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Water

EPA

Dissolved Oxygen

Water Quality Standards Criteria Digest A Compilation of State/Federal Criteria

ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY STANDARDS
CRITERIA DIGEST - CORRECTIONS

In December 1979, EPA published four documents containing the summaries of State Water Quality Standards. In those four documents a number of errors appeared which need correction. These corrections are listed below.

ACIDITY-ALKALINITY (pH)

1. Idaho. Page 7: add as the first phrase the following general statement - Values for all waters are to be within the range of 6.5 - 9.0.

2. Mississippi. Page 11: delete the criteria and uses for agriculture, industrial, and navigation.

BACTERIA

1. Alabama. Page 1: for F & WL, change the geometric mean of 100/100 to 1,000/100.

2. Florida. Page 9: for PWS change 1,000/100 fecal coliforms to 1,000/100 total fecal coliforms.

3. Nevada. Page 19: (a) second paragraph, change intrastate to interstate. (b) under the more stringent criteria, change interstate to intrastate and add Class B with Class A.

4. Tennessee. Page 29: for PWS, change total to fecal, and for F & WL replace "no criteria" with "same as Class 1."

5. Utah. Page 31: Continues as:

Utah (cont'd) Class C (PWS after treatment; recreation, excepting swimming unless natural purification action results in quality consistent with class "CR" standard and swimming is specifically approved by State board of health): Monthly arithmetic mean total coliforms not to exceed 5,000/100, except 20% of samples may exceed this if no more than 5% exceed 20,000/100, and monthly arithmetic mean coliforms shall not exceed 2,000/100.

Class CR (swimming): Monthly arithmetic mean coliforms not exceed 1,000/100; no more than 20% exceed this and no more than 5% exceed 4,000/100; and monthly arithmetic mean fecal coliforms exceed 200/100, provided no more than 10% exceed 400/100.

Class D (limited irrigation, not including lawns, rec. areas, dairy pastures, root crops or low growing crops for human consumption): Monthly arithmetic mean coliforms not exceed 5,000/100, except 20% of samples may exceed this if no more than 5% exceed 20,000/100.

Vermont

Class A (PWS with disinfection): Total coliforms not exceed 100/100. Fecal coliform: none attributable to discharge of domestic or industrial wastes.

Class B (PWS with treatment; bathing): Total coliforms not exceed 500/100. Fecal coliform not exceed 200/100.

Class C (secondary contact recreation): Fecal coliforms not to exceed 1,000/100.

Virginia

In all surface waters, except those areas where public or leased private shellfish beds are present, the fecal coliform bacteria shall not exceed a log mean of 200/100 ml with not more than 10% of total samples during any 30-day period exceeding 400/100 ml. Evaluation should be determined by either multi-tube fermentation for marine waters or membrane filtration method for freshwaters and should be based upon not less than 10% of samples taken over not more than a 30-day period.

Shellfish - In all open ocean or estuarine waters capable of propagating shellfish or in specific areas where public or leased private shellfish beds are present, and including those waters on which condemnation or restricted classifications are established by State Department of Health, the following standard will aply: the median fecal coliform value for a sampling station shall not exceed an MPN of 14/100 of samples and not more than 10% of the samples shall exceed 43 for a 5-tube, 3-dilution test or 49 for a 3-tube, 3-dilution test.

DISSOLVED OXYGEN

1. Idaho. Page 8: substitute the given criteria with the following:

   Cold Water Fishery - exceed 6 mg/l at all times, minimum daily average will be 7 mg/l.

   Warm Water Fishery - exceed 5 mg/l at all times, minimum daily average will be 6 mg/l.

   Miscellaneous - Salmonid Spawning; exceed 90% of saturation or 6 mg/l, whichever is greater.

2. Mississippi. Page 13: Substitute the given criteria with the following:

   Dissolved oxygen concentrations shall be maintained at a daily average of not less than 5. mg/l with an instantaneous nimimum of not less than 4.0 mg/l in streams; shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l in estuaries and in the tidally-affected portions of streams; and shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l in the epilimnion (i.e., the surface layer of lakes and impounments that are thermally stratified, or 5 feet from the water's surface (mid-depth if the lake or impoundment is less than 10 feet deep at the point of sampling) for lakes, and impoundments that are not stratified.

   Epilimnion samples may be collected at the approximate mid-point of that zone (i.e., the mid point of the distance or if the epilimnion is more than 5 feet in depth, then at 5 feet from the water's surface.

   (Applicable to all classes).

3. Oregon. Page 17: Replace the Cold Water Fishery criteria of 75% with 90% and delete the phrase "or 5-7 mg/l."

DISSOLVED SOLIDS

1. Arizona. Page 1: Delete the phrase for no requirements. Also, in the last sentence of paragraph change "goals" to "standards."

2. Kentucky. Page 10: Delete the use and criteria for industrial water supply.

3. North Carolina. Page 16: Replace the phrase for no requirements with Class A-II: total dissolved solids - 500 mg/l; sulfates - 250 mg/l.

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INTRODUCTION

This digest was compiled to provide general information to the public as well as to Federal, State, and local officials. It contains excerpts from the individual State-Federal water quality standards establishing pollutant specific criteria for navigable surface waters. The water quality standards program is implemented by the U.S. Environmental Protection Agency where responsibility for providing water quality recommendations, approving State-adopted standards for navigable waters, evaluating adherence to the standards, and overseeing enforcement of standards compliance, has been mandated by Congress.

The standards program, a nationwide strategy for surface water quality management, contains two major elements: the use (recreation, drinking water, fish and wildlife propagation, industrial, or agricultural) to be made of the navigable water; and criteria to protect these uses.

Water quality criteria (numerical or narrative specifications) for physical, chemical, temperature, and biological constituents are stated in the July 1976 U.S. Environmental Protection Agency publication Quality Criteria for Water (QCW), order # 055-001-01049-4, price $3.50, available from the Government Printing Office, Washington, D.C. The 1976 QCW, commonly referred to as the "Red Book," is the most current compilation of scientific information used by the Agency as a basis for assessing water quality. This publication is subject to periodic updating and revisions in light of new scientific and technical information.

Waters classified for the protection and propagation of fish and wildlife must contain sufficient dissolved oxygen to support aquatic life. Dissolved oxygen water quality criteria, the subject of this digest, are established so as to maintain a desirable, or good, fish population at all life-development stages. This is achieved by assuring that the dissolved oxygen concentrations do not fall below a certain minimum level which must be maintained throughout the range of varying natural conditions.

Reduced concentrations of dissolved oxygen can lead to detrimental effects such as taste and odors in waters, and limit the kinds of numbers of fish and other aquatic life present. To prevent these conditions the 1976 Quality Criteria for Water recommends that water should contain sufficient dissolved oxygen to maintain aerobic conditions in the water column and, except as affected by natural phenomena, at the sediment-water interface. A minimum concentration of dissolved oxygen to maintain good fish populations is 5.0 mg/l. The criterion for salmonid spawning beds is a minimum of 5.0 mg/l in the waters present around stream basin gravel.

Since water quality standards are revised from time to time, following procedures set forth in the Clean Water Act, individual entries in this digest may be superseded. This digest will be updated periodically. Because this publication is intended for use only as a general information reference, the reader needs to refer to the current approved water quality standards to obtain the latest information for special purposes and applications. These can be obtained from the State water pollution control agencies or the EPA Regional Offices.

Individual State-adopted criteria follow:

KEY

PWS	Public Water Supply
Rec.	Recreation
F&WL	Fish and Wildlife
Ind.	Industrial
Agric.	Agricultural
Mg/l	Milligrams per Liter
SAR	Sodium Absorption Ratio

(For explanation of use classifications, see EPA publication, General Stream Use Designations.)

DISSOLVED OXYGEN CRITERIA (Minimum Level)

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Alabama		5 mg/l*	Shellfish-5 mg/l*
Alaska	Fresh: 7 mg/l >5 mg/l in spawning gravel		>5 mg/l for waters not used by anadromous or resident fish. Total dissolved gas not to exceed 110% of saturation.
American Samoa	The concentration of dissolved oxygen shall not be less than 10% below the level which would occur naturally or 5.0 milligrams per litter, whichever is greater. If concentrations of dissolved oxygen which would occur naturally are less than 5.0 milligrams per liter, the dissolved oxygen shall not deviate due to the activities of man from the concentrations which would occur naturally.		
Arizona	6 mg/l	6 mg/l	
Arkansas	Dissolved Oxygen - The dissolved oxygen in the waters shall not be less than 5 milligrams per liter (mg/l), and in streams this shall be the critical deficit point of the dissolved oxygen profile. The only exceptions will be when periodic lower values are of natural origin and therefore beyond control of the water user. For trout and smallmouth bass waters the minimum dissolved oxygen content shall not be less than 6 mg/l. The dissolved oxygen sample in streams shall be taken at mid-depth or 5 feet, whichever is less, and at mid-stream in smaller streams. On the larger rivers the dissolved oxygen shall be determined by the average of concentrations in samples collected at quarter points across the river.		
California	(1a) Klamath River Basin Dissolved oxygen concentrations shall not be reduced below the following minimum levels at any time: Waters designated WARM, MAR, or SAL ..... 5.0 mg/l Waters designated COLD ..... 6.0 mg/l Waters designated SPWN..... 7.0 mg/l Waters designated SPWN during critical spawning and egg incubation periods..... 9.0 mg/l (1b) North Coastal Basin (Same as (1a)).		

* Except under extreme conditions may range between 5 mg/l and 4 mg/l if due to natural causes.

(2) San Francisco Bay Basin

For all tidal waters, the following objectives shall apply:

In the Bay downstream of Carquinez Bridge	5.0 mg/l minimum
Upstream from Carquinez Bridge	7.0 mg/l minimum

For nontidal waters, the following objectives shall apply:

Waters designated as cold water habitat	7.0 mg/l minimum
Waters designated as warm water habitat	5.0 mg/l minimum

(3) Central Coastal Basin
Objectives for inland surface waters, enclosed bays and estuaries.

The dissolved oxygen concentration shall not be reduced below the following minimum values at any time:

	Minimum DO, mg/l
Water designated AGR, excluding GWR	2.0
WARM	5.0
SPWN, MAR, or COLD	7.0

(4a) Santa Clara River Basin

The mean annual dissolved oxygen concentration shall be greater than 7 parts per million (ppm), provided that no single determination shall be less than 5.0 ppm, except when natural conditions cause lesser concentrations. Additionally, for cold surface streams and cold water spawning streams the dissolved oxygen content shall not fall below 6.0 and 7.0 mg/l, respectively, as the result of waste discharges.

(4b) Los Angeles River Basin
Objectives for inland surface waters, enclosed bays and estuaries.

Dissolved oxygen shall not fall below 5.0 mg/l at any time as the result of waste discharges; when natural factors cause lesser concentrations, then controllable water quality factors shall not cause further reduction.

For that area known as the outer harbor area of the Los Angeles-Long Beach Harbors, the mean annual dissolved oxygen concentrations shall be 6.0 mg/l or greater, provided that no single determination shall be less than 5.0 mg/l. When natural conditions cause lesser concentrations, then controllable water quality factors shall not cause further reduction.

Additionally, for cold surface streams and cold water spawning streams the dissolved oxygen content shall not fall below 6.0 and 7.0 mg/l, respectively.

(5a,b,c) Sacramento-San Joaquin Delta

This includes water quality objectives that apply to all inland surface waters (excluding the Delta) of the basins, and objectives that apply only to specific surface water bodies.

The monthly median of the mean daily dissolved oxygen concentration shall not fall below 85 percent of the saturation in the main water mass and the 95 percentile concentration shall not fall below 75 percent of saturation. The dissolved oxygen concentrations shall not be reduced below the following minimum levels at any time:

- Waters designated WARM	5.0 mg/l
- Waters designated COLD	7.0 mg/l
- Waters designated SPWN	7.0 mg/l

The following objectives apply to the water bodies specified. To the extent of any conflict with the above, the more stringent objective applies. The dissolved oxygen concentrations:

	Applicable Water Body
(1) Shall be maintained at or near established seasonal levels from Keswick Dam to Eye Street Bridge	Sacramento River, Shasta Dam to Eye Street Bridge
(2) Shall be greater than or equal to 9.0 mg/l from Keswick Dam to Hamilton City from 1 June to 31 August. When natural conditions lower the dissolved oxygen below this level, the concentration shall be maintained at or above 95 percent of the saturation.	Sacramento River, Shasta Dam to Colusa Basin Drain
(3) Shall be greater than or equal to 7.0 mg/l from Hamilton City to Eye Street Bridge from 1 June to 31 August.	Sacramento River, Shasta Dam to Eye Street Bridge
(4) Shall be greater than or equal to 7.0 mg/l all year.	Lake Natoma
(5) Shall be greater than or equal to 8.0 mg/l from Oroville Fish Barrier Dam to Honcut Creek from 1 September to 31 May.	Feather River, Fish Barrier Dam to Sacramento River
(6) Shall be greater than or equal to 8.0 mg/l from Cressey to New Exchequer Dam at all times.	Merced River, Source to McClure Lake
(7) Shall be greater than or equal to 8.0 mg/l from Waterford to La Grange from 15 October to 15 June.	Tuolumne River, Don Pedro Dam to San Joaquin River

The following specific numeric objectives apply to the waters of the Sacramento-San Joaquin Delta. All waters lying within the legal boundaries of the Delta are covered by these objectives unless otherwise specified.

The following objectives apply to indicated Delta waters:

The dissolved oxygen concentration shall not be reduced below the following levels:

- 7.0 mg/l in the Sacramento River and in all Delta waters west of the Antioch Bridge.
- 5.0 mg/l in all other Delta waters with the following exception: In certain bodies of water which are constructed for special purposes and from which fish have been excluded on the fishery is not important as a beneficial use.

(5D) Tulare Lake Basin

The dissolved oxygen content in all surface waters of the Basin, as a result of controllable water quality factors, shall not be reduced, at any time, below the following minimum concentrations:

Waters designated WARM	5.0 mg/l
Waters designated COLD or SPWN	7.0 mg/l

Waste discharges shall not cause median dissolved oxygen concentrations in the main water mass (at centroid of flow) of streams and above the thermocline in lakes to fall below 85 percent of saturation concentration, and the 95 percentile concentration to fall below 75 percent of saturation concentration.

Additionally, dissolved oxygen at any location shall not fall below 5 mg/l or the minimum value shown in Table 4-2, whichever is greater.

(6A) North Lahontan Basin

The dissolved oxygen concentration, in terms of percent saturation, shall not be depressed by more than 10 percent, nor shall the minimum dissolved oxygen concentration at any time be less than the following limits, whichever is more restrictive.

Waters designated WARM	5.0 mg/l
Waters designated COLD	7.0 mg/l

(6B) South Lahontan Basin

The dissolved oxygen concentrations, in terms of percent saturation, shall not be depressed by more than 10 percent, nor shall the minimum, dissolved oxygen concentration at any time be less than 80 percent of saturation of less than the following limits, whichever is more restrictive:

Waters designated WARM	5.0 mg/l
Waters designated COLD	7.0 mg/l

(7A) West Colorado River Basin

As a result of controllable water quality factors, the dissolved oxygen concentration shall not be reduced below the following minimum levels at any time:

Waters designated WARM or SAL	5.0 mg/l
Waters designated COLD	7.0 mg/l

When natural factors cause lesser concentrations, controllable water quality factors shall not cause further reduction.

(7B) East Colorado River Basin

As a result of controllable water quality factors, the dissolved oxygen concentration shall not be reduced below the following minimum levels at any time:

Colorado River (entire reach)	6.0 mg/l
Other waters designated WARM	5.0 mg/l
Other waters designated COLD	7.0 mg/l

Where natural factors cause lesser concentrations, controllable water quality factors shall not cause further reduction.

(8) Santa Ana River River Basin

(1) Within Bay water in general, tidal prisms of San Gabriel River, and flood control channels:

As a result of waste discharges, the mean annual dissolved oxygen concentration shall not be less than 5.0 mg/l nor shall the minimum dissolved oxygen concentration be below 5.0 mg/l at any time.

(2) Within dead-end channels in Newport Bay (channels west of Newport Boulevard and channel west of Lido Peninsula), tidal prism of Santa Ana Rver, and Newport Shores Marina:

The dissolved oxygen concentration shall be greater than 4 mg/l provided that not more than 20% of the samples collected at any station during any quarter shall be less than 4 mg/l and provided further that no single sample shall be less than 3 mg/l.

(3) Inland surface water (including rivers, streams, lakes and reservoirs):

The median dissolved oxygen concentration shall not fall below 85% of saturation in main water mass and the 95 percentile concentration shall not fall below 75% of saturation; dissolved oxygen at any location shall not fall below 5 mg/l for waters designated WARM or 6 mg/l for waters designated COLD.

(9) San Diego Basin

Dissolved oxygen levels shall not be less than 5.0 mg/l in inland surface waters with designated MAR or WARM beneficial uses or less than 6.0 mg/l in waters with designated COLD beneficial uses. The annual mean dissolved oxygen concentration shall not be less than 7 mg/l more than 10% of the time.

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
California(Cont.)	Estuarine waters - a min. of 5 mg/l for most waters, min. of 6 and 7 mg/l for other waters. Coastal waters - a min. of 5 mg/l with additional limits on the annual mean ave. which ranges from 6 to 7 mg/l.		
Colorado	6 mg/l	5 mg/l	PWS - 4 mg/l Industrial - 3 mg/l
Connecticut	**Class A and AA - 75% of saturation, 16 hours a day; 5 mg/l at any time. Class B - Same as Class A. Class C - Not less than 5 mg/l for more than 6 hours during any 24-hour period, at no time less than 4 mg/l. For cold water fishery, not less than 5 mg/l at any time. SA Not less than 6.0 mg/l SB Not less than 5.0 mg/l SC Same as C		
Delaware	9A. General criteria for all non-tidal portions of stream basins (segments). Daily average concentrations shall not be less than 5.0 mg/l nor less than 4.0 mg/l at any time except when natural phenomena cause this value to be depressed further. Specific criteria for all tidal portions of basins except Delaware River and Chesapeake and Delaware Canal, but including Atlantic Ocean and Delaware Bay below RM 48.2 in addition to general criteria in 9A. Any repeated indicator/criterion found here supersedes that of 9A. The dissolved oxygen levels shall not be less than a daily average of 6 mg/l nor go below 5 mg/l at any time. Specific criteria for Delaware River (from PA-DE line, RM 78.8 to Liston Point RM 48.2) in addition to the general criteria of 9A. Repeated indicator/criteria here supersede that of 9A. During April 1-June 15 and Sept. 16-Dec. 31 seasonal average concentration shall not be less than 6.5 mg/l in the entire zone. At no time shall the daily average concentration be less than 3.5 mg/l at Mile 78.8, 4.5 mg/l at Mile 70.0 and 6.0 mg/l at Mile 59.5.		

**For explanation of use classifications, see EPA publication, "General Stream Use Designations."

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
District of Columbia		4.0 mg/l min. 5.0 mg/l daily ave.	
Florida	PWS - 5 mg/l Shellfish - 24 hr. aver. 5 mg/l; min. 4 mg/l. Recreation - fresh: 5 mg/l marine: 24 hr. aver. 5 mg/l; min. 4 mg/l. Agriculture - 24 hr. aver. 4 mg/l; min. 3 mg/l. Navigation - 2.0 mg/l		
Georgia	5 mg/l (Daily Avg. 6 mg/l)	4 mg/l (Daily Avg. 5 mg/l)	Industry, Agriculture, Navigation, Urban streams - 3.0 mg/l
Guam	Concentrations of dissolved oxygen shall not be decreased from natural conditions at any time. Concentrations of dissolved oxygen shall not be decreased below 75 percent saturation at any time. Where natural conditions cause lower dissolved oxygen levels, controllable water quality factors shall not cause further reductions.		
Hawaii			Coastal Waters - **Class AA - 6 mg/l Class A - 5 mg/l Class B - 4.5 mg/l limited to docking areas. Fresh waters used for fish propagation - 5 mg/l.

**For explanation of use classifications, see EPA publication, "General Stream Use Designations."

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Idaho	75% saturation at seasonal low; 100% of saturation in spawning areas during spawning, hatching & fry states of salmonid fishes.		
Illinois	General Standards. Dissolved oxygen (STORET Number - 00300) shall not be less than 6.0 mg/l during at least 16 hours of any 24 hour period, not less than 5.0 mg/l at any time. Lake Michigan. Dissolved oxygen (STORET Number - 00300) except due to natural causes shall not be less than 90% of saturation. Secondary Contact & Indigenous Aquatic Life. Dissolved oxygen (STORET Number - 00300) shall not be less than 3.0 mg/l during at least 16 hours in any 24-hour period, nor less than 2.0 mg/l at any time, and after December 13, 1977, shall not be less than 4.0 mg/l at any time.		
Indiana	SPC 1R-4 General Standards. Warmwater Fish - Concentrations of dissolved oxygen shall average at least 5.0 mg/l per calendar day and shall not be less than 4.0 mg/l at any time (not approved by USEPA). Coldwater Fish - (aa) In those waters designated by the Indiana Department of Natural Resources for put-and-take trout fishing, dissolved oxygen concentrations shall not be less than 6.0 mg/l at any time or place. (bb)Spawning areas (during the spawning season) shall be protected by a minimum dissolved oxygen concentration of 7.0 mg/l. SPC 4R-2 Lake Michigan and Contiguous Harbor Areas. Parameter: Dissolved Oxygen (mg/l) — Inner Harbor, Gary Harbor and Burns Harbor: 7.0 — Lake Michigan: 7.0 SPC 7R-3 Grand Calumet River & Indiana Harbor Ship Canal. (Dissolved Oxygen) Concentrations of dissolved oxygen shall not be less than 4.0 mg/l at any time. SPC 10 R-2 Wolf Lake. (Dissolved Oxygen) Concentrations of dissolved oxygen shall average at least 5.0 milligrams per liter per calendar day and shall not be less than 4.0 milligrams per liter at any time, except at lower values associated with depth may be tolerated or caused by natural conditions.		

State

Indiana(Cont'd)

Rearing or Imprinting Areas

1. Trail Creek and tributaries upstream of U.S. Highway 35.

2. Little Calumet River and tributaries upstream (easterly) of the Wagner Road Bridge. The Wagner Road Bridge is located downstream of Chesterton at the southeast corner of the southwest quarter, Section 26, T 37 N, R 6 W, Porter County, Indiana.

3. Kintzele Ditch (Black Ditch) from Beverly Drive downstream to Lake Michigan.

4. Salt Creek above its confluence with the Little Calumet River.

Dissolved Oxygen: Concentrations shall not be less than 6.0 mg/l at any time or place. During the spawning season or during periods of rearing or imprinting, the dissolved oxygen shall not fall below 7.0 mg/l at any time or any place.

Migration Routes

The criteria listed below are for evaluation of the following streams used by salmonid fishes to migrate to and from natural spawning or rearing or imprinting areas. In those waters within migration routes where put-and-take trout fishing exists, the requirements of SPC 1R-4 shall apply.

Existing Migration Routes

Trail Creek from Highway 35 downstream to Lake Michigan. Little Calumet River from Wagner Road Bridge downstream to Lake Michigan via Burns Ditch.

Dissolved Oxygen: Concentrations shall average at least 6.0 mg/l during any 24-hour period and shall not be less than 5.0 mg/l at any time. During periods of migration, the dissolved oxygen shall not fall below 6.0 mg/l at any time or any place.

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Iowa	7 mg/l-16 hrs. 5 mg/l-any time.	5 mg/l-16 hrs. 4 mg/l-any time.	
Kansas		5 mg/l	
Kentucky	6.0 mg/l min. 7.0 mg/l min. during spawning.	5 mg/l-daily ave. 4 mg/l-min.	
Louisiana	The following dissolved oxygen values represent minimum values for the type of water specified. These values shall apply at all times except in naturally dystrophic waters or where natural conditions cause the dissolved oxygen to be depressed. For short periods of time, diurnal variations below the standard specified may occur. However, no waste discharge or activity of man shall lower the dissolved oxygen concentration to the point where the diurnal variation falls below the specified minimum. FRESH WATER- For a diversified warm water biota including game fish, the daily D.O. concentrations shall be above 5 mg/l assuming normal seasonal and daily variations are above this concentration. However, they may range between 5 and 4 mg/l for short periods of time during a 24-hour period, provided the water quality is favorable in all other respects. ESTUARINE WATER- Dissolved oxygen concentrations in estuaries and tidal tributaries shall not be less than 4 mg/l at any time or place except in naturally dystrophic waters, or where natural conditions cause D.O. to be depressed. COASTAL WATER- Dissolved Oxygen concentration in surface coastal waters shall be greater than 5 mg/l except when the upwellings and other natural phenomena may cause this value to be depressed.		

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Maine	**Class A - Not less than 75% saturation. Class B_1 - Not less than 75% saturation, and not less than 5 ppm at any time. Class B_2 - Not less than 60% saturation, and not less than 5 ppm at any time. Class C - Not less than 5 ppm at any time. Class D - Not less than 2 ppm. Tidal or Marine Waters: SA - Not less than 6 ppm. SB_1 - Not less than 6 ppm. SB_2 - Not less than 6 ppm. SC - Not less than 5 ppm. SD - Not less than 3 ppm.		
Maryland	4.0 mg/l min. 5.0 mg/l daily ave. (all except natural trout waters - NTW)	5.0 mg/l min. 6.0 mg/l daily ave. (NTW).	
Massachusetts	6 mg/l	5 mg/l	Coastal-not less than 6.0 mg/l.
Michigan	R 323.1064. Dissolved oxygen; Great Lakes, connecting waterways and inland streams. Rule 1064. A minimum of 6 milligrams per liter of dissolved oxygen in all Great Lakes and connecting waterways shall be maintained and, except for inland lakes as prescribed in rule 1065, a minimum of 6 milligrams per liter of dissolved oxygen shall be maintained at all times in all inland streams designated by these rules to be protected for coldwater fish. In all other waters, except for inland lakes as prescribed by rule 1065, a minimum of 5 milligrams per liter of dissolved oxygen shall be maintained as a daily average and no single value shall be less than 4 milligrams per liter in waters naturally capable of supporting warmwater fish. R 323.1065. Dissolved oxygen; inland lakes. Rule 1065. (1) The following standards for dissolved oxygen shall apply to inland lakes capable of supporting coldwater fish:		

** For explanation of use classifications, see EPA publication, "General Stream Use Designations."

Michigan (Cont'd)

(a) In warmwater inland lakes with little water exchange which are capable of sustaining a cold stratum of well-oxygenated water throughout the summer above a hypolimnion with very little oxygen, a minimum of 6 milligrams per liter of dissolved oxygen shall be maintained throughout the epilimnion and the upper one-third of the thermocline during the entire summer stagnation period. At all other times, the dissolved oxygen concentration shall be maintained at natural levels.

(b) In inland lakes capable of sustaining high oxygen values throughout the hypolimnion during periods of stagnation, dissolved oxygen concentrations greater than 6 milligrams per liter shall be maintained throughout the entire lake.

(c) In inland lakes which serve as principal anadromous fish migration routes, dissolved oxygen concentrations greater than 5 milligrams per liter shall be maintained throughout the epilimnion and the upper one-third of the thermocline in stratified lakes throughout periods of fish migration. In unstratified lakes, dissolved oxygen concentrations greater than 5 milligrams per liter shall be maintained throughout the entire lake during periods of fish migration.

(d) In shallow, unstratified coldwater inland lakes, dissolved oxygen concentrations greater than 6 milligrams per liter shall be maintained throughout the entire lake.

(2) The following standards for dissolved oxygen shall apply to inland lakes capable of supporting warmwater fish.

(a) In warmwater lakes with little water exchange, dissolved oxygen concentrations greater than 5 milligrams per liter shall be maintained throughout the epilimnion and the upper one-third of the thermocline during the entire summer stagnation period. At all other times, dissolved oxygen concentrations shall be maintained at natural levels.

(b) In warmwater lakes with a high rate of water exchange, dissolved oxygen concentrations greater than 5 milligrams per liter shall be maintained throughout the epilimnion and the upper one-third of the thermocline during the summer stagnation period. At all other times, dissolved oxygen concentrations greater than 5 milligrams per liter shall be maintained except in areas where natural oxygen depressions occur.

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Minnesota	Fisheries and Recreation Class A Dissolved Oxygen - Not less than 7 mg/l from Oct. 1 and continuing through May 31, and not less than 6 mg/l at other times. Class B Dissolved Oxygen - Not less than 6 mg/l from April 1 through May 13, and not less than 5 mg/l at other times. Class C Dissolved Oxygen - Not less than 5 mg/l from April 1 through Nov. 30 and not less than 4 mg/l at other times.		
Mississippi	Minimum dissolved oxygen concentration of 5.0 mg/l at all flows greater than the 7-day, once in ten year low flow (7Q10) with an allowance of a minimum of 4.0 mg/l at the 7Q10 flow.		
Missouri	6 mg/l	5 mg/l	
Montana	7 mg/l (D-1) 6 mg/l (D-2)	5 mg/l (D-3)	
Nebraska		4.0 to 7.0 mg/l depending on use and value of each classified stream segment	

*Not approved

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Nevada	5.0-8.0 mg/l, varies with stream and season.		
New Hampshire	6 mg/l	5 mg/l	

New Jersey Class FW-1-Natural conditions

FW-2,FW-3,TW-1	Trout Production	Trout Maintenance	Non-trout
	7.0 mg/l min.	6.0 mg/l 24hr.ave.	5.0 mg/l 24 hr ave
		5.0 mg/l min.	4.0 mg/l min.
TW-2			4.0 mg/l min.
TW-3			3.0 mg/l min.
CW-1, CW-2			5.0 mg/l min.

Delaware River

Zone 1 (Non-tidal)	5.0 mg/l 24 hr. ave. 4.0 mg/l min.
Zone 2 (Tidal-PWS)	5.0 mg/l 24 hr. ave. 6.5 mg/l seasonal ave. 4/1-6/15 and 9/6-12/31 3.5 mg/l 24 hr. ave. 6.5 mg/l seasonal ave.4/1-6/15 and 9/16-12/31
Zone 5	6.5 mg/l seasonal ave.4/1-6/15 and 9/16-12/31 3.5 mg/l 24 hr. ave. at R.M. 78.8 4.5 mg/l 24 hr. ave. at R.M. 70.0 6.0 mg/l 24 hr. ave. at R.M. 59.5
Zone 6	6.0 mg/l 24 hr. ave. 5.0 mg/l min.

Central Pine Barrens
Class FW - Central Pine Barrens - 85% sat. min.
Class Lower Mullica and Wading Rivers - 85% sat. min.

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
New Mexico	4-6 mg/l by segment (see State std.)		
New York Class N - Natural Conditions			
AA,A,B,C	Trout Spawning	Trout Maintenance	Non-trout
	7.0 mg/l Min.	6.0 mg/l MDA 5.0 mg/l min.	5.0 mg/l MDA 4.0 mg/l min
D			3.0 mg/l min
SA,SB,SC			5.0 mg/l min.
SD			3.0 mg/l min.
A Special (Great Lakes-epilimnion) -		6.0 mg/l Min.	
AA Special - Natural Conditions			
I (NY Harbor)			4.0 mg/l Min
II (NY Harbor-Most now Class SD or I)			30%
North Carolina	6 mg/l min. trout waters.	5 mg/l daily ave. 4 mg/l min.	4.0 mg/l, salt swamp waters. 5.0 mg/l, tidal salt waters. Fresh swamp water may be lower if caused naturally.
North Dakota	Criteria based on "fish species native to the area"-5 mg/l, or 5 mg/l-16 hrs. per day and 3 mg/l any time, by stream.	Not less than than 5.0 mg/l.	
Ohio	Warmwater Habitat - Not less than 5.0 mg/l during at least 16 hours of any 24-hour period. It may be less than 5 mg/l for a period not to exceed 8 hours within 24-hour period, but at no time shall the oxygen content be less than 4.0 mg/l. (Not approved by USEPA) Exceptional Warmwater Habitat - 6 mg/l as a minimum a all times. Coldwater Habitat - 6 mg/l as a minimum at all times. Seasonal Warmwater Habitat - 3.0 mg/l as a minimum at times. (Not approved by USEPA for designated waters) Limited Warmwater Habitat - Same as warmwater habitat except for specific lower limits assigned on a case by case basis. (Not approved by USEPA for designated waters)		

Ohio (Cont.)	Lake Erie outside excepted areas - 6 mg/l as a minimum at all times. Lake Erie in excepted areas - Same as warmwater habitat. Ohio River - Concentration shall average at least 5.0 mg/l per calendar day and shall not be less than 4.0 mg/l at any time or place outside the mixing zone. (Not approved by USEPA) Mahoning River Basin for Aquatic Life (Warmwater Fishery) - Not less than an average of 5.0 mg/l per calendar day and not less than 4.0 mg/l at any time. Lower Cuyahoga River - Dissolved Oxygen shall not be less than a daily average of 5.0 mg/l nor less than 4.0 mg/l at any time. The dissolved oxygen standard need not be met during the months of July, August, Sept., and Oct. for that portion of the Cuyahoga River from the confluence of the Cuyahoga River and Big Creek to the mouth of the Cuyahoga River.
Oklahoma	The dissolved oxygen concentration shall not be less than 5.0 mg/l for all warm waters and 6.0 mg/l for those waters designated as smallmouth bass or trout fisheries. It is recognized that diurnal fluctuations of dissolved oxygen occur in natural aquatic systems due to production and respiration processes. Due to these natural fluctuations, a 1.0 mg/l dissolved oxygen concentration deficit shall be allowed for not more than eight (8) hours during any twenty-four (24) hour period. The numerical and descriptive (i.e. bioassay related) limits shall be maintained at all times and apply to all perennial streams of the State with the exception of when the flow is less than the seven-day, two-year low flow value. For intermittent streams, the numerical and descriptive limits shall be maintained except when the flow is less than 1.0 cfs. All other general standards shall be maintained at all times and apply to all perennial and intermittent streams of the State except when conditions are attributable to natural phenomena. Furthermore, at times when the numerical and descriptive limits do not apply, the instream dissolved oxygen concentration shall be maintained to prevent nuisance conditions caused by man's activities.

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Oregon	75% saturation at seasonal low or 5-7 mg/l, by stream; 95% sat. in spawning areas during spawning, hatching and fry development.		Marine-not less than saturation Estuarine-6 mg/l
Pennsylvania	b_1 - Minimum daily average 6.0 mg/l; no value less than 5.0 mg/l. b_2 - Minimum daily average 5.0 mg/l; no value less than 4.0 mg/l. b_3 - Minimum daily average not less than 5.0 mg/l; during periods 4/1-6/15 and 9/16-12/31, not less than 6.5 mg/l as a seasonal average. b_4 - Minimum daily average not less than 3.5 mg/l; during periods 4/1-6/15 and 9/16-12/31, not less than 6.5 mg/l as a seasonal average. b_5 - For the period 2/15 to 7/31 of any year minimum daily average of 6.0 mg;1, no value less than 5.0 mg/l. For the remainder of the year minimum daily average of 5.0 mg/l, no value less than 4.0 mg/l. b_6 - No value less than 7.0 mg/l. b_7 - For the epilimnion of lakes, ponds, and impoundments, minimum daily average of 5.0 mg;1, no value less than 4.0 mg/l. b_8 - For lakes, ponds and impoundments only, no value less than 5.0 mg/l at any point. b_9 - Minimum daily average 7.0 mg/l, no value less than 6.0 mg/l.		
Puerto Rico	Class SA,SB 5.0 mg/l min. Class SC - 4.0 mg/l min. Class SD (PWS)5.0 mg/l Min. except for 4 hours within any 24 hour period when it can be no less than 4.0 mg/l.		

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Rhode Island	**Class A & B: 75% saturation, 16 hours/day 5 mg/l at any time. Class C: Minimum 5 mg/l at any time, minimum 4 mg/l sluggish eutrophic waters. Class D: Minimum of 2 mg/l at any time. SA: Not less than 6.0 mg/l at any time. SB: Not less than 5.0 mg/l at any time. SC: Not less than 5 mg/l during at least 16 hours of any 24-hour period nor less than 4 mg/l at any time.		
South Carolina	**Class A (swimming) - 5.0 mg/l minimum, 4.0 mg/l average in swamp waters. Class B - 5.0 mg/l daily average with a low of 4.0 mg/l, 4.0 mg/l average in swamp waters. Tidal salt waters - 5.0 mg/l minimum, classes SA and SB, 4.0 mg/l minimum, Class SC. AA - average of 6 mg/l unless natural conditions can be shown to contribute to values below this. AA - Trout - maintained at their natural condition or 6 mg/l; daily ave. of 7 mg/l. SAA - 5.0 mg/l.		
South Dakota	6 mg/l or 5 mg/l by stream	5 mg/l	Big Stone and Trauryse Lakes Min. 6 mg/l April and May.
Tennessee	PWS, Industrial Water S., Recreation, Irrigation, Livestock Watering & Wildlife & Navigation: There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions. Fish & Aquatic Life: The dissolved oxygen shall be maintained at 5.0 mg/l except in limited sections of the stream where (i) existing quality due to irretrievable man-induced conditions cannot be restored to 5.0 mg/l DO; (ii) the cost for application of effluent limitations more stringent than defined through §301 of FWPCAA is economically prohibitive when compared with the benefits to be obtained; or (iii) the natural background quality of the water is less than the desired minimum of 5.0 mg/l. In these limited sections, a minimum of 3.0		

** For explanation of use classifications, see EPA publication, "General Stream Use Designations."

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Tennessee (cont.)	mg/l dissolved oxygen will be allowed. The DO concentration shall be measured at mid-depth in waters having a total depth of ten (10) feet or less and at a depth of 5 feet of water having a total depth of greater than 10 feet. A minimum dissolved oxygen content of 6.0 mg/l shall be maintained in recognized trout streams.		
Texas		4-6 mg/l by segment tied to 7 day 2 year low flow.	Houston Ship Channel 2 mg/l. Tidal 3 to 5 mg/l, by stream.
Trust Territories	Dissolved oxygen shall be greater than 6.0 mg/l unless reduced by natural causes (FWL). Dissolved oxygen in surface waters shall not be reduced from natural conditions (PWS). Dissolved oxygen shall not be less than 6 mg/l in all saline surface waters from other than natural causes.		
Utah	6 mg/l	5.5 mg/l	PWS - B.O.D. - not more than 5 mg/l 20% of the time - not more than 10 mg/l 10% of the time.
Vermont	**Type I Waters Streams and rivers sustaining natural populations of brook trout, salmon, rainbow trout and brown trout. Dissolved oxygen content of these waters at near spawning areas not less than 7 mg/l; not less than 6 mg/l in non-spawning areas. Type II Waters Streams and rivers sustaining mixed populations of trout and bass not less than 6 mg/l. Type III Waters Warm water streams not less than 5 mg/l. Type IV Waters Oligotrophic lakes, ponds and reservoirs sustaining natural populations of trout and salmon not less than 6 mg/l. Type V Waters Other lakes and ponds not less than 5 mg/l.		

** For explanation of use classifications, see EPA publication, "General Stream Use Designations."

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Virginia	Major Class I	Minimum	Daily Average
	Open Ocean (Seaside of the Land Mass)	5.0	None
	Major Class II Estuarine (Tidal Water - Coastal Zone to Fall Line)	4.0	5.0
	Major Class III Free Flowing Streams (Coastal Zone and Piedmont Zone to the Crest of the Mountains)	4.0	5.0
	Major Class IV Mountainous Zone	4.0	5.0
	Major Class V Put and Take Trout Waters	5.0	6.0
	Major Class VI Natural Trout Waters	6.0	7.0
Virgin Islands	Class A - Natural conditions Class B - 5.5 mg/l min. Class C - 5.0 mg/l min.		
Washington	**Class AA - 9.5 mg/l Class A - 8.0 mg/l Class B - 6.5 mg/l or 70% saturation, whichever is greater. Class C -		Marine Water - Class AA-7.0 mg/l Class A-6.0 mg/l Class B-5.0 mg/l or 70% saturation, whichever is greater. Class C-4.0 mg/l or 50% saturation, whichever is greater.
	Lake Class - No measurable decrease from natural.		
West Virginia	Not less than 5 mg/l at any time except in Knawha River and Ohio River where it is 5 mg/l ave., 4 mg/l min.		

** For explanation of use classifications, see EPA publication, "General Stream Use Designations."

State	Cold Water Fishery	Warm Water Fishery	Miscellaneous
Wisconsin	Standards for Fish and Aquatic Life Except for waters classified as trout streams in Wisconsin Trout Streams, Publication 213-72, the dissolved oxygen content in surface waters shall not be lowered to less than 5 mg/l at any time. Streams classified as trout waters by the Department of Natural Resources (Wisconsin Trout Streams, Publication 213-72) shall not be altered from natural background by effluents that influence the stream environment to such an extent that trout populations are adversely affected. Dissolved oxygen in classified trout streams shall not be artificially lowered to less than 6.0 mg/l at any time, nor shall the dissolved oxygen be lowered to less than 7.0 mg/l during the spawning season. The dissolved oxygen in the Great Lakes tributaries used by stocked salmonids for spawning runs shall not be lowered below natural background during the period of habitation. Intermediate Aquatic Life Dissolved oxygen shall not be less than 3 mg/l. Marginal Surface Waters Dissolved oxygen shall not be less than 2 mg/l.		
Wyoming	6 mg/l	6 mg/l	

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