

TD223.U6
M59
1980

United States
Environmental Protection
Agency

Office of Water
Regulations and Standards
Washington, D.C. 20460

July 1980

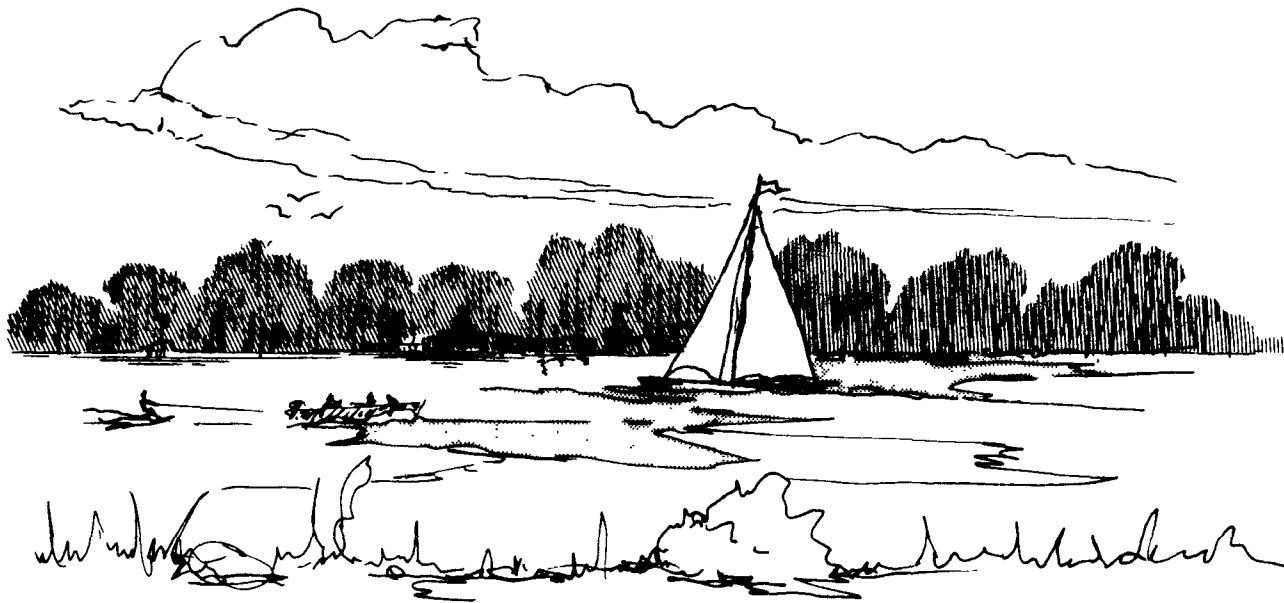
Water

TD223U 6M59



Mixing Zones

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



MIXING ZONES

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

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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.

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

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 wastes 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 in 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 1976 QCW recommends the following consideration to be included in State water quality standards mixing zone policy:

In essence, the positioning of mixing zones should be accomplished in a manner that will provide the greatest protection to aquatic life and for the various uses of water. Generally, shoreline and surface areas for waste admixture should be discouraged in preference to deep water, offshore designations. The relative social and ecological values of the aquatic life that may inhabit a particular waterway area should be given due consideration in zone definition. The designation of particular mixing zones is a task that should follow the biological, physical, and chemical appraisal of the receiving waterway.

Since water quality standards experience revisions and upgrading from time to time, following procedures set forth in the Clean Water Act, individual entries in this digest may be superseded. As these revisions are accomplished and allowing for the States to revise their standards accordingly, this digest will be updated and reissued. Because this publication is not intended for use other than as a general information resource, to obtain the latest information and for special purposes and applications, the reader needs to refer to the current approved water quality standards. These can be obtained from the State water pollution control agencies or the EPA or Regional Offices.

Individual State-adopted criteria follow:

ALABAMA

The reasonableness of the opportunity for the mixture of wastes and receiving waters shall be judged on the basis of the physical characteristics of the stream and approval by the Commission. Mixing zones shall not preclude passage of free-swimming and drifting aquatic organisms to the extent that their populations are significantly affected.

ALASKA

- (a) In applying the water quality criteria of sec. 20 of this chapter to surface waters, the department will, in its discretion, prescribe in wastewater disposal permits a volume of dilution for the effluent within the receiving water. Water quality standards shall be met at every point outside its boundaries. The department will disallow mixing zones in instances where the substance discharged is bioaccumulative in food chains, concentrates in sediments, is persistent, carcinogenic, mutagenic or teratogenic, or if the potential ecological or human health effects are so potentially adverse that a mixing zone is not appropriate.
- (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 for any surface water receiving a wastewater discharge, 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 the permit application under 18 AAC 15.010(a)(9) or 130 or 180, 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 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.

ARIZONA

No reference to mixing zones.

ARKANSAS

(b) Mixing Zones - 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, no single-value recommendation can 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.

CALIFORNIA

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 nonbuoyant 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.

COLORADO

- (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 LC50

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.

CONNECTICUT

Cognizance may be given to reasonable time and distance to allow mixing of effluent and receiving waters. Such instances shall not affect the water usage class adopted but shall be defined and controlled as appropriate by the Commissioner.

- (a) Wherever mixing zones are allowed, zones of passage, e.g., 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.
- (b) Because of varying local, physical and chemical conditions and biological phenomena, no single value can be given 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.
- (c) As a guideline, mixing zones should be limited to no more than 1/4 of the cross-sectional area and/or volume of flow, leaving at least 3/4 free as a zone passage.
- (d) Total area and/or volume assigned to mixing zones shall be limited to that which will: (1) not interfere with biological communities or populations of important species to a degree which is damaging to the ecosystems; (2) not diminish other beneficial uses disproportionately.

DELAWARE

Section 4 - Conditions/Exceptions

Where water quality standards are found to be unattainable, exceptions may apply:

1. In the discretion of the Department, water quality standards may not be required to be achieved in transition zones which may exist between adjacent zones of water quality.
2. In the discretion of the Department, water quality standards may not be required to be achieved in mixing zones.
3. Water quality standards for segments may be unattainable because of naturally occurring phenomena. In such cases, standards will be evaluated and modified by the Department as it deems appropriate.

Section 5 - Requirements for Mixing Zones

The following requirements shall apply to mixing zones.

1. Location: Mixing zones shall not be located in biologically important areas, including but not limited to nursery areas for aquatic life and water fowl. The stream or river channel is not to be included in any mixing zone in order to allow for the passage of anadromous fish.
2. Size: Any mixing zone shall not utilize more than approximately one-third of the receiving stream's width, and 10% of the area if the receiving water is a lake or estuarine stream.
3. Shape: "Shore hugging" plumes shall be designed to provide maximum protection to humans, aquatic life and wildlife.
4. Outfall Design: Outfalls shall be designed to provide maximum protection to humans, aquatic life and wildlife.
5. In Zone Quality: Waters in the mixing zone shall be free of the following:
 - (a) materials in concentrations that exceed 96-hour LC50 for biota significant to the indigenous (and anadromous) aquatic and marine community;
 - (b) Materials in concentrations that settle to form objectionable deposits, or smother or otherwise harm bottom dwelling aquatic and marine life or their habitats downstream from the mixing zone proper;
 - (c) Floating debris, oil, scum, and other matter in concentrations that constitute a nuisance;

- (d) Substances in concentrations that produce objectionable color, odor, taste or turbidity and,
 - (e) Substances in concentrations which produce undesirable aquatic or marine life or more nuisance species.
6. Heat dissipation areas shall not be longer than 3,500 feet, or twenty times the average width of the stream, whichever is less, measured from where the waste discharge enters the stream. In tidal streams, except for the Delaware River and Bay, the most restrictive length as determined herein shall be applied both upstream and downstream as measured from the point of discharge.
 7. Within any one heat dissipation area, only one shore shall be used in determining the limits of the area. The determination in estuarine waters shall take into special consideration the extent and nature of such water so as to meet the extent and purpose of the criteria and standards in order to provide for the passage of free-swimming and drifting organisms so that negligible or no effects are produced on their populations. Except for the Delaware River and Bay, at least 66% of the stream width, as measured at the extreme width of the heat dissipation area, shall remain free as a zone of passage for aquatic biota.

DISTRICT OF COLUMBIA

1. The positioning of mixing zones should be done in a manner that provides the greatest protection to aquatic life and for the various uses of water,
2. Within an estuary, the minimal dimension of the mixing area should not exceed 10% of the cross-sectional area of the waterway.

In addition to the inclusion of these mixing zone guidelines, the District of Columbia Water Quality Standards should specify that mixing zones are to be established for major discharges of pollutants which immediately threaten the nearby aquatic community or other expected water uses.

It is recommended that the District of Columbia adopt the guidelines for determining mixing zones, contained in the EPA Continuing Planning Process Guidelines, Section 5.5. These guidelines are as follows:

1. Permissible size of the zone is dependent on acceptable amount of damage and size of receiving water body;

2. Zone should be free from effluent substances that will settle to form objectionable color, odor or turbidity,
3. Zone should protect aquatic life in shallow areas which serve as nursery areas;
4. Number of mixing zones within a stream reach or impoundment should be limited to maintain a mixing zone to water body ratio;
5. Mixing zones should not form barriers to migratory aquatic life;
6. As a guideline, the quality for life within a mixing zone should be such that the 96-hour LC50 for biota significant to the area's aquatic life community is not exceeded.

FLORIDA

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) 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 water including any possible synergistic effects with other pollutants or nuisances 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 water: of Classes I, II, and III. However, an applicant for a specified mixing zone who affirmatively demonstrates in a public hearing, pursuant to Chapter 120, Florida Statutes, and after public notice in the Florida Administrative Weekly and in a newspaper of general circulation in the area where the mixing zone is proposed, 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 these 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, 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 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 longer than that necessary to meet water quality standards.
- (g) In lakes, estuaries, bays, lagoons, bayous and sounds, the area of a 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 that necessary to meet water quality standards.

- (h) 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.
 - (i) Additional standards which apply within mixing zones in Class I-A, II, and III waters are as follows:
 - (1) The dissolved oxygen within a mixing zone shall not average less than 4.0 milligrams per litre (mg/l) in the mixing zone volumes:
 - (2) The turbidity within the mixing zone shall not average greater than 75 Jackson Units in the mixing zone volume above natural background as related to a standards candle turbidimeter.
 - (j) Mixing zones in Class IV and V-A waters are subject only to provisions of (d) above and of Section 17-3.051 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 removed, 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 respecified by permits; 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. 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. In determining compliances with the provisions of 17-3.051(1), the average concentration of the waters in the mixing zone shall be measured or computed using scientific techniques approved by the Department; provided that, in no event shall the maximum concentration of

wastes in the mixing zone exceed the amount lethal to 50% of the test organisms in 36 hours (36 hr. LC50) for a species significant to the indigenous aquatic community. The dissolved oxygen value within a mixing zone shall not be less than 1.5 milligrams (mg/l) at any time or place.

5. Except for the minimum conditions of waters as specified in Section 17-3.051 and the provisions of Section 17-4.244, 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. 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 these 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, FAC 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 the mixing zone requirements of subsection 17-4.244(1) and the provisions relating to dissolved oxygen in subsection 17-4.244(4).
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 paragraph 17-4.244(1)(c) and 17-4.244(7)(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.

GEORGIA

Effluents 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.

HAWAII

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 necessary.

It is the objective of this limited zone to provide for a current realistic means of control over such discharges and at the same time, achieve the highest attainable level of water quality.

Establishment, Renewal, and Termination:

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.

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.

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 effect on the receiving water.

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.

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

- (1) 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
- (2) The discharge occurring or proposed to occur does not substantially endanger human health or safety; and
- (3) 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
- (4) 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.

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:

- (1) 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.
- (2) The Director of Health may issue a zone of mixing for a period not exceeding five years.
- (3) 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.

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.

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.

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

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 the Hawaii Administrative Procedure Act 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.

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.

IDAHO

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:
 - (1) 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 water at that point;
 - (2) The width of a mixing zone is not to exceed twenty-five percent (25%) of the stream width or three hundred (300) meters plus the horizontal length of the diffuser as measured perpendicular to the stream flow, whichever is less;
 - (3) 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,
 - (4) 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:
 - (1) The total horizontal area allocated to mixing zones is not to exceed ten percent (10%) of the surface area of the lake,

- (2) 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 Manual 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 Manual Sections 1-2200.01 "Hazardous Materials" and 1-2200.02 "deleterious Material", as well as from Manual 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.

ILLINOIS

201 Mixing Zones

- (a) In the application of any of the rules and regulations in 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 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.

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.
- (b) 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.

INDIANA

Sec. 4

(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 water effluents with the receiving water.

(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 ratio;
- (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 or 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.

Section 6. Water Quality Standards

(Minimum Water Quality Conditions) All waters at all times and at all places, including the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil or scum attributable to municipal, industrial, agricultural, and other land use practices or other discharges:

- (1) That will settle to form putrescent or otherwise objectionable deposits;
- (2) That are in amount sufficient to be unsightly or deleterious,
- (3) That produce color, odor or other conditions in such degree as to create a nuisance;
- (4) Which are in amount sufficient to injure, be toxic to or produce adverse physiological responses in humans, animals, aquatic life or plants. As a guideline, toxic substances should be limited to the 96-hour median lethal concentration (LC50) for biota significant to the indigenous aquatic community. This subsection shall not apply to the chemical control of aquatic plants or animals when that control is subject to approval by the Indiana Department of Natural Resource as provided by the Fish and Wildlife Act (IC 1971, 14-2-1); and
- (5) Which are in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae in such a degree as to create a nuisance, be unsightly or deleterious or be harmful to human, animal, plant, or aquatic life or otherwise impair the designated uses.

Lake Michigan and Contiguous Harbor Areas (temperature standards contain additional requirements for thermal plumes)

Section 5. (Mixing Zones) The mixing zone shall be considered a place where waste and receiving waters mix and not as a place where effluents are treated. All mixing zones will be determined on a case-by-case basis by the Indiana Stream Pollution Control Board after consideration of the following:

- (a) The dilution ratio;
- (b) The physical, chemical, and biological characteristics of the receiving body of water,
- (c) The physical, chemical, and biological characteristics of the waste effluent;

- (d) The present and anticipated uses of the receiving body of water,
- (e) The existence of and impact upon any spawning nursery areas of any indigenous aquatic species, and
- (f) The synergistic effects of overlapping mixing zones or the aggregate effects of adjacent mixing zones.

Section 4. (Water Quality Standards)

(Minimum Water Quality Conditions) All waters of Lake Michigan and the contiguous harbor areas at all times and at all places, including the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges:

- (1) That will settle to form putrescent or otherwise objectionable deposits,
- (2) That are in amount sufficient to be unsightly or deleterious,
- (3) That produce color, odor, or other conditions in such degree as to create a nuisance;
- (4) Which are in amounts sufficient to injure, be toxic to or produce adverse physiological responses in humans, animals, aquatic life, or plants. As a guideline, toxic substances should be limited to the 96-hour median lethal concentration (LC50) for biota significant to the indigenous aquatic community. This subsection shall not apply to the chemical control of aquatic plants or animals when that control is subject to the approval of the Indiana Department of Natural Resources as provided by the Fish and Wildlife Act (IC 14-2-1), and
- (5) Which are in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae in such a degree to create a nuisance, be unsightly or deleterious or be harmful to humans, animals, plant or aquatic life or otherwise impair the designated uses.

Grand Calumet River and Indiana Harbor Ship Canal

Section 4. (Mixing Zones)

- (a) All water quality standards in this Regulation, except those provided in subsection 5(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 ratio,
 - (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 and 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 shall it extend over 1/2 (50 percent) of the width of the stream.

Section 5. (Water Quality Standards)

(Minimum Water Quality Conditions) All waters at all times and at all places, including the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil or scum attributable to municipal, industrial, agricultural, and other land use practices or other discharges:

- (1) That will settle to form putrescent or otherwise objectionable deposits;
- (2) That are in amounts sufficient to be unsightly or deleterious;
- (3) That produce color, odor, or other conditions in such degree as to create a nuisance;
- (4) Which are in amount that will be toxic or harmful to human, animal, plant or aquatic life; and
- (5) Which are in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae in such a degree as to create a nuisance, be unsightly or deleterious or be harmful to human, animal, plant, or aquatic life or otherwise impair the designated uses.

Wolf Lake

Section 5. (Mixing Zone) The mixing zone shall be considered a place where waste and receiving waters mix and not as a place where effluents are treated. All mixing zones will be determined on a case-by-case basis by the Indiana Stream Pollution Control Board after consideration of the following:

- (a) The dilution ratio;
- (b) The physical, chemical, and biological characteristics of the receiving body of water;
- (c) The physical, chemical, and biological characteristics of the waste effluent;
- (d) The present and anticipated uses of the receiving body of water;
- (e) The existence of and impact upon any spawning or nursery areas of any indigenous aquatic species; and

- (f) The synergistic effects of overlapping mixing zones or the aggregate effects of adjacent mixing zones.

Section 4. Water Quality Standards

(Minimum Water Quality Conditions) All waters at all time and at all places, including the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil or scum attributable to municipal, industrial, agricultural, and other land use practices or other discharges:

- (1) That will settle to form putrescent or otherwise objectionable deposits;
- (2) That are in amounts sufficient to be unsightly or deleterious;
- (3) That produce color, odor, or other conditions in such degree as to create a nuisance;
- (4) Which are in amounts sufficient to injure, be toxic to or produce adverse physiological responses in humans, animals, aquatic life or plants. As a guideline, toxic substances should be limited to the 96-hour median lethal concentration (LC50) for biota significant to the indigenous aquatic community. This subsection shall not apply to the chemical control of aquatic plants or animals when that control is subject to approval by the Indiana Department of Natural Resource as provided by the Fish and Wildlife Act (IC 14-2-1), and
- (5) Which are in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae in such a degree as to create a nuisance, be unsightly or deleterious or be harmful to human, animal, plant, or aquatic life or otherwise impair the designated uses.
- (6) Which are in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae in such a degree as to create a nuisance, be unsightly or deleterious or be harmful to human, animal, plant, or aquatic life or otherwise impair the designated uses.

IOWA

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.
- 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.

KANSAS

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: 1) not interfere with biological communities or populations of important species to a degree which is damaging to the ecosystem, and 2) not diminish other beneficial uses disproportionately.

(Zones of Passage)

Zones of passage shall be provided in streams, reservoirs, or lakes wherever mixing zones are allowed, and 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 significant effects on their populations. Because of varying local physical and chemical conditions and biological phenomena, no single value can be given on the percentage of the receiving water area and/or volume necessary to allow a sufficient zone of passage. Ordinarily, mixing zones shall be limited to no more than 1/4 of the cross-sectional area and/or volume of flow of a stream or reservoir, leaving at least 3/4 free as a zone of passage.

KENTUCKY

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.

Section 1. Mixing Zones. The following guidelines are applicable in determining all mixing zones:

(1) The department 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) The mixing zone shall be free from pollutants which are in excess of 0.44 times the 96 hour LC₅₀ for a representative indigenous aquatic organism.

(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.

(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.

LOUISIANA

Mixing Zones

The total area and/or volume of a stream assigned to mixing zones will be limited to that which will: (1) not interfere with biological communities or populations of important species to a degree which is damaging to the ecosystem, (2) not diminish other beneficial uses disproportionately.

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 river (or stream) 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 and except when otherwise specified by the Louisiana Stream Control Commission in a valid waste discharge permit the mixing zone will be limited to no more than 1/4 of the cross-sectional area and/or volume of flow of stream or estuary, leaving at least 3/4 free as a zone of passage.

MAINE

Zone of Passage:

All discharges of pollutants shall, at a minimum, provide for a zone of passage for free-swimming and drifting organisms. Such zone of passage shall not be less than 3/4 of the cross-sectional area at any point in the receiving body of water. Such zone of passage may be reduced whenever the applicant for a discharge can demonstrate that (a) because of physical phenomena in the receiving body of water such minimum zone cannot be maintained and (b) such minimum zone of passage is not necessary to protect organisms in the receiving body.

MARYLAND

- A. Mixing zones are areas which are allowed for mixing of effluent waters with the receiving water. They have defined and identifiable limits, and the waters outside of the zones must meet the standards for that particular body of water.
- B. The Administration will establish the limits of a mixing zone, in terms of the Total area and/or volume of the receiving waters, so that: (a) there is no interference with biological communities or populations of important species to a degree which is damaging to the aquatic life or ecosystem; and (b) there is no diminishing of other legitimate beneficial uses.

MASSACHUSETTS

Regulation 2.2 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.

MICHIGAN

R 323.1082. Mixing Zones.

Rule 1082. (1) A mixing zone to achieve a mixture of a point source discharge with the receiving waters shall be considered a region in which organism response 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 toxic substance 96 hour TL_m for important species of fish or fishfood organisms shall not exceed 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 at any transect of a stream shall contain not more than 25% of the cross-section area or volume of flow of the stream or both unless it can be demonstrated to the commission that designation of a greater area or volume of streamflow will allow passage of fish and fishfood organisms so that effects on their immediate and future populations are negligible or not measurable. Watercourses or portions thereof which, without one of more point source discharges, would have no flow except during periods of surface runoff may be considered as a mixing zone for a point source discharge. For Lake Michigan, mixing zones shall not exceed a defined area equivalent to that of a circle of radius of 1,000 feet unless the discharger can demonstrate to the commission that the defined area for a thermal discharge is more stringent than necessary to assure the protection and propagation of a balanced indigenous population of aquatic life and wildlife in the receiving water.

MINNESOTA

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 diverse synergistic effects.

MISSISSIPPI

It is recognized that limited areas of mixing are unavoidable; however, mixing zones will not be used for, or considered as a substitute for waste treatment. Mixing zone limits will be defined by the Commission on a case-by-case basis. In all cases mixing zones will be restricted to as small an area as feasible. Adequate zones of passage for migration and free movement of fish and other aquatic biota will be maintained. Where there are several mixing zones close together, they will all be on the same side so that the passageway is continuous.

Also, mixing zones will not interfere with the established community of aquatic organisms nor adversely affect recreational uses of an area. Any mixing zone shall be free from materials in concentrations that exceed the 96-hour LC50 for biota significant to the indigenous aquatic community and shall comply with the general provisions of Section I and II of these standards.

MISSOURI

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. Bioaccumulative and persistent toxic substances are not exempted in mixing zones. 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. As a guideline for design of outfalls, no more than 25% of the cross-sectional area or volume of a stream shall be allowed as a mixing zone. However, plumes that do not allow for rapid mixing are not acceptable.

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

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

4. Zones of passage must be provided wherever mixing zones are allowed, where and when necessary to protect aquatic life. Because of varying local physical and chemical conditions and biological phenomena, no single value can be given on the percentage of river width necessary to allow passage of free-swimming and drifting organisms, so that negligible effects are produced on their populations. 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.

MONTANA

Existing discharges to state waters will be entitled a mixing zone as determined by the department. "Mixing zone" means that volume of state water wherein any pollutant may exceed allowable water quality standards.

NEBRASKA

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 as full body contact. 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 in such a manner that will not affect the assigned beneficial uses.

- (i) 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.
- (ii) The mixing zone should allow for a continuous zone of passage.
- (iii) The mixing zone shall not overlap with any other mixing zones in such a manner that the maintenance of beneficial uses in the body of water, as a whole, would be adversely affected.

NEW JERSEY

The total area and/or volume of a body of water assigned to non-thermal mixing areas 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 not diminish other beneficial uses disproportionately. Water quality criteria are intended to apply outside of designated non-thermal mixing areas.

In river systems, reservoirs, lakes, estuaries and coastal waters, zones of passage are considered to be 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 of passage must be provided wherever non-thermal mixing areas are allowed.

Heat Dissipation Area Determinations - The determination of heat dissipation areas shall take into special consideration the extent and nature of the receiving waters so as to meet the intent and purpose of the criteria and standards including provision for the passage of free-swimming and drifting organisms so that negligible or no effects are produced on their populations.

As a guideline, heat dissipation areas shall 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

including a minimum of 1/3 the surface measured from shore to shore at any flow.

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

NEW HAMPSHIRE

A heated discharge to a lake shall not raise the temperature more than 3 degrees F at the surface immediately outside a designated mixing zone.

The water temperature at the surface of an estuary shall not be raised to more than 90°F at any point, provided further, at least 50 percent of the cross-sectional area and/or volume of the flow of the estuary including a minimum of 1/3 of the surface as measured from water edge to water edge at any stage of tide, shall not be raised to more than 4°F over the temperature that existed before the addition of heat of artificial origin or a maximum of 83°F, whichever is less.

However, during July through September, if the water temperature at the surface of an estuary before the addition of heat of artificial origin is more than 83°F, an increase in temperature not to exceed 1.5°F, at any point of the estuarine passageway as delineated above, may be permitted.

New Hampshire had also adopted verbatim the entire criteria pertaining to temperature and zones of passage contained in Section 3 of the National Technical Advisory Report on Water Quality Criteria, dated April 1, 1968. This report makes recommendations regarding mixing zones and zones of passage on page 31.

The New Hampshire Water Pollution Commission may consider mixing zones, except as otherwise provided in these water quality standards or by statutes, 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 MEXICO

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 YORK

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 not apply to all waters of the State receiving thermal discharges, except as provided in section 704.6 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 or 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. At least 50 percent of the cross-sectional area and/or volume of the flow of water including a minimum of one-third of the surface as measured from water edge to water edge at any stage of tide (if tidal) shall not exceed designated temperature standards.

NEVADA

1. Zones of mixing for the assimilation of municipal, agricultural, and industrial discharges from point sources which have received the best degree of treatment or control practicable under existing technology are recognized as necessary. It is the objective of this limited zone to provide for a current realistic means of control over such discharges and at the same time achieve the highest attainable level of water quality.

2. Every application for a zone of mixing shall be made to the Director and shall be accompanied by a complete and detailed description of the present physical, chemical, biological, and radiological conditions of the receiving waters and of the proposed zone of mixing, and a demonstration that no appreciable harm to beneficial uses, either designated or actual, will result from the proposed zone of mixing, and such other information as the Director may prescribe. Applications shall identify, by discharge, the individual water quality parameters for which the zone of mixing is requested.

The applications for a zone of mixing shall be submitted along with an application for a discharge permit or a request for modification of a discharge permit.

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 request of the Director. The review shall result in a determination by the Director concerning the appropriateness of a zone of mixing for each water quality parameter, by discharge identified in the application.

4. The zone of mixing shall be established by the Director such that the water quality standards for individual parameters determined to be appropriate pursuant to Article 4.1.2.h.3 for the receiving water, but in no case including aesthetic and acute toxicity values, may be relaxed within the zone of mixing. In determining the size of a zone of mixing, each application will be reviewed on a case-by-case basis taking into consideration the quality of the effluent or wastewater discharged and the nature and condition of the receiving water including the effects of the effluent or wastewater on the designated or actual beneficial uses of the receiving water.

5. Zones of mixing shall not be granted by the Director:

a. unless the applicant and supporting information clearly demonstrates that the discharge occurring or proposed to occur does not substantially endanger human health or safety; and

b. unless the applicant and supporting information clearly demonstrate that the discharge occurring or proposed to occur will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on that body of water; and

c. Unless the Regional Administrator concurs in writing with the proposed zone of mixing.

6. Streams-mixing zones in which the water quality standards may be exceeded, shall be a maximum of $\frac{1}{3}$ of the cross-sectional area of the receiving water, allowing a minimum of a continuous $\frac{2}{3}$ of the receiving water as a zone of passage. The allowable stream-mixing zone shall be oriented in the stream in a manner which maximizes the effectiveness of the zone of passage.

7. Any zone of mixing granted pursuant to this section may be granted or renewed for periods not exceeding five years. Applications for renewal shall be made prior to the expiration of the zone of mixing. Applications for renewal of a zone of mixing may be granted by the Director provided that the applicant for renewal had met all of the conditions specified in the immediately preceding zone of mixing, granted pursuant to this Article; 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 emission than that attained pursuant to the terms of the immediately preceding zone of mixing at its expiration.

8. Unless an application for renewal of a zone of mixing has been made, the zone of mixing shall automatically terminate at the expiration of the period in the designation and no rights shall become vested in the designee.

9. A separate permit will not be issued for mixing zones. All requirements and authorizations shall be part of a discharge permit issued or reissued pursuant to Article 2. The fact sheet required by section 4.3 of the Procedural Regulations for Administration of Discharge Permits shall contain a summary of the data from which the zone of mixing was determined.

10. The Director shall periodically review all zones of mixing and may terminate any such zones for which the conditions of approval of the zone mixing have changed.

NORTH CAROLINA

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 (1).

NORTH DAKOTA

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 to be taken into account when mixing zones are determined:

- (1) The Water Quality Standards must be met at every point outside of the mixing zone. The Department may require a means of expediting mixing and dispersion of wastes, if found necessary.
- (2) 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.
- (3) The 96-hour TL_m for indigenous and/or resident fish and fish food organisms shall not be exceeded at any other point in the mixing zone.

NORTH DAKOTA (Cont'd)

- (4) 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.

OHIO

The following general water quality standards shall apply to all surface waters of the state including mixing zones. To every extent practical and possible as determined by the Director, these waters shall be:

(A) Free from suspended solids or other substances that enter the waters as a result of human activity and that will settle to form putrescent or otherwise objectionable sludge deposits, or that will adversely affect aquatic life.

(B) Free from floating debris, oil, scum and other floating materials entering the waters as a result of human activity in amounts sufficient to be unsightly or cause degradation;

(C) Free from materials entering the waters as a result of human activity producing color, odor or other conditions in such a degree as to create a nuisance;

(D) Free from substances entering the waters as a result of human activity in concentrations that are toxic and harmful to human, animal or aquatic life and/or are rapidly lethal in the mixing zone;

(E) Free from nutrients entering the waters as a result of human activity in concentrations that create nuisance growths of aquatic weeds and algae.

(A) NON-THERMAL

(1) Except as subsequent provisions of Division (A) of this Rule establish different limits, no 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) 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), (f) and (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 providing no violation of Sections (A)(1)(a), (b), (c) and (d) of this rule by the mixing zone in question.

MIXING ZONES

(3) For watercourses classified as Coldwater Habitat and Exceptional Warmwater habitat in Rule 3745-1-08 of the Ohio Administrative Code the standards set forth in Sections (A)(1)(a) through (d) of this rule shall apply, and in addition no mixing zone shall:

(a) constitute more than one-third of the width of the receiving watercourse nor constitute more than one-fifth of the area of any cross-section of the receiving watercourse; or

(b) extend downstream at any time a distance more than three times the width of the receiving watercourse at the point discharge.

(4) At least 90 percent of the volume of the mixing zone shall not exceed at any time the 24 to 96 hour median tolerance limit (TLM) or LC₅₀ for any representative aquatic species, 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," 14th Edition, 1975, published by the American Water Works Association and the Water Pollution Control Federation.

OHIO (Cont'd)

(5) For lakes and reservoirs except Lake Erie classified as State and National Resource Water in Rule 3745-1-05 of the Ohio Administrative Code, no mixing zone shall be permitted.

(6) For all streams classified as Seasonal Warmwater Habitat in Rule 3745-1-08 of the Ohio Administrative Code, the mixing zone criteria in Division (A)(1) through (5) of this rule will not apply.

(B) THERMAL

(1) 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 59F(15.0C) 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 Section (B)(1) of this rule on a case-by-case basis for all point source discharges subject to permit.

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

(a) interdict to 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 bath houses and/or life guards are provided.

(4) For all watercourses classified as Coldwater Habitat and Exceptional Warmwater Habitat in Rule 3745-1-08 of the Ohio Administrative Code, thermal mixing zones will not be permitted.

OHIO (Cont'd)

(5) For lakes and reservoirs, except Lake Erie, classified as State and national Resource Water in Rule 3745-1-05 of the Ohio Administrative Code, no thermal mixing zone shall be permitted.

(6) For all streams classified as Seasonal Warmwater Habitat in Rule 3745-1097 of the Ohio Administrative Code, the mixing zone criteria in Division (B)(1) through (3) of this rule will not apply.

(7) 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 Division (B)(1) through (3) of this rule.

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

<u>Ambient- °F(°C)</u>	<u>Daily Average Temperature-°F(°C)</u>	<u>Ambient- °F(°C)</u>	<u>Daily Average Temperature-°F(°C)</u>
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)		

OHIO (Cont'd)

LAKE ERIE STANDARDS

(B) MIXING ZONES

(1) Non-Thermal

For Lake Erie, outside of the excepted areas established in Division (C) of this rule, the following criteria will apply:

- (a) Except as subsequent provisions of this section provide different limits, no mixing zone shall:
 - (1) interdict the mouth of a stream, thereby blocking any portion of it; or
 - (2) interdict the migratory routes or interfere with natural movements, survival, reproduction, growth, or increase the vulnerability to predation of any representative aquatic species; or
 - (3) include spawning or nursery areas of any representative aquatic species; or
 - (4) include a public water supply intake; or
 - (5) include any bathing area where bath houses and/or lifeguards are provided,
 - (6) contact the shoreline, whenever such contact can be avoided.
- (b) At least 90 percent of the volume of the mixing zone shall not exceed at any time the 24 to 96 LC₅₀ for any representative aquatic species, 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," 15th Edition, 1975, published by the American Public Health Association, American Water Works Association and the Water Pollution Control Federation.

OHIO(Cont'd)

(2) Thermal

- (a) 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 the point nearest to the discharge that is accessible to the resident aquatic organisms shall not exceed the temperatures in Table 7d at the corresponding ambient temperature. At ambient temperatures of 59°F (15°C) and above the daily average temperature in a thermal mixing zone will be determined on a case-by-case basis.
- (b) Thermal mixing zone size limitations shall be established by the Director pursuant to Section (B)(2)(a) of this rule on a case-by-case basis for all point source discharges subject to permit.
- (c) Except as Division (B)(2)(a) and (B)(2)(b) of this rule establish different limitations, no thermal mixing zone shall:
 - (1) interdict the migratory routes or interfere with natural movements, survival, reproduction, growth, or increase the vulnerability to predation of any representative aquatic species;
 - (2) 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;
 - (3) include a public water supply intake; or
 - (4) include any bathing area where bath houses and/or lifeguards are provided.
- (d) Closed-cycle cooling blowdown discharge will be exempt from Divisions (B)(2)(a) and (b) of this rule.

OHIO(Cont'd)

LAKE ERIE STANDARDS

Table 7d: Daily average temperatures of thermal mixing zones at corresponding ambient temperatures. Shown as degrees Fahrenheit and Celsius.

<u>Ambient</u>	<u>Daily Average Temperature</u>	<u>Ambient</u>	<u>Daily Average Temperature</u>
32(0)	41(5.0)	46(7.8)	65(18.3)
33(0.6)	41(5.0)	47(8.3)	66(18.9)
34(1.1)	43(6.1)	48(8.9)	68(20.0)
35(1.7)	45(7.2)	49(9.4)	70(21.1)
36(2.2)	46(7.8)	50(10.0)	71(21.7)
37(2.8)	48(8.9)	51(10.6)	73(22.8)
38(3.3)	50(10.0)	52(11.1)	75(23.9)
39(3.9)	52(11.1)	53(11.7)	77(25.0)
40(4.4)	53(11.7)	54(12.2)	78(25.6)
41(5.0)	55(12.8)	55(12.8)	80(26.7)
42(5.6)	57(13.9)	56(13.3)	82(27.8)
43(6.1)	59(15.0)	57(13.9)	84(28.9)
44(6.7)	61(16.1)	58(14.4)	86(30.0)
45(7.2)	62(16.7)	59(15) and above-daily average limit will be determined on a case-by-case basis.	

Lake Erie within excepted areas shall comply with the requirements in Rule 3745-1-06.

OHIO RIVER STANDARDS

(M) Mixing Zone:

A mixing zone is an area contiguous to a discharge where receiving water quality may neither meet all quality criteria nor requirements otherwise applicable to the receiving water. It is obvious that any time an effluent is added to a receiving waterway, where the effluent is poorer in quality, there will be a zone of mixing. The mixing zone should be considered as a place where wastes and water mix and not as a place where effluents are treated. As appropriate, the regulatory agency will define the mixing zone in accordance with the following guidelines, provided, however, that no mixing zone shall be recognized for any wastewaters discharged without a valid permit.

- (1) The regulatory agency shall specify definable, numerical limits for mixing zones on a case-by-case basis, considering the linear distances from the point of discharge, surface area involvement, or volume of receiving water within the defined zone.

OHIO(Cont'd)

- (2) Conditions within the mixing zone shall not be lethal to aquatic biota which may enter the zone.
- (3) The location of a mixing zone shall not interfere with spawning areas, nursery areas, fish migration routes, potable water supply intakes, or bathing areas.

THE MAHONING RIVER BASIN

Upper Basin

Mixing zones shall be determined on a case-by-case basis with the requirement that each mixing zone shall be limited to the greatest practical extent and where possible not to overlap another one. In addition, a reasonable zone of passage will be preserved for the movement of fish and other aquatic biota.

Lower Basin

- (a) A mixing zone is a portion of a watercourse where effluent mixes with waters in the receiving watercourse, and the zone is managed to preserve the major region of the watercourse for its designated use(s), particularly in the cases of the highest use classification (Alg, PWS, ALsw and Rpc), thereby protecting a region for the passage of fish and for proper habitat of aquatic biota, and to preserve unhindered regions for public water supply and livestock watering intake and bathing.
- (b) Waters within a mixing zone will not be rapidly lethal to native aquatic biota and will have a temperature such that the water temperature outside the mixing zone will not be increased or decreased more than 5°F.
- (c) Water quality standards for the designated use(s) will be met outside of the mixing zone.

OKLAHOMA

SECTION 8.1 (a)

When a liquid of different quality than the receiving water is discharged to an aquatic system, a mixing zone is formed. The concept of mixing zone is recognized as a necessary element of Oklahoma's Water Quality Standards. In the case of perennial 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 dissolved oxygen concentration in a mixing zone shall be not less than 4.0 mg/l, and the concentration of toxic substances shall not exceed the 96 hr. LC₅₀ for the most sensitive indigenous species. Mixing zones in lakes and intermittent streams shall be designated on a case-by-case basis. It is recognized that

OKLAHOMA (Cont'd)

the water quality in the mixing zone may be unsuitable for certain beneficial uses. Where the overlapping mixing zones due to multiple outfalls occur, the total length of the mixing zone will be equal to the sum of the lengths of the individual mixing zones.

SECTION 82. ZONES OF PASSAGE

All discharges shall be regulated to insure that at the outfall and throughout the mixing zone, a zone of passage shall be maintained with the stream 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.

OREGON

4. a. The Department may suspend the applicability of all or part of the water quality standards set forth in this section, 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 discharge.
- b. The sole method of establishing such mixing zone shall be by the Department defining same in a waste discharge permit.
- c. In establishing a mixing zone in a waste discharge permit the Department:
 - 1) 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,
 - 2) May set other less restrictive water quality standards to be applicable in the mixing zone in lieu of the suspended standards, and
 - 3) Shall limit the mixing zone to that which in all probability, will
 - a) Not interfere with any biological community or population of any important species to a degree which is damaging to the ecosystem; and
 - b) Not adversely affect any other beneficial use disproportionately.

PENNSYLVANIA

No reference to mixing zones.

RHODE ISLAND

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 of 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.

SOUTH CAROLINA

5. Mixing Zone - as used in Section III, Number 11, shall mean a designated area within which specified water quality standards are not applicable. The boundary of this zone shall be determined by the Department of Health and Environmental Control on an individual project basis after consideration of the waste discharge and the receiving waters. A mixing zone shall not prevent free passage of fish and shall not interfere with the designated use outside its established boundary.

Fresh Waters - The water temperature at the inside boundary or the mixing zone shall not be more than 10 degrees C (18 degrees F) greater than that of water unaffected by the heated discharge. The appropriate temperature criteria or the size of the mixing zone will be determined on an individual project basis and will be based on biological, chemical, engineering and physical considerations. Any such determination shall assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on a body of water to which the heated discharge is made and shall allow passage of aquatic organisms.

Tidal Salt Waters - The size of the mixing zone will be determined on an individual project basis and will be based on biological, chemical, engineering and physical considerations. Any such determination shall assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on a body of water to which a heated discharge is made. Further, the mixing zones shall be kept at a minimum and shall allow the passage of aquatic organisms.

Lakes and Reservoirs - The water temperature at the inside boundary of the mixing zone shall not be more than 10 degrees C (18 degrees F) greater than that of water unaffected by the heated discharge. The appropriate temperature criteria of the size of the mixing zone will be determined on an individual project basis and will be based on biological, chemical, engineering and physical considerations. Any such determination shall assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on a body of water to which the heated discharge is made and shall allow passage of aquatic organisms.

SOUTH DAKOTA

Each discharge to a flowing water shall be 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 shall not contain more than seventy-five percent of the cross-sectional area of the stream, shall not extend over more than seventy-five percent of the width of the stream or one hundred yards, whichever is the least, and the dimensions parallel to the stream flow shall not exceed one-half mile. Mixing zone characteristics must not be lethal to aquatic organisms. The median tolerance limit for indigenous fish or fish food organisms, whichever is more stringent, shall not be exceeded at any point in the mixing zone. Mixing zones shall 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 shall be allowed which reaches a lake classified for the beneficial use of fish life propagation and causes impairment of any assigned beneficial use.

TENNESSEE

Mixing zone refers to that section of a flowing stream or impounded waters necessary for an effluent to become dispersed and mixed insofar as practical with the main flow or water body by appropriate methods at the discharge point. Such zones shall be restricted to as small an area and length as possible and shall not (i) prevent the free passage of fish or cause aquatic life mortality in the receiving waters; (ii) contain materials, that adequately represent the defined zone, in concentrations that exceed the 96-hour LC50 for biota significant to the aquatic community in the receiving waters; (iii) result in offensive conditions; (iv) produce undesirable aquatic life or result in dominance of nuisance species; (v) endanger the public health or welfare; or (vi) adversely affect the reasonable and necessary uses of the area. The mixing zone necessary in each particular case may be designated in the discharge permit as required by the Tennessee Water Quality Control Act (T.C.A., Section 70-324 through Section 70-342).

TEXAS

2. Mixing Zones

Where mixing zones are specifically defined in a valid waste control order issued by the Texas Water Quality Board or a National Pollutant Discharge Elimination System permit, the defined zone shall apply.

Where the mixing zone is not so defined, a reasonable zone shall be allowed. Because of varying local physical, chemical, and biological conditions, no single criterion is applicable in all cases. In no case, however, where fishery resources are considered significant, shall the mixing zone allowed preclude the passage of free-swimming and drifting aquatic organisms to the extent of significantly affecting their populations. Normally, mixing zones should be limited to no more than 25 percent of the cross-sectional area and/or volume of flow of the stream or estuary, leaving at least 75 percent free as a zone of passage unless otherwise defined by a specific Board Order or permit.

3. Buffer Zones in Bay and Gulf Waters

For all bay and gulf waters, exclusive of those contained in river or coastal basins as defined in Section IV, a buffer zone of 1,000 feet measured from the shoreline at ordinary high tide is hereby established. In this zone, the bacteriological requirements enumerated in other sections of these standards shall not apply. In these zones, the logarithmic mean (geometric mean) density of fecal coliform organisms shall not exceed 200/100 ml, nor shall more than 10% of the total samples exceed 400/100 ml. The foregoing percentages are applicable when examining data from not less than 5 samples collected over no more than 30 days. For routine observation and evaluation of water quality, lesser numbers of samples collected over longer periods will be used.

UTAH

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 concentration which will meet standards for all pollutants. 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 Section 1.3 of the Utah regulations.

VERMONT

RULE 14: Thermal Mixing Zones

As a requirement of any permit for the discharge of heated wastes to the waters of the State, the Secretary may designate a specific portion of the receiving waters as a thermal mixing zone. Thermal mixing zones shall be allowed only where the wastes otherwise conform with the technical and other requirements established for the receiving waters and shall be utilized solely for the dispersal and dilution of heated wastes which have been adequately treated in the judgment of the Secretary.

Thermal mixing zones shall be designated so as to not constitute a barrier to the passage or migration of fish or produce significant adverse effects on any fishery or other forms of wild or aquatic life. As a guideline, thermal mixing zones should be limited to no more than 25 percent of the cross-sectional area and/or volume of the receiving water.

VIRGINIA

Zones for mixing wastes with receiving water 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 waste treatment, and shall be implemented, to the greatest extent practicable, in accordance with the provisions of subsections A and D hereof. 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 will be determined on a case-by-case basis. The boundaries of these zones of admixture shall also 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.

WASHINGTON

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 VIRGINIA

(A) Definition - a mixing zone is an area contiguous to a discharge where receiving water quality may neither meet all quality criteria nor requirements otherwise applicable to the receiving water. The mixing zone is considered as a place of mixing and not as a place where effluents are treated.

(B) Management - management over those waters which receive waste discharges must be addressed to the task of maintaining the mixing areas in as small a volume and area as practicable. The geographic limits of a mixing zone is complicated by both the wastewater discharge and receiving water characteristics and will not be determined except on a case-by-case basis or where it is necessary to exercise more stringent controls over the receiving waters in question.

WISCONSIN

Water quality standards must be met at every point outside of a mixing zone. The size of the mixing zones cannot be uniformly prescribed, but 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% of the cross-sectional area or volume of flow of the stream and not extending more than 50% 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% 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.

WISCONSIN (Cont'd)

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

Categories of standards. (1) GENERAL. To preserve and enhance the quality of waters, standards are established to govern water management decision. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all waters including the mixing zone and the effluent channel meet the following conditions at all times and under all flow conditions.

(a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.

(b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the state.

(c) Materials producing color, odor, taste, or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.

(d) Substances in concentrations or combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

Lake Michigan and Lake Superior thermal standards. For Lake Michigan and Lake Superior the following thermal standards are established so as to minimize effects on the aquatic biota in the receiving waters.

(1)(a) Thermal discharges shall not raise the receiving water temperature more than 3°F above the existing natural temperature at the boundary of mixing zones established in paragraphs (b) and (c).

(b) 1. The mixing zone for a shoreline thermal discharge shall be the area included within the perimeter of a rectangular figure extending 1,250 feet in both directions along the shoreline from the outfall and 1,250 feet into the lake.

2. The mixing zone for an offshore thermal discharge shall be the area within a 1,000-foot radius circle with its center at the point of discharge.

(c) The department may, upon request from the owner of a source of thermal discharge, adjust the boundaries of the mixing zones established in paragraph (b) for that source. In no case may any mixing zone so established include an area greater than 72 acres nor may it include more than 2,800 feet of shoreline.

WISCONSIN (Cont'd)

Review of thermal standards.

(1) Whenever the owner of any source of thermal discharges that existed on or before July 31, 1975, in compliance with department guidelines and after opportunity for public hearing, can demonstrate to the satisfaction of the department that the mixing zone established pursuant to this chapter is more stringent than necessary to assure the protection and propagation of a balanced indigenous population of shellfish, fish and wildlife in and on the receiving water, the department may:

(a) Impose a mixing zone with respect to such thermal discharge that will assure the protection and propagation of such a population, or

(b) Exempt such thermal discharge from the thermal requirements of this chapter provided this exemption will not endanger the propagation of such a population.

(2) Any owner desiring a review pursuant to NR 102.07 (1) shall submit a demonstration to the department no later than June 30, 1976. The department shall reach a decision no later than December 31, 1976.

(3) In the event the owner fails to make a satisfactory demonstration pursuant to NR 102.07 (1), the department shall establish a compliance date for the thermal component to be achieved no later than July 1, 1979.

(4) Whenever the owner of any source of thermal discharges that commenced on or after August 1, 1975, in compliance with department guidelines and after opportunity for public hearing, can demonstrate to the satisfaction of the department that the mixing zone established pursuant to this chapter is more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on the receiving water, the department may:

(a) Impose a mixing zone with respect to such thermal discharge that will assure the protection and propagation of such a population, or

(b) Exempt such thermal discharge from the thermal requirements of this chapter provided this exemption will not endanger the propagation of such a population.

(5) In the event an owner fails to make a satisfactory demonstration pursuant to NR 102.07 (4), the discharge shall be in compliance with the thermal requirements of this chapter upon commencement of the discharge.

(6) The department may require the reduction of thermal discharges or the size and configuration of a mixing zone if it finds that environmental damage is imminent or existent.

WYOMING

From Section 10. Sampling Points. Except for Sections 15, 16, 17 and 18 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 seven consecutive day flow which has the probability of occurring once in ten years.

Mixing zone is defined by the State as that portion of a surface water body within which an effluent becomes thoroughly mixed with the water body.

AMERICAN SAMOA

In accordance with the granting of permission to discharge into the receiving waters of American Samoa, it shall be recognized that this permission does not authorize pollution. Approval of discharges will be made only upon evidence of a discharge meeting the requirements of the water quality standards of the receiving waters or the approval by the Environmental Quality Commission of an acceptable abatement schedule which is to be developed by the applicant if the waste discharge does not meet the requirement. The Commission, at its discretion, may define a dispersion zone for each discharge - outside of which the water quality standards will be strictly enforced. This dispersion zone may be defined for specific discharge parameters only; and shall not be construed as permission for unregulated discharge.

A dispersion zone shall be defined as an inverted forty-five degree conoidal shape cone ending six feet below the water surface. The apex of the cone shall begin at the point of discharge. This cone is to be the only dispersion zone under all normal tidal and current conditions. Water quality standards will be strictly enforced in the waters adjacent to the cone. A dispersion zone may be granted on a parameter by parameter basis (pH, temperature, etc.,) or for several parameters.

GUAM

The water quality criteria in Section II shall apply within a mixing zone unless specific alternate criteria are approved by the Administrator for specified parameters. The mixing zone shall be defined by specified 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:

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 mixing zones for any discharge, the following shall be considered:
 - a) size of receiving water, volume of discharge, stream bank 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.
2. An adequate zone of passage shall exist at all times for the movement or drift of aquatic life.
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.
4. Mixing zones shall not intersect any area of any waters in such a manner that the maintenance of aquatic life in the body of water as whole would be adversely affected.
5. The discharge shall not violate the basic standards applicable to all waters nor shall it unreasonably interfere with any actual or probable use of the waters within the mixing zone.

PUERTO RICO

General Provisions

No person shall cause or permit a discharge for which an IMZ (Initial Mixing Zone) or an FMZ (Final Mixing Zone), or both has not

PUERTO RICO (Cont'd)

been defined and authorized by the Board. For defining and authorizing any mixing zone, the Board shall take into consideration the following general conditions:

- A. These zones shall be provided solely for mixing. Mixing must be accomplished as quickly as possible through the use of means which insure that the waste is mixed with the dilution water in the smallest possible space.
- B. Suspended solids shall not settle to form observable deposits in the mixing zone as a result of the discharge.
- C. The concentration of waste discharge at the edge of the IMZ as defined in 5.2.1. (A) shall not exceed the TLM 96 hours.
- D. Nuisance growths of organisms shall not result in the mixing zone as a result of the discharge.
- E. Maximum vertical dispersion of wastewater discharge stream shall be provided for in the mixing zone.
- F. The mixing zone shall be located so as to allow, at all times, passageways for the movement or drift of the biota. In closed bodies of water, estuaries or rivers, any mixing zones shall be located close to the bank itself, in such manner that the passageway continues lengthwise for a considerable distance which permits the adequate and safe flow of free floating or drifting organisms. The passageway shall contain at least 75 percent of the cross-sectional area and/or volume of flow in the case of estuaries.
- G. A mixing zone shall not overlap with an adjacent mixing zone. Notwithstanding, overlapping may be allowed when demonstrated to the satisfaction of the Board that no adverse synergistic effect will result from the interaction of the overlapping mixing zones.
- H. A mixing zone shall be allowed only if the applicant demonstrates to the satisfaction of the Board that the best control technology economically feasible is being used or proposed.

Standards for Granting Initial Mixing Zone (IMZ)

No Initial Mixing Zone (IMZ) shall be defined and authorized unless the applicant proposed an IMZ that meets all of the following requirements:

- A. The largest dimension of the geometric figure that describes the IMZ shall not exceed four hundred feet (400 ft.) in all waters except ocean waters. For discharges to ocean waters, the IMZ shall be the volume of the mixture of wastewater and ocean water ascending from the outfall until the mixture becomes equal to the surrounding ocean water.

PUERTO RICO (Cont'd)

- B. The IMZ is mainly caused by the turbulence due to the momentum of the discharge and to the density gradient.
- C. Satisfies the provisions of Section 5.1 of this Regulation.
- D. At the boundary of the IMZ the water shall comply with all water quality standards set forth for the corresponding classification, except as provided in subsection 5.2.2.

Notwithstanding requirement (D) of the Subsection 5.2.1 the Board may define and authorize an IMZ only for those pollutants which comply with the water quality standards as the boundary of the proposed zone. In this case, the remaining pollutants not in compliance with water quality standards at the boundary of the proposed IMZ shall be subject to the provisions of Section 5.3.

In the proposal, the applicant shall take into consideration such aspects as the physico-chemical characteristics of the discharge and of the receiving body of water, and use the best currently available simulation or determination technique to describe the proposed IMZ.

Within 60 days of the submittal of an approvable application, the Board shall define and authorize an IMZ.

Final Mixing Zones (FMZ)

Condition Precedent

- A. When deemed absolutely necessary, the Board may allow a final mixing zone (FMZ) with respect to a discharge. The Board shall consider a proposed FMZ only if the applicant demonstrates to the satisfaction of the Board that requirement (D) of Subsection 5.2.1 cannot be met, and all water quality standards set forth in Article II can be met at the edge of the FMZ.
- B. The Board shall notify the applicant of its determination with respect to the need of a FMZ.
- C. Upon receiving an affirmative decision by the Board, the applicant may proceed to submit a proposed FMZ.

PUERTO RICO (Cont'd)

Standard for Granting Final Mixing Zone

- A. The Board shall define and authorize a FMZ only if the following conditions are met:
1. The proposed FMZ complies with the provisions of Section 5.1.
 2. The largest dimension of the geometric figure that describes the proposed FMZ does not exceed four thousand feet (4,000 ft.).
 3. The most advanced mathematical modeling method approved by the Board for the dispersion of effluents in a body of water was used in developing the proposed FMZ.
 4. The proposed FMZ is not located in spawning areas, shellfish growing areas, or any other areas which the Board may deem as inappropriate for the establishment of an FMZ.
 5. In developing the proposed FMZ, the size, nature and classification of the receiving body of water shall be taken into consideration.
 6. The proposed FMZ shall explicitly describe and define any IMZ's included therein.

VIRGIN ISLANDS

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.

Mixing Zone Criteria

- A. Mixing zones shall be provided solely for 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.
- B. 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.
- C. 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 effluent must be adequately pre-treated until the standards are met.

VIRGIN ISLANDS (Cont'd)

- D. No conditions shall be permitted to exist within the mixing zone:
(1) that are rapidly lethal (i.e. exceed the 96 hour median tolerance limit) to locally important and desirable indigenous aquatic life; (2) 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.
- E. Maximum vertical dispersion of wastewater discharge flow shall be provided for in the mixing zone.
- F. Mixing zones shall not intersect spawning or nursery areas, migratory routes, water intake nor mouths of rivers.
- G. Suspended solids in wastewaters being discharged shall not settle in measurable amounts in the mixing zones.

Mixing Zone Boundaries

- A. The mixing zone must be located in such manner as to allow at all times, passageways for the movement or 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.
- B. The passageway must contain 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.
- C. A mixing zone shall not overlap with an adjacent mixing zone.

(Thermal Mixing Zone can be found in Temperature Digest)

TRUST TERRITORIES - No reference to zones of mixing.