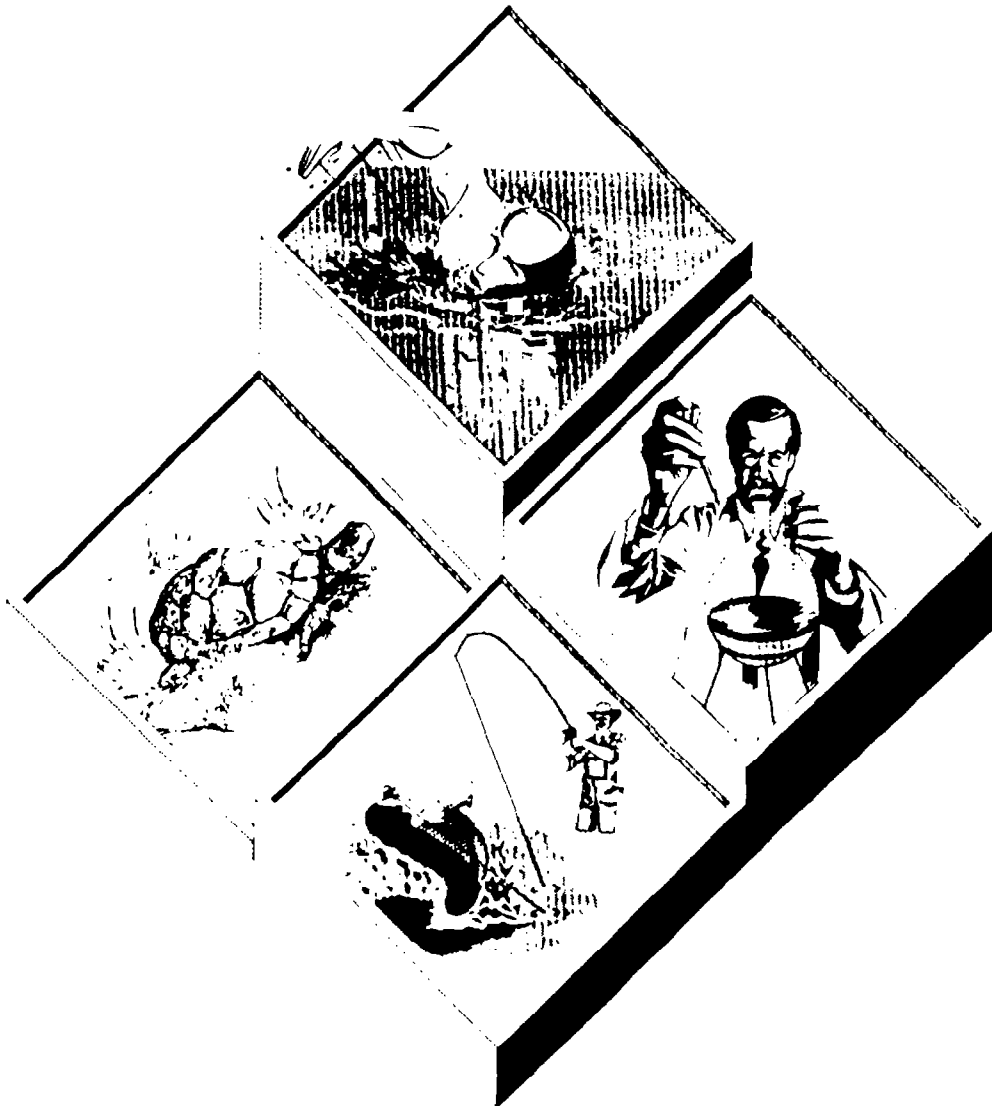


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Water Quality Standards Handbook:

Second Edition



"... to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

Contains Update #1
August 1994

Section 101(a) of the Clean Water Act



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WATER QUALITY STANDARDS
HANDBOOK
SECOND EDITION

Water Quality Standards Branch
Office of Science and Technology
U.S. Environmental Protection Agency
Washington, DC 20460

September 1993

Contains update #1
August 1994

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**U.S. Environmental Protection Agency
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Washington, DC 20460**

FOREWORD

Dear Colleague:

The following document entitled *Water Quality Standards Handbook - Second Edition* provides guidance issued in support of the Water Quality Standards Regulation (40 CFR 131, as amended). This Handbook includes the operative provisions of the first volume of the Handbook issued in 1983 and incorporates subsequent guidance issued since 1983. The 1993 Handbook contains only final guidance previously issued by EPA - it contains no new guidance.

Since the 1983 Handbook has not been updated in ten years, we hope that this edition will prove valuable by pulling together current program guidance and providing a coherent document as a foundation for State and Tribal water quality standards programs. The Handbook also presents some of the evolving program concepts designed to reduce human and ecological risks, such as endangered species protection; criteria to protect wildlife, wetlands, and sediment quality; biological criteria to better define desired biological communities in aquatic ecosystems; and nutrient criteria.

This Handbook is intended to serve as a "living document," subject to future revisions as the water quality standards program moves forward, and to reflect the needs and experiences of EPA and the States. To this end, the Handbook is published in a loose leaf format designed to be placed in three ring binders. This copy of the Handbook includes updated material for 1994 (see Appendix X), and EPA anticipates publishing additional changes periodically and providing them to Handbook recipients. To ensure that you will receive these updates, please copy the reader response card in Appendix W and mail it to the address on the reverse.

The Handbook also contains a listing, by title and date, of the guidance issued since the Handbook was first published in 1983 that is incorporated in the Second Edition. Copies of these documents are available upon request.

The *Water Quality Standards Handbook - Second Edition* provides guidance on the national water quality standards program. EPA regional offices and States may have additional guidance that provides more detail on selected topics of regional interest. For information on regional or State guidance, contact the appropriate regional water quality standards coordinator listed in Appendix U.

EPA invites participation from interested parties in the water quality standards program, and appreciates questions on this guidance as well as suggestions and comments for improvement. Questions or comments may be directed to the EPA regional water quality standards coordinators or to:

David Sabock, Chief
U.S. Environmental Protection Agency
Water Quality Standards Branch (4305)
401 M Street, S.W.
Washington, D.C. 20460
Telephone (202) 475-7315

Betsy Southerland, Acting Director
Standards and Applied Science Division

Note to the Reader

The Water Quality Standards Handbook, first issued in 1983, is a compilation of EPA's guidance on the water quality standards program and provides direction for States in reviewing, revising and implementing water quality standards. The *Water Quality Standards Handbook - Second Edition* retains all the guidance in the 1983 Handbook unless such guidance was specifically revised in subsequent years. An annotated list of the major guidance and policy documents on the water quality standards program issued since 1983 is included in the Introduction and material added to the Second Edition by periodic updates since 1993 is summarized in Appendix X. Material in the Handbook contains only guidance previously issued by EPA; it contains no new guidance.

The guidance contained in each of the documents listed in the Introduction is either: 1) incorporated in its entirety, or summarized, in the text of the appropriate section of this Handbook, or 2) attached as an appendix (see Table of Contents). If there is uncertainty or perceived inconsistency on any of the guidance incorporated into this Handbook, the reader is directed to review the original guidance documents or call the Water Quality Standards Branch at (202) 260-1315. Copies of all original guidance documents not attached as appendices may be obtained from the source listed for each document in the Reference section of this Handbook.

Limited free copies of this Handbook may be obtained from:

Office of Water Resource Center, RC-4100
U. S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460
Telephone: (202) 260-7786 (voice mail publication request line)

Copies may also be obtained from:

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Robert S. Shippen
Editor

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- C - *Biological Criteria: National Program Guidance for Surface Waters, April 1990.*
- D - *National Guidance: Water Quality Standards for Wetlands, July 1990.*
- E - *An Approach for Evaluating Numeric Water Quality Criteria for Wetlands Protection, July 1991.*
- F - *Coordination Between the Environmental Protection Agency, Fish and Wildlife Service and National Marine Fisheries Service Regarding Development of Water Quality Criteria and Water Quality Standards Under the Clean Water Act, July 1992.*
- G - *Questions and Answers on: Antidegradation, August 1985.*
- H - *Derivation of the 1985 Aquatic Life Criteria.*
- I - List of EPA Water Quality Criteria Documents.
- J - *Attachments to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria, October 1993.*
- K - *Procedures for the Initiation of Narrative Biological Criteria, October 1992.*
- L - *Interim Guidance on Determination and Use of Water-Effect Ratios for Metals, February 1994.*
- M - Reserved.
- N - *IRIS [Integrated Risk Information System] Background Paper.*
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- P - List of 126 Section 307(a) Priority Toxic Pollutants.
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- U - List of EPA Regional Water Quality Standards Coordinators.
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GLOSSARY

GLOSSARY

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

GLOSSARY

The "Act" refers to the Clean Water Act (Public Law 92-500, as amended (33 USC 1251, et seq.) (40 CFR 131.3.)

"Acute" refers to a stimulus severe enough to rapidly induce an effect; in aquatic toxicity tests, an effect observed in 96- hours or less is typically considered acute. When referring to aquatic toxicology or human health, an acute affect is not always measured in terms of lethality (USEPA, 1991a.)

"Acute-chronic ratio" (ACR) is the ratio of the acute toxicity of an effluent or a toxicant to its chronic toxicity. It is used as a factor for estimating chronic toxicity on the basis of acute toxicity data, or for estimating acute toxicity on the basis of chronic toxicity data (USEPA, 1991a.)

"Acutely toxic conditions" are those acutely toxic to aquatic organisms following their short-term exposure within an affected area (USEPA, 1991a.)

"Additivity" is the characteristic property of a mixture of toxicants that exhibits a total toxic effect equal to the arithmetic sum of the effects of the individual toxicants (USEPA, 1991a.)

"Ambient toxicity" is measured by a toxicity test on a sample collected from a water body (USEPA, 1991a.)

"Antagonism" is the characteristic property of a mixture of toxicants that exhibits a less-than-additive total toxic effect (USEPA, 1991a.)

"Aquatic community" is an association of interacting populations of aquatic organisms in a given water body or habitat (USEPA, 1990; USEPA, 1991a.)

"Averaging period" is the period of time over which the receiving water concentration is averaged for comparison with criteria concentrations. This specification limits the duration of concentrations above the criteria (USEPA, 1991a.)

"Bioaccumulation" is the process by which a compound is taken up by an aquatic organism, both from water and through food (USEPA, 1991a.)

"Bioaccumulation factor" (BAF) is the ratio of a substance's concentration in tissue versus its concentration in ambient water, in situations where the organism and the food chain are exposed (USEPA, 1991a.)

"Bioassay" is a test used to evaluate the relative potency of a chemical or a mixture of chemicals by comparing its effect on a living organism with the effect of a standard preparation on the same type of organism. Bioassays are frequently used in the pharmaceutical industry to evaluate the potency of vitamins and drugs (USEPA, 1991a.)

- "Bioavailability"** is a measure of the physicochemical access that a toxicant has to the biological processes of an organism. The less the bioavailability of a toxicant, the less its toxic effect on an organism (USEPA, 1991a.)
- "Bioconcentration"** is the process by which a compound is absorbed from water through gills or epithelial tissues and is concentrated in the body (USEPA, 1991a.)
- "Bioconcentration factor" (BCF)** is the ratio of a substance's concentration in tissue versus its concentration in water, in situations where the food chain is not exposed or contaminated. For non-metabolized substances, it represents equilibrium partitioning between water and organisms (USEPA, 1991a.)
- "Biological criteria"** are narrative expressions or numeric values of the biological characteristics of aquatic communities based on appropriate reference conditions. As such, biological criteria serve as an index of aquatic community health. It is also known as **biocriteria** (USEPA, 1991a.)
- "Biological integrity"** is the condition of the aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by community structure and function (USEPA, 1991a.)
- "Biological monitoring"** describes the use of living organisms in water quality surveillance to indicate compliance with water quality standards or effluent limits and to document water quality trends. Methods of biological monitoring may include, but are not limited to, toxicity testing (such as ambient toxicity testing or whole-effluent toxicity testing) and biological surveys. It is also known as **biomonitoring** (USEPA, 1991a.)
- "Biological survey or biosurvey"** is collecting, processing, and analyzing a representative portion of the resident aquatic community to determine its structural and/or functional characteristics (USEPA, 1991a.)
- "Biomagnification"** is the process by which the concentration of a compound increases in species occupying successive trophic levels (USEPA, 1991a.)
- "Cancer potency slope factor" (q_1^*)** is an indication of a chemical's human cancer-causing potential derived using animal studies or epidemiological data on human exposure; based on extrapolation of high-dose levels over short periods of time to low-dose levels and a lifetime exposure period through the use of a linear model (USEPA, 1991a.)
- "Chronic"** defines a stimulus that lingers or continues for a relatively long period of time, often one-tenth of the life span or more. Chronic should be considered a relative term depending on the life span of an organism. The measurement of a chronic effect can be reduced growth, reduced reproduction, etc., in addition to lethality (USEPA, 1991a.)
- "Community component"** is a general term that may pertain to the biotic guild (fish, invertebrates, algae), the taxonomic category (order, family, genus, species), the feeding strategy (herbivore, omnivore, predator), or the organizational level (individual, population, assemblage) of a biological entity within the aquatic community (USEPA, 1991a.)

- "Completely mixed condition"** is defined as no measurable difference in the concentration of a pollutant exists across a transect of the water body (e.g., does not vary by 5%) (USEPA, 1991a.)
- "Criteria"** are elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use (40 CFR 131.3.)
- "Criteria continuous concentration" (CCC)** is the EPA national water quality criteria recommendation for the highest instream concentration of a toxicant or an effluent to which organisms can be exposed indefinitely without causing unacceptable effect (USEPA, 1991a.)
- "Criteria maximum concentration" (CMC)** is the EPA national water quality criteria recommendation for the highest instream concentration of a toxicant or an effluent to which organisms can be exposed for a brief period of time without causing an acute effect (USEPA, 1991a.)
- "Critical life stage"** is the period of time in an organism's lifespan in which it is the most susceptible to adverse effects caused by exposure to toxicants, usually during early development (egg, embryo, larvae). Chronic toxicity tests are often run on critical life stages to replace long duration, life cycle tests since the most toxic effect usually occurs during the critical life stage (USEPA, 1991a.)
- "Critical species"** is a species that is commercially or recreationally important at the site, a species that exists at the site and is listed as threatened or endangered under section 4 of the Endangered Species Act, or a species for which there is evidence that the loss of the species from the site is likely to cause an unacceptable impact on a commercially or recreationally important species, a threatened or endangered species, the abundances of a variety of other species, or the structure or function of the community (USEPA, 1994a.)
- "Design flow"** is the flow used for steady-state waste load allocation modeling (USEPA, 1991a.)
- "Designated uses"** are those uses specified in water quality standards for each water body or segment whether or not they are being attained (40 CFR 131.3.)
- "Discharge length scale"** is the square root of the cross-sectional area of any discharge outlet (USEPA, 1991a.)
- "Diversity"** is the number and abundance of biological taxa in a specified location (USEPA, 1991a.)
- "Effective concentration" (EC)** is a point estimate of the toxicant concentration that would cause an observable adverse effect (such as death, immobilization, or serious incapacitation) in a given percentage of the test organisms (USEPA, 1991a.)
- "Existing uses"** are those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards (40 CFR 131.3.)

"Federal Indian Reservation," "Indian Reservation," or "Reservation" is defined as all land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and including rights-of-way running through the reservation (40 CFR 131.3.)

"Final acute value" (FAV) is an estimate of the concentration of the toxicant corresponding to a cumulative probability of 0.05 in the acute toxicity values for all genera for which acceptable acute tests have been conducted on the toxicant (USEPA, 1991a.)

"Frequency" is how often criteria can be exceeded without unacceptably affecting the community (USEPA, 1991a.)

"Harmonic mean flow" is the number of daily flow measurements divided by the sum of the reciprocals of the flows. That is, it is the reciprocal of the mean of reciprocals (USEPA, 1991a.)

"Indian Tribe" or "Tribe" describes any Indian Tribe, band, group, or community recognized by the Secretary of the Interior and exercising governmental authority over a Federal Indian reservation (40 CFR 131.3.)

"Inhibition concentration" (IC) is a point estimate of the toxicant concentration that would cause a given percent reduction (e.g., IC25) in a non-lethal biological measurement of the test organisms, such as reproduction or growth (USEPA, 1991a.)

"Lethal concentration" is the point estimate of the toxicant concentration that would be lethal to a given percentage of the test organisms during a specified period (USEPA, 1991a.)

"Lipophilic" is a high affinity for lipids (fats) (USEPA, 1991a.)

"Load allocations" (LA) the portion of a receiving water TMDL that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources (USEPA, 1991a.)

"Lowest-observed-adverse-effect-level" (LOAEL) is the lowest concentration of an effluent or toxicant that results in statistically significant adverse health effects as observed in chronic or subchronic human epidemiology studies or animal exposure (USEPA, 1991a.)

"Magnitude" is how much of a pollutant (or pollutant parameter such as toxicity), expressed as a concentration or toxic unit is allowable (USEPA, 1991a.)

"Minimum level" (ML) refers to the level at which the entire analytical system gives recognizable mass spectra and acceptable calibration points when analyzing for pollutants of concern. This level corresponds to the lowest point at which the calibration curve is determined (USEPA, 1991a.)

"Mixing zone" is an area where an effluent discharge undergoes initial dilution and is extended to cover the secondary mixing in the ambient water body. A mixing zone is an allocated impact zone where water quality criteria can be exceeded as long as acutely toxic conditions are prevented (USEPA, 1991a.)

- "Navigable waters"** refer to the waters of the United States, including the territorial seas (33 USC 1362.)
- "No-observed-adverse-effect-level" (NOAEL)** is a tested dose of an effluent or a toxicant below which no adverse biological effects are observed, as identified from chronic or subchronic human epidemiology studies or animal exposure studies (USEPA, 1991a.)
- "No-observed-effect-concentration" (NOEC)** is the highest tested concentration of an effluent or a toxicant at which no adverse effects are observed on the aquatic test organisms at a specific time of observation. Determined using hypothesis testing (USEPA, 1991a.)
- "Nonthreshold effects"** are associated with exposure to chemicals that have no safe exposure levels. (i.e., cancer) (USEPA, 1991a.)
- "Persistent pollutant"** is not subject to decay, degradation, transformation, volatilization, hydrolysis, or photolysis (USEPA, 1991a.)
- "Pollution"** is defined as the man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of water (33 USC 1362.)
- "Priority pollutants"** are those pollutants listed by the Administrator under section 307(a) of the Act (USEPA, 1991a.)
- "Reference ambient concentration" (RAC)** is the concentration of a chemical in water which will not cause adverse impacts to human health; RAC is expressed in units of mg/l (USEPA, 1991a.)
- "Reference conditions"** describe the characteristics of water body segments least impaired by human activities. As such, reference conditions can be used to describe attainable biological or habitat conditions for water body segments with common watershed/catchment characteristics within defined geographical regions.
- "Reference tissue concentration" (RTC)** is the concentration of a chemical in edible fish or shellfish tissue which will not cause adverse impacts to human health when ingested. RTC is expressed in units of mg/kg (USEPA, 1991a.)
- "Reference dose" (RfD)** is an estimate of the daily exposure to human population that is likely to be without appreciable risk of deleterious effect during a lifetime; derived from NOAEL or LOAEL (USEPA, 1991a.)
- "Section 304(a) criteria"** are developed by EPA under authority of section 304(a) of the Act based on the latest scientific information on the relationship that the effect of a constituent concentration has on particular aquatic species and/or human health. This information is issued periodically to the States as guidance for use in developing criteria (40 CFR 131.3.)
- "Site-specific aquatic life criterion"** is a water quality criterion for aquatic life that has been derived to be specifically appropriate to the water quality characteristics and/or species composition at a particular location (USEPA, 1994a.)

- "States"** include: the 50 States, the District of Columbia, Guam, the Commonwealth of Puerto Rico, Virgin Islands, American Samoa, the Trust Territory of the Pacific Islands, and the Commonwealth of the Northern Mariana Islands, and Indian Tribes that EPA determines qualify for treatment as States for the purposes of water quality standards (40 CFR 131.3.)
- "Steady-state model"** is a fate and transport model that uses constant values of input variables to predict constant values of receiving water quality concentrations (USEPA, 1991a.)
- "STORET"** is EPA's computerized water quality database that includes physical, chemical, and biological data measured in water bodies throughout the United States (USEPA, 1991a.)
- "Sublethal"** refers to a stimulus below the level that causes death (USEPA, 1991a.)
- "Synergism"** is the characteristic property of a mixture of toxicants that exhibits a greater-than-additive total toxic effect (USEPA, 1991a.)
- "Threshold effects"** result from chemicals that have a safe level (i.e., acute, subacute, or chronic human health effects) (USEPA, 1991a.)
- "Total maximum daily load" (TMDL)** is the sum of the individual waste load allocations (WLAs) and load allocations (LAs); a margin of safety is included with the two types of allocations so that any additional loading, regardless of source, would not produce a violation of water quality standards (USEPA, 1991a.)
- "Toxicity test"** is a procedure to determine the toxicity of a chemical or an effluent using living organisms. A toxicity test measures the degree of effect on exposed test organisms of a specific chemical or effluent (USEPA, 1991a.)
- "Toxic pollutant"** refers to those pollutants, or combination of pollutants, including disease-causing agents, which after discharge and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will, or on the basis of information available to the administrator, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring (33 USC section 1362.)
- "Toxic units" (TUs)** are a measure of toxicity in an effluent as determined by the acute toxicity units (TU_a) or chronic toxicity units (TU_c) measured (USEPA, 1991a.)
- "Toxic unit acute" (TU_a)** is the reciprocal of the effluent concentration that causes 50 percent of the organisms to die by the end of the acute exposure period (i.e., 100/LC₅₀) (USEPA, 1991a.)
- "Toxic unit chronic" (TU_c)** is the reciprocal of the effluent concentration that causes no observable effect on the test organisms by the end of the chronic exposure period (i.e., 100/NOEC) (USEPA, 1991a.)

"Use attainability analysis" (UAA) is a structured scientific assessment of the factors affecting the attainment of the use which may include physical, chemical, biological, and economic factors as described in section 131.10(g) (40 CFR 131.3.)

"Waste load allocation" (WLA) is the portion of a receiving water's TMDL that is allocated to one of its existing or future point sources of pollution (USEPA, 1991a.)

"Waters of the United States" refer to:

- (1) all waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are 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 the use or degradation of which would affect or could affect interstate or foreign commerce, including any such waters:
 - (i) which are or could be used by interstate or foreign travelers for recreational or other purposes;
 - (ii) from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
 - (iii) which are or could be used for industrial purposes 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 in paragraphs (1) through (4) of this definition;
- (6) the territorial sea; and
- (7) wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (1) through (6) of this definition. "Wetlands" are defined as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the Act (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet the criteria for this definition) are not waters of the United States. (40 CFR 232.2.)

"Water-effect ratio" (WER) is an appropriate measure of the toxicity of a material obtained in a site water divided by the same measure of the toxicity of the same material obtained simultaneously in a laboratory dilution water (USEPA, 1994a.)

"Water quality assessment" is an evaluation of the condition of a water body using biological surveys, chemical-specific analyses of pollutants in water bodies, and toxicity tests (USEPA, 1991a.)

"Water quality limited segment" refers to any segment where it is known that water quality does not meet applicable water quality standards and/or is not expected to meet applicable water quality standards even after application of technology-based effluent limitations required by sections 301(b)(1)(A) and (B) and 306 of the Act (40 CFR 131.3.)

"Water quality standards" (WQS) are provisions of State or Federal law which consist of a designated use or uses for the waters of the United States, water quality criteria for such waters based upon such uses. Water quality standards are to protect public health or welfare, enhance the quality of the water and serve the purposes of the Act (40 CFR 131.3.)

"Whole-effluent toxicity" is the total toxic effect of an effluent measured directly with a toxicity test (USEPA, 1991a.)