface. The streambed is the area that is kept practically bare of vegetation by the washing effect of stream water from year to year.

streambed permeability The capacity of the bottom of a watercourse to transmit water to and from underground layers.

stream biota The collective animal and plant life of a stream.

stream degradation *See also* degrading river.

stream discharge The rate of flow, or volume of water per unit time, flowing in a stream at a given place.

streamflow The volume of water per unit time flowing in a stream and usually measured at a stream gauge.

streamflow depletion The amount of water that flows into a valley or onto a particular land area, minus the water that flows out of the valley or off the particular land area.

streamflow record A tabulation of the flow of a stream. Such a record may include daily, monthly, annual, and instantaneous extremes of discharge.

streamflow regulation Control of the quantity or quality of water in a stream by regulating the release of impounded water.

streamflow wave A traveling wave caused by a sudden increase of flow. *See also* flood wave.

stream gauging The measurement of the velocity of a stream of water in a channel or an open conduit, as well as the cross-sectional area of the water, for the purpose of determining the discharge. Measurements are usually obtained in conjunction with a record of stage to give a stage–discharge relation for the channel. Stream gauging is also called gauging. *See also* discharge measurement.

stream gradient The general slope, or rate of change in vertical elevation per unit of horizontal distance, of the water surface of a flowing stream.

streaming current A current gradient generated when a solution or suspension containing electrolytes, polyelectrolytes, or charged particles passes through a capillary space, as influenced by adsorption and electrical double layers. This phenomenon is used in monitoring and controlling coagulation and flocculation processes. *See also* electrokinetic potential; electrophoretic mobility; streaming current monitor; zeta potential.

streaming current detector *See* streaming current monitor.

streaming current monitor An online instrument that measures the electrical charge characteristics of particles, typically used to monitor and control coagulation and residuals conditioning processes at a water treatment plant. The sensor in this instrument typically consists of a reciprocating piston and cylinder. As a sample passes through the sensor, charged particles adhere to the surface of the piston and cylinder. As the piston moves up and down, the relative motion of the charged particles produces an electric current. Changes in particle charge, caused by changes in raw water quality or coagulant dose, will cause a change in the streaming current. It is important to note that a streaming current reading is not numerically equivalent to the particle surface charge, zeta potential, or electrophoretic mobility of the particles in the sample. Cost savings in coagulant usage have been reported when streaming current detectors have been used to control the dosage, especially when the quality of the source water is highly variable. The instrument is also called a streaming current detector or sensor.

streaming current potential *See* electrokinetic potential; streaming current; streaming current monitor.

streaming flow Turbulent flow with a mean velocity less than Belanger's critical velocity. Streaming flow is also called subcritical flow. *See also* Belanger's critical velocity.

streaming potential The electric potential difference between a liquid and a capillary, diaphragm, or porous solid through which it is forced to flow. Streaming potential is related to zeta potential by factors that

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include the electrical conductivity, fluid viscosity, and structure of the porous solid.

streamlet A rivulet or rill.

streamline A line that is everywhere parallel to the instantaneous direction of motion in a fluid. Thus, if *u*, *v*, and *w* are the velocity components in Cartesian coordinates, the differential equations of the streamlines are

$$\frac{dx}{u} = \frac{dy}{v} = \frac{dz}{w}$$

The streamline field is customarily constructed in such a way that the spacing of the streamlines at a given point is inversely proportional to the speed of the motion at this point.

streamline flow A type of fluid flow in which a continuous steady motion of the particles occurs, with the motion at a fixed point always remaining constant. *See also* laminar flow.

stream rotor A sprinkler irrigation head that delivers rotating streams of water in arcs or full circles. Some types use a gear mechanism and water pressure to generate a single stream or multiple streams. Stream rotors have relatively low precipitation rates, and multiple stream rotors provide matched precipitation for varying arc patterns.

stream system A principal stream and all its tributaries.

stream upflow The groundwater moving parallel to and discharging into a surface stream within and through the porous streambed.

strength of association Refers to a measure of association between categorical variables in generating a chi-square statistic from contingency tables.

Streptomyces A genus of actinomycetes, a group of bacteria that resemble fungi in their branching filamentous structure. As the bacteria grow, they form branching filaments of cells that become a network of strands called a mycelium. They also form spores and produce numerous antibiotics including amphotericin B, nystatin, streptomycin, and novobiocin. There are more than 500 species within the genus *Streptomyces*, few of which are pathogenic to animals and plants. They are present in source waters.

stress (1) In ecology, a stimulus or series of stimuli of such magnitude as to tend to disrupt the balanced state of an organism or an ecosystem. (2) Good or bad physical or mental tension experienced by an individual. (3) The action on a body by any system of balanced forces such that deformation results, usually measured in pounds per square inch or kilopascals. (4) The force per unit area, usually measured in pounds per square inch or kilopascals. For engineering applications, the stress is typically evaluated as the applied force divided by the original cross-sectional area.

stress corrosion Corrosion that acts on metal at points of tensile stress, working, or vibration wear. Corrosion can be accelerated by stress, either residual internal stress in the metal or externally applied stress. Residual stresses can occur during fabrication and assembly and can be caused by exposure of the pipe to certain environmental conditions. Welding can cause high stress and be a source of trouble. Both process piping and water distribution piping can be subject to cracking as a result of stress corrosion.

stress corrosion cracking Cracking of water pipes as a result of stress corrosion.

stressor A specific mental or physical event that causes stress.

stress–strain curve A graph of the relationship between stress and strain defined by a tension test on a given material, which demonstrates the elastic and inelastic behavior of the material. Stress is typically graphed on the vertical axis, and the corresponding strain is graphed on the horizontal axis. The stress–strain curve is a valuable graph of basic material behavior because it depicts a number of mechanical properties of the material including the elastic stiffness, yield strength, and ultimate strength, and it provides a measure of ductility.

stress wave propagation The recording and analysis of sound waves as a solid material is impacted, such as a concrete structure being struck with a hammer, resulting in a specific ring or sound wave.

S-triazine *See under* triazine.

stringer The horizontal member of a shoring system, running parallel to the trench, to which the trench braces are attached. The stringers hold the uprights against the soil.

stringing (hydrants) The practice of dropping a weighted string down the barrel of a hydrant to determine if the barrel has fully drained.

string-wound element A cartridge-style filter element constructed by continuous spiral winding of natural or synthetic yarn around a preformed product water tube core and then a building up of layers to form a depth-type filter element.

strip To remove gases from water by passing large volumes of air through the water. *See also* air-stripping; packed tower aeration; stripping.

strip cropping A crop production system that involves planting alternating strips of row crops and close growing forage crops. The forage strips intercept and slow runoff from the less protected row crop strips.

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stripping A process of transferring a target compound from the liquid phase to the gas phase. *See also* air-stripping; forced-draft stripping; packed tower aeration.

stripping factor For gas–liquid contact systems, a unitless factor calculated as the product of Henry's constant and the gas velocity through the system, divided by the liquid velocity through the system. *See also* air-stripping; Henry's constant; Henry's law.

stromal cell A cell that is involved in establishing the structural matrix of an organ as opposed to one that serves the characteristic function of the organ (i.e., a differentiated cell). *See also* stem cell.

strong acid An acid that is completely ionized in dilute water solutions. The quantitative measure of acid strength is the acid dissociation constant, i.e., the equilibrium constant for a chemical reaction of the following form (in which A represents an anion):

$$HA + H_2O = H_3O^+ + A^-$$

For example, hydrochloric acid is completely ionized in water and is considered a strong acid. *See also* acid.

strong acid cation (SAC) exchanger A cation-exchange resin with an exchange site, i.e., an active group, usually sulfonic acid ($RSO_3^-H^+$), that is ionized throughout most of the pH range (pH 1 to pH 4). Neutral salts (e.g., sodium chloride, NaCl; magnesium sulfate, $MgSO_4$; calcium nitrate, $Ca(NO_3)_2$) are said to be split by the resin to form their corresponding free acids (hydrochloric acid, HCl; sulfuric acid, H_2SO_4; nitric acid, HNO_3). *See also* strong base anion exchanger; sulfonic acid.

strong acid ion exchange *See* strong acid cation exchanger.

strong base anion (SBA) exchanger An anion-exchange resin with an exchange site, i.e., an active group, usually quaternary amine ($-N^+(CH_3)_3$), that is ionized throughout most of the pH range (pH 0 to pH 13). Neutral salts (e.g., sodium chloride, NaCl; calcium sulfate, $CaSO_4$; potassium nitrate, KNO_3) are said to be split by the resin to form their corresponding free bases (sodium hydroxide, NaOH; calcium hydroxide, $Ca(OH)_2$; potassium hydroxide, KOH). *See also* strong acid cation exchanger.

strong base ion exchange *See* strong base anion exchanger.

structure Any of the improvements to land that are used or expected to be used in the operation of a utility, including buildings, utility lines, tanks, driveways, walks, and fences.

structure-based quantitative structure activity relationship model A modeling approach to determine adverse health effects of chemical contaminants on the basis of similarity of chemical structure to other compounds with known health effect.

structure contour A line passing through all points that are on the upper or lower surface of any geologic formation or aquifer and that have the same elevation above a given datum.

Structured Query Language (SQL) A data query language developed by IBM. An American National Standards Institute (ANSI) SQL standard was developed and later adapted by the International Organization for Standardization (ISO) that is adhered to by many relational database management systems. Many developers of geographic information system software have used Structured Query Language for performing database queries. *See also* geographic information system.

structure indicator The minimal energy that is necessary to lift a cubic meter of water to users and give it a pressure of 88 pounds per square inch (600 kilopascals), typical water pressure at a tap. It is also known as the ratio between the minimal energy and the annual quantity of delivered water.

Student's t distribution *See* t-test.

Student's t-test *See* t-test.

study precision and validity An evaluation of epidemiological studies to determine cause-and-effect relationships between exposure to a substance and disease outcome.

stuffing box A portion of the pump casing through which the shaft extends and in which packing or a mechanical seal is placed to prevent leakage.

stylet A slender, pointed instrument; a surgical probe.

S. typhimurium *See Salmonella typhimurium.*

styrene-acrylonitrile trimer A mixture of isomers with a molecular weight of 210 formed by the condensation of two moles of acrylonitrile and one mole of styrene. It is a by-product from the manufacture of styrene-acrylonitrile (SAN) plastics. SAN trimer has been detected in a drinking water supply in New Jersey.

styrene monomer ($C_6H_5CH{:}CH_2$) A chemical compound also called vinylbenzene. Styrene monomers are used in the manufacture of polystyrene, synthetic rubbers, thermoplastics, and resins. Styrene is regulated in drinking water by the US Environmental Protection Agency at a maximum contaminant level of 0.1 milligrams per liter. *See also* polystyrene; resin.

subacute A term used to describe a condition that is something less than acute. This term is imprecise and is used to describe toxicity tests involving multiple doses given over an extended time (e.g., from 5 to 30 days).

subaqueous Existing, taking place, or formed in or under water.

subaqueous pipe A pipe that is submerged in water.

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subarid Neither entirely arid nor strictly humid, but intermediate, with a slight tendency to be arid. *See also* semiarid.

subartesian well A nonflowing well in which the water rises by hydrostatic pressure above the saturation zone but not to the land surface.

subcapillary interstice An interstice, smaller than a capillary interstice, in which molecular attraction spans the entire space and water is held immovable against gravity by the forces of adhesion alone. Such water is pellicular and hygroscopic. *See also* pellicular water; supercapillary interstice.

subcapillary opening An opening smaller in size than a capillary opening.

subchronic Of intermediate duration. This term is usually used to describe studies or levels of exposure between 5 and 90 days.

subchronic toxicity test A toxicity test that involves a substantial treatment period. Most commonly this term is used to represent a 90-day study in rodents.

subcritical flow *See* streaming flow.

subcritical fluidization backwash A procedure to clean a filter in which backwash water is added at a rate that does not completely fluidize the bed; i.e., the particles are not freely supported by the liquid. Under a subcritical fluidization regime, the media are in greater contact, potentially "scouring" difficult-to-dislodge particles. When combined with air, this flow regime can implement a collapse pulsing backwash. Subcritical fluidization may be followed by full fluidization to allow the scoured particles to be released from the media bed for complete cleaning. *See also* collapse pulsing backwash; full fluidization backwash.

subcutaneous Located or found just beneath the skin.

subdrain A drain constructed beneath a lined conduit, such as a canal or tunnel, or beneath a dam or other structure. The purpose of a subdrain may be to prevent groundwater from entering the conduit, especially during construction, by providing the water with a method of escape, to prevent passage of water through to the downstream face of an earth dam, or to prevent or reduce uplift pressure in the case of a masonry dam.

suberin plant waxes A group of alcohols, aldehydes, ketones, esters, and acids that cover the underground parts and healed wound surfaces of plants.

subfluidization flow rate The rate of a fluid passing up through a suspension such that the particles in the suspension remain in contact with one another. *See also* backwash; extended terminal subfluidization wash; fluidization.

sublimation The direct passage of a substance from solid to vapor without appearing in the intermediate (liquid) stage.

submarine spring A freshwater spring that occurs in the ocean.

submerged aquatic vegetation (SAV) Aquatic types of vegetation, such as sea grasses, that cannot withstand excessive drying and therefore live with their leaves at or below the water surface. Submerged aquatic vegetation provides an important habitat for young fish and other aquatic organisms.

submerged crib A water treatment plant intake built of masonry, timber, or metal and resting on the bed of a waterway, with its top below normal water level, to protect the exposed ends of intake pipes and offer minimum resistance to floating ice and debris.

submerged jet flocculation A novel flocculation process in which coagulated water is introduced upward into a reactor chamber though a center nozzle. A perforated plate separates the chamber from the settling unit and creates turbulence that results in hydraulic mixing. The reported advantages of such a unit are low head loss, low electrical energy use, easy operation, and production of a low-turbidity effluent.

submerged membrane A membrane that is inserted into the water to be treated. A vacuum is applied to the membrane to draw the treated water through, leaving the rejected water behind. *See also* vacuum-driven membrane system.

submerged membrane system *See* submerged membrane.

submerged orifice An orifice discharging entirely underwater.

submerged outlet An outlet entirely covered by water.

submerged pipe A pipeline laid either on the bed or bottom or in an open or covered trench under the bed of a stream or other body of surface water.

submerged soil Soil that is underwater or saturated with water.

submerged spillway A spillway in which the water level downstream stands at an elevation higher than the crest of the spillway.

submerged tube A square tube with a length not exceeding 3.5 times the distance of the centerline of the tube below the hydraulic gradient, and with both ends submerged.

submerged weed An aquatic plant, such as pondweed, that grows entirely beneath the surface of water.

submerged weir A weir that, when in use, has the water level on the downstream side at an elevation equal to or higher than the weir crest. The rate of discharge is affected by the tailwater. A submerged weir is also called a drowned weir.

submergence (1) The condition of a weir when the elevation of the water surface on the downstream side is equal to or higher than that of the weir crest. (2) The ratio, expressed as a percentage, of the height

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of the water surface downstream from a weir above the weir crest to the height of the water surface upstream above the weir crest. The distances upstream or downstream from the crest at which such elevations are measured are important but have not been standardized. (3) The depth of flooding over a pump suction inlet.

submergent vegetation Aquatic plants that live completely beneath the surface of water.

submersible pump A pump designed to fit inside the well casing and to operate below the water level in a drilled well.

submetering Separate metering of a portion of water use associated with a metered water service connection.

submicrometer filter A cartridge-type membrane filter used in fine particle separation applications to remove particulates less than 1 micrometer in size.

subnatant liquid The liquid that remains beneath the surface of floating solids after flotation.

Subpart H utilities Water utilities that are subject to the US Environmental Protection Agency's Surface Water Treatment Rule, codified in the *Code of Federal Regulations* as Title 40, Part 141, Subpart H. Such utilities use surface water or groundwater under the direct influence of surface water.

subpermafrost water Water beneath the permafrost.

subset A group composed only of some, but not all, elements in a set.

subsidence tank A tank or basin in which water or another liquid containing settleable solids is retained for a sufficient time, and in which the velocity of flow is sufficiently low, for a part of the suspended matter to be removed by gravity. *See also* sedimentation basin.

subsidence velocity The vertical rate at which a solid particle settles in a liquid under the influence of gravity. *See also* settling velocity; Stokes's law.

subsiding basin *See* subsidence tank.

subsoil The layer of soil below the arable layer.

subsoil drain A land drain constructed at a sufficient depth to intercept water from the subsoil.

subsoil drainage The removal of surplus or excess groundwater from the soil mass. Subsoil drainage is accomplished by means of natural drainage or by such artificial means as drains placed under the soil surface.

substation An electric power-switching station, generally accompanied by a transformer.

substrate (1) A substance used by organisms for growth. (2) A substance acted upon by an enzyme. (3) The basic—and usually most abundant—component of a medium, or a sample of that component.

substratum (1) A part, substance, or element that underlies and supports another; a foundation. (2) In botany, the base or material to which a plant is attached and from which it gets nutrients; the substrate. This term is loosely used to refer to the subsoil.

subsurface Pertaining to, formed, or occurring underneath the ground surface.

subsurface air *See* soil air.

subsurface drainage The removal of excess water from the soil or from prepared beds by a system of underdrains. *See also* subsoil drainage.

subsurface drainage check A gate or other structure placed in a deep drainage ditch or covered drain and by use of which the drainage discharge can be controlled to maintain a constant groundwater level for subirrigation.

subsurface drip irrigation The application of water via buried pipe and emitters, with flow rates measured in gallons (liters) per hour.

subsurface filter A gallery, with openings in its sides and bottom, extending generally horizontally into a water-bearing formation to collect water.

subsurface float A submerged body attached by a line to a surface float. Movement of the surface float indicates movement of the subsurface float. A subsurface float is used for observing the time taken to traverse a measured distance or to indicate the direction of flow. Such a float is also called a double float. *See also* surface float.

subsurface irrigation Irrigation by means of underground porous tile or its equivalent.

subsurface runoff (1) Groundwater runoff from a temporary zone of saturation in the soil. The runoff occurs so rapidly that it cannot be distinguished on the stream hydrograph from overland runoff and is therefore included in direct runoff. (2) Water that enters the soil but returns to the surface or appears in channels at a lower level without entering the water table in the zone of saturation.

subsurface velocity The velocity of water flowing in an open channel or conduit at any point below the water surface. Such velocity may be greater or less than the surface velocity.

subsurface water Water in the lithosphere. Subsurface water may be in a liquid, solid, or gaseous state. It comprises suspended water and groundwater. *See also* groundwater.

subsurface water basin A pervious formation, with sides and bottom composed of relatively impervious material, in which groundwater is held or retained. Such a formation is also called a groundwater basin.

subterranean stream (1) A stream flowing through large interstices or openings in rock, such as caves or caverns. The stream must have a fairly high discharge and velocity and must not be a mere trickle passing through a small crack or fissure. (2) A well-defined

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body of groundwater having a measurable, though small, velocity and flowing in a definite direction and confined in a permeable formation by formations less permeable.

subterranean water Water that occurs in open spaces within the rock materials of the earth's crust. *See also* groundwater; subsurface water.

subtyping A process of using immunologic (or other) characteristics to separate and identify subtypes of bacteria in the same genus and species from each other.

subvariable spring A spring for which the difference between the maximum and minimum levels of discharge is at least 25 percent, but no more than 100 percent, of the average discharge.

success criteria Specific parameters that can be quantitatively compared to site-specific data and from which the degree of progress is determined.

suction dredge A scow carrying a centrifugal pump that has (1) a suction pipe reaching to the bottom to be excavated, and (2) a discharge pipe connecting to a pipeline conveying material to a place of deposit. A suction dredge is also called a hydraulic dredge or sand-pump dredge.

suction head (1) The head between the centerline of a pump and the level of water on the suction side. When the head is positive above the centerline, it is called suction head; otherwise it is sometimes called suction lift. (2) The head less than atmospheric pressure in a piping system.

suction lift The amount of head a pump located above the suction level must add to water to lift the water into the pump inlet or to the centerline of the pump. The amount of lift is limited by atmospheric pressure and is generally in the range of 20–25 feet (6.1–7.6 meters), depending on the elevation above sea level.

suction lift pump A pump set above the surface of the body of water that supplies the pump. This arrangement requires the water to be lifted from such surface to the pump cylinder or casing.

suction pipe The inlet pipeline of a pump; the suction side.

suction piping A pipe or system of pipes that carries water into the inlet of a pump.

suction pit A walled pit in which the suction pipe or inlet openings of a pump are placed. A suction pit is sometimes called a sump or wet well.

suction valve A valve located on the suction line of a pump and used to close the suction line or pump from the source.

suction wave A wave that advances upstream in an open conduit from a point where the flow has suddenly been increased, as by the sudden opening of a gate. The water flowing through the opening consists of the normal flow in the conduit plus an additional quantity of flow that has been accelerated by the increase in slope in the water surface. This phenomenon is the opposite of the hydraulic bore; the front of the wave faces downstream instead of upstream and has a flatter slope as it advances upstream. *See also* hydraulic bore.

sudden contraction A reduction in the cross-sectional area of a stream channel, conduit, or other hydraulic structure that occurs abruptly or over a distance that is small compared with the dimensions of the channel or conduit, such as depth or diameter.

SUFC *See* softening uniform formation conditions.

sugar of iron ($FeSO_4$) A common name for ferrous sulfate.

suggested no-adverse-response level (SNARL) An estimate of the contaminant concentration beneath which no adverse response is anticipated if the contaminant is ingested over a specified time period, assuming a dose level, body weight, daily water intake, and safety factor. The no-observed-adverse-effect level and the lowest-observed-adverse-effect level are used in place of the suggested no-adverse-response level to formulate a health advisory. *See also* dose; health advisory; lowest-observed-adverse-effect level; no-observed-adverse-effect level.

sulfate (SO_4^{2-}) An inorganic ion that is widely distributed in nature. It may be present in natural waters in concentrations ranging from a few to several thousand milligrams per liter.

sulfate-reducing bacteria (SRB) Bacteria characterized by their ability to reduce sulfate under anaerobic conditions, producing hydrogen sulfide (H_2S). Sulfate is used as an electron acceptor for the oxidation of organic materials. Sulfate-reducing bacteria are generally found in anaerobic soils and sediments, as well as in areas of drinking water systems where appropriate conditions exist. These organisms are involved in pipe corrosion. The sulfate-reducing bacteria of most importance belong to the genera *Thiobacillus* and *Desulfovibrio. See also Desulfovibrio;* electron acceptor; *Thiobacillus.*

sulfate reduction Chemical reduction of the sulfate ion (SO_4^{2-}) by anaerobic bacteria to form sulfide (S^{2-}) and hydrogen sulfide (H_2S). This reaction can occur in oxygen-deficient waters, which can be present in distribution system dead ends, storage reservoirs, and hot water tanks.

sulfide (S^{2-}) An anion often present in groundwater, especially in hot springs. Its common presence in wastewaters comes partly from the decomposition of organic matter, sometimes from industrial wastes, but mostly from the bacterial reduction of sulfate (SO_4^{2-}). Acidification of solutions of soluble sulfide

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compounds leads to the evolution of hydrogen sulfide (H_2S), a foul-smelling gas that can be poisonous. *See also* hydrogen sulfide; sulfate reduction.

sulfonamide antibiotics A group of synthetic antimicrobial agents derived from sulfonic acid. They are commonly used in human medicine and veterinary medicine (as growth promoters). Many of them have been detected in treated wastewater, farm runoffs, and surface water sources.

sulfonic acid ($-SO_2OH$) A specific acidic group that forms the exchange site (i.e., active group) in certain cation-exchange resins and gives these resins their ion-exchange capability. *See also* strong acid cation exchanger.

sulfotransferase Any of a class of conjugating enzymes that transfer sulfate (SO_4^{2-}) to form esters (R–CO–O–R') with hydroxyl (R–OH) or free amino groups ($R–NH_2$) on an organic compound. This esterification serves to increase the polarity of the compound, facilitating the compound's elimination in the urine.

sulfoxidation A process by which thioethers (R–S–R') are oxidized (usually by microsomal monooxygenases) to sulfoxides (R–(SO)–R').

sulfur (S) A nonmetallic element that occurs either free or combined (especially in sulfide (S^{2-}) and sulfate (SO_4^{2-}) compounds). Sulfur exists in several forms, including as yellow crystals. *See also* sulfate; sulfide.

sulfur bacteria *See Thiobacillus.*

sulfur compound joint A bell-and-spigot joint that was sealed with a melted sulfur compound rather than lead to reduce cost and eliminate the need to caulk the joint. Because of sulfur-reducing bacteria in many soils, the life of a sulfur compound joint has been found to be short, and these joints often must be reworked or joint clamps installed to stop leaks. *See also* joint clamp.

sulfur compound jointing material Any of the sulfur compounds used instead of lead to seal a bell-and-spigot joint because they offer cost savings and the ability to seal the joint without caulking. The compounds are subject to attack by sulfur bacteria and have been the cause of numerous joint leaks in systems where they were used. At the height of their popularity, as many as 50 such products were available; all contained 50 to 65 percent sulfur. Sulfur compound jointing materials are sometimes referred to as mineral lead.

sulfur dioxide (SO_2) An extremely effective oxidizing and reducing agent. It has many industrial uses, including use as a food additive (for inhibition of browning, of enzyme-catalyzed reactions, or of bacterial growth). Sulfur dioxide is also used as a dechlorination agent in drinking water facilities. *See also* dechlorination agent; oxidant; reducing agent.

sulfuric acid (H_2SO_4) A very strong, corrosive, and hazardous acid used as a regenerant for the cation stage of an ion-exchange deionization system. Sulfuric acid is also used occasionally to lower the pH of highly alkaline water. When higher concentrations of sulfuric acid are combined with high concentrations of calcium, calcium sulfate ($CaSO_4$) crystals precipitate, creating tenacious fouling of media particles. Sulfuric acid was once commonly called oil of vitriol.

sulfur mustard (HD) A chemical warfare agent that causes blistering of the skin and mucous membranes on contact. It has the chemical name 2,2'-dichlorodiethyl sulfide. A thick liquid at ambient temperature, it becomes a solid at 58°F. It is heavier than water as a liquid and heavier than air as a vapor. It does not occur naturally in the environment. It is often called mustard gas, but sulfur mustard is not likely to change into a gas immediately if it is released at ordinary temperatures. As a pure liquid, it is colorless and odorless, but when mixed with other chemicals, it looks brown and has a garlic-like smell. Sulfur mustard does not move from soil to groundwater, and it does not build up in the tissues of animals because it breaks down quickly. If sulfur mustard is put in water, it dissolves within minutes if the water is stirred, and slowly if is not. When it does dissolve, it reacts with water and changes to other compounds. A guideline for the maximum allowable amount of this chemical warfare agent in military drinking water has been developed by the National Research Council. *See also* National Research Council.

sulfur-reducing agent A sulfur-containing compound used as a reducing agent (e.g., sulfur dioxide, SO_2; sodium bisulfite, $NaHSO_3$; sodium sulfite, Na_2SO_3; sodium thiosulfate, $Na_2S_2O_3$). *See also* sodium bisulfite; sodium thiosulfate; sulfur dioxide.

sulfur spring A spring in which the water contains certain compounds of sulfur, usually in gaseous form. Such springs are usually identified by the odor of the hydrogen sulfide (H_2S) that emanates from them.

summation graph A graph showing the summation of the ordinates of a series of unit hydrographs spaced at unit rainfall duration intervals, such that the ordinates of the S-curves are expressed as the percentage of the total unit hydrograph volume and the abscissas expressed in units of time. *See also* S-curve hydrograph.

sum of five haloacetic acids (HAA5) The sum of the concentrations, in milligrams per liter, of five haloacetic acid compounds: monochloro-, dichloro-, trichloro-, monobromo-, and dibromoacetic acid. The Disinfectants and Disinfection By-Products Rule regulates the sum of these five species; data were not

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available on the occurrence and control of the other four haloacetic acid species that were under consideration for regulation during the rulemaking process. *See also* Disinfectants and Disinfection By-Products Rule; haloacetic acid; Stage 1 Disinfectants and Disinfection By-Products Rule; Stage 2 Disinfectants and Disinfection By-Products Rule.

sum of nine haloacetic acids (HAA9) The sum of the concentrations of nine haloacetic acid compounds, including monochloro-, dichloro-, trichloro-, monobromo-, dibromo-, bromochloro-, bromodichloro-, chlorodibromo-, and tribromoacetic acid. The presence in drinking water of first five in this list is regulated by the US Environmental Protection Agency. *See also* haloacetic acid; disinfection by-product.

sum of six haloacetic acids (HAA6) The sum of the concentrations, in milligrams per liter, of six haloacetic acid compounds, including the five species in HAA5 as well as bromochloroacetic acid. The Information Collection Rule required monitoring for these six species in order to develop data on the occurrence and control of these compounds for future disinfection by-product rulemaking efforts. *See also* Information Collection Rule; sum of five haloacetic acids.

sum of three haloacetic acids (HAA3) The sum of the concentrations of three brominated trihaloacetic acid compounds, including bromodichloro-, chlorodibromo-, and tribromoacetic acid. This typically refers to three haloacetic acids that were not included in the Information Collection Rule. *See also* haloacetic acid; Information Collection Rule; trihalogen-substituted acetic acid.

sump A tank or pit that receives drainage and stores it temporarily and from which the discharge is pumped or ejected.

sump pump A mechanism used for removing water from a sump or wet well. It may be energized by air, water, steam, or an electric motor. Ejectors and submerged centrifugal pumps, controlled either by a float or manually, are often used for this purpose.

sunk costs Those costs that have already either been incurred or committed. Sunk costs are not incremental costs and, as a result, no longer play a part in any decision-making process. For example, if $1.0 million has been spent on a new process or facility before it is determined that another process offers a far better way to achieve a goal, the sunk costs for the abandoned process should play no role in the decision-making process regarding the benefit–cost ratio or return on investment for the new process.

supercapillary interstice An interstice that is larger than a capillary interstice, in which water is not held at an appreciable height above a water table or hydrostatic pressure level, and through which the movement of water may be turbulent. *See also* subcapillary interstice.

supercapillary percolation Percolation through that portion of a porous medium where the size of the pore space is too large to generate appreciable capillary forces. *See also* capillary force; percolation.

superchlorination The addition of excess amounts of chlorine to a water supply to speed chemical reactions or ensure disinfection within a short contact time. The chlorine residual following superchlorination may be high enough to make the water unpalatable, so dechlorination is commonly employed before the water is used. *See also* dechlorination.

supercritical Pertaining to a fluid held in excess of its critical temperature and pressure. Such a substance acts physically like a gas yet chemically like a liquid.

supercritical flow *See* shooting flow.

supercritical fluid chromatography (SFC) A separation technique that has been used in the analysis of relatively polar, nonvolatile, or thermally labile compounds. It has proven to be complementary to gas and liquid chromatography. The mobile phase is a supercritical fluid, e.g., carbon dioxide (CO_2) that allows the chromatographic separation of analytes at low temperatures.

supercritical fluid extraction (SFE) A technique used in the analysis of solid matrices. Water and air samples can be analyzed indirectly by isolation of compounds onto an adsorbent phase and subsequent desorption of analytes by supercritical fluid extraction. The technique involves a fluid, such as carbon dioxide, held in excess of its critical pressure and temperature. Such a supercritical substance acts physically like a gas yet chemically like a liquid. Supercritical fluid extraction takes advantage of the fluid's solvating power, the extent of which depends on the density of the fluid.

supercritical water oxidation An emerging treatment technology in which the water to be treated is taken above its critical points, i.e., temperature above 705° Fahrenheit (374° Celsius) and pressure greater than 3,208 pounds per square inch (22,119 kilopascals). The technology can be economical for the treatment of hazardous organic waste streams.

superficial velocity *See* approach velocity.

Superfund Amendments and Reauthorization Act (SARA) Public Law 99-499, enacted in 1986, that enlarged and reauthorized the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly known as Superfund. The original legislation and amendments are codified generally as 42 US Code 9601–9675.

superimposed load *See* external load.

supernatant Located above or on top of something else.

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supernatant liquid The liquid situated over the surface of settled sediment. *See also* subnatant liquid.

supernatant liquor *See* supernatant liquid.

superoxide ($M(O_2)_x$, where $x = 1$ or 2 depending on the valence of metal M) A compound characterized by the presence of the superoxide anion (O_2^-) in its structure. *See also* superoxide anion.

superoxide anion (O_2^-) A highly reactive form of oxygen that is produced when molecular oxygen is reduced by a single electron (i.e., when it gains one electron). Superoxide anion is a common product of many different biological oxidations.

supersaturated Pertaining to a solution in which the solvent (e.g., water) contains more dissolved matter (solute) than is present in a saturated solution of the same components at an equivalent temperature. *See also* saturated solution.

supervisory control A mode of process control in which changes to operating conditions are made manually by an operator. In a supervisory-control mode, operators can use real-time information from online monitors to assist them with making control decisions, but control functions are not initiated automatically.

supervisory control and data acquisition (SCADA) A computer-monitored alarm, response, control, and data acquisition system used by drinking water facilities to monitor their operations.

supplemental water supply source A water source furnishing additional supplies when water needs to be obtained from more than just a primary source.

supplied-air respirator A respirator, full faced or half faced, with a continuous supply of grade D breathing air and with a 5-minute escape bottle serving as a backup supply. *See also* grade D air.

supplier of water Any entity that owns or operates a public water system.

supply and demand The combination of (1) the total amount of water available to a utility or water provider from all sources (supply) and (2) the total water use of all customers on the system (demand). Both supply and demand are frequently measured for peak-hour, peak-day, peak-month, and peak-season amounts, as well as for annual amounts.

supply chain management (SCM) Use of Web-based business networks to procure supplies in efforts to reduce costs of purchases and streamline the purchasing process.

supply curve A representation of the amount of a product that a firm will offer in the market at different prices. In the economics of pure competition, the prices at which a firm will offer its product are based on the firm's marginal cost curve for the product over a feasible range of output with a specified plant and production process. In a nonprofit monopoly situation, which is typical in the drinking water business, the supply curve is represented not by the marginal cost curve but by the average cost curve. The regulated monopoly will price not for profit maximization but rather to ensure that average revenue is equal to average cost.

supply line A conduit between a source of water supply and a distribution system.

supply management The use of specific measures by water utilities to enhance their capability to supply water, including capacity additions as well as efficiency improvements in the water supply infrastructure. Supply management includes the use of water audits, leakage management, metering, source protection, conservation, and source development that meets least-cost and other planning criteria.

support gravel The layer or layers of gravel that support the granular material in a granular media filter.

support media bed In filtration or ion exchange, a bed of material of a specific graded particle size (such as gravel) used as a subfill to support the primary medium bed. This bed improves the collection of processed water and promotes a more uniform distribution of the backwash water.

support spacing The recommended maximum distance between pipe supports to prevent excessive pipe deformation (bending).

suppressed contraction A condition existing in an orifice or weir when one or both sides, bottom, or all three are flush with the sides of the orifice or sides or crest of the weir. Such a condition eliminates the contraction in cross-sectional area for water passing through the orifice or over the weir.

suppressed weir A weir with one or both sides flush with the channel of approach. This arrangement prevents contraction of the nappe adjacent to the flush side. The suppression may occur at one end or both ends of the weir.

suppression A technique used in ion chromatography as a way of decreasing the conductivity of the eluant and increasing the conductivity of the analyte. Because conductivity detectors are commonly used in ion chromatography, the use of suppression has dramatically improved the sensitivity of ion chromatographic analyses. *See also* conductivity detector; ion chromatography.

suppressor device An ion-exchange–based device used in ion chromatography that provides continuous suppression of background conductivity and so enhances analyte response.

suppurative infection An infection associated with the formation or discharge of pus.

suprapermafrost water Groundwater above permafrost, forming what is called the suprapermafrost layer.

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surcharge pricing A method of charging for water use whereby customers are charged higher rates during times of peak usage. This method is used to pay for the extra costs associated with providing large amounts of water for short periods of time, such as during the summer months. Surcharge pricing can be used in combination with other pricing mechanisms, such as a flat rate, decreasing block rate, or increasing block rate.

surcharge storage Storage available above an established reservoir level. Such storage is sometimes used to control floods.

surface-active agent A substance—such as a detergent, wetting agent, or emulsifier—that, when added to water, lowers surface tension and increases the "wetting" capabilities of the water. Reduced surface tension allows water to spread and to penetrate fabrics or other substances, enabling them to be washed or cleaned. Surface-active agents are sometimes called surfactants or wetting agents. *See also* surface tension.

surface aeration The absorption of air through the surface of a liquid.

surface area For granular activated carbon, an area value empirically determined by the Brunauer-Emmett-Teller method. Such surface area is generally expressed in square meters per gram of activated carbon. *See also* Brunauer–Emmett–Teller method.

surface curve (1) The longitudinal profile assumed by the surface of a stream of water flowing in an open channel or conduit. Surface curves are usually catalogued into 12 classifications depending on the slope of the conduit bed and whether the depth of flow is greater than, less than, or between the normal depth and the critical depth. The 12 classifications of the surface curve are used to describe the possible gradually varied flows in an open channel: three for the mild slope (M1, M2, M3), three for the steep slope (S1, S2, S3), two for the critical slope (C1, C3), two for the horizontal slope (H2, H3), and two for the adverse slope (A2, A3). (2) The hydraulic grade line for an open conduit or for a closed conduit flowing partly full. *See also* hydraulic grade line.

surface detention That part of the rain that remains on the ground surface during rainfall and either runs off or infiltrates after the rain ends. Surface detention does not include depression storage. The detention depth increases until discharge reaches an equilibrium in which the rate of supply equals the surface runoff.

surface diffusion An intraparticle transport mechanism for adsorbed particles. Once adsorbed, particles can diffuse along a surface according to a concentration gradient of previously adsorbed particles.

surface drag Resistance to fluid flow caused by viscous shear in the boundary layer. Surface drag is also called skin friction.

surface drainage (1) The removal of surplus or excess surface water collecting on land. Surface drainage is accomplished by natural means or by such artificial means as levees, open ditches, and terracing. (2) Runoff.

surface evaporation Evaporation from the surface of a body of water, moist soil, snow, or ice. *See also* evapotranspiration.

surface-fed intermittent stream A stream or stretch of a stream that flows during a protracted period while receiving water from a surface source, usually the gradual and long-continued melting of snow in a mountainous area or other cold tributary area. This term may arbitrarily be restricted to streams or stretches of stream that flow continuously during periods of at least 1 month.

surface filtration Filtration that occurs at a surface layer (as opposed to within the depth of the filter bed as occurs with granular media filtration) of a filter. Surface filtration is accomplished by passing the material to be filtered over a grating, screen, diatomaceous earth layer, biofilm layer, sieve, or membrane fabric with micrometer-sized holes. The size of the filter holes determines which particles will pass through and which will be filtered out (the determinants of the straining mechanism). *See also* depth filtration; diatomaceous earth filtration; slow sand filtration.

surface float A float on a water surface. Observation of the float indicates the flow direction, and observation of the time the float takes to traverse a measured distance indicates the velocity. *See also* subsurface float.

surface loading rate (SLR) A unit process criterion expressing the rate at which the hydraulic surface of a treatment basin will receive a flow of water. The units of expression, volume per time per surface area, are equivalent to the units of velocity, thereby relating to the settling velocity of the "design" particle to be removed. Particles with settling velocities greater than the surface loading rate theoretically will be removed, whereas only a portion of the particles with settling velocities less than the surface loading rate will be removed. *See also* overflow rate.

surface microlayer The thin zone, usually several molecules thick, at the surface of a body of water within which physical processes are modified because of contact with the atmosphere, surface tension, and other surface phenomena. *See also* surface tension.

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Surface Mining Control and Reclamation Act (SMCRA) Public Law 95-87 (30 US Code 1201–1328), which seeks to protect the environment from the adverse effects of surface coal-mining operations. The Surface Mining Control and Reclamation Act requires permits for surface coal mining and reclamation.

surface overflow rate *See* surface loading rate.

surface pressure An inward pull acting on the free surface of a liquid. Surface pressure differs with differing curvature of the liquid surface. It increases with increasing convexity and decreases with increasing concavity of the surface of the liquid.

surface profile The longitudinal profile assumed by the surface of a stream of water flowing in an open channel.

surface pump A mechanical device for removing water from a sump or wet well.

surface runoff (1) That portion of the runoff of a drainage basin that has not percolated beneath the surface after precipitation. (2) The water that reaches a stream by traveling over the soil surface or by falling directly into the stream channels, including not only the large permanent streams but also the tiny rills and rivulets.

surface screen A device for excluding debris from a surface water intake.

surface slope The inclination of a water surface, expressed as the change in elevation per unit of surface length; the sine of the angle that the water surface makes with the horizontal. The tangent of that angle is ordinarily used, with no appreciable error resulting except for the steeper slopes.

surface soil The soil's uppermost part that is ordinarily moved in tillage, or its equivalent in uncultivated soils. Surface soil ranges in depth from 3 to 10 inches (7.5 to 25.0 centimeters) and is frequently designated as the plow layer.

surface storm flow That portion of the storm flow that is induced by gravity to move over the surface of the ground.

surface supply Water from streams and snow runoff, as distinguished from subterranean sources or groundwater.

surface sweep *See* rotary surface washer.

surface tension (σ) The strength with which a liquid forms a relatively tough "skin" or film on its surface. Surface tension is caused by the attraction between the molecules of the liquid, and it causes water molecules to stick together and form drops.

surface tension units *See in the Units of Measure section.*

surface wash (1) A supplementary method of washing the filtering medium of a rapid granular filter by applying water under pressure at or near the surface of the sand by means of a system of stationary or rotating jets. (2) The surface runoff draining into a ditch or drain. *See also* filter agitation; rotary surface washer; stationary surface washer.

surface washing *See* filter agitation.

surface wash nozzle A nozzle on a fixed grid of pipes or on rotary surface washers. The nozzles are designed to deliver high-velocity jets of water onto the surface of the filter medium and into the medium after it has been fluidized during backwashing. These nozzles are used to provide auxiliary scour and aid in cleaning dirt from the filter medium. *See also* backwash.

surface water All water on the surface, as distinguished from subsurface water or groundwater.

surface water drain A drain constructed to carry surface water.

surface water inlet An inlet providing entrance for surface water into a drain that is located below the ground surface.

surface water safe yield *See* impoundment safe yield.

Surface Water Treatment Rule (SWTR) The common name for the US Environmental Protection Agency regulation promulgated June 29, 1989, that set maximum contaminant level goals for *Giardia lamblia*, viruses, and *Legionella*, as well as National Primary Drinking Water Regulations for public water systems using surface water sources or groundwater under the direct influence of surface water. These regulations include (1) criteria under which filtration (including coagulation and sedimentation, as appropriate) are required and procedures by which the states are to determine which systems must install filtration, and (2) disinfection requirements. *See also* groundwater under the direct influence of surface water.

Surface Water Treatment Rule bin requirement table A table included in the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) that places water systems into categories, referred to as a bin, based on *Cryptosporidium* monitoring results. The bin category indicates any additional *Cryptosporidium* treatment requirements required to comply with the rule, which is focused on improved control of microbial contaminants.

surface weed *See* floating weed.

surfactant *See* surface-active agent.

surficial Of or relating to a surface. For example, the surficial velocity is the fluid velocity at the surface of the liquid.

surge A sudden increase in the movement or pressure of water in a pipe or container, usually caused by opening or closing of a valve, starting or stopping of a pump, or trapping of air in a water main. *See also* water hammer.

surge allowance That portion of the surge pressure that can be accommodated without changing pipe pressure

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class. The surge allowance is expected to accommodate pressure surges usually encountered in typical water distribution systems.

surge block A plug that is lowered and raised in a well to create pressure shocks and to dislodge fine materials from the well screen. Surge blocks are used to develop wells for water production.

surge chamber *See* surge tank.

surge pressure The pressure caused by a sudden movement of water or liquid from such causes as a directional change in the flow, the starting or stopping of a pump, and the opening or closing of a valve or fire hydrant. *See also* water hammer.

surger A device to develop a well resembling a disk that fits tightly in the well with a one-way valve. The surger is alternately pushed down into the well and then pulled up like a piston. It causes rapid hydraulic pressure changes and, somewhat like a syringe, pulls water and drilling cuttings from the formation into the well for removal. Once the well is fully developed and no residual drilling cuttings flow into the well, the surger is removed and the production pump is placed into the well.

surge suppressor A device, such as a ball valve or cone valve, that opens and closes slowly with the turning on and off of a pump to minimize the surges with changes in water motion.

surge tank A tank used to attenuate the pressure increase or decrease resulting from a sudden change in fluid momentum. A surge tank accumulates water in response to a pressure surge and supplies water in instances of moderate negative gauge pressure, thereby preventing damage to pumping and piping equipment. Surges result when sudden changes in a flow regime occur, such as when pumping equipment is stopped or valves are closed too quickly. *See also* water hammer.

surging and bailing A well development method that uses a surger to force drilling cuttings into the well and a bailer to remove the suspension of cuttings and water that flow into the well during use of the surger. *See also* bailer; surger.

surplus The amount by which the assets of a private utility exceed the total of the utility's liabilities, reserves, and capital stock; in a publicly owned utility, the amount by which the assets exceed the total liabilities, reserves, and municipal equity.

surrogate compound A substance that is not usually found in the environment but is chemically similar to an environmental contaminant. Such similarities allow the use of surrogate compounds as internal standards in organic analytical procedures. Surrogate compounds are used, for example, to determine recoveries and adjust the retention times of gas chromatographic methods.

surrogate measurement An analytical measurement for a nonspecific or indicator parameter that can be used in lieu of performing tests for specific contaminants. For example, dissolved organic halogen measurements can be made instead of (or in addition to) tests for specific halogen-substituted disinfection byproducts. Similarly, total coliform testing can be used as a surrogate measurement for pathogenic microorganisms in water (i.e., coliform densities can provide an indication of the degree of pollution of a water). *See also* total coliform; total organic halogen.

surveillance sample A water sample analyzed by a regulatory agency to evaluate the ability of a public water system to meet drinking water regulations. Surveillance samples taken at the discretion of the regulatory agency and without objection from the water supplier may be counted as monitoring samples.

surveying A branch of applied mathematics that provides techniques for determining the area of any portion of the earth's surface, the lengths and directions of the bounding lines, the contour of the surface, and an accurate delineation of the whole on paper.

survey meter A portable instrument, such as a Geiger counter or ionization chamber, used to detect nuclear radiation and to measure the dose rate.

suspected carcinogen A formal term applied by the International Agency for Research on Cancer or by the US Environmental Protection Agency to indicate that limited evidence exists that a chemical could produce cancer in humans. Giving a chemical this label entails using a "weight of evidence" approach that can be based on some combination of tests in experimental animals and results from human epidemiological studies. *See also* weight-of-evidence approach.

suspended-frame weir A movable timber weir in which the structural steel frames, in times of flood, can be raised from the river and supported by an overhead bridge.

suspended growth Biological growth that is uniformly dispersed and mixed in a liquid medium for the purposes of removing target compounds and contaminants. *Contrast with* biofilm.

suspended load The part of a liquid's sediment load that is in suspension.

suspended matter *See* suspended solids.

suspended sediment *See* suspended solids.

suspended solids Solid organic and inorganic particles that are held in suspension by the action of flowing water and are not dissolved. Suspended solids are retained on a standard glass fiber filter or a 0.45-micrometer pore diameter membrane filter after filtration of a well-mixed sample. The residue is dried at 217° to 221° Fahrenheit

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(103° to 105° Celsius). Suspended solids are also known as suspended matter or suspended sediment. *See also* solids; total suspended solids.

suspended water Subsurface water that partially occupies interstices in the zone of aeration. Suspended water is composed of hygroscopic, pellicular, mobile, and fringe water.

suspended water zone *See* unsaturated zone.

sustainability A decision-making concept describing development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

sustained yield A continual periodic or annual yield of plants or plant material from an area.

Sutro weir A weir with at least one curved side and a horizontal crest, formed so that the head above the crest is directly proportional to the discharge.

SUVA *See* specific ultraviolet absorbance.

Sv *See* sievert *in the Units of Measure section.*

SVB *See* spill-resistant pressure vacuum-breaker backsiphonage-prevention assembly.

swab A polyurethane foam plug, similar to a polypig but more flexible and less durable. *See also* polypig.

swabbing The process of lowering and raising a surge block or line swab to develop a well for water production.

Swamee–Jain expression An approximate formula developed by Swamee and Jain (1976) to determine the friction factor f as it appears in the Darcy–Weisbach equation. The Swamee–Jain expression is written as

$$f = \frac{1.325}{\left[\ln\left(\frac{\varepsilon}{3.7D} + \frac{5.74}{Re^{0.9}}\right)\right]^2}$$

Where:

ε = roughness height in feet or millimeters
D = the pipe diameter in feet or millimeters
Re = the Reynolds number, a dimensionless parameter

This formula can be applied in both US customary and Système International units. *See* also Darcy–Weisbach formula; Darcy–Weisbach roughness coefficient; Reynolds number.

swamp A flat, wet area that is usually or periodically covered by standing water and that supports a growth of grasses, shrubs, and trees. In contrast to a bog, the organic soil in a swamp is thin and readily permeated by roots and nutrients.

swamp gas *See* methane.

SWAP *See* Source Water Assessment Program.

SWD *See* side water depth.

SWDA *See* Solid Waste Disposal Act.

sweat joint A joint for copper pipe or tubing with fittings, created by heating of the joint until melted solder runs into the joint between the tubing and fitting, making a seal and connection as the solder cools.

sweep coagulation zone *See* zone of coagulation.

sweep-floc coagulation A process of overdosing coagulant to ensure that the hydrolyzed chemical will form sufficient precipitate to settle rapidly and "sweep" particles out of the suspension. Most conventional water treatment plants operate in the sweep-floc coagulation, or sweep flocculation, mode. *See also* adsorption–destabilization; bridging; double-layer compression.

sweep flocculation *See* sweep-floc coagulation.

sweep floc zone *See* zone of coagulation.

sweet brine Brine that contains sufficient sodium or potassium content and is relatively low in calcium, magnesium, or other interfering substances such that it is effective for use or reuse in regenerating exhausted ion-exchange resin. *See also* reclaimed brine; sour brine.

swelling The expansion of certain ion-exchange resins when they are converted into a specific ionic state (either exhaustion or regeneration, depending on the resin). This expansion is reversible. Some exchangers will expand as they exhaust. Cation-exchange water-softening resins will generally swell when they are exhausted (loaded with hardness ions) and will shrink when regenerated with heavier salt dosages of 10 to 15 pounds of sodium chloride (NaCl) or potassium chloride (KCl) per cubic foot (160 to 240 kilograms per cubic meter) of resin. Standard cation softening resin [8 percent polystyrene $((C_6H_5CHCH_2)_n)$/divinyl benzene $(C_6H_4(CH{:}CH_2)_2)$], in the calcium form, will shrink about 5 percent in volume when treated with a 25 percent salt-brine solution.

swirl Rotary motion of a flow superimposed on the forward motion.

switch A device to manually disconnect electrical equipment from the power source.

switchgear A heavy, constructed panel for a large motor or other equipment using high voltage, generally 1,200 to 7,200 volts. The device has circuit breakers and other protective features along with low-voltage transformers for control power. Frequent starting and stopping of the equipment should be limited because of high-voltage starting requirements and excessive wear to the equipment. Relatively new switchgear may have start limit controls—protective devices that prevent the starting of motors more than a limited number of times over a set time period to prevent overheating and damage.

SWL *See* static water level.

SWTR *See* Surface Water Treatment Rule.

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symbiosis The mutually beneficial cohabitation of two dissimilar organisms. For example, lichens, which grow on the surfaces of rocks, are examples of mutually beneficial relationships between algae and fungi.

symbol A graphical element used to represent a feature as a point on a map. A symbol is generally stored once in a library or file and is referenced multiple times within a graphic drawing. A geographic information system is equipped to display a wide variety of symbols representing points, lines, areas, and facilities. *See also* geographic information system.

symbology The choosing of symbols on a map, including specifications for line type, weight, symbol type, size, and orientation.

symmetrical membrane A type of membrane having a structure that is relatively uniform throughout.

symptomatology The medical science of disease symptoms.

syncarcinogenesis The administration of two carcinogens resulting in either additive or synergistic (i.e., more than additive) effects. Two types of syncarcinogenesis are recognized: that which occurs when the chemicals are administered together, and that which occurs when they are sequentially administered.

synchronous communication Communication occurring at timed intervals regulated by pulses from a computer clock. It is commonly used in data communications to synchronize a transmitter and receiver. Synchronous transmission of data between computers eliminates the need for start and stop bits. *See also* asynchronous communication.

synchronous motor An electric motor that is designed to run at synchronous speed. *See also* synchronous speed.

synchronous speed The speed of rotation of the magnetic field in an alternating current electric motor. This speed is a function of the frequency of the applied power and the number of poles in the motor.

synclinal spring A contact spring occurring at the outcrop of a pervious water-bearing stratum in a syncline.

syncline A folded geologic formation where the limbs of the fold dip (slope downward) toward the axis.

syndet *See* synthetic detergent.

synecology The study of the interrelationships between organism groups in a natural community and their environment.

Synedra A genus of diatom found in eutrophic fresh surface waters.

synergism A phenomenon in which the effects of two or more organisms or substances acting together are greater than the sum of their individual effects—often expressed as "2 + 2 = 5."

synoptic Varying with distance; longitudinal.

synthetic detergent A manufactured cleaning agent. Detergents can be classified as anionic, cationic, or nonionic.

synthetic estrogen A group of synthetic female hormones used for hormone replacement therapy, typically obtained from natural sources. Many of these hormones can survive wastewater treatment and have been detected in various water sources.

synthetic ion-exchange resin A manufactured ion-exchange resin, commonly made with cross-linked polymers having exchangeable functional groups. *See also* ion exchange.

synthetic membrane A manufactured membrane, commonly made with manufactured polymers.

synthetic organic chemical (SOC) An organic compound that is commercially made. Some synthetic organic chemicals are contaminants in drinking water and are regulated by the US Environmental Protection Agency. The regulated synthetic organic contaminants include volatile organic chemicals, pesticides, herbicides, polychlorinated biphenyls, selected treatment chemicals (e.g., acrylamide), and polynuclear aromatic hydrocarbons. *See also* acrylamide; herbicide; pesticide; Phase I Rule; Phase II Rule; Phase V Rule; polychlorinated biphenyl; polynuclear aromatic hydrocarbon.

synthetic organic compound (SOC) *See* synthetic organic chemical.

synthetic organic contaminant (SOC) *See* synthetic organic chemical.

synthetic organic matter *See* synthetic organic chemical.

synthetic resin *See* synthetic ion-exchange resin.

synthetic unit hydrograph A unit hydrograph developed for an ungauged drainage area, based on known physical characteristics of the basin.

Synura petersenii (S. petersenii) Golden-brown algae (chrysophyte) responsible for taste and odor problems in freshwater. *S. petersenii* produces a compound called nonadienal that imparts a distinct cucumber smell, which changes to a fatty rancid smell at high concentrations.

syringyl phenols A name for 2,6-dimethoxyphenol derivatives that could react with chlorine to form chlorinated by-products.

system (1) A combination of several pieces of equipment integrated to perform a single function. For example, a water treatment system employs various processes—such as coagulation, sedimentation, filtration, and disinfection—with the common objective of producing potable water. (2) An assemblage or combination of things, or a blend of functionally compatible components, to achieve objectives that have been properly determined.

system analysis *See* network analysis.

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systematic error *See* bias.

system atlas An up-to-date graphical representation of a water distribution system depicting such facilities as mains, service connections, fire hydrants, valves, tanks, and pump stations, along with utility property, easements, and rights-of-way. These facilities, as shown in a systematic manner, become geographic locations to form a map book or atlas used in the operation and maintenance of the distribution system.

system development charge A contribution of capital toward existing or planned future backup plant facilities that are needed to meet the service needs of the customers to whom such fees apply. Various terms are used to describe these charges in the water treatment industry, but the basic intent of the charges is to provide funds for use in financing all or a portion of the capital improvements necessary to serve new customers. *See also* capacity charge.

system development charge facilities Those facilities, or a portion of those facilities, that have been identified as being required for new customer growth. The cost of the facilities will be recovered in total or in part through a system development charge.

system efficiency *See* hardware efficiency.

Système International d'Unités (SI) *See in the Units of Measure section.*

system head curve A plot of the head loss in a water distribution system as a function of discharge in the system. Hydraulic engineers use system head curves to match pumps to hydraulic systems and to operate systems efficiently. Typically pumps and hydraulic systems operate efficiently over a narrow range of discharges and added heads, and the two parts must be carefully matched to avoid wasting energy.

systemic Acting within the body as a result of being absorbed and distributed by the blood.

systemic effect An effect observed at sites distant from the entry point of a chemical as a result of the chemical's absorption and distribution into the body. Chemicals that act locally on epithelial structures, such as the skin or lining of the stomach or intestine, would not be considered as producing systemic effects.

systemic toxicity Toxicity that occurs as a result of absorption of a chemical into the body. *See also* systemic effect.

system input volume The volume of water input to that part of the water supply system to which the water balance calculation relates. It is equal to the water volume derived from the water utility's own source waters plus water imported or purchased during the audit period.

system leakage The major component of the real losses, or physical losses, occurring in a water distribution network. Component analysis modeling segregates system leakage into three components: reported leaks (brought to the attention of the utility as a nuisance), unreported leaks (hidden leaks detected only through the active leakage control efforts of the water utility), and background losses (the smallest volume leaks that are undetectable by traditional sonic detection methods). For each of these types of leaks, their nature, flow rates, and run times are important in determining the appropriate leakage management strategy for a water utility. *See also* breaks and background estimates model; component analysis.

system loss *See* system leakage.

system performance The general rating of a system based on many parameters, which may include but are not limited to unaccounted for water, number of leaks, number of service interruptions, and energy usage.

systems analysis A systematic approach to assessing a problem, arriving at alternatives, and projecting the probable consequences of employing those alternatives in order to facilitate making correct decisions.

system submetering program A method to determine water use in multiunit housing and commercial areas so that the cost of water can be apportioned among the individual users.

systemwide running annual average (RAA) approach An approach to regulatory compliance that involves setting a limit on the RAA of a contaminant that is based on averaging test results from sampling points across the distribution system.

system with a single service connection A system that supplies drinking water to consumers via a single service line.

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T

T *See* absolute temperature; period.

T *See* tera; tesla *in the Units of Measure section.*

t *See* metric ton *in the Units of Measure section;* tonne *in the Units of Measure section.*

T-2 *See* trichothecene mycotoxin.

T-2 mycotoxin *See* T-2 toxin.

T-2 toxin A biological warfare agent that belongs to the trichothecene group of mycotoxins and is formed by fungi. T-2 toxin is often found in agricultural commodities. Also known as T-2 mycotoxin, it causes skin irritation, vomiting, and irregular heartbeat. A guideline for the maximum allowable amount of this chemical warfare agent in military drinking water has been developed by the National Research Council. *See also* National Research Council.

table (1) A condensed collection and arrangement of related numbers or other items assembled in some definite order, such as a table of logarithms. (2) A surface, such as a water table.

tablet method A method of disinfecting new or repaired water mains in which calcium hypochlorite tablets are placed in a section of pipe. As the water fills the pipe, the tablets dissolve, producing a chlorine concentration in the water.

tabun (GA) A clear, colorless, tasteless chemical warfare agent with a fruity odor that is classified as a nerve agent. It has the chemical name ethyl dimethylamidocyanophosphate. It is also known as GA and is the first and so most volatile in the G-series of nerve agents that also includes sarin (GB), soman (GD), and cyclosarin (GF). A guideline for the maximum allowable amount of this chemical warfare agent in military drinking water has been developed by the National Research Council. *See also* National Research Council.

TAC *See* technical assistance center.

tachometer generator A sensor for measuring the rotational speed of a shaft.

tachyzoite Rapidly multiplying form of parasites.

tactical planning Specific resource allocations or reallocations including line-item budgeting, business process reengineering, and organizational restructuring oriented toward affecting strategic investments but also ongoing utility operations, maintenance, and capital investment processes.

tagged and locked out Unavailable for use as a result of safety measures. This phrase describes a safety precaution to prevent the power to such electrical equipment as a pump motor from being turned on while maintenance is being performed on the equipment or to prevent operation of the equipment for other reasons. A tag is placed on the switchgear or starter to provide notice, and a lock is placed on the switchgear or starter to prevent its operation.

tagout To communicate to workers that a piece of equipment is out of service and not to be energized until the warning tag is removed.

tail bay The part of a canal lock immediately below the tail gates.

tailed phage The most numerous and most varied of all viruses. Tailed phages are identified by morphology, physicochemical properties, nucleic acid content, resistance to physical and chemical agents, serology, and nucleic acid hybridization reactions.

tail gate The gate at the low-level end of a lock.

tailgate safety meeting A safety meeting regularly held by members of the construction industry around the tailgate of a truck.

tailored water rate A system of water rates designed to meet the specific needs or requirements of a particular customer, usually a large industrial or commercial customer with high water usage.

tail pipe The suction pipe of a pump.

tailrace A channel that conducts water from a waterwheel; an afterbay.

tailwater Water discharged at the downstream end of a structure.

tainter gate A crest gate for which the face is a section of a cylinder that rotates about a horizontal axis downstream from the gate. The water pressure against the gate is concentrated in the axis; this arrangement reduces friction in raising and lowering the gate. A seal is placed along the sides and bottom of the gate face for watertightness. The gate is raised and lowered by winches or hoists attached to cables or chains fastened to the bottom edge of the gate and lying against its water face; this allows a vertical lifting force to be applied. A tainter gate can be closed under its own weight. Such gates were formerly called canal locks.

tall fescue A hybridized, cool-season turfgrass characterized by deeper root systems and more drought tolerance than bluegrass.

tangential filtration *See* crossflow filtration.

tangential flow filtration *See* crossflow filtration.

tangential flow ultrafiltration *See* crossflow filtration.

tangential turbine A turbine that depends on the impulse of moving water or steam delivered at high velocities against a set of vanes or buckets placed on the periphery of a wheel that is rotated by the impulse

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of the steam or water. Such a turbine is also called an impulse turbine.

tangible asset Permanent property of a physical nature, such as lands, buildings, mineral deposits, wells, reservoirs, plant equipment of all kinds, utensils, furnishings, rolling stock, or merchandise, intended for immediate use and permanent improvements. Tangible assets are also called physical assets.

tank A structure or container used to hold water for such purposes as aeration, disinfection, equalization, holding, sedimentation, treatment, mixing, dilution, feeding, or other handling of chemical additives.

tank farm A large facility for the storage of chemical or petroleum products in aboveground storage tanks.

tannin A colored compound formed in water when plant matter degrades.

tap The connection of a service line to a water line by means of a corporation stop. A tap is installed by drilling and threading the water main for the corporation stop or by using a tap saddle that attaches around the water main and provides threads for the corporation stop. *See also* corporation cock.

tape gauge A gauge to measure the distance to a water surface. It consists of a tagged or indexed chain, tape, or other line attached to a weight that is lowered to touch the water surface. When the weight touches the surface, the gauge height is then read on a graduated staff or opposite an index. Opposite ends of the tape may be attached to a float and counterbalance and the tape arranged to hang on a pulley. The gauge height may then be read on a graduated staff or opposite an index.

tap fee *See* system development charge.

tapping The drilling and threading of a hole in a water line with the insertion of a corporation cock to allow the connection of a water service line. *See also* corporation cock.

tapping gate A valve that attaches to a tapping sleeve and a tapping machine to allow a hole to be drilled in a water pipe. The valve is closed to make a shutoff when the drill and round section of pipe cut from the water pipe are removed through the open valve. The valve remains as part of the distribution system and provides a connection point for the new main.

tapping machine A tool that can be attached to a water main to drill and thread a hole in the water main and insert a corporation cock under pressure. *See also* corporation cock.

tapping sleeve A split sleeve used in making a wet connection where a single branch line is to be tapped into a water main under pressure.

tapping valve A valve with flanges that can be connected to a tapping tee and a drilling machine to drill a hole in a main through the valve. The drill is withdrawn and the valve closed, allowing removal of the drilling machine and then connection of the new water main.

tap saddle A device that encircles a water main and provides an outlet to connect a corporation cock.

tare weight The weight of a container when empty.

target compound A chemical for which an analytical protocol has been developed for detection. *See also* broad-screen analysis.

target concentration The chosen concentration in the effluent of a treatment process to designate when the treatment system must be stopped.

target organ A bodily organ in which a chemical produces its effects. In therapeutics, the effect may be a desirable effect, e.g., to alleviate symptoms of disease. In toxicology, the target organ is the organ in which adverse effects are produced.

taste (1) To ascertain the flavor of a substance by taking a portion into the mouth; to perceive or recognize by the sense of taste. (2) The act of tasting. Taste is one of the special senses that perceives and distinguishes the sweet, sour, bitter, or salty quality of a dissolved substance. It is mediated by taste buds on the tongue. Strictly speaking, *taste* refers to the four basic tastes just discussed, whereas *flavor* refers to the blend of taste and smell sensations evoked by a substance in the mouth. *See also* flavor; odor.

taste and odor The combination of sensations perceived by the mouth (i.e., by taste buds on the tongue) and nose. *See also* taste.

taste threshold The minimum concentration of a chemical or biological substance that can just be tasted. *See also* threshold odor; threshold odor number.

tax-exempt commercial paper (TECP) A short-term promissory note with an average maturity of 30 to 45 days. Such notes, which have a maximum maturity of 270 days, are intended to be refinanced (rolled over) continuously for periods that may exceed one year. Because of the refinancing aspect of the notes, the interest rates are variable, possibly changing with each refinancing.

taxonomic group A group of living organisms that are related to one another.

taxonomy The branch of biology pertaining to naming and classifying the diverse forms of life. Developed by Carolus Linneaus in the eighteenth century, taxonomy involves the binomial system of naming organisms according to genus and species; and a system for grouping species into a hierarchy of increasingly broad categories.

TBA *See* tertiary butyl alcohol; tribromoacetaldehyde.

2,4,6 TBA *See* 2,4,6-tribromoanisole.

TBAA *See* tribromoacetic acid.

TBAN *See* tribromoacetonitrile.

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TBM *See* bromoform (tribromomethane).
TBNM *See* bromopicrin (tribromonitromethane).
1,1,1-TBP *See* 1,1,1-tribromopropanone.
1,1,3-TBP *See* 1,1,3-tribromopropanone.
TBS *See* tetrapropylene-benzene sulfonate.
T_c *See* Kirpich formula.
TC *See* total carbon; total coliform.
TCA *See* trichloroacetaldehyde; trichloroacetate; 1,1,1-trichloroethane; 1,1,2-trichloroethane.
TCAA *See* trichloroacetic acid.
TCAN *See* trichloroacetonitrile.
TCD *See* thermal conductivity detector.
TCDD *See* 2,3,7,8-tetrachlorodibenzo-*p*-dioxin.
TCE *See* trichloroethylene.
T cell A lymphocyte (white blood cell) that is influenced by or passes through the thymus gland (i.e., a thymus-dependent lymphocyte). T-cells are of different types; some act to suppress whereas others assist the stimulation of antibodies within B-lymphocytes. They have additional immune system functions, as well, and are involved in cell-mediated immunity. Some are capable of killing tumor cells or cells from transplanted tissues.
$TCID_{50}$ *See* tissue culture infectious dose 50.
TCLP *See* toxicity characteristic leaching procedure.
TCM *See* chloroform (trichloromethane); total catchment management.
TCP *See* trichlorophenol.
1,1,1-TCP *See* 1,1,1-trichloropropanone.
1,1,3-TCP *See* 1,1,3-trichloropropanone.
1,2,3-TCP *See* 1,2,3-trichloropropane.
TCP/IP *See* transmission control protocol/Internet protocol.
TCR *See* Total Coliform Rule.
TCT *See* total chlorotriazine.
tcu *See* true color unit *in the Units of Measure section.*
TD *See* to deliver.
TDC *See* total direct count.
TDGP *See* total dissolved gas probe.
TDH *See* total dynamic head.
TDS *See* total dissolved solids.
1,1,3,3-TeBP *See* 1,1,3,3-tetrabromopropanone.
technical, managerial, and financial (TMF) capacity requirements Basic requirements that a small water system must meet as specified by the Safe Drinking Water Act. Primacy agencies are required to prevent the formation of new nonviable systems, and also to develop a comprehensive strategy to assist public water systems in obtaining adequate technical, managerial, and financial capacity to ensure compliance with the National Primary Drinking Water Regulations (NPDWRs).
technical assistance A one-to-one approach whereby any trained person or entity provides information and support to water systems in an effort to provide safe, adequate, and palatable drinking water.
technical assistance center (TAC) One of several universities around the nation designated and funded by US Environmental Protection Agency to address the needs of rural and small public water systems or public water systems that serve Native American tribes. Together, the small public water systems' technology assistance centers form a network with the common goal to protect public health, improve water system sustainability, and enhance compliance. They provide assistance in the following areas: technology verification, pilot and field testing of innovative technologies, training, and technical assistance.
technical summary document (TSD) A document prepared by the US Environmental Protection Agency and the US Army Corps of Engineers that summarizes the findings of a field study and literature review of the natural characteristics and functions of a wetland area. Preparation of a technical summary document is the first step in the advance identification process. The technical summary document is provided to the federal, state, and local review agencies for their consideration and recommendations. *See also* advance identification.
technological change A major or sweeping change in knowledge in such fields as applied science and engineering, e.g., the change from vacuum tubes to transistors to integrated circuits or the change from mixed-media filtration to membrane technology.
technological obsolescence A condition in which some thing or process continues to work but in common practice has been replaced by a newer version. A chemical laboratory that does not use new kinds of analytical instrumentation would suffer from technological obsolescence.
technology Specifically, the branch of knowledge that deals with industrial arts, applied science, engineering, and so on. Technology generally encompasses the sum of the ways in which members of a social group or society provide themselves with the material objects of their civilization.
technology transfer The sharing or transfer of new techniques, processes, or equipment by one agency or country with or to another. Technology can also be transferred from one advanced industrial use to another, e.g., aerospace instrumentation to water quality monitoring.
TECP *See* tax-exempt commercial paper.
1,1,1,3-TeCP *See* 1,1,1,3-tetrachloropropanone.
1,1,3,3-TeCP *See* 1,1,3,3-tetrachloropropanone.
tee A fitting in the shape of a letter *T* that has an opening perpendicular to the run, allowing a three-way connection.

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TEF *See* toxicity equivalency factor.

tegument The outer covering of an organism.

telemetering The use of devices and attachments for complete measuring, transmitting, receiving, recording, and integrating data from a distance by electrical translating means.

telemetry The use of an electrical link between a transmitter and a receiver. A telephone line can serve as the electrical link, but more frequently, the connection is wireless.

telemetry system A system designed to transmit signals to a more centralized location for control of, and data acquisition from treatment processes and distribution facilities. Typical means of signal transfer include wireless communications, telephone lines, radio waves, and computer networks.

telephone dial-inbound A type of automatic meter-reading system in which meter interface units at customers' premises call into the utility office to provide meter-reading data.

telephone dial-outbound A type of automatic meter-reading system in which a central computer polls meter interface units over the telephone lines, typically on the telephone company's secondary circuit.

telephone success factor (TSF) The percentage of time incoming calls are picked up within 20 seconds, used as an indicator of the efficiency of a customer call center.

telescoping A movement of the outer layers of a spiral-wound element in the direction of the feed flow, caused by excessive flow through the feed spacer. *See also* antitelescoping device; spiral wound.

television inspection The inspection of inaccessible or hazardous locations by the use of closed-circuit television. This term usually applies to truck-mounted, semiportable equipment used to inspect inside buried water lines.

telltale (1) A water-level indicator installed in a reservoir. (2) A small overflow pipe that indicates, by dripping, when a tank or cistern is full.

TEM *See* transmission electron microscopy.

temperature (1) The thermal state of a substance with respect to its ability to communicate heat to its environment. (2) A measure of the thermal state on some arbitrarily chosen numerical scale, e.g., Celsius, kelvin, or Fahrenheit. *See also* heat.

temperature, absolute *See* absolute temperature.

temperature approach The lowest temperature difference between the two fluids within a discrete-surface heat exchanger or between air and water in a cooling tower.

temperature correction factor For some pressure-driven membrane processes, a dimensionless coefficient accounting for effects of process fluid temperature variations. Such a factor can be used to calculate permeate flow rate at a given temperature by multiplication with permeate flow rate at a standard temperature.

temperature degree A unit on a scale to measure the hotness or coldness of anything, usually measured on a thermometer.

temperature-driven membrane A hydrophobic membrane that uses a thermal gradient across the membrane as the driving force. A portion of the liquid on the feed side vaporizes and passes through the membrane to the permeate side, where it condenses. Such a membrane can be used for water desalting, in which case the process is called membrane distillation.

temperature sensor A device that opens and closes a switch in response to changes in temperature. This device might be a metal contact, a thermocouple that generates a small electrical current proportional to the difference in heat, or a variable resistor for which the value changes in response to changes in temperature. A temperature sensor is also called a heat sensor.

temperature units *See in the Units of Measure section.*

temporal Transitory; lasting only for a time; transient.

temporal variation Change in some condition (e.g., water quality) that occurs over time.

temporarily absorbed water Water that reaches only the belt of soil water or the intermediate saturation zone, from which it escapes either by evaporation from film surfaces or by root absorption and transpiration from vegetation.

temporary dam A dam constructed of readily available materials and equipment in such a manner as to be nonpermanent and to perform as a cofferdam.

temporary hardness *See* carbonate hardness.

temporary partial disability An injury that does not result in death or permanent injury yet allows the employee to temporarily perform alternate duties that accommodate the disability until the employee is able to return to normal duties.

temporary spring A spring in which a discharge occurs only during certain periods and ceases at other periods. Such a spring is also called an intermittent spring.

temporary total disability An injury that does not result in death or permanent injury yet prevents the employee from performing duties. A full day of work after the day of the injury must be missed to fall under this Occupational Safety and Health Administration classification.

tender documents Documents constituting an offer or bid put forward for acceptance, for example, tender documents submitted in response to a request for proposals or request for tender proposals.

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tender-option bond A bond that can be redeemed by the bondholder on a date or dates prior to the stated maturity date. Such a bond is also known as a demand bond.

tenesmus A painfully urgent but ineffectual attempt to urinate or defecate.

tensile force A force applied to an object that tends to pull its material apart.

tensile strength A measure of the ability of pipe or other material to resist breakage when it is pulled lengthwise.

tensiometer A term used for two distinctly different devices: (1) A device used to measure the soil moisture pressure (tension suction) in the unsaturated zone. (2) A device to measure the interfacial (surface) tension of a liquid. *See also* surface tension; water tension.

tension (1) The French word for *voltage.* This French term is often found in print materials dealing with ozonation technology. (2) In English, a term usually used to mean high voltage, as in a high-tension transformer or high-tension lines. (3) The degree of stiffness or tautness.

Ten State Standards A reference manual providing guidance on the design of water treatment plants, prepared under the supervision of representatives from 10 states, including Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, and Wisconsin, as well as the province of Ontario, Canada.

TEQ (toxicological equivalency) *See under* hazard index.

tera (T) *See in the Units of Measure section.*

teratogen A chemical that is capable of producing structural abnormalities of the organs and skeleton that are observed at birth. *See also* carcinogen; developmental toxicity; mutagen; teratogenic effect.

teratogenesis The process of producing structural abnormalities of the skeleton or soft tissues during development.

teratogenic effect The inducement of malformations in utero. This effect is included in developmental toxicities. *See also* developmental toxicity; teratogen.

teratogenicity The capacity of a physical or chemical agent to cause teratogenesis in offspring. *See also* teratogenesis.

teratology The study of physical and chemical agents that induce developmental toxicities.

terbacil ($C_9H_{13}O_2N_2Cl$) The common name for the herbicide 3-*tert*-butyl-5-chloro-6-methyluracil. *See also* herbicide.

terbufos ($(CH_3CH_2O)_2P(S)\text{-}S\text{-}CH_2\text{-}S\text{-}C(CH_3)_3$) The common name for the soil insecticide and nematocide *S*-[[(1,1-dimethylethyl)thio]methyl]-*O*,*O*-diethyl phosphorodithioate. *See also* insecticide; nematocide.

term bond A bond with the entire principal maturing on one date.

terminal disinfection by-product concentration [DBP_t] The concentration of disinfection by-products present at the end of a disinfection by-product formation potential test at time *t.* This value equals the sum of the initial amount of disinfection by-products (i.e., the concentration present at the start of the test) and the disinfection by-product formation potential of the sample. *See also* disinfection by-product formation potential.

terminal half-life The time obtained by pharmacokinetic analyses for the slowest elimination half-life for a chemical or drug in the body. It is usually measured in the blood, but it can also be deduced from excretion rates into the urine or other body fluids (e.g., saliva). The terminal half-life is based on removal of the drug from the compartment for which the drug has the highest affinity. For example, highly fat-soluble compounds accumulated in fat deposits within the body are removed very slowly from that compartment; this removal would eventually dictate blood levels of the compound if the external exposure were removed. *See also* half-life; pharmacokinetics.

terminal head loss The head loss in a filter at which water can no longer be filtered at the desired rate because of the suspended matter filling the voids in the filter and greatly increasing the resistance to flow.

terminal ileum The distal portion of the small intestine, extending from the jejunum to the cecum. It is an important site in the neonatal mouse infectivity assay. *See also* neonatal mouse infectivity assay.

terminal settling velocity The maximum rate of sedimentation of a suspended particle that is not hindered in any way. *See also* Stokes's law.

terminal temperature The maximum temperature attained by the feedwater in a distillation device.

terminal total trihalomethane concentration ($TTHM_t$) The arithmetic sum of trihalomethane concentrations present at the end of a trihalomethane formation potential test at time *t.* This value equals the sum of the initial amount of total trihalomethanes (i.e., the concentration present at the start of the test) and the total trihalomethane formation potential of the sample. *See also* trihalomethane formation potential.

terminal trihalomethane concentration (THM_t) The concentration of a specific trihalomethane present at the end of a trihalomethane formation potential test at time *t.* This value equals the sum of the initial amount of the trihalomethane (i.e., the concentration present at the start of the test) and the trihalomethane

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formation potential of the sample. *See also* trihalomethane formation potential.

terrace (1) A flat, level (or nearly level) area of land bounded on at least one side by a definite steep slope rising upward from it and on the other sides by downward slopes. (2) A low embankment or ridge of earth constructed across a slope to control surface runoff and minimize soil erosion.

terrace spring A spring that has built up at its mouth a series of terraces or basins through deposition of material carried out of the earth in solution.

terrain conductivity curve A graph produced following surface geophysical measurement of the conductivity of earth materials by the use of electromagnetic waves. These measurements are especially useful for locating gravel, saline intrusions, cavities in the subsurface, contaminated plumes of groundwater, and bedrock topography.

terrestrial Growing, living, or peculiar to the land, as opposed to the aquatic environment.

tertiary butyl alcohol (TBA) A fuel oxygenate and also an impurity and a degradation by-product of methyl-*tert*-butyl ether (MTBE). It is of significance to groundwater contamination because of its mobility, recalcitrant nature, and potential toxicity. *See also* methyl-*tert*-butyl ether.

tertiary treatment Additional treatment of wastewater beyond secondary treatment but below potable so that it is usable for park irrigation and selected recreational purposes.

tertiary wastewater treatment *See* advanced wastewater treatment.

tesla (T) *See in the Units of Measure section.*

test In chemistry, a laboratory procedure used to analyze or examine a material in order to determine certain characteristics, such as to determine the concentration of constituents in water.

tested well capacity The maximum rate at which a well is known to have yielded water without appreciable increase in drawdown. If the well has been tested with the water level drawn down to the intake, the tested capacity is the total capacity.

testicle The organ in which sperm are produced. This organ also has a number of secretory functions that are, at least in part, responsible for secondary sex characteristics, including behavior that would be examined in a full evaluation of testicular function. A variety of testing procedures are applied to assess the effects of chemicals on male reproductive function.

testing A process of examining something for the purpose of gaining further knowledge about it.

test pit An open pit dug to permit the examination of the underlying material for suitability as a foundation or to test the current condition of buried water system facilities, such as valves and pipe.

test tube A slender glass or plastic tube with an open top and rounded bottom. Test tubes are used for a variety of tests.

test year The annualized period for which costs are to be analyzed and rates established.

1,1,3,3-tetrabromopropanone (1,1,3,3-TeBP) ($CHBr_2COCHBr_2$) A halogenated propanone in which four of the six hydrogen atoms of propanone have been replaced by bromine atoms. It is a disinfection by-product in chlorinated water. *See also* disinfection by-product; halopropanones.

2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) ($C_{12}H_4O_2Cl_4$) A chlorinated hydrocarbon that occurs as an impurity in the herbicide 2-(2,4,5-trichlorophenoxy)propionic acid. In addition, other environmental sources for this contaminant exist. 2,3,7,8-tetrachlorodibenzo-*p*-dioxin is highly toxic and persistent. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.00000003 milligrams per liter.

1,1,2,2-tetrachloroethane ($CHCl_2CHCl_2$) A volatile organic compound with various industrial uses, e.g., as a solvent. *See also* solvent; volatile organic compound.

tetrachloroethylene (PCE) ($Cl_2C=CCl_2$) The chemical name for perchloroethylene, a volatile organic compound used as a dry-cleaning or vapor-degreasing solvent. Tetrachloroethylene's presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.005 milligrams per liter. *See also* solvent; volatile organic compound.

1,1,1,3-tetrachloropropanone (1,1,1,3-TeCP) (CCl_3COCH_2Cl) A halogenated propanone in which four of the six hydrogen atoms of propanone have been replaced by chlorine atoms. It is a disinfection by-product in chlorinated water. *See also* disinfection by-product; halopropanones.

tetramethylammonium hydroxide (TMAH) A reagent commonly used in thermochemolysis. *See also* thermochemolysis.

tetrapropylene-benzene sulfonate (TBS) ($RC_6H_4SO_3^-$) A petrochemical product belonging to the class of synthetic detergents known as alkyl aryl sulfonates. It is one of the most useful surface-active products developed.

tetrasomy A condition in which a cell contains two additional chromosomes of a particular type in an otherwise diploid cell. Whereas the normal diploid cell has two of each type of chromosome, a tetrasomic cell has an additional pair of one of the chromosomes.

tetrathionate broth A peptone-based selective broth; used for the culture of *Salmonella* and *Shigella.*

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tetrodotoxin A neurotoxin produced by puffer fish for which there is no antidote.

texture The disposition or manner of arrangement of the particles or small constituents of a body or substance.

TFC (thin film composite) membrane *See under* composite membrane.

T. gondii *See Toxoplasma gondii.*

TH *See* total hardness.

THA *See* trihaloacetaldehyde.

THAA *See* trihaloacetic acid.

thallium (Tl) A metallic element with miscellaneous industrial uses, including in mercury alloys, rodenticides, and photoelectric applications. Thallium's presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.002 milligrams per liter. *See also* rodenticide.

thalweg (1) The line following the lowest part of a valley, whether underwater or not. The thalweg is usually the line following the deepest part or middle of the bed or channel of a river. (2) The middle or chief navigable channel of a waterway; the thread of a stream.

thatch The buildup of organic material at the base of turfgrass leaf blades. Thatch repels water and reduces infiltration capacity.

thematic mapping Portrayal of some geographic variable or "theme," such as land use, geology, or population distribution, by shading or symbolizing areas or map features to represent the value or class of that theme.

The NELAC Institute (TIN) *See* NELAC Institute, the.

theoretical discharge The discharge over a weir or through an orifice, tube, or pipeline as computed from such variables as cross-sectional area, head, and slope, with a corrective factor or coefficient applied to account for losses caused by frictional resistance, contractions, and similar occurrences.

theoretical model A theoretical representation of the working principles of a system. *See also* mathematical model; mechanistic equation; system.

theoretical pump displacement A pump manufacturer's published rating of a pump, expressed in units of gallons per minute (cubic meters per second) per 100 revolutions per minute.

theoretical velocity The velocity that water or another liquid under a given head would attain in passing through an orifice, conduit, or other structure if its flow were not reduced by friction or other losses.

therapeutic index The ratio of the dose required to produce a toxic or lethal effect to the dose required to produce a nonadverse or therapeutic response.

thermal conductivity A measure of the ability of a substance to conduct heat. Mathematically, thermal conductivity is the ratio of the rate of heat flow to the rate of temperature change in the particular substance.

thermal conductivity detector (TCD) A device used as a nonselective detector (i.e., one that responds to almost all compounds) in gas chromatography. Such a device operates based on a comparison of resistance values resulting from changes in the thermal conductivity of a heated source. As analytes in the eluent flow past the heated source, changes in the thermal conductivity are detected. Although not as sensitive as many other gas chromatographic detectors, this device is relatively rugged and simple to operate.

thermal conductivity units *See in the Units of Measure section.*

thermal-convection storm A storm, caused by local inequalities in the temperature, in which the rainfall is intense, short-lived, and limited to only a small area.

thermal expansion The increase in the dimensions of a material resulting from the application of heat. Thermal expansion is positive as temperature increases and negative as temperature decreases.

thermal log A type of geophysical log that measures the temperature of groundwater. Flow paths can be inferred from this type of log, as can groundwater velocities. *See also* geophysical log.

thermal ozone destructor A unit in an ozonation system that employs high temperature to destroy excess ozone.

thermal power Any type of energy or power generated or developed through the use of heat energy. In common practice, thermal power is electrical energy or power generated by the use of steam engines or turbines to drive electric generators.

thermal regeneration A process using combustion in the absence of oxygen for regenerating, or reactivating, the surface area of granular activated carbon to restore the activated carbon's adsorptive properties. The combustion typically takes place in two stages: the first, at a lower temperature, to drive off adsorbed organics, and the second, at a higher temperature, to regenerate the surface. *See also* granular activated carbon; reactivate; regeneration.

thermal spring A spring that discharges water having a temperature in excess of the normal local groundwater. Hot springs and warm springs are types of thermal springs. The water in a thermal spring is usually highly mineralized.

thermal stratification The formation of layers of different temperatures in bodies of water as a result of water density differences. *See also* destratification; epilimnion; hypolimnion; metalimnion; thermocline.

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thermal transfer plotter A peripheral device that makes graphic plots of computer data using a heating element to melt dots of waxy ink from a film substrate to a specially treated paper. Most thermal transfers require three or four passes to plot a color image. One primary color or black is plotted on each pass.

thermistor A thermally sensitive electrical resistor.

thermochemolysis A high-temperature reaction in the presence of a reagent that involves concomitant bond cleavage and in situ methylation, yielding a large number of products that can be separated and analyzed by various chromatographic techniques. An example of a reagent is tetramethylammonium hydroxide.

thermocline In a thermally stratified lake, the layer below the epilimnion and above the hypolimnion. The thermocline is the stratum in which a rapid rate of decrease in temperature occurs with depth. *See also* destratification; epilimnion; hypolimnion; metalimnion; thermal stratification.

thermocouple A heat-sensing device made of two conductors of different metals joined at their ends. An electric current is produced when a difference in temperature occurs between the ends.

thermoelectric power Electricity produced by heat when water is used for steam production.

thermograph An instrument designed to make an automatic record of temperature. The thermometric element is, most commonly, either a bimetallic strip or a metal tube filled with a liquid. In all types, the pen writes the record of temperature on a ruled sheet that is wrapped around a cylinder revolved by enclosed clockwork; from the trace thus made, the instantaneous behavior of the temperature may be determined.

thermography A technique that detects thermal infrared radiation and displays it as visible images. It may be used for detecting leaks from water mains by observing the change in the soil thermal characteristics compared to soil away from a potential leak.

thermophilic Pertaining to organisms whose optimal temperature for growth is above 50° Celsius.

thermophone An instrument for determining temperatures at different depths in a reservoir, in masonry dams, or in other structures.

thermoplastic Any of numerous materials, such as certain synthetic resins and plastics, that soften or fuse when heated and harden and become rigid when cooled, and that can usually be remelted and cooled time after time with no appreciable chemical change.

thermoplastic coating A coating applied to fittings for long-term corrosion protection.

thermoplastic pipe casing Plastic pipe used as riser pipe in well construction. Thermoplastic pipe casing is routinely used in all waters, but it is especially useful in highly corrosive waters. It is composed of polyvinyl chloride, acrylonitrile butadiene styrene, and rubber-modified polystyrene.

thermoset Any of numerous plastics and synthetic resins that, once solidified, will not resoften or fuse when heated. Thermoset materials may decompose at high temperatures but will not soften or melt.

theta (θ) *See* phase angle.

thickener Any process equipment or process that, after gravity sedimentation, increases the concentration of solids in sludges with or without the use of chemical flocculants. *See also* residuals thickening.

thickener supernatant The stream of liquid removed from a thickener after solids have settled from the liquid.

Thiessen polygon A geometric construction for determining the zone within which data taken at a rain-gauge station are applicable in a network of gauging stations. The points of location of rain gauges on a map are joined by straight lines and the lines' perpendicular bisectors are drawn, forming a polygon around each rain-gauge station.

thin film composite (TFC) membrane *See* composite membrane.

thin-layer chromatography A chemical separation technique in which the stationary phase is supported on a glass plate. Analytes are separated in two dimensions by partitioning between a liquid mobile phase and a solid stationary phase. *See also* paper chromatography.

thin-walled liner A painted or epoxy coating for the interior of pipe or pipe fittings.

Thiobacillus A genus of small, single-celled bacteria that can create gaseous hydrogen sulfide (H_2S) and the resulting "rotten egg" odor in water supplies.

thiosulfate-citrate-bile salts-sucrose agar A selective medium used for the culture of vibrio organisms.

thiram ($(((CH_3)_2NCS)_2S_2)$) The common name for tetramethylthiuram disulfide. It is used as a fungicide, seed protectant, and animal repellent. Thiram has been shown to react with nitrite (NO_2^-) under acidic conditions to produce the carcinogen *N*-nitrosodimethylamine ($(CH_3)_2N_2O$). *See also* fungicide; *N*-nitrosodimethylamine.

THM *See* trihalomethane.

THMFP *See* trihalomethane formation potential.

THM precursor *See* trihalomethane precursor.

THM_t *See* terminal trihalomethane concentration.

THNM *See* trihalonitromethane.

thread of a stream The line equidistant from both of a stream's edges at the ordinary level of the water in the stream. In some cases, this term has been construed to mean the median line of the main channel of the stream. *See also* thalweg.

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thread test A test for measuring the cohesiveness of soil. Soil that can be rolled to a thread that is 2 inches (5 centimeters) long and ⅛ in. (3 millimeters) in diameter without tearing is considered cohesive. *See also* ribbon test.

threat analysis The process in which an individual or group representing a danger or potential danger to a facility is subjected to systematic and thorough examination in order to identify significant facts and derive conclusions to facilitate development of an appropriate response.

threat assessment The process of using available intelligence, law enforcement, and open source information to arrive at a judgment of the actual or potential threat to a facility or program.

3-bromo-4-(dibromomethyl)-5-hydroxy-2(5H)-furanone *See under* bromo-4-(dibromomethyl)-5-hydroxy-2(5H)-furanone.

3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone *See under* chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone.

three haloacetic acids, sum of *See* sum of three haloacetic acids.

303(d) listing A list called for by Section 303(d) of the Clean Water Act, which requires states to identify and develop a priority listing of waters in the state that are not "fishable, swimmable" and to develop total maximum daily loads for them, with oversight from the US Environmental Protection Agency. *See also* total maximum daily load.

three-phase circuit A system of alternating current supply comprising three or four conductors. For a sinusoidal symmetrical and balanced three-phase circuit, the same magnitude of root-mean-square voltage exists between any two conductors.

three-phase power Alternating current power in which the current flow reaches three peaks in each direction per cycle.

3-quinuclidinyl benzilate (BZ, or QNB) *See under* quinuclidinyl benzilate.

threshold The dose rate or other stimulus level at which a biological response first occurs. For example, a nerve membrane must undergo a certain amount of depolarization before it will initiate an action potential (i.e., a nerve impulse). In toxicology and risk assessment, certain types of adverse effects are thought to have thresholds, i.e., doses beneath which the adverse effect will not be produced.

threshold limit value (TLV) An exposure limit established for chemicals by the American Conference of Governmental Industrial Hygienists. These values are the most widely accepted limits for chemicals encountered in the workplace.

threshold odor The minimum odor of a water sample that can just be detected after successive dilutions with odorless water. The threshold odor is also called the odor threshold.

threshold odor concentration (TOC) *See* odor threshold concentration.

threshold odor number (TON) A numerical value based on the greatest dilution of a sample with odor-free water that yields a definitely perceptible odor. For example, if odor were perceptible in 1:1, 2:1, and 3:1 dilutions of a sample with odor-free water, but not in a 4:1 dilution, the threshold odor number would be 3. *See also* odor threshold concentration.

threshold substance *See* trace substance.

threshold taste number (TTN) A number to describe taste levels. It is very similar to threshold odor number. It is a value based on the greatest dilution of a sample with taste-free water that yields a definitely perceptible taster. *See also* threshold odor number.

threshold treatment Prevention of the deposition of calcium carbonate ($CaCO_3$) in water, after softening treatment, by the addition of a small quantity of sodium hexametaphosphate. *See also* sodium hexametaphosphate.

threshold value model *See* AL.COL model.

thrombosis The formation of a clot of blood factors, mainly platelets and fibrin, that causes vascular obstruction.

throttle valve A valve installed to reduce the flow through a pipeline. A throttle valve may be any one of a number of types of valves designed for this purpose.

throttling The act of opening or closing a valve to control the rate of flow. The term is usually used to describe closing the valve.

throughfall In a vegetated area, the precipitation that falls directly to the ground or the rainwater or snowmelt that drops from twigs or leaves. *See also* stemflow.

throughput volume The volume of water passed through an ion-exchange resin bed or water treatment system before the exchanger or system reaches exhaustion.

thrust A force resulting from water under pressure and in motion. Thrust pushes against fittings, valves, and hydrants and can cause couplings to leak or entirely separate.

thrust anchor A block of concrete, often a roughly shaped cube, cast in place between a fitting and the undisturbed soil at the side or bottom of the pipe trench and tied to the fitting with anchor rods. A thrust anchor resists vertical thrust.

thrust bearing A bearing designed to resist thrust in line with a turning shaft (as well as the usual force at right angles to the shaft). It is often a cone-shaped

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roller bearing, but specially designed ball bearings are also used.

thrust block *See* thrust anchor.

thrust collar A plastic cylinder located between the last spiral-wound element and end plate to support the last element in a pressure vessel. It has the same diameter as the inside diameter of the pressure vessel. *See also* membrane element; spiral wound.

thrust forces Commonly used to describe the forces resulting from the time rate of changes in the momentum of a mass of moving fluid. The thrust is the result of increasing the fluid momentum in the direction opposite to that desired for the body. It is also used to describe the axial or longitudinal end loads at fittings, valves, etc., resulting from hydraulic pressure or thermal expansion.

thumb penetration A test that can be used to estimate the unconfined compressive strength of cohesive soils. Type A soils can be indented by the thumb with great effort. Type C soils can easily be penetrated several inches by the thumb and can be molded by light finger pressure. This test should be performed on undisturbed soil as soon as possible to prevent drying of the sample.

thunderstorm A local and short-lived atmospheric disturbance accompanied by electrical phenomena and heavy showery precipitation, often with gusts of wind and sometimes with hail. *See also* thermal-convection storm.

thymine dimer Cross linkage of thymine molecules of nucleic acids caused by exposure to ultraviolet light.

thyroid nodule A focal area of hyperplasia within the thyroid. Some of these lesions have the potential for neoplastic transformation (i.e., tumor development).

TIC *See* total inorganic carbon.

tidal Pertaining to periodic water level fluctuations caused by the action of lunar (moon) and solar (sun) forces upon the rotating earth.

tidal bore A wave of water having a nearly vertical front advancing upstream as a result of high tides in certain estuaries. *See also* bore.

tidal current A current brought about or caused by tidal forces.

tidal-current curve A graphical representation of the flow of tidal current. Time is shown on the abscissa and velocity of the current is shown on the ordinate, with the flood velocity considered positive and the ebb velocity negative. In general, a tidal-current curve approximates a cosine curve.

tidal day A time interval between tides; 24.84 hours. This term should not be confused with *tidal interval*. *See also* tidal interval.

tidal efficiency A barometric efficiency of an aquifer, expressed as the ratio of the groundwater elevation change in an aquifer to the change in oceanic tide elevation. This value can be used to estimate water reserves and hydraulic performance of wells in aquifers that have oceanic suboutcrops.

tidal flat *See* tidal marsh.

tidal flood interval The time between the transit of the moon over the meridian of a place and the time of the following tidal flood.

tidal flood strength The tidal flood current at the time of maximum velocity.

tidal inlet A transverse channel through a barrier bar or beach that permits seawater to sweep in and out of a lagoon.

tidal interval The average usual interval of time between tides. For diurnal tides, this value amounts to 12.42 hours from high water to high water. *See also* tidal day.

tidal marsh A low, flat marshland traversed by interlacing channels and tidal sloughs and usually inundated by tides. This term is usually applied to marshlands with brackish or salt water.

tidal range The height difference between consecutive low and high tide levels.

tidal river A river in which flow and water surface elevation are affected by the tides. Such effects usually occur in the lower stretch near the mouth, where the gradient is very flat. In some streams, the effects may extend 100 miles (160 kilometers) or more upstream from the mouth.

tidal table A table published by the National Oceanic and Atmospheric Administration's Office of Coast Survey that gives daily predictions of the times and heights of the tide. These predictions are usually supplemented by tidal differences and constants by means of which additional predictions can be made for numerous other places.

tidal water The water that rises and falls in a predictable and measurable rhythm or cycle as a result of the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm because of masking hydrologic, wind, or other effects.

tidal water level The altitude reached by a tidal surface, usually fitting in one of the following categories:

- High water (HW): The highest level reached by a rising tide.
- Higher high water (HHW): The higher of the two high waters of any lunar day. The single high water occurring daily during periods when the tide is diurnal is considered a higher high water.

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- Higher low water (HLW): The higher of the two low waters of any lunar day.
- Low water (LW): The lowest level reached by a falling tide.
- Lower high water (LHW): The lower of the two high waters of any lunar day.
- Lower low water (LLW): The lower of the two low waters of any lunar day. The single low water occurring daily during periods when the tide is diurnal is considered a lower low water.
- Mean high water (MHW): The mean level of high waters over a long period. When a tide is semidiurnal or mixed, only the higher high water values are included. In this case, mean high water is the same as mean higher high water.
- Mean higher high water (MHHW): The mean level of the higher high waters over a long period.
- Mean low water (MLW): The mean level of the low waters over a long period. When the tide is semidiurnal or mixed, only the lower low water values are included. In this case, mean low water is the same as mean lower low water.
- Mean lower low water (MLLW): The mean level of lower low water over a long period.

tidal wave (1) The general rise and fall of the surface of the ocean that is generated by gravity effects of the sun and moon and that travels around the earth each day. (2) An extremely large wave caused by a seismic disturbance or a great storm, often causing overflow of low-lying lands not usually inundated by ordinary wave or tidal action. *See also* bore; tsunami.

tide (1) The periodic rising and falling of water that results from the gravitational attraction of the moon and sun acting on the rotating earth. This term should not be used to designate the horizontal movement of the water; the correct term in that case is *tidal current.* (2) A flood in a stream. This meaning appears in colloquial usage in the southeastern United States. *See also* tidal current.

tide epoch The phase or time of occurrence of high water, calculated from a fixed time origin.

tide gauge (1) A staff gauge that indicates the height of the tide. (2) An instrument that automatically registers the rise and fall of the tide. In some instruments, the registration is accomplished by printing the heights at regular time intervals; in others by a continuous graph in which the height of the tide is shown on the ordinate of the curve and the corresponding time on the abscissa.

tide generator A device for generating tides in hydraulic models.

tideland (1) Land subject to overflow by water during the higher stages of the tide. (2) A coastal area situated above the mean low tide and below the mean high tide, alternately uncovered and covered by the ebb and flow of ordinary daily tides. *See also* tidal water level.

Tier 1 violation A violation of a National Primary Drinking Water Regulation (NPDWR) that arises any time a situation occurs where there is the potential for human health to be immediately impacted. Water suppliers have 24 hours to notify people who may drink the water of the situation. Water suppliers must use media outlets such as television, radio, and newspapers, post their notice in public places, or personally deliver a notice to their customers in these situations. Exceeding the maximum contaminant level for fecal coliform or nitrate/nitrite, violating a treatment technique requirement (turbidity or chlorine dioxide), violating a variance or exemption schedule, and a waterborne disease outbreak are all Tier 1 violations, which are further classified as acute or nonacute. *See also* acute violation.

Tier 3 violation A violation of a National Primary Drinking Water Regulation (NPDWR) that does not have a direct impact on human health (for example, failing to take a required sample on time). The water supplier has up to a year to provide a notice of a Tier 3 violation to its customers. The extra time gives water suppliers the opportunity to consolidate these notices and send them with annual water quality reports (consumer confidence reports).

Tier 2 form The annual reporting form for the Superfund Amendments and Reauthorization Act Title III for hazardous chemicals. The report form includes the following information: owner's name and address, location of facility, chemical descriptions, Chemical Abstracts Service number, physical and health hazards, quantities, types of storage and locations, certification and verification by authorized representative or owner. This form, along with any fees, must be returned by March 1 of each year.

Tier 2 violation A violation of a National Primary Drinking Water Regulation (NPDWR) of moderate severity. A Tier 2 violation occurs any time a water system provides water with levels of a contaminant that exceed US Environmental Protection Agency or primacy agency standards or that has not been treated properly, but that does not pose an immediate risk to human health. Violating a monitoring requirement, not using an approved test procedure, and issuing a variance or exemption are Tier 2 violations, and all must be reported to the public. The water system must notify its customers as soon as possible, but within 30 days of the violation. Notice may be provided via the media, posting, or through the mail.

tiered rate *See* inclining block rate.

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TIGER file *See* Topologically Integrated Geographic Encoding and Referencing/Line file.

tight junction A joining of cells so tightly together that chemicals must penetrate cell membranes to pass through the structure. For example, the endothelial cells that make up the capillary walls in the brain have tight junctions and so form part of the blood–brain barrier. Tight junctions in the epithelium of the skin also limit the absorption of polar material or high-molecular-weight materials through this organ. Similar junctions are found in the intestinal epithelium.

tile Ceramic pipe.

tile drainage The removal of surplus groundwater by means of buried pipes. Water enters through the unsealed joints or through perforations in the pipe. Water sometimes enters the drain tile through surface inlets.

tile field A system of open-jointed tile, usually laid on a rock fill, used for dispersing wastewater effluents into the ground. *See also* subsurface irrigation.

tile filter bottom A type of underdrainage system placed under a filter bed to provide a collecting system for the filtered water. *See also* filter bottom.

tile underdrainage A system of tile drains laid in covered trenches underground, in most cases with open joints, to collect and carry off excess groundwater.

tillage Plowing, seedbed preparation, and cultivation practices.

tilting dam An overflow dam constructed in such a way that a top section will tilt and allow the passage of excess water. Sections are set to tilt at various elevations of the impounded water. That is, the sections that tilt are set at different elevations; one tilts at a time, depending on the desired level at which water should start spilling.

tilting gate A crest gate, hinged at the top or bottom, that (1) automatically tilts or drops as water rises and flows over it as a result of an increase in discharge, and (2) resumes its original position when the flow is reduced.

TIM *See* iodoform.

timber dam A dam constructed of framed timbers. The dam may be of cellular or crib construction, filled with rock to give it stability; or it may attain such stability through its design.

timber shoring system Wood members of the shoring system. Minimum sizes of members are specified for use in different types of soil. Members that are to be selected on the basis of this information are the cross braces, the uprights, and the wales (horizontal rails), where wales are required. Six tables of information are available, two for each soil type.

time composite A composite sample consisting of several equal-volume samples taken at specified times. *See also* composite sample.

time lag (1) The time elapsing between the occurrence of corresponding changes in discharge or water level at two points in a river. (2) The time between the beginning, or center of mass, of rainfall to the peak, or center of mass, of runoff. (3) The time between the beginning of snow melt and the start of the resulting runoff. (4) The time required for processes and control systems to respond to a signal or to reach a desired level. (5) The time from the start of a study of biological growth until a biological culture begins to grow. *See also* time of flow.

time management A systematic method of allocating the time required to perform specific operations or tasks or to achieve a specific goal, with a view toward finding more efficient methods.

time of concentration (T_c) *See* Kirpich formula.

time-of-flight mass spectrometer A type of mass spectrometer in which the ions are separated based on their velocity through a drift tube portion of an instrument. Ions entering the drift tube have the same kinetic energy; therefore, the velocities of different ions depend on their masses. Because velocity through the instrument is inversely proportional to the ion's mass, lighter ions reach the end of the detector faster than heavier ions. Mass is calculated by measuring the time it takes for ions of a given mass to travel the distance of the drift tube. These instruments are often larger than other popular types of mass spectrometers. Because of the very fast acquisition of data within time-of-flight instruments, these devices can be useful for the analysis of short-lived chemical species. *See also* mass spectrometer.

time of flow The time required for water flowing in a stream to travel from a given point to some other downstream point. *See also* travel time.

time of travel The determination, usually by modeling, of the time in years for groundwater recharge to travel from a certain field point to the wellhead.

timer A device for automatically starting or stopping a machine or other device at a given time.

time series A data set collected over a long period of time at (usually) equal time intervals.

time series analysis In statistics, the use of a body of analytical methods for data collected over a period of time. Annual, quarterly, monthly, or daily data are forms of time series data. Such data contrast with data related to a single point in time, such as the diameter of a tree related to its height or the amount of water use per day for a number of families based on household size. Time series data are generally composed of seasonal patterns, cycles, trends, and irregular movements (random errors). Seasonal patterns are identified with seasonal indexes, from which cycles are isolated by means of moving averages and

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regression analysis; trends are most frequently identified by means of regression analysis. Regression analysis, exponential smoothing, and autoregressive integrated moving-average methods (such as the Box–Jenkins method) may be used to forecast time series data. *See also* autoregressive integrated moving average forecasting method.

time series model A model that can identify the nature of a phenomenon represented by the sequence of observation and forecasting or predicting the future values of a parameter. The model requires that the pattern of observed time series be identified and more or less formally described. Once the pattern is established, the model can interpret and integrate it with other data.

time to filter The time required in a capillary suction test to filter a fixed volume of sludge suspension through a porous membrane. The time is an indication of the filterability of the sludge sample. *See also* capillary suction test.

time units *See in the Units of Measure section.*

time-weighted average (TWA) The average value of a parameter (e.g., the concentration of a chemical in air) that varies over time.

time-weighted average (TWA) concentration A concentration of a toxic airborne material, weighted typically for an 8-hour exposure period.

tissue A group of similar cells in the body.

tissue culture Growth of tissue cells in vitro on artificial media for experimental research.

tissue culture assay Laboratory-based method for propagation or detection of many viruses or protozoans.

tissue culture infectious dose 50 ($TCID_{50}$) The concentration of virus at which 50 percent of the cells in a tissue culture become infected.

titer (1) The concentration of a substance in solution as determined by titration. (2) The concentration of a substance (chemical or microbial) based on a series of dilutions to a defined end point.

titrate To add a chemical solution of known strength to a sample drop-by-drop until a certain color change, precipitate, or pH change in the sample is observed (i.e., until the end point is reached).

titration A process of adding known volumes of a reagent solution to a sample. Specific chemical reactions are monitored until an end point is reached. Titrations are commonly used in water analyses for determining hardness, alkalinity, chlorine residual, and many other parameters.

titrimetric method Any laboratory procedure that uses titration to determine the concentration of a constituent in water.

TKN *See* total Kjeldahl nitrogen.

TLV *See* threshold limit value.

TMAH *See* tetramethylammonium hydroxide.

TMDL *See* total maximum daily load.

TMF capacity requirements *See* technical, managerial, and financial capacity requirements.

TMP *See* transmembrane pressure.

TNC *See* too numerous to count.

TNCWS *See* transient, noncommunity water system.

TNI *See* NELAC Institute, the.

TOBr *See* total organic bromine.

TOC *See* total organic carbon.

TOC (threshold odor concentration) *See under* odor threshold concentration.

TOCl *See* total organic chlorine.

TOD *See* total oxygen demand.

to deliver (TD) A TD mark on a pipette means "to deliver." The pipette is calibrated to deliver the calibrated volume of the pipette with a small drop left in the tip.

toe (1) The downstream edge at the base of a dam. (2) The line where a natural or fill slope intersects the natural ground. (3) The lowest edge of a backslope of a cut where it intersects the roadbed or bench.

toilet dam A flexible insert placed across the bottom of a toilet's reservoir tank to hold back water when the toilet is flushed, thereby not using the entire volume of water in the reservoir for each toilet flush. Use of a toilet dam is a water conservation technique.

toilet displacement device A toilet retrofit device (e.g., a dam, bag, or bottle) designed to displace water in a high-volume gravity-flush toilet tank in order to reduce the volume required for flushing. *See also* toilet dam.

tolerance An organism's capacity for enduring or being less responsive (i.e., adapting) to the influence of a drug or poison, particularly when such capacity is acquired by continued use of a substance or exposure to unfavorable environmental factors.

***ortho*-tolidine ($(C_6H_3(CH_3)NH_2)_2$)** *See ortho*-tolidine arsenite test; *ortho*-tolidine reagent; *ortho*-tolidine test.

***ortho*-tolidine (OT) test** An approximate technique for determining residual chlorine in water by using *ortho*-tolidine reagent and colorimetric standards. This test is no longer approved for use in water treatment. Its accuracy is affected by interfering substances and color, making the test largely obsolete.

***ortho*-tolidine arsenite (OTA) test** An approximate technique, no longer approved for use in water treatment, for differentiating between free available chlorine, combined available chlorine, and color caused by interfering substances. It involves using *ortho*-tolidine reagent, sodium arsenite ($NaAsO_2$) reagent, and colorimetric standards.

***ortho*-tolidine reagent** A solution prepared from *ortho*-tolidine crystals and used to determine colorimetrically

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the concentration of available chlorine. This reagent is no longer approved for chemical analysis of drinking water.

toluene ($C_6H_5CH_3$) A common name for methylbenzene, a volatile organic compound with miscellaneous industrial applications, including use as an admixture in aviation gasoline; as a solvent, diluent, or thinner; and in explosives (i.e., trinitrotoluene, or TNT ($CH_3C_6H_2(NO_2)_3$)). Toluene's presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 1 milligram per liter. *See also* solvent; volatile organic compound.

TON *See* threshold odor number; total organic nitrogen.

ton *See in the Units of Measure section.*

tone-frequency multiplexing A method of sending several signals simultaneously over a single channel by converting the signals into sounds (tones) and assigning a specific tone to each signal.

tonne *See in the Units of Measure section.*

too numerous to count (TNC) An expression used to indicate that the total number of bacterial colonies exceeds 200 on a 47-micrometer pore diameter membrane filter used for coliform detection.

top contraction (1) An abrupt or gradual drop in the roof of a conduit. (2) The extent of the drop in the water surface caused by a constriction or contraction.

top-down Utility Communications Architecture (UCA) In uniform communications architecture, this strategy layers the UCA-based utilitywide integration system on top of existing supervisory control and data acquisition and plant control systems. *See also* supervisory control and data acquisition.

topographic divide The line that follows the ridges or summits forming the exterior boundary of a drainage basin and that separates one drainage basin from another. A topographic divide is also called a drainage divide.

topographic feature A map feature that defines elevation information. Such features are often called third-dimension values or *z* values. Topographic data are usually compiled from aerial photographs at relatively large scales and at high levels of positional accuracy. The features recorded typically include contour lines, point elevations, and elevation values.

topographic geology The branch of geology that relates the shape of the land surface to the characteristics of the underlying soil and rocks.

topographic map A map that shows the elevation of the land in a specified area.

topographic mapping The process of delineating on maps the position and elevation of natural and constructed features of a place or region.

topography The configuration of a surface, including its relief and the position of its natural and artificial features.

topologic Pertaining to a geographic data structure in which the inherent spatial connectivity and adjacency relationships of the geographic features are implicitly stored and maintained.

Topologically Integrated Geographic Encoding and Referencing (TIGER)/Line file The nationwide digital database of base map features developed by the US Census Bureau in 1990. It is commonly used for street pattern backgrounds for water distribution system layouts and is also used for address matching for utility billing records to determine variations in per capita consumption in different portions of the distribution system. *See also* geographic information system.

topological structure The collective properties that define the relative positioning of data elements in space with respect to one another but without reference to actual distances. These properties are used (e.g., in a geographic information system) to define such relationships as polygon boundary segments, connectivity between points, networks, and area adjacencies. *See also* geographic information system.

topology (1) A branch of mathematics that deals with nonmetric spatial relationships, such as connectedness and adjacency. (2) In a geographic information system, the data that deal with topological relationships among point, line, and area objects (e.g., identifying which streets meet at an intersection, which streets bound a block, or which blocks front on a street). *See also* geographic information system.

topping Work performed to raise the level of the top of a levee. The results of such work are usually intended to be only temporary. However, topping is meant to create permanent results to increase flood protection when levees are below grade and a threat of overtopping exists.

topsoil The soil layer moved during cultivation.

torpedo sinker A type of weight attached to the bottom of a log line for observing depths in rapid streams.

torque A measure of twisting force (torsion) in pipe. Torque is measured as a force times the distance from the force to the axis of rotation. Torque is expressed in foot-pounds or inch-pounds (newton-meters).

torr *See in the Units of Measure section.*

tort litigation Lawsuit undertaken to correct a civil wrong for which a remedy may be obtained, usually in the form of damages. In general, a victim seeks money from a person, water system, or corporation, who harmed the victim. There are four elements to a tort, all of which must be present before the court can order a remedy: duty to the victim, breach of duty, causation, and injury.

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tortuosity The actual length of a sinuous flow path in a porous medium divided by the distance between the two ends of the path.

tortuous flow A type of fluid flow in which an unsteady motion of the particles occurs in a tortuous or meandering channel. *See also* turbulent flow.

tortuous path (1) A water flow path through channels that are constricted and marked by repeated twists, bends, and winding turns. (2) In an electrodialysis system, a water flow path in which spacers, turbulence promoters, or cross-traps are used to produce turbulence in the flow stream. *See also* turbulence.

total acidity The total of all forms of acidity in a solution, including mineral acidity, carbon dioxide (CO_2), and acid salts. *See also* acidity.

total alkalinity *See* alkalinity.

total available chlorine The total chlorine, present as free chlorine, chloramines, or other chlorine-containing species, that is present in a water and is still available for disinfection, oxidation of organic matter, or both. Note that the *total chlorine* may include organic chloramines that do not have disinfection capabilities; such species are not considered part of the total available chlorine. In most drinking water applications, the total chlorine and total available chlorine are quite similar; in chlorinated wastewater, however, organic chloramines may represent a significant fraction of the total chlorine. Thus, for drinking water, the more commonly used terms are *free chlorine* or *free available chlorine* for chlorine and *combined chlorine* for chloramines. In practice, when chloramines are the dominant species, with or without some free chlorine present, the terms *combined chlorine* and *total chlorine* are used interchangeably. *See also* chloramines; free available chlorine; organic chloramines; total chlorine.

total body clearance The rate at which a chemical is removed from the body, expressed in terms of volume cleared per unit time. *See also* clearance.

total bromine-substituted trihalomethanes *See* total trihalomethane bromine.

total capacity The maximum rate at which a well or spring will yield water by pumping after the water stored in the well or spring has been removed. Total capacity is the rate of yield when the water level is drawn down to the screen under conditions of constant discharge pressure. *See also* capacity.

total carbon (TC) A quantitative measure of the concentration of both total inorganic carbon and total organic carbon in water, as determined instrumentally, frequently by chemical oxidation to carbon dioxide (CO_2) and subsequent infrared detection in a carbon analyzer.

total catchment management (TCM) An integrated plan for the collection, treatment, and disposal of runoff from a drainage basin.

total chlorine The total concentration of the chlorine in a water, including the combined chlorine (i.e., inorganic and organic chloramines) and the free available chlorine. *See also* chloramines; combined chlorine; free available chlorine; organic chloramines.

total chlorine residual The total amount of chlorine residual present after a given contact time in a water sample, regardless of the type of chlorine. *See also* residual chlorine; total chlorine.

total chlorine-substituted trihalomethanes *See* total trihalomethane chlorine.

total-chlorine-to-free-ammonia ratio A fractional measure of biocide to food that is used by some investigators as an indicator of the ability to prevent nitrification. Some research indicates that at biocide to food ratios of at least 1.4 milligrams of Cl_2 per milligram of N, nitrification is more likely to be prevented. *See also* nitrification.

total chlorotriazine (TCT) A group of triazine herbicides, including atrazine, simazine, and cyanazine. Atrazine and simazine are regulated under the National Primary Drinking Water Regulation. Cyanazine is listed as an unregulated drinking water contaminant. *See also* National Primary Drinking Water Regulation; unregulated contaminant.

total chlorotriazine (TCT) degradate The degradation by-products of all triazine herbicides, including, but not limited to cyanazine and atrazine-desethyl. They are listed as unregulated drinking water contaminants. *See also* unregulated contaminant.

total coliform (TC) The group of bacteria used as warm-blooded animal fecal pollution indicator organisms of drinking water quality. Total coliforms in drinking water are regulated by the US Environmental Protection Agency. *See also* coliform group bacteria; Total Coliform Rule.

Total Coliform Rule (TCR) A rulemaking of the US Environmental Protection Agency (USEPA) that sets National Primary Drinking Water Regulations for total coliforms, fecal coliforms, and *Escherichia coli*. The rule was promulgated June 29, 1989 (54 *Federal Register* 27544–27568) and amended Jan. 15, 1991 (56 *Federal Register* 1556–1557). In September 2008, USEPA signed an Agreement in Principle to revise the Total Coliform Rule.

total coliform techniques *See* total coliform test.

total coliform test Any of several tests for the presence of indicator bacteria in water. The test used may be the multiple-tube fermentation test, the membrane filter test, the presence–absence test, or an enzyme test based on *ortho*-nitrophenol-β-D-galactopyranoside,

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4-methylumbelliferyl-β-D-glucuronide, or another substrate for which a specific test has been defined for detection of coliform bacteria. *See also* total coliform.

total concentration The concentration of a given constituent in water.

total direct count (TDC) A general term for the technique of counting microorganisms, whether thriving or not, with the help of a microscope. The microorganisms can be prepared by any one of a variety of methods, such as petri dishes, filtering, and staining.

total dissolved gas probe (TDGP) Device used for measuring dissolved gases in solution. It consists of a hollow cylindrical silicone membrane that rejects water but allows the transfer of dissolved gases from solution until the pressure within the membrane's cavity is in equilibrium with the pressure of gases in the solution.

total dissolved phosphorus The total phosphorus content of material that will pass through a filter of a specific pore size.

total dissolved solids (TDS) The weight per unit volume of solids remaining after a sample has been filtered to remove suspended and colloidal solids. The solids passing the filter are evaporated to dryness. The filter pore diameter and evaporation temperature are frequently specified.

total dissolved solids (TDS) test A test used to measure the total dissolved solids in water by first filtering out any undissolved solids and then evaporating the filtered water to dryness. The residue that remains represents the total dissolved solids. *See also* total dissolved solids.

total dynamic discharge head The total dynamic head plus the dynamic suction head or minus the dynamic suction lift.

total dynamic head (TDH) The difference in height between the hydraulic grade line on the discharge side of the pump and the hydraulic grade line on the suction side of the pump. This head is a measure of the total energy that a pump must impart to the water to move it from one point to another.

total hardness (TH) The total of the amounts of divalent metallic cations, principally calcium hardness and magnesium hardness, expressed in terms of calcium carbonate ($CaCO_3$) equivalent. *See also* carbonate hardness; noncarbonate hardness.

total head The total energy per unit weight of water in a hydraulic system. Total head is composed of pressure head, velocity head, and elevation head. The various heads are roughly analogous to the internal, kinetic, and potential energy of the water at the point of measurement in the system.

total heterotrophic bacteria Those bacteria detected or enumerated by the heterotrophic plate count method. *See also* heterotrophic plate count.

total inorganic carbon (TIC) The sum of the inorganic carbon species in water (i.e., carbonate, CO_3^{2-}; bicarbonate, HCO_3^-; and dissolved carbon dioxide, CO_2).

totalizer (1) A precipitation gauge used for catching and holding the total precipitation that occurs over a considerable period of time, such as several months or a year. Such a device is usually used in remote and inaccessible locations that can be visited only infrequently. (2) A device or meter that continuously measures and calculates (adds) total flows in cubic meters, gallons, million gallons, cubic feet, or some other unit of volume measurement. Such a device is also called an integrator.

total Kjeldahl nitrogen (TKN) The total concentration of organic nitrogen and ammonia nitrogen, i.e., nitrogen with a valence of –3 (N^{3-}). The amount of organic nitrogen can be obtained by separately measuring the ammonia nitrogen and subtracting that value from the total Kjeldahl nitrogen. *See also* Kjeldahl nitrogen; Kjeldahl nitrogen test; organic nitrogen.

total matter The sum of all suspended and dissolved matter in a water sample.

total maximum daily load (TMDL) A calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. Water quality standards are set by states, territories, and tribes. They identify the uses for each water body, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the water body can be used for the purposes the state has designated. The calculation must also account for seasonal variation in water quality. The Clean Water Act, Section 303 (d), establishes the water quality standards and TMDL programs with oversight from the US Environmental Protection Agency. *See also* 303(d) listing.

total nitrate plus nitrite The sum of nitrate nitrogen (NO_3-N) and nitrite nitrogen (NO_2-N) concentrations, which represents the total oxidized inorganic nitrogen. Total nitrate plus nitrite, in addition to nitrate and nitrite as separate chemicals, are regulated in drinking water by the US Environmental Protection Agency at a maximum contaminant level of 10 milligrams per liter. *See also* nitrate; nitrite.

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total nitrogen (N_{total}) A measure of the complete nitrogen content in water. In water, the forms of nitrogen of greatest interest are nitrate (NO_3^-), nitrite (NO_2^-), ammonia (NH_3), and organic nitrogen. All these forms of nitrogen, as well as nitrogen gas, are biochemically interconvertible and are components of the nitrogen cycle. The total nitrogen content of water can be determined by measuring nitrate, nitrite, ammonia, and Kjeldahl nitrogen. Alternatively, total nitrogen can be measured by evaporating a sample to dryness and performing an elemental analysis. *See also* ammonia; elemental analysis; nitrate; nitrite; nitrogen; nitrogen cycle; organic nitrogen; total Kjeldahl nitrogen.

total organic bromine (TOBr) A surrogate measurement of the total quantity of bromine-substituted organic compounds in a water sample. Total organic bromine is a component of total organic halogen. In source water, bromine-substituted organic molecules are typically present because of the existence of synthetic organic chemicals, whereas in finished water they typically occur as disinfection by-products and high-molecular-weight, partially halogen-substituted aquatic humic substances. *See also* aquatic humic substance; disinfection by-product; surrogate measurement; synthetic organic chemical; total organic halogen.

total organic carbon (TOC) A measure of the concentration of organic carbon in water, determined by oxidation of the organic matter into carbon dioxide (CO_2). Total organic carbon includes all the carbon atoms covalently bonded in organic molecules. Most of the organic carbon in drinking water supplies is dissolved organic carbon, with the remainder referred to as particulate organic carbon. In natural waters, total organic carbon is composed primarily of nonspecific humic materials. Total organic carbon is used as a surrogate measurement for disinfection by-product precursors, although only a small fraction of the organic carbon will react to form these by-products. Quantitatively, total organic carbon is determined by removing interfering inorganic carbon, such as bicarbonate (HCO_3^-), and oxidizing the organic carbon to carbon dioxide. Typically, the carbon dioxide is then measured with a nondispersive infrared detector. *See also* disinfection by-product precursor; dissolved organic carbon; particulate organic carbon; total inorganic carbon.

total organic chlorine (TOCl) A surrogate measurement of the total quantity of chlorine-substituted organic compounds in a water sample. Total organic chlorine is a component of total organic halogen. In source water, chlorine-substituted organic molecules are typically present because of the existence of synthetic organic chemicals, whereas in finished water they typically occur as disinfection by-products and high-molecular-weight, partially halogenated aquatic humic substances. *See also* aquatic humic substance; disinfection by-product; surrogate measurement; synthetic organic chemical; total organic halogen.

total organic halogen (TOX) A surrogate measurement of the total quantity of halogen-substituted organic material in a water sample. The presence of halogen-substituted organic molecules in source water is typically caused by synthetic organic chemicals, whereas in finished water it is typically caused by disinfection by-products and high-molecular-weight, partially halogenated aquatic humic substances. Total organic halogen is measured by the dissolved organic halogen test and is also called adsorbable organic halogen, carbon adsorbable organic halogen, or dissolved organic halogen. *See also* aquatic humic substance; disinfection by-product; halogen-substituted organic material; surrogate measurement; synthetic organic chemical.

total organic halogen formation potential (TOXFP) The amount of total organic halogen formed during a test in which a source or treated water is dosed with a relatively high amount of disinfectant (normally chlorine) and is incubated (stored) under conditions that maximize total organic halogen production. This value is not a measure of the amount of organic halogen that would form under normal drinking water treatment conditions; rather, it is an indirect measure of the amount of organic halogen precursors in a sample. If a water has a measurable level of organic halogen prior to the formation potential test (e.g., from synthetic organic chemicals in the source water), then the formation potential equals the terminal value measured at the end of the test minus the initial value. *See also* disinfection by-product formation potential; total organic halogen.

total organic nitrogen (TON) A measure of the organic nitrogen in water. Organic nitrogen is defined functionally as organically bound nitrogen in the trinegative state (N^{3-}). Analytically, organic nitrogen and ammonia can be determined together; the combination may be referred to as Kjeldahl nitrogen. *See also* total Kjeldahl nitrogen.

total oxygen demand (TOD) A quantitative measure of all oxidizable material in a sample of water, as determined instrumentally by measuring the depletion of oxygen after high-temperature combustion. *See also* total organic carbon.

total ozone demand The total amount of ozone (O_3) gas that must be mixed with a liquid, solid, or gas in order to satisfy all the ozone oxidation requirements. *See also* ozonation.

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total particulate phosphorus The total phosphorus content of material retained on a filter of a specific pore size.

total phosphorus The sum of all phosphorus forms in a sample.

total pumping head A measure of the energy increase imparted to each unit weight of liquid as it is pumped; the algebraic difference between the total discharge head and the total suction head.

total quality management (TQM) A comprehensive management approach based on the fundamental concept of continuous improvement developed primarily by W. Edwards Deming. Principal components are understanding and striving to meet customer expectations and needs; focusing on work processes that produce a service or product; and encouraging, respecting, and valuing employee contributions.

total reflectance/Fourier transform infrared (TR/FTIR) spectroscopy A technique for observing changes in the integrity of a surface as measured by the absorption of infrared light by target molecules on the surface.

total residual chlorine *See* total chlorine residual.

total residue *See* total solids.

total residue content The total amount of solids contained in a water sample. It includes both suspended and dissolved material. *See also* total solids.

total runoff The accumulated volumetric runoff from a drainage area for a definite period of time, such as a day, month, or year, or for the duration of a particular storm.

total solids The concentration of all suspended and dissolved solids in a liquid. This value was formerly called residue or total residue. It is measured by evaporation of a sample and subsequent drying in an oven at a defined temperature. Total solids includes total suspended solids and total dissolved solids. *See also* total dissolved solids; total suspended solids.

total solids content *See* total residuals content.

total specific ultraviolet absorbance (TSUVA) The ratio of the UV-254 measurement (measured in units of reciprocal centimeters) to the total organic carbon concentration (in units of milligrams per liter) in a water sample. It may be used in place of specific UV absorbance when the total organic carbon and dissolved organic carbon concentrations are usually very similar for a particular location, or as a convenient water parameter when dissolved organic carbon concentrations are not available. *See also* specific ultraviolet absorbance.

total static head The total height that the pump must lift the water when moving it from one point to another; the vertical distance from the suction free water surface to the discharge free water surface.

total suspended solids (TSS) A measure of all suspended solids in a liquid. A well-mixed sample is filtered through a standard glass fiber filter, and the residue retained on the filter is dried to a constant weight at 217° to 221° Fahrenheit (103° to 105° Celsius). The increase in the weight of the filter represents the total suspended solids. *See also* suspended solids.

total trihalomethane bromine (TTHM-Br) The molar sum of bromine in individual trihalomethanes. This value represents the numerator in both the bromine incorporation factor and in bromide utilization calculations. For example, in 1 mole of bromoform ($CHBr_3$), 3 moles of bromine are present (i.e., three bromine atoms per molecule of bromoform); thus, TTHM-Br = 3 for this example. *See also* bromide utilization; bromine incorporation factor for trihalomethanes; total trihalomethane chlorine.

total trihalomethane chlorine (TTHM-Cl) The molar sum of chlorine in individual trihalomethanes. For example, in 1 mole of chloroform ($CHCl_3$), 3 moles of chlorine are present (i.e., three chlorine atoms per molecule of chloroform); thus, TTHM-Cl = 3 for this example. *See also* total trihalomethane bromine.

total trihalomethanes (TTHM) The sum of the four chlorine- and bromine-containing trihalomethanes (i.e., chloroform, bromodichloromethane, dibromochloromethane, and bromoform). The US Environmental Protection Agency regulates the sum of these four species in drinking water on a mass concentration basis at a maximum contaminant level of 0.080 milligrams per liter calculated as an annual average of quarterly compliance samples. *See also* locational running annual average; trihalomethane.

total volatile solids (TVS) A measure of the volatile solids in a liquid. When the residue from a total solids test (dried at 217°–221° Fahrenheit, or 103°–105° Celsius) is ignited to constant weight at 932°±122° Fahrenheit (500°±50° Celsius), the remaining solids represent the fixed total solids, and the weight lost on ignition is the total volatile solids. Likewise, the residue from a total dissolved solids test (dried at 356° Fahrenheit, or 180° Celsius) or a total suspended solids test (dried at 217°–221° Fahrenheit, or 103°–105° Celsius) can be ignited to constant weight at 932°±122° Fahrenheit (500°±50° Celsius) in order to determine the volatile dissolved solids or the volatile suspended solids. *See also* fixed solids; total dissolved solids; total solids; total suspended solids; volatile solids; volatile suspended solids.

total water cycle management (TWCM) *See* total water management.

total water management The management of water resources with a comprehensive approach balancing

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resources, demands, and environmental issues. Total water management considers water supply, water quality and treatment, storage, conveyance, water auditing practices, loss control, potential use of alternative water supplies (such as water reuse or desalting of saline waters), conservation and demand-side management, effects of water users, and environmental needs and concerns.

total well capacity The maximum rate at which a well will yield water by pumping after the water stored in the well has been removed. Total well capacity is the rate of yield when the water level in the well is drawn down to the top of the screen.

tower crib A water treatment plant intake built on the bottom of a river or lake and extending above high water for the purpose of allowing water to be drawn at different levels.

TOX *See* total organic halogen.

toxaphene (approximate formula, $C_{10}H_{10}Cl_8$) A complex mixture of chlorinated hydrocarbons produced by the chlorination of camphene in which the content of combined chlorine is equal to 67–69 percent. Toxaphene is an insecticide whose presence in drinking water is regulated by the US Environmental Protection Agency (USEPA) at a maximum contaminant level of 0.003 milligrams per liter. Once widely used on crops such as cotton in the southern United States, its use has been banned in the United States because of its harmful effects. Toxaphene is a persistent, bioacculumative, and toxic (PBT) pollutant targeted by USEPA. Human exposure to toxaphene is still possible owing to its persistence in the environment. *See also* insecticide.

TOXFP *See* total organic halogen formation potential.

toxic Poisonous.

toxicant A substance that causes harmful effects to organisms on contact, inhalation, or ingestion. A toxicant is also called a poison.

toxic cyanobacteria Photosynthetic, toxin-producing, oxygen-generating prokaryotes belonging to the kingdom Monera.

toxicity The total adverse effect of a poisonous substance to which the body is exposed, typically by way of the mouth, skin, or lungs.

toxicity assessment A characterization of the toxicological properties and effects of a chemical, including all aspects of its absorption, metabolism, excretion, and mechanism of action, with special emphasis on establishment of dose–response characteristics.

toxicity characteristic leaching procedure (TCLP) An extraction procedure used to determine whether a solid waste is hazardous under the Resource Recovery and Conservation Act. The toxicity characteristic leaching procedure was promulgated by the US Environmental Protection Agency on March 29, 1990 (55 *Federal Register* 11799–11877). The method for this procedure appears in 40 CFR part 261, Appendix II.

toxicity equivalency factor (TEF) A means of estimating toxicity and normalizing the potency of a mixture of chemicals that induce toxicity by interacting with a common receptor molecule, allowing one to arrive at an estimate of the hazards these chemicals pose. The concept has been applied almost exclusively to mixtures of dioxin and dibenzofurans and has little application to other chemicals or chemical classes because the receptors involved in inducing toxicity are poorly understood. In the case of the dioxins and dibenzofurans ($C_{12}H_8O$), the toxicity equivalency factor is determined by the relative affinity of each component to the Ah receptor with 2,3,7,8-tetrachlorodibenzo-*p*-dioxin as the standard. A problem with this concept is that it fails to deal with the differing pharmacokinetic parameters of the different dioxins. *See also* Ah receptor; hazard index; 2,3,7,8-tetrachlorodibenzo-*p*-dioxin.

toxicodynamics The qualitative and quantitative description of the response produced following delivery of a chemical dose to its active site within the body. *See also* pharmacodynamics.

toxicokinetics The quantitative description of the absorption, distribution, and clearance of a chemical for which the expected effects are adverse rather than beneficial. *See also* pharmacokinetics.

toxicological equivalency (TEQ) *See* hazard index.

toxicology The study of the quantitative effects of chemicals on biologic tissue, particularly in terms of definite harmful actions and degrees of safety. *See also* acute; chronic; environmental health; potable water approval; product stewardship.

toxic pollutant A material that is contaminating the environment and can cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and length of exposure necessary to cause these effects can vary widely.

toxic substance A chemical element or compound, such as lead, radon, benzene (C_6H_6), dioxin, and numerous others, that has toxic properties following either ingestion, inhalation, or absorption into the body. There is considerable variation in the degree of toxicity among the various toxic substances and in the exposure levels that induce toxicity. *See also* toxicity.

Toxic Substances Control Act (TSCA) Public Law 94-469, enacted Oct. 11, 1976 (15 US Code 2601 *et seq.*), authorizing the US Environmental Protection Agency to screen existing and new chemicals used in manufacturing and commerce to identify potentially dangerous products or uses that should be subject to federal control.

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toxic tort claims Litigation claiming that a toxic or harmful substance (such as a contaminant in drinking water) caused the plaintiff illness or harm. *See also* tort litigation.

toxic waste Waste that, when it comes in contact with a biological entity, causes an adverse response.

toxin A poisonous substance that comes from another organism.

toxin gene A gene that codes for the production of a specific toxin. Toxin genes have been used as biomarkers to identify fecal waste sources in water; for example, toxin genes in *Escherichia coli* pathogenic to swine, cow, and human fecal material have been used as biomarkers in watershed management studies.

toxogenic Potential to be toxic, as in a toxogenic group of a chemical compound.

Toxoplasma gondii *See* toxoplasmosis.

toxoplasmosis A systemic disease caused by *Toxoplasma gondii,* an intracellular coccidian protozoan of felines. Mammals and birds are infected worldwide. The definitive hosts are cats and other felines that acquire infection mainly from eating infected mammals or birds. Only felines harbor the parasite in the intestinal tract, where the sexual stage of the parasite's life cycle occurs. Oocysts shed in feces by cats remain infective in water or moist soil for long periods of time. Intermediate hosts, including sheep, cattle, goats, rodents, swine, and chickens, may carry infective cysts that may remain viable for long periods in tissue, especially muscle and brain tissue. Human infections may be acquired from raw or undercooked meat, raw milk containing cysts, or other foods or water contaminated with feline feces. Children become infected by ingesting infective oocysts from soil in sandboxes and play areas where cats have defecated. The infection is not directly transmitted person-to-person except in utero and is rarely acquired by blood transfusion. Infections are common in humans and frequently asymptomatic. Acute disease may cause symptoms resembling infectious mononucleosis. A primary infection during early pregnancy may lead to fetal infection, with death of the fetus or other serious effects, including brain damage. Later in pregnancy, material infection results in mild or subclinical fetal disease with delayed manifestations.

2,4,5-TP *See* silvex.

T-phage A tailed coliphage. *See also* coliphage.

TQM *See* total quality management.

trace (1) A very small quantity of a constituent. (2) The amount of rainfall or other form of precipitation that occurs when the quantity is so small that it cannot be measured in the rain gauge. (3) The chart record made by a self-registering instrument.

trace element An element essential to plant nutrition, animal nutrition, or both in a trace concentration of 1 percent or less of the total nutrition budget, e.g., iron, manganese, zinc, copper, potassium, or sodium. Such elements are also called micronutrients.

trace metal A metal that is present in relatively small concentrations in water. *See also* trace element.

trace of precipitation An amount of precipitation too small to be measured in a gauge, usually less than 0.005 inches (0.125 millimeters).

trace of rain An amount of rain too small to be measured.

tracer (1) A foreign substance mixed with or attached to a given substance for subsequent determination of the location or distribution of the foreign substance. (2) An element or compound that has been made radioactive so that it can be easily followed (traced) in biological and industrial processes. Radiation emitted by the radioisotope pinpoints its location.

tracer gas method A leak detection method often used for pinpointing small leaks in new pipelines undergoing hydrostatic testing but also applicable to leak detection on pipelines in active service. A gas is injected into a section of water main that is believed to have a leak. At the point of leakage, the gas can be detected above the surface of the pipeline, thereby indicating the location of the leak. Helium gas or a premixed hydrogen-in-nitrogen mixture can be used, although helium gas requires that the main be removed from service and dewatered.

tracer study A study using a substance that can readily be identified in water (such as a dye) to allow one to determine the distribution and rate of flow in a basin, pipe, groundwater, or stream channel.

tracer test A type of flow test in which a tracer is used to determine flow paths, arrival times, and dispersion effects in water systems.

trace substance A substance that is found during water analysis in a concentration high enough to be detected but too low to be quantified accurately by standard testing methods. A trace substance is sometimes referred to as a threshold substance.

train *See* process train.

trans Pertaining to an isomer for which a given atom or organic functional group is positioned on the opposite side of the carbon axis or backbone. *See also cis;* isomer.

transbasin diversion The deliverance of water from its natural basin into another basin.

transceiver A device that is capable of both transmitting and receiving information or data. When the device is simultaneously transmitting and receiving, it utilizes collision-detection logic.

***trans*-2, *cis*-6-nonadienal** *See under* nonadienal.

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transcription The process of transferring the sequence information from deoxyribonucleic acid into messenger ribonucleic acid. The messenger ribonucleic acid transcript is processed and used as a template for the synthesis of proteins.

***trans*-1,2-dichloroethylene** *See under* dichloroethylene.

transducer An electromechanical device that senses some varying condition (such as temperature or pressure) measured by a primary sensor and converts it to an electrical or other signal for transmission to some other device (a receiver) for processing or decision making.

transect Any imaginary line along which samples are taken at specified distance intervals. Transect sampling is usually done on large bodies of water, such as rivers and lakes.

transfer (conveyance of a water right) The passing of title to a water right; a permanent assignment as opposed to a temporary lease or disposal of water.

transfer pipette *See* volumetric pipette.

transfer pump A pump specifically designed to convey water or chemical solutions from one tank to another.

transfer ribonucleic acid (tRNA) *See* ribonucleic acid.

transformation Acquisition by a cell of the property of uncontrolled growth.

transformer A device used with alternating current to increase current while decreasing voltage, or to decrease current while increasing voltage.

transgenic animal A test animal (e.g., a rodent) in which a gene has been added to alter the response of the animal to a chemical to be tested. *See also* knockout animal.

transient Passing through from one place to another.

transient, community water system *See* transient water system.

transient, noncommunity water system (TNCWS) A noncommunity water system that does not serve at least 25 of the same people over 6 months of the year in a nonresidential area such as a campground, motel, or gas station. *See also* noncommunity water system; nontransient, noncommunity water system.

transient analysis A pipe network analysis that models pressure waves created by sudden changes in system flow rates.

transient cross-connection A condition in which backflow can occur in a normally pressurized system because of sudden pressure changes caused by surges such as those that occur when a valve is rapidly closed. *Contrast with* cross-connection.

transient system *See* transient water system.

transient water system (TWS) A public water system that serves a transient population. *See also* transient, noncommunity water system.

transition A short section of a conduit used as a conversion section to unite two conduits having different hydraulic elements.

transition zone The relatively thin layer between the upper and lower layers of the water in a reservoir where the temperature changes readily with the depth. *See also* thermocline.

transit time (1) In a sonic transit time flowmeter, the time duration for the sonic pulse to travel from the transmitter to the receiver. (2) The time for a segment of water to flow from one location to another.

translation The synthesis of protein using messenger ribonucleic acid as a template of information that dictates the sequence in which amino acids are assembled.

translatory wave A moving or advancing wave or series of waves that tend to overtake each other and form a single larger wave. A translatory wave is caused by any sudden change in the conditions of flow.

transmembrane flux Flux through a membrane. *See also* flux.

transmembrane pressure (TMP) (1) For a pressure-driven membrane process, the net driving force across the membrane. (2) For microfiltration and ultrafiltration with negligible osmotic pressure differential across the membrane, the hydraulic pressure differential from the feed side to permeate side.

transmissibility coefficient An outdated form of the term *aquifer transmissivity. See also* aquifer transmissivity; permeability coefficient.

transmission The process or act of passing along or conveying something, such as moving water from one point to another via pipelines and conduits.

transmission channel In a telemetry system, the wire, radio wave, fiber-optic line, or microwave beam that carries the data from the transmitter to the receiver.

transmission constant *See* hydraulic conductivity; permeability coefficient.

transmission control protocol/Internet protocol (TCP/IP) A complex set of rules and standards that control communications on the Internet, allowing data exchange with other users. The rules were developed by the US Department of Defense.

transmission electron microscope A microscope in which the image is formed by an electron beam transmitted through the specimen, as opposed to the image being formed by an electron beam reflected (incident) from the specimen. *See also* scanning electron microscope.

transmission electron microscopy (TEM) Use of a transmission electron microscope to visually examine structures too fine to be resolved with ordinary, or light, microscopes, or to study surfaces that emit electrons. *See also* transmission electron microscope.

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transmission lag The dead time specifically associated with transmitting the measured value of a variable between its measuring instrument and the receiving instrument, such as a controller or recorder.

transmission line A pipeline that transports source water to a water treatment plant or treated water to a distribution grid system.

transmission main A water main that transports water from the main supply or source to a distant area where the water is distributed through distribution lines.

transmission of germicidal ultraviolet (UV) irradiation The percentage of light at a wavelength of 253.7 nanometers transmitted through water.

transmission of infection Any mechanism by which an infectious agent is spread directly or indirectly from a source or reservoir of infection to a person. These mechanisms are as follows: (1) Direct transmission of an infectious agent to a receptive portal of entry, usually by touching, kissing, biting, sexual activities, or direct projection of droplet spray onto the conjunctiva or mucous membranes by sneezing, coughing, and so on. (2) Indirect transmission in which a vehicle serves as an intermediate means by which an infectious agent is transported. The agent may or may not have multiplied or developed in or on the vehicle. Vehicles may include contaminated inanimate materials or objects (fomites, such as toys, diapers, or soiled clothes), water, food, milk, or biological products (such as blood or tissue). (3) Indirect transmission by a vector from either (a) the carriage of an infectious agent by a crawling or flying insect through the soiling of its feet or proboscis or by passage of organisms through the agent's gastrointestinal tract, or (b) injection of salivary gland fluid during biting, or regurgitation or deposition of feces or other material that may penetrate the skin through a bite wound or after scratching. (4) Indirect transmission by airborne dissemination of microbial aerosols suspended in the indoor and outdoor air environment to the respiratory tract. (Note: droplets and other large particles promptly settle and are not considered airborne.)

transmissivity A measure of the ability to transmit water. *See also* aquifer transmissivity.

transmittance The ratio of the power of a beam of light after passing through a sample to the initial power. It can be multiplied by 100 to obtain percentage of transmittance. The equation is $T = P/P_0$, with P_0 the initial power and P the final power. It is related to absorbance through an exponential function. *See also* absorbance.

transmittancy The ability of water to transmit or convey ultraviolet energy.

transmitter The part of a pressure differential meter that measures the signal from the primary element and sends another signal to the receiver.

transmutation The change that takes place in a radioactive substance because of radioactive disintegration.

transpiration The process by which water vapor is lost to the atmosphere from living plants.

transpiration ratio The ratio of the weight of water lost to the atmosphere from a plant to the weight of dry plant substance produced.

transportation In geology, the movement of detached soil material across the land surface or through the air. Transportation may be brought about by running water, wind, or gravity. *See also* erosion.

transport capacity A measure of the ability of a stream to transport a suspended load. Transport capacity is expressed in terms of the total weight of the particles.

transport competency A measure of the ability of a stream to transport sediment at a given velocity. Transport competency is expressed in terms of the dimensions of the particles that may be transported.

transported soil Soils formed by the consequent or subsequent weathering of materials transported and deposited by some agency, such as water, air, or ice.

transporting erosive velocity A flow velocity that is high enough not only to maintain sediment in movement but also to scour the bed of a stream or canal.

transport pore In granular activated carbon, a pore larger than the largest adsorption pores. Transport pores function as a diffusion path to transport organic and inorganic adsorbates. Adsorption does not occur in these locations, even at near-saturated conditions.

transport process An exchange of heat, mass, or momentum between materials or objects.

transverse flow An operating condition, in some types of pressure-driven membrane water treatment processes, where the feedwater and resulting concentrate or retentate pass tangentially across the surface of the membrane and the permeate passes in a perpendicular direction through the membrane barrier. With hollow-fiber membranes, transverse flow commonly means that pressurized feed passes tangentially on the outside of the membrane fibers and that the permeate flows outside in, or shell side to lumen, and is collected from the inner lumen of the fibers (opposite the permeate flow direction, as in a crossflow hollow-fiber membrane). *See also* crossflow; hollow-fiber membrane; lumen.

transverse Mercator projection A map projection that is used to establish zones in the State Plane Coordinate System. *See also* State Plane Coordinate System.

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trap A device used to prevent a material flowing or carried through a conduit from reversing its direction of flow or movement or from passing a given point.

trapezoidal weir A weir with a trapezoid-shaped notch.

trapway The outlet of a toilet where the waste exits to the drainline.

trash Debris that may be removed from reservoirs by coarse racks.

trash gate A gate over which floating trash may be skimmed off or through which trash removed from racks may be discharged.

trashrack *See* bar screen.

trash screen A screen installed or constructed in a waterway to collect and prevent the passage of trash.

trauma An injury that was caused by a force outside the body. For example, hitting the hand with a hammer would be considered a trauma injury.

traveling backwash system System used with long, rectangular filter boxes that are subdivided into numerous cells and consisting of a backwash pump and a backwash water collection system. As the system passes slowly down the filter box, each cell is washed individually. The system can operate intermittently or continuously. It is most commonly used in wastewater treatment. As turbidity regulations have become more stringent, it is seldom used in water treatment. *See also* automatic backwash filter.

traveling bridge sludge collector A mechanism that collects sludge from the bottom of a rectangular sedimentation basin by moving a bridge horizontally across tracks on the top walls of the basin. The bridge supports a suction-type sludge collection mechanism that extends to the bottom of the basin. The sludge is suctioned out into a channel that runs parallel to the basin at the surface.

traveling screen A trash screen that revolves such that water always passes through a clean area of the screen.

traveling wave A translatory wave in an open channel traveling downstream because of a sudden increase of flow, or traveling upstream when the rate of flow is suddenly diminished or stopped. *See also* bore; tidal bore.

travel-stop nut A nut, used in dry-barrel hydrants, that is screwed onto the threaded section of the main rod. It is located at the bottom of the base of the packing plate, or revolving nut, and prevents downward travel (opening) of the hydrant valve.

travel time The time for a water particle to travel from one location to another along a flow line.

tray aerator A device used to transfer target compounds from the liquid to the gaseous phase by cascading water over sequential trays that create turbulence in the liquid, thereby promoting mass transfer. *See also* stripping.

treated water Water that has been subjected to treatment processes.

treatment plant The central portion of water facilities that contains various treatment processes exclusive of collection or distribution of water.

treatment plant residue An accumulation of solid material removed from water during treatment.

treatment system A combination of various unit processes with a common objective of producing potable water. *See also* potable water.

treatment technique (TT) requirement A requirement of the National Primary Drinking Water Regulations that specifies, for a particular contaminant, one or more specific treatment techniques that lead to a reduction in the level of the contaminant sufficient to achieve compliance with the requirements of 40 *Code of Federal Regulations* Part 141. *See also* best available technology.

treatment toolbox A list of treatment and management options for *Cryptosporidium* reduction specified in the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). Water systems required to provide additional treatment for *Cryptosporidium* under the LT2ESWTR are able to apply any one or more of these options, in accordance with US Environmental Protection Agency guidance.

tree-based statistical model A statistical model used to define a relationship between predictor and response variables, such as for predicting coliform occurrence based on historical information gathered from a group of distribution systems.

tree diagram A graphical method of mapping out in increasing detail, e.g., the full range of paths and tasks that need to be accomplished in order to achieve a goal and related subgoals or how a drinking water regulation will affect various categories of water utilities.

tree-forest cover Trees and shrubs that cover the soil, protecting it from variations in humidity and temperature, as well as from erosion.

tree system A distribution system pipe fitting that centers around a single arterial main that decreases in size with length. Branches angling off from the original main may also have subbranches.

trellis drainage pattern A stream pattern that is characterized by many more or less right-angle bends and is commonly developed in regions of folded geological structure. The rectilinear arrangement resembles a trellis.

tremie A box or frame of wood or metal used for depositing concrete underwater. Its upper section forms a hopper above water to receive the concrete, and it may be moved laterally or vertically by any suitable device, such as a traveling crane.

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tremie pipe A small pipe inserted into the annular space between a borehole and well casing to place filter pack materials, cements, and grouts.

trench An excavation made for installing pipes and masonry walls, as well as for other purposes. A trench is distinguished from a ditch in that the opening is temporary and is eventually backfilled.

trench box A box that can be stacked, laid end to end with other such boxes, and interlocked to provide protection on deep excavations. Trench boxes are fabricated by manufacturers that specialize in excavation safety systems. They must be able to withstand the forces that are imposed from the surrounding earth to prevent cave-ins and thereby protect workers.

trench brace The horizontal member of a shoring system that runs across a trench, attached to the stringers.

trench fill revetment In the United States, a covering of loose stone or blocks laid on the berm of a river embankment to protect the embankment from erosion. *See also* loose apron; riprap.

trenchless operation A process of slip lining or in-place pipe replacement that eliminates the necessity of digging a trench.

trench shield *See* shield.

TR/FTIR spectroscopy *See* total reflectance/Fourier transform infrared spectroscopy.

triangular weir A weir having a notch that is triangular in shape. *See also* V-notch weir.

S-triazine A group of S-triazine rings containing chemicals commonly used as herbicides. Atrazine, a common S-triazine herbicide, has been detected in many surface waters and groundwater. Its presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.003 milligrams per liter. *See also* atrazine.

triazine herbicides ($R_3C_3N_3$) A family of herbicides based on a symmetrical triazine structure, where there are a variety of attached groups (R). The triazine structure is composed of a six-membered ring with alternating carbon and nitrogen atoms, where every other carbon–nitrogen bond is a single bond and the other bonds are double bonds. The R groups are attached to the carbon atoms. *See also* atrazine; cyanazine; herbicide; prometon; simazine.

tribromamine (NBr_3) The bromine-substituted analog of trichloramine (NCl_3) that can be formed during the chloramination of bromide-containing water. *See also* bromamines.

tribromoacetaldehyde (TBA) (CBr_3CHO) A brominated analog of trichloroacetaldehyde. It is a disinfection by-product and is formed in chlorinated or ozonated water high in bromide. It is not stable in drinking water and can undergo hydrolysis reactions to form tribromomethane or bromoform. It is commonly referred to as bromal. *See also* disinfection by-product; haloacetaldehydes.

tribromoacetic acid (TBAA) (CBr_3COOH) The bromine-substituted analog of trichloroacetic acid that may be formed during the chlorination or ozonation of bromide-containing water. Research suggests that this haloacetic acid is relatively unstable in water. *See also* haloacetic acid.

tribromoacetonitrile (TBAN) (CBr_3CN) A halogenated acetonitrile in which three hydrogen atoms have been replaced by bromine atoms. It is a disinfection by-product formed in chlorinated water high in bromide. *See also* disinfection by-product; haloacetonitrile.

2,4,6-tribromoanisole (2,4,6 TBA) An organic compound that gives an unpleasant and moldy smell in corked wine and a musty odor in drinking water. This compound has an extremely low odor threshold concentration, so trace levels impart strong odors in water. *See also* odor threshold concentration.

tribromomethane (TBM) ($CHBr_3$) The chemical name for bromoform. *See also* bromoform.

tribromonitromethane (TBNM) (CBr_3NO_2) A halogenated nitromethane in which three hydrogen atoms of nitromethane have been replaced by bromine atoms. It is commonly called bromopicrin. It is a disinfection by-product formed in chlorinated or ozonated water high in bromide. *See also* disinfection by-product; halonitromethanes.

1,1,1-tribromopropanone (1,1,1-TBP) (CBr_3COCH_3) A halogenated propanone in which three hydrogen atoms of propanone have been replaced by bromine atoms (on the same carbon atom). It is a disinfection by-product formed in chlorinated water high in bromide. It is unstable in drinking water and can undergo hydrolysis reactions to form tribromomethane or bromoform. *See also* disinfection by-product; halopropanones.

1,1,3-tribromopropanone (1,1,3-TBP) ($CHBr_2COCH_2Br$) A halogenated propanone in which three of the six hydrogen atoms of propanone have been replaced by bromine atoms. It is a disinfection by-product in chlorinated water. *See also* disinfection by-product; halopropanones.

tributary A stream or other body of water—surface or underground—that contributes its water to another and larger stream or body of water.

tributary groundwater Water below the earth's surface that is hydrologically or physically connected to natural stream water so as to affect the first water's flow, whether in movement from or to that stream.

trichloramine (NCl_3) A compound that is formed by the chlorination of water containing ammonia (NH_3). This compound is also called nitrogen trichloride.

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Trichloramine is the last in a sequence of compounds formed by the continual addition of ammonia—first monochloramine (NH_2Cl), then dichloramine ($NHCl_2$), and finally trichloramine. Thus, this species is not normally detected in chloraminated waters. Trichloramine has little disinfection capacity and is a source of taste and odors. Upon additional chlorination, trichloramine will be converted to elemental nitrogen gas, and any additional chlorine (HOCl) will be measured as free chlorine. *See also* breakpoint chlorination; chloramines.

trichloroacetaldehyde (TCA) (CCl_3CHO) Also known as chloral, a halogenated acetaldehyde in which three hydrogen atoms of acetaldehyde have been replaced by chlorine atoms. It is a disinfection by-product formed in chlorinated water. When dissolved in water, it forms a hydrate and is commonly referred to as chloral hydrate. *See also* chloral hydrate; disinfection by-product.

trichloroacetate (TCA) (CCl_3COO^-) A salt of trichloroacetic acid. At drinking water pH levels, trichloroacetic acid is present as the trichloroacetate ion. *See also* trichloroacetic acid.

trichloroacetic acid (TCAA) (CCl_3COOH) A haloacetic acid containing three chlorine atoms. Typically, this acid and dichloroacetic acid ($CHCl_2COOH$) are the principal haloacetic acids formed during chlorination, except in waters containing moderate amounts of bromide ion (Br^-). Trichloroacetic acid is also commercially prepared for miscellaneous industrial uses, including use as an herbicide. *See also* dichloroacetic acid; haloacetic acid; herbicide.

1,1,1-trichloroacetone *See under* 1,1,1-trichloropropanone.

trichloroacetonitrile (TCAN) (CCl_3CN) A halogenated acetonitrile in which three hydrogen atoms of acetonitrile have been replaced by chlorine atoms. It is a disinfection by-product formed in chlorinated water. *See also* disinfection by-product; haloacetonitrile.

1,2,4-trichlorobenzene ($C_6H_3Cl_3$) A volatile organic compound used as a solvent and an insecticide. Trichlorobenzene's presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.07 milligrams per liter. *See also* insecticide; solvent; volatile organic compound.

trichloroethane *See* 1,1,1-trichloroethane; 1,1,2 trichloroethane.

1,1,1-trichloroethane (TCA) (CH_3CCl_3) A volatile organic compound used as a solvent and a pesticide. 1,1,1-tricholorethane's presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.2 milligrams per liter. *See also* pesticide; solvent; volatile organic compound.

1,1,2-trichloroethane (TCA) ($CHCl_2CH_2Cl$) A volatile organic compound used as a solvent. 1,1,2-trichloroethane's presence in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.005 milligrams per liter. *See also* solvent; volatile organic compound.

trichloroethene *See* trichloroethylene.

trichloroethylene (TCE) ($CHCl=CCl_2$) A volatile organic compound that has been used as a metal degreaser, as a solvent, in dry cleaning, and as a fumigant. Trichloroethylene (also called trichloroethene) is regulated in drinking water by the US Environmental Protection Agency at a maximum contaminant level of 0.005 milligrams per liter. *See also* fumigant; solvent; volatile organic compound.

trichloromethane (TCM) ($CHCl_3$) The chemical name for chloroform. *See also* chloroform.

trichloronitromethane (chloropicrin) (PS) (CCl_3NO_2) A halogenated nitromethane in which three hydrogen atoms of nitromethane have been replaced by chlorine atoms. It is a disinfection by-product formed in chlorinated water. It is commonly referred to as chloropicrin. Industrially, chloropicrin is used as a pesticide, as a fungicide, and in tear gas. *See also* disinfection by-product; halonitromethanes; pesticide.

trichlorophenol (TCP) A chlorophenol with three chlorine atoms. One of the trichlorophenols is 2,4,6-trichlorophenol ($C_6H_2Cl_3OH$), which is a fungicide, herbicide, and defoliant. In addition, 2,4,6-trichlorophenol can be formed during the chlorination of water. However, this disinfection by-product is typically detected at low (or sub) microgram-per-liter levels. *See also* chlorophenols; defoliant; disinfection by-product; fungicide; herbicide.

2-(2,4,5-trichlorophenoxy)propionic acid (2,4,5-TP) ($Cl_3C_6H_2OCH(CH_3)COOH$) *See* silvex; *see also* herbicide.

1,1,1-trichloropropanone (1,1,1-TCP) (CCl_3COCH_3) A halogen-substituted ketone containing three chlorine atoms. Typically, this compound is the principal halogen-substituted ketone formed during chlorination, except in waters containing moderate amounts of bromide (Br^-). It is converted to chloroform ($CHCl_3$) during base-catalyzed hydrolysis, and has also commonly been referred to as 1,1,1-trichloroacetone. *See also* base-catalyzed hydrolysis; disinfection by-product; haloketone; halopropanones.

1,1,3-trichloropropanone (1,1,3-TCP) ($CHCl_2COCH_2Cl$) A halogenated propanone in which three of the six hydrogen atoms of propanone have been replaced by chlorine atoms. It is a disinfection

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by-product in chlorinated water. *See also* disinfection by-product; halopropanones.

1,2,3-trichloropropane (1,2,3-TCP) ($CH_2ClCHClCH_2Cl$) A volatile organic compound used as a paint and varnish remover, solvent, and degreasing agent. It is listed as an unregulated contaminant by the US Environmental Protection Agency and has been detected in low levels in drinking water sources across the United States. It is a suspected carcinogen. *See also* unregulated contaminant; volatile organic compound.

trichothecene mycotoxin (T-2) Toxin produced by several fungal species and that can be used as a bioweapon. It causes skin irritation, swelling, and blistering. *See also* T-2 toxin.

triclosan An antimicrobial agent used in soaps, toothpastes, and detergents. It has been detected in surface and groundwater as a pharmaceutical and personal care product. It also reacts with chlorine to form disinfection by-products such as trihalomethanes. *See also* disinfection by-product.

trigger level A contaminant concentration specified in a National Primary Drinking Water Regulation (NPDWR) that, if exceeded, would require the water system to take additional action and/or provide additional treatment. *See also* action level.

trigger point An instantaneous condition for a demand-initiated regeneration water softener or in a valve control cycle when the regeneration step is about to be started.

trigger value A water quality parameter value set in conjunction with an alarm, so that plant operators are automatically alerted if a value is reached. It is commonly used with online turbidimeters and automated data collection systems. *See also* alarm.

trihaloacetaldehyde (THA) (CX_3CHO) A halogenated acetaldehyde in which three hydrogen atoms of acetaldehyde have been replaced by halogen atoms. It is a disinfection by-product formed in chlorinated water. Four common trihalogenated acetaldehydes are trichloroacetaldehyde, bromodichloroacetaldehyde, dibromochloroacetaldehyde, and tribromoacetaldehyde. *See also* disinfection by-product; haloacetaldehydes.

trihaloacetic acid (THAA) (CX_3COOH) A halogenated acetic acid in which three hydrogen atoms of acetic acid have been replaced by halogen atoms. It is a disinfection by-product formed in chlorinated water. Four common trihalogenated acetic acids are trichloroacetic acid, bromodichloroacetic acid, dibromochloroacetic acid, and tribromoacetic acid. *See also* disinfection by-product; haloacetic acid.

trihaloacetonitriles (CX_3CN) A group of halogenated acetonitriles that includes trichloroacetonitrile, a disinfection by-product formed in chlorinated water. *See also* disinfection by-product.

trihalogen-substituted acetic acid (TXAA) Acetic acid with three halogen atoms substituted for three hydrogen atoms. *See also* disinfection by-product; haloacetic acid.

trihalomethane (THM) (CHX_3) Any of numerous organic compounds named as derivatives of methane (CH_4) in which three halogen atoms (chlorine, bromine, iodine, singly or in combination) are substituted for three of the hydrogen atoms. Trihalomethanes (THMs) are formed during the disinfection of water with free chorine. Because of their carcinogenic potential and other possible health effects, the presence of these compounds in drinking water is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.080 milligrams per liter for the sum of the four regulated THMs, referred to as total trihalomethanes (TTHMs). *See also* disinfection by-product; locational running annual average; total trihalomethanes.

trihalomethane (THM) precursor A substance that can be converted into a trihalomethane during disinfection. Typically, most of these precursors are constituents of natural organic matter. In addition, the bromide ion (Br^-) is a precursor material. Trihalomethane formation potential tests are used to indirectly measure the level of trihalomethane precursors in a sample. *See also* bromide; natural organic matter; trihalomethane; trihalomethane formation potential.

trihalomethane formation potential (THMFP) The amount of trihalomethanes formed during a test in which a source or treated water is (1) dosed with a relatively high amount of disinfectant (normally chlorine) to produce a residual at the end of the test of about 3 milligrams per liter and (2) incubated or stored under conditions that maximize THM production (e.g., neutral to alkaline pH, warm water temperature, contact time of 4 to 7 days). This value is not a measure of the amount of trihalomethanes that would form under normal drinking water treatment conditions, but rather an indirect measure of the amount of trihalomethane precursors in a sample. If a water has a measurable level of trihalomethanes prior to the formation potential test (e.g., in a chlorinated sample), then the formation potential equals the terminal concentration measured at the end of the test ($TTHM_t$) minus the initial concentration ($TTHM_0$). *See also* disinfection by-product precursor; trihalomethane; trihalomethane precursor; uniform formation conditions.

trihalonitromethane (THNM) (CX_3NO_2) A halogenated nitromethane in which three hydrogen atoms of nitromethane have been replaced by halogen atoms.

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It is a disinfection by-product formed in chlorinated water. Four common trihalonitromethanes are trichloronitromethane, bromodichloronitromethane, dibromochloronitromethane, and tribromonitromethane. Trichloronitromethane is commonly referred to as chloropicrin. *See also* disinfection by-product; halonitromethanes; trichloronitromethane (chloropicrin).

trihalopropanones (CX_3COCH_3) A subclass of halopropanones in which three hydrogen atoms have been replaced by halogen atoms.

triiodomethane *See* iodoform.

1,2,4-trimethylbenzene ($C_6H_3(CH_3)_3$) A volatile organic compound with various industrial uses, e.g., in the manufacture of dyes and pharmaceuticals. *See also* volatile organic compound.

triple-blind study *See* double-blind study.

triple-expansion steam pump A direct connected steam pump in which steam is exhausted from the high-pressure cylinder to an intermediate cylinder, where it expands, and is then further exhausted to a third cylinder.

triple-media filter A filter containing three media—typically anthracite coal, supported by sand, supported by garnet or ilminite—that stratify after backwashing according to their respective specific gravities. Triple-media filtration *may* have improved filtration properties over dual-media filters in some applications. A triple-media filter is sometimes called a mixed-media filter. *See also* dual-media filtration.

triplex pump A reciprocating pump with three single-acting cylinders placed next to each other in line, all connected with the same suction and discharge line, with valves arranged so that the intake and discharge through the pump are continuous.

tripolyphosphate A water-soluble chelating agent for certain metals in solution. As sodium tripolyphosphate, the formula is $Na_5P_3O_{10}$. *See also* sodium tripolyphosphate.

trisodium phosphate (TSP) ($Na_3PO_4 \cdot 12H_2O$) An alkaline chemical additive used in some membrane-cleaning solutions.

trivalent Having a valence of three.

trivalent chromium (Cr(III)) *See* chromium.

trivalent ion An ion having a valence charge of three. The charge can be positive or negative.

tRNA (transfer ribonucleic acid) *See under* ribonucleic acid.

troph *See* trophozoite.

trophic level Any of the stages of the food chain at which an organism feeds.

trophic status An indicator of the ability of a lake to support plant growth as measured by phosphorus content, algal abundance, and depth of light penetration. *See also* eutrophic; mesotrophic; oligotrophic.

trophozoite The vegetative state or phase of a protozoan parasite life cycle in which asexual reproduction occurs. A trophozoite is sometimes called a troph.

tropic tide A tide occurring semimonthly when the effect of the moon's maximum declination is greatest.

trouble management Ability to quickly pinpoint water main leaks and water usage at predetermined intervals and general monitoring of water use through a geographic information system. *See also* geographic information system.

troubleshooting (1) A process of finding ways and methods to resolve disputes or impasses. (2) A process of discovering and eliminating the cause of trouble in, e.g., mechanical equipment, distribution systems, treatment plants, or power lines.

trough A structure, usually with a length several times its transverse dimensions, used to hold or transport water or other liquids.

true cohesion In soil stabilization, the resistance of particles to being pulled apart, resulting from the attraction between molecules at the point of contact.

true color The color of water from which the turbidity has been removed. *See also* true color unit *in the Units of Measure section.*

true color unit *See in the Units of Measure section.*

true groundwater velocity The actual or field velocity of groundwater percolating through water-bearing material. This velocity is equal to the volume of groundwater passing through a unit cross-sectional area per unit time divided by the effective porosity. True groundwater velocity is also called actual groundwater velocity, effective groundwater velocity, or field groundwater velocity.

true monthly mean precipitation The weighted mean precipitation for each month for a large area, derived from the study of an isohyetal map of the area. The weighted precipitation is the product of an isohyetal value and the area represented by this value. The sum of the weighted precipitations for the entire area is divided by the total basin area to determine the value of the mean precipitation for the whole area. *See also* isohyet.

true power Power available to do useful work. *See also* active power; complex power; instantaneous power; reactive power.

true strain The integral of the change (i.e., the deformation) in length (dL/L) evaluated from L_0 to L. This results in the expression $\ln[L/L_0]$, where L_0 is the initial length and L is the total length. *See also* engineering strain; strain.

true stress The force over the instantaneous area. It accounts for Poisson effects and inelastic changes in the cross-sectional properties. *See also* engineering stress; stress.

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truncation of data The act of reducing the number of significant figures after a decimal point because of inaccuracies in the measurement technique. *See also* significant figures.

trunk main A large pipe serving as a supply main or feeder main in a water distribution system.

trunnion A roller device, placed under ton containers of chlorine, for example, to hold them in place.

trypsin One of the proteolytic enzymes of the pancreatic juice, important in the digestive processes.

tryptic soy broth (TSB) This commonly used broth is a highly nutritious basic medium for culturing many kinds of microorganisms. It is a nonselective medium.

tryptophan ($C_{11}H_{12}N_2O_2$) An amino acid produced in the digestive process and essential in human nutrition.

TS *See* total solids.

TSB *See* tryptic soy broth.

TSCA *See* Toxic Substances Control Act.

TSD *See* technical summary document.

TSF *See* telephone success factor.

TSP *See* trisodium phosphate.

TSS *See* total suspended solids.

tsunami A gravity wave caused by an underwater seismic disturbance, such as sudden faulting, landsliding, or volcanic activity. *See also* tidal wave.

TSUVA *See* total specific ultraviolet absorbance.

t-test The test most often used in regression analysis to provide a measure of the goodness of fit for individual independent variables that enter the regression equation. The t-test, which is often called *Student's t-test,* is related to the concept of normal probability. It uses specific numbers of standard errors to define an area under a probability curve that approaches a normal curve when the sample size is about 50 observations. For example, a span of 2 standard errors on either side of the sample mean encompasses about 95 percent of the area under a normal curve, leaving about 5 percent of the area in the tails. In this context, including in a regression analysis an independent variable that has a *t* value of 2.0 means that about a 5 percent probability exists that the variable could be significant in the regression equation by chance (i.e., not be a true causal influence). Consequently a *t* value of 2.0 is usually used to determine whether variables should be included in or excluded from regression equations. A t-test can be either a one-tailed test or a two-tailed test. *See also* one-tailed test; regression analysis; standard error of the coefficient; two-tailed test.

TTHM *See* total trihalomethanes.

[$TTHM_0$] *See* instantaneous total trihalomethane concentration.

TTHM-Br *See* total trihalomethane bromine.

TTHM-Cl *See* total trihalomethane chlorine.

$TTHM_t$ *See* terminal total trihalomethane concentration.

TTN *See* threshold taste number.

TT requirement *See* treatment technique requirement.

tube (1) A closed conduit used to convey fluids. A tube may take many different forms, e.g., converging, diverging, uniform diameter, or special shape. (2) An instrument for determining the velocity and quantity of flow. *See also* Pitot tube.

tubercle (1) A small knob or button of rust formed on the inside of an iron pipe. (2) An attached deposit of metallic salts in pipes, frequently resembling a bunch of grapes.

tubercular corrosion A type of corrosion that occurs when pitting corrosion products build up at the anode over the top of the underlying pit. In iron and steel pipes, tubercles are made up of rust or iron oxides plus other compounds. These tubercles may appear as individual nodules or may be so plentiful that they grow together to form a continuous tuberculated surface. Copper pipe may also form tubercles that are generally smaller in size than those for iron.

tuberculation (1) The formation of tubercles in pipe. (2) Localized corrosion at scattered locations resulting in knoblike mounds.

tube settler A unit constructed of parallel tubes that are typically arranged in a honeycomb fashion and are approximately 2 inches (5 centimeters) in width oriented at a 45° to 60° angle from horizontal. Tube settlers are used to improve settling in a sedimentation basin. The units are placed at the end of the sedimentation basin (across the entire width) and flow travels upward through the tubes and exits at the top, prior to being discharged from the basin. The inclined tubes provide a much shorter distance for particles to settle prior to being captured, resulting in a low overflow rate, and they are often used to maintain particle removal at higher flow rates, thereby reducing the need to construct additional basins. The tubes restrict the largest eddy that can be formed so that the flow is nearly laminar, giving less disturbing settling. *See also* inclined plate settler; shallow-depth sedimentation.

tube settling A shallow-depth sedimentation process that uses a series of inclined tubes. *See also* tube settler.

tube well A well constructed by pushing or hammering a tube into the ground. The bottom of the tube is closed and tapered like an arrow. Holes in the side of the tube allow water to enter the tube and come to the surface.

tubing (1) Flexible pipe of small diameter, usually less than 2 inches (5 centimeters). (2) A special grade of high-test pipe fitted with couplings and fittings of special design.

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tubular membrane A membrane installed within a porous tube that provides membrane support. Feed flow passes through the tube, and permeate passes through the membrane barrier in a perpendicular direction.

tubular spring A spring that issues through more or less rounded openings, such as solution passages in limestone or gypsum or natural channels in basaltic lava.

tubular well Normally, a well of small diameter installed with a strainer or sand point without gravel packing. The slots in the strainer are selected to suit the formation penetrated so that the well will not pump excessive amounts of sand after development.

tularemia Disease caused by the bacterium *Francisella tularensis* and carried by ticks, affecting both animals and humans. It is also known as rabbit fever.

tumbling basin A basin holding a cushion of water, designed to absorb energy from vertically dropping water.

tumor (1) A growth of tissue in which the multiplication of cells is not fully under control and has the potential for progression to cancer. (2) Broadly speaking, a swelling that signals inflammation.

tumorigenic response An effect elicited by a physical, chemical, or microbial agent that results in the formation of tumors. *See also* carcinogenic; tumor.

tumor incidence The fraction of animals having a tumor of a certain type.

tumor initiator A physical or chemical agent that is capable of producing an irreversible event that carries with it a probability of a tumor being produced. Ordinarily, such agents act by interacting with deoxyribonucleic acid to produce a mistake in its replication so that a mutation arises in a critical site. Such mutations alter the cell's response to growth control mechanisms. Because a mutation is an irreversible event, the effects of a tumor initiator are demonstrably irreversible in appropriately designed experiments. Certain chemicals will stimulate the growth of such altered cells. These latter types of chemicals are referred to as tumor promoters. *See also* carcinogenic; tumor promoter.

tumor promoter (1) In toxicology, a chemical that increases the growth rate of clones of cells that develop into tumors. (2) In molecular biology, a region within a deoxyribonucleic acid sequence to which a protein binds to increase the synthesis of messenger ribonucleic acid from particular genes. This region is also called the promoter region. *See also* carcinogenic; messenger ribonucleic acid; tumor initiator.

tundra Level or undulating plainland without trees, as characteristic of Arctic regions.

tuning The act of adjusting the proportional band, integral factor, derivative factor, or any combination of the three in an automatic controller.

turbid Having a cloudy or muddy appearance.

turbidimeter An instrument that measures the amount of light scattered by suspended particles in a water sample, with a standard suspension used as a reference nephelometer.

turbidimetry (1) The measurement of turbidity based on the ratio of the intensity of light scattered at a fixed angle by the particles in suspension to the intensity of the incident light. (2) The depth at which a target disappears beneath the layer of turbid medium. *See also* nephelometric turbidimeter; nephelometric turbidity unit *in the Units of Measure section.*

turbidity (1) A condition in water caused by the presence of suspended matter, resulting in the scattering and absorption of light. (2) Any suspended solids that impart a visible haze or cloudiness to water and can be removed by treatment. (3) An analytical quantity, usually reported in nephelometric turbidity units, determined by measurements of light scattering. The turbidity in finished water is regulated by the US Environmental Protection Agency. *See also* color; nephelometric turbidity unit *in the Units of Measure section.*

turbidity breakthrough Passage of turbidity all the way through a filter such that a measurable change in turbidity can be detected. In the filtration process, a filter ripening period occurs in which turbidity declines, followed by an operating time when the turbidity is typically less than the goal value and is relatively stable, followed by a steady increase. Under ideal conditions, terminal head loss should precede breakthrough, thereby protecting the filtered water quality from a sharp increase in particulates. *See also* terminal head loss; turbidity.

turbidity spike An abrupt increase in turbidity, generally used to describe a sudden rise of source water or filtered water turbidity.

turbidity unit *See under* nephelometric turbidity unit *in the Units of Measure section.*

turbine Any of various machines having a rotor, usually with vanes or blades, driven by the pressure, momentum, or reactive thrust of a moving fluid, such as steam, water, hot gases, or air. The moving fluid occurs either in the form of free jets or as a fluid passing through and entirely filling a housing around the rotor.

turbine efficiency (1) The ratio of energy converted into useful work to the energy supplied to the turbine. (2) The energy difference between the water in a wheel pit and the tailwater.

turbine meter A meter for measuring flow rates by measuring the speed at which a turbine spins in water,

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indicating the velocity at which the water is moving through a conduit of known cross-sectional area.

turbine pump A series of small-diameter centrifugal pumps (called bowls) that are connected together and driven by a single motor through one shaft. Using a series of bowls is necessary to provide the head because of the limited diameter of the bowls, especially in a deep well application.

turbopump A pumping device in which one or more turbine impellers rotate on a shaft with one or more pump impellers. The hydraulic energy of a pressurized flow stream passing through the turbine impeller(s) is transferred through the common shaft to the flow stream being pumped. For example, in a high-pressure reverse osmosis system, a feedwater pump having an energy recovery turbine installed on the same shaft as the pumping impellers and motor is a turbopump. The pressurized waste concentrate flow stream passes through the energy recovery turbine and lowers the required energy input from the drive motor.

turbulence A pattern of water flow characterized by cross currents and eddies that mix the water (as opposed to a streamlined or laminar flow pattern). Turbulence may be caused by excessive flow rates, by curves or rough surfaces in the flow channel, or by turbulence promoters (such as baffles) purposely created to mix the water. Turbulence significantly increases pressure drop in a system. *See also* Kolmogorov microscale; laminar flow.

turbulence promoter A device inserted into a channel to improve the mixing characteristics and increase the turbulence and velocity gradient. Typical turbulence promoters include baffles, spiral wires, balls, spacers, and static mixers. *See also* baffle; static mixer; velocity gradient.

turbulent flow A flow regime characterized by random motion of the fluid particles in the transverse direction, as well as motion in the axial direction. Turbulent flow occurs at high Reynolds numbers and is the type of flow most common in industrial fluid systems. It is a type of flow in which forces caused by inertia are more significant than forces caused by viscosity and in which adjacent fluid particles are more or less random in motion. *See also* Reynolds number.

turbulent velocity That velocity of water flowing in a conduit in excess of which the flow will always be turbulent and beneath which the flow may be either turbulent or laminar, depending on circumstances.

turfgrass Hybridized grasses that, when regularly mowed, form a dense growth of leaf blades and roots.

turn-down ratio The ratio of the design range of an instrument to the range of acceptable accuracy or precision. *See also* effective range.

turned joint A joint used in wooden and other pipes in which the inside of the bell (or enlarged end of one length of pipe) is turned or bored on a lathe to an accurate fit, the outside of the spigot (or end of the joining length of pipe) is also turned to a fit, and the two lengths of pipe are driven together by a wooden ram or other tool. The contacting surfaces may be painted or greased, and a small amount of cementing material added to the outside. A turned joint is also called a turned-and-bored joint.

turnkey automation A term that refers to a system or software package that is complete and needs no other components to perform its intended function. Turnkey means that a product is ready to use with minimal set-up.

turnkey construction A construction process in which the owner contracts with an outside consultant who is given the responsibility to design, construct, and start up a facility. Upon completion, the project is turned over to the owner for operations and maintenance.

turnkey system (1) A system for which components from various vendors are assembled by an integrator who installs the system and provides necessary data and applications to perform a set of functions. The integrator generally assumes responsibility for the performance of all individual components of the system. (2) A system that is immediately operational upon installation.

turn-on (or turn-off) charges Fees assessed by a utility for activating (or deactivating) water service to a customer. Emergency turnoffs normally are exempted from such charges.

turnover *See* overturn.

TVS *See* total volatile solids.

TWA *See* time-weighted average.

TWA concentration *See* time-weighted average concentration.

TWCM *See* total water cycle management.

twin dosing tanks Two dosing tanks of equal capacity, each equipped with a dosing device so that they may be used alternately. *See also* dosing tank.

two-bed A pairing of cation- and anion-exchange tanks, typically operating in series. A two-bed is best used for the deionization of relatively high volumes of water and is capable of producing product water with resistivity of up to 1 megohm-centimeter.

two-film theory *See* film theory.

2,4-dichlorophenol *See under* dichlorophenol.

2,4-dichlorophenoxyacetic acid *See under* dichlorophenoxyacetic acid.

2,4-dinitrophenol *See under* dinitrophenol.

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2,4-dinitrotoluene *See under* dinitrotoluene.

2-methylisoborneol *See under* methylisoborneol.

2-methylphenol *See under* methylphenol.

2 out of 5 odor test *See* odor test, 2 out of 5.

2,6-dinitrotoluene *See under* dinitrotoluene.

two-tailed test A statistical procedure to determine whether the differences between two sets of data are significant. In a two-tailed test, differences in either direction (i.e., greater or smaller) are considered. *See also* one-tailed test; t-test.

2,3,7,8-tetrachlorodibenzo-*p*-dioxin *See under* tetrachlorodibenzo-*p*-dioxin.

2,2-dichloropropane *See under* dichloropropane.

TWS *See* transient water system.

TXAA *See* trihalogen-substituted acetic acid.

type A soil Cohesive soil with an unconfined, compressive strength of 1.5 tons per square foot (144 kilopascals) or greater. Examples of cohesive soils are clay, silty clay, sandy clay, clay loam, and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered type A. However, no soil is type A if any of the following apply: (1) the soil is fissured; (2) the soil is subject to vibration from heavy traffic, pile driving, or similar effects; (3) the soil has been previously disturbed; (4) the soil is part of a sloped, layered system where the layers dip into the excavation on a slope of 4 horizontal to 1 vertical or greater; or (5) the material is subject to other factors that would require it to be classified as a less stable material. *See also* soil and rock deposit classification.

type B soil (1) Cohesive soil with an unconfined compressive strength greater than 0.5 ton per square foot (48 kilopascals) but less than 1.5 tons per square foot (144 kilopascals). (2) Granular cohesionless soil, including angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and, in some cases, silty clay loam and sandy clay loam. (3) Previously disturbed soil, except those soils that would otherwise be classed as type C soil. (4) Soil that meets the unconfined compressive strength or cementation requirements for type A but is fissured or subject to vibration. (5) Dry rock that is not stable. (6) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than 4 horizontal to 1 vertical, but only if the material would otherwise be classified as type B. *See also* soil and rock deposit classification.

type C soil (1) Cohesive soil with an unconfined compressive strength of 0.5 ton per square foot (48 kilopascals) or less. (2) Granular soil, including gravel, sand, and loamy sand. (3) Submerged soil or soil from which water is freely seeping. (4) Submerged rock that is not stable. (5) Material in a sloped, layered system where the layers dip into the excavation or a slope of 4 horizontal to 1 vertical or steeper. *See also* soil and rock deposit classification.

type IV settling The settling of particles that are at such a high concentration that the particles touch each other and settling can occur only by the compression of the compacting mass. Such settling is also called compression settling.

type 1 anion-exchange resin Strong-base anion-exchange resin with positively charged trimethyl quaternary amine ($-RN^+(CH_3)$) functional groups on a polystyrene divinylbenzene matrix. *See also* anion exchange; strong base anion exchanger.

type I settling The settling of discrete, nonflocculent particles in a dilute suspension. The particles settle as separate units, and no apparent interaction occurs between particles. Such settling is also called free settling.

type III settling The settling of a suspension intermediate in concentration between type II and type IV. The particles are so close together that interparticle forces hinder the settling of neighboring particles. The particles remain in fixed positions relative to each other, and all settle at a constant velocity. As a result, the mass of particles settle as a zone. Such settling is also called zone settling or hindered settling.

type 2 anion-exchange resin Strong-base anion-exchange resin with positively charged dimethylethanol quaternary amine ($-RN^+(CH_3)_2C_2H_5OH$) functional groups on a polystyrene divinylbenzene matrix. *See also* anion exchange; strong base anion exchanger.

type II settling The settling of flocculent particles in a dilute suspension. The particles flocculate during settling; thus, they increase in size and settle at a faster velocity as time passes. Such settling is sometimes called flocculent settling.

typhoid fever A serious infectious disease caused by the bacterium *Salmonella typhi.* It was one of the most widespread and important of all bacterial diseases until the advent of adequate water treatment processes, including disinfection. The disease, although generally thought of as a gastrointestinal infection, is actually a generalized infection of the body, and symptoms may include frontal headache, lack of appetite, nosebleed, muscular weakness, and diarrhea. Death can occur if the illness is not diagnosed and treated aggressively. Typhoid fever is generally acquired through contaminated drinking water, and epidemics still persist, primarily in undeveloped and developing countries where drinking water treatment and wastewater treatment are inadequate and the level of sanitation in the general population remains at a low level. Typhoid fever is sometimes just called typhoid. *See also* waterborne disease.

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typhus A bacterial disease spread by lice or fleas caused by one of two types of bacteria: *Rickettsia typhi* or *Rickettsia prowazekii.* The form of typhus depends on which type of bacteria causes the infection. *Rickettsia typhi* causes murine or endemic typhus, which are rarely deadly, and *Rickettsia prowazekii* causes epidemic typhus, which can be deadly without treatment. It is not related to typhoid fever and is not transmitted through drinking water.

typologies of institutional structure Identification and classification of elements or units that characterize a governmental or private utility or company.

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U

UARL *See* unavoidable annual real losses.

UBA *See* utility business architecture.

UBT *See* upper bin technology.

uc *See* uniformity coefficient.

UCA™ *See* Utility Communications Architecture.

UCM *See* Unregulated Contaminant Monitoring program; Unregulated Contaminant Monitoring Rounds 1 and 2.

UCMR 1 *See* Unregulated Contaminant Monitoring Rule 1.

UCMR 2 *See* Unregulated Contaminant Monitoring Rule 2.

UDA *See* utility data architecture.

UEL *See* upper explosion limit.

UF *See* ultrafiltration; uncertainty factor.

UFC *See* uniform formation conditions.

UFRV *See* unit filter run volume.

UFW *See* unaccounted-for water.

UIC Program *See* Underground Injection Control Program.

ultimate burst pressure *See* ultimate pressure.

ultimate disposal The final release of biologically and chemically stable residuals into the environment.

ultimate pressure The most extreme pressure a pipe can resist for a short time before failing. It is also referred to as ultimate burst pressure.

ultimate standard water demand A schedule of the requirements of water—in terms of both quantity and time of need—for a particular purpose and, in some cases, for a particular locality. The purpose may be irrigation of various specified crops, municipal or domestic water supply, plant transpiration, or power.

ultracentrifugation Centrifugation at speeds creating forces that will sediment macromolecules, such as proteins and viruses, thus allowing them to be separated from the fluid that contains them.

ultrafiltration (UF) A pressure-driven membrane process that separates submicron particles (down to a 0.01-micrometer size or less) and dissolved solutes (down to a molecular weight cutoff of approximately 1,000 daltons) from a feed stream by using a sieving mechanism that is dependent on the pore size rating of the membrane. *See also* molecular weight cutoff.

ultra-low-flush toilet A water-conserving or low-water-use fixture for elimination of human waste matter. It uses about 1.5 gallons (6 liters) per flush. Some models improve performance by using compressed air to assist in flushing the waste.

ultrapure water High-purity water that has extremely low organic and inorganic content and a resistivity of approximately 18 megohms. Ultrapure water is commonly used for industrial applications, e.g., as semiconductor rinse water. *See also* 18-megohm water.

ultrasonically catalyzed oxidation *See* sonolysis.

ultrasonic flowmeter A device that measures the flow rate of a fluid in a channel or pipe by transmitting and receiving sound waves that cross diagonally through the flow path. The length of time required for the wave to cross the flow is proportional to the flow velocity. This velocity, together with the cross-sectional area, can be used to calculate a flow rate.

ultrasonic nebulizer A device used in such atomic spectrometry techniques as inductively coupled plasma spectroscopy. Ultrasonic nebulizers are sample introduction devices that produce aerosol particles more efficiently than conventional nebulizers, resulting in improved sensitivity in, e.g., inductively coupled plasma analyses.

ultrasound Sound waves produced by electrical devices having a frequency between 20 to 100 kilohertz.

ultraviolet (UV) *See* ultraviolet irradiation.

ultraviolet (UV) absorber A substance that absorbs ultraviolet radiation. UV absorbers are added to plastic products (e.g., in plastic tanks and fittings) and rubber products to make them less likely to decay as a result of absorbing UV rays.

ultraviolet (UV) absorption Retention by a substance of incident ultraviolet radiation, followed by a compensatory change in the energy state of the substance's molecules. For example, the UV component of sunlight is absorbed as the light passes through glass and some organic compounds, with the radiant energy being transformed into thermal energy. Typical wavelengths range from 180 to 400 nanometers.

ultraviolet (UV) chamber An area where the water is irradiated with ultraviolet rays to disinfect the water or produce hydroxyl radicals (•OH). *See also* advanced oxidation process; germicidal ultraviolet; hydroxyl radical; ozone–biodegradation process; ozone–hydrogen peroxide process; ozone–ultraviolet light process; pulsed ultraviolet light–hydrogen peroxide process; sonolysis; ultraviolet light–hydrogen peroxide process; ultraviolet light disinfection.

ultraviolet (UV) demand The amount of ultraviolet irradiation required to inactivate certain microorganisms.

ultraviolet (UV) detector A device used in the analysis of both organic and inorganic compounds. An ultraviolet detector generates radiation (in the UV range) that interacts with certain types of compounds. The difference in radiation is detected and transformed into an

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electrical signal within an instrument. This signal, when calibrated, is related to particular compounds at a particular concentration. When used in water analyses, the device is often interfaced with an instrument such as a high-performance liquid chromatograph or ion chromatograph. *See also* high-performance liquid chromatography; ion chromatography.

ultraviolet (UV) dose The energy density (the total amount of energy applied per unit area) that is equal to the irradiance energy (power times exposure time) divided by the area irradiated. The units are joules per square meter (or millijoules per square centimeter). US customary units are not used. The ultraviolet dosage received by a waterborne microorganism in a reactor vessel accounts for the effect on UV intensity of the absorbance of the water, absorbance of the quartz sleeves, reflection and refraction of light from the water surface and reactor walls, and the germicidal effectiveness of the UV wavelengths. It is also called fluence.

ultraviolet (UV) dose-pacing A method to control the dose delivered by an ultraviolet reactor by altering the lamp intensity output and/or lamp status to vary the output of irradiance in the reactor, based on changes in operating conditions. Relationships among delivered dose and UV irradiance sensor values, flow rate, and UV absorbance must be determined during reactor validation if this method of operation is to be used.

ultraviolet (UV) dose–response The relationship indicating the level of inactivation of a microbe as a function of ultraviolet dose. Inactivation is often plotted as $\log_{10}(N_0/N)$ where N_0 is the number of microbes present prior to UV light exposure and N is the number of microbes present after UV light exposure.

ultraviolet (UV) extinction A process of eliminating or reducing ultraviolet radiation. The extinction (A) of ultraviolet irradiation can be determined by

$$A = \varepsilon bc$$

Where:

ε = the molar extinction coefficient

b = the path length of the absorption cell, in centimeters

c = the molar concentration of the ultraviolet-absorbing substance, in moles per liter

The value of the molar extinction coefficient is characteristic of the absorbing functional group [e.g., carbon–carbon double bond, carbonyl group (C=O)] in a molecule. *See also* ultraviolet absorption.

ultraviolet (UV) fluence rate *See* ultraviolet dose.

ultraviolet (UV) installation All of the components of the ultraviolet disinfection process, including, but not limited to, UV reactors, control systems, piping, valves, and building or enclosure.

ultraviolet (UV) intensity The power per unit area passing through an area perpendicular to the direction of propagation. Ultraviolet intensity describes the magnitude of UV light in a UV reactor and in bench-scale UV experiments.

ultraviolet (UV) intensity sensor A photosensitive detector used to measure the ultraviolet intensity at a point within the UV reactor.

ultraviolet (UV) irradiation Radiation in the region of the electromagnetic spectrum that includes wavelengths from 10 to 390 nanometers. *See also* radiation.

ultraviolet (UV) light Radiation having a wavelength shorter than 390 nanometers (the shortest wavelength of visible light) and longer than 10 nanometers (the longest wavelength of X-rays). This wavelength puts ultraviolet light at the invisible violet end of the light spectrum. UV light may be used as a disinfectant or to create hydroxyl radicals (•OH). *See also* advanced oxidation process; germicidal ultraviolet; hydroxyl radical; ozone–ultraviolet light process; pulsed ultraviolet light–hydrogen peroxide process; ultraviolet light–hydrogen peroxide process; ultraviolet light disinfection.

ultraviolet (UV) light disinfection A process for inactivating microorganisms by irradiating them with ultraviolet light. The UV waves disrupt the metabolic activities of the organisms, rendering them inactive and incapable of reproduction. The UV light does not leave a disinfectant residual, however, so a form of chlorine disinfection must be applied if a residual is desired. To allow the irradiation to reach the organisms effectively, the water to be disinfected must be relatively free of particles, as in a filtered water. *See also* germicidal ultraviolet.

ultraviolet (UV) light spectrophotometry An analytical technique of determining the electronic structure of a molecule through that molecule's absorption of energy in the ultraviolet region of the spectrum.

ultraviolet (UV) ray *See* ultraviolet irradiation.

ultraviolet (UV) reactor The vessel or chamber where exposure to ultraviolet light takes place, consisting of UV lamps, quartz sleeves, UV intensity sensors, quartz sleeve cleaning systems, and baffles or other hydraulic controls. The UV reactor also includes additional hardware for controlling UV dose, typically comprising, but not limited to, UV intensity sensors, UV transmittance monitors, ballasts, and control panels.

ultraviolet (UV) reactor validation A process by which an ultraviolet reactor's disinfection performance is determined relative to operating parameters that can be monitored. Reactors are validated to indicate that they achieve a certain delivered UV dose for a range of

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flow, UV intensity, and water quality conditions (e.g., UV transmittance). *See also* ultraviolet dose; ultraviolet transmittance.

ultraviolet absorbance (UVA) A measure of the amount of ultraviolet light that is absorbed by a substance (e.g., water, microbial deoxyribonucleic acid, lamp envelope, quartz sleeve) at a specific wavelength (e.g., 254 nanometers). This measurement accounts for absorption and scattering in the medium (e.g., water). Typically the absorbance is measured on a per centimeter basis in a 1-centimeter quartz cuvette. Standard Method 5910B details this measurement method. However, for UV disinfection applications, the sample should not be filtered or adjusted for pH as described in *Standard Methods for the Examination of Water and Wastewater.*

ultraviolet absorbance at 254 nanometers (UV-254 or UV_{254}) A measure of water's ultraviolet absorbance at a wavelength of 254 nanometers. This value is an indirect measure of compounds containing double bonds (including, but not limited to, aromatic compounds). Therefore, this measurement has been considered representative of the humic content of natural organic matter, as well as acting as a surrogate for disinfection by-product precursors. *See also* aromatic hydrocarbon; disinfection by-product precursor; humic material; natural organic matter; specific ultraviolet absorbance; ultraviolet irradiation.

ultraviolet light–hydrogen peroxide ($UV–H_2O_2$) process An advanced oxidation process used in water treatment in which hydrogen peroxide is irradiated with ultraviolet light to form hydroxyl radicals. Being strong oxidants, the hydroxyl radicals will oxidize the contaminants in the process stream, making this an advanced oxidation process. In the older literature, this process was sometimes called the hydrogen peroxide–visible–ultraviolet (H_2O_2/vis-UV) process in recognition of the possible role that the visible light emitted by the UV lamp might play in the creation of the hydroxyl radicals. *See also* advanced oxidation process; hydroxyl radical; ozone–biodegradation process; ozone–hydrogen peroxide process; ozone–ultraviolet light process; pulsed ultraviolet light–hydrogen peroxide process; sonolysis.

ultraviolet oxidation (UVOX) A process used to oxidize target compounds in water by irradiating them with ultraviolet light, either with or without the addition of hydrogen peroxide (H_2O_2). The UV light causes double bonds in organic compounds to vibrate, eventually liberating electrons and changing the molecular structure. When H_2O_2 is used, UV light irradiation results in the formation of hydroxyl radicals (•OH), which are very strong oxidizing agents. This is called an advanced oxidation process. *See also* advanced oxidation process; hydroxyl radical; ultraviolet light–hydrogen peroxide process.

ultraviolet-persulfate oxidation A method for organic carbon determination in which the carbon is oxidized to carbon dioxide by persulfate in the presence of ultraviolet light. The evolved carbon dioxide can be measured by various techniques.

ultraviolet transmittance (UVT) A measure of the fraction of incident light transmitted through the water column. UVT is the ratio of the light entering the water to that exiting the water and is usually reported for a path length of 1 centimeter. (If an alternate path length is used, it should be specified.) UVT is often represented as a percentage and is related to the UV absorbance by the following equation: $\%UVT = 100 \times 10^{-A}$. As the ultraviolet absorbance increases, UVT decreases.

ultraviolet–visible (ultraviolet–vis, or UV–vis) spectrophotometry A technique where wavelengths in the ultraviolet or visible range can be used to determine the absorbance of a sample. A sample can also be scanned over a wavelength range to determine the absorbance as a function of wavelength.

ultraviolet–visible (UV–vis) irradiation Radiant energy in both the ultraviolet and visible wavelengths.

Umezakia A cyanobacteria associated with toxic algal blooms. *Umezakia natans* is a cylindrospermopsin-producing species that can cause liver damage (hepatotoxin). It is most common in subtropical, tropical, and arid zone water bodies.

UMI *See* Utility Management Institute.

unaccounted-for water (UFW) *See* nonrevenue water.

unamortized credit A credit entirely accounted for in the current account period.

unamortized debit A debit entirely accounted for in the current account period.

unauthorized consumption Any water taken from the water distribution network without the authorization of the water utility. This may include (unpermitted) water withdrawn from fire hydrants, illegal connections, bypasses to customers' meters, meter or meter-reading equipment tampering, or similar actions. Unauthorized consumption is one of the primary components of apparent losses. *See* water audit; water balance.

unavoidable annual real losses (UARL) Real (leakage) losses in water utilities that cannot be totally eliminated. The estimated volume of UARL represents the lowest technically achievable annual real losses for a well-maintained and well-managed system. Equations for calculating UARL for individual systems were developed and tested by the International Water Association's Water Loss Task Force

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and published in 2000. The equations take into account measured frequencies, flow rates, durations of background losses, reported leaks, and unreported leaks, as well as the pressure/leakage relationship (assumed to be linear for most large networks). A straightforward equation was developed, given below:

UARL (gallons) = (5.41Lm + 0.15Nc + 7.5Lp) × P

Where:

Lm = length of water mains, miles
Nc = number of service connections
Lp = total length of private pipe, miles (miles = Nc × average distance from curbstop to customer meter)
P = average pressure in the system, psi

The ratio of current annual real losses (CARL) to the UARL is the infrastructure leakage index (ILI), which is a powerful leakage benchmarking performance indicator. *See also* current annual real losses; infrastructure leakage index.

unbilled sale The estimated amount due a utility for services rendered but not yet billed.

unbuffered Pertaining to a solution lacking the solutes that would resist a change in pH.

unbundling cost *See* rebundling cost.

uncertainty analysis *See* complete uncertainty analysis.

uncertainty factor (UF) A factor (or combination of factors) applied by the US Environmental Protection Agency in deriving a reference dose to account for differences in response to toxicity within the human population and between humans and animals. For example, quantitative data describing the dose–response relationships for toxic chemicals in humans are rare. Uncertainty factors are intended to compensate for such factors as intra- and interspecies variability, the small number of animals tested compared with the size of the exposed population, sensitive subpopulations, and possible synergistic effects. For instance, to avoid the possibility that humans are more sensitive than the species in which the toxicological data were obtained, the no-observed-adverse-effect level in animals is multiplied by 0.1 or some other value to provide an estimate that would be more protective of humans. *See also* no-observed-adverse-effect level; reference dose; toxicity.

unconfined aquifer An aquifer for which the upper boundary of flow is a water table. *See also* aquifer.

unconfined compressive strength The load, or stress, per unit area at which a soil will fail in compression. It can be determined by laboratory testing or estimated in the field by using a pocket penetrometer, thumb penetration tests, or other methods. Samples are typically taken from shallow boreholes or trial pits during the design of roads, airport runways, and light construction. An unconfined compression test should be performed at the site as soon as possible after extraction of the soil sample so that the soil moisture content does not change. *See also* thumb penetration.

unconfined groundwater The water in an aquifer where a water table exists.

unconformity spring A contact spring at the surface outcrop of the boundary between two different geologic formations, the upper one being water bearing and the lower one being impervious or less pervious.

unconsolidated formation A formation of sediment that is loosely arranged or unstratified (not in layers) or for which the particles are not cemented together (soft rock). Such a formation can occur either at the ground surface or at a depth below the surface. *See also* consolidated formation.

unconsolidated material Loosely arranged, uncemented material, such as soil or sand.

unconstrained demand The demand that would be experienced if not for natural replacement and conservation.

uncontrolled storage Water storage that is not controlled by gates or other control devices. An example is water above a spillway, which is not gated; hence, the water level elevation cannot be controlled.

underbed A layer of gravel or grout used to fill the bottom of a filter or softener tank, usually in a system with a manifold and lateral underdrain design. *Underbed* is not the same per se as the media support bed, which is a layer of granular material (e.g., gravel) used to support filtering media. *See also* filter underdrain.

undercut-slope bank A stream bank eroded by stream action.

underdrain *See* filter underdrain.

underflow (1) The filtered water collected after filtration. (2) The wash water distributed through the filter for backwash. (3) The solids collected at the bottom of a tank.

underflow conduit A permeable formation that underlies a surface stream channel, has a bottom and sides that are more or less definitely limited by formations of relatively low permeability, and contains groundwater that percolates downstream.

underflow flow That movement of water of a given density along or near the bottom of an impoundment or tank beneath water of a lesser density.

underground drainage Natural or artificial evacuation of waters beneath the surface of the earth. Underground drainage is also called internal drainage.

underground injection control Any means of regulating waste disposal by underground injection.

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Underground Injection Control (UIC) Program A regulatory program of the US Environmental Protection Agency established by the Safe Drinking Water Act. It is intended to protect underground sources of drinking water from contamination by injection of wastes.

underground runoff Water flowing toward stream channels after infiltration into the ground.

underground storage tank (UST) A tank situated underground and used for holding, e.g., industrial chemicals, gasoline, or other petroleum products.

underground utility (1) A subsurface system of pipes and conduits or a subsurface development for conveying water, wastewater, drainage, gas, power, or communications or for protecting electric wires or cables. (2) Any buried system.

underground water Water that occurs in the lithosphere. *See also* groundwater.

underground watercourse A known and defined subterranean channel that was created by natural conditions and contains flowing water. An underground watercourse is clearly distinct from an aquifer in that the flow moves in a channel, not through a porous medium. This type of channel is sometimes called an underground river.

underregistration A condition in which a meter records less water than is actually flowing through the meter.

undershot head gate A canal head gate at which the water passes from the river into the canal through gate openings that are formed, when the gates are raised, between the sill of the gate opening and the lower edge of the gate.

undershot wheel A waterwheel operated by the impact of flowing water against paddles or vanes on the periphery while the paddles or vanes are partly or wholly submerged in the moving stream of water.

underwriter An entity, generally an investment banking firm, that purchases bonds directly from an issuer and resells them to individual and institutional investors.

undeveloped landscape *See* unlandscaped natural area.

Unfunded Mandate Reform Act Public Law 104-4, which was enacted March 22, 1995, and is intended to end the imposition, in the absence of full consideration by the US Congress, of federal mandates on state, local, and tribal governments without adequate federal funding in a manner that would displace other essential state, local, and tribal government priorities, unless Congress deliberately chooses to impose the mandate.

unidirectional flushing A distribution system flushing method using closed valves and the opening of consecutive fire hydrants to create a single-direction water flow pattern, providing a sufficient velocity to cause a scouring action. This method provides an effective flushing action with less water than is used by randomly opening fire hydrants in a conventional method.

unified biofilm approach The study of biofilm formation processes using a single parameter, adenosine triphosphate, as a measure of active biomass to compare biofilm concentrations under different conditions. This facilitates the understanding and controlling of biofilm formation processes in water treatment and distribution systems.

uniform application interface The mid-level foundation in the Utility Communications Architecture that uses clients/service architecture and includes a standard set of services to access data, control devices, report events, and create data logs, among other tasks.

uniform communication infrastructure The lowest-level foundation, also known as protocol stacks, in the Utility Communications Architecture, which specifies standards at the physical and data link network and transport and application levels.

uniform corrosion Corrosion that results in an equal amount of material loss over an entire pipe surface.

uniform data model The highest-level foundation of Utility Communications Architecture technology where every device—pump, valve, flowmeter, etc.—is modeled with a representative data set containing all monitoring and control information about the device. *See also* uniform communication infrastructure.

uniform depth *See* normal depth.

uniform flow A type of flow for which the properties of flow do not change with respect to position. Laminar flow in a rectangular channel is uniform flow, whereas radial flow to a well is nonuniform.

uniform formation conditions (UFCs) Conditions found in a test protocol that is used to evaluate disinfection by-product formation in a distribution system and can be uniformly applied for any water. This protocol stands in contrast to the simulated distribution system test, which is based on site-specific conditions. The uniform formation conditions include an incubation time of 24 ± 1 hours, a temperature of 68° ± 1.8° Fahrenheit (20.0° ± 1.0° Celsius), a pH of 8.0 ± 0.2, and a 24-hour free chlorine residual of 1.0 ± 0.3 milligrams per liter. These values were based on typical (average) conditions used in US distribution systems. The conditions for determining disinfection by-product precursors (formation potential) are different. *See also* disinfection by-product; disinfection by-product precursor; formation potential; simulated distribution system test.

uniformity coefficient (uc) A measure of the distribution of particle sizes for a sediment or media, such

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as filter media. The coefficient may be calculated as follows:

$$uc = \frac{d_{60}}{d_{10}}$$

Where:

d_{60} = the grain size, in millimeters, for which 60 percent (by weight) of the sediment's grains are finer, as shown on the sediment's grain size distribution curve

d_{10} = the grain size, in millimeters, for which 10 percent (by weight) of the sediment's grains are finer, as shown on the sediment's grain size distribution curve

uniform particle size The particle size distribution screen sizing for ion exchanger and filtration media as established by US mesh standards.

uniform rate A utility pricing structure in which the price per unit is constant as consumption increases. This rate is also known as a flat fee or a uniform block rate. *See also* flat fee.

uniform volume charge A single charge per unit of volume for all water used. Because the amount customers pay is directly related to the volume of water consumed, uniform volume charges may contribute to water use efficiency (conservation).

uninterruptible power supply (UPS) A power supply (usually battery operated) that is used in the event of a commercial power failure. Most businesses isolate computers and other critical equipment by supplying power through the batteries at all times. Other businesses use motor-driven generators to supply power. The motors normally use commercial power, and if they fail they automatically switch over to a battery supply. These systems are extremely reliable and provide good clean power, free from the voltage fluctuations common to commercial power grids.

union (1) A device used to connect pipes. A union commonly consists of three pieces: the thread end, fitted with exterior and interior threads; the bottom end, fitted with interior threads and a small exterior shoulder; and the ring, which has an inside flange at one end while the other end has an inside thread like that on the exterior of the thread end. When a union is in use, a gasket is placed between the thread and bottom ends, which are drawn together by the ring. Gaskets are often supplanted by ground joints. Unions are used extensively because they permit connection with little disturbance of the pipe positions. (2) A number of people, societies, states, or the like associated or joined together for some common purpose, e.g., workers joined together in a labor or trade union.

unit A single thing, person, or other entity that is considered an elementary functional constituent of the whole. *See also* process train.

unit cancer risk An estimate of the lifetime risk caused by each unit of exposure in the low-exposure region.

unit cost The cost of a unit of product or service, for example, the cost of pumping 1 million gallons of water.

***United States Pharmacopeia* (USP)** The official authority for drug product standards, including water quality standards for pharmaceutical uses. The *United States Pharmacopeia* was established by the US Congress in 1884 to control makeup of drugs. *See also* pharmaceutical grade water.

unit filter run volume (UFRV) The volume of water that is processed through a filter in a single filter run between backwashes. The purpose of determining the unit filter run volume is to compare the throughput of a filter under different filtration rates. Although filter run times will decrease as filtration rate increases, the unit filter run volume may stay the same or increase because of the higher filtration rate. The unit filter run volume is expressed as volume/area/run (e.g., gallons/square feet/run).

unitgraph *See* unit hydrograph.

unit hydrograph The discharge-versus-time relationship at the outlet for a particular watershed that results from 1 inch (25.4 millimeters) of water (rainfall excess) uniformly applied over the entire watershed at a uniform rate during a specified period of time. A unit hydrograph is also called a unitgraph.

unit hydrograph method A procedure, originated by L.K. Sherman, for determining the rates of surface runoff in a drainage basin based on observations of rainfalls and the corresponding observed hydrographs of surface runoff from the same basin. This method is based on the concept that in a given drainage basin, surface runoff from rainfall occurring in a unit of time will produce hydrographs of approximately equal abscissa values and with ordinate values varying with the quantity of rainfall minus infiltration and other subtractions.

unit power The number of watts produced from a theoretical 1-meter-diameter waterwheel or turbine operating under a 1-meter head. US customary units are not used.

unit risk The risk associated with a particular dose or dose rate of an agent (i.e., chemical, microbe, or physical agent) or circumstance (e.g., risk per mile driven in an automobile or per mile flown in airplanes). In the former case, the units are usually exposed in terms of dose rate, such as milligrams per kilogram per unit body weight for a lifetime.

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unit speed The speed of a theoretical 1-meter-diameter waterwheel or turbine operating under a 1-meter head. US customary units are not used.

unit water use The quantity of water used at an industrial plant per unit of production. For example, it may be expressed in gallons (cubic meters) per pound (kilogram) or per unit of product.

univalent Having a valence of one. This term is equivalent to *monovalent.*

universal gravitational constant (*G*) *See in the Units of Measure section.*

universal soil loss equation A formula developed by the US Department of Agriculture for predicting rates of soil loss by sheet erosion:

$$A = (R)(K)(LS)(C)(P)$$

Where:

A = the average annual soil loss, in tons per acre
R = the rainfall factor
K = a soil erodibility factor
LS = a slope length and steepness factor
C = a cropping and management factor
P = the supporting conservation factor

For information on the details of these factors, contact the Natural Resources Conservation Service (formerly the Soil Conservation Service) of the US Department of Agriculture in a specific county or state.

Universal Transverse Mercator (UTM) A map projection and plane coordinate system based on 60 north and south trending zones, each 16° of longitude wide, that circle the globe. The Universal Transverse Mercator grid is commonly used in geographic information system technology in the United States. *See also* geographic information system.

UNIX® An operating system for computers, developed at the University of California at Berkeley and at AT&T Bell Laboratories. Originally developed for scientific applications on large processors, UNIX is widely used in computer network systems and is a multiuser, multitasking operating system.

unlandscaped natural area The portion of a development site where existing plant communities have not been removed or replaced.

unmetered rate A charge for water assessed monthly, bimonthly, quarterly, or annually based on the amount of land and size of structure rather than on the total amount of water delivered to the premises. This type of rate is also called a flat fee. *See also* flat fee.

unplanned reuse Unintentional water reuse; reuse without a system designed and constructed for reuse purposes—for example, a community's use of a river as a public drinking water supply source where a significant portion of the river flow stream is derived from treated wastewater discharges from upstream communities.

unreasonable risk to health (URTH) A contaminant concentration set by the US Environmental Protection Agency or the state primacy agency under the Safe Drinking Water Act (SDWA) at or beneath which the risk to human health is considered reasonable. A utility's drinking water may not exceed unreasonable-risk-to-health concentrations if the utility wishes to receive a variance or exemption under the SDWA.

unregulated contaminant A contaminant that the US Environmental Protection Agency requires water systems to monitor but for which the agency does not have a maximum contaminant level goal or maximum contaminant level. *See also* maximum contaminant level; maximum contaminant level goal.

Unregulated Contaminant Monitoring (UCM) program A program of the US Environmental Protection Agency (USEPA) mandated by the Safe Drinking Water Act (SDWA) that collects data for contaminants suspected to be present in drinking water but that do not have health-based standards. The program was established in 1988, and a number of activities have been part of the program. Every 5 years, USEPA must review the list of contaminants, largely based on the Contaminant Candidate List. The SDWA Amendments of 1996 created changes in the program, including the formation of the National Contaminant Occurrence Database (NCOD) to store all of the data and to reduce the monitoring requirement for small water systems. The UCM program includes UCM Rounds 1 and 2; Unregulated Contaminant Monitoring Rule 1 (UCMR 1); and Unregulated Contaminant Monitoring Rule (UCMR 2). *See also* Unregulated Contaminant Monitoring Rounds 1 and 2; Unregulated Contaminant Monitoring Rule 1; Unregulated Contaminant Monitoring Rule 2.

Unregulated Contaminant Monitoring (UCM) Rounds 1 and 2 Monitoring required of water systems by the US Environmental Protection Agency for contaminants in drinking water for which there were no health-based standards conducted from 1988 through 1997. State drinking water programs managed the UCM Round 1 that required public water systems serving more than 500 people to monitor for 62 contaminants. UCM Round 2 required public water system monitoring sample data for 48 unregulated contaminants. The UCM program was mandated by the Safe Drinking Water Act.

Unregulated Contaminant Monitoring Rule 1 (UCMR 1) Monitoring required of water systems by the US Environmental Protection Agency for contaminants in drinking water for which there were no health-based standards conducted from 2001 through

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2005. The Safe Drinking Water Act Amendments of 1996 redesigned the Unregulated Contaminant Monitoring program to incorporate a tiered monitoring approach. The rule required all large water systems and a nationally representative sample of small public water systems to monitor for 25 contaminants. UCMR 1 had Assessment Monitoring (List 1) and Screening Survey (List 2) components. Assessment Monitoring was conducted by large public water systems, and 800 representative small systems, for 12 List 1 contaminants using established analytical methods. Screening Survey (List 2) monitoring was conducted by a randomly selected set of 300 large and small water systems. There were 13 organic chemicals and one microorganism monitored for List 2 Screening Survey. List 2 contaminants required specialized analytical methods.

Unregulated Contaminant Monitoring Rule 2 (UCMR 2) Monitoring required of water systems by the US Environmental Protection Agency for contaminants in drinking water for which there were no health-based standards to be conducted by the end of 2010. UCMR 2 includes both Assessment and Screening Survey monitoring and a tiered approach to monitoring requirements. All large water systems and 800 representative small systems are required to monitor for 10 List 1 contaminants during a 12-month period between January 2008 and December 2010 using established analytical methods. For the Screening Survey, all large systems must monitor for 15 List 2 contaminants. List 2 contaminants required specialized analytical methods.

unreported leaks Hidden leaks that are found only by the water utility's active leakage control program. With passive or limited active leakage control, these leaks go undetected and run for long periods of time, causing mounting water losses. Effective active leakage control programs detect such leaks shortly after they arise, providing the opportunity for quick repairs that minimize the leak duration and amount of lost water. *See also* system leakage.

unsanitary Not sanitary; unhealthy; liable to promote disease; contrary to principles known to promote or safeguard health. *See also* insanitary.

unsaturated (1) In the context of a chemical compound, not having all available valence bonds along the alkyl chain satisfied. In such compounds, the extra bonds usually form double or triple bonds (chiefly with carbon). An unsaturated compound (e.g., ethylene, C_2H_4) has fewer hydrogen atoms than the corresponding saturated compound (e.g., ethane, C_2H_6). (2) *See* unsaturated zone. *See also* alkane; saturated; valence.

unsaturated zone The zone that is situated between the land surface and the water table and that contains, in the pore space, water at less than atmospheric pressure, as well as air.

unslaked lime *See* lime.

unstable (1) Readily decomposing or changing otherwise in chemical composition or biological activity. (2) Corrosive or scale-forming.

unsteady flow Flow that occurs when, at any point in the flow field, the magnitude or direction of the specific discharge changes with time. Nonequilibrium flow to a well or varying flow from a constant displacement pump is unsteady flow. Unsteady flow is also called transient flow or nonsteady flow.

unsteady nonuniform flow Flow in which the velocity and the quantity of water flowing per unit time at every point along the conduit vary with respect to time and position.

unwater To remove water from an excavation or from within a cofferdam so that work within the unwatered area can be conducted in dryness.

upflow A pattern of water flow in which a solution (usually water or regenerant) enters at the bottom of the vessel or column and flows out at the top of the vessel or column during any phase of a treatment unit's operating cycle. This term is used to describe ion-exchange system, filtration, or granular activated carbon adsorber flow patterns or water flow through filter media. An ion-exchange system can have upflow during the treatment cycle and downflow during regeneration. Upflow is also called countercurrent operation. *See also* countercurrent operation.

upflow clarifier A unit that combines flocculation and settling in a single tank. The flocculation portion of the tank is designed to provide the necessary mixing for good floc formation, while the sedimentation portion acts as a true upflow-type clarifier with the surface overflow rate controlling particle removal. A sludge or solids blanket may or may not be involved. *See also* sludge-blanket clarifier; solids-contact basin; upflow contact clarifier.

upflow coagulation Coagulation achieved by passing liquid, to which coagulating chemicals may have been added, upward through a blanket of settling sludge.

upflow contact clarifier A unit process in which both flocculation and particle separation occur. Coagulated water is passed upward through a solids blanket, allowing flocculation and particle separation to take place in a single step. The sludge blanket is typically 6 to 10 feet (2 to 3.5 meters) below the water surface, and clarified water is collected in launder troughs along the top of the unit. Solids are continually withdrawn from the sludge blanket to prevent

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undesired accumulation. *See also* launder trough; sludge-blanket clarifier; solids-contact basin; upflow clarifier.

upflow filter A gravity or pressure filtration system in which the water flows upward, generally first through a coarse medium and then through a fine medium, before discharging.

upflow floc blanket reactor *See* upflow contact clarifier.

upflow softening A pattern of water flow used in softeners whereby the water flows upward through the ion-exchange bed. The media are restricted in movement, usually because they are in the form of a packed bed. The regeneration brine usually flows downward in such systems.

upflow tank (1) *See* upflow contact clarifier. (2) A vertical-flow tank.

upgrade A modification of an existing system, procedure, or program to improve effectiveness.

upland (1) High land, especially at some distance from the ocean. (2) Ground elevated above the lowlands between hills or along rivers.

uplift The upward pressure against the base of an impervious dam, transmitted by water in the foundation from the water behind the dam; or pressure on the upper surface of any horizontal joint or crack in a dam. Such pressure tends to offset the weight of the dam and in some cases to overturn it; it reduces the dam's stability or resistance to overturning.

upper barrel *See* upper section.

upper bin technology (UBT) A water treatment process, defined by the US Environmental Protection Agency (USEPA) as providing advanced treatment for *Cryptosporidium* removal. A provision of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) established *Cryptosporidium* occurrence bins or action bins to characterize the *Cryptosporidium* occurrence of a given source water. Under the provisions of the LT2ESWTR, utilities were required to monitor their source water for *Cryptosporidium.* The arithmetic mean of 12 months of results is used to determine in which bin a utility is placed. The four action bins were defined by USEPA as follows:

Bin 1	< 0.075 oocyst/liter
Bin 2	0.075 to < 1.0 oocyst/liter
Bin 3	1.0 to < 3.0 oocyst/liter
Bin 4	≥ 3.0 oocyst/liter

Utilities in bin 3 or 4 must use at least 1-log credit over and above that provided by conventional treatment from one or more specific toolbox alternatives, referred to as upper bin technologies (UBT), which include ultraviolet irradiation, chlorine dioxide, ozone, in-bank filtration, membranes, slow sand filtration, and bag or cartridge filters.

upper-bound estimate An estimate of a value not likely to be lower than the true value. Such an estimate is often used in risk assessment.

upper distributor The piping arrangement inside and at the top of softeners and filters to distribute the incoming water more uniformly over the resin or filter media bed. In small domestic units, this distributor also distributes the brine for regeneration.

upper explosion limit (UEL) The maximum concentration of a substance in the air that will burn or detonate when ignited. The upper explosion limit is expressed as a percentage of vapor or gas in the atmosphere by volume.

upper section The upper part of the main hydrant assembly, including the outlet nozzles and outlet nozzle caps. The upper section is usually constructed of gray cast iron. The upper section is also known as the upper barrel, nozzle section, or head.

upper valve plate A portion of the main valve assembly of a standard compression hydrant that closes against the seat. *See also* seat.

upright The vertical part of a timber shoring system used for excavations. The upright braces the sheet piling that prevents cave-ins. *See also* timber shoring system.

UPS *See* uninterruptible power supply.

upstream In the opposite direction of a flow.

uptake The rate of reversible or irreversible buildup of a compound or element in an organism through inhalation, ingestion, absorption, or a combination of the three, with subsequent assimilation, utilization, clearance, or a combination of the three. *See also* clearance.

U pump A reciprocating piston pump in which the valves are placed in the piston and the flow through the cylinder is in one direction with no reversal.

upwelling An upward flow of water from a subsurface current.

uranium (U) A metallic element with three natural radioactive isotopes (i.e., U-234, U-235, and U-238). The US Environmental Protection Agency began regulating uranium in drinking water in November 2000, as stipulated in a court ruling on November 18, 1996. The maximum contaminant level was set at 0.03 milligrams per liter. *See also* isotope; radioactive.

Urban and Regional Information Systems Association (URISA) An international professional organization for geographic information system users. *See also* geographic information system.

urban runoff Surface drainage from streets, parking areas, and other developed areas of cities and towns.

urban-rural competition Political competition that frequently occurs between rural areas and urban centers,

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particularly with regard to federal funding, water rights, and water customers.

urea broth Culture media used to differentiate microorganisms. Hydrolysis of urea by urease releases ammonia. This causes a change in alkalinity and the color indicator (phenol red) will change from yellow to red. Urease-positive organisms produce a pink color; urease-negative organisms cause no change in the broth color.

URISA *See* Urban and Regional Information Systems Association.

URTH *See* unreasonable risk to health.

USACE *See* US Army Corps of Engineers.

US Agency for International Development (USAID) An agency within the US government's executive branch that administers US foreign economic and humanitarian assistance programs in the developing world. The agency functions under an administrator to conduct a worldwide network of programs in more than 100 countries.

USAID *See* US Agency for International Development.

US Army Corps of Engineers (COE, Corps, or USACE) The US Army command responsible for managing the Army's real property, performing the full cycle of real property activities (requirements, programming, acquisition, operations, maintenance, and disposal); managing and executing engineering, construction, and real estate programs for the Army and the US Air Force; and performing research and development in support of these programs. The USACE manages and executes civil works programs, including research and development, planning, design, construction, operations, and maintenance, as well as real estate activities related to rivers, harbors, and waterways; administers laws for the protection and preservation of navigable waters and related sources, such as wetlands; and assists in recovery from natural disasters.

USBR *See* US Bureau of Reclamation.

US Bureau of Reclamation (USBR) An agency within the US government's Department of the Interior, established in 1902, whose mission is to manage, develop, and protect water and related resources in an environmentally and economically sound manner. The agency oversaw the construction of many of the dams, power plants, and canals in 17 western states. It is the largest wholesaler of water in the United States. It also focuses on water conservation, water recycling, reuse, and desalting. The agency is responsible for the large-capacity Yuma Desalting Plant, which incorporates reverse osmosis technology to desalt agricultural return water near Yuma, Arizona.

USCM *See* US Conference of Mayors.

US Conference of Mayors (USCM) A nonprofit organization founded in 1932 and headquartered in Washington, D.C. Membership consists of cities with populations over 30,000, represented by their mayors. The US Conference of Mayors promotes improved municipal government by cooperation between cities and the federal government; provides educational information, technical assistance, and legislative services to cities; conducts research programs; and compiles statistics.

US customary units *See the Units of Measure section.*

US Department of Agriculture (USDA) An agency of the US government's executive branch responsible for improving and maintaining farm income and expanding markets abroad for agriculture products. It works to enhance the environment and maintain production capacity by helping landowners protect the soil, water forests, and other natural resources. It administers national programs for rural development, credit, conservation, and research, and it safeguards and ensures standards of quality in the daily food supply through inspection and grading services.

US Department of Commerce (DOC) An agency of the US government's executive branch responsible for encouraging, serving, and promoting US international trade, economic growth, and technological advancement. It administers programs to prevent unfair foreign trade competition; provides social and economic statistics and analyses for business and government planners; provides research and support for the increased use of scientific, engineering, and technological development; works to improve understanding and beneficial use of the earth's physical environment and oceanic resources; grants patents and registers trademarks; develops policies and conducts research on telecommunications; provides assistance to promote development; promotes travel to the United States by residents of foreign countries; and assists in the growth of minority businesses.

US Department of Energy (DOE) An agency of the US government's executive branch that is responsible for energy policy and nuclear safety. Its purview includes the nation's nuclear weapons program, nuclear reactor production for the US Navy, energy conservation, energy-related research, radioactive waste disposal, and domestic energy production, many of which are funded through its system of national laboratories.

US Department of Homeland Security (DHS) An agency of the US government's executive branch, formed by the Homeland Security Act of 2002 and intended to provide a unifying core for the vast national network of organizations and institutions involved in efforts to secure the United States. This department was created primarily from a conglomeration of

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existing federal agencies in response to the terrorist attacks of Sept. 11, 2001.

US Department of Interior (DOI) An agency of the US government's executive branch responsible for most nationally owned public lands and natural resources. It fosters the sound use of land and water resources; protects fish, wildlife, and biological diversity; preserves the environmental and cultural values of national parks and historic places; and assesses mineral resources and works to ensure that their development is in the best interest of all citizens by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for island territories under US administration.

US Department of Labor (DOL) An agency of the US government's executive branch that controls the following departments: Occupational Health and Safety Administration, the National Institute for Occupational Safety and Health, the Bureau of Labor Statistics, the Mine Safety and Health Administration, the Pension and Welfare Benefits Administration, the Veterans' Employment and Training Service, and the Employment Standards Administration.

US Department of Transportation (DOT, also USDOT) The department of the US government responsible for railroads, motor carriers, hazardous materials, and vehicle and highway safety.

US Department of Veterans Affairs (VA) A US government agency dedicated to providing services to veterans of military service.

USDOT *See* US Department of Transportation.

useful life The amount of time during which conduits, equipment motors, and so on can perform their assigned functions.

useful storage Water storage that is readily available for discharge into a distribution system, such as water in an elevated storage tank or in a ground storage tank that can be pumped into the system. Water in a ground storage tank below the suction level of the pump would be storage but not useful storage.

US Environmental Protection Agency (USEPA) An independent agency of the executive branch of the US government, created Dec. 2, 1970, to permit coordinated and effective government action on behalf of the environment. It administers the implementation of environmental laws to abate and control pollution systematically through monitoring, standard setting, enforcement, and research activities. *See also* regional office.

US Environmental Protection Agency consensus method for microscopic particulate analysis A consensus methodology of the microscopic particulate analysis (MPA) that was developed for the purpose of identifying those drinking water supplies that are under the direct influence of surface water and published by the US Environmental Protection Agency (USEPA) in 1992 as part of the guidance developed for the Surface Water Treatment Rule (SWTR). The methodology describes sample collection, equipment and supplies needed, sample processing, analyst qualifications, and interpretive analysis. A table was included in this consensus method that assigned risks of a groundwater being under the influence of surface water according to the number of certain bio-indicators identified by the MPA. Once this determination was made, those groundwaters directly influenced by surface water were required to comply with the requirements as set forth in the USEPA SWTR. *See also* microscopic particulate analysis.

US Environmental Protection Agency cost curve A method developed by the US Environmental Protection Agency to estimate capital and operational costs of water treatment facilities. The original programming was completed in the 1970s and 1980s, however, the methodology used to develop the curves is still valid and often used.

US Environmental Protection Agency water treatment plant (WTP) model A computer model used by the US Environmental Protection Agency in developing the Disinfectants and Disinfection By-Products Rule. The empirically based model simulates disinfection by-product formation, removal of natural organic matter, inorganic water quality changes, and disinfectant decay in water treatment processes. This model is part of the Disinfection By-Product regulatory assessment model. *See also* disinfectant; Disinfectants and Disinfection By-Products Rule; disinfection by-product; disinfection by-product regulatory assessment model; natural organic matter.

USEPA *See* US Environmental Protection Agency.

USEPA WTP model *See* US Environmental Protection Agency water treatment plant model.

user The product water consumer. Users are also called customers.

user charge A fee paid by a utility customer for a specific service, such as a laboratory fee for a test run, a tap fee, or a meter charge. *See also* rate making; rate structure analysis.

user fee The periodic (monthly, bimonthly, quarterly, or other) charges made to the user of water service through the water utility's rate structure. *See also* water bill.

US Fish and Wildlife Service (USFWS) A bureau within the US Department of the Interior that is responsible for migratory birds, endangered species, certain marine mammals, inland sport fisheries, and specific fishery and wildlife research activities. Its

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mission is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the people of the United States.

USFWS *See* US Fish and Wildlife Service.

USGBC *See* US Green Building Council.

USGCRP *See* US Global Change Research Program.

US Geological Survey (USGS) The federal agency within the Department of the Interior with the responsibility to provide information and understanding of the natural resources and the landscape of the United States and the natural hazards that affect them.

US Global Change Research Program (USGCRP) A research program focused on the interactions of natural and human-induced changes in the global environment and their implications for society. The USGCRP began as a presidential initiative in 1989 and was codified by Congress in the global Change Research Act of 1990 (Public Law 101-606), which mandated development of a coordinated interagency research program.

US Government Accountability Office (GAO) The investigative arm of the US Congress established by the Budget and Accounting Act of 1921 (31 USC 702). It is charged with examining all matters relating to the receipt and disbursement of public funds. GAO independently audits government agencies. It is under the control and direction of the comptroller general of the United States, who is appointed by the president of the United States with the advice and consent of the Senate for a term of 15 years.

US Green Building Council (USGBC) A coalition of representatives from every sector of the building industry that promotes environmentally responsible, profitable, and healthy buildings. More than 6,000 member organizations work together to develop a variety of programs and services and to forge strategic alliances with key industry and research organizations, as well as federal, state, and local government agencies. *See also* green building.

USGS *See* US Geological Survey.

USP *See United States Pharmacopeia.*

USP grade water *See* pharmaceutical grade water.

USPHS *See* US Public Health Service.

US Public Health Service (USPHS) An agency within the US Department of Health and Human Services responsible for promoting the protection and advancement of the nation's physical and mental health by coordinating with the states to set and implement national health policy and pursue effective intergovernmental relations; generating and upholding cooperative international health-related agreements, policies, and programs; conducting medical and biomedical research; sponsoring and administering programs for the development of health resources and the prevention and control of diseases and alcohol and drug abuse; providing resources and expertise to the states and other public and private institutions in the planning, direction, and delivery of physical and mental health care services; and enforcing laws to ensure the safety and efficacy of drugs and to protect against impure and unsafe foods, cosmetics, medical devices, and radiation-producing projects.

UST *See* underground storage tank.

utility An organization—either created by a state or other government agency through legislative action or owned by an individual, partnership, or corporation—with the primary purpose of providing a designated area with, e.g., potable water, gas, electricity, or wastewater service at reasonable costs so that the people of the area can improve their health, safety, and welfare. *See also* water utility.

utility belt A leather or nylon belt with pouches, pockets, and loops to hold tools and parts.

utility business architecture (UBA) A framework that enables standardization of communication protocols among a utility's technical and business functions, allowing full exchange of data. It electronically links treatment and distribution, administration, customers, vendors, and even other utilities to permit them to share information.

Utility Communications Architecture (UCA™) Standards for data communications for the utility industry (developed by the Electric Power Research Institute) based on three foundations: (1) a uniform data model (called device object models); (2) a uniform application interface (uses client/server architecture) that includes a standard set of service to access data, control devices, and report events; and (3) a uniform communications infrastructure or protocol stacks that specify standards at the physical and data link, network and transport, and application levels.

utility data architecture (UDA) A framework that enables standardization of the data among a utility's internal and external technical and business functions. UDA has been deferred in favor of the utility business architecture. *See* utility business architecture.

utility line Any underground or overhead transmission line, pipe, cable, or wire for the conveyance of public or private water, wastewater, or natural gas or the transmission of electrical, radio, or telecommunications service.

Utility Management Institute (UMI) A program developed by North American Development Bank to enable utility management to enhance managerial, leadership, and financial skills with instruction by utility professionals and private sector consultants and that includes interactive exercises and experience sharing. *See also* North American Development Bank.

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utility method A method of accounting used by most investor-owned and regulated utilities for rate-making analysis (as opposed to the cash requirements method). The major features of this method are the use of accrual accounting, the inclusion of depreciation in operating expenses, and the inclusion of a return on investment as part of the net revenue requirement that must to be recovered from water rates. *See also* cash requirements method; net revenue requirement; rate of return; return on investment.

utility oven A laboratory oven used primarily to dry labware and chemicals prior to weighing or to sterilize labware.

utilization factor (1) The ratio, usually expressed decimally, of the water flowing in a stream that is used for power development to the quantity that is available for use. The latter quantity is limited by the flow as indicated by the flow-duration curve and also, at higher stages, by the capacity of the waterwheels. (2) The factor representing the ratio of net power to gross power in a power-generating scheme.

UTM *See* Universal Transverse Mercator.

U-tube contactor An ozone contactor designed in a vertical, U-tube configuration. Detention time is provided by the volume available in the U-tube. This type of contactor reduces surface area requirements and allows higher concentrations of ozone to remain in solution as a result of the pressure created by the vertical column of water.

U-tube manometer A device for measuring gauge pressure or differential pressure by means of a U-shaped transparent tube partly filled with a liquid of known specific gravity, often water. A pressure slightly greater or less than atmospheric may be measured by connecting one leg of the "U" to the pressurized space and observing the height of liquid while the other leg is open to the atmosphere. Similarly, a small differential pressure may be measured by connecting both legs to separate pressurized locations (e.g., high- and low-pressure regions across an orifice or Venturi). The liquid rises in one leg and drops in the other; the difference between the levels in the two legs is proportional to the difference in pressures.

UV (ultraviolet) *See under* ultraviolet irradiation.

UV-254, UV_{254}
See ultraviolet absorbance at 254 nanometers.

UVA *See* ultraviolet absorbance.

UVA-254, UVA_{254}
See ultraviolet absorbance at 254 nanometers.

UV absorbance *See* ultraviolet absorbance.

UV absorber *See* ultraviolet absorber.

UV chamber *See* ultraviolet chamber.

UV demand *See* ultraviolet demand.

UV dose *See* ultraviolet dose.

UV extinction *See* ultraviolet extinction.

UV–H_2O_2 *See* ultraviolet light–hydrogen peroxide process.

UV–H_2O_2 process *See* ultraviolet light–hydrogen peroxide process.

UV irradiation *See* ultraviolet irradiation.

UV light *See* ultraviolet light.

UV light disinfection *See* ultraviolet light disinfection.

UV light spectroscopy
See ultraviolet light spectrophotometry.

UVOX *See* ultraviolet oxidation.

UVT *See* ultraviolet transmittance.

UV–vis irradiation *See* ultraviolet–visible irradiation.

UV–vis spectrophotometry *See* ultraviolet–visible spectrophotometry.

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V

V *See* apparent volume of distribution.

V *See* volt *in the Units of Measure section.*

VA *See* volt-ampere *in the Units of Measure section;* vulnerability assessment.

VA (Veterans Administration) *See* US Department of Veterans Affairs.

vaccine A preparation of virus used to immunize a host. The virus may be live-attenuated, mutant, or inactivated.

vaccine-strain A type of virus from a specific source, maintained in successive cultures.

vacuole A small cavity in the protoplasm of a cell.

vacuum A space in which the pressure is far less than normal atmospheric pressure so that the remaining gases do not affect processes being carried on in the space. In a water system, a vacuum is created when water is discharged from a low point in a closed system without a point for air to enter the system. Such a vacuum can result in backflow from connections to the system.

vacuum breaker A mechanical device that prevents backflow due to a siphoning action created by a partial vacuum. A vacuum breaker allows air into the piping system, breaking the vacuum.

vacuum deaeration The use of special equipment operating under a vacuum to remove dissolved gases from liquid.

vacuum decay test *See* vacuum hold test.

vacuum-driven membrane system Low-pressure membrane systems, such as some types of microfiltration and ultrafiltration systems, in which hollow-fiber membranes are immersed/submerged in a nonpressurized feed/process tank. Filtered water is collected in the center lumen of the fibers and the transmembrane pressure is created by the head in the feed/process tank and the suction created by a filtrate or permeate pump or gravity siphon on the filtered water side of the membrane barrier. *See also* hollow fiber; lumen; microfiltration, ultrafiltration.

vacuum filter A device used to remove water from sludge by applying suction through a filter fabric. A partially submerged, horizontal cylindrical drum covered by a fine filter fabric rotates continuously through an open container filled with sludge. A partial vacuum is applied to the filter fabric, thus drawing solids to the surface of the filter fabric and allowing water (i.e., filtrate) to pass through the fabric. The filtrate is discharged or recycled for further treatment, and the solids are scraped from the fabric in the nonsubmerged zone for ultimate disposal. *See also* filter press.

vacuum filtration Filtration by means of a vacuum filter. This is one of the oldest mechanical dewatering techniques in continuous use. In municipal softening, this process is used to separate water from lime sludge for sludge disposal. *See also* vacuum filter.

vacuum freezing A form of desalination using a vacuum to help cool and fast-freeze source water having a high total dissolved solids content. This process separates the solids by concentrating them in the portion of the water that does not freeze or that freezes last, in a manner similar to what occurs in the cloudy centers of ice cubes.

vacuum hold test A membrane integrity test in which a vacuum is applied to the membrane product and monitored for pressure changes over a period of time. No vacuum change, or a very slow rate of vacuum decay with acceptable criteria, indicates integrity. It is typically used for spiral-wound reverse osmosis and nanofiltration membrane elements by applying a vacuum to the element's permeate carrier tube. *See also* integrity breaches; integrity testing; membrane; membrane integrity; nanofiltration; reverse osmosis.

vacuum pan An airtight container used to produce granulated water softener salt by a process involving the evaporation, in a partial vacuum, of brine turned to steam.

vacuum pump A pump used to provide a partial vacuum needed for such filtering operations as the membrane filter test.

vacuum relief valve A valve that admits air to relieve vacuum conditions and that permits accumulated air to escape. Such a valve is also called an air-and-vacuum valve or a vacuum valve.

vacuum valve *See* vacuum relief valve.

vadose Pertaining to liquids in the earth's crust down to the groundwater level.

vadose water All suspended water in the aeration zone, including water in the capillary fringe at the bottom, soil water at the top, and intermediate waters.

vadose-water discharge Discharge of soil water not derived from the zone of saturation.

vadose zone The unsaturated portion of the soil column between the land surface and the water table. A better term is *unsaturated zone. See also* unsaturated zone.

valence An integer representing (1) the number of hydrogen atoms with which one atom of an element (or one radical) can combine (in which case the valence

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is negative) or (2) the number of hydrogen atoms the atom or radical can displace (in which case the valence is positive). For example, calcium has a valence of +2 and chloride has a valence of –1.

validation (1) In water treatment, a determination upon testing that a representative sample of water treated by a particular equipment model has met the requirements of a specified standard. (2) In modeling, the process of testing a mathematical equation used in a model with an independent data set (i.e., with data that were not used in developing the equation). *See also* certification.

validation study The demonstration of the performance of an analytical method before it is used. Items included are accuracy and precision for analytes of interest, analyte detection limits, and calibration linearity (the concentration range over which detector response is linear). Ideally, several laboratories would perform a validation study in order to be able to more realistically assess method performance.

valley fill The sedimentary deposits laid down in a valley after the time of its formation.

valley spring A spring occurring on the side of a valley at the outcrop of the water table.

valley storage (1) The volume of water below the water surface profile. (2) The natural storage capacity or volume occupied by a stream in flood after that stream has overflowed its banks. This storage includes the quantity of water within the main channel (channel storage) and that which has overflowed its banks (lateral storage).

valley train Outwashed material laid down by a stream flowing from a glacier.

value The magnitude of a measurement; e.g., the pH of a water sample has a certain value, such as 6.5.

value engineering A process by which an engineering design is subjected to intense peer review by a designated group of experts in the field with the purpose of challenging design concepts and assumptions. The results are then reviewed by the design team. Costs are developed for alternative concepts and are compared with the initial design, thereby potentially reducing the overall cost of the project.

valve A mechanical device installed in a water distribution system or treatment plant to close off or regulate the flow of water in the system. *See also* ball valve; butterfly valve; check valve; cone valve; corporation cock; curb stop and box; gate valve; pet cock.

valve-and-hydrant map A mapped record that pinpoints the location of valves throughout the distribution system. It is generally a plat-and-list or intersection map. *See also* intersection map method; plat-and-list map method.

valve box A housing that encloses the operating nut of a gate valve and extends to the ground surface, allowing an access opening for an operating or valve key to be inserted and connected to the operating nut so that the valve may be opened and closed. It is also called a buffalo box.

valve exercising The routine and scheduled closing and opening of valves on a specific time period such as once a year or every six months.

valve-exercising program The periodic and scheduled inspection and operation of valves in a water distribution system to maintain the valves in working condition for use in an emergency.

valve key A metal wrench with a socket to fit a valve nut and with a long handle for operating a gate valve from a distance of several feet.

valve map *See* valve-and-hydrant map.

valve seat The port against or into which a disc or tapered stem is pressed or inserted to shut down flow.

valve stem The rod by means of which a valve is opened or closed. The rod lifts and pushes down the gate.

valve tower A hollow cast-iron or masonry tower built within a reservoir and equipped with drawoff pipes at different levels for withdrawing water for supply purposes.

valve vault A concrete structure with an access opening that completely houses a valve, allowing access to the valve for maintenance, inspection, and operation. The structure is usually constructed just beneath ground or street level, with a round or rectangular frame and lid for entry into the vault.

valving The designated arrangement of irrigation circuits and the corresponding remote-control valves.

vanadium (V) A metallic element with various industrial uses, including in the manufacture of alloy steels.

van der Waals forces Weak attractive forces acting between molecules. These attractive forces between colloidal particles allow the coagulation process to take place.

van Dorn sampler A suspended sediment point sampler used to collect samples at a water depth of 6.5 feet (2 meters) or greater. The long axis of the sampling cylinder can be either horizontal or vertical as the cylinder is lowered.

vane shear A device used in determining a soil's unconfined compressive strength. Two cross blades attached to a vertical rod are forced into the soil and turned like a valve wrench. A torque reading is taken from the indicator once the soil fails. A second test indicates the soil's remolded strength.

van 't Hoff equation An equation developed by Jacobus Henricus van 't Hoff to express the relationship

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between chemical equilibrium constant (K) and temperature (T) that is typically described as

$$\ln\left(\frac{K_2}{K_1}\right) = -\frac{\Delta H^\circ}{R}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]$$

Where:

K_1 = equilibrium constant at absolute T_1
K_2 = equilibrium constant at absolute T_2
T_1 and T_2 = temperature
ΔH° = standard enthalpy change
R = gas constant

vapor (1) The gaseous form of any substance for which the usual form is a liquid or a solid. (2) Visible particles of moisture suspended in air, such as mist or fog. *See also* evaporation.

vapor blanket The layer of air that overlies a body of water and that, because of its proximity to the water, has a higher content of water vapor than the surrounding atmosphere.

vapor compression (VC) *See* vapor compression distillation.

vapor compression (VC) distillation A desalting process in which heated saline water is introduced as a fine spray on the outside walls of heated tubes in a chamber for which the pressure is lower than required for vaporization, causing some of the water to vaporize. The tubes are heated by the compression of the vapor collected from the chamber and subsequent condensation of distillate (product water) inside the tubes from compressor discharge. Typically the vapor is compressed by using a mechanically driven compressor or a steam jet thermocompressor. Units of one to four stages are common.

vapor density The relative weight of a gas or vapor as compared with some specific standard, such as air.

vaporimeter An instrument for measuring the volume or pressure of a vapor.

vaporization The process by which a substance (e.g., water) changes from the liquid or solid state to the gaseous state.

vapor pressure The pressure at which a substance is in a state of balance between its liquid and solid states.

vapor-pressure deficit The difference between actual vapor pressure and the vapor pressure of a saturated atmosphere, for given conditions of temperature and pressure.

vapor recompression evaporator An energy-saving evaporation device in which the vapor evaporated is compressed mechanically or mixed with high-pressure live steam. Increasing the vapor pressure increases the temperature of the compressed vapor. This compressed vapor can then be used as a heat source. This type of evaporator is commonly used in seawater desalination by distillation. *See also* desalting; distillation.

VAR *See* volt-ampere-reactive *in the Units of Measure section.*

variability Variation that occurs within the elements or members of a data set or population and is usually irreducible through further measurement. The variability of a factor (e.g., variation of drinking water intake among different people) cannot be accurately characterized by a single value, but must be described by one or more measures derived from relevant data (e.g., average, median, percentiles, geometric mean) as well as by the degree of variation (e.g., variance, geometric standard deviation, absolute deviation, dispersion, skewness).

variable Any characteristic, attribute, event, or mathematical term, that can have different values and for which measurements (quantitative or otherwise) are made in an epidemiologic study or other type of study or experiment.

variable, dependent *See* dependent variable.

variable, independent *See* independent variable.

variable, measured *See* measured variable.

variable, process *See* process variable.

variable charge The portion of a water bill that varies with water use; also known as a commodity charge.

variable costs Those costs of production that vary directly with production. In the water industry, expenses for energy and chemicals are variable costs. Variable costs contrast with fixed costs, which do not change with the volume of product produced. *See also* breakeven analysis.

variable-displacement pump A pump for which the discharge is inversely proportional to the total head delivered by the pump. For example, a centrifugal pump is a variable-displacement pump.

variable frequency Relating to a type of telemetry signal in which the frequency of the signal varies as the parameter being monitored varies.

variable-frequency drive (VFD) A motor speed controller that uses adjustment of the applied power frequency to affect motor speed control. This type of controller is used with induction motors.

variable number of tandem repeats (VNTRs) *See* microsatellite polymorphisms.

variable-speed drive (VSD) *See* variable-frequency drive.

variable-speed pump A pump that can be operated at a variable speed to change the flow rate delivered in the process. Variable-speed pumps are driven by motors that can draw variable current, thereby modulating the speed and changing the flow rate. Variable-speed pumps are often used to reduce pump cycling

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(i.e., on–off operation) and to allow continuous operation of downstream processes.

variable spring A spring for which the difference between the maximum and minimum discharge is greater than the value of the average discharge.

variance (1) A temporary relief from compliance with a maximum contaminant level that may be granted to a public water system by a state primacy agency under the Safe Drinking Water Act. A variance may be granted only if (a) the system cannot meet the maximum contaminant level in spite of the application of best available technology, treatment techniques, or other means (taking costs into consideration) because of the characteristics of the source water, and (b) the variance will not result in an unreasonable risk to health. A system may also be granted a variance from a specified treatment technique if it can show that, because of the nature of the source water, such treatment is not necessary to protect public health. (2) In statistics, a measure of the variation in a group of observations or a data set. The variance is (a) the sum of the squares of deviations from the mean divided by the number of degrees of freedom or (b) the standard deviation squared. *See also* exemption; standard deviation; unreasonable risk to health; variability.

variance criteria US Environmental Protection Agency and primacy agency criteria that must be met in order for a water system to apply for variance from a National Primary Drinking Water Regulation.

varied flow A type of flow occurring in a stream or conduit having a variable cross section or slope. When the discharge is constant, the velocity changes with each change of cross section and slope.

variola The causative agent of smallpox, a contagious disease characterized by purulent skin eruptions. The virus is a member of the genus *Orthopoxvirus*, subfamily Chordopoxvirinae of the family Poxviridae. There are two clinical forms of smallpox. Variola major is the cause of the severe and most frequent form of smallpox, with a more extensive rash and higher fever, and has an overall fatality rate of about 30 percent. Variola minor is the cause of a less common form of smallpox, and a much less severe disease, with death rates of 1 percent or less. Smallpox is now eradicated after a successful worldwide vaccination program. The last case of smallpox in the United States was in 1949, and the last naturally occurring case in the world was in Somalia in 1977. Variola virus is relatively stable in the natural environment. If aerosolized, it retains its infectivity for at least several hours if not exposed to sunlight or ultraviolet light.

varve A distinct band that represents the annual deposit of sedimentary materials, regardless of origin. This band usually consists of two layers: (1) a thin, dark-colored layer of clay laid down in the fall and winter and (2) a thick, light-colored layer of silt and fine sand laid down in the spring and summer.

vascular system A well-developed system of conducting tissue in plants to transport water, mineral salts, and foods. *See also* cardiovascular system.

vasculature The arrangement of blood vessels in the body or in an organ or part of the body.

vault (1) An arched structure, usually made of bricks, concrete, or stones, framing a ceiling or roof over a hall, room, or other wholly or partially enclosed construction. (2) An underground chamber used by a utility in its distribution system to house pumps, meters, and so on.

VC distillation *See* vapor compression distillation.

V. cholerae *See Vibrio cholerae.*

vector (1) A quantity having both magnitude and direction. (2) An organism that serves to transmit disease from one source to another. *See also* vector data.

vector-borne transmission Transmission of an infectious agent to a human by an insect or animal that carries the agent. The agent may or may not multiply in the vector. *See also* fecal–oral transmission; transmission of infection.

vector data Data composed of *x*–*y* coordinates. In a geographic information system, these coordinates represent locations on the earth. These data take the form of single points when graphically displayed. Vector data can define polygons, objects, and other complex entities that can be manipulated or displayed on the basis of their attributes. *See also* geographic information system.

vector sum The algebraic sum of two or more vector quantities (i.e., quantities having both magnitude and direction).

vegetal discharge As applied to groundwater, the discharge of water through the physiologic functioning of plants. The water may be taken into roots of plants directly from the saturation zone or from the capillary fringe, which in turn is supplied from the saturation zone. The water is discharged from the plants by transpiration.

vegetation The sum total of macrophytes that occupy a given area.

vegetation tank A soil-filled tank used for measuring evaporation and evapotranspiration. Such a tank is also called a soil tank. *See also* lysimeter.

vegetative control Nonpoint-source pollution control practices that involve plants (vegetative cover) to reduce erosion and minimize the loss of pollutants.

vehicle-borne transmission Transmission of infectious or other etiologic agents to a human host through contaminated materials, such as water, food,

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diapers, or bedding, in which the agent may or may not have multiplied. *See also* fecal–oral transmission; transmission of infection; vector-borne transmission.

velocity The time rate of change of position of a body. Velocity represents the rate of movement of water flowing in a pipe, conduit, drainage way, or basin. It is expressed in units of distance per time, such as feet (meters) per second.

velocity–area method A method used to determine the discharge of a stream or any open channel by measuring the velocity of the flowing water at several points within the cross section of the stream and summing up the products of these velocities and their respective fractions of the total area.

velocity coefficient A numerical factor, always less than unity, that expresses the ratio between the actual velocity issuing from an orifice or other hydraulic structure or device and the theoretical velocity that would occur if no friction losses were caused by the orifice, structure, or device. The square of the velocity coefficient is a measure of the efficiency of a structure as a waterway.

velocity gradient (*G*) A measure of the mixing intensity in a water process. The velocity gradient, which is expressed in units per second, is dependent on the power input, the viscosity, and the reactor volume. Very high velocity gradients (greater than 300 per second) are used for complete mixing and dissolution of chemicals in a coagulation process, whereas lower values (less than 75 per second) are used in flocculation to bring particles together and promote agglomeration. Often, though incorrectly, *G* can be used to refer to mean velocity gradient. *See also* coagulation; flocculation; mean velocity gradient; orthokinetic (shear) flocculation.

velocity head The theoretical vertical height through which a liquid body may be raised by its kinetic energy. Velocity head is equal to the square of the velocity divided by twice the acceleration of gravity. *See also* head.

velocity meter A water meter using a rotor with vanes (such as a propeller) and operating on the principle that the vanes move at about the same velocity as the flowing water.

velocity of approach The mean velocity in a conduit immediately upstream from a weir, dam, Venturi tube, or other structure.

velocity profile The relationship between the velocity of fluid flowing adjacent to the conduit wall or membrane surface and that flowing at a distance from the wall or surface.

velocity pump The general class of pumps that use a rapidly turning impeller to impart kinetic energy or velocity to fluids. The pump casing then converts this velocity head, in part, to pressure head. It is also known as a kinetic pump.

velocity-rod correction The correction to be applied to the velocity value given by a velocity rod in order to convert that value into mean velocity.

velocity units *See in the Units of Measure section.*

vena contracta The most contracted sectional area of a stream, jet, or nappe issuing through or over an orifice or weir notch. It occurs downstream from the plane of such notch or orifice.

Venn diagram A drawing that employs circles to represent logical relationships between, and operations on, sets by the inclusion, exclusion, or intersection of the circles.

ventilate To provide an exchange of fresh air in a confined space, room, or building, usually by means of a fan or blower.

ventilator A piece of equipment, such as a fan or blower, that provides air exchange to a building, room, or pit.

Venturi A constriction in a pipe, tube, or flume consisting of a tapered inlet, a short straight constricted throat, and a gradually tapered outlet; fluid velocity is greater and pressure is lower in the throat area than in the main conduit upstream or downstream of the Venturi. It is used to measure flow rate. *See also* Venturi flume; Venturi meter; Venturi principle; Venturi tube.

Venturi flume A flow-measuring device in which the flow is calculated based on the difference in elevation in different sections of the flume. The flume has a restricted cross-sectional area at its center, causing a change in velocity that results in changes in flow depth that can be related to flow on the basis of hydraulic principles. This nonmechanical method of flow measurement is reliable and effective as long as the geometry of the flume is well understood and is calibrated. *See also* parshall flume.

Venturi meter An instrument for measuring fluid flow rate in a piping system by use of a nozzle section to increase velocity and produce a head difference that can be measured and mathematically converted to a flow rate value. A Venturi meter is also used in a filter rate-of-flow controller. *See also* filter rate-of-flow controller.

Venturi principle The phenomenon in a Venturi device whereby the constricted throat causes an increase in flow velocity and a decrease in pressure. The phenomenon can be used to measure flow or to draw other fluids into the flow through a small inlet.

Venturi tube A type of primary element used in a pressure differential meter that measures flow velocity based on the amount of pressure drop through the tube.

versenate Disodium dihydrogen salt of versene $(HOOCCH_2)_2\ NCH_2CH_2N(CH_2COOH)_2$. Versenate

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can be used in water analysis to detect water hardness or to colorimetrically measure hardness quality. *See also* ethylenediaminetetraacetic acid.

vertex A point defining the beginning or end of a line feature or defining a change in alignment of the feature. A vertex is defined by a pair of *x–y* coordinates.

vertical-flow tank A sedimentation tank in which water enters near the bottom, rises vertically, and flows out at the top.

vertical integration A marketing technique through which a company provides the full range of services required by a water utility including, but not limited to, engineering, management, financing, construction, and operations.

vertical mowing Mechanical cultivation of turfgrass by the use of vertically oriented knives to penetrate cored material, thatch, or underlying soil.

vertical pump (1) A reciprocating pump in which the piston or plunger moves in a vertical direction. (2) A centrifugal pump in which the pump shaft is in a vertical position.

vertical screw pump A pump that is similar in shape, characteristics, and use to a horizontal screw pump but that has the axis of its runner in a vertical position. *See also* horizontal screw pump.

vertical survey control monument A monument or benchmark that provides the control structure from which elevations can be measured, as used in compilation of topographic data. When aerial photography is the source for compilation, these monuments or other vertical control points are marked for clear visibility on the photographs. Specific densities of vertical control points must be available to achieve particular levels of accuracy.

vertical-tube distillation Distillation using vertically oriented evaporation tubes. *See also* multiple-effect distillation.

vertical turbine pump A centrifugal pump, commonly of the multistage diffuser type, in which the pump shaft is mounted vertically.

vertical velocity curve A curve showing the relation between depth and velocity, at a given point and along a vertical line, of water flowing in an open channel or conduit. Such a curve is also called a mean velocity curve.

very fine sand Sediment particles having diameters between 0.062 and 0.125 millimeters.

very poorly drained Pertaining to a soil condition in which water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season.

very small system A public water system serving between 25 and 500 people.

very very small system A public water system serving 25 to 100 people.

Veterans Administration *See* US Department of Veterans Affairs.

VFAR *See* virulence factor activity relationship.

VFD *See* variable-frequency drive.

viability (1) An indication of whether a water system has the technical, financial, and managerial capabilities to provide drinking water that complies with federal and state drinking water regulations. (2) The ability to live, grow, and develop.

viability index One of several parameters used in the study of the toxicology of a chemical on the reproductive system. This index is defined as the number of offspring that survive 4 days past birth (in rodents).

viable (1) Capable of living. (2) Acceptable or beneficial.

viable-nonculturable (VNC) A classification used to describe a physiological adaptation exhibited by many culturable bacteria as a response to environmental conditions. The organisms remain alive as measured by one or more viability parameters (nutrient uptake, enzyme activity, photosynthesis respiration, energy charge) but fail to grow in vitro on culture media.

vibration sensor A device that detects abnormal reverberation or shaking of pumps or motors.

Vibrio A genus of gram-negative, straight or curved rod shaped, facultatively anaerobic bacteria belonging to the family Vibrionaceae. These organisms are primarily aquatic bacteria found in seawater and freshwater and in association with aquatic animals. This genus contains several species that are pathogenic for humans, as well as for marine vertebrates and invertebrates.

Vibrio cholerae (V. cholerae) A bacterial pathogen that causes cholera. Epidemic strains of *V. cholerae* serovar O:1 (O1) may be divided into the classic and El Tor biovarieties (biovars). *V. cholerae* is subdivided on the basis of the O antigens, and the O1 serovars produce cholera toxin that is regulated by chromosomal genes. In general, O1 serovars produce cholera toxin, but nontoxigenic O1 serovars also occur. Transmission of toxigenic *V. cholerae* O1 to humans is by food or water that has been contaminated by fecal material from infected persons, and in epidemic outbreaks the disease rapidly becomes endemic. The natural reservoir of *V. cholerae* O1, long thought to be humans, is unknown, but recent evidence has suggested that it may be the aquatic environment.

***Vibrio cholerae* El Tor** *See Vibrio cholerae.*

video inspection An inspection of inaccessible or hazardous locations using closed-circuit television. This term is usually applied to truck-mounted, semiportable equipment used to inspect the insides of large-diameter

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water mains, pipes, and intakes. Video inspection is also called television inspection.

viewshed The area that is visible from a specific location, e.g., from a ridge top or building location. Obstructions to sight caused by terrain and other physical features reduce the viewshed.

vintage rate A program in which customers are classified and customer rates and charges are based on the date or period when a customer connects to and first obtains service from the utility system. Such rates and charges can include user rates; customer contributions of capital for system development, main extension, connection fees; or charges for ancillary services rendered. The concept has been used during periods of rising average costs to reflect the higher costs associated with serving new customers.

vinyl chloride (CH_2:CHCl) A vinyl monomer. Vinyl compounds are the basis of a number of important plastics. The presence in drinking water of this volatile organic compound is regulated by the US Environmental Protection Agency at a maximum contaminant level of 0.002 milligrams per liter. *See also* monomer; plastic; volatile organic compound.

vinyl ester A premium resin system with excellent corrosion resistance.

violation A failure by a water utility to meet all of the National Primary Drinking Water Regulations and all state and local regulations. Utilities that have failed to meet these regulations are said to be "in violation."

viradel method A method used for concentrating viruses from large volumes of water by using electropositive cartridge filters. The virus is eluted from the filter cartridge by an organic flocculation concentration procedure.

viral Pertaining to or caused by a virus.

viral gastroenteritis *See* waterborne disease.

viral nucleic acid Central genetic nucleic acid core of a virus, which is surrounded by a protein coat. Unlike prokaryotes and eukaryotes, viruses contain only one type of nucleic acid—deoxyribonucleic acid or ribonucleic acid—which can be single-stranded or double-stranded. *See also* deoxyribonucleic acid; ribonucleic acid.

VIRALT A semianalytical groundwater flow and contaminant transport (viral-transport) model (i.e., a computer program) commissioned by the US Environmental Protection Agency to predict virus concentrations in groundwater from various sources. It simulates the fate of viruses in groundwater flow systems and is used to help define wellhead protection areas. This program can be used to calculate capture zones and contaminant breakthrough curves for pumping wells.

virgin granular activated carbon (virgin GAC) Granular activated carbon that has not been used in a prior treatment application. Virgin granular activated carbon typically has the highest adsorption capacity. Though granular activated carbon can subsequently be regenerated or reactivated to restore its adsorptive properties, a small amount of the adsorption capacity is lost in each reactivation cycle.

virion Infective form of a virus.

virtual safe dose A dose for which the estimate of risk is low enough that virtually no one in a population is expected to be affected by the exposure. An officially stated virtual safe dose will usually reflect a definite point from a specified mathematical model for estimating low-level risks (e.g., one in a million lifetime extra risk from a given exposure to a chemical), but agencies may differ on the point. For example, some might accept one in a million as the low-level risk, whereas others may accept as high as one in 10,000.

virtual water A term used to describe the total amount of water used in the production of a commodity or a service. For example, the virtual water value of 2.2 pounds (1 kilogram) of beef is 4,227 gallons (16,000 liters). It is also called embedded water.

virulence The ability of an infectious agent to produce pathologic effects.

virulence factor activity relationship (VFAR) Method of characterizing the variability of virulence for specific organisms and the factors that influence that variability. It was developed as a way to relate the architectural and biochemical components of a microorganism to its potential to cause human disease.

virulent Extremely poisonous or pathogenic.

virus (1) A minute organism not visible by light microscopy. A virus is an obligate parasite dependent on nutrients inside cells for its metabolic and reproductive needs. It consists of a strand of either deoxyribonucleic acid or ribonucleic acid, but not both, separated by a protein covering called a capsid. (2) A computer program that replicates itself through incorporation into other programs.

viscosity (absolute) *See* absolute viscosity; Newtonian flow; non-Newtonian flow.

viscous Having a sticky quality.

viscous flow A type of fluid flow in which a continuous steady motion of the particles exists, with the motion at a fixed point always remaining constant. Viscous flow is also called streamline flow. *See also* laminar flow.

visible absorption The amount of light absorbed by a sample in the wavelength range of 400–750 nanometers.

vital dye A dye or stain that is capable of penetrating living cells or tissues and not inducing immediate

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evident degenerative changes. A vital dye is also called a vital stain.

vital stain *See* vital dye.

vital statistic Tabulated information about births, deaths, marriages, and so on, used for demographic purposes.

vitrified clay pipe A pipe made from various clays or combinations of clays that are shaped, dried, and fired to a point where the glass-forming components fuse to form a bond between the crystalline grains. Such pipe is used for drains at water treatment plants and for wastewater lines.

vitriol *See* sulfuric acid.

vivianite ($Fe_3(PO_4)_2 \cdot (H_2O)_8$) Hydrated Fe(II) phosphate. It can form in iron distribution system pipes when phosphate is present, such as when phosphate corrosion inhibitors are used under reducing conditions.

VNC *See* viable-nonculturable.

V-notch weir A triangular weir. In US customary units, the flow through a V-notch weir is given by

$$Q = 2.54\ H^{2.5}$$

Where:

Q = the flow, in cubic feet per second
H = the head, in feet

In Système International units,

$$Q = 1.38\ H^{2.5}$$

Where:

Q = the flow, in cubic meters per second
H = the head, in meters

VNTRs (variable number of tandem repeats) *See under* microsatellite polymorphisms.

VOC *See* volatile organic compound.

Voges–Proskauer test Test used to assist in differentiating between various Enterobacteriaceae.

voice annunciator A recorded or synthesized voice that gives information to the operator.

void The percentage by volume of the interstices to total bed volume. *See also* void space; void volume.

void ratio The ratio of the volume of voids to the volume of particles in a mass of particles, sand, ion-exchange resin, or other porous medium.

void space A pore or open space in rock or granular material, not occupied by solid matter. It may be occupied by air, water, or other gaseous or liquid material. A void space is also called an interstice or a void.

void volume The volume occupied by the interstitial spaces between the particles of ion exchangers, filter media, or other granular materials in a bed or column. Void volume is often expressed as a percentage of the total volume occupied by the medium bed. *See also* void ratio.

volatile Capable of turning to vapor (evaporating). This term should be associated with a temperature and pressure because they determine whether or not a chemical is volatile. A chemical may be volatile under one set of conditions but not another.

volatile acids Fatty acids that contain six or less carbon atoms (commonly acetic, propionic, butyric) that can be distilled at atmospheric pressure. They are intermediate products of anaerobic degradation of carbohydrates, proteins, and fat. They are commonly monitored in the anaerobic digestion process because an accumulation of volatile acids usually indicates unbalanced conditions in anaerobic treatment. Many of these volatile acids are also detected in ozonated water as ozonation by-products. *See also* ozonation by-product.

volatile constituent A sample component that is readily lost by evaporation. Volatile constituents include dissolved gases as well as substances with low boiling points.

volatile liquid A liquid that easily vaporizes or evaporates at room temperature.

volatile matter The apparent loss of matter from a residue ignited at 1,022 ±77° Fahrenheit (550 ±25° Celsius) for a period of time sufficient to reach a constant weight of residue, usually 10–15 min. *See also* volatile solids.

volatile organic carbon *See* purgeable organic carbon.

volatile organic compound (VOC) A class of organic compounds that includes gases and volatile liquids. Many volatile organic compounds are used as solvents. A number of these compounds are regulated by the US Environmental Protection Agency. *See also* organic compound; solvent; volatile.

volatile organic contaminant *See* volatile organic compound.

volatile residue *See* volatile solids.

volatile solids (VS) In the laboratory analysis of the solids content of a substance (such as water), the portion of the total suspended solids, dissolved solids, or both that become expulsed or driven off after heating or burning of a given sample of the substance at a specified temperature and for a specified time. *See also* fixed solids; volatile matter.

volatile suspended solids (VSS) That fraction of suspended solids, including organic matter and volatile inorganic salts, that will ignite and burn when heated to 1,022° Fahrenheit (550° Celsius) for 60 minutes in an oxygen-containing atmosphere.

volatilization Loss of a substance through evaporation.

volcanic spring A spring with water derived at considerable depths and brought to the surface by volcanic forces.

volcanic water Water furnished by lava flows.

volt (V) *See in the Units of Measure section.*

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voltage The electrical pressure available to cause a flow of current (amperage) when an electrical circuit is closed. Voltage is measured in volts. *See also* electromotive force.

voltage-driven membrane An electrodialysis membrane.

volt-ampere (VA) *See in the Units of Measure section.*

volt-ampere-reactive (VAR) *See in the Units of Measure section.*

voltmeter An instrument for the measurement of a potential difference, in volts or in fractions or multiples thereof, between two points.

voltmeter-ohmmeter-ammeter A test instrument having a number of different ranges for measuring voltage, current, and resistance.

volume (1) The amount of space occupied in three dimensions; cubic contents or cubic magnitude. (2) The quantity, strength, or loudness of sound. *See also* decibel *in the Units of Measure section.*

volume charge That portion of a water rate that is related to the volume of water used. The volume charge can be a single unit charge for all volume used, or it can be increased or decreased at selected block levels. *See also* inclining block rate; rate structure analysis.

volume per volume (v/v) The initial volume of the solute divided by the final volume of the solution. When multiplied by 100, the value becomes the percentage by volume. *See also* solute; solution.

volumetric Based on the volume of some factor. For example, volumetric titration is a means of measuring unknown concentrations of water quality indicators in a sample by determining the volume of titrant or liquid reagent needed to complete particular reactions. *See also* gravimetric.

volumetric analysis Any of a number of quantitative analyses based on the addition of known volumes of a reagent solution until a chemical equivalence point is reached. Water samples are commonly titrated with standardized solutions until a given end point is observed. The volume of standardized solution required is proportional to the concentration of the analyte.

volumetric dry feeder *See* volumetric feeder.

volumetric feeder A chemical feeder that adds specific volumes of dry chemical. *See also* gravimetric feeder.

volumetric flask A squat bottle with a long, narrow neck, used to prepare fixed volumes of solution. Each flask is calibrated for a single volume only.

volumetric mass transfer coefficient ($K_L a$) An empirically derived constant describing the liquid-phase resistance of a contaminant or constituent to transfer to the gas phase. The volumetric mass transfer coefficient is expressed in units of time^{-1} and is used to establish the quantity of material transferred per unit time per unit volume. It is dependent on the physical properties of the liquid, the diffusivity of the compound to be removed, and the specific interfacial area available for mass transfer in the treatment process. *See also* mass transfer coefficient.

volumetric pipette A pipette calibrated to deliver a single volume only, also known as a transfer pipette.

volume units *See in the Units of Measure section.*

volute A spiral casing for a centrifugal pump designed so the pump rotation or speed will be converted to pressure in a smooth transition as the water leaves the impeller and is discharged from the pump.

volute pump A centrifugal pump with a casing made in the form of a spiral or volute as an aid to the partial conversion of the velocity energy into pressure head as the water leaves the impellers.

vortex A revolving mass of water that forms a whirlpool. This whirlpool is caused by water flowing out of a small opening in the bottom of a basin or reservoir. A funnel-shaped opening is created downward from the water surface.

vortex pump A pump with a recessed impeller that creates a negative gauge pressure, thereby drawing liquid into the pump cavity and passing the liquid to the discharge. Solids are drawn into the vortex of the swirling liquid and are discharged by centrifugal force from the open pump chamber, seldom touching the impeller. Although vortex pumps (which are also called recessed impeller pumps) are inefficient, they are used to pump sludges or slurries (e.g., fluids with high solids concentrations) in instances when having the impeller contact the material and directly transport the fluid is undesirable.

vortex-shedding meter A flowmeter in which fluid velocity is determined from the frequency at which vortices are generated by an obstruction in the flow or a bend in a pipe. *See also* vortex.

VS *See* volatile solids.

VSAT™ *See* Vulnerability Self Assessment Tool.

VSD *See* variable-speed drive.

VSS *See* volatile suspended solids.

vulnerability The susceptibility or likelihood that a public water system or source water would be contaminated or otherwise adversely affected by an activity, practice, or unexpected emergency condition.

vulnerability assessment (VA) A systematic analysis required by the US Environmental Protection Agency of all water systems serving more than 3,300 people that is used to determine the risks posed to the operations of water supply, treatment, and distribution systems. VAs are conducted by the state primacy agency and serve as the basis for the state to allow a water system to lessen monitoring frequencies for certain contaminants. VA is also known as risk assessment or threat assessment.

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vulnerability assessment tool A prepared document such as that prepared by the Water Research Foundation or the National Rural Water Association with step-wise guidance meant to facilitate a vulnerability assessment.

Vulnerability Self Assessment Tool (VSAT™) A proprietary software developed to assist water and wastewater utilities to perform vulnerability assessments using a qualitative risk assessment methodology. VSAT™ software is available free of charge on the US Environmental Protection Agency Web site for wastewater utilities (VSAT wastewater™), drinking water utilities (VSAT water™), and utilities providing both services (VSAT water/wastewater™).

vulnerable population Population at risk of disease.

v/v *See* volume per volume.

VX *See o*-ethyl *s*-2-diisopropylaminoethylmethyl phosphonothiolate.

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W

W *See* watt *in the Units of Measure section.*

w *See* width.

wadi A valley, ravine, or watercourse that is dry except during the rainy season. This term is usually used in reference to northern African and Arabian locales. *See also* intermittent stream.

waiver A document that is issued by the primacy agency and that permits a water system either not to monitor or to perform reduced monitoring for a specific contaminant.

waiver for filtration A document issued by the primacy agency stating that a water source can be distributed to users without prior filtration.

wale A horizontal member of a timber shoring system for excavation. The wale is located behind the uprights and sheeting piling that serve as the vertical retainers of the system. Crossbraces are between the wales across the excavation. *See also* timber shoring system.

wall effect A condition in flow-through treatment using spherical or approximately spherical media in which flow bypasses the media and instead flows along the column or cell walls. At high Reynolds numbers, there is an increased risk that wall effects will disturb the intended flow pattern through the media. To minimize wall effects under a wide variety of flow conditions (Reynolds numbers), the column or vessel diameter should be at least 50 times greater than that of the media. For lower Reynolds numbers, lesser column-to-media diameters are acceptable. *See also* Reynolds number.

WAN *See* wide area network.

warm-climate hydrant A fire hydrant with a two-piece barrel that is the main valve located at ground level.

warm-season turf grass Turf grass that grows vigorously during warm summer months and that generally loses its green color and is dormant during winter if the average temperature drops below about 50° Fahrenheit (10° Celsius). Some warm-season turf grass may die if exposed to subfreezing temperatures for extended periods. Warm-season turf grasses include Bermuda grass, buffalo grass, St. Augustine grass, and zoysia grass.

warm spring A thermal spring with water having a temperature lower than 98° Fahrenheit (37° Celsius).

warning An indication of a hazard level between the levels indicated by the terms *caution* and *danger*. *See also* notice.

wash (1) The flow of a body of water. (2) The floodplain of an intermittent stream. This meaning is encountered principally in the arid regions of the United States and is usually applied to sand, gravel, and boulder deposits. (3) Loose or eroded surface material of the earth transported and deposited by running water. (4) A gully. (5) A marsh, bay, fen, or inlet. (6) The rough water above a breakwater or jetty that is caused by a wave breaking on it. (7) To clean a unit process.

wash boring (1) The operation of drilling or boring a hole through soft material with a wash drill. (2) A hole bored by means of a wash drill.

wash drill A pipe from which water is discharged under pressure to liquefy soils and lift them to the surface.

wash load As related to transport processes, that part of the suspended load of a stream that is composed of particle sizes not generally found in shifting portions of the streambed. Wash load is also called fine sediment load.

washout valve A valve installed in a low point or depression on a pipeline to allow drainage of the line. Such a valve is also called a blowoff valve.

wash water Water that is used to clean a unit process. Wash water is typically identified as backwash water and is associated with the water used to clean a filter media or membrane surface. *See also* filter backwash; spent filter backwash water.

wash-water rate The rate at which wash water is applied to a rapid granular filter during the washing process. This rate is usually expressed as the rate of rise of water in the filter in inches per minute, centimeters per minute, gallons per minute per square foot, meters per hour, or cubic meters per square meter per minute.

wash-water tank An elevated tank at a rapid granular filtration plant, into which water is pumped at a rate such that the tank will be filled between washings and set at a height such that the wash water will have a pressure of about 15 pounds per square inch (102 kilopascals) at the underdrain.

wash-water trough A trough placed above filter media to collect backwash water and carry it to the drainage system.

waste (1) Something that is superfluous or rejected; something that can no longer be used for its original purpose. (2) Any solid, liquid, or gaseous emission of no known use that results from human activity.

waste extraction test (WET) A method used in California to ensure that drinking water residuals meet

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that state's requirements in order to be disposed of in a landfill.

waste gate A gate inserted in a canal for wasting surplus water.

waste-heat evaporator An evaporator that uses the heat given off by another device, such as a diesel engine, a gas turbine, or an exhaust gas flue, as its source of heat for the feedwater.

waste metering A process of measuring water flowing into a temporarily isolated portion of a water supply pipe network. Assessing the minimum nightflow into the zone during the early morning hours by performing nightflow analysis provides reliable quantification of leakage occurring in the zone. *See also* district metered area.

wastewater The used water and water-carried solids from a community (including used water from industrial processes) that flow to a treatment plant. Stormwater, surface water, and groundwater infiltration may also be included in the wastewater that enters a wastewater treatment plant. The term *sewage* usually refers to household wastes, but it has been replaced by the term *wastewater.*

wastewater renovation Treatment of wastewater for reuse.

wastewater reuse *See* water reuse.

wastewater treatment plant (WWTP) A facility that receives wastewater (and sometimes runoff) from domestic or industrial sources, or both, and by a combination of physical, chemical, and biological processes treats the wastewater to less harmful by-products. A wastewater treatment plant is also known by the abbreviation STP (sewage treatment plant). *See also* publicly owned treatment works.

wasteway A channel used to convey water discharged into it from a spillway, escape, or sluice.

wasteweir A structure installed in a canal or open conduit to allow spilling or wasting of excess water from other sources that might reach the canal and cause damage by overflowing the banks. The water being spilled or wasted goes to a drainage system or nearby watercourse. A wasteweir usually consists of a short section of canal with a level crest, protected against erosion or cutting, with an elevation that is below the top of the canal bank but above the normal water surface in the canal. *See also* spillway.

WATEQ A family of computerized chemical equilibrium speciation programs developed by the US Geological Survey. The original WATEQ was written in 1973 and provided the basis for many subsequent models. Later variants include WATEQ4F, which can be downloaded at no cost from the USGS Web site. These programs take analytical water chemistry data and compute equilibrium aqueous speciation and saturation states of solids of interest, as well as various other parameters, such as ion balance errors and ion ratios.

water (1) A transparent, odorless, tasteless compound of hydrogen and oxygen, H_2O. At a pressure of 1 atmosphere (101.3 kilopascals), water freezes at 32° Fahrenheit (0° Celsius) and boils at 212° Fahrenheit (100° Celsius). Water, in a more or less impure state, constitutes rain, oceans, lakes, rivers, and other such surface water bodies as well as groundwater. It contains 11.188 percent hydrogen and 88.812 percent oxygen by weight. It may exist as a solid, liquid, or gas. As normally found in the lithosphere, hydrosphere, and atmosphere, it may have other solid, gaseous, or liquid materials in solution or suspension. (2) To wet, supply, or irrigate with water.

water, 18 megohm *See* 18 megohm water.

water age The time from when water is treated to when it reaches the customer.

water allowance *See* water budget.

water analysis An examination of constituents in water for chemical, physical, or biological characteristics. Such analyses can be quantitative or qualitative.

Water and Wastewater Equipment Manufacturers Association (WWEMA) A trade organization of manufacturers of equipment for water, wastewater, or industrial waste treatment or disposal plants. The group is based in Washington, D.C.

water appropriation Establishing, through law, the right to utilize a designated amount of water from a defined source. *See also* appropriation doctrine.

water association A nonprofit, nontaxing organization formed to provide drinking water–related services for a specific area.

water audit A thorough examination of the accuracy of water agency records, accounts, policies, and practices regarding the volumes of water that are moved from source to treatment to distribution; ultimately segregating volumes reaching customers from volumes of loss. Water audits are essential to assess both the efficiency of water supply management and the operational and financial impacts of water loss. The American Water Works Association (AWWA) supports use of the method developed by the International Water Association (IWA) in conjunction with AWWA in 2000 (IWA/AWWA method). Water audits can be performed in "top-down" fashion (desktop assessment of records) or "bottom-up" fashion (detailed field measurements and investigations to confirm records). *See also* water balance.

water balance (1) The summary structure of the water audit that shows water management from source to customer, with all quantities ultimately balancing in summation. The water balance summary of this

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Chart W.1 Water balance summary of water audit from source to customer

System Input Volume (corrected for known errors)	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption (Including Water Exported)	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Nonrevenue Water (NRW)
			Unbilled Unmetered Consumption	
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies	
			Data Handling Errors	
		Real Losses	Leakage on Transmission and Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to Point of Customer Metering	

Note: All data in volume for the period of reference, typically one year.

method is shown in Chart W.1. (2) A method used to estimate evaporation from a water surface, based on a measurement of the continuity of water. This method uses the following equation:

$$E = I - O - S$$

Where (in any consistent set of units):

E = evaporation
I = inflow
O = outflow
S = the change in the lake, reservoir, or impoundment volume

water banking A process whereby unused water allocations are kept for use in future water allocations.

water-based disease A disease for which the pathogen spends an essential part of its life in water or is dependent on aquatic organisms for completion of its life cycle. Examples include primary meningoencephalitis (caused by *Naegleria*), schistosomiasis (caused by *Schistosoma*), and dracunculiasis (caused by *Dracunculus*).

water-based pathogens A grouping of pathogenic microorganisms that are naturally present in water, such as *Legionella* and *Mycobacterium* (which cause respiratory disease), cyanobacteria (blue-green algae) (which produce toxins), and certain parasites, such as *Naegleria.*

water-bearing bed A porous, water-bearing formation. Such a formation is also called a water-bearing deposit. *See also* aquifer.

water-bearing deposit *See* water-bearing bed. *See also* aquifer.

water-bearing formation A geologic formation that contains water. Usually, a geologic formation that contains and transmits water is called an aquifer. Strictly speaking, however, a geologic formation that is a poor transmitter of water but still contains water could be considered a water-bearing formation. An example might be a clay-rich bed of material that forms the confining layer in a confined aquifer system. The clay-rich layer contains water but transmits it slowly. *See also* aquifer.

water-bearing medium A geologic formation that will supply water to wells or drains at a rate sufficient to justify extraction of the water. Such a formation is also called a water-bearing stratum. *See also* aquifer.

water-bearing stratum *See* water-bearing medium.

water bill A statement issued to a customer on a regular basis detailing the amount of money owed for water supplied during a described period of time based on a predetermined rate.

water bloom A prolific growth of plankton, including cyanobacteria (blue-green algae), that may occur and be so dense that it imparts a greenish, yellowish, or brownish color to water near the surface of a lake, pond, impoundment, or reservoir. A water bloom often causes tastes and odors in water. *See also* algal bloom.

water body Water impounded in a natural or artificial basin or moving in a definable watercourse, such as a river or stream.

waterborne corrosion product Drinking water distribution system corrosion products originating in water.

waterborne disease A disease transmitted through the ingestion of contaminated water. Water acts as a passive carrier of the infectious agent or chemical. Water is only one mode of transmission, and epidemiological investigation is necessary to identify water as the source of infection. Cholera (caused by *Vibrio cholerae*) and typhoid fever, the classic waterborne diseases, continue to occur but are important primarily in the developing countries of the world. Outbreaks of these diseases are occasionally reported in the United States and other more industrialized countries. During the period 1971–2002, 891 waterborne outbreaks were reported in the United States, resulting in 598,105

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cases of illness and 103 deaths. Approximately 50 percent of these outbreaks were classified as acute gastrointestinal illness of undetermined etiology, characterized by such symptoms as abdominal cramps, nausea, vomiting, and diarrhea occurring 24 to 48 hours after consumption of contaminated water. Identified causative agents included protozoan (*Giardia*, *Cryptosporidium*, and occasionally *Entamoeba histolytica*), bacterial (*Campylobacter*, *Shigella*, *Salmonella*, *Yersinia*), toxigenic (*Escherichia coli*), or viral (norovirus, rotavirus, hepatitis A virus). Acute chemical poisonings (copper, fluoride, and nitrate were the most frequently identified) accounted for some of the outbreaks. *See also* fecal–oral transmission.

waterborne disease outbreak (WBDO) A significant occurrence of acute infectious illness in at least two persons that is epidemiologically associated with the ingestion of water from a public water system that is deficient in treatment, as determined by the appropriate local or state agency.

waterborne emergency An emergency caused by drinking water contamination that typically requires a boil water warning because of the presence of pathogens in drinking water.

waterborne illness *See* waterborne disease.

waterborne pathogen Any of a group of pathogenic microorganisms that are excreted or shed by infected humans, infected animals, or both in their feces and are then acquired by ingestion. Waterborne organisms may be transmitted directly by ingestion of water or indirectly by, e.g., contamination of food during washing or processing or transmission through the skin or the anal area during recreational use of water (as in hot tubs). *See also* fecal–oral transmission.

water-break An arrangement of obstructions placed in a ditch or ravine to reduce wash.

water budget The quantity of water needed to maintain plants and other features in an ornamental landscape.

water budget approach A method of establishing water efficiency standards by describing limits on water consumption for irrigated landscapes.

water budget tiered rate A water rate structure that makes allowance for a specified amount of water usage by individual customers (the budget) at a base rate per unit of water. Use in excess of this amount is billed at increasingly higher rates. It is a form of inverted rates, with usage blocks defined based on percentage of water budget amount (for example, 125 percent, 150 percent, and 200 percent).

water charger A device for filling the water passage of a pump for the purpose of priming the pump. *See also* pump primer.

water closet A flushable toilet.

WATER CO$T model A computer software program developed for the US Environmental Protection Agency to determine the capital and operational costs for a treatment system of a capacity greater than 1 million gallons per day (3,785 cubic meters per day).

water column (1) The water above the valve in a set of pumps. (2) A measure of head or pressure in a closed pipe or conduit. *See also* head.

water compensation The quantity of water that must be allowed to pass diversion works to satisfy the needs of holders of prior rights on the stream.

water conditioning *See* water treatment.

water conservation Promotion of the efficient use of water through the economically or socially beneficial lessening of water withdrawals, water use, or water waste. Conservation can forestall future supply capacity needs and can be implemented on the supply side as well as on the demand side. It can consist of both temporary measures used during emergencies and permanent measures used to improve long-term efficiency.

water conservation incentive A policy or regulation, rate strategy, or public education campaign designed to promote customer awareness about the value of reducing water use and to motivate consumers to adopt specific water conservation measures.

water conservation voucher A credit voucher issued to a water customer so that they may receive a water efficiency device or service. It is a type of water conservation incentive.

water consumption Water that reaches the customer destination, including residential, commercial, industrial, or agricultural customers. Consumption is the volume registered by customer meters in those water utilities that provide customer meters. Consumption does not include water that is lost to leakage in the distribution system; however it includes leakage and water waste that occurs inside the customer premises, downstream of the customer metering point. Consumption occurs in both authorized and unauthorized manners and may be billed or unbilled. *See also* water audit; water balance.

water content In plant ecology, the water of the soil or habitat. Physiologically, water content is the available water supply; physically, it is the total amount of soil water. It is also called moisture content.

water correction Treatment—other than filtration, softening, and chlorination—used to stabilize water to reduce its tendency to corrode pipes, form incrustations, and so on. *See also* corrosion inhibitor.

watercourse (1) A running stream of water. (2) A natural or artificial channel for the passage of water.

watercourse bed The part of a watercourse that carries water at ordinary stages.

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water cycle *See* hydrologic cycle.

water demand A schedule of the water requirements for a particular purpose, as for irrigation, power, municipal supply, plant transpiration, or storage.

water-demand curve A curve of the summation of water demands over an assumed period of time.

water demand risk analysis The risk associated with forecasting water demands. Inaccurate forecasts could lead to the design of facilities that are much larger than needed or are grossly inadequate to provide the desired level of service. A number of elements in a water demand forecast have an inherent amount of error built in: population and account growth, consumption per account by account group, the response to the utility's price policy, weather, and more. The utility forecaster will want to design facilities to meet demand, say, 90 percent of the time, which requires an assessment of the potential range of demand. Usually, a confidence interval can be constructed around each of the contributing variables; this interval can be used, with little difficulty, to produce mean or average forecasts. However, combining the probabilities of all the variables to predict a joint probability distribution for all variables simultaneously is a more complex process. Monte Carlo and simulation programs are now readily available that permit this kind of risk analysis to be applied to water demand and water supply forecasts over extended periods. *See also* Monte Carlo analysis.

water-dependent activity An activity that requires access or reasonable proximity to water to fulfill its basic purpose.

Water Desalination Act of 1996 Public Law 104-298, enacted by the 104th Congress, authorizing the Secretary of the Interior to conduct studies regarding the desalination of water and water reuse, and for other purposes.

water-distributing pipe In plumbing, a pipe that conveys water from the service pipe to the plumbing fixtures and other outlets.

water district A quasi-governmental taxing entity formed to provide and finance services related to drinking water for a specific area.

water efficiency A function, task, process, or result involving the use of the minimal amount of water feasible. It is an indicator of the relationship between the amount of water required for a particular purpose and the quantity of water used or delivered.

water-efficient landscape An ornamental landscape that minimizes water requirements and consumption through proper design, installation, and management.

water engine (1) An engine operated to raise water. (2) An engine propelled by water.

Water Engineering Research Laboratory (WERL) An office within the US Environmental Protection Agency's Office of Research and Development that was responsible for research support for the agency's water programs. The office was eliminated when the agency was reorganized in the late 1980s.

Water Environment Federation (WEF) A technical society, formerly known as the Water Pollution Control Federation, representing chemists, biologists, ecologists, geologists, operators, educational and research personnel, industrial wastewater engineers, consultant engineers, municipal officials, equipment manufacturers, and university professors and students dedicated to the enhancement and preservation of water quality and resources. It seeks to advance fundamental and practical knowledge concerning the nature, collection, treatment, and disposal of domestic and industrial wastewaters, as well as the design, construction, operation, and management of facilities for these purposes. It disseminates technical information and promotes good public relations and regulations that improve water quality and the status of individuals working in this field.

water equivalent of snow The depth of water that would result if an accumulation of snow, at a point or over an area, were reduced to water by melting.

water factor (WF) The number of gallons of water needed to wash each cubic foot of laundry for a particular model of clothes washer. It is a water efficiency calculation that allows a comparison of clothes washer water use that is independent of clothes washer capacity. The term is expressed as gallons per cycle per cubic feet, where F is the quotient of the total weighted per-cycle water use divided by the capacity of the washer. The lower the WF value, the more efficient the washer.

Water Factory 21 An Orange County (California) Water District treatment plant that treats a combination of secondary wastewater effluent and deep well water and then injects it into the Santa Ana River Basin aquifers to prevent seawater intrusion. Beginning in the late 1970s, Water Factory 21 was one of the early facilities developed to inject treated effluent into drinking water aquifers.

waterfall A very steep or perpendicular descent of the water of a stream.

water feature A fountain, pool, water sculpture, canal, channel, waterfall, constructed pond or lake, or other element using water as part of its design composition.

water filtration plant (WFP) A facility designed to treat water by means of filtration. In the most generic sense of this term, a facility that provides potable water and uses a filtration process, with or without

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sedimentation, is often called a water filtration plant. *See also* filtration.

water flea *See Daphnia.*

water flooding A process in underground mining (e.g., in oil recovery) in which oil or a mineral from underground formations is replaced by an infusion of water to bring the underground substance to the surface for recovery. Water flooding is also known as oil well flooding.

water-flow formula One of a number of formulas for determining velocity or discharge of water in a conduit or channel, e.g., the Chezy, Darcy–Weisbach, Hazen–Williams, Kutter, and Manning formulas. *See also* Chezy open-channel formula; coefficient; Darcy–Weisbach formula; Hazen–Williams formula; Kutter formula; Manning formula.

water flux *See* flux; flux rate.

water for injection (WFI) *See* pharmaceutical grade water.

Water for People (WFP) A nonprofit organization founded in 1991 that works to receive, administer, and expend funds to help developing countries organize and implement drinking water and sanitation projects that improve the health and welfare of the population. It also provides related technical referral and technical literature distribution services, as well as training programs, technical assistance services, and exchange of information. Its Web site is www.waterforpeople.org.

water gap (1) A pass in a mountain ridge through which a stream flows. (2) A constricted section of a stream valley where the stream bank material has been more resistant to erosion than the other material in the locality and has therefore confined the erosive action of the stream to narrower lateral limits. A water gap is also called a narrows, although the latter term is sometimes applied to a small gap.

water glass ($Na_2O•xSiO_2$) The common name of a sodium silicate substance used for corrosion control in potable waters or as an ingredient in the manufacture of synthetic gel zeolite. *See also* corrosion control.

water-gradient contour map A graphic illustration of how water pressure varies throughout a water distribution system under varying demand conditions. Contour maps are generated from the results of computer simulation models or from SCADA data showing pressure at various points throughout a system. The maps are typically generated through computer simulation models because of the much larger number of points for pressure data than can be monitored with SCADA. *See also* pressure zone map.

water hammer The phenomenon of pressure oscillation that occurs in pipes when a valve is opened or closed very rapidly, creating a sound similar to someone hammering on a pipe. When a valve position is changed quickly, the water pressure in a pipe increases and decreases in a very quick sequence, potentially causing serious damage to the system. The speed of the pressure wave created by an instantaneous shutoff of a system is given as

$$C = \sqrt{\frac{E_v}{2\rho}}$$

Where (in any consistent set of units):

C = the speed of the pressure wave
E_v = the bulk modulus of elasticity of water
ρ = the density of water

at 68° Fahrenheit (20° Celsius) and 1 atmosphere (101.3 kilopascals), C is 4,866.5 feet per second (1,483.3 meters per second).

water-hammer arrester A device used on a service pipe to protect plumbing fixtures from the effects of water hammer. *See also* water hammer.

water harvesting A process of capturing and using water runoff from storms on-site.

waterhead *See* head.

water hole (1) A natural hole or hollow containing water. (2) A hole in the dry bed of an intermittent stream. (3) A spring in a desert. (4) A pool, pond, or small lake.

water horsepower (WHP) The amount of power applied by a pump actually entering the water. In US customary units, WHP is computed as

$$\text{WHP} = \frac{Qh\text{SG}}{3{,}956}$$

Where:

WHP = the water horsepower, in horsepower
Q = the discharge, in gallons per minute
h = the added head, in feet
SG = specific gravity

In Système International units, water horsepower is computed as

$$\text{WHP} = Q\gamma h$$

Where:

WHP = the water horsepower, in newton-meters per second
Q = the discharge, in cubic meters per second
γ = the specific weight of the liquid, in newtons per cubic meter
h = the added head, in meters

The water horsepower supplied by a pump is always less than the electric horsepower required by the pump because of mechanical inefficiencies and friction.

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water industry e-market Utilization of the Internet for a variety of purposes, including purchasing, outsourcing, and solicitation of vendors and contractors.

Water Information Sharing and Analysis Center (WaterISAC) A rapid-notification system and information resource that was developed to convey information regarding threats to American, Canadian, and Australian drinking water and wastewater systems through an Internet-based, highly secure subscription service available only to water and wastewater utilities. It provides a means for rapid dissemination of alerts, expert analysis, and other information specific to the water community.

water infrastructure financing Financing provided through the US Environmental Protection Agency's State Revolving Loan Funds to improve water treatment facilities and to reduce cross-border environmental threats.

Water Infrastructure Network (WIN) A broad-based coalition of local elected officials, drinking water and wastewater service providers, state environmental and health administrators, engineers, and environmentalists dedicated to preserving and protecting the health, environmental, and economic gains that US drinking water and wastewater infrastructure provides.

Water Infrastructure Security Enhancements (WISE) program A program funded by the US Environmental Protection Agency to address physical infrastructure security needs for water supply, wastewater and stormwater, and online contaminant monitoring systems. The program is coordinated by representatives of the American Society of Civil Engineers, the American Water Works Association, and the Water Environment Federation and includes the development of voluntary standards, training, and guidance.

water intake (1) The total gross quantity of water withdrawn from supply in a given interval, usually a day, month, or year. Water intake is also called pumpage. (2) The physical structure capable of removing water from a source, such as a lake. *See also* intake.

WaterISAC *See* Water Information Sharing and Analysis Center.

water jacket An outer casing that holds water or through which water flows and circulates to absorb heat and cool the interior of the mechanism or machinery that the casing surrounds.

water law The body of laws dealing with water—either surface water or groundwater—in its natural state, its maintenance in that state, and its use for various purposes. *See also* call; conditional water right; junior rights; riparian water right.

water level (1) The free water surface of a body of water. (2) The elevation of the free water surface of a body of water above or below any datum. The water level is also called the gauge height or stage.

water-level gauge A gauge, recording or otherwise, that indicates the water level in a well, surface body of water, reservoir, or other receptacle.

water-level recorder A device for producing, graphically or otherwise, a record of the rise and fall of a water surface with respect to time. Such a device is also called a water-stage register.

waterlogged (1) Saturated with water. (2) In a condition such that the groundwater stands at a level that is detrimental to plant growth. Waterlogged land may result from excessive irrigation or seepage, coupled with inadequate drainage.

waterlogged soil A soil so continuously wet as to drive out all gases and in which normal upland plants cease to grow.

waterlogged tank A tank (as in a domestic water well pumping system) in which too much water has accumulated and has replaced some of the air in the tank's air cushion, causing a disruption in the normal pressure pattern needed for pumping and uniform water flow.

waterlogging The accumulation of excessive moisture in the soil within the zone or depth desirable for favorable root development of plants.

water loss (1) As per the International Water Association/American Water Works Association (IWA/AWWA) water audit method, the difference between system input volume and authorized consumption. Water losses can be considered as a total volume for the whole system or for partial systems such as transmission or distribution systems or individual zones. Water losses consist of real losses plus apparent losses. (2) In water supply and water power, that portion of the precipitation that reaches the surface of the ground or vegetation and is returned to the atmosphere by evaporation and plant transpiration. (3) In flood hydrology, that part of the storm rainfall that does not appear as runoff for the duration of the flood. *See also* nonrevenue water; water audit; water balance.

water main The water pipe, located beneath the ground, from which domestic water supply is delivered to the service pipe leading to specific premises.

water main friction coefficient *See* Darcy–Weisbach formula.

water management (1) The combination of regulations, laws, and policies and their implementation and enforcement by the private sector and various levels of government by which a water body is used, preserved, and enhanced for the benefit of present and succeeding generations. (2) The monitoring, planning, and administration of water resources for various

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purposes. Where these purposes include water supply, navigation, flood control, or irrigation, then the design, financing, operation, maintenance, and evaluation of performance of projects for these purposes are also included.

water mass transfer coefficient *See* solvent (water) permeability coefficient.

water matrix effect *See* matrix effect.

water meter An instrument, mechanical or electronic, used for recording (in cubic feet, gallons, or cubic meters) the quantity of water passing through a particular pipeline or outlet. In water-processing systems, meters may initiate certain functions, such as automatically starting the regeneration cycle in an ion-exchange system.

water meter corrosion Corrosion of a water meter as a result of one of the following causes: excessive wearing of mechanical parts, erosion resulting from excessive velocity through the meter, or direct connection of dissimilar metals (i.e., erosion corrosion, galvanic corrosion).

water metering The measurement of water supplied to consumers by the installation of a meter at each consumer's service. *See also* metered system.

water-meter load factor The ratio, expressed as a percentage, of the annual registration of a meter in cubic feet (cubic meters) to the discharge capacity of the meter, operating continuously, in cubic feet per year (cubic meters per year).

water mining A process of withdrawing groundwater accumulated in the ground at a rate faster than it is being replenished. Water mining is also called depletion. *See also* groundwater recharge.

WATER model A computer software program developed for the US Environmental Protection Agency to determine the capital and operational cost for a treatment system of a capacity not exceeding 1 million gallons per day (3,785 cubic meters per day).

water of compaction Water furnished by a reduction of pore space that has resulted from compaction of sediments.

water of condensation Water formed by condensation of water vapor from the atmosphere, from soil, and from air in rock interstices, as well as water vapor arising from the magmosphere or from the volcanic forces of the lithosphere.

water of crystallization The water that combines with salts when they crystallize. Water of crystallization combines in a definite quantity and is a molecular constituent of the crystalline compound.

water of dehydration Water that was once in chemical combination with certain minerals but has been released by later chemical changes.

water of dilation Water in excess of water of saturation held by sedimentary material in an inflated state.

water of hydration Water that has been chemically combined with a substance to form a hydrate and that can then be removed (as by heating) without essentially changing the chemical composition of the substance.

water of imbibition The amount of water that a rock can contain above the saturation zone.

water of infiltration That part of surface water or precipitation that infiltrates into the upper parts of the lithosphere through small capillary pores of the soil and interstices in the rock.

water of saturation Water that completely fills the interstices of rock or of earth when the particles are in contact. *See also* saturated zone.

water of supersaturation Water that is in excess of water of saturation in a granular material in which the particles have lost contact—as in the case of quicksand, plastic clay, or flowing mud—and are more or less separated by water. *See also* water of dilation.

water permeability coefficient *See* solvent (water) permeability coefficient.

waterphone A device used to locate points of leakage in an underground water pipe system under pressure.

water plant *See* drinking water treatment plant.

water pocket (1) A water hole in the bed of an intermittent stream. (2) The hole formed in the bed by a stream falling over a nearly vertical face.

water pollution The addition into water of harmful or objectionable materials and substances in large enough quantities to adversely affect the water's usefulness.

Water Pollution Control Federation (WPCF) The former name of the Water Environment Federation. *See also* Water Environment Federation.

water power Any type of energy or power that can be or has been developed through use of the energy in falling or moving water. In common practice, this term is applied to electric energy or power generated by waterwheels used to drive electric generators.

water-pressure engine An engine similar to a steam engine but using water under pressure instead of steam.

water pressure plane A zone in a distribution system that covers a specific area and maintains pressure within a certain range either by pumping or by keeping the water within certain levels in an elevated tank.

water privilege (1) The right to use water; the right to use running water to turn machinery. (2) A stream or body of water capable of being used to drive machinery.

water processing *See* water treatment.

water-producing zone A porous, water-bearing geologic formation; an aquifer. *See also* aquifer; saturated zone.

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water productivity The value of economic goods and services per unit of water used.

water provider A city, town, private water company, or public water wholesaler responsible for the direct or indirect distribution of water to its customers.

water purification *See* water treatment.

water purveyor An agency or person that supplies water (usually potable water) to someone else.

water quality The chemical, physical, and biological characteristics of water with respect to its suitability for a particular purpose. The same water may be acceptable for one purpose or use but unacceptable for another, depending on its characteristics and the requirements for the particular use. *See also* drinking water regulation; water quality criteria.

Water Quality and Health Council An independent, multidisciplinary group sponsored by the Chlorine Chemistry Division of the American Chemistry Council. The group's mission is to promote science-based practices and policies to enhance water quality and health by advising industry, health professionals, policy makers, and the public. *See also* Chlorine Chemistry Division.

Water Quality Association (WQA) An organization of individuals and firms engaged in the manufacture, assembly, distribution, or retail selling of water treatment equipment, supplies, and services. The association promotes the acceptance and use of water quality products; provides activities, programs, and services designed to improve economy and efficiency within the industry; and conducts expositions and certification and equipment validation programs.

water quality certification (WQC) Certification by the state in which a discharge originates or would originate, under Section 401 of the Clean Water Act (33 US Code Section 1341), that the discharge will comply with the applicable effluent limitations and water quality standards established by the state. Such certification is required for any applicant of a federal permit or license to conduct any activity that may result in a discharge of a pollutant into waters of the United States.

water quality criteria Scientific standards on which a decision or judgment may be based concerning the suitability of water of a specific quality to support a designated use.

water quality determinant *See* water quality parameter.

water quality guideline A numerical concentration limit or narrative statement recommending a designated water use.

water quality monitoring The process of measuring water quality characteristics, usually at regular intervals over a long period of time, at the same location.

water quality monitoring network A series of locations that have been chosen according to the objectives of the program and at which biota, sediment, and water samples are collected, usually at regular time intervals over a long period of time.

water quality objective A numerical concentration or statement of criteria established for water at a specified site based on the water's designated uses.

water quality parameter A measurable physical, chemical, radiological, or biological characteristic of an aquatic environment. Such a parameter is also called a water quality determinant or water quality variable. *See also* drinking water standard; primary maximum contaminant level; secondary maximum contaminant level.

water quality regulation (1) A regulation issued by a government agency that applies to a surface water based on intended or designated use, typically setting one or more water quality standards. (2) A regulation issued by a government agency that applies to drinking water quality, typically setting one or more drinking water quality standards. *See also* drinking water regulation; National Primary Drinking Water Regulation; National Secondary Drinking Water Regulation.

water quality sampling station A designated location on a water body where biota, sediment, or water are sampled for the purpose of physical, chemical, radiological, or biological analysis.

water quality standard (1) A numerical limit set by a government agency for a constituent or pollutant that applies to a surface water, typically based on the water's intended use. (2) A numerical limit set by a government agency for a constituent or pollutant that applies to drinking water. *See also* drinking water standard; National Primary Drinking Water Regulation; National Secondary Drinking Water Regulation.

water quality variable *See* water quality parameter.

water ram A device for lifting water, powered by the water hammer or impulse of water produced by periodically stopping the flow of water in the supply pipeline. A water ram is also called a hydraulic ram. *See also* water hammer.

water rate Generally, all of the components of the rates for water on a water bill. A water rate includes the monthly service charge if applicable, including a minimum charge; the water rate per unit of water consumed, which could be a single unit rate or an increasing or decreasing block rate; and any surcharges, such as those to recover costs of providing water to elevated areas or for summer use. A water rate does not include fees for turning services on or off, connection charges, or assessments. *See also* assessment district; capacity charge; rate making; water bill.

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water reclamation The treatment of wastewater to produce reclaimed water that is discharged to the environment or directly to a water reuse system. *See also* reclaimed wastewater.

water recycle The reuse of reclaimed water for an application in which the water was already originally used. This term is often associated with industrial water reuse.

water regain *See* water retention.

water-related disease A disease transmitted by contaminated water through ingestion, inhalation of aerosols, dermal contact, poor sanitation and hygiene, or insects that breed in water. *See also* water-based disease; waterborne disease; water-vectored disease; water-washed disease.

water requirement (1) Water needed for process makeup. (2) The water needed by crops for normal growth under field conditions.

Water Research Foundation Formerly known as the American Water Works Association Research Foundation (AwwaRF), a member-supported international nonprofit organization that sponsors research to enable water utilities, public health agencies, and other professionals to provide safe and affordable drinking water to the public. Its Web site is www.waterresearchfoundation.org.

water resources Water in various forms—such as groundwater, surface water, rain, snow, ice, clouds, and reclaimed or reused water—that is potentially useful for some purpose.

Water Resources Development Act (WRDA) A series of public laws that authorize federal spending for US Army Corps of Engineers water projects. The Water Resources Development Act of 1986 (P.L. 99-662) authorized $16 billion in total spending for construction of 263 water projects. The Water Resources Development Act of 1988 (P.L. 100-676) authorized 16 new water projects with an estimated federal cost of $1.7 billion. The Water Resources Development Act of 1990 (P.L. 101-640) authorized 26 new US Army Corps of Engineers water projects, and the Water Resources Development Act of 1992 (P.L. 102-580) authorized 23 new US Army Corps of Engineers water projects with an estimated federal cost of $1.56 billion.

water-retaining capacity The quantity of water retained against the pull of gravity by rock or earth that has become saturated and has been allowed to drain completely to a remote body of mobile water by way of continuous capillary interstices. *See also* specific retention.

water retention The amount of water, expressed as a percentage of the wet weight of an ion exchanger, retained within the resin bead and on the surface of fully swollen and drained ion-exchange media. Water retention is also called water regain.

water reuse The reuse of reclaimed water for one or more purposes, generally only as part of a planned reuse scheme. *See also* direct reuse; indirect reuse; nonpotable reuse; planned reuse; potable reuse; unplanned reuse; water recycle.

water right A legal right to use the water of a natural stream or water furnished through a ditch or canal for general or specific beneficial use. *See also* water law.

water right acquired by prescription A legal right to use water gained by one's own efforts or actions, acquired through the continued use of the water over a long period of time. *See also* call; conditional water right; junior rights; riparian water right.

water rights A body of law that determines water ownership. *See also* appropriation doctrine; English rule; prior appropriation; water law.

water-right value The monetary value of the right to use water from a given source. This value may be expressed in dollars per unit rate of flow or per unit of volume diverted during a year.

water sale Delivery of water to consumers at a predetermined rate or price.

water saver A toilet that meets the standard of 3.5 gallons (13 liters) per flush cycle as defined by American Society of Mechanical Engineers–American National Standards Institute Standard A112.19.6. A water saver should not be confused with a low-flow toilet using no more than 1.6 gallons (6 liters) per flush cycle. *See also* ultra-low-flush toilet.

water-saving device *See* water-saving fixture.

water-saving fixture A plumbing fixture or other appliance specifically designed to lessen water use when installed.

water-saving kit A set of devices sometimes distributed by utilities to reduce customer water usage.

Water Sector Coordinating Council (WSCC) A group of representatives from different water and wastewater volunteer organizations formed in 2004 to coordinate security issues and responses that affect the water industry. The WSCC serves as a policy, strategy, and coordination mechanism and recommends actions to reduce and eliminate significant homeland security vulnerabilities to the water sector through interactions with the federal government and other critical infrastructure sectors. Members of the WSCC include representatives from each of the following organizations: American Water Works Association, Water Research Foundation, Association of Metropolitan Water Agencies, National Association of Clean Water Agencies, National Association of Water Companies, National Rural Water Association, Water Environment Federation, and the Water Environment Research Foundation.

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water service pipe In plumbing, the pipe from the water main or other source of water supply to the premises being served.

water service schedule A statement required from water supply companies by state regulatory commissions, setting forth the rates to be charged to consumers.

watershed (1) An area from which water drains and contributes to a given stream. (2) The drainage basin area contained within the bounds specified by a divide and above a specified point on a stream. In water supply engineering, a watershed is also called a catchment area; in river control engineering, it is called a drainage area, a drainage basin, or a catchment area. (3) The divide between drainage basins.

watershed boundary The high point on a watershed that directs the flow of water in a certain direction. This boundary is also called the watershed divide.

watershed divide *See* watershed boundary.

watershed management A combination of planning, design, construction, operation, and government programs for the highest and best uses of a drainage area.

watershed planning (1) The process of planning the use and treatment of land and water that will most nearly meet all the objectives of soil and water conservation from the standpoint of both the individual farms and all the residents of the watershed. (2) The process of considering the interrelated uses of water from several watersheds to meet regional water supply requirements as well as local watershed objectives. This process may be part of state or national water resource planning.

watershed sanitation (1) The removal of actual sources of pollution of a watershed, as well as the prevention of potential sources. (2) Measures undertaken to minimize unavoidable pollution or to improve the quality of water for drinking.

watershed survey A technical review of a drainage area, usually for purposes of planning, design, and watershed control programs.

watershedwide atrazine ban A voluntary program initiated at the local level to encourage farmers to participate in a total ban or reduction of atrazine used within a specific watershed for the purpose of lowering concentrations of atrazine in runoff to surface water sources of drinking water. Where it has been practiced, participating farmers have indicated that voluntary compliance with such a ban is quicker and more effective at lowering atrazine concentrations in drinking water than waiting for mandatory regulatory compliance.

watersoaked Term applied to a porous body that has its pores and other openings completely filled with water. *See also* waterlogged; waterlogged soil.

water softener (1) A chemical compound that, when introduced into water used for cleaning or washing, will counteract the effects of the hard water minerals (calcium and magnesium) and produce the effect of softened water. For example, detergent additives and polyphosphates are water softeners. *See also* sodium hexametaphosphate. (2) A pressurized water treatment device in which hard water is passed through a bed of cation-exchange media (either inorganic or synthetic organic) for the purpose of exchanging calcium and magnesium ions for sodium or potassium ions, thus producing a softened water that is more desirable for laundering, bathing, and dishwashing. This cation-exchange process was originally called zeolite water softening. Most modern water softeners use a sulfonated bead form of styrene ($C_6H_5CH{:}CH_2$)/divinyl benzene ($C_6H_4(CH{:}CH_2)_2$) cation resin. *See also* hard water.

water softener salt Salt suitable for regenerating residential and commercial cation-exchange water softeners. The most commonly used salt for this purpose is sodium chloride (NaCl) in crystal or pelletized form. Rock-grade salt should be 96–99 percent NaCl; evaporated salt should be greater than 99 percent NaCl. Potassium chloride (KCl) may also be used for the regeneration cycle in the cation-exchange process, thus minimizing amount of sodium added to both the softened water and the spent regenerant water going to the drain.

water softening The removal of calcium and magnesium ions, which are the principal causes of hardness in water. The cation-exchange resin method is most commonly used for residential and commercial water treatment. In municipal and industrial water treatment, the process can be lime softening or lime–soda ash softening, called precipitative softening. Desalting processes also remove hardness ions. Nanofiltration, reverse osmosis, and electrodialysis membrane processes can be used for water softening. Nanofiltration membranes are sometimes called softening membranes. *See also* desalting; ion exchange; lime–soda ash softening; lime softening; membrane; nanofiltration; water softener.

waters of the United States The sum total of the following (as specified in 33 *Code of Federal Regulations* 328.a): (1) All waters that are currently used, or were used in the past, or may be susceptible to use by the United States in interstate or foreign commerce, including all waters subject to the ebb and flow of the tide. (2) All interstate waters, including interstate wetlands. (3) All other waters, such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, for which

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use, degradation, or destruction could affect interstate or foreign commerce, including any such waters (a) that are or could be used by interstate or foreign travelers for recreation or other purposes, (b) from which fish and shellfish are or could be taken and sold in interstate or foreign commerce, or (c) that are used or could be used for industrial purpose by industries in interstate commerce. (4) All impoundments of waters otherwise defined as waters of the United States under this definition. (5) Tributaries of waters identified under headings (1) to (4) above. (6) The territorial seas. (7) Wetlands adjacent to waters (other than waters that are themselves wetlands).

water solubility The maximum concentration of a chemical compound that can result when the compound is dissolved in water. If a substance is water soluble, it can very readily disperse through the environment.

water source The basic origin of a water, either a surface source (such as a lake, river or reservoir) or a subsurface source (such as a well). After treatment and pumping via pipelines, the treated and pumped water becomes potable water. For water-desalting treatment, seawater or saline water is the source.

waterspout A conduit or orifice from which water is spouted.

water spreading The artificial application of water to lands for the purpose of storing it in the ground for subsequent withdrawal by pumps for crops. *See also* spreading.

water-stage register *See* water-level recorder.

water-stage transmitter A device designed to transmit electrically a reading of the water level as it changes, for recording on a mechanically actuated chart.

water standard A criterion of water quality established as a basis of control for various water use classifications. *See also* water quality standard.

water still A device used to produce distilled water by evaporation and condensation of water.

water stop (1) A valve installed in a water service pipe for control of the flow of water to a building. A water stop is also called a curb stop and box, meter stop, or cutoff. (2) A flexible material installed in the construction joint of a concrete structure to prevent leakage at the joint.

water storage Water that is contained in tanks, reservoirs, clearwells, and the distribution system, and is readily available for use. This can include water for a specific purpose, such as fire protection.

water submeters (1) Secondary meters that account for a specific water use (such as cooling water) that is lost to evaporation. (2) Secondary meters used to account for another user's water after it has passed through a first user's system.

water supplier A person who owns or operates a public water system.

water supply (1) In general, the sources of water for public or private uses. (2) The furnishing of a good quality potable water under satisfactory pressure for domestic, commercial, industrial, and public service, as well as an adequate quantity of water under reasonable pressure for firefighting.

Water Supply and Sanitation Collaborative Council (WSSCC) An international organization administered by the World Health Organization that enhances collaboration in the water supply and sanitation sector, specifically in order to attain universal coverage of water and sanitation services for poor people around the world. WSSCC is a combination of a professional association and an international nongovernmental organization. It operates with a mandate from the United Nations General Assembly.

Water Supply and Water Resources Division (WSWRD) The division within the US Environmental Protection Agency's Office of Research and Development responsible for funding and conducting research on drinking water issues other than those pertaining to health effects. Health effects research is the responsibility of the National Health and Environmental Effects Research Laboratory. *See also* National Health and Environmental Effects Research Laboratory.

water supply development The planning, design, and construction of sources of water for public or private uses.

water supply facility The works, structures, equipment, and processes required to supply and treat water for domestic, industrial, and fire use.

Water Supply Improvement Association (WSIA) A predecessor of the organization currently named International Desalination Association (IDA). *See also* International Desalination Association.

water supply source A river, brook, stream, lake, reservoir, impoundment, spring, or aquifer from which a supply of water is or can be obtained. The use of the term *raw water* for source water is discouraged.

water supply system (1) Collectively, all property involved in a water utility, including land, water source, collection systems, dams and hydraulic structures, water lines and appurtenances, pumping system, treatment works, and general properties. (2) In plumbing, the water distribution system in a building or complex of buildings, including appurtenances.

water surface profile A trace of water-surface level showing the gradual variation of depth that takes place along a channel when the flow is nonuniform. *See also* hydraulic grade line.

water system Collectively, all of the property involved in the *operation* of a water utility, including land,

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water lines and appurtenances, pumping stations, treatment plants, and general property.

water system appurtenance A structure, device, or appliance—other than a pipe or conduit—that is used in connection with a water distribution system, such as a valve, hydrant, corporation cock, or service.

water system master plan A plan developed or updated by many water utilities every 5 years or so to identify the facilities and capacities necessary to meet current and future water demands. Such a plan includes assessments of account growth by customer type and area, as well as related water demands; supply sources and alternatives; water auditing practices, water loss control; infrastructure security; information technology; transmission, treatment, distribution, and storage facility requirements; compliance with water quality regulations through the treatment plants and the distribution system; fire flow requirements; hydraulic evaluation; and any other issues that deal with the parts or the whole of the water system. The water system is often modeled (simulated) and evaluated against hydraulic criteria to identify any deficiencies that might emerge at key nodes and milestone points, usually at 5- or 10-year increments up through buildout. Water rates are often evaluated as a part of the master plan, particularly if conservation goals are part of the long-run supply plan. *See also* capital improvement plan.

water system operation (WSO) A term usually referring to the operation of a water distribution system. The system begins with treatment plant output, and includes the transmission and distribution system, clear water reservoirs, pump stations, valves, hydrants, and other ancillary facilities. The water system operator controls flows, pressures, levels, and supply to and within the distribution system. The system is usually operated through a supervisory control and data acquisition (SCADA) interface. The operations center or load control is staffed by certified water system operators.

water table The surface in an unconfined aquifer where the water pressure is atmospheric. The water table is determined by measuring the water level in shallow wells installed a few feet into the zone of saturation. *See also* piezometric surface map.

water table aquifer An aquifer confined only by a lower impermeable layer. *See also* unconfined aquifer.

water-table contour A line connecting all points on a water table that have the same elevation above a given datum. *See also* isopiestic line.

water-table decline A downward movement of the water table, also called phreatic decline. *See also* mining groundwater.

water-table depression cone *See* circle of influence; cone of depression; drawdown; well cone of influence; zone of influence.

water-table fluctuation The alternate upward and downward movement of a water table. Such movement is also called phreatic fluctuation.

water-table gradient The rate of change of altitude per unit of horizontal distance in the water table at a given place and in a given direction. If the direction is not mentioned, it is generally understood to be the direction along which the maximum rate of change occurs. Where the rate of change is uniform between two points, the gradient is equal to the ratio of the altitude difference between the two points to the horizontal distance between them.

water-table isobath An imaginary line on the ground surface or a line on a map connecting all points at which the vertical distance above a certain water table is the same.

water-table map A contour map of the upper surface of an unconfined groundwater body.

water-table outcrop A place where the water table intersects the surface of the ground.

water-table profile (1) A line formed by the intersection of a water table with a vertical plane. (2) A graphical representation of such a line.

water-table rise Upward movement of a water table.

water-table slope *See* water-table gradient.

water-table spring A spring that occurs at the intersection of a water table and the surface.

water-table stream A concentrated groundwater flow at the water table in a formation or structure of high permeability.

water-table wave A wavelike movement of the water table in the direction of its slope. *See also* groundwater wave.

water-table well A well in which the source of supply is free groundwater in the saturation zone below a water table.

water-tank indicator A wood or metal strip bearing measurement marks and numbers, or a dial and needle (used with a float), to indicate the depth of water in a tank.

water tension The negative water pressure in unsaturated porous materials. The negative water pressure represents the energy per unit weight of water that must be exerted on the soil column to remove water. This energy is required to overcome both the capillary forces that "suck" water into the porous material and the adsorptive forces between the water and porous materials. In contrast, a saturated material has water at positive pressure that represents the energy per unit weight of water that can be recovered by draining. Tension is also called suction. To remove water from unsaturated

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materials, suction—i.e., negative pressure—must be applied; to force water into saturated materials, pressure must be applied.

watertight Impermeable to water unless sufficient pressure occurs to cause rupture. This term applies to water treatment equipment and materials of a certain level of precision of construction and fit.

water tightness test A hydrostatic test for newly installed piping in a distribution system. It involves pressurizing the line up to a specific pressure and determining the rate at which water is lost while the pressure is maintained over a length of time.

water tower A tower containing a tank in which water is stored, normally for providing local storage in a distribution system where ground-level storage would provide inadequate pressure. *See also* ground storage; standpipe.

water transport For membrane processes, the passage of water through a membrane. Water transport is desirable in reverse osmosis and nanofiltration and undesirable in electrodialysis. *See also* electrodialysis; nanofiltration; reverse osmosis; solvent (water) permeability coefficient.

water transport coefficient *See* solvent (water) permeability coefficient.

water treatment (1) The act of removing contaminants from source water by addition of chemicals, filtration, and other processes, thereby making the water safe for human consumption. (2) The act of adjusting water quality to satisfy the requirements of any end use. *See also* potable water.

water treatment facility *See* drinking water treatment facility.

water treatment plant (WTP) *See* drinking water treatment plant.

water treatment plant (WTP) simulation model A model developed by the US Environmental Protection Agency to simulate disinfection by-product (DBP) precursor removal and DBP formation in various common water treatment unit processes. The model allows the user to combine and run various unit processes in a given sequence to predict treatment process performance with respect to disinfection and DBP formation. In addition to simulating the effect of traditional water treatment processes, such as coagulation (or lime softening), flocculation, sedimentation, and filtration, the model can support many advanced disinfection and DBP control processes (e.g., enhanced coagulation, granular activated carbon adsorption, microfiltration, ultrafiltration, nanofiltration, reverse osmosis, ozonation, biological filtration, and chlorine dioxide addition). The model can be used in evaluating the relative effect of treatment on disinfection and DBP formation.

water treatment plant waste Residuals resulting from the treatment of water. Waste may take the form of a liquid (e.g., filter backwash water), solid (e.g., dried sludge cake), or gas (e.g., off-gas from air-stripping or activated carbon regeneration furnaces). *See also* activated carbon regeneration; air-stripping; filter backwash.

water treatment works (WTW) *See* drinking water treatment plant.

water tunnel (1) In a hydraulic laboratory, a device similar to a wind tunnel that uses water for the working fluid. (2) In water supply systems, a tunnel used to transport water.

water usage fee A fee based on the quantity of water used by each customer of a community water system.

water use Refers to water used for a specific purpose, such as for domestic use or irrigation, commercial, industrial, or agricultural activities. It also refers to water withdrawal, distribution, consumptive use, wastewater collection, and return flow.

water use efficiency Use of water in a way that meets the needs of the customer without waste. The term is often used interchangeably with *water conservation.*

water utility The collective set of features of a system that provides potable water to the public, including the source water facilities, treatment plant, and water distribution network. This term is typically used to designate all aspects of a given system.

water vapor The gaseous form of water; molecules of water present as a gas in an atmosphere of other gases. Water vapor moves from higher to lower vapor pressure regions to maintain vapor pressure equilibrium. It is also called aqueous vapor.

water-vectored disease A disease transmitted by insects that breed in water, like malaria-carrying mosquitoes, or insects that bite near water. Examples of such diseases include yellow fever, dengue fever, filariasis, malaria, and onchocerciasis.

water-washed disease A disease closely related to poor hygienic habits and sanitation. The availability of a sufficient quantity of water is felt to be more important than water quality in controlling these diseases.

water waste survey A survey undertaken to locate, measure, and control locations where water leaks away or is in any way wasted. *See also* active leakage control; leak survey; water audit.

waterway Any natural or artificial channel or depression in or under the ground surface that provides a course for water flowing either continuously or intermittently.

water well An artificial excavation that derives water from the interstices of the rocks or soil that it penetrates.

waterwheel A wheel so arranged with floats, buckets, or other such equipment that it may be turned by

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flowing water. The energy of moving water causes the wheel to revolve either by the weight of water dropping from a higher to a lower level and hitting a portion of the wheel or by dynamic pressure caused by a change in direction or velocity of a stream of water striking a part of the wheel. A waterwheel is also called simply a wheel.

water wheeling The movement of drinking water from a wholesale provider, through another system's pipe network, to a final user's system.

water wing A wall on the bank of a river adjoining a bridge abutment to protect the abutment's foundation from the action of the current. A water wing is sometimes referred to as a bund or a wing dike. *See also* wing wall.

water withdrawal The volume of water drawn or abstracted from a water source such as a well, lake, stream, river, quarry, or other source in a given period of time.

water works, waterworks *See* water utility.

waterworks aluminum Aluminum sulfate ($Al_2(SO_4)_3 \cdot 14 H_2O$). *See also* alum.

water year A continuous 12-month period during which a complete annual cycle occurs, arbitrarily selected from the presentation of data relative to hydrologic or meteorologic phenomena. The US Geological Survey uses the period October 1 to September 30 in the publication of its records of stream flow. A water year is also called a climatic year.

watt (W) *See in the Units of Measure section.*

wattmeter An instrument for measuring real power in watts.

wave front In a granular activated carbon adsorber, the activated carbon loading gradient that exists in the critical bed depth. This gradient corresponds to the gradual transition of the activated carbon from fresh (or virgin) to spent (or exhausted). *See also* mass transfer zone.

wavelength A measure of light or sound that corresponds to the distance between the maxima of the light or sound waves in a beam. The shorter the distance, the higher the frequency and energy of the beam.

wavenumber A measure of energy used in infrared spectrometry that is inversely proportional to wavelength by the following equation:

$$\text{wavenumber (in units of per centimeter)} = \frac{1}{\text{wavelength (in micrometers)}} \times 10^4$$

The wavenumber is often the preferred quantity in infrared spectrometry because it is proportional to the vibrational energy of a molecule.

waves of pollution Successive masses of polluted water occurring at intervals in a moving body of water.

wave velocity (1) The velocity at which the front of an increment of flow moves downstream. (2) The speed at which an individual wave form advances. *See also* celerity.

Wb *See* weber *in the Units of Measure section.*

WBDO *See* waterborne disease outbreak.

weak acid An acid that is only partially ionized in dilute water solutions. The quantitative measure of acid strength is the acid dissociated constant. For example, acetic acid (CH_3COOH) is a weak acid. *See also* acid; strong acid.

weak acid cation exchanger Those cation-exchange products with functional groups that are not capable of splitting neutral salts to form corresponding free acids. Weak acid cation-exchange resins have a much higher (three to four times higher) regeneration efficiency than their strong acid counterparts. They can only exchange ions in the neutral to alkaline pH range. Thus they can remove carbonate hardness. They cannot remove noncarbonate hardness as the pH would drop too low. *See also* free acid form; strong acid cation exchanger.

weak base anion exchanger Those anion-exchange products with functional groups that are not capable of splitting neutral salts to form corresponding free bases. Weak base anion-exchange resins have a much higher (three to four times higher) regeneration efficiency than their strong base counterparts, but they can only exchange anions in the acidic pH range. If the solution is neutral or basic, no exchange will take place. *See also* free base form; strong base anion exchanger.

weapon of mass destruction (WMD) Generally, any weapon capable of inflicting a large number of deaths immediately or over a period of time. Examples include chemical, biological, radiological, and explosive weapons.

wearing ring A ring installed between the casing and impeller of a centrifugal pump to reduce the space and slip of water, improving the efficiency of the pump.

weather (1) The present climate; one phase in the succession of phenomena for which the complete cycle, recurring with some degree of uniformity every year, constitutes the climate of any locality; the meteorological condition of the atmosphere defined by the measurement of the six meteorological elements: air temperature, barometric pressure, wind velocity, humidity, clouds, and precipitation. (2) To disintegrate or decompose rock at or near the surface by physical and chemical action of atmospheric agencies.

weather adjustment Water demand, revenues, or other variables adjusted to approximate those of a normal weather year; also known as weather normalization.

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weathering A geological transformation process of alteration, decomposition, and disintegration caused by the chemical and physical action of atmospheric agents on minerals and rocks, at the level of or near the surface of the lithosphere.

weathering zone The top layer of the lithosphere in the katamorphic zone, extending from the surface of the ground to the groundwater table. In this belt, the physical and chemical processes are destructive, resulting in a breaking down of the material. The zone is characterized by dissolution, softening, and a decrease in volume of its material. Below the belt of weathering lies the belt of cementation. *See also* aeration zone; anomorphic zone; katamorphic zone.

weather normalization *See* weather adjustment.

weather-normalized Statistically accounting for departures of weather variables from normal. Multiple regression analysis is frequently used in water demand forecasting to identify and quantify the causal influences of numerous variables on water demand. Weather is almost always a significant variable in such analyses, especially if monthly data are analyzed. As it does with other variables, regression analysis derives a coefficient (partial derivative) for each weather variable, stating how much water demand changes per unit of change in the weather variable. These coefficients can then be applied to historical periods to restate water demand on a normalized basis, i.e., as if the actual weather had been normal. This is accomplished by substituting normal weather (long-run average) into the demand (regression) equation in place of actual weather data. Similarly, forecasts for future periods can be expressed in terms of normal weather by applying the regression coefficients to normal (long-run average) weather for these periods. The regression coefficients may further be used to predict the sensitivity of water demand to abnormal weather in a given period for peaking or revenue-planning analyses. *See also* multiple linear regression analysis.

Web-based GIS technology Use of Internet resources to display geographic information system (GIS) data needed by multiple users. Examples include sites that allow members of the public to locate their address, register a complaint, apply for a permit, or perform other routine applications related to a particular geographic point. The technology allows users to view geographic data without having to purchase individual software licenses.

Web browser A computer program that requests, retrieves, interacts with, and displays electronic files from the World Wide Web.

weber (Wb) *See in the Units of Measure section.*

Weber number A numerical quantity used as an index to characterize the type of flow in a hydraulic structure where surface tension influences motion phenomena as a result of tension in the elastic skin, particularly when considerable curvature of this skin exists, in conjunction with the resisting force of inertia. The Weber number is useful in certain studies of surface waves, formation of drops and air bubbles, entrainment of air in flowing water, and other related phenomena. In equation form

$$W_e = \frac{\rho V^2 L}{\sigma}$$

Where:

W_e = the Weber number
ρ = the fluid density
V = the characteristic velocity of the system (e.g., the mean, surface, or maximum velocity, depending on the situation)
L = the characteristic length (e.g., diameter or depth, depending on the situation)
σ = the surface tension

These terms must be expressed in consistent units so that the Weber number will be dimensionless.

weep hole An opening formed during the construction of retaining walls, aprons, canal linings, and foundations to permit drainage of water collecting behind and beneath such structures. Such drainage is needed to reduce hydrostatic head.

weeping Leakage of minute amounts of fluid through a pipe wall.

WEF *See* Water Environment Federation.

Weibull–Gamma model A mathematical model used to assess microbial risk and to develop dose–response relationship for various types of infection. Other models used for this purpose include beta-Poisson model and exponential model. A Weibull–Gamma model is typically described in the following form:

$$P = 1 - [1 + (Dose)^b/\beta]^{-\alpha}$$

where P is the probability of infection (i.e., response to the dose); Dose can be in any typical unit such as number of oocysts per milliliter; b is a parameter defining the shape of the dose–response curve; and α and β are values defined by the dose–response curve specific to individual organisms.

Weibull model A low-dose extrapolation model based on a distribution of sensitivities in a population (i.e., based on the idea that some level of exposure exists beneath which individuals would not respond with an adverse effect—a threshold). The Weibull model expresses the probability of an adverse effect at low doses by establishing a dose-response relationship that

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considers a distribution of thresholds in a population. It generally provides estimates of risk that are intermediate between those provided by the linearized multistage model and multihit models. *See also* linearized multistage model; log-probit model; logit model; multihit model; multistage model; one-hit model; probit model; threshold; Weibull–Gamma model.

weight (wt) A quantity of force associated with an object, depending on the context. Considerable confusion exists in the use of this term. In commercial and everyday use, the term *weight* nearly always means mass, e.g., in the context of a person's weight. This nontechnical use of the term *weight* in everyday life will probably persist. In science and technology, a body's weight refers to the force that, if applied to the body, would give it an acceleration equal to the local acceleration of free fall (with *local* usually referring to a location with respect to the surface of the earth). In this context, the local acceleration of free fall is represented by the symbol *g* (commonly referred to as the gravitational constant or the acceleration of gravity). The term *force of gravity* is preferred instead of *weight.* Because of its dual usage, the term *weight* should be avoided in technical practice, except under circumstances in which its meaning is completely clear. When the term is used, knowing whether mass or force is intended is important. Note, however, that on the surface of the earth, weight is often expressed in mass units. For example, a value in terms of milligrams per liter is conventionally considered weight per unit volume. *See also* earth's gravitational constant *in the Units of Measure section;* mass; universal gravitational constant *in the Units of Measure section.*

weight concentration ratio In ultrafiltration, the ratio of the initial weight of the feedwater to the weight of the reject water remaining at any time during the process.

weighted average A calculated average of a set of observations in which some observations are given more or less importance than others by assignment of weighting factors. A weighting factor greater than 1 is assigned to increase the importance of an observation, whereas a weighting factor less than 1 is assigned to signify less importance.

weighted monthly mean precipitation *See* true monthly mean precipitation.

weighting agent A material, such as bentonite, added to low-turbidity waters to provide additional particles for good floc formation.

weight-of-evidence approach An examination of all the available data to make a scientific judgment of whether a chemical is carcinogenic in humans. It includes data obtained from epidemiological analysis, where cause can be narrowed to a few agents or a defined mixture of agents; animal data in which concordance across species is examined; and mechanistic data, which may provide insight into processes that induced the tumor at the high doses normally tested. This information is then examined in light of human exposures to determine if the chemical could possibly or even probably be a human carcinogen.

weight per volume (w/v) The weight of the solute divided by the final volume of the solution. If a dilute solution is prepared in water, the density of the solution will be approximately 1 gram per milliliter. Thus, the weight-per-volume value can be readily converted to a weight-per-weight (or percent by weight) basis. Units of milligrams per liter represent an example of a weight-per-volume unit for a trace level of a solute. *See also* solute; solution; weight per weight.

weight per weight (w/w) The weight of the solute divided by the final weight of the solution. When multiplied by 100, the value becomes the percent by weight. Units of parts per million represent an example of a weight-per-weight unit for a trace level of a solute. *See also* parts per million *in the Units of Measure section;* solute; solution.

weight units *See in the Units of Measure section.*

weir A dam-like device with a crest and some side containment of known geometric shape placed perpendicular to flow to measure or control the flow rate of water in a channel.

weir box A box installed in a narrow open channel upstream from a weir to provide an enlargement of the waterway, for the purpose of reducing the velocity of approach to the weir.

weir diameter The length of a line from one edge of a circular clarifier's circular weir to the opposite edge, passing through the center of the circle formed by the weir. Many circular clarifiers have circular weirs within the outside edges of the clarifiers. All the water leaving such a clarifier flows over this weir.

weir head (1) The vertical distance from the crest of a weir to the water surface upstream of the weir. (2) The energy head of the water measured above the height of the crest of the weir.

weir loading *See* weir loading rate.

weir loading rate (1) In a solids contact unit, the rate—in gallons per minute per foot (cubic meters per minute per meter) of weir length—at which clarified or treated liquid is leaving the unit. (2) A guideline used to determine the length of weir needed on settling tanks and clarifiers in treatment plants. Such a value is used by operators to determine whether weirs are hydraulically (flow) overloaded. Maximum weir loading rates are often specified to avoid undesirable performance resulting from poor outlet hydraulics. For example, high weir loading rates in a sedimentation basin can cause high, localized

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vertical velocities, resulting in poor particle settling. *See also* overflow weir.

weir overflow rate *See* weir loading rate.

weir teeth The portion of a notched weir plate that is designed to maintain a constant level behind the weir. Water flows through the notches, or teeth, and a constant level is maintained behind the weir. *See also* alligator teeth; V-notch weir.

welded steel pipe Steel pipe made from sheets of steel curved into a cylindrical shape with the edges welded together. Field joints may be flanged, screwed, or welded. The seams may form a spiral running around the circumference of the pipe with welding along the seam. *See also* riveted steel pipe.

well (1) An artificial excavation that derives water from the interstices of the rocks or soil that the excavation penetrates. (2) A shaft or hole into which water may be conducted by ditches to drain water away from a construction area.

well capacity The maximum rate at which a well will yield water under a stipulated set of conditions, such as a given drawdown, pump and motor, or engine size. Well capacity may be expressed in terms of cubic feet per second, gallons per minute, cubic meters per minute, or other similar units. *See also* circle of influence; cone of depression; zone of influence.

well casing The nonperforated riser pipe that connects a well to the surface.

well clogging A geochemical, physical, or biological process that causes plugging or clogging of aquifer sediment or well screens, resulting in lower efficiency and decreased production. Clogging can occur because of geochemical or biological reactions that cause minerals to precipitate and plug pore spaces or well screens, physical plugging by smaller sediments or colloidal materials, and by biological slimes and other bacteriological deposits that can create corrosion cells.

well cone of influence The depression, roughly conical in shape, produced in a water table or other piezometric surface by the extraction of water from a well at a given rate. The volume of the cone will vary with the rate and duration of withdrawal of water. Such a cone is also called a cone of depression. *See also* circle of influence; cone of depression; drawdown; zone of influence.

well curb A concrete or masonry parapet built around a well at ground level to prevent drainage of surface water into the well.

well development The process of cleaning the fines and drilling residue from a new well to improve its yield and quality for subsequent use in water production.

well field A group of wells treated as a single entity for administrative, production, and treatment purposes. Hydraulic models frequently treat several wells in the same geographic area as a single well with a discharge equivalent to that of all the wells in the well field.

well field placement The process of arranging wells to achieve a desired output from an aquifer.

well flooding (1) A process of diverting water from streams when the supply exceeds the demand and allowing it to pass into the saturation zone through a well constructed for that purpose. As a result, the water may be stored for future use. (2) The overtopping of a well by floodwaters. *See also* flood spreading; spreading.

wellhead The surface appurtenance (top) of a particular well. The wellhead is the location of the pump motor (unless the motor and pump are both submersible), the concrete slab that surrounds the well casing, and any plumbing dedicated to that particular well. A group of wells that are geographically close may share a storage tank, but each well has its own wellhead. A group of wells is often called a well field. *See also* well field.

wellhead protection A process of guarding against potential groundwater contamination for a specific groundwater source.

wellhead protection area (WHPA) The surface and subsurface area that surrounds a water well or well field supplying a public water system and through which contaminants may move toward and reach the water well or well field. Frequently a 1-year, 5-year, or 10-year time of contaminant travel is used to define the size of the protection area, and this area has restricted land-use activity to protect the quality of the water serving the water supply well. *See also* well isolation zone.

wellhead protection program (WHPP) A state program authorized by Section 1428 of the Safe Drinking Water Act to protect wellhead areas from contaminants that may have any adverse effects on the health of persons. The state wellhead protection program, at a minimum, must (1) specify the duties of state agencies, local governmental entities, and public water supply systems with respect to the development and implementation of the wellhead protection program; (2) for each wellhead, determine the wellhead protection area based on all reasonably available hydrogeologic information on groundwater flow, recharge, and discharge, as well as other information the state deems necessary to adequately determine the wellhead protection area; (3) identify within each wellhead protection area all potential anthropogenic sources of contaminants that may have any adverse effect on the health of persons; (4) describe a program that contains, as appropriate, technical assistance, financial assistance, implementation of control measures, education, training, and demonstration projects to protect the

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water supply within wellhead protection areas from such contaminants; (5) include contingency plans for the location and provision of alternative drinking water supplies for each public water system in the event of well or well field contamination by such contaminants; and (6) include a requirement that consideration be given to all potential sources of such contaminants within the expected wellhead area of a new water well that serves a public water supply system. *See also* wellhead protection area.

well hydrograph A graphical representation of the fluctuations of the water surface in a well (plotted along the ordinate) against time (plotted along the abscissa).

well infiltration area The area of a water-bearing formation that contributes to a well.

well intake The well screen, perforated sections of casing, or other openings through which water from a water-bearing formation enters a well.

well interference The additional drawdown observed when two or more wells are operating in the same aquifer. Neglecting the effect of other wells can lead to inadequate suction head at a well's pump if the expected drawdown was computed based on only the one well operating.

well isolation zone A surface or zone of restricted land use surrounding a water well or well field that supplies a public water system. Such restricted land uses prevent contaminants caused by forbidden activities from moving toward and reaching the water well or well field. *See also* wellhead protection area.

well log A record of the thickness and characteristics of the soil, rock, and water-bearing formations encountered during the drilling (sinking) of a well.

well monitoring The process of measuring, by on-site instruments or laboratory methods, the quality of water in a well.

well mouth The orifice or opening at the upper end of a well, generally at or near the surface, that provides access to the interior of the well.

well plate kit An autosampler tray consisting of a large number (tens to thousands) of tightly packed slots for samples for high-throughput analyses. The kit permits multiple samples to be processed simultaneously.

well plug A watertight and gastight seal installed in a borehole or well to prevent movement of fluids. Wells are plugged when they are abandoned to prevent the introduction of pollutants into the subsurface.

well point A pointed hollow tube driven into the ground with a small screened portion near the end. Well points are used primarily for construction dewatering and water quality sampling, but they can also supply production quantities of water in appropriate regions.

well-point method A method of removing water from the ground by the use of well points.

well-point system A system of well points, header pipe, pumps, valves, discharge pipe, and appurtenances installed for removing water from the ground.

well record A concise statement (tabular or otherwise) containing all the available data regarding the hydraulic performance of a well. In some sections of the United States, this term is applied only to the record of fluctuations of the water level in a well, along with the date when each change in the water level elevation was observed and measured.

well recovery The decrease in drawdown of the water table (return to predevelopment conditions) when a pumping well is shut off.

well screen A sleeve with slots, holes, gauze, or wire wrap placed at the end of a well casing to allow water to enter the well. The screen prevents sand from entering the water supply.

well seepage area *See* well infiltration area.

well shooting The act of firing a charge of nitroglycerin or other high explosive in the bottom of a well to increase the flow of water.

well strainer A type of well screen manufactured from woven screen of varied gauge wrapped on a casing perforated with holes. This type of screen is used in well points that are driven into the ground with percussion for shallow domestic wells or for dewatering purposes. *See also* well point.

well water Water obtained from a well built into or drilled into the zone of saturation. *See also* groundwater.

Wenner array *See* dipole array.

WERL *See* Water Engineering Research Laboratory.

Western blot A procedure used to detect proteins in which the proteins are first electrophoretically separated and then transferred to a paper matrix such as nitrocellulose. Subsequent probing of the proteins immobilized on such a solid support membrane with antibodies or specific ligand reagents allows individual components of a complex mixture to be analyzed.

WET *See* waste extraction test.

wet-barrel hydrant A fire hydrant with no main valve. Under normal, nonemergency conditions, the barrel is full and pressurized (as long as the lateral piping to the hydrant is under pressure and the gate valve ahead of the hydrant is open). Each outlet has an independent valve that controls discharge from that outlet. The wet-barrel hydrant is used mainly in areas where temperatures do not drop below freezing. The hydrant has no drain mechanism.

wet-bulb depression The difference in degrees between the current or concurrent temperatures of the dry-bulb and wet-bulb thermometers of a psychrometer. *See also* psychrometer.

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wet-bulb temperature The temperature of air as measured by the wet-bulb thermometer in a psychrometer. This temperature will be lower than that measured by the dry-bulb thermometer in inverse proportion to the humidity. Wet-bulb and dry-bulb temperatures are the same when the air is saturated. *See also* dry-bulb temperature; relative humidity.

wet-bulb thermometer One of two similar thermometers of a psychrometer, the bulb of which is moistened by means of a special wick. (The other thermometer is a dry-bulb thermometer.) *See also* wet-bulb temperature.

wet chemistry analysis The use of laboratory procedures to analyze a sample of water such that liquid chemical solutions are used instead of, or in addition to, laboratory instruments.

wet connection A connection made to a water main under pressure by a pipe-tapping machine without an interruption in service.

wetland An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

wetland boundary The line along the ground at which a shift from a wetland to a nonwetland area occurs, as determined on the basis of a certified wetland scientist's judgment.

wetland creation The conversion of a persistent upland or shallow water area into a wetland through human activity.

wetland determination The process by which an area is identified as a wetland or nonwetland.

wetland enhancement *See* enhanced wetland.

wetland function The physical, chemical, and biological processes or attributes of a wetland without regard to their importance to society.

wetland hydrology In general terms, permanent or periodic inundation or prolonged soil saturation sufficient to create anaerobic conditions in the soil.

wetland indicator status The exclusiveness with which a plant species occurs in wetlands. *See also* facultative plant; facultative upland plant; facultative wetlands plant; obligate wetlands species.

wetlands buffer zone The area within a wetlands that is regulated for protection.

wetland value A wetland process or attribute that is valuable or beneficial to society.

wet-line correction In wire sounding to measure water depths, the correction applied to that part of the line below the water surface, where large vertical angles are induced because of high water velocities, great depth, insufficient sounding weight, or any combination. *See also* air-line correction.

wetness index A numerical quantity, usually expressed as a percentage, calculated as the ratio of the annual runoff of a stream or drainage basin for a given year to the average runoff over a considerable period of years.

wet-salt saturator tank A type of brine tank in which the saturated brine is always above the undissolved salt level in the bottom of the tank. This type of tank is used on large commercial water softeners and older manual residential softeners. Most automatic, home-sized water softeners now use dry-salt saturator tanks. *See also* dry-salt saturator tank.

wet scrubber A device installed to remove dust from a dry chemical feeder by means of a continuous water spray.

wet-shake test A test used to help determine the soil type in an excavation. A person performs this test by taking a soil patty approximately ⅛ to ¼ inches (3 to 6 millimeters) thick in the palm of his or her hand. The person wipes the surface clear of any water, then slaps the back of his or her hand. If water comes to the surface, the soil is considered to be mostly cohesive silt or sand. An absence of water indicates that the soil is mostly cohesive clay. The wet-shake test is also called the pat test.

wet soil Soil that contains significantly more moisture than moist soil but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

wet tap A connection made to a water main when it is full or under pressure. *Compare with* dry tap.

wetted perimeter The length of wetted contact between a stream of flowing water and its containing conduit or channel, measured in a plane at right angles to the direction of flow. *See also* hydraulic radius.

wet testing For a membrane product, such as a reverse osmosis and nanofiltration membrane element, the performance testing of the membrane product at standard test conditions, typically at the manufacturing facility. *See also* nanofiltration; reverse osmosis.

wetting A process by which a liquid is absorbed by a solid surface and forms a liquid film that wets the surface.

wetting agent *See* surface-active agent.

wet-top hydrant A dry-barrel hydrant in which the threaded end of the main rod and the revolving or operating nut are not sealed from water in the barrel when the main valve of the hydrant is open and the hydrant is in use.

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wet volume capacity The maximum liquid volume that a unit process is designed to hold. Additional volume, or freeboard, is often provided so that the process does not overflow.

wet well A basin that is used to collect a specified volume of water and therefore permit the continuous operation of unit processes. For example, a pumping wet well is used to ensure that a minimum volume is available to be pumped to subsequent unit processes. The level in the wet well may vary, and the pumping rate may be changed, to respond to needed changes in the flow rate and to permit continuous plant operation.

WF *See* water factor.

WFI (water for injection) *See* water for injection *under* pharmaceutical grade water.

WFP *See* water filtration plant; Water for People.

wheel *See* waterwheel.

wheeling charge Fees assessed by a utility or company for the use of its facilities to another utility, district, company, or organization for transmission of electricity, gas, oil, water, and so forth that are owned by the transmitter. Charges for use of transmission facilities, volumes to be transmitted, and times when such transfers can occur are set forth in use agreements or contracts.

wheel pit An enclosure in which waterwheels are located.

Whipple grid A micrometer reticule grid used along with a stage micrometer with a standardized, accurately ruled scale for calibration of a microscope. The grid is placed in the eyepiece of the microscope. A Whipple grid is also called a Whipple square.

whirl vortex The whirling or circular motion that is generated in water passing out of a small opening or orifice in the bottom of a basin or other receptacle and that creates a funnel-shaped opening downward from the water surface, extending ultimately below the bottom of the basin. *See also* vortex.

white blood cell count The number of white blood cells present in a specified volume of blood. This count can be broken down for various types of white blood cells. *See also* lymphocyte.

white light extinction sensor A detector used for particle counting, especially for oils in the aerospace industry.

white paper A document prepared as an argument concerning a particular issue on behalf of an organization. It may establish a more argumentative tone than a position paper.

whitewater blanket The layer of air bubbles that exists in the contact zone (inlet zone) and at the top of the main portion (separation zone) of a dissolved air flotation tank. The whitewater blanket enables flotation of flocs. *See also* dissolved air flotation.

WHO *See* World Health Organization.

wholesale contract An agreement whereby water is sold by one utility to another utility and is delivered at one or more major points for resale to individual customers by the purchaser.

wholesale water system A water system, public, private or cooperative, that sells or otherwise delivers water to another water system, usually smaller, on a regular basis at least 60 days per year and not on an emergency basis.

wholesome water Water that is safe and palatable for human consumption. *See also* potable water.

WHP *See* water horsepower.

WHPA *See* wellhead protection area.

WHPP *See* wellhead protection program.

wicket dam A movable dam consisting of a sill and a number of wickets or rectangular panels of wood or iron, hinged on the sill and held up nearly vertical by a hinged prop that has a footing on the sill and can be tripped, dropping the wickets flat on the sill.

wide area network (WAN) A network designed for relatively large geographic areas. Such a network may consist of multiple local area networks connected together via communication links. Such networks commonly link multiple office locations in different cities for a single company or consortium of companies.

wide-crested weir A weir having a substantial width of crest in the direction parallel to the direction of water flow over it. The nappe is supported on the crest for an appreciable length, and the weir produces no bottom contraction of the nappe. Such a weir is also called a broad-crested weir.

width (*w*) The smaller of the two dimensions in the measurement of a rectangular object. *See also* length.

Wilcoxon rank-sum test A nonparametric statistical test used for comparing two groups of data that fall within certain limits (e.g., the number of animals that died within certain limits of time). The data in the two groups and the sum of the ranks (i.e., the sum of the rank orders of each data point in the group) found in each group are compared.

Wild and Scenic Rivers Act (WSRA) A public law enacted in 1968 (16 US Code Section 1271 *et seq.*) to protect rivers selected for preservation because of their "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values."

wilderness A wild and uncultivated region (e.g., a desert or a forest) that is inhabited only by wild animals and is generally unchanged by humans.

wildlife habitat Part of the terrestrial ecosystem on which wildlife can be supported.

wild variable Any input to a feedforward controller that is not impacted, even indirectly, by the output from the controller. An example would be the flow

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signal used for pacing of chemicals in a water plant. *See also* feed-forward control.

willful violation A knowing breach of a standard or failure to correct known hazards that results in an Occupational Health and Safety Administration citation. A repeat of a willful violation can result in a monetary fine.

willingness-to-pay model The amount of money people are willing to pay for a certain service, such as future reduction of risk.

WIN *See* Water Infrastructure Network.

wind Air in natural motion along the earth's surface.

windage Water carried from a stripping tower by the wind. This water is not available for recirculation.

windbreak A line of trees, shrubs, or other vegetation usually planted perpendicular or nearly so to the principal wind direction to protect such things as soil, crops, homesteads, and roads against the effects of wind, such as wind erosion and the drifting of soil and snow.

wind deposit Soil deposited by the action of the wind. A wind deposit is also called an aeolian deposit.

wind direction The point of the compass from which the wind blows (not that toward which it is moving).

wind gap A narrow opening through a range of hills or mountains, originally formed as a water gap but from which the original stream that formed it has been diverted.

wind gauge An instrument for measuring the force or velocity of wind; an anemometer. *See also* anemometer.

windings The wiring in an electric motor laid around the stator and embedded in an insulating resin material.

wind pump A pump operated by the force of the wind rotating a multiple-blade propeller. A wind pump is sometimes called a windmill.

windrow composting A method of composting material by applying it in rows, with space between the rows to allow for placing, mixing, and removing the composted material. A special machine is used to periodically intermix and turn over the material to promote stabilization. *See also* composting.

wind setup In lakes and reservoirs, a deviation from a still water surface elevation caused by the transport of surface water by winds. *See also* seiche.

wind tide In any body of water, a deviation from a still water surface elevation caused by the transport of surface water by winds.

wind wave (1) A wave formed and growing in height under the influence of wind. (2) Loosely, any wave generated by wind.

wing dam A wall, crib, row of piles, stone jetty, or other barrier projecting outward from the shore or bank into a stream or other body of water for such purposes as protecting the shore or bank from erosion, arresting sand movement along the shore, or concentrating the low flow of a stream into a smaller channel. A wing dam is also called a groin, jetty, or spur.

wing screen A screen for which the screening elements are set in radial planes of curved vanes rotating on a horizontal axis.

wing wall (1) The wall of a dam structure extending from the headwall downstream a distance equal to the length of the apron, constructed to prevent sloughing of banks or channels and to direct and confine overfall. (2) The wall extending from a culvert headwall, intended to prevent sloughing of embankment into the waterway.

Winkler titration An iodometric titration method for volumetrically determining dissolved oxygen in water. It is used both to determine dissolved oxygen and to calibrate other methods of determining dissolved oxygen. Several modifications of the procedure are available to account for certain interferences.

wire dam A dam constructed of rock held together by wire mesh, used principally in flood protection works. Such a dam is sometimes called a wire-wrapped dam.

wireless technology Combination of both hardware and software that allows computers and other peripherals to operate without hard-wired connections.

wire-mesh screen A screen made of a wire fabric attached to a metal frame. Such a screen is usually part of a motorized system so that it can move continuously through the water and be automatically cleaned with a water spray. A wire-mesh screen removes finer debris from the water than a bar screen.

wire sounding A process of measuring water depth by using a calibrated wire with a sounding weight on the bottom.

wire-to-water efficiency The efficiency of a pump and motor together. This value is also called the overall efficiency and can be computed by the following equation: (total dynamic head × 0.00315)/(bowl efficiency × motor efficiency). It is expressed in units of kilowatt hours/1,000 gallons pumped.

wire-weight gauge A river gauge in which a weight suspended on wire is lowered to the water surface from a bridge or other overhead structure to allow the distance from a point of known elevation on the bridge to the water surface to be measured.

WISE program *See* Water Infrastructure Security Enhancements program.

withdrawal In pharmacology and therapeutics, a syndrome that occurs following discontinuation of the use of a drug that imparts some physical dependence with repeated use (i.e., addiction). The symptoms of withdrawal are specific to the nature of the drug. For example, barbiturates produce a different complex of symptoms than heroin.

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WMD *See* weapon of mass destruction.

wobble meter *See* nutating-disk meter.

Wolinella succinogenes (W. succinogenes) A gram-negative, helical bacterium found in the bovine rumen. This bacterial species of the family Helicobacteraceae is not pathogenic, although other species of the family are, including *Helicobacter pylori. W. succinogenes* is the sole member of the genus *Wolinella.*

wood-based granular activated carbon Granular activated carbon that is made from wood as a raw material. This substance has a larger external pore structure than comparable products that reportedly can assist in maintaining a biologically active population, particularly under colder temperatures. *See also* biologically enhanced activated carbon.

wood screw pump A pump that has a horizontal cylindrical casing and in which a runner with radial blades like those of a ship's propeller operates. *See also* horizontal screw pump.

work In a mechanical sense, an energy transfer across a system boundary in an organized form such that its sole effect is equivalent to the raising of a mass. *See also* energy.

workable residuals Residuals that can readily be forked or shoveled from a residuals drying bed. Workable residuals ordinarily have less than 75 percent moisture.

workforce diversity Personnel in the utility at all levels of employment—managers, supervisors, technicians, work crews—who are multicultural and not dominated by any one nationality, color, or gender.

work hour An industrial time unit of 60 minutes (1 hour) of work by one person for a previously agreed-on rate of compensation. This term has replaced the term *man hour.*

working barrel The metal tube or pump cylinder that is fastened to the lower end of the dropline of a deep well and that contains the valves and pistons of a reciprocating pump.

working capital Cash, materials, supplies, and other similar current assets necessary in the operation of the enterprise. It is usually measured by the excess of current assets over current liabilities, or sometimes as a percentage of annual operation and maintenance expense levels.

working pressure *See* operating pressure.

working pressure head The actual head of water flowing at any point in a conduit; the vertical height from the centerline of a conduit to the hydraulic grade line.

work in progress Construction work undertaken but not yet completed.

work order A written order authorizing and directing the performance of a certain task and issued to the person who is to direct the work. Items of information shown on the order are the nature and location of the job, specifications of the work to be performed, and the work order number to be referred to in reports of the amount of labor, materials, and equipment used.

works A group or assemblage of physical devices and structures for any of a variety of useful purposes, e.g., a water treatment plant.

workstation A high-performance computer system designed for use by an individual. The workstation is engineered for networking and providing powerful computational capabilities for graphics and technical applications.

work units *See in the Units of Measure section.*

World Health Organization (WHO) A specialized agency of the United Nations with primary responsibility for international health matters and public health. Created in 1948, the World Health Organization promotes the development of comprehensive health services, the prevention and control of diseases, the improvement of environmental conditions, the development of health-related human resources, the coordination and development of biomedical and health services research, and the planning and implementation of health programs. The organization is headquartered in Geneva, Switzerland.

World Wide Web (www) A worldwide series of linked computer files residing in machines scattered throughout the Internet. The World Wide Web is accessed via browser software that allows users to view and interact with graphics and text. The World Wide Web is hypertext based. It is sometimes called simply the Web.

worst-case scenario A set of assumptions that represent the worst possible outcome of a circumstance, theory, or estimate.

wound-rotor induction motor A type of electric motor, similar to a squirrel-cage induction motor but easier to start and capable of variable-speed operation.

woven-hose lining A process of renovating structurally sound water mains by installing a thin fabric hose that attaches to the inside pipe wall by a heat-cured epoxy resin, thereby providing internal corrosion protection and covering small leaks or leaking joints.

WPCF *See* Water Pollution Control Federation.

WQA *See* Water Quality Association.

WQC *See* water quality certification.

WRDA *See* Water Resources Development Act.

wrought-iron pipe Pipe made of true wrought iron.

wrought pipe Pipe made by welding long steel plates with butt or lap welds or by piercing and drawing a seamless tube from a billet.

WSIA *See* Water Supply Improvement Association; International Desalination Association.

WSO *See* water system operation.

WSRA *See* Wild and Scenic Rivers Act.

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WSSCC *See* Water Supply and Sanitation Collaborative Council.

W. succinogenes *See Wolinella succinogenes.*

WSWRD *See* Water Supply and Water Resources Division.

wt *See* weight.

WTP (water treatment plant) *See* drinking water treatment plant.

WTP simulation model *See* water treatment plant simulation model.

WTW (water treatment works) *See* drinking water treatment plant.

w/v *See* weight per volume.

w/w *See* weight per weight.

WWEMA *See* Water and Wastewater Equipment Manufacturers Association.

www *See* World Wide Web.

wye (1) A pipe branching off a straight main run at an angle of 45°. (2) A polyphase electric circuit for which the phase difference is 120° and that, when drawn, resembles the letter *Y*.

wye strainer A screen shaped like the letter *Y*. The water flows in at the top of the *Y*, and the debris in the water is removed in the bottom two branches of the *Y*.

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X

X *See* halogen.

x bitmap (XBM) A simple computer image format. X bitmaps appear only in black and white. They are used in UNIX applications and found in HyperText Markup Language documents. *See also* HyperText Markup Language.

XBM *See* x bitmap.

xenobiotic A synthetic product not formed by natural biosynthetic processes; a foreign substance or poison. The production of many novel xenobiotics has introduced into the environment many compounds that microorganisms normally do not encounter and are therefore not prepared to biodegrade. Many of these compounds are toxic to living systems, and their presence in aquatic and terrestrial habitats often has serious ecological consequences, including major kills of indigenous biota. *See also* anthropogenic; biodegradation; biota; synthetic organic chemical.

xenon-gas flash lamp *See* pulsed ultraviolet light.

Xeriscape™ A landscape design approach involving seven principles that promote water efficiency: (1) planning and design; (2) soil improvements; (3) efficient irrigation; (4) zoning of plants; (5) mulches; (6) turf alternatives; and (7) appropriate maintenance. The word comes from the Greek *xeros,* which means "dry." The concept was developed by the Denver Water Department.

xeriscaping A landscaping practice that involves selecting trees and shrubs that require small amounts of water.

xerophreatophyte A phreatophyte that is able to resist drought.

xerophyte A plant structurally adapted to growth in an area of limited water supply, such as a desert.

X-linked *See* cross-linkage.

X-ray (1) Electromagnetic radiation with a very short wavelength (0.01 to 12 nanometers), shorter than for ultraviolet radiation, capable of penetrating solids and ionizing gases. (2) An image created by short-term exposure of an object to X-rays, used in spectrometry analysis and medical therapy.

X-ray diffraction (XRD) A technique used in the identification of crystalline compounds. This technique is also used to study the structure of crystals. Within a laboratory instrument, X-rays bombard a sample and interact with the layers of atoms composing a crystal. The ordered structure of a crystal scatters the X-rays and produces a diffraction pattern characteristic of the substance. The traditional way of recording diffraction patterns is on a photographic surface. This information can be used to empirically identify the crystalline substance.

X-ray fluorescence A technique used for the identification and semiquantitative analysis of solids and liquids. Following absorption of X-rays, excited atoms in a sample emit fluorescent X-rays that are characteristic of the atoms.

X-ray photoelectron spectroscopy A technique in which the sample is illuminated with soft (1.5-kilovolt) X-ray radiation in an ultrahigh vacuum. The photoelectric effect leads to the production of photoelectrons, the energy spectrum of which can be determined in a beta-ray spectrometer.

XRD *See* X-ray diffraction.

x terminal A high-resolution video display that contains a network card, processor, and memory.

***x–y* coordinates** The elements of a Cartesian coordinate system that specify the location of a point on a plane. Most maps are based on a geographic reference grid that indicates the horizontal (*x*) and vertical (*y*) coordinates of all features included on the map. The grid is defined by an origin point, and coordinates are defined as increments from this origin along the *x* and *y* axes. The reference grid may be an arbitrary local coordinate system, or it may be based on a global reference grid (e.g., latitude–longitude) that accurately references map features to absolute positions on the earth's surface.

xylene ($C_6H_4(CH_3)_2$) The common name for dimethylbenzene, a commercial mixture of three isomers, *ortho-*, *meta-*, and *para*-xylene. Xylenes are used in aviation gasoline and protective coatings, and they are used as solvents and insecticides. These volatile organic compounds are regulated in drinking water by the US Environmental Protection Agency at a maximum contaminant level of 10 milligrams per liter. *See also* insecticide; isomer; solvent; volatile organic compound.

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Y

yard (yd) *See in the Units of Measure section.*

yard meter A water service separate from the domestic service and used only for irrigation purposes. An irrigation water rate, without charges for wastewater, applies for a yard meter.

Y connection (1) A pipe fitting with three branches positioned in one plane in the pattern of the letter *Y.* (2) More generally, any junction of three pipes or open channels forming roughly, in plan view, the letter *Y.*

yd *See* yard *in the Units of Measure section.*

yd^3 *See* cubic yard *in the Units of Measure section.*

yeast A broad group of fungal microorganisms capable of causing fermentation.

yellow water Water that is colored as a result of the presence of iron. The iron can originate either from the source water or from corrosion reactions with iron piping. Yellow water is sometimes referred to as red water.

Y. enterocolitica *See Yersinia enterocolitica.*

Yersinia A genus of bacteria in the family Enterobacteriaceae and characterized as gram-negative, fermentative, facultatively anaerobic, rod-shaped bacteria. The most important species is *Yersinia enterocolitica,* toxigenic strains of which are human pathogens. All species of *Yersinia* are widely distributed in the aquatic environment, but few appear to be pathogenic for humans.

Yersinia enterocolitica (Y. enterocolitica) A species of gram-negative, rod-shaped bacteria that has been implicated in a few outbreaks of waterborne yersiniosis, as well as in foodborne outbreaks. Swine, and possibly wild rodents, appear to be natural reservoirs of these organisms and may cause frequent contamination of water. This organism is able to grow well at low temperatures (including refrigerator temperatures) and may adapt well to the aquatic environment. Thus, isolation of this species from the environment—from refrigerated food samples or from clinical samples—involves using cold enrichment, followed by plating on one or more selective enrichment media. (Cold enrichment involves the use of low-temperature—39° Fahrenheit (4° Celsius)—incubation. These bacteria are better able than others to grow at low temperatures; hence, they grow to increased numbers while other bacteria do not.)

Yersinia pestis (Y. pestis) A species of gram-negative coccobacillus belonging to the family Enterobacteriaceae. *Y. pestis* is primarily a rodent pathogen, with humans being an accidental host when bitten by an infected rat flea or through direct exposure to infected tissues or respiratory droplets. The organism can live from months to years at freezing temperatures, and can also remain viable in dry sputum, flea feces, and buried bodies. *Y. pestis* causes plague**,** a disease characterized in the early stages by fever, chills, headache, and malaise. Within hours of the initial flea bite, the infection enters the bloodstream, leading to involvement of the liver, spleen, and lungs. Severe bacterial pneumonia develops, with the patient exhaling large numbers of viable organisms into the air during coughing fits. Also known as the Black Death, the plague swept across Europe and Asia in a series of pandemics during the Middle Ages, causing the death of one third of the world's population at that time. Left untreated, 50 percent to 60 percent of infected individuals die. Most human cases in the United States occur in the states of New Mexico, Arizona, Colorado, California, Oregon, and Nevada. Plague also exists in Africa, Asia, and South America.

yersiniosis An acute enteric disease caused by *Yersinia pseudotuberculosis* (with symptoms including abdominal pain mimicking appendicitis) or *Y. enterocolitica* (with symptoms including diarrhea, fever). Bloody diarrhea is seen in 10 to 30 percent of children infected with *Y. enterocolitica;* adults often report joint pain. *Y. pseudotuberculosis* primarily causes zoonosis, with humans as incidental hosts. *Y. enterocolitica* has been recovered from a wide variety of animals, with the pig being the principal reservoir. About two thirds of *Y. enterocolitica* cases occur among infants and children. *See also* waterborne disease; zoonosis.

yield (1) The quantity of water, expressed as a rate of flow, that can be collected for a given use or uses from surface water or groundwater sources on a watershed. The yield may vary based on the use proposed, the plan of development, and economic considerations. (2) Total runoff. (3) The stream flow in a given interval of time derived from a unit area of watershed, usually expressed in cubic feet per second per square mile (cubic meters per second per square kilometer). (4) An expression of the amount of material ultimately produced by a given process, e.g., volume or weight of sludge produced. (5) The net amount of a desired product from a chemical reaction.

yield curve A graphical depiction of the series of annual returns to investors.

yield per foot (meter) The amount of water produced per foot (meter) of drawdown. As applied to groundwater, the yield per foot (meter) is the same as the specific capacity of a well. As applied to a surface

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reservoir or impoundment, the yield per foot (meter) is the volume of water produced for each foot (meter) of decline in storage depth. *See also* circle of influence; cone of depression; drawdown; specific capacity; zone of influence.

yoke (1) A designed meter setter providing proper spacing, alignment, and bracing of the inlet and outlet pipes, allowing simplified setting and removal of meters. (2) A 45° branch in the shape of a letter *Y*.

young professional (YP) Term used to describe people just starting their careers, typically 35 years old or younger.

young river In geological terms, a river that is actively eroding its channel.

young valley A valley that is in its earliest stages of development. Such a valley is usually V-shaped in cross section, with a narrow bottom, relatively steep slopes, and poorly developed small tributaries. *See also* youthful valley.

youthful valley A stream valley that is still in the early stages of its development. Such a valley is usually V-shaped in cross section, has a narrow bottom with a steep gradient, has few tributaries, and is of relatively short length.

YP *See* young professional.

Y. pestis *See Yersinia pestis.*

yr *See* year *in the Units of Measure section.*

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Z

***z* coordinate** The third element of a point's location in space in a Cartesian coordinate system. The horizontal positions are identified by *x* and *y* coordinates. The *z* coordinate identifies the vertical position, or elevation, of a point or feature. *See also x–y* coordinates.

zebra mussel A bivalve that has become a serious pest because it blocks intake pipes. *See also Dreissena polymorpha;* quagga mussel.

Zeeman background correction An instrumental technique of compensating for interferences in graphite furnace atomic absorption spectrophotometry. In this technique, a strong magnetic field divides spectral lines into polarized components. Background correctors based on the Zeeman effect are independent of the analyte and wavelength used in the determination.

zeolite Any of numerous hydrated sodium alumina silicates, either naturally occurring mined products or synthetic products, with ion-exchange properties. Zeolites were formerly used extensively for residential and commercial water softening but have been largely replaced by synthetic organic cation resin ion exchangers. Modified zeolites, such as manganese greensand and synthetic manganese zeolites, are still used as catalyst/oxidizing filter media for the removal of iron, hydrogen sulfide, and manganese. *See also* cation-exchange resin; manganese greensand; manganese zeolite.

zeolite filter In water softening, a treatment unit designed to remove certain chemical constituents from water by base exchange. Zeolite is the exchange medium. *See also* zeolite process.

zeolite process A process of softening water by passing it through a zeolite substance that exchanges other constituents for hardness constituents in the water.

zeolite softening The removal of calcium and magnesium hardness from water by a base-exchange process using natural or synthetic zeolites. Since the introduction of synthetic organic cation-exchange resins, zeolite softening has generally been replaced by cation-exchange softening. Zeolite softening was also called base exchange. *See also* cation exchange.

zero-base budget A system of budgeting in which resource allocations, from zero to the top, are determined within the total budget in terms of achieving organization objectives, with opportunities and risks taken into account. A process in finance justifying an overall budget each fiscal year or review period rather than dealing only with proposed changes from a previous budget.

zero-coupon bond A bond purchased at a large discount relative to its value at maturity. The bond then earns interest that is reinvested, helping the bond grow to its stated value at maturity. For example, a 5-year $1,000 zero-coupon bond earning interest of 8.0 percent per year would be initially sold for $680.58 and redeemed 5 years later for $1,000. The retention of interest makes a zero-coupon bond a powerful earning instrument. Although the interest is not paid out to the bondholders as it is earned, it is taxable in the year it is earned. A zero-coupon bond is also called a capital-appreciation bond. *See also* deep-discount bond.

zero discharge Term used to describe the operation of a facility that results in no discharge to a body of water. In water treatment, this commonly means the recycle of all liquid streams and the disposal of solids on land. Land spraying of liquids or use as irrigation water would similarly be considered to be zero discharge if the material does not reach a water body. Discharge to a wastewater plant would not be zero discharge as the effluent of the wastewater plant generally is discharged to a water body.

zero-moisture index The amount of precipitation *uniformly* distributed throughout the year that would supply all the water needed for maximum evaporation and transpiration. Annual precipitation in excess of the zero-moisture index will produce surface runoff and recharge to the groundwater system. Annual precipitation less than the zero-moisture index will require moisture stored in the soil to be used to satisfy the evaporation–transpiration requirement. The zero-moisture index is so called because annual precipitation at this value would not change the soil moisture content during the year.

zero-order kinetics *See* reaction order.

zero point of charge (ZPC) The pH corresponding to a surface charge of zero on a particle. Many particles found in natural waters have surface charges dependent on the solution pH and can exhibit both positive and negative charges (i.e., can be amphoteric). *See also* electrokinetic potential; electrophoretic mobility; streaming current.

zero soft water Water produced by the cation-exchange process and having less than 1.0 grain per gallon (17.1 milligrams per liter) as calcium carbonate ($CaCO_3$).

zero-valent iron The elemental iron, Fe^0, or iron species having a valence of zero, which can be used as an in situ treatment method for the cleanup of soils and

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groundwater contaminated with halogenated hydrocarbons or leachable heavy metals. It can be injected underground at the contaminated site in granular form or in slurry for in situ remediation. *See also* valence.

ζ *See* electrokinetic potential.

zeta meter *See* zeta potential meter.

zeta plus filter *See* electropositive filter.

ζ potential *See* zeta potential.

zeta potential (ζ) An operationally determined measure of the charge of a particle. According to Gouy-Chapman theory, the distribution of charge in the vicinity of a charged particle can be thought of in terms of an electric double layer. One layer is seen as fixed to the particle surface, while the other is distributed in the liquid around the particle. When the particle moves through the liquid, the fixed layer of charge moves with the particle, while the outer layer remains stationary. The interface between these two layers is referred to as the shear plane. Note that the distance between the actual particle surface and the shear plane cannot be accurately measured. Zeta potential is theoretically defined as the difference in electric potential at this shear plane and the bulk liquid. Operationally, zeta potential (ζ) can be calculated from electrophoretic mobility measurements, in which the velocity of a particle subjected to a known electric field is measured. For particles greater than 0.5 micrometers in diameter, electrophoretic mobility (EPM) and zeta potential are related as follows:

$$EPM = \left(\frac{\varepsilon_w}{\mu}\right)\zeta$$

Where:

EPM = electrophoretic mobility
ε_w = the dielectric constant of water
μ = the dynamic viscosity of water
ζ = zeta potential

See also electrokinetic potential.

zeta potential meter A device used to measure the zeta potential of a water sample. This type of meter is used to control the dosage of coagulants in water treatment and is also called an electrophoretic mobility apparatus.

zinc (Zn) A metallic element that is an essential growth element in terms of nutrition. Zinc is used industrially in alloys, electroplating, batteries, and fungicides. *See also* fungicide; zinc orthophosphate.

zinc orthophosphate ($Zn_3(PO_4)_2$) A chemical used in corrosion control that reacts with the surface of a pipe to form a protective coating. *See also* corrosion; corrosion inhibitor.

zinkgeriesel The granular zinc precipitate that results from corrosion of galvanized pipe.

ZLD (zero liquid discharge) *See* zero discharge.

zone of aeration The soil or rock located between the ground surface and the top of the water table.

zone of coagulation Term used to describe one of the four conditions for particulate removal by coagulation based on the initial solids concentration of the water and the coagulant dose. The four zones are typically shown graphically where the residual turbidity is plotted as a function of coagulant dose. In zone 1, insufficient coagulant is present to allow destabilization of the particles. As the concentration of the positively charged coagulant is increased, the negatively charged particles are neutralized, and they tend to agglomerate. This zone of coagulation, zone 2, is called the destabilization by charge neutralization zone. As the concentration of the positively charged coagulant is increased further, however, the particles may become positively charged and again resist agglomeration. This is called the restabilization zone, or zone 3. Finally, at high concentrations of the coagulant, the particles may become enmeshed in the chemical precipitate formed by the coagulant. This zone, zone 4, is called the sweep coagulation zone or the sweep floc zone. *See also* coagulant, coagulation.

zone of influence The area around a well or well field that experiences a measurable drawdown during pumping of the well or group of wells. *See also* circle of influence; cone of depression; drawdown; well cone of influence.

zone of saturation That part of an aquifer that has all available pore spaces filled with water.

zone settling *See* type III settling.

zoning A civil process that specifies which types of land use are allowable in specific locations.

zoonosis An infection or disease transmissible under natural conditions from vertebrate animals to humans.

zooplankton Microscopic animals living unattached in aquatic ecosystems. They include single-celled animals and small crustacea.

zoospore An asexual spore produced by certain algae and some fungi. *See also* spore.

ZPC *See* zero point of charge.

zwitterion A molecule in which the positive and negative groups are equally ionized. At the isoelectric point—the pH at which the net charge of a molecule in solution is zero—amino acids exist almost entirely in the zwitterion state. In the zwitterion structure of an amino acid, the acidic proton from the carboxyl group has been appropriated by the basic nitrogen of the amino group. *See also* amino acid; isoelectric point; zero point of charge.

zygote The cell formed by the union of two gametes.

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About the Editors

Nancy E. McTigue, *Editor*

Nancy E. McTigue has worked actively in the water field since earning her bachelor's degree at Wellesley College and her master's degree in environmental engineering at Stanford University. Her career has included positions at the US Environmental Protection Agency and the American Water Works Association Research Foundation (now the Water Research Foundation). For the past twenty years, she has served as director of research for EE&T, an environmental consulting firm that provides services to water utilities worldwide. Her work has included technical reports and presentations on various aspects of drinking water treatment optimization and management issues facing the industry. She has been an active and committed volunteer for AWWA throughout her career, serving on and chairing many committees and advisory boards.

James M. Symons, *Editor Emeritus*

James M. Symons, retired, is the Cullen Distinguished Professor Emeritus of Civil Engineering, University of Houston. He holds master of science and doctor of science degrees in sanitary engineering from the Massachusetts Institute of Technology and a bachelor's degree in civil engineering from Cornell University. He is a diplomate of the American Academy of Environmental Engineers and a member of the National Academy of Engineering and American Water Works Association. In addition to his academic career, he has worked for the US Environmental Protection Agency and the US Public Health Service and has received numerous research and publications awards and honors. He is also the author emeritus of *Plain Talk About Drinking Water*, fifth edition, published by AWWA.

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APPENDIXES

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Appendix 1

Units of Measure

acceleration units In US customary units, feet per second squared. In Système International, meters per second squared.

acre A unit of area. This is not a Système International unit.

acre-foot (acre-ft) A unit of volume. One acre-foot is the equivalent amount or volume of water covering an area of 1 acre that is 1 foot deep. This is not a Système International unit.

ampere (A) In Système International, that constant current that, if maintained in two straight parallel conductors of infinite length or negligible cross section and placed 1 meter apart in a vacuum, would produce a force equal to 2×10^{-7} newton per meter of length (adopted at the 9th General Conference on Weights and Measures in 1948).

ampere-hour (A•h) A unit of electric charge equal to 1 ampere flowing for 1 hour. This is not a Système International unit.

angstrom (Å) A unit of length equal to 10^{-10} meter. This is not a Système International unit.

areal standard unit (asu) count A unit of measurement used in the evaluation of the number of aquatic plankton, frequently algae, in water (this number is sometimes called the standing crop). A small volume of water is examined microscopically and the number of areal standard units counted. One areal standard unit is equal to four small squares in a Whipple grid at a magnification of 200. Areal standard units represent the number per unit volume. *See also* Whipple grid *in the Glossary section.*

atmosphere (atm) A unit of pressure equal to 14.7 pounds per square inch (101.3 kilopascals) at average sea level under standard conditions. This is not a Système International unit.

atomic mass unit (amu) A unit of mass equivalent to one twelfth the atomic weight of carbon.

atto Prefix meaning 10^{-18}, used in Système International.

avoirdupois (avdp) The weight of an object in the English system in which 1 pound equals 16 ounces. This weight is not given in Système International units. To convert to SI units, multiply pounds by 454 to obtain grams and ounces by 28.4 to obtain grams.

bar A unit of pressure defined as 100 kilopascals. This is not a Système International unit.

barrel (bbl) A unit of volume, frequently 42 gallons for petroleum or 55 gallons for water. It is also a commercial unit of volume used to measure dry commodities, equal to 4.083 cubic feet. This is not a Système International unit.

baud A measure of analog data transmission speed that describes the modulation rate of a wave, or the average frequency of the signal. One baud equals 1 signal unit per second. If an analog signal is viewed as an electromagnetic wave, one complete wavelength or cycle is equivalent to a signal unit. The term *baud* has often been used synonymously with *bits per second.* The baud rate may equal bits per second for some transmission techniques, but special modulation techniques frequently deliver a bits-per-second rate higher than the baud rate.

becquerel (Bq) In Système International, the becquerel is the activity of a radionuclide decaying at the rate of one spontaneous nuclear transition per second.

billion electron volts (BeV) A unit of energy equivalent to 10^9 electron volts.

billion gallons per day (bgd) A unit for expressing the volumetric flow rate of water being pumped, distributed, or used. This is not a Système International unit.

binary digits (bits) per second (bps) A measure of the data transmission rate. A binary digit is the smallest unit of information or data, represented by a binary "1" or "0."

British thermal unit (Btu) A unit of energy. One British thermal unit is the quantity of heat required to raise the temperature of 1 pound of pure water 1° Fahrenheit. This is not a Système International unit.

bushel (bu) A unit of volume. This is not a Système International unit.

caliber (1) The diameter of a round body, especially the internal diameter of a hollow cylinder. (2) The diameter of a bullet or other projectile, or the diameter of a gun's bore. In US customary units, usually expressed in hundreths or thousandths of an inch and typically written as a decimal fraction (e.g., 0.32). In Système International units, expressed in units of millimeters.

calorie (gram calorie) A unit of energy. One calorie is the amount of heat necessary to raise the temperature of 1 gram of pure water at 15° Celsius by 1° Celsius. This is not a Système International unit.

candela (cd) In Système International, a unit of luminous intensity. One candela is the luminous intensity, in a given direction, of a source that emits monochromatic

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radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of $^1/_{683}$ watt per steradian (adopted by the 16th General Conference on Weights and Measures in 1979).

candle A unit of light intensity. One candle is equal to 1 candela. This is not a Système International unit. Candelas are the preferred units.

candlepower A unit of light intensity. One candlepower is equal to 1 candela. This is not a Système International unit. Candelas are the preferred units.

centi (c) Prefix meaning 10^{-2}, used in Système International. Its use should be avoided except in the measurement of area and volume.

centimeter (cm) A unit of length defined as one hundredth of a meter.

centimeter–gram–second (CGS) system A metric system of physical measurements in which the fundamental units of length, mass, and time are the centimeter, the gram, and the mean solar second. This is not the Système International system.

centipoise A unit of absolute viscosity equivalent to 10^{-2} poise. This is not a Système International unit. *See also* poise.

chloroplatinate (Co–Pt) unit (cpu) *See* color unit.

cobalt–platinum unit *See* color unit.

colony-forming unit (cfu) A unit of expression used in enumerating bacteria by plate-counting methods. A colony of bacteria develops from a single cell or a group of cells, either of which is a colony-forming unit.

color unit The unit used to report the color of water. Standard solutions of color are prepared from potassium chloroplatinate (K_2PtCl_6) and cobaltous chloride ($CoCl_2 \cdot 6H_2O$). Adding the following amounts in 1,000 milliliters of distilled water produces a solution with a color of 500 color units: 1.246 grams potassium chloroplatinate, 1.00 grams geobaltous chloride, and 100 milliliters concentrated hydrochloric acid (HCl).

conductance units In US customary system, mhos. In Système International, siemens; seconds cubed amperes squared per square meter per kilogram.

conductivity units In US customary system, micromhos per centimeter. In Système International, siemens per meter; seconds cubed amperes squared per meter per kilogram.

coulomb (C) In Système International, a quantity of electricity or electric charge. One coulomb is the quantity of electricity transported in 1 second by a current of 1 ampere, or about 6.25×10^{18} electrons. Coulombs are equivalent to ampere-seconds.

coulombs per kilogram (C/kg) A unit of exposure dose of ionizing radiation. *See also* roentgen.

counts per minute (cpm) In an examination of water for radioactivity, the number of disintegrations measured in 1 minute after correction for background; a net count rate. The net count rate is used in the calculation of a radioisotope's concentration.

cubic feet (ft^3) A unit of volume equivalent to a cube with a dimension of 1 foot on each side. This is not a Système International unit. *See also* 100 cubic feet (ccf).

cubic feet per hour (ft^3/h) A unit for indicating the rate of liquid flow past a given point. This is not a Système International unit.

cubic feet per minute (ft^3/min, CFM, cfm) A unit for indicating the rate of liquid flow past a given point. This is not a Système International unit.

cubic feet per second (ft^3/s, CFS, cfs) A unit for indicating the rate of liquid flow past a given point. This is not a Système International unit.

cubic inch ($in.^3$) A unit of volume equivalent to a cube with a dimension of 1 inch on each side. This is not a Système International unit.

cubic meter (m^3) A unit of volume equivalent to a cube with a dimension of 1 meter on each side.

cubic yard (yd^3) A unit of volume equivalent to a cube with a dimension of 1 yard on each side. This is not a Système International unit.

curie (Ci) A unit of radioactivity. One curie equals 37 billion disintegrations per second, or approximately the radioactivity of 1 gram of radium. This is not a Système International unit.

current density units In US customary system, amperes per square foot. In Système International, amperes per square meter.

cycles per second (cps) A unit for expressing the number of times something fluctuates, vibrates, or oscillates each second. These units have been replaced by hertz. One hertz equals 1 cycle per second.

cytopathic unit (cpu) A unit used to measure changes in cells (e.g., tissue culture) caused by microorganism infection.

dalton (D) A unit of weight. One dalton designates $^1/_{16}$ the weight of oxygen-16. One dalton is equivalent to 0.9997 atomic weight unit, or nominally 1 atomic weight unit. The Système International accepts dalton as an alternative name for the unified atomic mass unit, often used in microbiology and biochemistry to state the masses of large organic molecules. These measurements are typically in kilodaltons (kDa). *See also* atomic mass unit.

darcy (da) Unit used to describe the permeability of a porous medium (e.g., the movement of fluids through underground formations studied by petroleum engineers, geologists or geophysicists, and groundwater specialists). A porous medium is said to have a permeability of 1 darcy if a fluid of 1-centipoise viscosity that completely fills the pore space of the medium will flow through it at a rate of 1 cubic centimeter per second per

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square centimeter of cross-sectional area under a pressure gradient of 1 atmosphere per centimeter of length. In Système International units, 1 darcy = 9.87×10^{-13} square meters.

day (d) A unit of time equal to 24 hours.

deca *See* deka.

deci Prefix meaning 10^{-1}, used in Système International. Its use should be avoided except for the measure of area and volume.

decibel (dB) A dimensionless ratio of two values expressed in the same units of measure. It is most often applied to a power ratio and defined as decibels = 10 $\log_{10}$ (actual power level/reference power level), or dB = 10 $\log_{10}$ (W_2/W_1), where W is the power level in watts per square centimeter for sound. Power is proportional to the square of potential. In the case of sound, the potential is measured as a pressure, but the sound level is an energy level. Thus, dB = 10 $\log_{10}$ $(p_2/p_1)^2$ or dB = 20 $\log_{10}$ (p_2/p_1), where p is the potential. The reference levels are not well standardized. For example, sound power is usually measured above 10^{-12} watts per square centimeter, but both 10^{-11} and 10^{-16} watts per square centimeter are used. Sound pressure is usually measured above 20 micropascals in air. The reference level is not important in most cases because one is usually concerned with the difference in levels, i.e., with a power ratio. A power ratio of 1.26 produces a difference of 1 decibel.

deciliter (dL) A unit of volume defined as one tenth of a liter. This unit is often used to express concentration in clinical chemistry. For example, a concentration of lead in blood would typically be reported in units of micrograms per deciliter.

degree (°) A measure of the phase angle in a periodic wave. One degree is $^1/_{360}$ of the complete cycle of the periodic wave. Three hundred sixty degrees equals 2π radians.

degree Celsius (°C) A unit of temperature. The degree Celsius is exactly equal to the kelvin and is used in place of the kelvin for expressing Celsius temperature (symbol t) defined by the equation $t = T - T_0$, where T is the thermodynamic temperature in kelvin and T_0 = 273.15 kelvin by definition.

degree Fahrenheit (°F) A unit of temperature on a scale in which 32° marks the freezing point and 212° the boiling point of water at a barometric pressure of 14.7 pounds per square inch. This is not a Système International unit.

degree kelvin (K) *See* kelvin.

degree Rankine (°R) A unit of temperature. One Rankine degree is equal to one Fahrenheit degree, but the zero point of the scale is set at absolute zero. This is not a Système International unit.

deka (da) Prefix meaning 10^1, used in Système International. Its use should be avoided except for the measure of area and volume.

density units (1) In US customary system, pounds mass per cubic foot or slugs per cubic foot. In Système International, kilograms per cubic meter or grams per cubic centimeter. (2) In US customary system, bits per inch or track.

dram (dr) Small weight. Two different drams exist: the apothecary's dram (equivalent to 3.8879 grams) and the avoirdupois dram (equivalent to 1.7718 grams).

dyne A unit of force in the centimeter–gram–second metric system adopted in 1881, defined as that force that will impart to a free mass of 1 gram an acceleration of 1 centimeter per second squared. This is not a Système International unit.

earth's gravitational constant (g) As adopted by the International Committee on Weights and Measures, 32.174 feet per second squared (9.80665 meters per second squared). It is also called the acceleration of gravity.

einstein A unit of measure expressing the total energy of 1 mole of light photons, which depends on the wavelength. In equation form,

$$E = \frac{hc}{\lambda}$$

Where:

E = total energy per photon, in joules
$h = 6.63 \times 10^{-34}$ joule-seconds per photon
$c = 3.0 \times 10^8$ meters per second
λ = wavelength, in meters

As an example, for $\lambda = 254 \times 10^{-9}$ meters, 1 einstein is 7,870 watt-minutes or 472.2 kilojoules.

electrical potential units In Système International, volts; meters squared kilograms per seconds cubed per ampere.

electric charge density units In Système International, coulombs per cubic meter; ampere-seconds per cubic meter.

electric charge units In Système International, coulombs; ampere-seconds.

electric current units In Système International, amperes.

electric field strength units In Système International, volts per meter; meter-kilograms per second cubed per ampere.

electric flux density units In Système International, coulombs per square meter; ampere-seconds per square meter.

electric resistance units In Système International, ohms; meters squared kilograms per second cubed per ampere squared.

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electromotive force units In Système International, volts; meters squared kilograms per second cubed per ampere.

electron volt (eV) In the US customary system, a unit of energy commonly used in the fields of nuclear and high-energy physics. One electron volt is the energy transferred to a charged particle with single charge when that particle falls through a potential of 1 volt. An electron volt is equal to 1.6×10^{-19} joule.

energy density units In Système International, joules per cubic meter; kilograms per meter per second squared.

energy units In US customary system, British thermal units; foot-pounds force; horsepower hours; kilowatt-hours. In Système International, joules; newton-meters; kilograms square meters per second squared.

entropy units In US customary system, British thermal units per degree Rankine. In Système International, joules per kelvin; meters squared kilograms per second squared per kelvin.

equivalents per liter (eq/L) In Système International, an expression of concentration equivalent to normality. The normality of a solution (equivalent weights per liter) is a convenient way of expressing concentration in volumetric analyses. *See also* normality *in the Glossary section.*

exa (E) A prefix meaning 10^{18}, used in Système International. Its use should be avoided except in the measurement of area and volume.

farad (F) In Système International, the unit of electrical capacitance. One farad is the capacitance of a capacitor between the plates of which a difference of potential of 1 volt appears to be present when the capacitor is charged by a quantity of electricity equal to 1 coulomb. Farads are equivalent to seconds to the fourth amperes squared per meter squared per kilogram.

fathom A unit of length equivalent to 6 feet, used primarily in marine measurements. This is not a Système International unit.

feet (ft) The plural form of a unit of length (the singular form is *foot*). This is not a Système International unit.

feet board measure (fbm) A unit of volume. One board foot is represented by a board measuring 1 foot by 1 foot by 1 inch thick (144 cubic inches). A board measuring 0.5 feet by 2 feet by 2 inches thick would equal 2 board feet. This is not a Système International unit.

feet per hour (ft/h) A unit for expressing the rate of movement. This is not a Système International unit.

feet per minute (ft/min) A unit for expressing the rate of movement. This is not a Système International unit.

feet per second (ft/s, fps) A unit for expressing the rate of movement. This is not a Système International unit.

feet per second squared (ft/s^2) A unit of acceleration (rate of change of linear motion). For example, the acceleration caused by gravity is 32.2 ft/s^2 at sea level. This is not a Système International unit.

feet squared per second (ft^2/s) A unit used in flux calculations. This is not a Système International unit.

femto (f) Prefix meaning 10^{-15} in Système International.

fluid ounce (fl oz) A unit for expressing volume, equivalent to $^1/_{128}$ of a gallon. This is not a Système International unit.

foot A unit of length, equivalent to 12 inches. This is not a Système International unit. *See also* US customary system of units.

foot of water (39.2° Fahrenheit) A unit for expressing pressure or elevation head. This is not a Système International unit.

foot per second per foot (ft/s/ft; s^{-1}) A unit for expressing velocity gradient. This is not a Système International unit.

foot-pound, torque A unit for expressing the energy used in imparting rotation, often associated with the power of engine-driven mechanisms. This is not a Système International unit.

foot-pound, work A unit of measure of the transference of energy when a force produces movement of an object. This is not a Système International unit.

force units In US customary system, pound force. In Système International, newton; kilogram-meters per second squared.

formazin turbidity unit (ftu) A turbidity unit appropriate when a chemical solution of formazin is used as a standard to calibrate a turbidimeter. If a nephelometric turbidimeter is used, nephelometric turbidity units and formazin turbidity units are equivalent. *See also* nephelometric turbidity unit.

frequency units In US customary system, cycles per second. In Système International, hertz; number per second.

gallon (gal) A unit of volume, equivalent to 231 cubic inches. It is also called US gallon. This is not a Système International unit. *See also* Imperial gallon.

gallons per capita per day (gpcd) A unit typically used to express the average number of gallons of water used by the average person each day in a water system. The calculation is made by dividing the total gallons of water used each day by the total number of people using the water system. This is not a Système International unit.

gallons per day (gpd) A unit for expressing the discharge or flow past a fixed point. This is not a Système International unit.

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gallons per day per square foot (gpd/ft^2, gfd, gsfd) A unit of flux equal to the quantity of liquid in gallons per day through 1 square foot of area. It may also be expressed as a velocity in units of length per unit time. In pressure-driven membrane treatment processes, this unit is commonly used to describe the volumetric flow rate of permeate through a unit area of active membrane surface. It is generally referred to as the hydraulic loading rate. In settling tanks, this rate is called the overflow rate. This is not a Système International unit.

gallons per flush (gal/flush, gpf) The number of gallons used with each flush of a toilet. This is not a Système International unit.

gallons per hour (gph) A unit for expressing the discharge or flow of a liquid past a fixed point. This is not a Système International unit.

gallons per minute (gpm) A unit for expressing the discharge or flow of a liquid past a fixed point. This is not a Système International unit.

gallons per minute per square foot (gpm/ft^2) A unit for expressing flux, the discharge or flow of a liquid through a unit of area. In a filtration process, this unit is commonly used to describe the volumetric flow rate of filtrate through a unit of filter media surface area. It may also be expressed as a velocity in units of length per unit time. This is not a Système International unit.

gallons per second (gps) A unit for expressing the discharge or flow past a fixed point. This is not a Système International unit.

gallons per square foot (gal/ft^2) A unit for expressing flux, the discharge or flow of a liquid through each unit of surface area of a granular filter during a filter run (between cleaning or backwashing). This is not a Système International unit.

gallons per square foot per day *See* gallons per day per square foot.

gallons per year (gpy) A unit for expressing the discharge or flow of a liquid past a fixed point. This is not a Système International unit.

gamma (γ) A symbol used to represent 1 microgram. Use of this symbol should be avoided. The preferred symbol is μg.

giga (G) Prefix meaning 10^9 in Système International.

gigabyte A unit of computer memory. One gigabyte equals 1 megabyte times 1 kilobyte, or 1,073,741,824 bytes (roughly 1 billion bytes).

gigaliter (GL) A unit of volume defined as 1 billion liters.

grad A unit of angular measure equal to $^1/_{400}$ of a circle. It is also called grade or gon. This is not a Système International unit.

grain (gr) A unit of weight. This is not a Système International unit.

grains per gallon (gpg) A unit sometimes used for reporting water analysis concentration results in the United States and Canada. This is not a Système International unit.

gram (g) A fractional unit of mass. One gram was originally defined as the weight of 1 cubic centimeter or 1 milliliter of water at 4° Celsius. Now it is $^1/_{1,000}$ of the mass of a certain block of platinum–iridium alloy known as the international prototype kilogram, preserved at Sèvres, France.

gram-milliequivalent The equivalent weight (in grams) divided by 1,000.

gram molecular weight The molecular weight of a compound in grams. For example, the gram molecular weight of carbon dioxide (CO_2) is 44.01 grams. *See also* mole.

gray (Gy) In Système International, the unit of *absorbed* ionizing radiation dose. One gray, equal to 100 rad, is the absorbed dose when the energy per unit mass imparted to matter by ionizing radiation is one joule per kilogram. *See also* rad; rem; sievert.

heat capacity units In US customary system, British thermal units per Rankine for a fixed and specified mass. In Système International, joules per kelvin; meters squared kilograms per second squared per kelvin.

heat flux density units In US customary system, British thermal units per hour per square foot. In Système International, watts per square meter; kilograms per second cubed.

heat units In US customary system, British thermal units; foot-pounds force; horsepower hours; kilowatt-hours. In Système International, joules; newton-meters; kilograms square meters per second squared.

hectare (ha) A unit of area equivalent to 10,000 square meters. This is not a Système International unit.

hecto (h) A prefix meaning 10^2 in Système International. Its use should be avoided except when measuring area and volume.

henry (H) In Système International, the unit of electric inductance, equivalent to meters squared kilograms per second squared per ampere squared. One henry is the inductance of a closed circuit in which an electromotive force of 1 volt is produced when the electric current in the circuit varies uniformly at a rate of 1 ampere per second.

hertz (Hz) In Système International, the unit of measure of the frequency of a periodic phenomenon in which the period is one second, equivalent to second^{-1}. Hertz units were formerly expressed as cycles per second.

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horsepower (hp) A standard unit of power. This is not a Système International unit. *See also* US customary system of units.

horsepower-hour (hp•h) A unit of energy or work. This is not a Système International unit.

hour (h, hr) An interval of time equal to one twenty-fourth of a day. This is not a Système International unit.

hundredweight (cwt) A unit of weight. This is not a Système International unit.

illuminance units In Système International, lux; candela-steradians per meter squared.

Imperial gallon A unit of volume used in the United Kingdom, equivalent to the volume of 10 pounds of freshwater. It is also called UK gallon. This is not a Système International unit.

inch (in.) A unit of length. This is not a Système International unit.

inches per minute (in./min) A unit of velocity. This is not a Système International unit.

inches per second (in./s) A unit of velocity. This is not a Système International unit.

inch of mercury (32° Fahrenheit) A unit of pressure or elevation head. This is not a Système International unit.

inch-pound (in.-lb) A unit of energy or torque. This is not a Système International unit.

irradiance units In Système International, watts per meter squared; kilograms per second cubed.

Jackson turbidity unit (JTU) An obsolete term for expressing turbidity. *See also* nephelometric turbidity unit.

joule (J) In Système International, the unit for energy, work, or quantity of heat, equivalent to meters squared kilograms per second squared. One joule is the work done when the point of application of a force of 1 newton is displaced a distance of 1 meter in the direction of the force (1 newton-meter).

kelvin (K) In Système International, the unit of thermodynamic temperature. One kelvin is $^{1}/_{273.16}$ of the thermodynamic temperature of the triple point of water (adopted at the 13th General Conference on Weights and Measures in 1967). No degree sign (°) is used. Zero kelvin is absolute zero, the complete absence of heat.

kilo (k) Prefix meaning 10^3, in Système International.

kilobase (Kb) A set of 1,000 bases (i.e., adenine, thymine, guanine, cytosine, or uracil) of deoxyribonucleic acid or ribonucleic acid.

kilobyte (KB) A unit of measurement for digital storage of data in various computer media, such as hard disks, random access memory, and compact discs. One kilobyte is 1,024 bytes.

kilocycle *See* kilohertz.

kilograin A unit of weight equivalent to 1,000 grains.

kilogram (kg) In Système International, the unit of mass. One kilogram is equal to the mass of a certain block of platinum–iridium alloy known as the international prototype kilogram (nicknamed Le Grand K), preserved at Sèvres, France, and adopted at the 1st and 3rd General Conferences on Weights and Measures in 1889 and 1901. Because the alloy's mass fluctuates slightly, a new standard is under development with a definition based on an invariable property of nature.

kilohertz (kHz) A unit of frequency equal to 1,000 hertz, or 1,000 cycles per second.

kiloliter A unit of volume equal to 1,000 liters or 1 cubic meter.

kilopascal (kPa) A unit of pressure equal to 1,000 pascals.

kiloreactive volt-ampere (kvar) A unit of reactive power equal to 1,000 volt-amperes reactive.

kilovolt (kV) A unit of electrical potential equal to 1,000 volts.

kilovolt-ampere (kVA) A unit of electrical power equal to 1,000 volt-amperes. This is not a Système International unit.

kilowatt (kW) A unit of electrical power equal to 1,000 watts.

kilowatt-hour (kW•h) A unit of energy or work. This is not a Système International unit.

knot The unit of speed used in navigation. One knot is equal to 1 nautical mile (6,080.20 feet) per hour. This is not a Système International unit.

lambda (λ) A symbol used to represent 1 microliter. Use of this symbol should be avoided. The preferred symbol is μL.

length units In US customary system, feet. In Système International, meters.

light intensity units In Système International, candelas.

linear feet (lin ft) A unit of distance in feet along an object. This is not a Système International unit.

liter (L) A unit of volume. One liter of pure water weighs 1,000 grams at 4° Celsius at 1 atmosphere of pressure.

liters per day (L/d) A unit for expressing a volumetric flow rate past a given point.

liters per minute (L/min) A unit for expressing a volumetric flow rate past a given point.

lumen (lm) In Système International, the unit of luminous flux equivalent to candela-steradian. One lumen is the luminous flux emitted in a solid angle of 1 steradian by a point source having a uniform intensity of 1 candela.

luminance units In Système International, candelas per meter squared.

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luminous flux units In Système International, lumens; candelas per steradian.

lux (lx) In Système International, the unit of illuminance. One lux is the illuminance intensity given by a luminous flux of 1 lumen uniformly distributed over a surface of 1 square meter. One lux is equivalent to 1 candela-steradian per meter squared.

magnetic field strength units In Système International, amperes per meter.

magnetic flux density units In Système International, teslas; kilograms per second squared per ampere.

magnetic flux units In Système International, webers; meters squared kilograms per second squared per ampere.

mass density units In US customary system, pounds mass per cubic foot. In Système International, kilograms per cubic meter.

mass units In US customary system, slugs; pounds mass. In Système International, kilograms. *See also* weight units.

Mbps Megabits per second. A unit of data transfer speed as measured in megabits (1,000,000 bits). In computer terminology, a bit is a digit of data.

mega (M) Prefix meaning 10^6 used in Système International.

megabyte (MB) A unit of computer memory storage equivalent to 1,048,576 bytes.

megahertz (mHz) A unit of frequency equal to 1 million hertz, or 1 million cycles per second.

megaliter (ML) A unit of volume equal to 1 million liters. This is not a Système International unit.

megohm A unit of electrical resistance equal to 1 million ohms. This is the unit of measurement for testing the electrical resistance of water to determine its purity. The closer water comes to absolute purity, the greater its resistance to conducting an electric current. Absolutely pure water has a specific resistance of more than 18 million ohms across 1 centimeter at a temperature of 25° Celsius. *See also* ohm.

meter (m) In Système International, a unit of length. One meter is the length of the path traveled by light in a vacuum during a time interval of 1/299,792,458 second (adopted by the 17th General Conference on Weights and Measures in 1983).

meters per second per meter (m/s/m; s^{-1}) A unit for expressing velocity gradient.

metric system A system of units started in about 1900 based on three basic units: the meter for length, the kilogram for mass, and the second for time—the so-called MKS system. Decimal fractions and multiples of the basic units are used for larger and smaller quantities. The principal departure of Système International from the more familiar form of metric engineering units is the use of the newton as the unit of force instead of the kilogram-force. Likewise, the newton instead of kilogram-force is used in combination units including force, for example, pressure or stress (newton per square meter), energy (newton-meter = joule), and power (newton-meter per second = watt). *See also* Système International d'Unités.

metric ton (t) A unit of weight equal to 1,000 kilograms. A metric ton is sometimes called a tonne.

mho A unit of electrical conductivity in US customary units equal to 1 siemens, which is a Système International unit. *See also* siemens.

micro (µ) Prefix meaning 10^{-6} in Système International.

microgram (µg) A unit of mass equal to one millionth of a gram.

micrograms per liter (µg/L) A unit of concentration for dissolved substances based in their weights.

microhm (µohm) A unit of electrical resistance equal to one millionth of an ohm.

micrometer (µm) A unit of length equal to one millionth of a meter.

micromho (µmho) A unit of electrical conductivity equal to one millionth of a mho. This is not a Système International unit. *See also* microsiemens.

micromhos per centimeter (µmho/cm) A measure of the conductivity of a water sample, equivalent to microsiemens per centimeter. Absolutely pure water, from a mineral content standpoint, has a conductivity of 0.055 micromhos per centimeter at 25° Celsius. This is not a Système International unit.

micromolar (µM) A concentration in which the molecular weight of a substance (in grams) divided by 10^6 (i.e., 1 µmol) is dissolved in enough solvent to make 1 liter of solution. *See also* micromole; molar.

micromole (µmol) A unit of weight for a chemical substance, equal to one millionth of a mole. *See also* mole.

micron (µ) A unit of length equal to 1 micrometer. Micrometers are the preferred units.

microsiemens (µS) A unit of conductivity equal to one millionth of a siemens. The microsiemens is the practical unit of measurement for conductivity and is used to approximate the total dissolved solids content of water. Water with 100 milligrams per liter of sodium chloride (NaCl) will have a specific resistance of 4,716 ohm-centimeters and a conductance of 212 microsiemens per centimeter. Absolutely pure water, from a mineral content standpoint, has a conductivity of 0.055 microsiemens per centimeter at 25° Celsius.

microwatt (µW) A unit of power equal to one millionth of a watt.

microwatt-seconds per square centimeter (µW-s/cm^2) A unit of measurement of irradiation intensity and retention or contact time in the operation of ultraviolet systems.

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mil A unit of length equal to one thousandth of an inch. This is not a Système International unit.

mile (mi) A unit of length, equivalent to 5,280 feet. This is not a Système International unit.

miles per hour (mph) A unit of speed. This is not a Système International unit.

milli (m) Prefix meaning 10^{-3} in Système International.

milliampere (mA) A unit of electrical current equal to one thousandth of an ampere.

milliequivalent (meq) A unit of weight equal to one thousandth the equivalent weight of a chemical.

milliequivalents per liter (meq/L) A unit of concentration for dissolved substances based on their equivalent weights.

milligram (mg) A unit of mass equal to one thousandth of a gram.

milligrams per liter (mg/L) The unit used in reporting the concentration of matter in water as determined by water analyses.

millijoule (mJ) A unit of energy or work equal to 10^6 joules.

millijoules per square centimeter (mJ/cm^2) Ultraviolet energy per unit area incident on a surface. Doses for treatment by ultraviolet lamps are expressed as millijoules per square centimeter.

milliliter (mL) A unit of volume equal to one thousandth of a liter.

millimeter (mm) A unit of length equal to one thousandth of a meter.

millimicron (mμ) A unit of length equal to one thousandth of a micron. This unit is correctly called a nanometer.

millimolar (mM) A concentration in which the molecular weight of a substance (in grams) divided by 10^3 (i.e., 1 mmol) is dissolved in enough solvent to make 1 liter of solution. *See also* millimole; molar.

millimole (mmol) A unit of weight for a chemical substance, equal to one thousandth of a mole. *See also* mole.

million electron volts (MeV) A unit of energy equal to 10^6 electron volts. This unit is commonly used in the fields of nuclear and high-energy physics. *See also* electron volt.

million gallons (mil gal, MG) A unit of volume equal to 10^6. This is not a Système International unit.

million gallons per day (mgd) A unit for expressing the volumetric flow rate of water being pumped, distributed, or used. This is not a Système International unit.

millirem (mrem; roentgen equivalent man) An expression or measure of the extent of biological injury that would result from the absorption of a particular radionuclide at a given dose over 1 year.

millirem per year The annual radiation absorbed dose equivalent. The US Environmental Protection Agency has established a drinking water MCL (maximum contaminant level) of 4 millirem per year for beta particle and photon emitters in drinking water.

mils per year (mpy) A unit for expressing the loss of metal due to corrosion. Assuming the corrosion process is uniformly distributed over the test surface, the corrosion rate of a metal coupon may be converted to a penetration rate (length per time) by dividing the unit area of metal loss by the metal density (mass per volume). The penetration rate, expressed as mils per year, describes the rate at which the metal surface is receding because of the corrosion-induced metal loss. *See also* mil.

minute (min) A unit of time equal to 60 seconds. This is not a Système International unit. This unit is not to be confused with the navigational term *minute* as in *minute-of-arc*.

molar (*M*) A unit for expressing the molarity of a solution. A 1-molar solution consists of 1 gram molecular weight of a compound dissolved in enough water to make 1 liter of solution. A gram molecular weight is the molecular weight of a compound in grams. For example, the molecular weight of sulfuric acid (H_2SO_4) is 98. A 1-molar, or 1-mole-per-liter, solution of sulfuric acid would consist of 98 grams of H_2SO_4 dissolved in enough distilled water to make 1 liter of solution. *See also* molarity *in the Glossary section.*

molar energy units In US customary system, British thermal units per mole. In Système International, joules per mole; meters squared kilograms per second squared per mole.

molar entropy units In US customary system, British thermal units per mole per kelvin. In Système International, joules per mole per kelvin; meters squared kilograms per second squared per mole per kelvin.

molar heat capacity units In US customary system, British thermal units per mole per Rankine. In Système International, joules per mole per kelvin; meters squared kilograms per second squared per mole per kelvin.

mole (mol) In Système International, the amount of substance that contains as many elementary entities as atoms in 0.012 kilogram.

moles per liter (mol/L) A unit of concentration for a dissolved substance.

moment-of-force units In US customary system, pounds-force feet. In Système International, newton-meters; meters squared kilograms per second squared.

nano (n) Prefix meaning 10^{-9} in Système International.

nanometer (nm) A unit of length defined as 10^{-12} meter.

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nephelometric turbidity unit (ntu, NTU) A unit for expressing the cloudiness (turbidity) of a sample as measured by a nephelometric turbidimeter. A turbidity of 1 ntu is equivalent to the turbidity created by a 1:4,000 dilution of a stock solution of 5.0 milliliters of a 1.000-gram hydrazine sulfate ($(NH_2)_2 \cdot H_2SO_4$) in 100 milliliters of distilled water solution plus 5.0 milliliters of a 10.00-gram hexamethylenetetramine ($(CH_2)_6N_4$) in 100 milliliters of distilled water solution that has stood for 24 hours at 25 ± 3° Celsius.

newton (N) In Système International, the unit of force. One newton is equivalent to 1 kilogram-meter per second squared. It is that force that, when applied to a body having a mass of 1 kilogram, gives it an acceleration of 1 meter per second squared. The newton replaces the unit kilogram force, which is the unit of force in the metric system.

ohm (Ω) In Système International, the unit of electrical resistance, equivalent to meters squared kilograms per second cubed per ampere squared. One ohm is the electrical resistance between two points of a conductor when a constant difference of potential of 1 volt, applied between these two points, produces in this conductor a current of 1 ampere, with this conductor not being the source of any electromotive force.

100 cubic feet (ccf) A unit of volume. This is not a Système International unit.

ounce (oz) A unit of force, mass, and volume. This is not a Système International unit.

ounce-inch (oz-in.) A unit of torque. This is not a Système International unit.

parts per billion (ppb) A unit of proportion, equal to 10^{-9}. This expression represents a measure of the concentration of a substance dissolved in water on a weight per weight basis or the concentration of a substance in air on a weight per volume basis. One liter of water at 4° Celsius has a mass equal to 1.000 kilogram (specific gravity equal to 1.000, or 1 billion micrograms. Thus, when 1 microgram of a substance is dissolved in 1 liter of water with a specific gravity of 1.000 (1 microgram per liter), this would be one part of substance per billion parts of water on a weight per weight basis. This terminology is now obsolete, and the term *micrograms per liter* (µg/L) should be used for concentrations in water. *See also* parts per million.

parts per million (ppm) A unit of proportion, equal to 10^{-6}. This terminology is now obsolete, and the term *milligrams per liter* (mg/L) should be used for concentrations in water. *See also* parts per billion.

parts per thousand (ppt) A unit of proportion, equal to 10^{-3}. This terminology is now obsolete, and the term *grams per liter* (g/L) should be used for concentrations in water. *See also* parts per billion.

parts per trillion (ppt) A unit of proportion, equal to 10^{-12}. This terminology is now obsolete, and the term *nanograms per liter* (ng/L) should be used for concentrations in water. *See also* parts per billion.

pascal (Pa) In Système International, the unit of pressure or stress equivalent to kilograms per meter per second squared. One pascal is the pressure or stress of 1 newton per square meter.

pascal-second (Pa•s) A unit of absolute viscosity equivalent to kilogram per second per meter cubed. The viscosity of pure water at 20° Celsius is 0.0010087 pascal-second.

permeability units (1) For electricity: in Système International, henrys per meter; meter-kilograms per second squared per ampere squared. (2) For groundwater and petroleum engineering, in US customary system, gallons per day per square foot; in Système International, darcys.

permittivity units In Système International, farads per meter; seconds to the fourth amperes squared per cubic meter per kilogram.

peta (P) A Système International prefix meaning 10^{15}.

pF A numerical measure of the energy with which water is held in the soil. It is expressed as the common logarithm of the head, in centimeters of water, necessary to produce the suction corresponding to the capillary potential. *See also* moisture tension *in the Glossary section*.

pico Système International prefix meaning 10^{-12}.

picocurie (pCi) A unit of radioactivity. One picocurie represents a quantity of radioactive material with an activity equal to one millionth of one millionth of a curie, i.e., 10^{-12} curie. This is not a Système International unit.

picocuries per liter (pCi/L) A radioactivity concentration unit. This is not a Système International unit.

picogram (pg) A unit of mass equal to 10^{-12} gram or 10^{-15} kilogram.

picosecond (ps) A unit of time equal to one trillionth (10^{-12}) of a second.

plain angle units In US customary system, degrees. In Système International, radians.

plaque-forming unit (pfu) A unit expressing the number of infectious virus particles. One plaque-forming unit is equivalent to one virus particle.

platinum–cobalt (Pt–Co) color unit (PCU) *See* color unit.

poise (P) A unit of absolute viscosity, equivalent to 1 gram mass per centimeter per second. This is not a Système International unit.

pores per linear inch (ppi) The number of bubbles per inch of open celled foams.

pound (lb) In US customary units, a unit used to represent either a mass or a force. This can be a confusing

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unit because two terms actually exist, *pound mass* (lbm) and *pound force* (lbf). One pound force is the force with which a 1-pound mass is attracted to the earth. In equation form,

$$\text{pounds force} = (\text{pounds mass})\left(\frac{\text{local acceleration due to gravity}}{\text{standard acceleration due to gravity}}\right)$$

One pound mass, on the other hand, is the mass that will accelerate at 32.2 feet per second squared when a 1-pound force is applied to it. As an example of the effect of the local acceleration due to gravity, at 10,000 feet (3,300 meters) above sea level, where the acceleration due to gravity is 32.17 feet per second squared (979.6 centimeters per second squared) instead of the sea level value of 32.2 feet per second squared (980.6 centimeters per second squared), the force of gravity on a 1-pound mass would be 0.999 pounds force. On the surface of the earth at sea level, pound mass and pound force are numerically the same because of the acceleration due to gravity being applied to an object, although they are quite different physical quantities. Neither pound unit is a Système International unit.

pounds per day (lb/d) A unit for expressing the rate at which a chemical is added to a water treatment process. This is not a Système International unit.

pounds per square foot (lb/ft^2) A unit of pressure. This is not a Système International unit.

pounds per square inch (psi) A unit of pressure. This is not a Système International unit.

pounds per square inch absolute (psia) A unit of pressure reflecting the sum of gauge pressure and atmospheric pressure. This is not a Système International unit. *See also* absolute pressure *in the Glossary section.*

pounds per square inch gauge (psig) A unit of pressure reflecting the pressure measured with respect to that of the atmosphere. The gauge is adjusted to read zero at the surrounding atmospheric pressure. This is not a Système International unit. *See also* gauge pressure *in the Glossary section.*

power units In US customary units, horsepower; British thermal units per hour; foot-pounds force per minute. In Système International, watts; volt-amperes; meters squared kilograms per second cubed.

pressure units In US customary units, pounds per square inch. In Système International, pascals; kilograms per meter per second squared.

pump horsepower The power (in units of horsepower) that must be delivered to a pump shaft in order to achieve a certain rate of flow of water at a certain pressure. *See also* pump kilowatts.

pump kilowatts Système International equivalent of pump horsepower.

quantity-of-electricity units In Système International, coulombs; ampere seconds.

quantity-of-heat units In US customary systems, British thermal units; horsepower hours; foot-pounds force. In Système International, joules; meters squared kilograms per second squared.

rad (radiation absorbed dose) A unit of adsorbed dose of ionizing radiation. Exposure of soft tissue or similar material to 1 roentgen results in the absorption of about 100 ergs (10^{-5} joules) of energy per gram, and this was defined by the International Commission on Radiation Units and Measurements in 1953 as 1 rad. This is not a Système International unit. *See also* gray; rem; sievert.

radian (rad) In Système International, the unit of measure of a plane angle between two radii of a circle that cut off on the circumference an arc equal in length to the radius. This unit is also used to measure the phase angle in a periodic electrical wave. Note that 2 π radians is equivalent to 360°.

radiance units In US customary system, British thermal units per hour per square foot per steradian. In Système International, watts per square meter per steradian.

radians per second (rad/s) A unit of angular frequency.

radiant flux units In US customary system, British thermal units per hour. In Système International, watts; meters squared kilograms per second cubed.

radiant intensity units In US customary system, British thermal units per hour per steradian. In Système International, watts per steradian.

radioactivity units In US customary system, picocuries. In Système International, becquerels.

rem (roentgen equivalent man) A unit of *equivalent* dose of ionizing radiation, developed by the International Commission on Radiation Units and Measurements in 1962 to reflect the finding that the biological effects of ionizing radiation were dependent on the nature of the radiation as well as other factors. For X and gamma radiation, the weighting factor is 1; thus, 1 rad equals 1 rem. For alpha radiation, however, 1 rad equals 20 rem. This is not a Système International unit. *See also* gray; rad; sievert.

revolutions per minute (rpm) A unit for expressing the frequency of rotation, or the number of times a fixed point revolves around its axis in 1 minute.

revolutions per second (rps) A unit for expressing the frequency of rotation, or the number of times a fixed point revolves around its axis in 1 second.

roentgen (r) The quantity of electrical charge produced by X or gamma radiation. One roentgen of exposure will produce about 2 billion ion pairs per cubic centimeter of air. It was first introduced at the

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Radiological Congress held in Stockholm as the special unit for expressing exposure to ionizing radiation. It is now obsolete. *See also* gray; rad; rem; sievert.

Saybolt standard unit (SSU) Standard measure of the viscosity of oil and grease used for lubricating bearings.

second (s, sec) (1) In Système International, the duration of 9,192,631,770 periods of radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom (adopted at the 13th General Conference on Weights and Measures in 1967). (2) $^{1}/_{31,556,925.9747}$ of a year.

second feet A unit of flow equivalent to cubic feet per second. This is not a Système International unit.

second-foot day A unit of volume. One second-foot day is the discharge during a 24-hour period when the rate of flow is 1 second foot (i.e., 1 cubic foot per second). This is not a Système International unit. In ordinary hydraulic computations, 1 cubic foot per second flowing for 1 day is commonly taken as 2 acre-feet. The US Geological Survey now uses the term *cfs day* (cubic feet per second day) in its published reports.

section A unit of area in public land surveying. One section is a land area of 1 square mile. This is not a Système International unit.

siemens (S) In Système International, the derived unit for electrical conductance, equivalent to seconds cubed amperes squared per meter squared per kilogram. One siemens is the electrical conductance of a conductor in which a current of 1 ampere is produced by an electric potential difference of 1 volt.

sievert (Sv) In Système International, the unit of *equivalent* ionizing radiation dose, adopted by the General Conference on Weights and Measures in 1977. One sievert is the dose equivalent when the adsorbed dose of ionizing radiation multiplied by the dimensionless factors *Q* (quality factors) and *N* (product of any other multiplying factors) stipulated by the International Commission on Radiological Protection is 1 joule per kilogram. One sievert is equal to 100 rem. *See also* gray; rad; rem.

slug In the US customary system, the base unit of mass. A slug is a mass that will accelerate at 1 foot per second squared when 1 pound force is applied. This is not a Système International unit.

solid angle units In Système International, steradians.

specific energy units In US customary system, British thermal units per pound mass. In Système International, joules per kilogram; square meters per second squared.

specific entropy units In US customary system, British thermal units per pound mass per Rankine. In Système International, joules per kilogram per kelvin; square meters per second squared per kelvin.

specific flux For pressure-driven membrane processes, the permeate (water) flux divided by the net driving pressure. In US customary system, units are gallons per square foot per day per pounds per square inch. In Système International, they are grams per square meter per second per kilopascal. Specific flux is commonly temperature-corrected to a standard or constant temperature to negate water temperature effects for performance analysis, in which case it is sometimes called the temperature-corrected specific flux. Specific flux is equal to specific productivity divided by the active membrane area. *See also* flux; net driving pressure; specific productivity; temperature correction factor *all in the Glossary section.*

specific gravity (sp gr) The ratio of the density of a substance to a standard density. For solids and liquids, the density is compared to the density of water at 39.2° Fahrenheit (4° Celsius) (i.e., 1 kilogram per liter). For gases, the density is compared to the density of air at standard temperature and pressure (i.e., 1.2 grams per liter). The specific gravities of representative solids and liquids are given in Table 1.

Table 1 Specific Gravities of Various Solids and Liquids

Substance	Specific Gravity
Solids	
Aluminum (20°C)	2.7
Steel (20°C)	7.8
Copper (20°C)	8.9
Activated carbon* †	0.13–0.45 (avg. 0.19)
Lime*†	0.32–0.80
Dry alum*†	0.96–1.2
Soda ash*†	0.48–1.04
Coagulant aids (polyelectrolytes) *†	0.43–0.56
Table salt*†	0.77–1.12
Liquids	
Liquid alum (36°Bé, 15.6°C)	1.33
Water (4°C)	1.00
Hydrofluosilicic acid (30%, –8.1°C)	1.25–1.27
Sulfuric acid (18°C)	1.83
Ferric chloride (30%, 30°C)	1.34

* Bulk density used to determine specific gravity.
† Temperature and/or pressure not given.

specific volume units In US customary system, gallons per pound. In Système International, cubic meters per kilogram.

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specific weight units In US customary system, pounds force per cubic foot. In Système International, newtons per cubic meter.

speed of light In a vacuum, 1.86×10^5 miles per second (2.99×10^8 meters per second).

speed units In US customary system, feet per second. In Système International, meters per second.

square foot (ft^2) A unit of area equivalent to that of a square 1 foot on a side. This is not a Système International unit.

square inch ($in.^2$) A unit of area equivalent to that of a square 1 inch on a side. This is not a Système International unit.

square meter (m^2) A unit of area equivalent to that of a square 1 meter on a side.

square mile (mi^2) A unit of area equivalent to that of a square 1 mile on a side. This is not a Système International unit.

standard cubic feet per minute (SCFM, scfm) A unit for expressing the flow rate of air. This unit represents cubic feet of air per minute at standard conditions of temperature, pressure, and humidity (32° Fahrenheit, 14.7 pounds per square inch absolute, and 50 percent relative humidity). This is not a Système International unit.

steradian (sr) In Système International, the unit of measure of a solid angle that, having its vertex in the center of a sphere, cuts off an area on the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere.

surface tension units In US customary system, pounds force per foot. In Système International, newtons per meter; kilograms per second squared.

Système International d'Unités (SI) The international system of units of measure as defined by the periodic meeting of the General Conference on Weights and Measures (CGPM). This system is sometimes called the International Metric System or Le Système International d'Unités. Système International, as it is called, is a rationalized selection of units from the metric system with seven base units for which names, symbols, and precise definitions have been established. Many derived units are defined in terms of the base units, with symbols assigned to each and, in some cases, given names, e.g., the newton (N). The great advantage of Système International is its establishment of one and only one unit for each physical quantity—the meter for length, the kilogram (not the gram) for mass, the second for time, and so on. From these elemental units, units for all other mechanical quantities are derived. Another advantage is the ease with which unit conversions can be made, as few conversion factors need to be invoked. Tables 2–5, at the end of this section, list some especially important units. Appendix 2 lists equivalent factors to convert US customary units to Système International d'Unités.

temperature units In US customary system, degrees Celsius for chemistry and degrees Fahrenheit for engineering. In Système International, kelvin.

tera (T) A prefix meaning 10^{12} in Système International.

tesla (T) In Système International, the unit of magnetic flux density, equivalent to kilograms per second squared per ampere. One tesla is the magnetic flux density given by a magnetic flux of 1 weber per square meter.

thermal conductivity units In US customary system, British thermal units per hour per degree Fahrenheit per foot. In Système International, watts per meter per kelvin; meter-kilograms per second cubed per kelvin.

time units In US customary system and Système International, seconds.

ton A unit of force and mass defined as 2,000 pounds. A ton is sometimes called a short ton or US ton. This is not a Système International unit.

tonne (t) A unit of mass defined as 1,000 kilograms. This is not a Système International unit. A tonne is sometimes called a metric ton.

torr A unit of pressure. One torr is equal to 1 centimeter of mercury at 0° Celsius. This is not a Système International unit.

true color unit (tcu) A unit of color measurement based on the platinum–cobalt color unit. This unit is applied to water samples in which the turbidity has been removed. One true color unit equals 1 color unit. *See also* color unit.

turbidity unit *See* nephelometric turbidity unit.

universal gravitational constant (G) In US customary system, 3.434×10^{-8} pounds force per square foot per slug squared. In Système International, 6.67×10^{-11} newton-meters squared per kilogram squared.

US customary system of units A system of units based on the yard and the pound, commonly used in the United States and defined in "Unit of Weights and Measures (United States Customary and Metric): Definitions and Tables of Equivalents," *National Bureau of Standards Miscellaneous Publication MP 233,* Dec. 20, 1960. Most of the units have a historical origin from the United Kingdom, e.g., the length of a king's foot for the length of 1 foot, the area a team of horses could plow in a day—without getting tired—for an acre, the load a typical horse could lift in a minute for horsepower, and so forth. No organized method of multiples and fractions is involved. Appendix 2 lists equivalent factors to convert US customary units to Système International d'Unités. *See also* Système International d'Unités.

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velocity units In US customary system, feet per second. In Système International, meters per second.

volt (V) In Système International, the unit of electrical potential, potential difference, and electromotive force, equivalent to meters squared kilograms per second cubed per ampere. One volt is the difference of electric potential between two points of a conductor, carrying a constant current of 1 ampere, when the power dissipated between these points is equal to 1 watt.

volt-ampere (VA) A unit used for expressing apparent power and complex power.

volt-ampere-reactive (VAR) A unit used for expressing reactive power.

volume units In US customary system, cubic feet. In Système International, cubic meters.

watt (W) In Système International, the unit of power and radiant flux, equivalent to meters squared kilograms per second cubed. One watt is the power that gives rise to the production of energy at the rate of 1 joule per second. Watts represent a measure of active power and instantaneous power.

weber (Wb) In Système International, the unit of magnetic flux, equivalent to meters squared kilograms per second squared per ampere. One weber is the magnetic flux that, linking a circuit of one turn, produces in the circuit an electromotive force of 1 volt as the magnetic flux is reduced to zero at a uniform rate in 1 second.

weight units In US customary system, pounds force. In Système International, newtons. *See also* mass units.

work units In US customary system, foot-pounds force. In Système International, joules; meters squared kilograms per second squared.

yard (yd) A unit of length equal to 3 feet. This is not a Système International unit.

year (y, yr) A unit of time equal to 365 days, 5 hours, 49 minutes, and 12 seconds.

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Table 2 Base Système International Units

Quantity	Unit	Abbreviation
length	meter	m
mass	kilogram	kg
time	second	sec
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

Table 3 Supplementary Système International Units

Quantity	Unit	Abbreviation
plane angle	radian	rad
solid angle	steradian	sr

Table 4 Derived Système International Units with Special Names

Quantity	Unit	Abbr.	Equivalent-Units Abbr.
frequency (of a periodic phenomenon)	hertz	Hz	s^{-1}
force	newton	N	kg•m/s^2
pressure, stress	pascal	Pa	N/m^2
energy, work, quantity of heat	joule	J	N•m
power, radiant flux	watt	W	J/s
quantity of electricity, electric charge	coulomb	C	A•s
electric potential, potential difference, electromotive force	volt	V	W/A
electrical capacitance	farad	F	C/V
electrical resistance	ohm	Ω	V/A
electrical conductance	siemens	S	A/V
magnetic flux	weber	Wb	V•s
magnetic flux density	tesla	T	Wb/m^2
inductance	henry	H	Wb/A
luminous flux	lumen	lm	cd•Sr
luminance	lux	lx	lm/m^2
activity (of a radionuclide)	becquerel	Bq	disintegrations/s
absorbed ionizing radiation dose	gray	Gy	J/kg
ionizing radiation dose equivalent	sievert	Sv	J/kg

Table 5 Some Common Derived Units of Système International

Quantity	Unit	Abbr.
absorbed dose rate	grays per second	Gy/s
acceleration	meters per second squared	m/s^2
angular acceleration	radians per second squared	rad/s^2
angular velocity	radians per second	rad/s
area	square meter	m^2
concentration (amount of substance)	moles per cubic meter	mol/m^3
current density	amperes per square meter	A/m^2
density, mass	kilograms per cubic meter	kg/m^3
electric charge density	coulombs per cubic meter	C/m^3
electric field strength	volts per meter	V/m
electric flux density	coulombs per square meter	C/m^2
energy density	joules per cubic meter	J/m^3
entropy	joules per kelvin	J/K
exposure (X and gamma rays)	coulombs per kilogram	C/kg
heat capacity	joules per kelvin	J/K
heat flux density irradiance	watts per square meter	W/m^2
luminance	candelas per square meter	cd/m^2
magnetic field strength	amperes per meter	A/m
molar energy	joules per mole	J/mol
molar entropy	joules per mole per kelvin	J/(mol•K)
molar heat capacity	joules per mole per kelvin	J/(mol•K)
moment of force	newton-meter	N•m
permeability (magnetic)	henrys per meter	H/m
permittivity	farads per meter	F/m
power density	watts per square meter	W/m^2
radiance	watts per square meter per steradian	W/(m^2•sr)
radiant intensity	watts per steradian	W/sr
specific heat capacity	joules per kilogram per kelvin	J/(kg•K)
specific energy	joules per kilogram	J/kg
specific entropy	joules per kilogram per kelvin	J/(kg•K)
specific volume	cubic meters per kilogram	m^3/kg
surface tension	newtons per meter	N/m
thermal conductivity	watts per meter per kelvin	W/(m•K)
velocity	meters per second	m/s
viscosity, absolute	pascal-second	Pa•s
viscosity, kinematic	square meters per second	m^2/s
volume	cubic meter	m^3
wave number	per meter	m^{-1}

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