CHAPTER 5
GENERAL POLICIES

States may, at their discretion, adopt certain policies in their standards affecting the application and implementation of standards. For example, policies concerning mixing zones, water quality standards variances, and critical flows for water quality-based permit limits may be adopted. Although these are areas of State discretion, EPA retains authority to review and approve or disapprove such policies (see 40 CFR 131.13).

5.1 Mixing Zones

It is not always necessary to meet all water quality criteria within the discharge pipe to protect the integrity of the water body as a whole. Sometimes it is appropriate to allow for ambient concentrations above the criteria in small areas near outfalls. These areas are called mixing zones. Whether to establish a mixing zone policy is a matter of State discretion, but any State policy allowing for mixing zones must be consistent with the Clean Water Act and is subject to approval of the Regional Administrator.

A series of guidance documents issued by EPA and its predecessor agencies have addressed the concept of a mixing zone as a limited area or volume of water where initial dilution of a discharge takes place. Mixing zones have been applied in the water quality standards program since its inception. The present water quality standards regulation allows States' to adopt mixing zones as a matter of States discretion. Guidance on defining mixing zones previously has been provided in several EPA documents, including FWPCA (1968); NAS/NAE (1972); USEPA (1976); and USEPA (1983a).

EPA's current mixing zone guidance, contained in this Handbook and the *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a), evolved from and supersedes these sources.

Allowable mixing zone characteristics should be established to ensure that:

- mixing zones do not impair the integrity of the water body as a whole,
- there is no lethality to organisms passing through the mixing zone (see section 5.1.2, this Handbook); and
- there are no significant health risks, considering likely pathways of exposure (see section 5.1.3, this Handbook).

EPA recommends that mixing zone characteristics be defined on a case-by-case basis after it has been determined that the assimilative capacity of the receiving system can safely accommodate the discharge. This assessment should take into consideration the physical, chemical, and biological characteristics of the discharge and the receiving system; the life history and behavior of organisms in the receiving system; and the desired uses of the waters. Mixing zones should not be permitted where they may endanger critical areas (e.g., drinking water supplies, recreational areas, breeding grounds, areas with sensitive biota).

EPA has developed a holistic approach to determine whether a mixing zone is tolerable (Brungs, 1986). The method considers all the impacts to the water body and all the impacts that the drop in water quality will have on the surrounding ecosystem and water body uses. It is a multistep data collection and analysis procedure that is particularly sensitive to overlapping mixing zones. This method includes the identification of all upstream and downstream water bodies and the ecological and cultural data pertaining to them; the collection of data on all present and future discharges to the water body; the assessment of relative environmental value and level of protection needed for the water body; and, finally, the allocation of environmental impact for a discharge applicant. Because of the difficulty in collecting the data necessary for this procedure and the general lack of agreement concerning relative values, this method will be difficult to implement in full. However, the method does serve as a guide on how to proceed in allocating a mixing zone.

Mixing zone allowances will increase the mass loadings of the pollutant to the water body and decrease treatment requirements. They adversely impact immobile species, such as benthic communities, in the immediate vicinity of the outfall. Because of these and other factors, mixing zones must be applied carefully, so as not to impede progress toward the Clean Water Act goals of maintaining and improving water quality. EPA recommendations for allowances for mixing zones, and appropriate cautions about their use, are contained in this section.

MIXING ZONES

A limited area or volume of water where initial dilution of a discharge takes place and where numeric water quality criteria can be exceeded but acutely toxic conditions are prevented.

The *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a, sections 2.2, 4.3, 4.4) discusses mixing zone analyses for situations in which the discharge does not mix completely with the receiving water within a short distance. Included are discussions of outfall designs that maximize initial dilution in the mixing zone, critical design periods for mixing zone analyses, and methods to analyze and model nearfield and farfield mixing.

5.1.1 State Mixing Zone Methodologies

EPA recommends that States have a definitive statement in their standards on whether or not mixing zones are allowed. Where mixing zones provisions are part of the State standards, the State should describe the procedures for defining mixing zones. Since these areas of impact, if disproportionally large, could potentially adversely impact the productivity of the water body and have unanticipated ecological consequences, they should be carefully evaluated and appropriately limited in size. As our understanding of pollutant impacts on ecological systems evolves, cases could be identified where no mixing zone is appropriate.

State water quality standards should describe the State's methodology for determining the location, size, shape, outfall design, and in-zone quality of mixing zones. The methodology should be sufficiently precise to support regulatory actions, issuance of permits, and determination of BMPs for nonpoint sources. EPA recommends the following:

- **Location**

Biologically important areas are to be identified and protected. Where necessary to preserve a zone of passage for migrating fish or other organisms in a water course, the standards should specifically identify the portions of the waters to be kept free from mixing zones.

Where a mixing zone is allowed, water quality standards are met at the edge of that regulatory mixing zone during design flow conditions and generally provide:

- a continuous zone of passage that meets water quality criteria for free-swimming and drifting organisms; and
- prevention of impairment of critical resource areas.

Individual State mixing zone dimensions are designed to limit the impact of a mixing zone on the water body. Furthermore, EPA's review of State waste load allocations (WLAs) should evaluate whether assumptions of complete or incomplete mixing are appropriate based on available data.

In river systems, reservoirs, lakes, estuaries, and coastal waters, zones of passage are defined as continuous water routes of such volume, area, and quality as to allow passage of free-swimming and drifting organisms so that no significant effects are produced on their populations. Transport of a variety of organisms in river water and by tidal movements in estuaries is biologically important for a number of reasons:

- food is carried to the sessile filter feeders and other nonmotile organisms;
- spatial distribution of organisms and reinforcement of weakened populations are enhanced; and
- embryos and larvae of some fish species develop while drifting.

Anadromous and catadromous species must be able to reach suitable spawning areas. Their young (and in some cases the adults) must be assured a return route to their growing and living areas. Many species make migrations for spawning and other purposes. Barriers or blocks that prevent or interfere with these types of essential transport and movement can be created by water with inadequate chemical or physical quality.

Size

Various methods and techniques for defining the surface area and volume of mixing zones for various types of waters have been formulated. Methods that result in quantitative measures sufficient for permit actions and that protect designated uses of a water body as a whole are acceptable. The area or volume of an individual zone or group of zones must be limited to an area or volume as small as practicable that will not interfere with the designated uses or with the established community of aquatic life in the segment for which the uses are designated.

To ensure that mixing zones do not impair the integrity of the water body, it should be determined that the mixing zone will not cause lethality to passing organisms and that, considering likely pathways of exposure, no significant human health risks exist. One means to achieve these objectives is to limit the size of the area affected by the mixing zones.

In the general case, where a State has both acute and chronic aquatic life criteria, as well as human health criteria, independently established mixing zone specifications may apply to each of the three types of criteria. For application of two-number aquatic life criteria, there may be up to two types of mixing zones (see Figure 5-1). In the zone immediately surrounding the outfall, neither the acute nor the chronic criteria are met. The acute criteria are met at the edge of this zone. In the next mixing zone, the acute, but not the chronic, criteria are met. The chronic criteria are met at the edge of the second mixing zone. The acute mixing zone may be sized to prevent lethality to passing organisms, the chronic mixing zone sized to protect the ecology of the water body as a whole, and the health criteria mixing zone sized to prevent significant human risks. For any particular pollutant from any

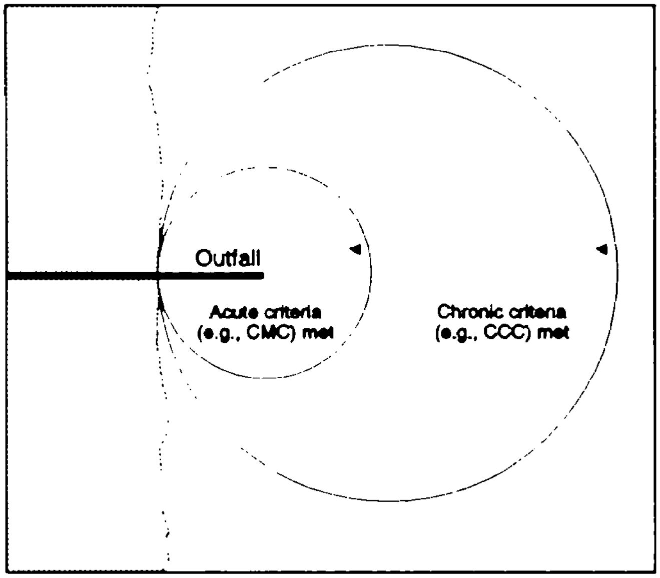


Figure 5-1. Diagram of the Two Parts of the Aquatic Life Mixing Zone

particular discharge, the magnitude, duration, frequency, and mixing zone associated with each of the three types of criteria (acute and chronic aquatic life, and human health) will determine which one most limits the allowable discharge.

Concentrations above the chronic criteria are likely to prevent sensitive taxa from taking up long-term residence in the mixing zone. In this regard, benthic organisms and territorial organisms are likely to be of greatest concern. The higher the concentrations occurring within certain isopleths, the more taxa are likely to be excluded, thereby affecting the structure and function of the ecological community. It is thus important to minimize the overall size of the mixing zone and the size of elevated concentration isopleths within the mixing zone.

To determine that, for aquatic life protection, a mixing zone is appropriately sized, water quality conditions within the mixing zone may be compared to laboratory-measured or predicted toxicity benchmarks as follows:

- It is not necessary to meet chronic criteria within the mixing zone, only at the edge of the mixing zone. Conditions within the mixing zone would thus not be adequate to assure survival, growth, and reproduction of all organisms that might otherwise attempt to reside continuously within the mixing zone.

- If acute criteria (criterion maximum concentration, or CMC, derived from 48- to 96-hour exposure tests) are met throughout the mixing zone, no lethality should result from temporary passage through the mixing zone. If acute criteria are exceeded no more than a few minutes in a parcel of water leaving an outfall (as assumed in deriving the section 5.1.2 options for an outfall velocity of 3 m/sec, and a size of 50 times the discharge length scale), this likewise assures no lethality to passing organisms.

- If a full analysis of concentrations and hydraulic residence times within the mixing zone indicates that organisms drifting through the centerline of the plume along the path of maximum exposure would not be exposed to concentrations exceeding the acute criteria when averaged over the 1-hour (or appropriate site-specific) averaging period for acute criteria, then lethality to swimming or drifting organisms should ordinarily not be expected, even for rather fast-acting toxicants. In many situations, travel time through the acute mixing zone must be less than roughly 15 minutes if a 1-hour average exposure is not to exceed the acute criterion.

Where mixing zone toxicity is evaluated using the probit approach described in the water quality criteria "Blue Book" (NAS/NAE, 1973), or using models of toxicant accumulation and action in organisms (such as described by Mancini, 1983, or Erickson et al., 1989), the phenomenon of delayed mortality should be taken into account before judging the mixing zone concentrations to be safe.

The above recommendations assume that the effluent is repulsive, such that free-swimming organisms would avoid the mixing zones. While most toxic effluents are repulsive, caution is necessary in evaluating attractive mixing zones of known effluent toxicity, and denial of such mixing zones may well be appropriate. It is also important to assure that concentration isopleths within any plume will not extend to restrict passage of swimming organisms into tributary streams.

In all cases, the size of the mixing zone and the area within certain concentration isopleths should be evaluated for their effect on the overall biological integrity of the water body. If the total area affected by elevated concentrations within all mixing zones combined is small compared with the total area of a water body (such as a river segment), then mixing zones are likely to have little effect on the integrity of the water body as a whole, provided that they do not impinge on unique or critical habitats. EPA has developed a multistep procedure for evaluating the overall acceptability of mixing zones (Brungs, 1986).

Shape

The shape of a mixing zone should be a simple configuration that is easy to locate in a body of water and that avoids impingement on biologically important areas. In lakes, a circle with a specified radius is generally preferable, but other shapes may be specified in the case of unusual site requirements. Most States allow mixing zones as a policy issue but provide spatial dimensions to limit the areal extent of the mixing zones. The mixing zones are then allowed (or not allowed) after case-by-case determinations. State regulations dealing with streams and rivers generally limit mixing zone widths, cross-sectional areas, and flow volumes, and allow lengths to be determined on a case-by-case basis. For lakes, estuaries, and coastal waters, dimensions are usually specified by surface area, width, cross-sectional area, and volume. "Shore-hugging" plumes should be avoided in all water bodies.

Outfall Design

Before designating any mixing zone, the State should ensure that the best practicable engineering design is used and that the location of the existing or proposed outfall will avoid significant adverse aquatic resource and water quality impacts of the wastewater discharge.

In-Zone Quality

Mixing zones are areas where an effluent discharge undergoes initial dilution and are extended to cover the secondary mixing in the ambient water body. A mixing zone is an allocated impact zone where acute and chronic water quality criteria can be exceeded as long as a number of protections are maintained, including freedom from the following:

(1) materials in concentrations that will cause acutely toxic conditions to aquatic life;

(2) materials in concentrations that settle to form objectionable deposits;

(3) floating debris, oil, scum, and other material in concentrations that form nuisances;

(4) substances in concentrations that produce objectionable color, odor, taste, or turbidity; and

(5) substances in concentrations that produce undesirable aquatic life or result in a dominance of nuisance species.

Acutely toxic conditions are defined as those lethal to aquatic organisms that may pass through the mixing zone. As discussed in section 5.1.2 below, the underlying assumption for allowing a mixing zone is that a small area of concentrations in excess of acute and chronic criteria but below acutely toxic releases can exist without causing adverse effects to the overall water body. The State regulatory agency can decide to allow or deny a mixing zone on a site-specific basis. For a mixing zone to be permitted, the discharger should prove to the State regulatory agency that all State requirements for a mixing zone are met.

5.1.2 Prevention of Lethality to Passing Organisms

Lethality is a function of the magnitude of pollutant concentrations and the duration an organism is exposed to those concentrations. Requirements for wastewater plumes that tend to attract aquatic life should incorporate measures to reduce the toxicity (e.g., via pretreatment, dilution) to minimize lethality or any irreversible toxic effects on aquatic life.

EPA's water quality criteria provide guidance on the magnitude and duration of pollutant concentrations causing lethality. The CMC is used as a means to prevent lethality or other acute effects. As explained in Appendix D to the *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a), the CMC is a toxicity level and should not be confused with an LC_{50} level. The CMC is defined as one-half of the final acute value (FAV) for specific toxicants and 0.3 acute toxicity unit (TU_a) for effluent toxicity (USEPA, 1991a. chap. 2). The CMC describes the condition under which lethality will not occur if the duration of the exposure to the CMC level is less than 1 hour. The CMC for whole-effluent toxicity is intended to prevent lethality or acute effects in the aquatic biota. The CMC for individual toxicants prevents acute effects in all but a small percentage of the tested species. Thus, the areal extent and concentration isopleths of the mixing zone must be such that the 1-hour average exposure of organisms passing through the mixing zone is less than the CMC. The organism must be able to pass through quickly or flee the high-concentration area. The objective of mixing zone water quality recommendations is to provide time-exposure histories that produce negligible or no measurable effects on populations of critical species in the receiving system.

Lethality to passing organisms can be prevented in the mixing zone in one of four ways. The first method is to prohibit concentrations in excess of the CMC in the pipe itself, as measured directly at the end of the pipe. As an example, the CMC should be met in the pipe whenever a continuous discharge is made to an intermittent stream. The second approach is to require that the CMC be met within a very short distance from the outfall during chronic design flow conditions for receiving waters (see section 5.2, this Handbook).

If the second alternative is selected, hydraulic investigations and calculations indicate that the use of a high-velocity discharge with an initial velocity of 3 m/sec, or greater, together with a mixing zone spatial limitation of 50 times the discharge length scale in any direction, should ensure that the CMC is met within a few minutes under practically all conditions.

The discharge length scale is defined as the square root of the cross-sectional area of any discharge pipe.

A third alternative (applicable to any water body) is not to use a high-velocity discharge.

Rather the discharger should provide data to the State regulatory agency showing that the most restrictive of the following conditions are met for each outfall:

- The CMC should be met within 10 percent of the distance from the edge of the outfall structure to the edge of the regulatory mixing zone in any spatial direction.

- The CMC should be met within a distance of 50 times the discharge length scale in any spatial direction. In the case of a multiport diffuser, this requirement must be met for each port using the appropriate discharge length scale of that port. This restriction will ensure a dilution factor of at least 10 within this distance under all possible circumstances, including situations of severe bottom interaction, surface interaction, or lateral merging.

- The CMC should be met within a distance of 5 times the local water depth in any horizontal direction from any discharge outlet. The local water depth is defined as the natural water depth (existing prior to the installation of the discharge outlet) prevailing under mixing-zone design conditions (e.g., low-flow for rivers). This restriction will prevent locating the discharge in very shallow environments or very close to shore, which would result in significant surface and bottom concentrations.

A fourth alternative (applicable to any water body) is for the discharger to provide data to the State regulatory agency showing that a drifting organism would not be exposed to 1-hour average concentrations exceeding the CMC, or would not receive harmful exposure when evaluated by other valid toxicological analysis (USEPA, 1991a, chap. 2). Such data should be collected during environmental conditions that replicate critical conditions.

For the third and fourth alternatives, examples of such data include monitoring studies, except for those situations where collecting chemical samples to develop monitoring data would be impractical, such as at deep outfalls in oceans, lakes, or embayments. Other types of data could include field tracer studies using dye, current meters, other tracer materials, or detailed analytical calculations, such as modeling estimations of concentration or dilution isopleths.

The following outlines a method, applicable to the fourth alternative, to determine whether a mixing zone is tolerable for a free-swimming or drifting organism. The method incorporates mortality rates (based on toxicity studies for the pollutant of concern and a representative organism) along with the concentration isopleths of the mixing zone and the length of time the organism may spend in each isopleth. The intent of the method is to prevent the actual time of exposure from exceeding the exposure time required to elicit an effect:

$$\sum \left(\frac{T(n)}{ET(X) \ at \ C_{(n)}} \right) \leq 1$$

where T(n) is the exposure time an organism is in isopleth n, and ET(X) is the "effect time." That is, ET(X) is the exposure time required to produce an effect (including a delayed effect) in X percent of organisms exposed to a concentration equal to $C_{(n)}$, the concentration in isopleth n. ET(X) is experimentally determined; the effect is usually mortality. If the summation of ratios of exposure time to effect time is less than 1, then the percent effect will not occur.

5.1.3 Human Health Protection

For protection of human health, the presence of mixing zones should not result in significant health risks when evaluated using reasonable assumptions about exposure pathways. Thus, where drinking water contaminants are a concern, mixing zones should not encroach on drinking water intakes. Where fish tissue residues are a concern (either because of measured or predicted residues), mixing zones should not be projected to result in significant health risks to average consumers of fish and shellfish, after considering exposure duration of the affected aquatic organisms in the mixing zone and the patterns of fisheries use in the area.

While fish tissue contamination tends to be a far-field problem affecting entire water bodies rather than a narrow-scale problem confined to mixing zones, restricting or eliminating mixing zones for bioaccumulative pollutants may be appropriate under conditions such as the following:

- Mixing zones should be restricted such that they do not encroach on areas often used for fish harvesting particularly of stationary species such as shellfish.

- Mixing zones might be denied (see section 5.1.4) where such denial is used as a device to compensate for uncertainties in the protectiveness of the water quality criteria or uncertainties in the assimilative capacity of the water body.

5.1.4 Where Mixing Zones Are Not Appropriate

States are not required to allow mixing zones and, if mixing zones are allowed, a State regulatory agency may decide to deny a mixing zone in a site-specific case. Careful consideration must be given to the appropriateness of a mixing zone where a substance discharged is bioaccumulative, persistent, carcinogenic, mutagenic, or teratogenic.

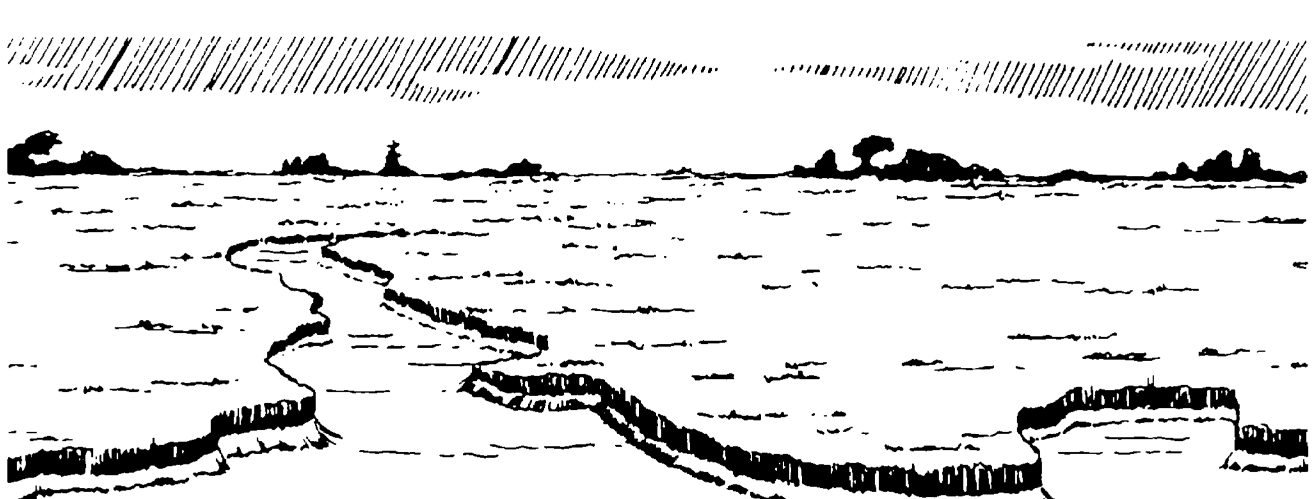
Denial should be considered when bioaccumulative pollutants are in the discharge. The potential for a pollutant to bioaccumulate in living organisms is measured by:

- the bioconcentration factor (BCF), which is chemical-specific and describes the degree to which an organism or tissue can acquire a higher contaminant concentration than its environment (e.g., surface water);

- the duration of exposure; and

- the concentration of the chemical of interest.

While any BCF value greater than 1 indicates that bioaccumulation potential exists, bioaccumulation potential is generally not considered to be significant unless the BCF exceeds 100 or more. Thus, a chemical that is discharged to a receiving stream resulting in



low concentrations and has a low BCF value will not result in a bioaccumulation hazard. Conversely, a chemical that is discharged to a receiving stream resulting in a low concentration but having a high BCF value may result in a bioaccumulation hazard. Also, some chemicals of relatively low toxicity, such as zinc, will bioconcentrate in fish without harmful effects resulting from human consumption.

Factors such as size of zone, concentration gradient within the zone, physical habitat, and attraction of aquatic life are important in this evaluation. Where unsafe fish tissue levels or other evidence indicates a lack of assimilative capacity in a particular water body for a bioaccumulative pollutant, care should be taken in calculating discharge limits for this pollutant or the additivity of multiple pollutants. In such instances, the ecological or human health effects may be so adverse that a mixing zone is not appropriate.

Another example of when a regulator should consider prohibiting a mixing zone is in situations where an effluent is known to attract biota. In such cases, provision of a continuous zone of passage around the mixing area will not serve the purpose of protecting aquatic life. A review of the technical literature on avoidance/attraction behavior revealed that the majority of toxicants elicited an avoidance or neutral response at low concentrations (Versar, 1984). However, some chemicals did elicit an attractive response, but the data were not sufficient to support any predictive methods. Temperature can be an attractive force and may counter an avoidance response to a pollutant, resulting in attraction to the toxicant discharge. Innate behavior such as migration may also supersede an avoidance response and cause a fish to incur a significant exposure.

5.1.5 Mixing Zones for the Discharge of Dredged or Fill Material

EPA, in conjunction with the Department of the Army, has developed guidelines to be applied in evaluating the discharge of dredged or fill material in navigable waters (see 40 CFR 230). The guidelines include provisions for determining the acceptability of mixing discharge zones (section 230.11(f)). The particular pollutant involved should be evaluated carefully in establishing dredging mixing zones. Dredged spoil discharges generally result in temporary short-term disruption and do not represent continuous discharge that will affect beneficial uses over a long term. Disruption of beneficial uses should be the primary consideration in establishing mixing zones for dredge and fill activities. State water quality standards should reflect these principles if mixing zones for dredging activities are referenced.

5.1.6 Mixing Zones for Aquaculture Projects

The Administrator is authorized, after public hearings, to permit certain discharges associated with approved aquaculture projects (section 318 of the Act). The regulations relating to aquaculture (40 CFR 122.56 and 125.11) provide that the aquaculture project area and project approval must not result in the enlargement of any previously approved mixing zone. In addition, aquaculture regulations provide that designated project areas must not include so large a portion of the body of water that a substantial portion of the indigenous biota will be exposed to conditions within the designated projects area (section 125.11(d)). Areas designated for approved aquaculture projects should be treated in the same manner as other mixing zones. Special allowances should not be made for these areas.

5.2 Critical Low-Flows

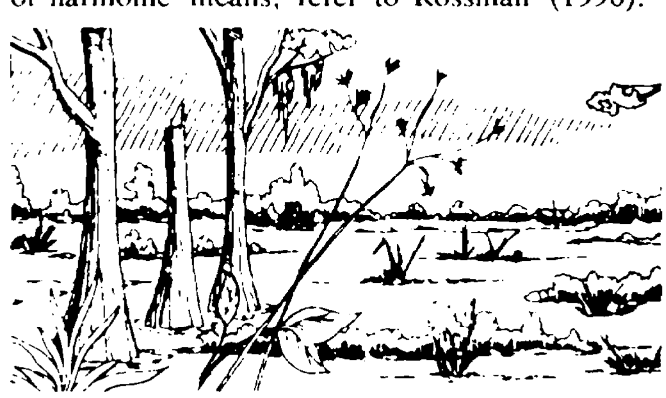
Water quality standards should protect water quality for designated uses in critical low-flow situations. In establishing water quality standards, States may designate a critical low-flow below which numerical water quality criteria do not apply. At all times, waters shall be free from substances that settle to form objectionable deposits; float as debris, scum, oil, or other matter; produce objectionable color, odor, taste, or turbidity; cause acutely toxic conditions; or produce undesirable or nuisance aquatic life.

To do steady-state waste load allocation analyses, these low-flow values become design flows for sizing treatment plants, developing waste load allocations, and developing water quality-based effluent limits. Historically, these so-called "design" flows were selected for the purposes of waste load allocation analyses that focused on instream dissolved oxygen concentrations and protection of aquatic life. EPA introduced hydrologically and biologically based analyses for the protection of aquatic life and human health with the publication of the *Technical Support Document for Water Quality-based Toxics Control.* These concepts have been expanded subsequently in guidance entitled *Technical Guidance Manual for Performing Wasteload Allocations, Book 6, Design Conditions*, (USEPA, 1986c). These new developments are included in Appendix D of the 1991 *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a). The discussion here is greatly simplified; it is provided to support EPA's recommendation for baseline application values for instream flows and thereby maintain the intended stringency of the criteria for priority toxic pollutants. EPA recommended either of two methods for calculating acceptable low-flows, the traditional hydrologic method developed by the U.S. Geological Survey and a biologically based method developed by EPA.

Most States have adopted specific low-flow requirements for streams and rivers to protect designated uses against the effects of toxics. Generally, these have followed the guidance in the TSD. EPA believes it is essential that States adopt design flows for steady-state analyses so that criteria are implemented appropriately. The TSD also recommends the use of three dynamic models to perform waste load allocations. Because dynamic waste load models do not generally use specific steady-state design flows but accomplish the same effect by factoring in the probability of occurrence of stream flows based on the historical flow record, only steady-state conditions will be discussed here. Clearly, if the criteria are implemented using inadequate design flows, the resulting toxics controls would not be fully effective because the resulting ambient concentrations would exceed EPA's criteria.

In the case of aquatic life, more frequent violations than the assumed exceedences once in 3 years would result in diminished vitality of stream ecosystems characteristics by the loss of desired species such as sport fish. Numeric water quality criteria should apply at all flows that are equal to or greater than flows specified in Exhibit 5-1.

EPA is recommending the harmonic mean flow to be applied with human health criteria for carcinogens. The concept of a harmonic mean is a standard statistical data analysis technique. EPA's model for human health effects assumes that such effects occur because of a long-term exposure to low concentration of a toxic pollutant (for example, 2 liters of water per day for 70 years). To estimate the concentrations of the toxic pollutant in those 2 liters per day by withdrawal from streams with a high daily variation in flow, EPA believes the harmonic mean flow is the correct statistic to use in computing such design flows rather than other averaging techniques. For a description of harmonic means, refer to Rossman (1990).



AQUATIC LIFE

Acute criteria (CMC)	1Q10 or 1B3
Chronic criteria (CCC)	7Q10 or 4B3

HUMAN HEALTH

Non-carcinogens	30Q5
Carcinogens	Harmonic mean flow

Where:

1Q10 is the lowest one day flow with an average recurrence frequency of once in 10 years determined hydrologically;

1B3 is biologically based and indicates an allowable exceedence of once every 3 years. It is determined by EPA's computerized method (DFLOW model);

7Q10 is the lowest average 7 consecutive day low flow with an average recurrence frequency of once in 10 years determined hydrologically;

4B3 is biologically based and indicates an allowable exceedence for 4 consecutive days once every 3 years. It is determined by EPA's computerized method (DFLOW model);

30Q5 is the lowest average 30 consecutive day low flow with an average recurrence frequency of once in 5 years determined hydrologically; and

harmonic mean flow is a long term mean flow value calculated by dividing the number of daily flows analyzed by the sum of the reciprocals of those daily flows.

Exhibit 5-1. EPA recommendations for design flows

EPA has produced guidance on flow considerations (USEPA, 1986d) which calculates design flows based on steady-state modeling. Two design flows are calculated, one for the criterion continuous concentration (CCC) and one for the criterion maximum concentration (CMC). The CCC is the 4-day average concentration of a pollutant in ambient water that should not be exceeded more than once every 3 years on average. The CCC is therefore, a chronic concentration. The CMC is a 1-hour average concentration in ambient waters that should not be exceeded more than once every 3 years on average. The CMC is an acute concentration. Note that when a criterion specifies a 4-day average concentration that should not be exceeded more than once every 3 years, this should not be interpreted as implying that a 4Q3 low-flow is appropriate for use as the design flow.

EPA had recommended interim use of the 1Q5 and 1Q10 low-flow as the CMC design flow and the 7Q5 and 7Q10 low-flows as the CCC design flow for unstressed and stressed systems, respectively. Further consideration of stress placed on aquatic ecosystems resulting from exceedences of water quality criteria indicates that there is little justification for different design flows for unstressed and stressed systems. All ecosystems have been changed and, therefore, stressed as a result of human activities. Therefore, the recommended design flow for CMC is 1Q10 and for CCC is 7Q10. States may designate other design or low-flows but such flows, must be scientifically justified. That many streams within a State have no flow at 7Q10 is not adequate justification for designating alternative flows.

5.3 Variances From Water Quality Standards

EPA first formally indicated allowability of State WQS variance provisions in Decision of the General Counsel No. 44, dated June 22, 1976, which specifically considered an Illinois variance provision, and expanded upon the acceptability of State WQS variance procedures in Decision of the General Counsel No. 58 (OGC No. 58) dated March 29, 1977 (published, in part, at 44 F.R. 39508 (July 6, 1979)). Subsequent guidance has elaborated on or clarified the policy over the years. For example, the Director of EPA's Criteria and Standards Division transmitted EPA's definition of a WQS variance to the Regional WQS Coordinators on July 3, 1979, and on March 15, 1985, the Director of the Office of Water Regulations and Standards, responding to questions raised on WQS variances, issued a reinterpretation of the factors that could be considered when granting variances.

Variance procedures involve the same substantive and procedural requirements as removing a designated use (see section 2.7, this Handbook), but unlike use removal, variances are both discharger and pollutant specific, are time-limited, and do not forego the currently designated use.

A variance should be used instead of removal of a use where the State believes the standard can ultimately be attained. By maintaining the standard rather than changing it, the State will assure that further progress is made in improving water quality and attaining the standard. With a variance, NPDES permits may be written such that reasonable progress is made toward attaining the standards without violating section 402(a)(1) of the Act, which requires that NPDES permits must meet the applicable water quality standards.

State variance procedures, as part of State water quality standards, must be consistent with the substantive requirements of 40 CFR 131. EPA has approved State-adopted variances in the past and will continue to do so if:

- each individual variance is included as part of the water quality standard;
- the State demonstrates that meeting the standard is unattainable based on one or more of the grounds outlined in 40 CFR 131.10(g) for removing a designated use;
- the justification submitted by the State includes documentation that treatment more advanced than that required by sections 303(c)(2)(A) and (B) has been carefully considered, and that alternative effluent control strategies have been evaluated;
- the more stringent State criterion is maintained and is binding upon all other dischargers on the stream or stream segment;
- the discharger who is given a variance for one particular constituent is required to meet the applicable criteria for other constituents;
- the variance is granted for a specific period of time and must be rejustified upon expiration but at least every 3 years (Note: the 3-year limit is derived from the triennial review requirements of section 303(c) of the Act.);
- the discharger either must meet the standard upon the expiration of this time period or must make a new demonstration of "unattainability";
- reasonable progress is being made toward meeting the standards; and
- the variance was subjected to public notice, opportunity for comment, and public hearing. (See section 303(c)(1) and 40 CFR 131.20.) The public notice should contain a clear description of the impact of the variance upon achieving water quality standards in the affected stream segment.

CHAPTER 6

PROCEDURES FOR REVIEW AND REVISION OF WATER QUALITY STANDARDS

(40 CFR 131 - Subpart C)

Table of Contents