Presented below are water quality standards that are in effect for Clean Water Act purposes.

EPA is posting these standards as a convenience to users and has made a reasonable effort to assure their accuracy. Additionally, EPA has made a reasonable effort to identify parts of the standards that are not approved, disapproved, or are otherwise not in effect for Clean Water Act purposes.
PREAMBLE

THE ISSUE OF MIXING ZONES IS COMPLICATED AND DETAILED DETERMINATIONS CAN BE MADE ONLY ON A CASE-BY-CASE BASIS. HOWEVER, SOME GENERAL GUIDANCE CAN BE PROVIDED AND THIS IS PRESENTED BELOW.

I. Introduction

A mixing zone is an area or volume of a waterbody in the immediate vicinity of a discharge where the initial dilution of the discharge occurs. Within a mixing zone excursions from certain water quality criteria may be tolerable, provided this does not interfere with the existing or designated uses of the segment. Water quality criteria apply at the boundary of the mixing zone. Where mixing zones are not permitted, water quality criteria apply at the outfall structure.

II. Water Quality Standards

The Surface Water Quality Standards set forth the general requirements for mixing zones (314 CMR 4.03(2)). The regulation provides narrative statements for the protection of receiving waters where mixing zones are permitted.

Mixing Zones - In applying these standards the Division may recognize a limited area of volume of waterbody as a mixing for the initial dilution of a discharge. Waters within a mixing zone may fail to meet specific water quality criteria provided the following conditions are met:

a) Mixing zones shall be limited to an area or volume as small as feasible. The location, design and operation of the discharge shall minimize impacts on aquatic life and other beneficial uses.

b) Mixing zones shall not interfere with the migration or free movement of fish or other aquatic life. There shall be safe and adequate passage for swimming and drifting organisms with no deleterious effects on their populations.

c) Mixing zones shall not create nuisance conditions, accumulate pollutants in sediments or biota in toxic amounts or otherwise diminish the existing or designated uses of the segment disproportionately.

III. Location of Mixing Zones

Mixing zones are permitted at the discretion of the Division. Mixing zones are not appropriate in areas with critical water uses or where it is necessary to maintain a zone of passage.
IV. In Zone Water Quality

The quality of water within a mixing zone must a) protect public health b) protect aquatic life and c) prevent nuisance conditions.
a) Protection of Public Health

The presence of mixing zones should not result in significant health risks when evaluated using reasonable assumptions about exposure pathways. The two primary exposure pathways are drinking water ingestion and fish and shellfish consumption. The principal means of protection means of protection is the designation of critical uses thereby prohibiting mixing zones from these sensitive areas.

Levels of chemicals that bioaccumulate in the edible portions of fish and shellfish to unacceptable levels are specifically prohibited by the Water Quality Standards (314 CMR 4.05(5)(e)(3)). Therefore concentrations of pollutants within a mixing zone may have to be controlled in order to meet standards outside of a mixing zone. Mixing zones should be restricted such that they do not encompass areas used for fish harvesting; particularly of stationary species such as shellfish.

Genotoxic pollutants are those that cause carcinogenic, mutagenic and teratogenic responses in humans. The development of criteria for these pollutants incorporates significant margins of safety. Since rapid toxic effects generally do not occur with these pollutants restrictions within a mixing zone are unnecessary. Compliance with these criteria will be regulated at the edge of the mixing zone.

b) Protection of Aquatic Life

Aquatic life often becomes the governing concern with determining the in-zone water quality of mixing zones. In this regard the aquatic community can be divided into:

1. non-mobile and sessile benthic organisms;
2. swimming and drifting organism.

To protect populations of non-mobile and sessile benthic organisms the habitat exposed to the mixing zone must be minimized and critical habitats must be avoided. The organisms within a mixing zone may experience severe damage to individuals, including lethality, because chronic criteria can be exceeded. A mixing zone may represent a living space denied these organisms. Therefore a mixing zone must be located and sized such that any such loss is not significant to the biological community of the receiving water segment.

To protect swimming and drifting organisms the in-zone quality must be such that these organisms can pass through the mixing zone without acute exposure to toxicants.

One way to prevent acute exposures is to prohibit acute concentrations at the outfall structure or within a short distance from it. The Division's toxic policy (reference 1) uses 0.3 toxic units as a criterion for acute toxicity. The policy places effluent limits of 1.0 toxic unit on discharges with less than 100:1 dilution and 2.0 toxic units on all others. Additional requirements are imposed where dilutions are very low. These effluent limitations assure that 0.3 toxic units are met within a short distance of the outfall and that acutely toxic exposures will not occur in the mixing zone.

Alternatively, EPA's Technical Support Document (reference 2) provides guidance for the prevention of lethality to passing organisms. The Division considers this information a valid basis for a site-specific demonstration or compliance with meeting the acute criterion with a "short distance" of the outfall. In any such site-specific demonstration the Division considers 2.0 toxic units the technology-based upper limit for whole effluent toxicity. In order to exceed this...
limit the proponent must further demonstrate that the technology to meet 2.0 Toxic Units in the effluent is not reasonably available or feasible.

The effluent limit of 2.0 Toxic Units also applies to intermittent discharges such as stormwater and combined sewer overflows in order to prevent lethality to passing organisms.

c) Prevention of Nuisance Conditions

Waters within a mixing zone are not expected to meet the same aesthetic requirements as waters outside of a mixing zone. However the waters within a mixing zone should not create a nuisance condition or detract from the overall aesthetic value of the segment.

Nuisance conditions may occur from pollutants that settle to form objectionable deposits; float as debris, scum or other matter; produce objectionable odor, color or turbidity; or produce undesirable species of aquatic life. The measurement of these criteria is often subjective. Implementation of technology based treatment requirements substantially reduces the possibility of aesthetics becoming a concern.

v. Size and Shape

Mixing zones should be limited to an area or volume as small as feasible. Available technology should be employed to insure that the design, operation and location of the outfall structure all insure minimum mixing zone size. In some cases levels of treatment higher than those necessary do meet criteria after complete mixing may be necessary to reduce or minimize the area or volume of a mixing zone.

The size of a mixing zone is determined by physical and hydrologic considerations such as, velocity, momentum, density, advection and dispersion. When an effluent is discharged to a waterbody these forces disperse the wastewater until it is uniformly distributed. This process can be divided into two parts; 1) initial dilution; and 2) complete mixing.

Initial dilution is the process which results in the rapid and irreversible turbulent mixing of the wastewater with the receiving water around the point of discharge. Initial dilution is considered complete when the momentum induced velocity of the discharge ceases to produce significant mixing of the wastewater. For the special case of a submerged buoyant discharge, characteristic of most municipal and industrial wastes that are released from submarine outfalls, the momentum of the discharge and the initial 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. Effluents that meet water quality standards within the zone of initial dilution (ZID), provided they do not violate other mixing zone restrictions, are considered to be de minimus. Further justification of the size and shape is not necessary.

Complete mixing occurs when the concentrations of pollutants within a waterbody reach a uniform concentration. This is accomplished by advection and dispersion. The use of this portion of the receiving water as a mixing zone needs to be justified by applying the following antidegradation considerations:

1. No less environmentally damaging alternative site for the activity, source for disposal, or method of elimination of the discharge is reasonably available or feasible;

2. To the maximum extent feasible the discharge or activity is designed and conducted to minimize the size and shape of the mixing zone; and
The mixing zone will not impair the integrity of the waterbody as a whole, including the existing and designated uses.

These antidegradation provisions (appropriately modified to apply to mixing zones) assure that mixing zone size and shape are minimized. When the mixing zone extends beyond the ZID acute criteria should be met within the ZID. If acute criteria are not met within a ZID it must be demonstrated that acute exposures are not likely to occur within the mixing zone.

Mixing zone size and shape will vary with hydrologic conditions. Mixing zone criteria apply at critical or worst case hydrologic conditions. Worst case conditions must be selected case-by-case, with critical resources being the determining factor. Worst case conditions are often those that produce the highest receiving water concentrations. However, it is possible that conditions with lower receiving water concentrations but larger areal extent may be considered worst case if the mixing zone encompasses a critical resource under these alternate conditions. Therefore the Division avoids delineating mixing zone areas on maps. Rather, the mixing zone is analyzed under critical conditions and effluent limits are set in order to comply with mixing zone criteria. Compliance with mixing zone criteria can then be accomplished by effluent monitoring. The size and shape of any authorized mixing zone larger than a ZID, along with the assumptions and appropriate justification shall be documented for the public participation process as part of the Division’s normal Permit Procedures (314 CMR 2.00).

Table I provides a decision tree for mixing zone policy and Table II provides a summary of the policy.
TABLE I
MIXING ZONE FLOW CHART

Is the discharge located in a critical use area?
  YES → No M.Z. Allowed
  NO

Does discharge meet whole effluent toxicity (state policy) requirements?
  YES
  NO → site-specific in-zone toxicity study (EPA criteria)

Will criteria be met within the ZID?
  YES → Approve M.Z. (not specifically defined in permit)
  NO

Is size and shape of M.Z. minimized?
  1. Design
  2. Operation
  3. Location
  4. Level of Treatment
  5. Alternatives
  YES

Are uses diminished disproportionately?
  YES
  NO

Approve regulatory M.Z. specifically define in permit

NO
## TABLE II
### SUMMARY OF MIXING ZONE POLICY

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CRITERIA</th>
<th>IMPLEMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Location</td>
<td>a) Avoid Critical Uses</td>
<td>Avoid:</td>
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<tr>
<td></td>
<td></td>
<td>- Water supply intakes</td>
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<tr>
<td></td>
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<td>- Productive shellfish Areas</td>
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<tr>
<td></td>
<td></td>
<td>- Bathing beaches</td>
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<td></td>
<td></td>
<td>- Sensitive aquatic life habitats</td>
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<tr>
<td></td>
<td>b) Provide Zone of Passage</td>
<td>Where necessary for anadromous or catadromous fisheries.</td>
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<td></td>
<td>Provide half the width or volume of the waterbody free from mixing zones.</td>
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<tr>
<td>2. In-Zone Quality</td>
<td>a) Protect Public Health</td>
<td>- Avoid sensitive areas</td>
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<tr>
<td></td>
<td></td>
<td>- Where necessary limit concentrations for fish and shellfish edibility</td>
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<td></td>
<td></td>
<td>- Meet criteria at edge of zone</td>
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<tr>
<td></td>
<td>b) Protect Aquatic Life</td>
<td>- Prohibit acute exposures to toxics within the zone by:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a) State toxic policy, or;</td>
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<td></td>
<td></td>
<td>b) EPA TSD criteria</td>
</tr>
<tr>
<td></td>
<td>c) Prevent Nuisance Conditions</td>
<td>Apply aesthetic criteria as applicable</td>
</tr>
<tr>
<td>3. Size and Shape</td>
<td>Minimize Size</td>
<td>- Minimize by technology;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>design</td>
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<td></td>
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<td>location</td>
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<td>level of treatment</td>
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<td></td>
<td>- Meet criteria within the ZID, or; justify larger area through antidegradation provisions</td>
</tr>
</tbody>
</table>
REFERENCES


