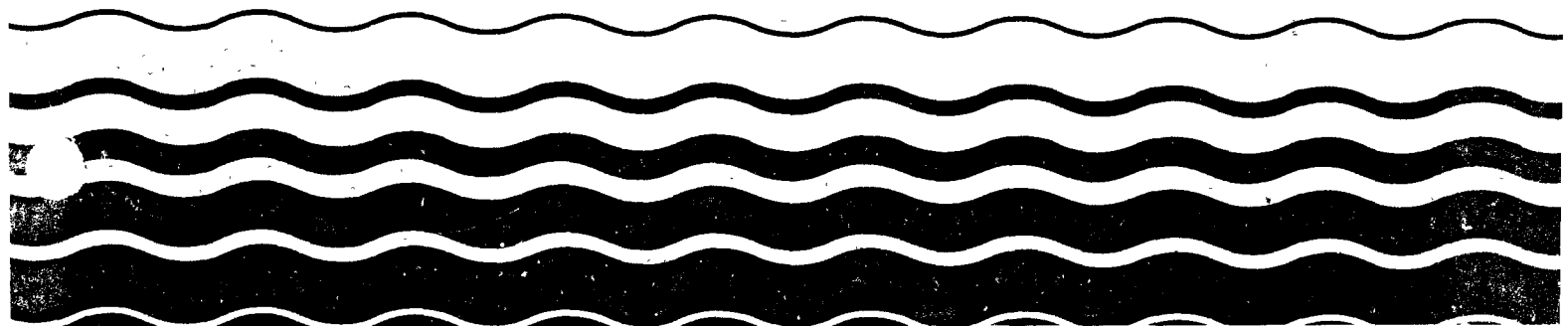


...ixing Zones

Water Quality Standards Criteria Summaries: A Compilation of State/Federal Criteria



DISCLAIMER

This publication was prepared by Battelle under contract to the U.S. Environmental Protection Agency (Contract 68-03-3534). Secondary information sources were used to compile data presented in this document. Each State was given an opportunity to review and provide comments on a draft of this information document. In no event shall either the United States or Battelle have any responsibility or liability for any use, misuse, or reliance upon the information contained herein, nor does either warrant or otherwise represent in any way the accuracy, adequacy, efficacy, or applicability of the contents hereof.

The reader should consult the water quality standards of a particular State for exact regulatory language applicable to that State. Copies of State water quality standards may be obtained from the State's Water Pollution Control Agency or its equivalent.

Additional information may also be obtained from the:

Standards Branch
Criteria and Standards Division (WH-585)
Office of Water Regulations and Standards
U.S. Environmental Protection Agency
Washington, D.C. 20460
202-475-7315

This document may be obtained only from the National Technical Information Service (NTIS) at the following address:

National Technical Information Service
5285 Front Royal Road
Springfield, Virginia 22161
703-487-4650

The NTIS order number is: PB89-141477.

INTRODUCTION

This digest is compiled to provide general information to the public as well as to Federal, State, and local officials. It contains excerpts from the individual Federal-State water quality standards establishing pollutant specific criteria for interstate 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 interstate waters, evaluating adherence to the standards, and overseeing enforcement of standards compliance has been mandated by Congress.

Standards, a nationwide strategy for surface water quality management, contain three major elements: the use (recreation, drinking water, fish and wildlife propagation, industrial, or agricultural) to be made of the navigable water; criteria to protect these uses; and an antidegradation statement to protect existing high quality waters, from degradation by the addition of pollutants. Guidance for the development of standards by individual States is contained in two EPA documents entitled Water Quality Standards Handbook (1983) and Quality Criteria for Water (1986).

Mixing zones in State water quality standards, which are the subject of this digest, enable a State to achieve aquatic protection through a less stringent stream management approach. The mixing zone is a designated area or location of a receiving water where waste waters and receiving waters mix and the ambient water quality criteria do not need to be met. Although this mechanism permits a zone of somewhat less desirable water quality than required by the State in ambient waters, it does provide a diluting function which aids in the achievement of the standards. If no such zone is recognized by a State, then the waters must meet the criteria at the point of discharge.

The primary purpose of designating mixing zones is to limit areas of degradation and to not require excessive wastewater treatment. Furthermore, the in zone quality should be at a level to support the most sensitive aquatic life form indigenous to the receiving water body. The 1983 EPA Water Quality Handbook recommends the following consideration to be included in State water quality standards mixing zone policy:

A limited mixing zone, serving as a zone of initial dilution in the immediate area of a point source of pollution, may be allowed.* Whether to establish a mixing zone policy is a matter of State discretion. Such a policy, however, must be consistent with the Act and is subject to the approval of the Regional Administrator.

Careful consideration must be given to the appropriateness of a mixing zone where a substance discharged is bioaccumulative, persistent, carcinogenic, mutagenic, or teratogenic. In such cases the State must consider such effects as sediment deposition, bioaccumulation in aquatic biota, bioconcentration in the food chain, and the known or predicted safe exposure levels for the

*In the broadest sense, the zone surrounding, or downstream from, a discharge location is an "allocated impact zone" where numeric water quality criteria can be exceeded as long as acutely toxic conditions are prevented.

substance. The effects of bioaccumulation will depend on the predicted duration/concentration exposure of the biota; thus the likelihood that the mixing zone will be inhabited by resident biota for a sufficiently long time to cause adverse effects, should be considered. Factors such as size of the zone, concentration gradient within the zone, physical habitat, attraction of aquatic life, etc., are important in this evaluation. In some instances, the ecological and human health effects may be so adverse that a mixing zone is not appropriate.

REFERENCES

- 5 California Water Quality Standards, ca. 1975.
- 9 Florida Administrative Code, Chapter 17-4, 1987 and Florida Administrative Code, Chapter 17-3, 1988.
- 12 Idaho Department of Health and Welfare Rules and Regulations, Title 1, Chapter 2, "Water Quality Standards and Wastewater Treatment Requirements", 1980.
- 35 Ohio Water Quality Standards, Chapter 3745-1 of the Administrative Code, Ohio Environmental Protection Agency, 1985.
- 42 Tennessee's Water Quality Criteria and Stream Use Classifications for Interstate and Intrastate Streams, Tennessee Water Quality Control Board: Department of Health and Environment, 1987.
- 43 Texas Surface Water Quality Standards, Texas Water Commission, Rule Change, 1988.
- 44 Utah Standards of Quality for Waters of the State, Wastewater Disposal Regulations: Part II, State of Utah Department of Health: Division of Environmental Health, 1988.
- 45 Vermont Water Quality Standards, State of Vermont Water Resource Board, 1987.
- 51 Water Quality Standards for American Samoa, 1984, p. 12-16.
- 53 Revised Guam Water Quality Standards, Guam Environmental Protection Agency, 1984, p. 15-19.
- 54 Commonwealth of Northern Mariana Islands Marine and Fresh Water Quality Standards, Commonwealth Register, Vol. 8 No. 5, 1986, p. 4470.
- 55 Puerto Rico Water Quality Standards Regulation, Environmental Quality Board, 1983.
- 56 Marine and Fresh Water Quality Standard Regulations, Trust Territory, 1986, p. 11-14.
- 57 Virgin Islands Water Pollution Regulations, Department of Conservation and Cultural Affairs, 1985, Title 12, p. 266-267.

ENVIRONMENT REPORTER, The Bureau of National Affairs, Inc., Washington, D.C.
20037

- 1 Page 701:1002, June 26, 1986
- 2 Pages 706:1012-1013, November 7, 1986

3 Page 711:1006, February 7, 1986
4 Page 716:1004, August 30, 1985
6 Page 726:1005, March 22, 1985
7 Pages 731:1001-1002, May 14, 1982
8 Page 736:1002, March 28, 1986
12 Pages 756:1011-1012, September 20, 1985
13 Page 766:0504, March 28, 1986
14 Page 771:1002, August 10, 1984
15 Page 776:1004, February 13, 1987
16 Pages 781:1002-1003, March 27, 1987
17 Pages 786:1007-1008, November 29, 1985
18 Page 791:1009, January 18, 1985
20 Pages 801:1003-1004, April 19, 1985
21 Page 806:1002, June 21, 1985
22 Page 811:1007, February 13, 1987
23 Page 816:1011, June 25, 1982
24 Page 821:1002, October 25, 1985
25 Page 826:1007, June 21, 1985
26 Page 831:1011, October 4, 1985
27 Page 836:1002, March 27, 1987
29 Page 846:1006, October 5, 1984
30 Page 851:1004, April 11, 1986
31 Page 856:1002, June 11, 1982
32 Pages 861:1002, 1040-1041, November 29, 1985
33 Page 866:1006, September 6, 1985
34 Page 871:1004, June 7, 1985
36 Page 881:1014, September 26, 1986

37 Page 886:1007, May 9, 1986
39 Page 901:1002, August 9, 1985
40 Pages 906:1004-1005, November 29, 1985
41 Page 911:1003, March 22, 1985
46 Page 936:1001, February 28, 1986
47 Page 941:1002, October 21, 1983
48 Pages 946:1002-1003, August 10, 1984
49 Page 951:1003, December 19, 1986
50 Page 956:1004, July 5, 1985
52 Page 741:1005, March 28, 1986

State

Alabama¹

Mixing Zone Narrative

In making any tests or analytical determinations to determine compliance or non-compliance with water quality criteria, samples shall be collected in such manner and at such locations approved by a duly authorized representative of the Commission as being representative of the receiving water after reasonable opportunity for dilution and mixture with the wastes discharged thereto. Mixing zones, i.e., that portion of the receiving waters where mixture of effluents and natural waters take place, shall not preclude passage of free-swimming and drifting aquatic organisms to the extent that their populations are significantly affected.

Alaska²

(a) In applying the water quality criteria of 18 AAC 70.020, the department (Alaska Department of Environmental Conservation) will, in its discretion, prescribe its permits or certifications a volume of dilution for an effluent or substance within a receiving water. Water quality standards may be exceeded within this mixing zone. However the standards must be met at every point outside its boundaries. The department will not allow mixing zones if:

- (1) There is significant potential for adverse environmental or health effects due to discharge of a substance that bioaccumulates in food chains; concentrates in sediments, or is persistent, carcinogenic, mutagenic or teratogenic, or
- (2) Other potential environmental or health effects are so adverse that a mixing zone is not appropriate. A mixing zone will be granted only after the applicant has shown to the department's satisfaction that wastes or substances that may exceed the water quality criteria limits will be treated using the methods found by the department to be most effective.

(b) The department will, in its discretion, establish effluent limitation requirements in its wastewater disposal permits in lieu of or in addition to a defined mixing zone.

(c) No individual mixing zone or combination of mixing zones will be permitted to form a barrier to the migratory routes of aquatic species.

(d) In determining the size of the mixing zones, the department will consider the following:

- (1) The physical, biological and chemical characteristics of the receiving water;
- (2) The effects of the discharge on the present and anticipated protected water uses and quality of the receiving water;
- (3) The mixing characteristics of the receiving water; and
- (4) The characteristics of the effluent, including flow rate and composition.

(e) Unless it is demonstrated to the satisfaction of the department, in accordance with (f) of this section, that the size limitations can be increased, mixing zones will be as small as practicable and will comply with the following size limitations:

- (1) The cumulative linear width of the mixing zone(s) intersected on any given cross section of a river or stream will not exceed one third of the total width of that cross section;
- (2) The total horizontal area allocated to all mixing zones on a lake will not exceed 10 percent of the lake's surface area;
- (3) The cumulative linear length of the mixing zone(s) intersected on any given cross section of an estuary, inlet, cove, channel, or other marine water measured at mean lower low water may not exceed 10 percent of the total length of that cross section, nor may the total horizontal area allocated to mixing zones in these waters exceed 10 percent of the surface area measured at mean lower low water.

(f) A person conducting an operation for which a mixing zone is sought or required by the department shall submit to the department all information necessary for assignment of a mixing zone, including

- (1) Type of operation being conducted;
- (2) The characteristics of the effluent, including flow rate and composition;
- (3) The characteristics of the receiving water at the location of the proposed discharge or activity including but not limited to, where

State

Mixing Zone Narrative

appropriate, water quality, flow rate, current patterns, depth and width, and seasonal changes;

- (4) A description of the extent to which the operation may impact the physical, biological and chemical characteristics of the receiving water; and
- (5) A proposed design for outfall and diffuser structures.

Arizona³

(A) The following requirements establish the allowable conditions for a mixing zone;

1. The shape of a mixing zone should be a simple configuration;
2. Shore and bottom hugging plumes shall be avoided;
3. A zone of passage of not less than one-half of the stream cross-sectional area shall be provided when the receiving water is a flowing stream;
4. The length of a mixing zone shall not exceed 500 meters in a flowing stream;
5. The surface area of a mixing zone shall not exceed 10 percent of the surface area of a lake, reservoir or other impoundment;
6. In no case shall water quality in a mixing zone:
 - (a) Interfere with protected uses in areas beyond such zone;
 - (b) Interfere with the established community of aquatic life in areas of the water body beyond such zone;
 - (c) Impinge on biologically-important areas in areas beyond such zone;
 - (d) Contain materials in concentrations that exceed the 96-hour LC 50 for biota significant to the indigenous aquatic community.

B. The Council (Arizona Water Quality Control Council) shall determine conformance with R9-21-211.A. when requested. The determinations shall be made either:

1. As part of the review of plans and specifications for proposed wastewater treatment facilities requiring new construction or modifications to existing capacity or treatment. Determination of such conformance shall commence with plans and specification submitted after the effective date of this Regulation; or
2. When a request, accompanied by information necessary to determine the fulfillment of requirements given in R9-21-211.A., is submitted to the Council.

C. When the Council determines that a proposed mixing zone satisfies the requirements given in R9-21-211.A., the Council may specify that within the approved mixing zone, one or more pollutants, but not fecal coliform may be allowed to exceed the limits established R9-21-203, D., R9-21-205, or R9-21-208.

Arkansas⁴

The effects of wastes on the receiving stream shall be determined after the wastes have been thoroughly mixed with the stream water, but consideration will also be given to the quality of the waste effluent in determining the adequacy of treatment. Outfall structures should be designed to minimize the extent of mixing zones and in the larger streams the zone of mixing shall not exceed 1/4 of the cross sectional area and/or volume of the stream flow. The remaining 3/4 of the stream shall be maintained as a zone of passage for swimming and drifting organisms, and shall remain of such quality that stream ecosystems are not significantly affected.

In the smaller streams, because of varying local physical and chemical conditions and biological phenomena, a site-specific determination shall be made on the percentage of river width necessary to allow passage of critical free-swimming and drifting organisms so that negligible or no effects are produced on their populations. As a guideline no more than 2/3 the width of smaller streams should be devoted to mixing zones thus leaving at least 1/3 free as a zone of passage. In lakes and reservoirs the size of mixing zones shall be defined by the Department of Pollution Control and Ecology on an individual basis, and the area shall be kept at a minimum.

Mixing zones shall not prevent free passage of fish or significantly affect aquatic ecosystems.

California⁵

Ocean Waters:

Initial dilution is the process which results in the rapid and irreversible turbulent mixing of wastewater with ocean water around the point of discharge.

For a submerged buoyant discharge, characteristic of most municipal and industrial wastes that are released from the submarine outfalls, the momentum of the discharge and its buoyancy act together to produce turbulent mixing. Initial dilution in this case is completed when the diluting wastewater ceases to rise in the water column and first begins to spread horizontally.

For shallow water submerged discharges, surface discharges, and non-buoyant discharges, characteristic of cooling water wastes and some individual discharges, turbulent mixing results primarily from the momentum of discharge. Initial dilution, in these cases, is considered to be completed when the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution.

For the purpose of this plan, minimum initial dilution is the lowest average initial dilution within any single month of the year. Dilution estimates shall be based on observed waste flow characteristics, observed receiving water density structure and the assumption that no currents of sufficient strength to influence the initial dilution process flow across the discharge structure.

The Executive Director shall issue guidelines to be used by the State and Regional Boards for determining the initial dilution achieved by each ocean discharge.

Colorado⁶

(a) The mixing zone is that area of a water body designated on a case-by-case basis by the Division which is contiguous to a point source and in which the standards may not apply. The mixing zone is intended to serve as a zone of initial dilution in the immediate area of a discharge; however, the ecological and human health effects of some pollutants may be so adverse that a mixing zone for such pollutants will not be allowed.

(b) The size and shape of the mixing zone will be determined by the Division considering the following factors:

- (i) Where necessary to protect aquatic life, there shall be a zone of passage around the mixing zone which allows sufficient passage of aquatic life so as not to have a detrimental effect on their population.
- (ii) Biological communities or populations of imported species shall not be interfered with to a degree which is damaging to the ecosystem in adjacent waters; nor shall there be detrimental effects to other beneficial uses.
- (iii) There shall be no mixing zones for certain harmful substances such as those identified pursuant to 307(a) of the Federal Act.
- (iv) Mixing zones shall not overlap so as to cause harmful effects in adjacent waters or to interfere with zones of passage.
- (v) Concentrations of harmful substances in the mixing zone shall not exceed the 96-hour LC-50 concentrations for biota significant to the aquatic community.
- (vi) The conditions of the mixing zone shall be controlled so as to comply with items 1(a), (b) and (f) of the Basic Standards, Section 3.1.11.
- (vii) In establishing a mixing zone, potential groundwater aquifer contamination shall be considered.
- (viii) The Division will also be guided by other concerns such as the mixing zone discussion in EPA, Guidelines for State and Areawide Water Quality Management Program Development, published November 1976, or similar documents.

Connecticut⁷

The zone of influence of a discharge may be described as the soil or water area needed to allow the treatment of effluent by soils or the mixing of effluent with ground or surface waters. The establishment of zones of influence created by a permitted discharge shall not affect the adopted water usage class. The zone of influence is used by the

Mixing Zone Narrative

commissioner in permitting and regulating discharges to the waters of the State. The Commissioner is required to determine whether any proposed system to treat a discharge will protect the waters of the State from pollution.

A. Surface Waters

1. Wherever zones of influence are allowed, zones of passage for free swimming and drifting aquatic organisms shall be provided.
2. No minimum criteria can be given for zones of passage because of varying hydraulic, physical/chemical, and biological considerations.
3. As a guideline, zones of influence should be limited to no more than 25% of the cross-sectional area or volume of flow, leaving at least 75% free for a zone of passage.
4. The cross-sectional area or volume of flow assigned to zones of influence shall be limited to that which will not adversely affect biological value to a degree which is damaging to the ecosystem.

B. Groundwaters

1. Zones of influence may be allowed and the determination of boundaries of a zone shall be required when natural soil materials are used to treat a discharge or to allow the dilution of substances by groundwater to acceptable concentrations for discharge to the surface waters in an effluent/groundwater mix which will not violate the established water quality classification for the surface water.
2. The zone of influence for subsurface sewage disposal systems which are permitted under the authority delegated to the Commissioner of Health Services by Section 25-54i-1.0-5.2 shall be defined as the area required by the separating distances established as minimum requirements of the Public Health Code.
3. The zone of influence for all other discharges to the groundwater shall be the area in which the groundwater could be in violation of any pertinent Federal and State drinking water standards or otherwise be polluted by the discharge.

Mixing Zone Narrative

The following requirements shall apply to mixing zones:

1. **Location:** Mixing zones shall not be located in areas of special importance, such as nursery areas for aquatic life or waterfowl, approved shellfish areas, or heavily utilized primary contact recreation areas. Zones shall not be located in such a manner as to disrupt the passage of fishes or other organisms.

2. **Size:** Size of the zone shall be minimized. No interference with established aquatic communities or diminution of designated uses shall be allowed.

3. **Shape:** Allowable shapes shall be simple configurations, and shall be determined on a site-specific basis using appropriate scientific methods. Shore-hugging plumes shall be prohibited in all water bodies.

4. **Outfall Design:** Outfalls shall be designed to provide maximum protection to humans, aquatic life and wildlife.

5. **In Zone Quality:** All mixing zones shall be free of the following:

- (a) Materials in concentrations that will cause acute toxicity to aquatic life, or present unacceptable risk to human health,
- (b) Materials in concentrations that settle to form objectionable deposits,
- (c) Floating debris, oil, scum, foam, and other matter in concentrations that form nuisances,
- (d) Substances in concentrations that produce objectionable color, odor, taste or turbidity, and
- (e) Substances in concentrations which produce undesirable aquatic or marine life, result in a dominance of nuisance species, or affect species diversity.

Note: The United States Environmental Protection Agency publications, Water Quality Standards Handbook, December, 1983, or Technical Support Document for Water Quality-Based Toxics Control, September, 1985, or other sources deemed acceptable by the Department, may be used, in addition to the above general requirements, as guidelines for determining the specifics of mixing zones.

Florida⁹

17-4.244 Mixing Zones: Surface Waters.

(1) Zones of mixing for non-thermal components of discharges.

(a) The Department may allow the water quality adjacent to a point of discharge to be degraded to the extent that only the minimum conditions described in Section 17-3.051(1), Florida Administrative Code, apply within a limited, defined region known as the mixing zone. Under the circumstances defined elsewhere in this section, a mixing zone may be allowed so as to provide an opportunity for mixing and thus to reduce the costs of treatment. However, no mixing zone or combination of mixing zones shall be allowed to significantly impair any of the designated uses of the receiving body of water.

(b) A zone of mixing shall be determined based on consideration of the following:

1. The condition of the receiving body of water including present and future flow conditions and present and future sources of pollutants.
2. The nature, volume and frequency of the proposed discharge of waste including any possible synergistic effects with other pollutants or substances which may be present in the receiving body of water.
3. The cumulative effect of the proposed mixing zone and other mixing zones in the vicinity.

(c) Except for the thermal component of discharges and nitrogen and phosphorus acting as nutrients, to which this paragraph is inapplicable, mixing zones which do not adhere to all of provisions (1)(d) through (1)(i) below shall be presumed to constitute a significant impairment of the designated uses of surface waters of Classes I, II and III. However, an applicant for a specified mixing zone who affirmatively demonstrates after public notice in the Florida Administrative Weekly and in a newspaper of general circulation in the area where the mixing zone is proposed, and after a public hearing, if

one is requested, that a proposed mixing zone which does not comply with one or more of the provisions of paragraphs (1)(d) through (1)(i) will not produce a significant adverse effect on the established community of organisms in the receiving body of water or otherwise significantly impair any of the designated uses of the receiving body of water, shall be exempt from those requirements. The Secretary shall authorize that mixing zone for which the applicant makes an affirmative demonstration by the preponderance of competent substantial evidence that the applicable requirements of this section have been met.

- (d) A mixing zone shall not include an existing drinking water supply intake nor include any other existing water supply intake if such mixing zone would significantly impair the purposes for which the supply is utilized.
- (e) A mixing zone shall not include a nursery area of indigenous aquatic life nor include any area approved by the Department of Natural Resources for shellfish harvesting.
- (f) In canals, rivers, streams, and other similar water bodies, the maximum length of a zone of mixing shall be 800 meters unless a shorter length is necessary to prevent significant impairment of a designated use. In no case, shall a mixing zone be larger than is necessary for the discharge to completely mix with the receiving water to meet water quality standards.
- (g) In lakes, estuaries, bays, lagoons, bayouts, sounds, and coastal waters, the area of mixing zone shall be 125,600 square meters unless a lesser area is necessary to prevent significant impairment of a designated use. In no case shall a mixing zone be larger than is necessary to meet water quality standards.
- (h) In open ocean waters, the area of a mixing zone shall be 502,655 square meters unless a lesser area is necessary to prevent significant impairment of a designated use. In no case shall a mixing zone be larger than is necessary to meet water quality standards.
- (i) The mixing zones in a given water body shall not cumulatively exceed the limits described below:

1. In rivers, canals, and other similar water bodies: 10% of the total length;
 2. In lakes, estuaries, bays, lagoons, bayous and sounds: 10% of the total area.
- (j) Additional standards which apply within mixing zones in Class I, II and Class III waters are as follows:
1. The dissolved oxygen within a mixing zone shall not average less than 4.0 milligrams per liter in the mixing zone volume; and,
 2. The turbidity within the mixing zone shall not average greater than 41 Nephelometric Turbidity Units in the mixing zone volume above natural background.
- (k) Mixing zones in Class IV and V waters are subject only to the provisions of (d) above and of Section 17-3.051, F.A.C., and shall not significantly impair the designated uses of the receiving body of water.
- (2) Until such time as a permit is issued, modified, or renewed, discharges in existence prior to the effective date of this rule shall continue to meet such mixing zone restrictions (for each component or characteristic of a discharge):
- (a) As are specified by permit; or,
 - (b) Which were applied to the discharge in the Department's permitting process prior to the effective date of this rule.
- (3) Except for discharges covered by (2) above, after the adoption of this rule there shall be no zone of mixing for any component of any discharge unless a Department permit containing a description of its boundaries has been issued for that component of the discharge.
- (4) (a) Waters within mixing zones shall not be degraded below the applicable minimum standards prescribed for all waters at all times in Section 17-3.051, F.A.C. In determining compliance with the provisions of 17-3.051(1), F.A.C., the average concentration of the wastes in the mixing zone shall be measured or computed using scientific techniques approved by the Department;

provided that, the maximum concentration of wastes in the mixing zone shall not exceed the amount lethal to 50% of the test organisms in 96 hours (96 hr LC₅₀) for a species significant to the indigenous aquatic community, except as provided in subsection (b) or (c) below. The dissolved oxygen value within any mixing zone shall not be less than 1.5 milligrams per liter at any time or place.

- (b) The maximum concentration of wastes in the mixing zone (except for open ocean discharges) may exceed the 96 hr LC₅₀ only when all of the following conditions are satisfied.
1. Dilution ratio of the effluent exceeds 100:1 under critical conditions. That is, flow in the receiving waters exceeds 100 units for every unit of effluent flow under critical conditions. Critical conditions are defined as those under which least dilution of the effluent is expected, e.g., maximum effluent flow and minimum receiving stream flow.
 2. High rate diffusers or other similar means are used to induce rapid initial mixing of the effluent with the receiving waters such that exposure of organisms to lethal concentrations is minimized.
 3. Toxicity must be less than acute (as defined in Rule 17-3.021(1), F.A.C.) no more than a distance of 50 times the discharge length scale in any spatial direction. The discharge length scale is defined as the square-root of the cross-sectional area of any discharge outlet. In the case of a multiport diffuser, this requirement must be met for each port using the appropriate discharge length scale of that port. This restriction will ensure a dilution factor of at least 10 within the distance under all possible circumstances, including situations of severe bottom interaction, surface interaction, or lateral merging.
 4. The effluent when diluted to 30% of full strength, shall not cause more than 50% mortality in 96 hours (95 hr. LC₅₀) in a species significant to the indigenous aquatic community.

5. If the following pollutants are present in the effluent, their concentrations (in the effluent) shall not exceed the values listed:

Acrylonitrile	65	µg/l
Aldrin	7.5	ng/l
Dieldrin	7.5	ng/l
Benzene	4	mg/l
Benzidine	53	ng/l
Beryllium	6.4	µg/l
Cadmium	100	µg/l
Carbon Tetrachloride	694	µg/l
Chlordane	48	ng/l
Hexachlorobenzene	74	ng/l
Chlorinated ethanes:		
1,2-dichloroethane	24.3	mg/l
1,1,2-trichloroethane	4.2	mg/l
1,1,2,2-tetrachloroethane	1	mg/l
Hexachloroethane	874	µg/l
Chloroalkyl Ethers:		
bis(chloromethyl) ether	184	ng/l
bis(2-chloroethyl) ether	136	µg/l
Chloroform	1.57	mg/l
Chromium (hexavalent)	0.5	mg/l
DDT	2.4	µg/l
Dichlorobenzidine	2	µg/l
1,1-Dichloroethylene	185	µg/l
Dinitrotoluene	11	µg/l
Diphenylhydrazine	56	µg/l
Ethylbenzene	33	mg/l
Fluoranthene	540	µg/l
Halomethanes	1.6	mg/l
Heptachlor	29	ng/l
Hexachlorocyclohexane		
α Hexachlorocyclohexane	310	ng/l
β Hexachlorocyclohexane	547	ng/l
γ Hexachlorocyclohexane	625	ng/l
Lead	0.5	mg/l
Mercury	1.5	µg/l
Nickel	1	mg/l
Nitrosamines	124	µg/l
Polynuclear aromatic hydrocarbons	3	µg/l
Polychlorinated biphenyls (PCBs)	8	ng/l
Selenium	100	µg/l
Tetrachloroethylene	885	µg/l
Thallium	480	µg/l
Toxaphene	73	ng/l
Trichloroethylene	8	mg/l
Vinyl Chloride	52	mg/l

(c) For open ocean discharges, the effluent when diluted to 30% full strength, shall not cause

more than 50% mortality in 96 hours (96 hr. LC₅₀) in a species significant to the indigenous aquatic community. Rapid dilution shall be ensured by the use of multiport diffusers. The discharge shall otherwise comply with federal law.

- (5) Except for the minimum conditions of waters as specified in Section 17-3.051, F.A.C., and the provisions of Section 17-4.244, F.A.C., no other water quality criteria apply within a mixing zone.
- (6) Mixing zones for dredge and fill permits shall not be subject to provisions (1)(c) through (1)(j), (2), (3), (4), or (5) of this section, provided that applicable water quality standards are met at the boundary and outside the mixing zone.
 - (a) The dimensions of dredge and fill mixing zones shall be proposed by the applicant and approved, modified or denied by the Department.
 - (b) Criteria for departmental evaluation of a proposed mixing zone shall include site-specific biological and hydrographic considerations.
 - (c) In no case, however, shall the boundary of a dredge and fill mixing zone be more than 150 meters downstream in flowing streams or 150 meters in radius in other bodies of water, where these distances are measured from the cutterhead, return flow discharge, or other points of generation of turbidity or other pollutants.
- (7) Where a receiving body of water fails to meet a water quality standard for pollutants set forth in department rules, a steam electric generating plant discharge of pollutants that is existing or licensed on July 1, 1984, may be granted a mixing zone, provided that:
 - (a) The standard would not be met in the water body in the absence of the discharge; and
 - (b) The discharge is in compliance with all applicable technology-based effluent limitations; and
 - (c) The discharge does not cause a measurable increase in the degree of noncompliance with the standard at the boundary of the mixing zone; and

(d) The discharge otherwise complies with the mixing zone provisions specified in this section.

(8) Additional relief from mixing zone restrictions necessary to prevent significant impairment of a designated use is through:

(a) Reclassification of the water body pursuant to Section 17-3.081, Florida Administrative Code;

(b) Variance granted for any one of the following reasons:

1. There is no practicable means known or available for the adequate control of the pollution involved.

2. Compliance with the particular requirement or requirements from which a variance is sought will necessitate the taking of measures, which, because of their extent or cost, must be spread over a considerable period of time. A variance granted for this reason shall prescribe a timetable for the taking of measures required.

3. To relieve or prevent hardship of a kind other than those provided for in paragraphs 1. or 2. Variances and renewals thereof granted upon authority of this sub-paragraph shall each be limited to a period of 24 months except that variances granted pursuant to the Florida Electrical Power Plant Siting Act may extend for the life of the permit or certification.

(c) Modification of the requirements of this section for specific criteria by the Secretary upon compliance with the notice and hearing requirements for mixing zones set forth in (1)(c) above and upon affirmative demonstration by an applicant by the preponderance of competent substantial evidence that:

1. The applicant's discharge from a source existing on the effective date of this rule complies with best technology economically achievable, best management practices, or other requirements set forth in Chapter 17-6, F.A.C., and there is no reasonable relationship between the economic, social, and environmental costs and the economic, social and environmental benefits to be obtained by imposing more stringent discharge

limitations necessary to comply with mixing zone requirements of Subsection 17-4.244(1), F.A.C., and the provisions relating to dissolved oxygen in Subsection 17-4.244(4), F.A.C.

2. No discharger may be issued more than one permit or permit modification or renewal which allows a modification pursuant to this subsection unless the applicant affirmatively demonstrates that it has undertaken a continuing program, approved by the Department, designed to consider water quality conditions and review or develop any reasonable means of achieving compliance with the water quality criteria from which relief has been granted pursuant to this subsection.
 3. With respect to paragraphs 17-4.244(1)(c), F.A.C., and 17-4.244(7)(c), F.A.C., the applicant must affirmatively demonstrate the minimum area of the water body necessary to achieve compliance with either subsection. Within a minimum area determined by the Secretary to be necessary to achieve compliance, the discharger shall be exempt from the criterion for which a demonstration has been made.
- (d) Whenever site specific alternative criteria are established pursuant to Section 17-3.031, or Subsection 17-3.061(3)(g), Florida Administrative Code, a mixing zone may be issued for dissolved oxygen if all provisions of Section 17-4.244, Florida Administrative Code are met with the exception of Subparagraph 17-4.244(1)(j)1., or Subsection 17-4.244(4) Florida Administrative Code.

Specific Authority: 403.061, 403.062, 403.087, 403.504, 403.704, 403.804, 403.805, F.S.

Law Implemented: 403.021, 403.061, 403.087, 403.088, 403.101, 403.121, 403.141, 403.161, 403.182, 403.201, 403.502, 403.702, 403.708, F.S.

History: Formerly part of 17-3.05, Revised and Renumbered 3-1-79, Amended 10-2-80, 1-1-83, 2-1-83, 12-19-84, 4-26-87.

State

Georgia¹⁰

Mixing Zone Narrative

Effluent released to streams or impounded waters shall be fully and homogeneously dispersed and mixed insofar as practical with the main flow or water body by appropriate methods at the discharge point. Use of a reasonable and limited mixing zone may be permitted on receipt of satisfactory evidence that such a zone is necessary and that it will not create an objectionable or damaging pollution condition.

Hawaii¹¹

Zones of mixing for the assimilation of municipal, agricultural, and industrial discharges which have received the best degree of treatment or control are recognized as being necessary. It is the objective of this limited zone to provide for a current realistic means of control over such discharges so as to achieve the highest attainable level of water quality or otherwise to achieve the minimum environmental impact considering initial dilution, dispersion, and reactions from substances which may be considered to be pollutants.

Establishment, Renewal, and Termination:

1. Application for establishment of the zone of mixing shall be made concurrently with any discharge permits whenever applicable and the conditions of the zone of mixing may be incorporated as conditions of such discharge permits. Every application for a zone of mixing shall be made on forms furnished by the Director of Health and shall be accompanied by a complete and detailed description of present conditions, how present conditions do not conform to standards, and such other information as the Director of Health may prescribe.

2. Each application for a zone of mixing shall be reviewed in light of the descriptions, statements, plans, histories, and other supporting information as may be submitted upon the request of the Director of Health, and in light of the effect or probable effect upon the water quality standards established pursuant to this Chapter.

3. Whenever an application is approved, the Director of Health shall establish the zone of mixing taking into account protected uses of the body of water, existing natural conditions of the receiving water, character of the effluent, and the adequacy of the design of the outfall and diffuser system to achieve maximum dispersion and assimilation of the treated or controlled waste with a minimum of undesirable or noticeable effects on the receiving water.

Mixing Zone Narrative

4. Approval of a zone of mixing shall be made only after a public hearing is held by the Director of Health in the county where the source is situated in accordance with the Hawaii Administrative Procedure Act and the Rules of Practice and Procedure of the Department of Health or after the public notification and comment process duly established for a discharge permit in the case when the zone of mixing is being considered concurrently with the discharge permit.

5. No zone of mixing shall be granted by the Director of Health unless the application and the supporting information clearly show that:

- (a) The continuation of the function or operation involved in the discharge by the granting of the zone of mixing is in the public interest; and
- (b) The discharge occurring or proposed to occur does not substantially endanger human health or safety; and
- (c) Compliance with the existing water quality standards from which a zone of mixing is sought would produce serious hardships without equal or greater benefits to the public; and
- (d) The discharge occurring or proposed to occur will not unreasonably interfere with any actual or probable use of the water areas for which it is classified, and has received (or in the case of a proposed discharge, will receive) the best degree of treatment or control.

6. Any zone of mixing or renewal thereof shall be granted within the requirements of this section and for time periods under conditions consistent with the reasons therefore and within the following limitations:

- (a) If the zone of mixing is granted on the ground that there is no practicable means known or available for the adequate prevention, control, or abatement of the discharge involved, it shall be only until the necessary means for prevention, control, or abatement become practicable and subject to the taking of any substitute or alternate measures that the Director of Health may prescribe. No renewal of a zone of mixing granted under this subsection shall be allowed without a thorough review of known

and available means of preventing, controlling, or abating the discharge involved.

- (b) The Director of Health may issue a zone of mixing for a period not exceeding five years.
- (c) Every zone of mixing granted under this section shall include, but not be limited to, conditions requiring the grantee to perform effluent and receiving water sampling and report the results of each sampling to the Director of Health, and a program of research to develop practicable alternatives to the methods of treatment or control in use by the grantee may be required if such research is deemed prudent by the Director of Health.

7. Any zone of mixing granted pursuant to this section may be renewed from time to time on terms and conditions and for periods not exceeding five years which would be appropriate on initial granting of a zone of mixing; provided that the applicant for renewal had met all of the conditions specified in the immediately preceding zone of mixing, and provided further, that the renewal, and the zone of mixing established in pursuance thereof, shall provide for discharge not greater in quantity of mass emissions than that attained pursuant to the terms of the immediately preceding zone of mixing at its expiration. No renewal shall be granted except on application. Therefore, any such application shall be made at least sixty days prior to the expiration of the zone of mixing.

8. No zone of mixing granted pursuant to this part shall be construed to prevent or limit the application of any emergency provisions and procedures provided by law.

9. The establishment of any zone of mixing shall be subject to the concurrence of the U.S. Environmental Protection Agency.

10. The Director of Health, on his own motion, or upon the application of any person, shall terminate a zone of mixing, if after a hearing, he determines that the water area does not meet the basic criteria applicable to all water areas, or that the zone of mixing granted will unreasonably interfere with any actual or probable use of the water area that the discharge does not receive (or in the case of a new discharge will not receive) the best degree of treatment or control.

Such termination shall be made only after a hearing held by the Director of Health on the Island where the area is situated in accordance with chapter 91, HRS and the rules of Practice and Procedure of the Department of Health. Upon such termination, the standards of water quality applicable thereto shall be those established for the water as otherwise classified.

11. Upon expiration of the period stated in the designation, the zone of mixing shall automatically terminate and no rights shall become vested in the designee.

Idaho¹²

After a biological, chemical, and physical appraisal of the receiving water and the proposed discharge and after consultation with the person(s) responsible for the wastewater discharge, the Department will determine the applicability of a mixing zone and, if applicable, its size, configuration, and location. In defining a mixing zone, the Department will consider the following principles:

(a) The mixing zone may receive wastewater through a submerged pipe, conduit or diffuser.

(b) The mixing zone is to be located so it does not cause unreasonable interference with or danger to existing beneficial uses.

(c) When two (2) or more individual mixing zones are needed for a single activity, the sum of the areas and volumes of the several mixing zones is not to exceed the area and volume which would be allowed for a single zone.

(d) Multiple mixing zones can be established for a single discharge, each being specific for one (1) or more pollutants contained within the discharged wastewater.

(e) Mixing zones in flowing receiving waters are to be limited to the following:

i. The cumulative width of adjacent mixing zones when measured across the receiving water is not to exceed fifty percent (50%) of the total width of the receiving water at that point.

ii. The width of a mixing zone is not to exceed twenty-five percent (25%) of the stream width of three hundred (300) meters plus the horizontal length of the

diffuser as measured perpendicularly to the stream flow, whichever is less.

iii. The mixing zone is to be no closer to the ten (10) year, seven (7) day low-flow shoreline than fifteen percent (15%) of the stream width.

iv. The mixing zone is not to include more than twenty-five percent (25%) of the volume of the stream flow.

(f) Mixing zones in reservoirs and lakes are to be limited to the following:

i. The total horizontal area allocated to mixing zones is not to exceed ten percent (10%) of the surface area of the lake.

ii. Adjacent mixing zones are to be no closer than the greatest horizontal dimension of any of the individual zones.

(g) The water quality within a mixing zone is subject to General Water Quality Standards contained in Idaho Department of Health and Welfare Rules and Regulations Sections 1.2200,3., "Radioactive Materials", 1.2200,04., "Floating and Submerged Matter", and 1.2200,05. "Excess Nutrients", and can be exempt from the standards contained in Sections 1.2200,01. "Hazardous Materials" and 1.2200,02. "Deleterious Material", as well as from Section 1.2250, as determined appropriate, provided that the receiving water's existing quality is not in violation of that standard or provision.

(h) Concentrations of hazardous materials within the mixing zone must not exceed the ninety-six (96) hour LC50 for biota significant to the receiving water's aquatic community.

Illinois¹³

(a) In the application of this Chapter, whenever a water quality standard is more restrictive than its corresponding effluent standard then an opportunity shall be allowed for the mixture of an effluent with its receiving waters. Water quality standards must be met at every point outside of the mixing zone. The size of the mixing zone cannot be uniformly prescribed. The governing principle is that the proportion of any body of water or segment thereof within mixing zones must be quite small if the water quality standards are to have any meaning. This principle shall be applied on a case-by-case basis to ensure that neither any individual source nor the

aggregate of sources shall cause excessive zones to exceed the standards. The water quality standards must be met in the bulk of the body of water, and no body of water may be used totally as a mixing zone for a single outfall or combination of outfalls. Moreover, except as otherwise provided in this Chapter, no single mixing zone shall exceed the area of a circle with a radius of 183 meters (600 feet). Single sources of effluents which have more than one outfall shall be limited to a total mixing area no larger than that allowable if a single outfall were used.

b) In determining the size of the mixing zone for any discharge, the following must be considered:

1. The character of the body of water;
2. The present and anticipated future use of the body of water;
3. The present and anticipated water quality of the body of water;
4. The effect of the discharge on the present and anticipated future water quality;
5. The dilution ratio; and
6. The nature of the contaminant.

(c) In addition to the above, the mixing zone shall be so designed as to assure a reasonable zone of passage for aquatic life in which the water quality standards are met. The mixing zone shall not intersect any area of any such waters in such a manner that the maintenance of aquatic life in the body of water as a whole would be adversely affected, nor shall any mixing zone contain more than 25% of the cross-sectional area or volume of flow of a stream except for those streams where the dilution ratio is less than 3:1.

Temperature standards contain additional requirements for heated discharges.

Indiana¹⁴

(a) All water quality standards in this Regulation, except those provided in subsection 6(a) below, are to be applied at a point outside of the mixing zone to allow for a reasonable admixture of waste effluents with the receiving waters.

(b) Due to varying physical, chemical, and biological conditions, no universal mixing zone may be prescribed. The Board shall determine the mixing zone

upon application by the discharger. The applicability of the guideline set forth in Section 4(c) will be on a case-by-case basis and any application to the Board should contain the following information.

- (1) The dilution ration;
- (2) The physical, chemical, and biological characteristics of the receiving body of water;
- (3) The physical, chemical, and biological characteristics of the waste effluent;
- (4) The present and anticipated uses of the receiving body of water;
- (5) The measured or anticipated effect of the discharge on the quality of the receiving body of water;
- (6) The existence of an impact upon any spawning or nursery areas of any indigenous aquatic species;
- (7) Any obstruction of migratory routes of any indigenous aquatic species; and
- (8) The synergistic effects of overlapping mixing zones of the aggregate effects of adjacent mixing zones.

(c) Where possible, the general guideline is to be that the mixing zone should be limited to no more than $1/4$ (25 percent) of the cross-sectional area and/or volume of flow of the stream, leaving at least $3/4$ (75 percent) free as a zone of passage for aquatic biota, nor should it extend over $1/2$ (50 percent) of the width of the stream.

Iowa¹⁵

Mixing zone in the receiving water. The area of diffusion of an effluent in the receiving water is a mixing zone and the water quality standards shall be applied beyond the mixing zone.

The mixing zone shall be a specified linear distance, volume, or area which is determined on a case-by-case basis using the following criteria:

(a) The mixing zone shall be as small as practicable and shall not be of such size or shape as to cause or contribute to the impairment of water uses.

Mixing Zone Narrative

(b) The mixing zone shall contain not more than 25 percent of the cross sectional area or volume of flow in the receiving body of water;

(c) The mixing zone shall be designed to allow an adequate passageway at all times for the movement or drift of aquatic life;

(d) Where there are two or more mixing zones in close proximity, they shall be so defined that a continuous passageway for aquatic life is available.

(e) The mixing zone shall not intersect any area of any waters in such a manner that the maintenance of aquatic life in the body of water as a whole would be adversely affected.

In determining the size and location of the mixing zone for any discharge on a case-by-case basis, the following shall be considered:

(f) The size of the receiving water, the volume of discharge, the stream bank configuration, the mixing velocities, and other hydrologic or physiographic characteristics;

(g) The present and anticipated future use of the body of water;

(h) The present and anticipated future water quality of the body of water;

(i) The ratio of the volume of waste being discharged to the seven-day, ten-year flow of the receiving stream; and

(j) The mixing zone shall be free from unsightly floating materials and wastewater constituents in concentrations which are toxic or harmful to human, animal or plant life, which will settle to form sludge deposits, or which will produce aesthetically objectionable color or odor.

Kansas¹⁶

1. The water quality criteria listed herein shall apply beyond the mixing zone for each individual discharge, except that concentrations within the mixing zone area shall be maintained below acute toxicity levels for any parameter or combination of parameters. The total area and/or volume of a receiving stream assigned to mixing zones shall be limited to that which will:

- a) Not interfere with biological communities or populations of important species to a degree

which is damaging to the ecosystem; and

- b) Not disproportionately diminish other beneficial uses.

2. Zones of passage shall be provided wherever mixing zones are allowed. Such zones shall be continuous water routes of the volume, area, and quality necessary to allow passage of free swimming and drifting organisms with no harmful effects on their populations.

3. In streams where the ratio of stream flow to discharge is greater than 3:1 (flow:discharge), mixing zones shall be limited to no more than 1/4 of the cross-sectional area, or volume of the stream, or both, leaving at least 3/4 free as a zone of passage.

4. In streams in which the ratio of stream flow to discharge is equal to or less than 3:1 (flow:discharge), mixing zones shall be established on a case-by-case basis. More stringent treatment technology may be required, when necessary, to protect the designated uses of the surface water segment and to otherwise meet the requirements of these regulations.

Kentucky¹⁷

Mixing zone means a domain of a water body contiguous to a treated or untreated wastewater discharge of quality characteristics different from those of the receiving water. The discharge is in transit and progressively diluted from the source to the receiving system. The mixing zone is the domain where wastewater and receiving water mix.

The following guidelines are applicable in determining all mixing zones:

(1) The cabinet shall, on a case-by-case basis, specify definable geometric limits for mixing zones. Applicable limits shall include but may not be limited to the linear distances from the point of discharge, surface area involvement, volume of receiving water, and taking into account other nearby mixing zones.

(2) Concentrations of toxic substances which exceed the ninety-six (96) hour LC50 or other appropriate LC50 tests for representative indigenous aquatic organisms are not allowed at any point within the mixing zone. A zone of initial dilution may be assigned on a case-by-case basis at the discretion of the cabinet. Concentrations of toxic substances which exceed one-third (1/3) the ninety-six (96) hour LC50

or other appropriate LC50 tests for representative indigenous aquatic organisms are to be met at the edge of the zone of initial dilution. Chronic criteria for the protection of aquatic life are to be met at the edge of the allowable mixing zone.

(3) The location of a mixing zone shall not interfere with spawning areas, nursery areas, fish migration routes, public water supply intakes, bathing areas, nor preclude the free passage of fish or other aquatic life.

(4) Whenever possible the mixing zone shall not exceed one-third ($1/3$) of the width or cross-sectional area of the receiving stream and in no case shall exceed one-half ($1/2$) of this volume.

(5) In lakes and other surface impoundments, the volume of a mixing zone shall not affect in excess of ten (10) percent of the volume of that portion of the receiving waters available for mixing.

(6) In all cases, a mixing zone must be limited to an area or volume which will not adversely alter the legitimate uses of the receiving water; nor shall a mixing zone be so large as to adversely affect an established community of aquatic organisms.

(7) In the case of thermal discharges, a successful demonstration conducted under Section 316(a) of the Clean Water Act shall constitute compliance with all provisions of this section.

(8) Criteria listed in Section 4 of 401 KAR 5:031 do not apply in the mixing zone.

Louisiana¹⁸

Mixing Zones - Mixing zones are those portions of waterbodies where effluent waters are dispersed into receiving waters. They are exempted from criteria for those substances that are rendered non-toxic by dilution, dissipation or transformation. Mixing zones must, however, be defined and have identifiable limits, and the waters outside of mixing zones must meet the Standards for that particular body of water. Mixing must be accomplished as quickly as possible to insure that the waste is mixed with the allocated dilution water in the smallest practicable area.

A mixing zone shall not significantly affect a nursery area for aquatic life or habitat for waterfowl nor any area approved by the state for shellfish harvesting. A mixing zone shall not include an existing public water supply intake nor include any other existing

water supply intake if such mixing zone would significantly impair the purposes for which the supply is utilized.

Mixing zones must be free of the following:

1. Floating debris, oil, scum, and other material in concentrations that constitute a nuisance
2. Substances in concentrations which produce undesirable or nuisance aquatic life
3. Materials in concentrations that will cause acute toxicity to aquatic life. Acute toxicity refers to an aquatic life lethality, such as fish kills, caused by the passage through a mixing zone of migrating fish moving up or downstream, or by less mobile forms drifting through a mixing zone.

The state shall on a case-by-case basis specify definable geometric limits for mixing zones. Applicable limits shall include but may not be limited to the linear distances from point source discharges, surface area involvement, volume of receiving water and taking into account other nearby mixing zones.

As a guideline, the mixing zone in canals, rivers, streams, and other flowing waterbodies shall be no more than one-third the width of the receiving stream at the point of discharge. A mixing zone shall not overlap another mixing zone in such a manner, or be so large, as to impair any designated water use in the receiving stream when considered as a whole.

In lakes, estuaries, bays, lagoons, and sounds, the area of mixing shall not be so large as to cause impairment of a designated use and will be defined by the Office on a case-by-case basis.

Zones of Passage - In rivers, streams, reservoirs, lakes, estuaries and coastal waters, zones of passage are continuous water routes of the volume, area and quality necessary to allow passage of free-swimming and drifting organisms with no significant effects produced on their populations. These zones must be provided wherever mixing zones are allowed.

Because of varying local physical and chemical conditions and biological phenomena, no single value can be given on the percentage of stream width necessary to allow passage of critical free-swimming and drifting organisms so that negligible or no effects are produced on their populations. However, except when otherwise specified in a valid wastewater

State

Mixing Zone Narrative

discharge permit, the mixing zone will be limited to no more than one-third of the width of the receiving stream leaving at least two-thirds free as a zone of passage.

Exceptions - The Standards shall not apply to:

1. Effluents
2. A valid state wastewater discharge permit and/or a National Pollution Discharge Elimination System Permit.

Maine¹⁹

Not specified

Maryland²⁰

Mixing Zone Policy:

1. Effluents may be mixed with surface waters in the mixing zone.
2. Effluents may not be treated in the mixing zone.
3. Surface waters outside the mixing zones shall meet the water quality standards for that particular body of water.
4. The Department may designate mixing zones subject to the following requirements:
 - (a) There shall be no interference with biological communities or populations of indigenous species to a degree which is damaging to the aquatic life or ecosystem;
 - (b) There shall be no diminishing of other legitimate beneficial uses;
 - (c) Mixing zones may not form barriers to the migratory routes of aquatic life;
 - (d) Mixing zones shall be designated and located to protect surface waters and shallow water shoreline areas.
 - (e) The general water quality criteria set out in §C (General Water Quality Criteria) of this regulation apply within the mixing zones.
5. A mixing zone is not permitted for toxic materials identified in §D(2) (Specific Water Quality Criteria) of this regulation.

6. Except for thermal mixing zones established by regulation .13, mixing zones may not exceed the following maximum limits.

- (a) In freshwater streams and rivers, a mixing zone width may not exceed one-third of the width of the surface water body.
- (b) In lakes, the combined area of all mixing zones may not exceed 10 percent of the lake surface area.
- (c) In estuarine areas, the maximum cross-sectional area of the mixing zone may not exceed 10 percent of the cross-sectional area of the surface water body.

Massachusetts²¹

Mixing Zones - In applying these standards, the Division may recognize, where appropriate, a limited mixing zone or zone of initial dilution on a case-by-case basis. The location, size and shape of these zones shall provide for the maximum protection of aquatic resources. At a minimum, mixing zones must

- (a) Meet the criteria for aesthetics;
- (b) Be limited to an area or volume that will minimize interference with the designated uses or established community of aquatic life in the segment;
- (c) Allow an appropriate zone of passage for migrating fish and other organisms; and
- (d) Not result in substances accumulating in sediments, aquatic life or food chains to exceed known or predicted safe exposure levels for the health of humans or aquatic life.

Michigan²²

R 323.1082. Mixing Zones Rule 82.

1. A mixing zone to achieve a mixture of a point source discharge with the receiving waters shall be considered a region in which the response of organisms to water quality characteristics is time dependent. Exposure in mixing zones shall not cause an irreversible response which results in deleterious effects to populations of important aquatic life and wildlife. As a minimum restriction, the final acute value for aquatic life shall not be exceeded in the mixing zone at any point inhabitable by these organisms, unless it can be demonstrated to the

commission that a higher concentration is acceptable. The mixing zone shall not prevent the passage of fish or fish food organisms in a manner which would result in adverse impacts on their immediate or future populations. Watercourses or portions thereof which, without 1 or more point source discharge, would have flow except during periods of surface runoff may be considered as a mixing zone for a point source discharge. The area of mixing zones should be minimized. To this end, devices for rapid mixing, dilution, and dispersion are encouraged where practicable.

2. For toxic substances, not more than 25% of the receiving water design flow, as stated in R 323.1090, shall be utilized when determining effluent limitations for surface water discharges, unless it can be demonstrated to the commission that the use of a larger volume is acceptable. The commission shall not base a decision to grant more than 25% of the receiving water design flow for purposes of developing effluent limitations for discharges of toxic substances solely on the use of rapid mixing, dilution, or dispersion devices. However, where such a device is or may be employed, the commission may authorize the use of a design flow greater than 25% if the effluent limitations which correspond to such a design flow are shown, based upon a site specific demonstration, to be consistent with Act No. 245 of the Public Acts of 1929, as amended, being §323.1 et seq. of the Michigan Compiled Laws, and other applicable law.

3. For substances not included in subrule (1) of this rule, the design flow, as stated in R323.1090, shall be utilized when determining effluent limitations for surface water discharges if the provisions in subrule (1) of this rule are met, unless the commission determines that a more restrictive volume is necessary.

4. For all substances, defined mixing zone boundaries may be established and shall be determined on a case-by-case basis.

5. Mixing zones in the Great Lakes, their connecting waters, and inland lakes shall be determined on a case-by-case basis.

Minnesota²³

Means for expediting mixing and dispersion of sewage, industrial waste, or other waste effluents in the receiving, interstate waters are to be provided so far as practicable when deemed necessary by the Agency to maintain the quality of the receiving interstate

waters in accordance with applicable standards. Mixing zones can be established by the Agency on an individual basis, with primary consideration being given to the following guidelines:

- (a) Mixing zones in rivers shall permit an acceptable passageway for the movement of fish;
- (b) The total mixing zone or zones at any transect of the stream should contain no more than 25% of the cross-sectional area and/or volume of flow of the stream, and should not extend over more than 50% of the width;
- (c) Mixing zone characteristics shall not be lethal to aquatic organisms;
- (d) For contaminants other than heat, the 96 hour median tolerance limit for indigenous fish and fish food organisms should not be exceeded at any point in the mixing zone;
- (e) Mixing zones should be as small as possible, and not intersect spawning or nursery area, migratory routes, water intakes, nor mouths of rivers; and
- (f) Overlapping of mixing zones should be minimized and measures taken to prevent adverse synergistic effects. This provision shall also apply in cases where a Class 7 water is tributary to a Class 2 water.

Mississippi²⁴

It is recognized that limited areas of mixing are sometimes unavoidable; however, mixing zones shall not be used for, or considered as a substitute for waste treatment. Mixing zones constitute an area whereby physical mixing of a wastewater effluent with a receiving water body occurs. Applications of mixing zones shall be made on a case-by-case basis and shall only occur in cases involving large surface water bodies in which a long distance or large area is required for the wastewater to completely mix with the receiving water body.

The location of a mixing zone shall not significantly alter the designated uses of the receiving water outside its established boundary. Adequate zones of passage for the migration and free movement of fish and other aquatic biota shall be maintained. No conditions shall be allowed to exist within the mixing

State

Mixing Zone Narrative

zone that would result in an endangerment to public health, nuisances, or fish mortality.

Missouri²⁵

1. The mixing zones shall be exempted from the specific criteria for those substances that are rendered non-toxic by dilution, dissipation, or rapid transformation. Acutely toxic concentrations of substances are not allowed in the mixing zone. The mixing zone shall not overlap another mixing zone in such a manner that the maintenance of aquatic life in the body of water as a whole would be adversely affected.

2. In determining the size and location of the mixing zone for any discharge, the following characteristics must be considered:

- i. The size of the river, the volume of discharge, the stream bank configuration, the mixing velocities, and other hydrologic or physiographic characteristics;
- ii. The present and anticipated future uses of the water, including type of aquatic life supported; and
- iii. The dilution ratio, that is, the ratio of the seven (7)-day once-in-ten (10)-year low flow of the receiving stream to the average dry weather flow of the discharge.

C. Zones of passage must be provided wherever mixing zones are allowed. As a guideline, at least three quarters of the cross-sectional area or volume of flow of a stream should be left free as a zone of passage.

Montana²⁶

Discharges to surface waters may be entitled a mixing zone which will have a minimum impact on surface water quality, as determined by the department.

Nebraska²⁷

The Water Quality Standards shall apply at and beyond the mixing zone boundaries. The mixing zone exception does not apply to fecal coliform criteria in waters designated a primary contact recreational use. The boundary limits of the mixing zone shall be a specified linear distance, volume, or area, and should meet the conditions listed below unless the physical characteristics of the receiving waters require special considerations. In the latter case the Department will establish mixing zones applicable to the physical characteristic of the receiving waters in

State

Mixing Zone Narrative

such a manner that will not affect the assigned beneficial uses.

(a) The mixing zone should be kept as small as possible and shall not be of a size or shape that would impair or contribute to the impairment of water use.

(b) The mixing zone shall allow for a continuous zone of passage for aquatic life.

(c) The mixing zone shall not overlap other mixing zones if beneficial uses are adversely affected.

Nevada²⁸

Not specified

New Hampshire²⁹

The commission (New Hampshire Water Supply and Pollution Control Commission) may consider mixing zones, except as otherwise provided in these rules or by statute; and where mixing zones are allowed, they shall conform to the latest requirements of the Environmental Protection Agency or to the requirements of the Commission which shall be no less rigorous than existing federal requirements.

New Jersey³⁰

Water quality within a mixing zone may be allowed to fall below applicable water quality criteria provided the existing and designated uses outside the mixing zone are not adversely impacted.

Mixing zone requirements will be determined by the Department (New Jersey Department of Environmental Protection) on a case-by-case basis taking into special consideration the extent and nature of the receiving waters so as to meet the intent and purpose of the criteria and standards.

The total area and volume of a waterway or waterbody assigned to mixing zones shall be limited to that which will not interfere with biological communities or populations of important species to a degree which is damaging to the ecosystem or which diminishes other beneficial uses disproportionately. Furthermore, significant acute mortality of aquatic biota shall not occur within the mixing zone.

Zones of passage shall be provided for the passage of free-swimming and drifting organisms wherever mixing zones are allowed.

State

Mixing Zone Narrative

Temperature changes in designated heat dissipation areas shall not cause mortality of the aquatic biota nor create conditions which allow the introduction or maintenance of populations of undesirable organisms at nuisance levels.

Adjacent heat dissipation areas: Where waste discharges would result in heat dissipation areas in such close proximity to each other as to impair protected uses, additional limitations shall be prescribed to avoid such impairment.

No heat dissipation areas shall be permitted in waters classified as FW2-TP or within 1500 feet of the shoreline in SC waters.

New Mexico³¹

Mixing Zones and Zones of Passage - In any waters receiving a waste discharge, a continuous zone must be maintained in the stream or reservoir where the water is of adequate quality to allow the migration of all desirable aquatic life presently common in New Mexico waters with no significant effect on their populations. Wastewater mixing zones, in which the standards may be exceeded, shall generally be less than 1/4 of the cross-sectional area of the stream or reservoir, allowing at least 3/4 of the stream or reservoir as a zone of passage.

New York³²

Collection of Samples - In making any tests of analytical determinations to determine compliance or non-compliance of sewage, industrial wastes or other waste discharges with established standards, samples shall be collected in such manner and at such locations as are approved by the commissioner. In approving such locations, the commissioner shall be guided by the fact that:

(a) There must be prompt mixing of the discharge with the receiving waters;

(b) That the mixing will not interfere with biological communities to a degree which is damaging to the ecosystems; and

(c) That the mixing will not diminish other beneficial uses disproportionately.

Mixing Zone Criteria - The following criteria shall apply to all waters of the State receiving thermal discharges, except as provided in section 704.6 (Applicability of Criteria) of this Part.

(a) The department shall specify definable, numerical limits for all mixing zones (e.g. linear distances from the point of discharge, surface area involvement, or volume of receiving water entrained in the thermal plume).

(b) Conditions in the mixing zone shall not be lethal in contravention of water quality standards to aquatic biota which may enter the zone.

(c) The location of mixing zones for thermal discharges shall not interfere with spawning areas, nursery areas and fish migration routes.

Criteria Governing Thermal Discharges: General Criteria

(a) The following criteria shall apply to all waters of the State receiving thermal discharges, except as provided in section 704.6 (Applicability of Criteria):

1. The natural seasonal cycle shall be retained.
2. Annual spring and fall temperature changes shall be gradual.
3. Large day-to-day temperature fluctuations due to heat of artificial origin shall be avoided.
4. Development or growth of nuisance organisms shall not occur in contravention of water quality standards.
5. Discharges which would lower receiving water temperature shall not cause a violation of water quality standards and section 704.3 (Mixing Zone Criteria).
6. For the protection of the aquatic biota from severe temperature changes, routine shutdown of an entire thermal discharge at any site shall not be scheduled during the period from December through March.

North Carolina³³

A mixing zone may be established in the area of a discharge in order to provide reasonable opportunity for the mixture of the wastewater with the receiving waters. The limits of such mixing zones will be defined by the division on a case-by-case basis after consideration of the magnitude and character of the waste discharge and the size and character of the receiving waters. Such zones shall not:

- (1) Prevent free passage of fish around or cause fish mortality within the mixing zone,
- (2) Result in offensive conditions,
- (3) Produce undesirable aquatic life or result in a dominance of nuisance species outside of the assigned mixing zone.
- (4) Endanger the public health or welfare.

In addition, a mixing zone shall not be assigned for fecal coliform organisms in waters classified "A-II", "B", "SB", or "SA." For the discharge of heated wastewater, compliance with federal rules and regulations pursuant to Section 316(a) of the Federal Water Pollution Control Act, as amended, shall constitute compliance with this Subsection (b).

North Dakota³⁴

The size and configurations of a mixing zone cannot be uniformly prescribed for all streams due to the particular characteristics of each stream. However the following considerations are taken into account when mixing zones are determined:

- (a) The Water Quality Standards must be met at every point outside the mixing zone. The department (North Dakota State Department of Health) may require a means of expediting mixing and dispersion of wastes, if found necessary.
- (b) The total mixing zone (or zones) at any cross-sectional area of the stream should not be larger than 25 percent of the cross-sectional area or volume of flow and shall not extend more than 50 percent of the width. Mixing zones shall provide an acceptable passageway for movement of fish and other aquatic organisms.
- (c) The 96-hour LC-50 for indigenous and/or resident fish and fish food organisms shall not be exceeded at any point in the mixing zone.
- (d) Mixing zones shall be as small as possible and shall not intersect spawning or nursery areas, migratory routes, or municipal water intakes. Overlapping of mixing zones should be avoided or minimized to prevent adverse synergistic effects.

General

(A) Non-Thermal

1. Where necessary to attain or maintain the use designated for surface water by these water quality standards, the director may establish, as a term of a discharge permit or a permit to install issued pursuant to Chapter 3745-31 of the Administrative Code, a mixing zone applicable to the non-thermal constituents of the point source discharge authorized by such permit. No mixing zone established by the director will:

- (a) Interdict the migratory routes or interfere with natural movements, survival, reproduction, growth, or increase the vulnerability to predation of any representative aquatic species;
- (b) Include spawning or nursery areas of any representative aquatic species;
- (c) Include a public water supply intake;
- (d) Include any bathing area where bath houses and/or lifeguards are provided;
- (e) Constitute more than one-half of the width of the receiving watercourse nor constitute more than one-third of the area of any cross-section of the receiving watercourse;
- (f) Constitute more than one-fifth of the area of any cross-section of the mouth of a receiving watercourse (the mouth constituting that area of the stream from the confluence upstream for a distance five times the width of the stream at the confluence);
- (g) Extend downstream at any time a distance more than five times the width of the receiving watercourse at the point discharge;

2. The Director may waive the requirements of Sections (A)(1)(e), (A)(1)(f) and (A)(1)(g) of this rule whenever a discharger provides:

- (a) Information defining the actual boundaries (where the Water Quality Standards are met) of the mixing zone in question; and
- (b) Information and data proving no violation of Sections (A)(1)(a), (A)(1)(b), (A)(1)(c),

and (A)(1)(d) of this rule by the mixing zone in question.

3. When establishing a mixing zone, the director shall require that the zone which is physically inhabitable by aquatic life not exceed at any time the forty-eight to ninety-six hour median tolerance limit (TLM) or LC₅₀ for any representative aquatic species, as determined from applicable scientific literature or as determined by static bioassays for persistent toxicants and dynamic bioassays for non-persistent toxicants in accordance with methods described in "Standard Methods for the Examination of Water and Wastewater," fifteenth edition, 1981, published by the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation or "Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices," June, 1983, available from the Ohio Environmental Protection Agency offices in Columbus, Bowling Green, Logan, Dayton, and Twinsburg.

4. For lakes and reservoirs, except Lake Erie defined as state resource waters by rule 3745-1-05 of the (Ohio) Administrative Code, no mixing zone shall be permitted.

(B) Thermal

1. The director may establish as a term of a discharge permit or a permit to install issued pursuant to Chapter 3745-31 of the Administrative Code, a mixing zone applicable to the thermal component of the point source discharge authorized by such permit. A thermal mixing zone to permit dilution and cooling of a waste heat discharge shall be considered a region in which organism response to temperature is time-dependent. Exposure to temperatures in a thermal mixing zone shall not cause an irreversible response which results in deleterious effects to the wildlife and aquatic life representative of the receiving waters. The daily average temperature in a thermal mixing zone at a point nearest to the discharge that is accessible to the resident aquatic organisms shall not exceed the temperature in Table 1 at the corresponding ambient temperature. At ambient temperatures of fifty-nine degrees Fahrenheit (fifteen degrees Celsius) and above, the daily average temperature in a thermal mixing zone will be determined on a case-by-case basis.

2. Thermal mixing zone size limitations shall be established by the director pursuant to paragraph (B)(1) of this rule on a case-by-case basis for all point source discharges subject to permit. The analytical methods for determining mixing zones are

those set forth in paragraph (C) of rule 3745-1-03 of the Administrative Code.

3. Except as paragraphs (B)(1) and (B)(2) of this rule establish different limitations, no thermal mixing zone shall:

- (a) Interdict the migratory routes or interfere with natural movements, survival, reproduction, growth, or increase the vulnerability to predation of any representative aquatic species;
- (b) Interfere with or prevent the recovery of an aquatic community or species population that could reasonably be expected as previously limiting water quality conditions improve,
- (c) Include a public water supply intake, or;
- (d) Include any bathing area where bathhouses and/or lifeguards are provided.

4. For all watercourses classified as coldwater habitat and exceptional warmwater habitat in rules 3745-1-08 to 3745-1-32 of the Administrative Code, thermal mixing zones will not be permitted.

5. For lakes and reservoirs, (except Lake Erie), classified as state resource waters in rule 3745-1-05 of the Administrative Code, no thermal mixing zone shall be permitted.

6. Discharges of closed-cycle cooling blowdown with a flow of less than five percent of the seven-day once-in-ten-year low-flow of the receiving water body will be exempt from paragraphs (B)(1) to (B)(3) of this rule.

Table 1: Daily average temperatures of thermal mixing zones at corresponding ambient temperatures as required in paragraph (B)(1) of this rule. Shown as degrees Fahrenheit and (Celsius).

Ambient °F(°C)	Daily Average Temp. °F(°C)	Ambient °F(°C)	Daily Average Temp. °F(°C)
32(0)	50(10.0)	48(8.9)	71(21.7)
33(0.6)	50(10.0)	49(9.4)	73(22.8)
34(1.1)	50(10.0)	50(10.0)	75(23.9)
35(1.7)	51(10.6)	51(10.6)	76(24.4)
36(2.2)	52(11.1)	52(11.1)	78(25.6)
37(2.8)	54(12.2)	53(11.7)	79(26.1)
38(3.3)	55(12.8)	54(12.2)	81(27.2)
39(3.9)	57(13.9)	55(12.8)	83(28.3)
40(4.4)	58(14.4)	56(13.3)	85(29.4)
41(5.0)	60(15.6)	57(13.9)	86(30.0)
42(5.6)	62(16.7)	58(14.4)	88(31.1)
43(6.1)	63(17.2)	59(15) and above - daily average limit will be determined on a case-by- case basis pursuant to Rule 3745-1-06(B)(1) and (2).	
44(6.7)	65(18.3)		
45(7.2)	66(18.9)		
46(7.8)	68(20.0)		
47(8.3)	70(21.1)		

Table 12d. Daily average temperatures of thermal mixing zones at corresponding ambient temperatures. Shown as degrees Fahrenheit and (Celsius).

Ambient °F(°C)	Daily Average Temp. °F(°C)	Ambient °F(°C)	Daily Average Temp. °F(°C)
32 (0)	52 (11.1)	46 (7.8)	65 (18.3)
33 (0.6)	52.5 (11.4)	47 (8.3)	66 (18.9)
34 (1.1)	53.5 (11.9)	48 (8.9)	68 (20.0)
35 (1.7)	54.4 (12.4)	49 (9.4)	70 (21.1)
36 (2.2)	55 (12.8)	50 (10.0)	71 (21.7)
37 (2.8)	56 (13.3)	51 (10.6)	73 (22.8)
38 (3.3)	57 (13.9)	52 (11.1)	75 (23.9)
39 (3.9)	58 (14.4)	53 (11.7)	77 (25.0)
40 (4.4)	59 (15)	54 (12.2)	78 (25.6)
41 (5.0)	59.5 (15.3)	55 (12.8)	80 (26.7)
42 (5.6)	60 (15.6)	56 (13.3)	82 (27.8)
43 (6.1)	61 (16.1)	57 (13.9)	84 (28.9)
44 (6.7)	62 (16.7)	58 (14.4)	86 (30.0)
45 (72.)	63 (17.2)	59 (15)	and above-daily average limit. will be determined on a case-by-case basis.

Ohio River

(D) Mixing zone designation:

(1) A "mixing zone" shall be deemed to exist for each discharge. When required, the specific numerical limits for any mixing zone shall be determined on a case-by-case basis, and shall include considerations for existing uses, linear distance (i.e., length and width) from the point of discharge, surface area involved, and volume of receiving water within the defined zone.

(2) Conditions within the mixing zone shall not be injurious to human health, in the event of a temporary exposure.

(3) Conditions within the mixing zone shall not be injurious to human health, in the event of a temporary exposure.

(4) The mixing zone shall be free from substances attributable to sewage, industrial wastes, toxic

wastes, other wastes, cooling water, or residues from potable water treatment plants in quantities which:

- (a) Settle to form sludge deposits;
 - (b) Float as debris, scum, or oil;
 - (c) Contaminate natural sediments so as to cause or contribute to a violation of:
 - (i) Appropriate stream criteria and parameter levels outside the mixing zone; or
 - (ii) Any condition of the designated uses of the water.
 - (d) Impart a disagreeable flavor or odor to flesh of fish or other aquatic life, wildlife or livestock which are consumed by man and which acquire such a flavor because of passage through or ingestion of the waters from the mixing zone.
- (5) The mixing zone shall be located so as not to interfere significantly with migratory movements and passage of fish, other aquatic life and wildlife. No waste discharge related to the mixing zone shall, outside the limits of the mixing zone, interfere with potable water supply intakes, bathing areas, reproduction of fish, other aquatic life and wildlife; or adversely affect fish or aquatic life normally inhabiting waters prior to addition of waste discharged; or result in any other violations of appropriate stream criteria and parameter levels relating to the designated use at or above critical river flow as shown below.

Critical Flow Values

River Reach

Critical Flow

<u>From</u>	<u>To</u>	<u>in</u>
<u>cfs*</u>		
Pittsburgh	Montgomery dam (mp 32.4)	4,800
Montgomery	Willow Island dam (mp 161.8)	5,800
Willow Island	Gallipolis dam (mp 279.2)	6,800
Gallipolis	Greenup dam (mp 341.0)	8,500
Greenup	Meldahl dam (mp 436.2)	9,800
Meldahl	Mcalpine dam (mp 605.8)	11,000
Mcalpine	Uniontown dam (mp 846.0)	13,000
Uniontown	Smithland dam (mp 918.5)	18,800
Smithland	Cairo point (mp 981.0)	46,300

=
 =
 *Minimum seven day, ten year low flow based on
 calculations by the U.S. Corps of Engineers.

Oklahoma³⁶

When a liquid of different quality than the receiving water is discharged into an aquatic system, a mixing zone is formed. The concept of a mixing zone is recognized as a necessary element in Oklahoma's Water Quality Standards.

In streams, the mixing zone extends downstream a distance equivalent to thirteen (13) times the width of the water at the point of effluent discharge. The concentration of toxic substances in a mixing zone shall not exceed the 96-hour LC50 for sensitive indigenous species. Mixing zones in lakes shall be designated on a case-by-case basis.

It is recognized that the water quality in a portion of the mixing zone may be unsuitable for certain beneficial uses. Where overlapping mixing zones occur because of multiple outfalls, the total length of the mixing zone will extend thirteen (13) stream widths downstream from the downstream discharge.

Zones of Passage - All discharges shall be regulated to insure that a zone of passage shall be maintained within the stream at the outfall and throughout the mixing zone that shall be no less than seventy-five percent (75%) of the cross-sectional area or flow volume, whichever is more beneficial to the free-swimming and drifting organisms. Water quality

State

Mixing Zone Narrative

standards shall be maintained throughout the zone of passage. Zones of passage in lakes shall be designated on a case-by-case basis.

Oregon³⁷

The Department may suspend the applicability of all or part of the water quality standards set forth in this rule, except those standards relating to aesthetic conditions, within a defined immediate mixing zone of specified and appropriately limited size adjacent to or surrounding the point of waste water discharge.

The sole method of establishing such mixing zone shall be by the Department defining same in a waste discharge permit.

In establishing a mixing zone in a waste discharge permit, the Department:

(a) May define the limits of the mixing zone in terms of distance from the point of the waste water discharge or the area or volume of the receiving water or any combination thereof;

(b) May set other less restrictive water quality standards to be applicable in the mixing zone in lieu of the suspended standards; and

(c) Shall limit the mixing zone to that in all probability, will:

i. Not interfere with any biological community or population of any important species to a degree which is damaging to the ecosystem; and

ii. Not adversely affect any other beneficial use disproportionately.

Pennsylvania³⁸

Not specified

Rhode Island³⁹

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

Non-thermal Mixing Zones - In applying these standards the director may recognize, where appropriate, a limited mixing zone or zone of initial dilution on a case-by-case basis. The locations, size, and shape of these zones shall provide for the maximum protection of aquatic resources. At a minimum, mixing zones must:

- (a) Meet the criteria for aesthetics;
- (b) Be limited to an area or volume that will minimize interference with the designated uses in the segment;
- (c) Allow an appropriate zone of passage for migrating fish and other organisms; and
- (d) Not result in substances accumulating in sediments, aquatic life or food chains to exceed known or predicted safe exposure levels for the health of humans or aquatic life.

South Carolina⁴⁰

A region or zone (called the mixing zone) in which one or more specified water quality standards and classified uses are not applicable may be allowed by the Department (South Carolina Department of Health and Environmental Control). The size of the mixing zone shall be kept to a minimum and may be determined on an individual project basis considering biological, chemical, engineering, hydrological, and physical factors.

(a) **Surface Waters:** Mixing zones which are used for waste treatment effluents shall allow safe passage of aquatic organisms, and shall allow the protection and propagation of a balanced indigenous population of aquatic organisms in and on the water body. The mixing zone size shall be based upon critical flow conditions. The mixing zone shall not be an area of waste treatment nor shall it interfere with or impair existing recreational uses, existing drinking water supply uses, existing industrial or agricultural uses, or existing or potential shellfish harvesting uses. [see Antidegradation (1)(a)].

(b) **Ground Waters:** The numeric standards for Class GB ground water, Section E. (11) (Class Descriptions and Specific Standards), are applicable unless a mixing zone solely within the bounds of the applicant's property, setting forth certain conditions is granted by the Department. Such a mixing zone shall be granted upon satisfactory demonstration to the Department that:

- (1) Reasonable measures have been taken or binding commitments are made to minimize the addition of contaminants to ground water and/or control the migration of contaminants in ground water; and
- (2) The ground water in question is confined to the uppermost aquifer which has little or no potential of being an Underground Source of Drinking Water, and discharges or will discharge to surface waters without contravening the surface water standards set forth in this regulation; and
- (3) The contaminant(s) in question occurs on the property of the applicant, and there is minimum possibility for ground-water withdrawals (present or future) to create drawdown such that contaminants would flow offsite; and
- (4) The contaminants or combination of contaminants in questions are not dangerously toxic, mobile, or persistent.

South Dakota⁴¹

Each discharge to a flowing water is entitled to a mixing zone at the edge of which the criterion established for the beneficial uses of the receiving water shall be met. Mixing zones in streams must permit an acceptable passageway for movement of aquatic organisms. The total mixing zone or zones, at any transect of a stream may not contain more than 75 percent of the cross-sectional area of the stream and may not extend over more than 75 percent of the width of the stream or 100 yards, whichever is least. The dimensions of the total mixing zone parallel to the stream flow may not exceed one-half mile. Mixing zone characteristics must not be lethal to aquatic organisms. The 96-hour median lethal concentration for indigenous fish or fish food organisms, whichever is more stringent, may not be exceeded at any point in the mixing zone. Mixing zones may not intersect spawning or nursery areas, migratory routes, water intakes, or mouths of rivers. Mixing zones should not overlap, but where they do, measures shall be taken to prevent adverse synergistic effects.

Lakes not allowed a mixing zone. Discharges to lakes are not entitled to a mixing zone. These effluents shall meet the water quality standards at the point of discharge. No discharge of pollutants is allowed

State

Mixing Zone Narrative

which reaches a lake classified for the beneficial use of fish life propagation and causes impairment of an assigned beneficial use.

Tennessee⁴²

Mixing zone refers to that section of a flowing stream or impounded waters in the immediate vicinity of an outfall where an effluent becomes dispersed and mixed. Such zones shall be restricted in area and length and shall not (i) prevent the free passage of fish or cause aquatic life mortality in the receiving water; (ii) contain materials in concentrations that exceed recognized acute toxicity levels for biota significant to the aquatic community in receiving water; (iii) result in offensive conditions; (iv) produce undesirable aquatic life or result in dominance of a nuisance species; (v) endanger the public health or welfare; or (vi) adversely affect the reasonable and necessary uses of the area; (vii) create a condition of chronic toxicity beyond the edge of the mixing zone; and (viii) adversely affect nursery and spawning areas.

Texas⁴³

(b)Mixing zones. A reasonable mixing zone will be allowed at the discharge point of permitted discharges into surface water in the state, in accordance with the following provisions.

(1) The following portions of the standards do not apply within mixing zones:

(A) site-specific criteria, as defined in §307.7 of this title (relating to Site-specific Criteria and Uses) and listed for each classified segment in Appendix A of §307.10 of this title (relating to Appendices A through C);

(B) numerical chronic criteria for toxic materials as established in §307.6 of this title (relating to Toxic Materials);

(C) total chronic toxicity restrictions as established in §307.6 of this title (relating to Toxic Materials); and

(D) maximum temperature differentials as established in §307.4(f) of this title (relating to General Criteria).

(E) dissolved oxygen criteria for unclassified waters, as established in §307.4(h) of this title (relating to General Criteria).

(F) dissolved oxygen criteria for intermittent streams and barge canals, as established in §307.4(j) of this title (relating to General Criteria).

(G) fecal coliform criteria for unclassified waters, as established in §307.4(k) of this title (relating to General Criteria).

(2) Numerical acute criteria for toxic materials and preclusion of total acute toxicity as established in §307.6 of this title (relating to Toxic Materials) are applicable even in mixing zones. Numerical acute criteria may be exceeded in small zones of initial dilution at discharge sites. Zones of initial dilution are restricted to the immediate point of discharge and must be substantially smaller than designated mixing zones.

(3) Provisions of the general criteria in §307.4 of this title (relating to General Criteria) remain in effect in mixing zones unless specifically exempted in this section.

(4) Water quality standards do not apply to treated effluents at the immediate point of discharge prior to any contact with either ambient waters or a dry streambed.

(5) Where a mixing zone is defined in a valid commission or National Pollutant Discharge Elimination System (NPDES) permit, the mixing zone defined in the permit will apply.

(6) Mixing zones shall not preclude passage of free-swimming or drifting aquatic organisms to the extent that aquatic life use is significantly affected.

(7) Mixing zones will not overlap unless it can be demonstrated that no applicable standards will be violated in the area of overlap. Existing and designated uses will not be impaired by the combined impact of a series of contiguous mixing zones.

(8) Mixing zones will not encompass an intake for a domestic drinking water supply. Thermal mixing zones are excepted from this provision unless elevated temperatures adversely affect drinking water treatment.

(9) Mixing zones will be individually specified for all permitted domestic discharges with a permitted monthly average flow equal to or exceeding one million gallons per day and for all permitted industrial discharges to water in the state (excepting discharges which consist entirely of stormwater runoff). For

State

Mixing Zone Narrative

domestic discharges with permitted monthly average flows less than one million gallons per day, a small mixing zone will be assumed; and the commission may require specified mixing zones as appropriate. For existing permits and pending permit applications as of the date of adoption of this chapter, mixing zones will be defined upon permit renewal or amendment.

Utah⁴⁴

A mixing zone is a limited portion of a body of water, contiguous to a discharge, where dilution is in progress but has not yet resulted in concentrations which will meet certain standards for all pollutants. At no time, however, shall concentrations within the mixing zone be allowed which are acutely lethal as determined by bioassay or other approved procedure. Mixing zones may be delineated for the purpose of guiding sample collection procedures. The zone shall be small in extent and must not form a barrier to migrating aquatic life. Domestic wastewater effluents discharged to mixing zones shall meet effluent requirements specified in R448-1-3.

Vermont⁴⁵

A. **Designation** - Mixing zones shall not be created in any Class A water. In all other waters, the Secretary may, in conjunction with the issuance of a permit, designate a specific portion of the receiving waters not exceeding 200 feet from the point of discharge as a mixing zone for any waste which has been properly treated to comply with all applicable state and federal treatment requirements and effluent limitations. Within any mixing zone the Secretary may, in accordance with the terms of a permit, waive the provisions of sections 1-03, 3-01, 3-03(B), and 3-04(B) provided that the quality of the waters downstream of the mixing zone complies with all applicable provisions of these rules.

B. **Mixing Zone Criteria** - The Secretary shall insure that conditions within any mixing zone shall:

1. Not create a public health hazard, and
2. Not constitute a barrier to the passage or migration of fish or result in an undue adverse effect on fish, aquatic biota or wildlife, and
3. Not interfere with any existing use of the waters.

Virginia⁴⁶

Zones for mixing wastes with receiving waters shall be determined on a case-by-case basis; shall be kept as small as practical; shall not be used for, or considered as, a substitute for minimum treatment technology required by the Federal Water Pollution Control Act and other applicable State and Federal

laws; and shall be implemented, to the greatest extent practicable, in accordance with the provisions of subsections 1.01A and 1.01B of the Virginia Water Quality Standards, and shall not contain toxic substances in acutely toxic concentrations. An area of initial dilution may be allowed. This area of initial dilution will be determined on a case-by-case basis and shall not at any time exceed the lethal concentration for appropriate representative species for time periods of exposures likely to be encountered by that species and likely to cause acute effects. Mixing within these zones shall be as quick as practical and may require the installation and use of devices which insure that waste is mixed with the allocated receiving waters in the smallest practical area. The need for such devices shall be determined on a case-by-case basis. The boundaries of these zones of admixture shall be such as to provide a suitable passageway for fish and other aquatic organisms. In an area where more than one discharge occurs and several mixing zones are close together, these mixing zones shall be so situated that this passageway is continuous.

Washington⁴⁷

The total area and/or volume of a receiving water assigned to a dilution zone shall be as described in a valid discharge permit as needed and be limited to that which will:

(a) Not cause acute mortalities of sport, food, or commercial fish and shellfish species of established biological communities within populations or important species to a degree which damages the ecosystem.

(b) Not diminish aesthetic values or other beneficial uses disproportionately.

West Virginia⁴⁸

In the permit review and planning process or upon the request of a permit applicant or permittee the Chief may establish on a case-by-case basis an appropriate mixing zone.

(A) The following criteria shall be applied to the establishment of mixing zones:

(1) Mixing zones shall:

- i. Be kept as small as practical in area and length;
- ii. Not be used for, or considered as, a substitute for waste treatment;

- iii. Provide for as rapid a mixing as practicable;
 - iv. Not prevent the free passage of aquatic species or include spawning or nursery areas;
 - v. Not overlap a public water supply intake;
 - vi. Not cause or contribute to any of the conditions prohibited in Section 3; and
 - vii. Not interfere with any designated use category.
- (2) The boundaries of the mixing zone shall reflect
- (a) Receiving water body characteristics such as:
 - i. Water quality
 - ii. Local meteorology
 - iii. Flow regime (including low-flow records),
 - iv. Magnitude of water exchange at point of discharge,
 - v. Stratification phenomena,
 - vi. Waste capacity of the receiving system including retention time,
 - vii. Turbulence and speed of flow,
 - viii. Morphology of the receiving system as related to plume behavior, and biological phenomena,
 - ix. Designated water use categories; and
 - (b) Discharge characteristics such as :
 - i. Flow regime,
 - ii. Volume,
 - iii. Design,

- iv. Location
- v. Rate of mixing and dilution, and
- vi. Plume behavior and mass-emission rates of constituents including knowledge of their persistence, toxicity, and chemical or physical behavior with time.

(B) Where the 7-day, 10-year return frequency is 5 cfs or less, no mixing zone may be established.

(C) In order to facilitate a determination or assessment of a mixing zone pursuant to this section, the Chief may require a permit applicant or permittee to submit such information as deemed necessary.

Wisconsin⁴⁹

Water quality standards must be met at every point outside of a mixing zone. The size shall be based on such factors as effluent quality and quantity, available dilution, temperature, current, type of outfall, channel configuration and restrictions to fish movement. As a guide to the delineation of a mixing zone, the following shall be taken into consideration:

- (a) Limiting mixing zones to as small an area as practicable, and conforming to the time exposure responses of aquatic life.
- (b) Providing passageways in rivers for fish and other mobile aquatic organisms.
- (c) Where possible, mixing zones being no larger than 25 percent of the cross-sectional area or volume of flow of the stream and not extending more than 50 percent of the width.
- (d) For contaminants other than heat, the 96-hour TLM to indigenous fish and fish food organisms not being exceeded at any point in the mixing zone.
- (e) Mixing zones not exceeding 10 percent of a lake's total surface area.
- (f) Mixing zones not interfering with spawning or nursery areas, migratory routes, nor mouths of tributary streams.
- (g) Mixing zones not overlapping, but where they do, taking measures to prevent adverse synergistic effects.

State

Mixing Zone Narrative

(h) Restricting the pH to values greater than 4.0 s.u. and to values less than 11.0 s.u. at any point in the mixing zone for the protection of indigenous fish and food organisms.

Exemptions. The thermal mixing zone provisions of this chapter are not applicable to municipal waste and water treatment plants, to vessels, or to discharges to enclosed harbors.

Resource Management Exemptions. Application of chemicals for water resource management purposes in accordance with statutory provisions is not subject to the requirements of the standards except in case of water used for public water supply.

Wyoming⁵⁰

Except for Sections 15 (Settleable Solids), 16 (Floating Solids), 17 (Taste, Odor and Color) and 28 (Undesirable Aquatic Life) of these regulations, compliance with Water Quality Standards shall be determined after allowing reasonable time for mixing. Size of the mixing zone shall be determined after consideration of the effect of the discharge on the biological community, water uses and aesthetic conditions, as well as consideration of the flow conditions and physical nature of the receiving water. The portion of a surface water body designated as a mixing zone shall be limited to that which will not interfere with biological communities or populations of important species to a degree which is damaging to the ecosystem and which will not cause substantial damage to other beneficial uses. In addition, there shall be a zone of passage through the mixing zone sufficient to allow passage of free-swimming and drifting organisms in a manner producing no significant effects on their populations, except during periods when stream flows are less than the average of the minimum 7 consecutive day flow which has the probability of occurring once in 10 years.

American Samoa⁵¹

The activities of man will result in the production of a variety of effluents that must be discharged into the waters of the territory for disposal. Although the policy of the EQC is to maximize the quality of all waters in American Samoa, the EQC realizes that for a variety of reasons it will not always be feasible to generate effluents whose quality equals or exceeds that required of the receiving water. Therefore, effluents discharged into waters of certain water quality categories will be allowed an area of initial dilution called a zone of mixing. In the zone or mixing some water quality parameters will be

assigned maximum concentrations that are less stringent than permitted in the waters surrounding the zone of mixing. Areas where zones of mixing will not be allowed and the water quality parameters that can be changed in a zone of mixing are listed in the following criteria and procedures. The criteria and procedures must be complied with to establish a zone of mixing.

A. Criteria:

A zone of mixing can only be granted by the Environmental Quality Commission if the application and the supporting information clearly shows that all or the following conditions have been met:

1. The beginning or continuation of the function or operation involved in a discharge by the granting of the zone of mixing is in the public interest; and
2. The proposed discharge does not substantially endanger human health or safety; and
3. Compliance with the existing water quality standards at the point of discharge would produce serious economic hardships without equal or greater benefit to the public; and
4. Alterations generated by a proposed discharge do not disrupt the marine ecology of the receiving waters outside the zone of mixing; and
5. A zone of mixing shall not be granted for fresh surface waters, Pala Lagoon, Fagatele Bay, that portion of Pago Pago Harbor described in section IV.B.3.c. , or in those waters in Manu'a described in section Iv.C.5 . Those water quality parameters which are subject to zones of mixing are chlorophyll a, light penetration depth, nutrients, pH, temperature, turbidity, and fecal coliform. Furthermore, those water quality parameters which are subject to zones of mixing must conform to alternative within-zone limits determined by the EQC. The zone of mixing is defined in section V.B.4.g . Determination of effluent limits for toxic substances must comply with section VI.A.8,9 ; and
6. The proposed discharges shall be substantially free from visible floating materials, grease, oil, scum, foam and other floating matter attributable to sewage, industrial wastes, or other activities; and

7. The proposed discharge will not result in a lowering of water quality outside the zone of mixing so as to violate the standards of Section VI as they may be applicable.

B. Procedures To Apply For Zone Of Mixing:

1. Every application for a zone of mixing shall be accompanied by a complete and detailed description of present conditions, how present conditions compare to standards, and such other information as the Commission may prescribe.
2. Application for a zone of mixing for an existing discharge must be filed within six months of the effective date of these standards. The EQC will certify a proposed NPDES permit (initial issuance or reissuance) only if conformance with the standards is demonstrated or a zone of mixing approved.
3. Each application for a zone of mixing shall be reviewed in light of the descriptions, statements, plans, histories, and other supporting information as may be submitted upon the request of the EQC and the effect or probable effect on the water quality standards established in Section VI of these standards.
4. A zone of mixing, or a renewal, shall be granted within the requirements of this section for the following time periods and conditions:
 - (a) If a zone of mixing is granted on the grounds that there is no technically and/or financially efficient means known, or available, for the adequate prevention, control, or abatement of the discharge involved, it shall be only until the necessary means of prevention, control, or abatement becomes practicable and it shall be subject to the taking of any substitute or alternative measures that the EQC may prescribe.

No renewal of a zone of mixing granted under this section shall be allowed without a thorough review of known and available means of preventing, controlling or abating the discharge involved.

- (b) The Environmental Quality Commission may permit a zone of mixing for a period not exceeding five years. Any zone of mixing

approval is subject to EPA concurrence.

- (c) Every zone of mixing granted under this section shall include, but not be limited to, grantee requirements to perform effluent and receiving water sampling and testing and to report the results of each test to the Environmental Quality Commission. A program of research to develop practicable alternatives to the methods of treatment or control in use by the grantee may be required as a condition of the zone of mixing.
- (d) Any zone of mixing granted pursuant to this section may be renewed periodically on terms and conditions (for periods not exceeding five years) which would be appropriate for the initial granting of a zone of mixing, provided that:
 - (1) The applicant for renewal has met all of the conditions specified in the previously prescribed zone of mixing; and
 - (2) No renewal shall be granted except on application therefore. Any such application shall be made at least 120 days prior to the expiration of the current zone of mixing permit.
- e. The Environmental Quality Commission on its own motion, or upon the application of any person, shall terminate a zone of mixing if, after a hearing, it is determined that:
 - (1) The water area outside the zone of mixing does not meet the standards applicable to that water as given in section VI; or
 - (2) The zone of mixing granted will unreasonably interfere with any actual or probable use of the water area; or
 - (3) If any NPDES permit condition is not being met and the discharger has failed to take action to bring the effluent into compliance.

Such termination shall be made only after a hearing held by the Environmental Quality Commission in accordance with the

Administrative Procedures Act of the American Samoa Code. Upon such termination, the standards of water quality applicable thereto shall be those established for the water as otherwise classified.

- f. Upon expiration of the period stated in the zone of mixing, the zone of mixing shall automatically terminate and no rights shall be vested to the grantee. If a renewal of a zone of mixing has been applied for as specified in Section V.B.4.d the zone of mixing shall continue until the renewal is approved or denied by the EQC.
- g. Whenever an application is approved, the zone of mixing shall be defined as the initial dilution volume and shall be determined by PLUME or some other EQC approved model. The initial dilution volume is to be the only dispersion zone that will be considered as a zone of mixing. Water quality standards will be strictly enforced in the waters adjacent to the zone of mixing. Requirements for discharge permits shall be determined to assure compliance with the zone of mixing at zero current and worst case receiving water conditions and to assure protection of adjacent waters under other current conditions.

Further, the following will be considered by the EQC in determining whether to grant or deny a zone of mixing:

- (1) Protected uses of the body of water;
 - (2) Existing natural conditions of the receiving water;
 - (3) Character of the effluent;
 - (4) Adequacy of the design of the outfall and diffuser system to achieve the desired dispersion and assimilation in the receiving water; and
 - (5) Other pertinent policies or plans of Territorial agencies.
- h. No part of a shoreline, reef or bottom substrate shall be included in any zone of mixing.

- i. No zone of mixing granted pursuant to this section shall be construed to prevent or limit the application of any emergency provisions or procedures provided by law.

VI. Standards or Water Quality

A. The following standards apply to all fresh surface water, embayments, open coastal water and oceanic waters of the Territory, (2,4,7,8,9,10,11,12 and 13) shall apply as a minimum within the zone of mixing).

1. They shall be substantially free from materials attributable to sewage, industrial wastes, or other activities of man that will produce color, odor, or taste, either of itself or in combinations, or in the biota.
2. They shall be substantially free from visible floating materials, grease, oil, scum, foam, and other floating matter attributable to sewage, industrial wastes, or other activities of man.

District of Columbia⁵²

Mixing zones shall be established for point source discharges of pollutants which immediately threaten the present nearby aquatic community or present or future water uses. The following factors shall be used in establishing mixing zones:

- (a) Permissible size of the zone shall be dependent on an acceptable amount of impact and the size of the receiving water body;
- (b) Mixing zones shall be free from discharged substances that will settle to form objectionable deposits; float to form unsightly masses; or produce objectionable color, odor, or turbidity;
- (c) Mixing zones shall protect aquatic life in shallow areas which serve as nursery areas;
- (d) A mixing zone, or two (2) or more mixing zones, shall not form a barrier to migratory aquatic life;
- (e) As a guideline, the quality for life within a mixing zone shall be such that the acute toxicity for biota significant to the area's aquatic life community is not exceeded;
- (f) The positioning of mixing zones shall be done in a manner that provides the greatest protection to aquatic life and for the various uses of the water; and,

(g) Within the estuary, the maximal dimension of the mixing area shall not exceed ten percent (10%) of the numerical value of the cross-sectional area of the waterway and shall not occupy more than one third (1/3) of the width of the waterway.

Guam⁵³

Mixing Zones in Receiving Waters - Whenever a Water Quality Standard is more restrictive than the corresponding effluent standard then an opportunity may be allowed by the Agency for the mixture of an effluent with its receiving water provided that the zone in which mixing occurs will not adversely affect the designated uses of the receiving waters. If mixing zones are used, Water Quality Standards for a receiving water must be met at every point outside of the boundaries of the designated mixing zone. The following criteria apply to all mixing zones:

1. Whenever mixing zones are allowed, zones of passage, i.e., continuous water routes of the volume, area, and quality necessary to allow passage of free-swimming and drifting organisms with no significant effects produced on their populations, shall be provided.
2. Where two or more mixing zones are in close proximity, they shall be so defined that a continuous zone of passage for aquatic life is available.
3. Biologically important areas, including spawning and nursery areas, shall be protected.
4. No criteria shall be set aside in the mixing zone which shall cause conditions in the mixing zone to be lethal to aquatic life and wildlife which may enter the zone or injurious to human health in the event of a temporary exposure.
5. The area or volume of an individual mixing zone shall be limited to an area or volume that will minimize impacts on users.
6. The discharge shall not violate the basic standards applicable to all waters (Section II A and Section III E) nor shall it unreasonably interfere with any actual or probable use of the water within the mixing zone.
7. For those water quality criteria eligible for a mixing zone, alternate limits will be established if the limits in II B are to be revised in the zone of mixing.

C. Boundaries of Non-thermal Mixing Zones - Non-thermal discharges shall be permitted by the National Pollutant Discharge Elimination System (NPDES) permit process or through the Guam Environmental Protection Agency's local permit program only after careful analysis of the nature of the effluent and a thorough study to assess the consequences of the effluent upon the environment. Mixing zones for non-thermal discharges shall be based on the following models, taking into consideration the criteria in Section III B above.

1. Mixing Zones for Non-Thermal Discharges into Surface Waters - For non-thermal discharges into streams and rivers the mixing zone will be limited to no more than 1/4 of the cross sectional area and/or volume of flow of the stream, leaving at least 3/4 free as a Zone of Passage. The mixing zone shall not extend more than 5 stream widths downstream from the point of discharge. Mixing zones will not be allowed in standing bodies of water.
2. Mixing Zones for Non-Thermal Discharges into Coastal Waters - For non-thermal discharges to coastal waters the mixing zone shall be equal in depth to the depth of the water over the diffuser, in width to twice the depth of the water plus the width of the diffuser, and in length to twice the depth of the water plus the length of the diffuser, with the diffuser geographically centered within the mixing zone.

All discharges to marine waters will comply with the Ocean Discharge Criteria promulgated under Section 403 (c) of the federal Clean Water Act.

D. Mixing Zones for Thermal Discharges - Thermal discharges pertain to effluent water with a temperature component either above or below ambient conditions of the receiving body of water. All thermal discharges, existing or proposed, into receiving bodies of water shall be subject to criteria established in Section 316 (a) of the Federal Water Pollution Control Act (FWPCA), Public Law 95-217. Thermal discharges shall be permitted by the National Pollutant Discharge Elimination System (NPDES) permit process or through the Guam Environmental Protection Agency's local permit program only after careful analysis of the nature of the effluent and a thorough study to assess the consequences of the effluent upon the environment.

1. All Above-Ambient Discharges:

- a) Shall conform to a zone of mixing defined for that particular discharge on a case-by-case basis. This zone of mixing shall be defined by the following references or other references depicting appropriate thermal mixing zone models.

- Water Quality Criteria, March 1973. EPA.
- Quality Criteria for Water, July 1976. EPA.
- Biological Methods for the Assessment of Water Quality. American Society of Testing and Materials, July 1976.

And take into consideration the following criteria:

- Time of exposure
- Concentration of effluent
- Depth of discharge
- Type of environment
- Volume of discharge
- Mass emission rate of critical materials
- Aesthetics and the assessment of damage to biota on the population basis

Although final authority in defining a zone of mixing rests with the GEPA, it is intended that cooperation between the discharger and the Agency will result in the most appropriate zone.

- b) Shall not increase the temperature of the receiving body of water to cause substantial damage or harm to the flora and fauna or interfere with the beneficial uses assigned therein.
- c) Shall comply with all other water quality criteria as defined in these standards, unless specific criteria are established in the discharge permit.
- d) These zones of mixing shall be monitored by the discharger on a regular schedule established by the NPDES Permit and/or GEPA Discharge Permit, to ensure compliance with established criteria.
- e) If the Agency, pursuant to notice and opportunity for public hearings, finds evidence that a discharge has caused

substantial damage, it may require conversion of such discharge to an approved alternative method. In making such a determination, the Agency may consider:

1. The nature and extent of damage to the environment.
2. Projected lifetime of discharge.
3. Adverse economic and environmental impacts, marine and terrestrial, resulting from such conversion
4. All available data, reports, surveys and projects related to the discharge.
5. Such other factors which may prove to be appropriate.

2. **Above-Ambient Discharges in Existence Prior to Approval of These Standards.**

- a) Shall be given special attention when defining a zone of mixing. All criteria established for part D-1 above, shall apply with special emphasis on specific criteria listed in part D-1a.
- b) It is the intent of this section to establish a reasonable zone of mixing for discharges not in compliance with existing laws, codes and practices.
- c) Description of mixing zones for Tanguisson and Piti/Cabras Power Plants.

1. Tanguisson Power Plant Zone of Mixing
The zone of mixing for the Tanguisson Power Plant is defined as, a rectangle of approximately 10,000 m² with the following reference points.

Northern Boundary - North side of intake channel

South Boundary - 1969 ft (600 m) south of intake channel

Eastern Boundary - Shoreline at mean high tide

Western Boundary - 591 ft (180 m)
off-shore or a depth of approximately
23 ft (7m)

2. Piti/Cabras Zone of Mixing

The zone of mixing for the Piti/Cabras Power Plants combined is inclusive of all water in the Commercial Port and Piti Channel area bordered by a line from the GORCO Tanker mooring and the Navy Fuel Pier on Dry Dock Island. Because of the topography of this area, no zone of passage can be designated.

3. Below-Ambient Discharges.

All below-ambient discharges shall follow the same guidelines set down for thermal discharges and be evaluated on a case-by-case basis.

Marianas Islands⁵⁴

The water quality criteria in these regulations shall apply within a mixing zone unless specific alternate criteria are approved by the Chief for specified parameters. The mixing zone, in accordance with Part 4(j), shall be defined by specific linear distance, volume or area, discharge location, maximum flow, and maximum concentrations of important constituents which are determined on a case-by-case basis using the following criteria:

9.1 Mixing zones shall be as small as practicable and shall not be of such size or shape as to cause or contribute to the impairment of water uses. In determining the size and location of the mixing zone for any discharge, the following shall be considered:

- (a) Size of receiving water volume of discharge, streambank or shoreline configuration, the mixing velocities, and other hydrologic and physiographic characteristics;
- (b) Present and anticipated future use of the body of water;
- (c) Present and anticipated future quality of the body of water; and
- (d) The ratio of the maximum flow rate of waste being discharged to the lowest recorded flow rate of the receiving waters.

9.2 An adequate zone of passage shall exist at all times for the movement or drift of aquatic life.

- 9.3 Where two or more mixing zones are in close proximity, they shall be so defined that a continuous zone of passage for aquatic life is available.
- 9.4 Mixing zones shall not intersect any area of the waters in such a manner that the maintenance of aquatic life in the body of water as a whole would be adversely affected.
- 9.5 The discharge shall not violate the basic standards applicable to all water nor shall it unreasonably interfere with any actual or probable use of the waters within the mixing zone.

Puerto Rico⁵⁵

PUERTO RICO MIXING ZONES

5.1 **Requirements for the Authorization of Mixing Zones** - A discharge will be permitted for which a mixing zone has not been defined and authorized by the Board only when the petitioner demonstrates to the satisfaction of the Board that the discharge, undiluted, complies with all the water quality standards (at the discharge sampling point).

5.2 **Natural Background Concentration** - If the petitioner demonstrates to the satisfaction of the Board, through extensive field monitoring and investigations, that the natural background concentration of the receiving waters exceed one or more of the water quality standards set forth for the corresponding classification, the Board may allow the parameters in the discharge to be equal to or less than the natural background values.

5.3 **Mixing Zone Authorization Application** - Each application for a mixing zone shall include the following:

1. Evidence that the project has complied with Article 4-C, Law No. 9 of June 18, 1970, Environmental Public Policy Act, as amended, if the application is related to a new or modified discharge; a new or modified submerged outfall; or a new or modified discharge channel, by the submittal of the corresponding environmental document.
2. Physical, chemical and biological characterization of the discharge and of the

receiving waters at the site in which the background concentration is measured, as specified in the latest version of the "Mixing Zone and Bioassay Guidelines" approved by the Board. This characterization shall include the results of bioassays using organisms approved by the Board and following the methodology described in said guidelines.

3. Existing discharge flow or proposed discharge flow for new or modified discharges.
4. Concentration of each one of the substances or parameters that do not comply with the applicable water quality standards at the point of discharge, after using best practicable technology (BPT), as defined by EPA, for their control.
5. Detailed hydraulic design calculations for the proposed discharge system demonstrating that the best engineering practices (BEP) have been used for obtaining the required dilution in the least possible tridimensional space.
6. Description of each mathematical model utilized to determine the critical initial dilution for open coastal waters and dilution for closed body of waters, used to define the mixing zone and the corresponding calculations, and/or the field studies where the oceanographic data, measurements of the physical/chemical parameters around the existing discharges and the associated ecological studies demonstrate the extension and effects of the mixing zone.
7. Diagram showing the proposed mixing zone and indicating the coordinates of the points that define the boundaries of the mixing zone.
8. Proposed method to validate and calibrate (if necessary) each mathematical model, including a monitoring plan and a Quality Assurance Plan that includes field sampling and laboratory analysis.
9. Proposed method for the maintenance of the discharge system.
10. Discussion of agreements reached with the Board on how the applicable provisions of Article 5 of this Regulation will be compiled.

5.4 General Standards for Granting Interim Authorizations for Mixing Zones - An interim authorization for a mixing zone will be granted when the petitioner has submitted an application in which it is demonstrated, to the satisfaction of the Board, the following:

1. Compliance with Article 4-C, Law No. 9 of June 18, 1970, Environmental Public Policy Act, as amended, when the application is related to a new or modified discharge, new or modified submerged outfall, or a new or modified discharge channel.
2. The proposed discharge system constitutes the best engineering practices (BEP) to minimize the size of the tridimensional space of the mixing zone, maintaining the required dilution.
3. Solids in the discharge will not settle on the bottom of the receiving waters.
4. At the boundaries of the proposed mixing zone, after critical initial dilution for open coastal waters and after dilution for closed bodies of waters each one of the following requirements are met:
 - a. The concentration of pollutants or physical parameters, as defined in Section 5.5, do not exceed the applicable water quality standards.
 - b. The acute toxicity units do not exceed the criteria maximum concentration (CMC).
 - c. The chronic toxicity units do not exceed criteria continuous concentration units (CCC).
 - d. For fresh waters, and in coastal waters where the effluent is not discharged through a high rate diffuser, the CMC shall be reached in the most restrictive of the following conditions:
 1. Ten percent (10%) of the distance from the boundary of the outfall to the mixing zone boundary.
 2. A distance of fifty (50) times the discharge length scale in any spacial direction. This requirement, in the case of multiple ports diffusers, shall be met for each port using the discharge length scale of said port.

3. A distance of five (5) times the local water depth in any horizontal direction from any port discharge.
4. The discharge shall not cause the growth or propagation of organisms that negatively disturb the ecological equilibrium in areas adjacent to the mixing zone.
5. The mixing zone shall be located as to allow, at all times, passageways for the movement or drift of the biota. Also, the passageways shall comply with the following in the specific cases mentioned:
 - a. If the receiving body of water is a closed body of water, estuary, river or creek, the mixing zone shall be located close to the bank itself in such a manner that the passageway permits the adequate and safe flow of free floating, swimming or drifting organisms, or organisms that have self propulsion.
 - b. If the receiving body of water is an estuary, the surface area and volume of passageway shall be at least seventy-five percent (75%) of the corresponding surface area of the volume of the receiving body of water across each segment of the estuary.
 - c. If the receiving body of water is a river or a creek, the surface area and the cross-sectional area of the passageway at the point of discharge and downstream of this point shall be at least sixty-seven percent (67%) of the surface area and the cross-sectional area of each segment of the river or creek.
 - d. If the receiving body of water is a closed body of water, the sum of all mixing zone surface areas shall not exceed twenty percent (20%) of the surface area of the receiving body of water.
6. The mixing zones requested will not overlap with an adjacent mixing zone.
7. The control technology in accordance with Article 6, Section 8, of this Regulation is

being used or proposed.

8. The mixing zones shall be free of debris scum, floating oils, and any substances which produce objectionable odors.
9. Each mathematical model used by the petitioner to define the mixing zones and inputs of said mathematical model were approved by the Board.
10. The mixing zones shall not be located in a recognized fish spawning or aquatic organism nursery area.
11. The mixing zones shall not affect in any manner drinking water supply intakes or water intakes for livestock enterprises located less than one hundred (100) meters upstream, or five (5) kilometers downstream.
12. Except in the case of cooling waters, mixing zone limits in coastal waters shall not be located in such a manner that its boundaries are at a distance less than one (1) kilometer from areas designated as public beaches, or classified as SA, and in every body of water shall be restricted to avoid interferences with the designated uses of the receiving waters.
13. The proposed methodology to calibrate and validate each mathematical model used is acceptable to the Board.
14. The proposed method for maintaining in good working conditions the discharge system is acceptable to the Board.
15. The proposed method for defining the mixing zone boundaries is acceptable to the Board.
16. Each proposed mixing zone complies with applicable requirements set forth in Article 5 of this Regulation.

5.5 **Mixing Zone Boundaries** - The mixing zone boundaries shall be determined according to the procedures described in "Mixing Zone and Bioassays Guidelines" approved by the Board.

5.6 **Additional Standards for Granting Interim Authorization for Mixing Zones** - Interim authorizations for mixing zones shall be granted when

the petitioner demonstrates to the satisfaction of the Board compliance with the requirements set forth in the "Mixing Zone and Bioassay Guidelines", approved by the Board.

5.7 Period to Grant Interim Authorization for Mixing Zones - Within sixty (60) days of the submittal of an approvable application, the Board shall make public their intention to issue or modify the Water Quality Certificate and to define a Mixing Zone Interim Authorization. The effectiveness of said interim or final mixing zone authorization will be when EPA incorporates it in the final NPDES permit of the petitioner.

5.8 Period of Validity of Interim Mixing Zone Authorization - The interim mixing zone authorization shall be valid for a period not to exceed one and a half (1 1/2) years; or until the NPDES permit expires; or a date which the Board determines, based on the data submitted by the petitioner pursuant to Section 5.9 or that the mixing zone(s) cannot be validated, whichever occurs first.

5.9 Calibration and Validation of Mathematical Models Used to Define a Mixing Zone - In the process of obtaining a mixing zone authorization, the petitioner shall submit to the Board information related to the following:

1. Calibration

The petitioner shall calibrate those mathematical models that require calibration as part of the process of granting an interim authorization for a mixing zone.

2. Monitoring Program for Validation

The petitioner shall implement a one (1) year monitoring program to obtain the necessary data required to validate each mathematical model during two (2) seasons (winter and summer).

The monitoring program shall include as a minimum:

a. Continuous flow measurements.

b. Sampling of a frequency to be established by the Board on a case-by-case basis, at the following locations:

1) Effluent.

- 2) Station approved by the Board to determine the background concentration for each one of the substances for which a mixing zone is requested.
 - 3) Stations approved by the Board at the boundaries of each mixing zone.
3. Analysis for all parameters that prompted the mixing zone application and other parameters needed to run each corresponding mathematical model.
 4. Current velocities at a frequency to be established by the Board on a case-by-case basis, if current velocities are an input to the mathematical model used to define the mixing zone.
 5. Show that the model passes the validation test. This shall be done by means of a comparative analysis between the obtained values in the sampling program, against the values indicated by the model for corresponding points throughout the periphery of the mixing zone. The model whose calculated limits are equal to or less than the ones obtained through the sampling program shall be validated. Since the field data are affected by variations in water currents, tides, etc., which vary as a function of time, the referred comparison shall be done considering the data obtained in real time or as close to it as possible.
- 5.10 Standards for Granting Final Mixing Zones Authorizations - A final mixing zone authorization will be issued if the mathematical model is validated as established in Section 5.9 of this Regulation.
- 5.11 Period of Validity of Final Authorization of Mixing Zone - A final authorization of a mixing zone shall be valid for a period not to exceed five (5) years, but in no case will it exceed the expiration date of the NPDES permit.
- 5.12 Renewal of Mixing Zone Authorizations - At least one hundred and eighty (180) days prior to the expiration date of a final mixing zone, the person to whom the authorization was issued, shall submit a complete application for the renewal of the mixing zone authorization. The renewal application shall contain the information that has changed with respect to the information previously submitted in compliance with the specifications of Section 5.3, and a

certification indicating that the remainder of the information has not changed.

5.13 Revocation of Interim and Final Authorizations of Mixing Zones - The Board may revoke an interim or final authorization of a mixing zone for the following reasons:

1. The mathematical model used to define the mixing zone was not validated. The Board, upon request by the petitioner, can approve a Compliance Plan in which corrective actions are committed to take place within the shortest time possible to obtain the necessary validation. The Board can maintain in force the Interim Authorization while the conditions incorporated in the mentioned plan are executed.
2. The petitioner's failure to fully disclose all relevant facts in the authorization application or renewal, or the petitioner's misrepresentation of any relevant facts during the mixing zone evaluation or during the validation process.
3. Non-compliance with any applicable provision in article 5 of this Regulation.
4. Changes in the conditions under which the mixing zone was approved, including, but not limited to, discharge flow, effluent characteristics, and the discharge system, as originally approved by the Board.
5. There is an imminent threat to human health or the environment.

5.14 Procedures for Revoking Mixing Zone Authorizations - If there are reasons to revoke a mixing zone authorization as specified in Section 5.11, the Board shall notify the person to whom the authorization was granted indicating the intention of revoking the authorization by means of a Show Cause Order. The procedures to follow are those specified in EQB's Internal Regulations for Administrative Hearings. Notwithstanding the foregoing, the Board may immediately revoke a mixing zone authorization without previous notice, nor the opportunity of hearings if there is an imminent threat to human health or the environment.

5.15 Ocean Outfall and Diffuser Requirements - The ocean outfalls and the diffusers shall be designed, constructed and operated in accordance to best engineering practices. When the proposed discharge

State

Mixing Zone Narrative

system incorporates said technology, the petitioner shall include in the mixing zone application, information regarding the following:

1. Length and diameter of the diffuser.
2. Number, diameter and the diffuser ports distribution.
3. Maximum and minimum exit velocities in the diffuser ports.
4. Measures to avoid the intrusion of surrounding waters within the diffuser.
5. The Froude number used for the design of the ports.
6. Outfall diameter and average value of the transversal area that will be full under normal operating conditions.
7. Minimum and maximum design velocities for the outfall flow.
8. Any other design detail that could contribute to optimize the discharge's fast dilution.

5.16 **Compliance Plans** - As requested by the petitioner, the Board may consider and approve Compliance Plans for existing discharges that do not comply with the requirements specified in this Regulation. Such plans shall indicate the way in which those discharges will be made to comply, using the best engineering practices and within the shortest period of time, which will not exceed the NPDES permit expiration date, but under no circumstances should exceed more than three (3) years.

Trust Territory⁵⁶

(1) **General** - The water quality criteria in Part 6(B) shall apply within a mixing zone unless specific alternative criteria have been approved by the Board and concurred upon by the U.S. Environmental Protection Agency. Mixing zones will not be granted in lieu of reasonable control measures to reduce point source pollutant discharges but will be granted to compliment the application of reasonable controls.

(2) **New Discharges** - All new point source discharges beginning after the effective date of these regulations shall apply to the Board for a zone of mixing on forms supplied by the Board, unless it can be demonstrated that the point of discharge will meet

Mixing Zone Narrative

the applicable water quality standards at the point of discharge. It shall be a violation of these standards for any person to commence discharging from a new point source without either obtaining a valid mixing zone from the Board or demonstrating to the Board's satisfaction that a mixing zone is not required.

Any application for a zone of mixing must contain the following:

- (a) Evidence that a NPDES permit has been applied for and will be obtained.
- (b) A description of the waste to be discharged including flow rate and pollutant types and quantities.
- (c) The location of the discharge and a description of the disposal methods (e.g., outfall size, number and type of diffusers, etc.).
- (d) Evidence that the concentration of toxic substances present in the discharge will not violate water quality standards for toxic substances.
- (e) Identification of those substances for which the mixing zone is required.
- (f) Either:
 - i. A certification for each substance identified in (e) above, that after initial mixing, the concentration of the substance will not exceed the applicable water quality standard. The following equation shall be used to calculate concentration after initial dilution:

$$C_f = \frac{C_e + C_b (D_I)}{D_I + 1}$$

Cf = Concentration after mixing

Ce = Effluent concentration (instantaneous maximum)

Cb = Background concentration

DI = Dilution ratio

- ii. A description of the shape, size, volume and other physical characteristics of the mixing

zone required for each pollutant in the discharge so that the applicable water quality standards will be achieved at the boundary of the zone. The mixing zone shall be defined under those conditions of tide, wind, runoff, density stratification and discharge that would require the largest zone of mixing.

iii. Method (i) above should be used over method (ii) whenever possible.

(g) Evidence that the basic water quality standards (Part 6(a)) will not be violated within the mixing zone.

(h) A proposed schedule of effluent and receiving water monitoring to determine compliance with the proposed mixing zone.

(3) Existing Discharges - All existing point source discharges must apply to the Board for a mixing zone or demonstrate that one is not required within eighteen (18) months of the effective date of these standards. The application procedure is identical to the one for new sources.

(4) It shall be in violation of these standards for any person to knowingly present false or misleading information to the Board in an application for a mixing zone.

(5) Determination by the Board

(a) Review of Application

In reviewing a mixing zone application, the Board will consider:

- i. Present and anticipated uses of the water body.
- ii. Whether an adequate zone of passage will exist for the movement of aquatic life.
- iii. The proximity of other mixing zones.
- iv. Whether the granting of a mixing zone is in the public interest.

The Board may request additional information from the applicant that is deemed relevant to the Board's determination.

State

Mixing Zone Narrative

(b) Issuance of Mixing Zone

The Board may either approve, conditionally approve or disapprove a mixing zone application after conducting a public hearing on the application. The Board will notify the applicant in writing of its determination after receiving EPA concurrence. The notification will include, but is not limited to:

- i. The duration of the mixing zone.
- ii. Any conditions placed upon the Board's approval of the application. Conditions may include:
 - (a) Effluent and receiving water monitoring and reporting requirements.
 - (b) A timetable for the reduction or elimination of the discharge.
- iii. The parameters for which the mixing zone is being granted and the alternative criteria that will apply within the mixing zone.

If the Board disapproves a mixing zone application, it will notify the applicant of the reasons for the disapproval.

Virgin Islands⁵⁷

The need, location, size and depth of the mixing zones in surface waters and estuaries shall be established according to the following mixing zone criteria and boundaries.

(a) Mixing Zone Criteria:

1. Mixing zones shall be provided solely of mixing. Mixing must be accomplished as quickly as possible through the use of devices which insure that the waste is mixed with the allocated dilution water in the smallest practicable area.
2. For the protection of aquatic life resources, the mixing zones, must not be used for or be considered as, a substitute for waste treatment facilities.
3. At the boundary of the mixing zone the water should comply with all the water quality standards set forth for its classification. If, after complete mixing with the available dilution water, these requirements are not met, the

Mixing Zone Narrative

effluent must be adequately pretreated until standards are met.

4. No conditions shall be permitted to exist within the mixing zone, (A) that are rapidly lethal (i.e. exceed the 96-hour median tolerance limit) to locally important and desirable indigenous aquatic life, (B) that prohibit planktonic organisms from being carried through the mixing zone. These organisms will be exposed to its conditions only for the period of time required to drift through the mixing zone and will survive without undue damage or stress while they are passing through.
5. Maximum vertical dispersion of waste water discharge flow shall be provided for in the mixing zone.
6. Mixing zones shall not intersect spawning or nursery areas, migratory routes, water intakes or mouths of rivers.
7. Suspended solids in waste waters being discharged shall not settle in measurable amounts in the mixing zones.

(b) Mixing Zone Boundaries:

1. The mixing zone must be located in such manner as to allow at all times, passageways for the movement on drift of the biota (pelagic or invertebrate organisms). The width of the mixing zone and the volume of flow in it shall depend on and will be determined by the nature of the water current and/or the estuary. The area, depth, and volume of the flow must be sufficient to provide a usable and desirable passageway for fish and other aquatic organisms.
2. The passageway must contain at least 75 percent of the cross sectional area and/or volume of flow of the estuary, and should extend to at least 50% of the width.
3. A mixing zone shall not overlap with an adjacent mixing zone.