

**EXHIBIT 5**

**STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS  
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
Water Resources**

**WATER QUALITY REGULATIONS**



July 2006

**AUTHORITY:** These regulations are adopted in accordance with Chapter 42-35 pursuant to Chapters 46-12 and 42-17.1 of the Rhode Island General Laws of 1956, as amended

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS  
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
Water Resources

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**"Waterbody segment"** means a defined section or described area which is part of a larger surface waterbody of the state.

**"Water quality criteria"** means elements of the State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use.

**"Water quality limited waters"** means any segment of a surface waterbody where the water quality does not meet applicable water quality standards, and is not expected to meet applicable water quality standards, even after the application of the technology-based effluent limitations required by Sections 301(b) and 306 of the Act.

**"Water quality standard"** means provisions of State or Federal law which consist of a designated use(s) and water quality criteria for the waters of the State. Water Quality Standards also consist of an antidegradation policy.

**"Waters of the State" or "The Waters"** means all surface water and groundwater of the State of Rhode Island, including all tidewaters, territorial seas, wetlands, and land masses partially or wholly submerged in water; and both inter- and intra-state bodies of water which are, have been or will be used in commerce, by industry, for the harvesting of fish and shellfish or for recreational purposes.

**"Wetlands"** means 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. Freshwater wetlands are determined by the Department in accordance with the Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands Act, as amended. Coastal wetlands are determined by rules and regulations under the jurisdiction of the Coastal Resources Management Council.

## **Rule 8. - SURFACE WATER QUALITY STANDARDS**

A. **Purpose.** A water quality standard defines the water quality goals of a surface waterbody, or portion thereof, by designating the use or uses of the water and by setting criteria necessary to protect the uses. Water quality standards are intended to protect public health, safety and welfare, enhance the quality of water and serve the purposes of the Clean Water Act and Chapter 46-12 of the General Laws of Rhode Island. "Serve the purposes of the Act" (as defined in Section 101(a)(2) and 303(c) of the Clean Water Act) means that water quality standards should, whenever attainable, provide water quality, including quantity, for the protection and propagation of fish and wildlife and for recreation in and on the water and take into consideration their use and value as public water supplies, propagation of fish and wildlife, recreation in and on the water, agricultural, industrial, and other purposes including navigation.

Such standards serve the dual purposes of establishing the water quality goals for a specific surface water body or waterbody segment and serve as the regulatory basis for the establishment of water-quality-based-treatment controls and strategies beyond the technology-based levels of treatment required by Sections 301(b) and 306 of the Clean Water Act.

B. Water Use Classification - The surface waters of the state shall be assigned to one of the classes listed below. Each class is defined by the designated uses, which are the most sensitive and therefore governing water uses which it is intended to protect. Surface waters may be suitable for other beneficial uses, but shall be regulated to protect and enhance the designated uses. In no case shall waste assimilation or waste transport be considered a designated use.

(1). Freshwater:

(a). Class AA<sup>@</sup> - These waters are designated as a source of public drinking water supply (PDWS) or as tributary waters within a public drinking water supply watershed (the terminal reservoir of the PDWS are identified in Appendix A), for primary and secondary contact recreational activities and for fish and wildlife habitat. These waters shall have excellent aesthetic value.

(b). Class A - These waters are designated for primary and secondary contact recreational activities and for fish and wildlife habitat. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have excellent aesthetic value.

(c). Class B<sup>\*</sup> - These waters are designated for fish and wildlife habitat and primary and secondary contact recreational activities. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value.

(d). Class B1<sup>\*</sup> - These waters are designated for primary and secondary contact recreational activities and fish and wildlife habitat. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value. Primary contact recreational activities may be impacted due to pathogens from approved wastewater discharges. However all Class B criteria must be met.

(e). Class C - These waters are designated for secondary contact recreational activities and fish and wildlife habitat. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These water shall have good aesthetic value.

<sup>@</sup> Class AA waters used for public drinking water supply may be subject to restricted recreational use by State and local authorities.

<sup>\*</sup> Certain Class B and B1 waterbody segments may have partial use designations assigned to them as noted in rule 8.B.(3) below.

(2). Seawater:

(a). Class SA<sup>\*@</sup> - These waters are designated for shellfish harvesting for direct human consumption, primary and secondary contact recreational activities, and fish and wildlife habitat. They shall be suitable for aquacultural uses, navigation and industrial cooling. These waters shall have good aesthetic value.

(b). Class SB\* - These waters are designated for primary and secondary contact recreational activities; shellfish harvesting for controlled relay and depuration; and fish and wildlife habitat. They shall be suitable for aquacultural uses, navigation, and industrial cooling. These waters shall have good aesthetic value.

(c). Class SB1\* - These waters are designated for primary and secondary contact recreational activities and fish and wildlife habitat. They shall be suitable for aquacultural uses, navigation, and industrial cooling. These waters shall have good aesthetic value. Primary contact recreational activities may be impacted due to pathogens from approved wastewater discharges. However all Class SB criteria must be met.

(d). Class SC - These waters are designated for secondary contact recreational activities, and fish and wildlife habitat. They shall be suitable for aquacultural uses, navigation, and industrial cooling. These waters shall have good aesthetic value.

\* Certain Class SA, SB and SB1 waterbody segments may have partial use designations assigned to them as noted in rules 8.B(3) below.

@ Some Class SA waters contain Closed Safety Zones which are waters in the vicinity of an approved sanitary discharge which may be impacted in the event of complete failure of treatment and are therefore, currently prohibited to shellfishing. Although shellfishing use is restricted, all SA criteria must be met.

(3). Partial Uses - In accordance with rule 19 of these regulations, the Department may designate a partial use for the above listed water use classifications. Partial use denotes specific restrictions of use assigned to a waterbody or waterbody segment that may affect the application of criteria. For example, a partial use designation may be appropriate where waters are impacted by activities such as combined sewer overflows and concentrations of vessels. Additional partial uses may be so designated by the Director if provided in accordance with rule 19.

(a). CSO - These waters will likely be impacted by combined sewer overflows in accordance with approved CSO Facilities Plans and in compliance with rule 19.E.1 of these regulations and the Rhode Island CSO Policy. Therefore, primary contact recreational activities; shellfishing uses; and fish and wildlife habitat will likely be restricted.

(b). Concentration of Vessels - These waters are in the vicinity of marinas and/or mooring fields and therefore seasonal shellfishing closures will likely be required as listed in the most recent (revised annually) RIDEM document entitled Shellfish Closure Areas; however, all Class SA criteria must be attained.

Please note that partial use designations are represented by the lower case letters, "a" or "b", which appear in brackets {} next to the classification as found in Appendix A.

C. Water Quality Classifications - All surface waters of the State have been categorized according to the water use classification of rules 8.B.(1), (2), and (3) based on considerations of public health, safety and welfare, recreation, propagation and protection of fish and wildlife, and economic and social benefit. The surface waters of the State are classified according to the list of water segments in Appendix A. For waterbodies not listed in Appendix A, the following apply:

- (1). All streams tributary to Class A waters shall be Class A.
- (2) All waters tributary to Class AA waters shall be Class AA.
- (3). All freshwaters hydrologically connected by surface waters and upstream of Class B, B1, SB, SB1, C or SC waters shall be Class B unless otherwise identified in Appendix A of these regulations.
- (4). All other fresh waters, including, but not limited to, ponds, kettleholes and wetlands not listed in Appendix A shall be considered to be Class A.
- (5). All seawaters not listed in Appendix A shall be considered to be Class SA. All saltwater and brackish wetlands contiguous to seawaters not listed in Appendix A shall be considered to be Class SA.
- (6). All saltwater and brackish wetlands contiguous to seawaters listed in Appendix A shall be considered the same class as their associated seawaters.

D. Water Quality Criteria - The following physical, chemical and biological criteria are parameters of minimum water quality necessary to support the surface water use classifications of rule 8.B. and shall be applicable to all waters of the State.

(1). General Criteria - The following minimum criteria are applicable to all waters of the State, unless criteria specified for individual classes are more stringent:

(a). At a minimum, all waters shall be free of pollutants in concentrations or combinations or from anthropogenic activities subject to these regulations that:

- i. Adversely affect the composition of fish and wildlife;
- ii. Adversely affect the physical, chemical, or biological integrity of the habitat;
- iii. Interfere with the propagation of fish and wildlife;
- iv. Adversely alter the life cycle functions, uses, processes and activities of fish and wildlife; or
- v. Adversely affect human health.

(b). Aesthetics - all waters shall be free from pollutants in concentrations or combinations that:

- i. Settle to form deposits that are unsightly, putrescent, or odorous to such a degree as to create a nuisance, or interfere with the existing or designated uses;
- ii. Float as debris, oil, grease, scum or other floating material attributable to wastes in amounts to such a degree as to create a nuisance or interfere with the existing or designated uses;
- iii. Produce odor or taste or change the color or physical, chemical or biological conditions to such a degree as to create a nuisance or interfere with the existing or designated uses; or,

- iv. Result in the dominance of species of fish and wildlife to such a degree as to create a nuisance or interfere with the existing or designated uses.

(c). Radioactive substances - The level of radioactive materials in all waters shall not be in concentrations or combinations which will likely be harmful to humans, fish and wildlife, or result in concentrations in organisms producing undesirable conditions.

(d). Nutrients - Nutrients shall not exceed the limitations specified in rule 8.D.(2) and 8.D.(3) and/or more stringent site-specific limits necessary to prevent or minimize accelerated or cultural eutrophication.

(e). Thermal Mixing Zones - In the case of thermal discharges into tidal rivers, fresh water streams or estuaries, where thermal mixing zones are allowed by the Director, the mixing zone will be limited to no more than one quarter (1/4) of the cross sectional area and/or volume of river flow, stream or estuary, leaving at least three quarters (3/4) free as a zone of passage. In wide estuaries and oceans, the limits of mixing zones will be established by the Director.

(f). Non-thermal Mixing Zones - In the case of non-thermal discharges, in applying these standards the Director may recognize, where appropriate, a limited acute and/or chronic mixing zone(s) on a case-by-case basis. The locations, size and shape of these zones shall provide for the maximum protection of fish and wildlife.

(g). At a minimum, all mixing zones must:

- i. Meet the criteria for aesthetics, in accordance with rule 8.D.(1).b;
- ii. Be limited to an area or volume that will prevent interference with the existing and designated uses in the associated waterbody segment and beyond;
- iii. Allow an appropriate zone of passage for migrating fish and other organisms, prohibit lethality to organisms passing through the mixing zone, and protect for spawning and nursery habitat; and
- iv. Not allow substances to accumulate in sediments, fish and wildlife or food chains such that known or predicted safe exposure levels for the health of humans or fish and wildlife will be exceeded.

(h). For activities that will likely cause or contribute to flow alterations, streamflow conditions must be adequate to support existing and designated uses.

(2). Class-specific Criteria for Freshwaters - see Table 1

(3). Class-specific Criteria for Seawaters - see Tables 2 and 3

E. Applicable Conditions - The water quality standards apply under the most adverse conditions, as determined by the Director according to sound engineering and scientific practices on a case-by-case basis unless defined below.



(1). The ambient water quality criteria are applicable at or in excess of the following flow conditions:

(a). Aquatic Life Criteria - The acute and chronic aquatic life criteria for freshwaters shall not be exceeded at or above the lowest average 7 consecutive day low flow with an average recurrence frequency of once in 10 years (7Q10). The acute and chronic aquatic life criteria for seawater shall not be exceeded beyond the boundary of the mixing zone(s), as defined and determined by rules 8.D.(1).e, f and g of these regulations, and thence throughout the waterbody. If a mixing zone has not been established, these criteria shall not be exceeded in any portion of the receiving water.

(b). Human Health Criteria - The freshwater human health criteria for non-carcinogens and carcinogens are applicable at or in excess of the harmonic mean flow, which is a long-term mean flow value calculated by dividing the number of daily flows analyzed by the sum of the reciprocals of those daily flows. For seawaters, the ambient human health water quality criteria for carcinogens and non-carcinogens are applicable when the most adverse hydrographic and pollution conditions occur at the particular point of evaluation.

F. Federal Approval and Periodic Review - These water quality standards are subject to approval by the administrator pursuant to section 303(c) of the Clean Water Act. In accordance with paragraph 303(c)(1) of the Act, the Water Quality Standards shall be reviewed periodically but at least once every three years, and amended as necessary.

G. Symbolic Representative of Water Quality Standards - The Director shall issue maps from time to time which indicate assigned water use classification.

TABLE 1. 8.D.(2). Class-Specific Criteria - Fresh Waters

CRITERION	CLASS AA <sup>1</sup>	CLASS A	CLASS B, B1, B(a), B1(a)	CLASS C
1. Dissolved Oxygen	<p><u>Cold Water Fish Habitat</u> - Dissolved oxygen content of not less than 75% saturation, based on a daily average, and an instantaneous minimum dissolved oxygen concentration of at least 5 mg/l, except as naturally occurs. For the period from October 1st to May 14th, where in areas identified by the RI Division of Fish and Wildlife as cold water fish spawning areas the following criteria apply: For species whose early life stages are not directly exposed to the water column (ie, early life stages are intergravel), the 7 day mean water column dissolved oxygen concentration shall not be less than 9.5 mg/l and the instantaneous minimum dissolved oxygen concentration shall not be less than 8 mg/l. For species that have early life stages exposed directly to the water column, the 7 day mean water column dissolved oxygen concentration shall not be less than 6.5 mg/l and the instantaneous minimum dissolved oxygen concentration shall not be less than 5.0 mg/l.</p> <p><u>Warm Water Fish Habitat</u> - Dissolved oxygen content of not less than 60% saturation, based on a daily average, and an instantaneous minimum dissolved oxygen concentration of at least 5.0 mg/l, except as naturally occurs. The 7 day mean water column dissolved oxygen concentration shall not be less than 6 mg/l.</p>	<p>None allowable.</p>		<p>None in such amounts that would impair any usages specifically assigned to this class.</p>
2. Sludge deposits, solid refuse, floating solids, oil, grease, scum		<p>None allowable.</p>		<p>None in such concentrations that would impair any usages specifically assigned to this class. Turbidity not to exceed 10 NTU over natural background.</p>
3. Color and turbidity.		<p>None in such concentrations that would impair any usages specifically assigned to this class. Turbidity not to exceed 5 NTU over background.</p>		<p>None in such concentrations that would impair any usages specifically assigned to this class. Turbidity not to exceed 10 NTU over natural background.</p>
4. Fecal Coliform Bacteria (MPN/100ml)	<p><b>Drinking Water Supply Criteria:</b> - applied at the terminal reservoir of the system - Not to exceed a geometric mean value of 20 MPN/100 ml and not more than 10% of the samples shall exceed a value of 200.</p>			<p>None in such concentrations that would impair any usages specifically assigned to this class.</p>
5. Enterococci	<p><b>Primary Contact Recreational/Swimming Criteria-</b> Not to exceed a geometric mean value of 200 MPN/100 ml and not more than 10% of the total samples taken shall exceed 400 MPN/100 ml, applied only when adequate enterococci data are not available.</p> <p><b>Primary Contact Recreational/Swimming Criteria</b>                      Non-Designated Bathing Beach Waters Geometric Mean Density: 54 colonies/100 ml                      Designated Bathing Beach Waters Geometric Mean Density: 33 colonies/100 ml                      Single Sample Maximum*: 61 colonies/100 ml</p> <p>* Criteria for determining beach swimming advisories at designated beaches as evaluated by Health.</p>			<p>None in such concentrations that would impair any usages specifically assigned to this class.</p>
6. Taste and odor		<p>None other than of natural origin and none associated with nuisance algal species.</p>		<p>None in such concentrations that would impair any usages specifically assigned to this class nor cause taste or odor in edible portions of fish.</p>
7. pH (Standard Units)		<p>6.5 - 9.0 or as naturally occurs.</p>		

TABLE 1. 8.D.(2). Class-Specific Criteria - Fresh Waters, cont.

CRITERION	CLASS AA*	CLASS A	CLASS B, B1, B{a}, B1{a}	CLASS C
8. Temperature/ Temperature increase				No activity shall raise the temperature of the receiving waters above the recommended limit on the most sensitive receiving water use nor cause the growth of undesirable or nuisance species of biota. In no cases shall an activity cause the temperature to exceed 83 degrees F. Heated discharges into designated coldwater habitats shall not raise the temperature above 68 degrees F outside an established thermal mixing zone. In no case shall the temperature of the receiving water be raised more than 4 degrees F.
9. Chemical constituents				<p>a. None in concentrations or combinations that could be harmful to humans or fish and wildlife for the most sensitive and governing water class use, or unfavorably alter the biota, or which would make the waters unsafe or unsuitable for fish and wildlife or their propagation, impair the palatability of same, or impair waters for any other existing or designated use. None in such concentrations that would exceed the Water Quality Criteria and Guidelines as found in Appendix B.</p> <p>b. The ambient concentration of a pollutant in a water body shall not exceed the Ambient Water Quality Criteria and Guidelines, (Appendix B) for the protection of aquatic organisms from acute or chronic effects, unless the criteria or guidelines are modified by the Director based on results of bioassay tests conducted in accordance with the terms and conditions provided in the RIDEM Site Specific Aquatic Life Water Quality Criteria Development Policy.</p>
10. Nutrients				<p>a. Average Total Phosphorus shall not exceed 0.025 mg/l in any lake, pond, kettlehole or reservoir, and average Total P in tributaries at the point where they enter such bodies of water shall not cause exceedance of this phosphorus criteria, except as naturally occurs, unless the Director determines, on a site-specific basis, that a different value for phosphorus is necessary to prevent cultural eutrophication.</p> <p>b. None in such concentration that would impair any usages specifically assigned to said Class, or cause undesirable or nuisance aquatic species associated with cultural eutrophication, nor cause exceedance of the criterion of 10(a) above in a downstream lake, pond, or reservoir. New discharges of wastes containing phosphates will not be permitted into or immediately upstream of lakes or ponds. Phosphates shall be removed from existing discharges to the extent that such removal is or may become technically and reasonably feasible.</p>
<p>† Class AA waters used for public drinking water supply may be subject to restricted recreational use by State and local authorities.</p>				

TABLE 2. 8.D.(3). Class-Specific Criteria - Sea Waters

CRITERION	CLASS SA, SA (b)	CLASS SB, SB1, SB(a), SBI(a)	CLASS SC
See Table 3			
1. Dissolved Oxygen		None allowable.	None in such amounts that would impair any usages specifically assigned to this class.
2. Sludge deposits, solid refuse, floating solids, oil, grease, scum	None in such concentrations that would impair any usages specifically assigned to this class. Turbidity not to exceed 5 NTU over background.		None in such amounts that would impair any usages specifically assigned to this class.
3. Color and turbidity	None in such concentrations that would impair any usages specifically assigned to this class. Turbidity not to exceed 10 NTU over background.		None in such concentrations that would impair any usages specifically assigned to this class. Turbidity not to exceed 10 NTU over background.
4. Fecal Coliform Bacteria (MPN/100ml)	<p><b>Shellfishing Criteria:</b> - Not to exceed a geometric mean MPN value of 14 and not more than 10% of the samples shall exceed an MPN value of 49 for a three-tube decimal dilution.</p> <p><b>Primary Contact Recreational/Swimming Criteria:</b> - Not to exceed a geometric mean value of 50 MPN/100 ml and not more than 10% of the total samples taken shall exceed 400 MPN/100 ml, applied only when adequate enterococci data are not available.</p>		None in such concentrations that would impair any usages specifically assigned to this class.
5. Enterococci	<p><b>Primary Contact Recreational/Swimming Criteria</b>            Geometric Mean Density: 35 colonies/100 ml            Single Sample Maximum*: 104/100 ml</p> <p>* Criteria for determining beach swimming advisories at designated beaches as evaluated by HEALTH.</p>		None in such concentrations that would impair any usages specifically assigned to this class.
6. Taste and odor	None allowable except as naturally occurs.	None in such concentrations that would impair any usages specifically assigned to this class nor cause taste or odor in edible portions of fish or shellfish.	None in such concentrations that would impair any usages specifically assigned to this class nor cause taste or odor in edible portions of fish or shellfish.
7. pH (Standard Units)	6.5 - 8.5 but not more than 0.2 units outside of the normally occurring range.		
8. Temperature/ Temperature Increase	Activities shall not increase the temperature except where the increase will not exceed the recommended limit on the most sensitive receiving water use and in no case shall an activity cause the temperature to exceed 83 degrees F nor raise the normal temperature more than 1.6 degrees F, 16 June through September and not more than 4 degrees F from October through 16 June. All measurements shall be made at the boundary of such mixing zones as is found to be reasonable by the Director.		
9. Chemical constituents	<p>a. None in concentrations or combinations that could be harmful to humans or fish and wildlife for the most sensitive and governing water class use, or unfavorably alter the biota, or which would make the waters unsafe or unsuitable for fish and wildlife or their propagation, impair the palatability of same, or impair the waters for any other existing or designated use. None in such concentrations that would exceed the Water Quality Criteria and Guidelines as found in Appendix B.</p> <p>b. The ambient concentration of a pollutant in a water body shall not exceed the RIDEM Ambient Water Quality Criteria &amp; Guidelines (Appendix B) for the protection of aquatic organisms from acute or chronic effects, unless the criteria or guideline is modified by the Director based on results of bioassay tests conducted in accordance with the terms and conditions provided in the RIDEM Site Specific Aquatic Life Water Quality Criteria Development Policy.</p>		
10. Nutrients	None in such concentration that would impair any usages specifically assigned to said Class, or cause undesirable or nuisance aquatic species associated with cultural eutrophication. Shall not exceed site-specific limits if deemed necessary by the Director to prevent or minimize accelerated or cultural eutrophication. Total phosphorus, nitrates and ammonia may be assigned site-specific permit limits based on reasonable Best Available Technologies. Where waters have low tidal flushing rates, applicable treatment to prevent or minimize accelerated or cultural eutrophication may be required for regulated nonpoint source activities.		

Table 3  
Saltwater Dissolved Oxygen Criteria

- I. For **surface waters above a seasonal pycnocline**, not less than an instantaneous value of 4.8 mg/l more than once every three years, except as naturally occurs.
- II. For waters **below the seasonal pycnocline**, Aquatic Life Uses are considered to be protected if conditions do not fail to meet protective thresholds, as described below, more than once every three years. DO criteria presented here shall be protective of the most sensitive life stage – survival effects on larvae which affects larval recruitment – for both persistent and cyclic conditions. This criteria evaluates effects of exposure to low DO over time on larval recruitment. Because larval recruitment occurs over the whole season, the low DO exposure effects are cumulative. Exposures are evaluated on a daily basis to determine the total seasonal exposure. The criteria to protect larval survival is established to limit the number of exposure days over the range of low DO conditions such that the cumulative percentage of larvae affected shall not exceed a 5% reduction in larval recruitment over the season. If the Director determines that a smaller percent impairment on larval recruitment is necessary on a site specific basis, a criteria modification will be processed in accordance with Rule 19.F. Protection of larval survival will also afford adequate protection of juvenile and adult life stages. The critical recruitment season for evaluation of DO exposure is defined as May 1 through October 31. While recruitment may occur at other periods of the year, this timeframe reflects periods when hypoxia are most prevalent.

Waters with a DO concentration above an instantaneous value of 4.8 mg/l shall be considered protective of Aquatic Life Uses. When instantaneous DO values fall below 4.8 mg/l, the waters shall not be:

1. Less than 2.9 mg/l for more than 24 consecutive hours during the recruitment season; nor
2. Less than 1.4 mg/l for more than 1 hour more than twice during the recruitment season; nor
3. Shall they exceed the cumulative DO exposure presented in Table 3.A.

**The method for calculating cumulative low DO exposure throughout the recruitment season is as follows:**

- A. For **persistent low DO conditions** (low DO conditions that vary little within a day, e.g., <0.5 mg/l), the limit represents allowable DO conditions below 4.8 mg/l provided the exposure duration (number of days observed) does not exceed the corresponding allowable number of days (as presented in Table 3.A.) that ensure adequate larval recruitment over the course of the season. The cumulative seasonal low DO effects are evaluated by totaling the fractions of the observed (or projected) exposure duration (in days) divided by the allowable number of days for each DO concentration. The sum of the decimal fractions shall not exceed 1.0. The minimum daily DO measurement is used to represent the daily DO value. The criteria for 24 hour DO concentration and allowable number of days as presented in Table 3.A. are calculated using the following equation:

$$\sum t_i(\text{actual})/t_i(\text{allowed}) < 1.0$$

$$DO_i = 13.0 / (2.80 + 1.84e^{(-0.10t_i)})$$

Where  $DO_i$  = allowable concentration (mg/l)  
 $t_i$  = exposure interval duration (days)  
 $i$  = exposure interval

- B. For **cyclic low DO conditions** (DO conditions that fluctuate broadly within a day, e.g. >0.5 mg/l) the limit represents the allowable number of days at a given daily larval percent mortality that protects against greater than 5% cumulative impairment of larval recruitment over a recruitment season. The maximum daily percent larval mortality is a function of DO minimum for any exposure interval/range (mg/l) and the duration of the interval (hours) and

is determined using the Time-to-death (TTD) curves presented in Figure 3.A. (from EPA-822-R-00-012, November 2000) The maximum daily percent larval mortality from cyclic exposures is determined from the observed data point falling closest to a TTD curve of greatest effect (ie., highest percent mortality). The calculated maximum daily percent larval mortality shall not exceed the allowable number of days as presented in Table 3.A and Figure 3.B. Cumulative cyclic low DO effects observed over the course of the season are evaluated by tallying the number of days at each percent mortality observed for the season. The observed number of days at each percent mortality are divided by the allowable number of days for each percent mortality. The sum of the decimal fraction shall not exceed 1.0.

Table 3.A.  
Saltwater DO Criteria For Waters Below the Seasonal Pycnocline

24 Hour (Daily) DO Exposure Concentration (mg/L)	Daily Percent Larval Mortality (%)	Allowable Number of Days Without Exceeding a 5% Reduction in Seasonal Larval Recruitment
4.6	4.96	42
4.5	6.05	30
4.4	7.36	24
4.3	8.93	20
4.2	10.79	18
4.1	12.98	16
4	15.55	14
3.9	18.51	12
3.8	21.88	10
3.7	25.69	9
3.6	29.89	8
3.5	34.47	7
3.4	39.36	6
3.3	44.46	5
3.2	49.69	4
3.1	54.92	3
3	60.05	2
2.9	64.97	1

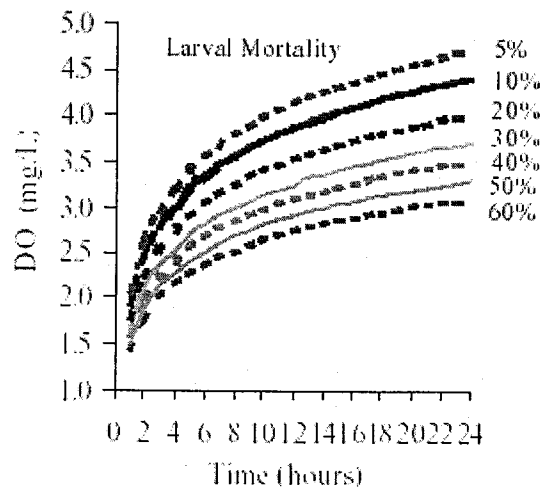


Figure 3.A. Time To Death (TTD) Curves for 5-60% Mortality

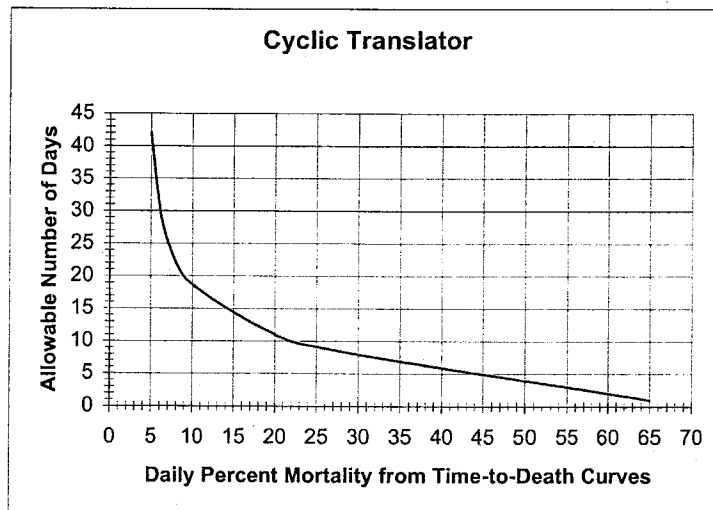


Figure 3.B. Cyclic Translator for Waters Below the Seasonal Pycnocline

For seasons with both cyclic and persistent cycles of low DO, all the data will be treated as cyclic exposure patterns with the persistent data set at the 24 hour/1-day exposure duration. Daily percent mortalities will be determined from Figure 3.A., and Table 3.A. will be used to determine the acceptable number of days the low DO pattern can occur over the course of the season.

III. For waters without a seasonal pycnocline, DO concentrations above 4.8 mg/l shall be considered protective of Aquatic Life Uses. When instantaneous DO values fall below 4.8 mg/l, the waters shall not be:

1. Less than 3.0 mg/l for more than 24 consecutive hours during the recruitment season; nor
2. Less than 1.4 mg/l for more than 1 hour more than twice during the recruitment season; nor
3. Shall they exceed the cumulative DO exposure presented in Table 3.A.

Cumulative low DO exposures in the 2.95 - 4.8 mg/l range shall be evaluated as described above in Section II but shall not exceed the information presented in Table 3.B.

For persistent low DO conditions in waters without a seasonal pycnocline, the criteria for 24 hour DO concentration and allowable number of days as presented in Table 3.B are calculated using the following equation:

$$DO_i = 17.523/3.3 + 2.01e^{(-0.091 t_i)}$$

Where  $DO_i$  = allowable concentration (mg/l)  
 $t_i$  = exposure interval duration (days)  
 $i$  = exposure interval

For cyclic low DO conditions in waters without a seasonal pycnocline, the daily percent mortalities for observed data are determined from Figure 3.A. and shall not exceed the allowable number of days presented in Table 3.B and Figure 3.C.

Table 3.B.  
Saltwater DO Criteria For Waters without a Seasonal Pycnocline

24 Hour (Daily) DO Exposure Concentration (mg/L)	Daily Percent Larval Mortality (%)	Allowable Number of Days Without Exceeding a 5% Reduction in Seasonal Larval Recruitment
4.6	4.96	16
4.5	6.05	14
4.4	7.36	12
4.3	8.93	11
4.2	10.79	10
4.1	12.98	8
4.0	15.55	7
3.9	18.51	6
3.8	21.88	5
3.7	25.69	4
3.6	29.89	3
3.5	34.47	2
3.4	39.36	1

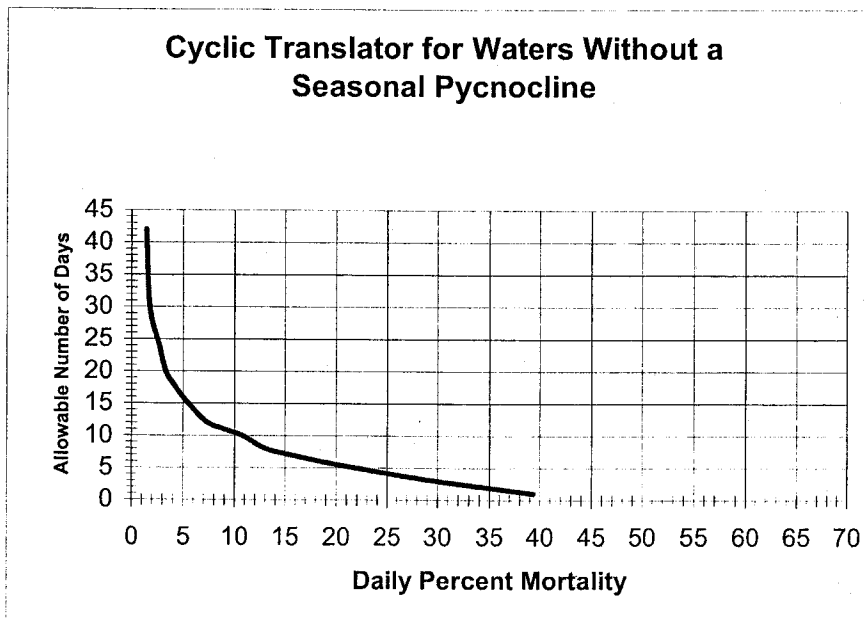


Figure 3.C. Cyclic Translator for Waters Without a Seasonal Pycnocline

For seasons with both cyclic and persistent cycles of low DO, all the data will be treated as cyclic exposure patterns with the persistent data set at the 24 hour/1-day exposure duration. Daily percent mortalities will be determined from Figure 3.A., and Table 3.B. will be used to determine the acceptable number of days the low DO pattern can occur over the course of the season.