

# **Mixing Zones: Unreasonable Interference—Discussion Paper #1**

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**State of Idaho  
Department of Environmental Quality**

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## Background

A mixing zone is an area within the receiving water body where dilution of a discharge takes place and where exceedances of numeric criteria are allowed if criteria cannot be met by the discharger at end-of-pipe. Mixing zones are not specifically called out in the Clean Water Act (CWA) but instead are an optional component of water quality standards (WQS) as described in 40 CFR 131.13. Mixing zones may only be authorized by a state if the state has a mixing zone policy. Mixing zone policies must be approved by the United States Environmental Protection Agency (EPA). Available records show that Idaho's mixing zone policy has been in the state's standards since 1980, and few changes to the policy's wording have occurred since then.

According to EPA's *Water Quality Standards Handbook* (EPA 1994), "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."

The Idaho Department of Environmental Quality (DEQ) is undertaking this rulemaking to revise the current language regarding mixing zones to clarify how it reviews and evaluates the need for, and applicability of, mixing zones. DEQ is proposing to retain the narrative standard in the current mixing zone rule that stipulates that "a mixing zone should be located so it does not cause unreasonable interference with or danger to existing beneficial uses" (IDAPA 58.01.02.060.01.b). Unreasonable interference is not defined in the current rule; instead, the rule states that "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 the mixing zone and, if applicable, its size, configuration, and location" (IDAPA 58.01.02.060.01). DEQ believes this language does not fully describe the information needed from the regulated community to ensure that an authorized mixing zone does not cause an unreasonable interference or danger to beneficial uses. To provide clarity and more certainty, DEQ is proposing to set out in the rule what constitutes an unreasonable interference or danger to beneficial uses.

The uses potentially affected by a mixing zone include aquatic life uses as well as recreation and drinking water supplies. The potential impact of a mixing zone on these uses, and the manner in which the impact can be avoided, should be considered when determining if an unreasonable interference exists. This discussion paper will address what DEQ considers to be an unreasonable interference with beneficial uses.

## Protection of Aquatic Life

In general, mixing zones have the potential to impact aquatic life by affecting fish passage, spawning, egg incubation, rearing, thermal conditions, and acute toxicity. Each of these topics is explored below.

## **Interference with Fish Passage, Spawning, Egg Incubation, or Rearing**

Many salmonids migrate downstream as juveniles then return upstream to spawn as adults; resident fish species also move considerable distances, especially as adults (Young 1995). Therefore, adequate zones of passage are necessary to maintain the biological integrity of the water body. Anadromous species must be able to reach suitable spawning areas (EPA 1994). Of particular concern in Idaho is the protection of the spawning activities of salmonids (trout and salmon). To protect all the various aquatic life stages in Idaho's waters, DEQ evaluates the potential impacts associated with authorized discharges and mixing zones where excursions above the criteria, which were developed to support aquatic life, are allowed.

### **Zone of Passage**

According to EPA, to preserve a zone of passage for migrating fish or other organisms in the water course, state WQS should specifically identify the portions of the waters to be kept free from mixing zones (EPA 1994). Mixing zones are limited in size to allow for an adequately sized zone of passage for aquatic organisms; the *Water Quality Criteria: Report of the National Technical Advisory Committee to the Secretary of the Interior* "Green Book" (USDI 1968) recommends that a minimum of 75% of the stream width be left as a zone of passage. This width consideration has been translated in various ways by states in developing mixing zone size limitations. Idaho's WQS require that the width of a mixing zone is not to exceed 25% of the width of the stream. This size limitation is also established as a volume of the stream flow used to quantify the mixing zone size and to calculate wasteload allocations and/or effluent limits.

From a physical perspective, the mixing zone size limitations included in Idaho's WQS have historically been presumed to provide an adequate zone of passage. However, location of the plume relative to channel characteristics suitable for fish movement matters (DEQ 2000). Thus, DEQ can vary from the size limitations depending upon site specific conditions. In some cases, a larger mixing zone may still adequately allow for a zone of passage. In other cases, a smaller mixing zone may be needed to protect passage.

The following are of primary concern in evaluating the zone of passage: concentrations of various pollutants that are known to elicit an avoidance behavior and location of the mixing zone relative to suitable stream velocities and depths for fish passage.

### ***Avoidance Behavior***

In considering the allowable size of a mixing zone, DEQ takes into account not only the applicable water quality criteria but also the concentrations of various pollutants known to elicit an avoidance response in both the expected resident and migratory fish species. Since fish have been shown to have their upstream passage blocked when encountering elevated concentrations of pollutants, any permitted mixing zone must provide a sufficient zone of fish passage such that the allowed mixing zone does not have the potential to interfere with fish movements.

### ***Suitable Stream Velocities and Depths for Fish Passage***

Site-specific considerations of both channel morphology and species of particular concern should be considered, especially for discharges with small dilution factors. Evaluation of channel

morphology could be completed in conjunction with modeling efforts, as these efforts may involve detailed description of the receiving water. Of particular concern are instances in which a mixing zone is proposed for stream channels that contain a limited percentage of stream width with characteristics (e.g., depth or flow volume) capable of supporting fish passage. For example, it is not unusual for limited areas of some streams to contain areas with a well-defined thalweg adjacent to a comparatively large gravel bar over which only shallow flow travels. In such situations, a mixing zone could occupy less than 25% of the stream width, or less than 25% of the stream flow, but much more of the useable area of the stream for fish passage. In such cases, a site-specific determination of the appropriate physical extent of a mixing zone should be made. As indicated, such considerations must take into account requirements of species of concern (e.g., migrating Chinook salmon).

### **Spawning, Egg Incubation, and Rearing**

When a discharge is located near a spawning area, the mixing zone could interfere with the capability of the area to support spawning, egg incubation, and rearing of juvenile fish species. Therefore, DEQ has proposed looking at impacts to spawning as part of unreasonable interference. Any discharge that significantly alters habitat, lowers the dissolved oxygen content of the receiving water, contains bioaccumulative pollutants or suspended solids, or increases the temperature of a water body has the potential to impact spawning activities in several ways. For example, discharges containing elevated suspended solids may clog the gravel beds that salmonids depend upon for egg incubation. Incubating eggs are also very sensitive to long-term exposures to pollutants such as hydrocarbons, polychlorinated biphenyls (PCBs), pesticides, and other pollutants that sequester onto lipid molecules in the developing embryos (NMFS 2004). Juvenile fish inhabiting an area of a water body where a wastewater discharge exists are exposed to pollutants contained in the discharge at higher rates than fish that are more mobile and are just passing through the discharge plume. Thus, it is necessary to consider the effects of the discharge and mixing zone on fish rearing. Multiple studies have shown behavioral effects in fish associated with exposure to various pollutants (EPA 2002a).

### **Jeopardy to Endangered Species Act Listed Species, or Destruction or Adverse Modification to Critical Habitat**

The Endangered Species Act (ESA) requires that any action authorized, funded, or carried out by a federal agency not jeopardize the continued existence of any endangered or threatened species or result in the destruction (or adverse modification) of critical habitat of such species. Critical habitat is identified for salmon and steelhead in the Federal Register (2005). Mixing zone authorizations that allow for excursions above criteria can be of particular concern to such species because of their limited range in Idaho, low populations, or threats to their existence. Thus, DEQ proposes taking into consideration the existence of endangered species in the area of the discharge when determining whether the mixing zone will cause unreasonable interference with uses.

On May 7, 2014, the National Marine Fisheries Service (NMFS) concluded in its ESA Section 7(a)(2) Biological Opinion (BiOp) that the effect of approving some of Idaho's criteria for toxic substances is likely to result in destruction or adverse modification of designated critical habitat and jeopardize the continued existence of Snake River spring/summer Chinook salmon, Snake

River fall Chinook salmon, Snake River Sockeye salmon, and Snake River Basin Steelhead. NMFS identified adjusting mixing zones to ensure an adequate zone of passage as one reasonable and prudent alternative to avoid jeopardy associated with certain toxics.

Although mixing zone size and location will always be an issue, until new criteria for toxic substances are adopted, additional scrutiny will be paid to mixing zones located in the habitat of ESA-listed species. DEQ believes it is consistent with the conclusions in the BiOp to include impacts on ESA-listed species in the mixing zone rule. Further consultation with NMFS, United States Fish and Wildlife Service, and Idaho Department of Fish and Game may be necessary to determine potential impacts of mixing zones on spawning areas of listed species.

## **Heat in the Discharge that Causes Thermal Shock, Instant Lethality, or Loss of Cold Water Refugia**

Heat in a discharge can cause thermal shock, instant lethality, or a loss of cold water refugia. According to *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards* (EPA 2003), the following considerations should be taken into account when conducting a mixing zone analysis:

- Within 2 seconds of plume travel from the point of discharge, maximum temperatures should not exceed 32°C.
- The cross-sectional area of the receiving water body exceeding 25°C should be limited to less than 5%.
- The cross-sectional area of the receiving water body exceeding 21°C should be limited to less than 25%, or if upstream temperatures exceed 21°C, then at least 75% of the receiving water body should not have temperature increases of more than 0.3°C.
- In spawning and egg incubation areas, the maximum daily average stream temperatures should not exceed 9°C, or the temperatures should not be increased by more than 0.3°C above ambient stream temperatures during times when spawning and incubation occurs.

## **Attraction to Discharge Plume**

According to EPA (1994), most toxicants elicit avoidance or neutral responses at low concentrations. However, heated discharges may attract certain species of fish. Discharges that attract free-swimming organisms have the potential to adversely affect aquatic life because free-swimming organisms may remain within the mixing zone area for longer periods of time. DEQ may consider restricting or denying mixing zones for discharges that attract free-swimming organisms or waterfowl.

## **Acute Toxicity to Aquatic Life Outside the Zone of Initial Dilution**

IDAPA 58.01.02.210 includes numeric water quality criteria that address the effects of toxic pollutants on aquatic life. Further toxicity data can be found in EPA's ECOTOX databases (<http://cfpub.epa.gov/ecotox>). It is possible to allow for a zone of initial dilution (ZID) and, at the same time, ensure no acutely toxic conditions occur. Acute criteria, which are defined as one-half the final acute value for specific toxicants, describe the concentration at which toxic effects (such as lethality) will not occur when the exposure is less than 1 hour. Acutely toxic conditions

cause lethality after short-term exposure (e.g., 1 hour or less) and should be avoided by limiting the magnitude of pollutant concentrations as well as ensuring that the frequency and duration of exposure to elevated concentrations is limited (EPA 2002b). DEQ believes that acute toxicity outside of the ZID constitutes unreasonable interference with aquatic life uses. If rapid and complete mixing cannot be achieved within a minimal distance from the point of discharge, then other treatment technologies and discharge alternatives should be considered as mixing zones should not be used as substitutes for more efficient treatment of acutely toxic discharges.

## **Protection of Human Health**

In considering the authorization of a mixing zone, DEQ considers potential impacts to human health and safety. Depending on the beneficial use of the water body, various human health-based water quality criteria may be appropriate for use in evaluating and regulating the mixing zone. Potential impacts can be evaluated through water quality criteria associated with ingestion of water (domestic water supply uses), incidental ingestion of untreated water when recreating in or on the water and consumption of fish (recreational uses). In determining whether human health-based criteria should be considered, the designated use of the water body in question must be known. The following sections address water quality criteria developed to protect domestic water supply, contact recreation, and fish consumption.

### **Concentrations of Pollutants that Exceed Maximum Contaminant Levels at Drinking Water Intake Structures**

Those water bodies designated as domestic water supply (IDAPA 58.01.02.100.03.a) should have water quality appropriate for use as drinking water supplies. The establishment of any mixing zone that exceeds maximum contaminant levels (MCLs) at a drinking water intake is considered to be an unreasonable interference with the drinking water supply use.

Water quality criteria designed to protect human health for some pollutants are more restrictive (i.e., allowable concentrations are lower) than corresponding water quality criteria designed to protect aquatic life. Some human health criteria are more stringent than the MCLs because the MCLs take economics of treatment into account, whereas CWA criteria do not. Therefore, even where MCLs are met, there may be more stringent criteria that DEQ will consider when evaluating the impacts of a mixing zone authorization.

### **Interference with Public Swimming Areas**

DEQ believes exceeding bacteria criteria within public swimming areas is an unreasonable interference with recreational uses. Of particular concern for discharges from wastewater treatment plants is *Escherichia coli* (*E. coli*). Those waters designated for protection of contact recreation must not contain *E. coli* in concentrations exceeding a geometric mean of 126 *E. coli* organisms per 100 milliliters based on a minimum of five samples taken every 3 to 7 days over a 30-day period (IDAPA 58.01.02.251.01.a). If the discharge plume impinges on a public swimming beach, then a mixing zone for *E. coli* is not appropriate, as it may cause unreasonable interference with beneficial uses and unacceptable risk to human health.

## Bioaccumulative Pollutants

Pollutants that are toxic, persistent, and bioaccumulative have been linked to significant adverse effects in humans and animals. Bioaccumulation is the uptake of a substance in an organism from the environment (e.g., food, water, and sediment) that leads to the organism having a higher internal concentration of the substance than what is found in its surrounding environment because of an inability to break it down and/or secrete it. Though similar to bioaccumulation, bioconcentration involves uptake from water only. In general, substances that are more lipid-soluble, and less water-soluble, are more likely to bioaccumulate.

To implement this provision in the rule, DEQ will need to more precisely identify pollutants that are of concern. Some states have published lists of pollutants considered to be of concern because of bioaccumulation. Examples of pollutants that have a high potential to bioaccumulate and that are currently present in some discharges throughout Idaho include PCBs, arsenic, selenium, and methylmercury (the form of mercury that has the potential to bioaccumulate).

If a substance tends to bioaccumulate, then bioaccumulation will occur in all water systems; however, its intensity will vary with site-specific conditions. In general, the residence time of the substance will increase the propensity to bioaccumulate. For example, fish occupying a fast-flowing stream are likely less subject to bioaccumulation than those occupying a lake. Potential accumulation of bioaccumulative pollutants in sediments may also have an adverse impact on aquatic life. Sessile organisms, such as bivalves, have much higher rates of exposure and tend to bioaccumulate greater amounts of pollutants because they cannot move away from localized discharges. Mixing zones should not encroach on areas often used for fish harvesting, particularly of stationary species such as shellfish (EPA 1991).

## Fish Consumption

Although consumption of aquatic organisms (e.g., fish, mussels, and crawdads) is not a separate beneficial use, it is an exposure pathway that is incorporated into the human health criteria applied to waters protected for either domestic water supply or recreational uses. Application of these criteria is based on the opportunity for exposure, not the actual occurrence of exposure. The evaluation of existing or proposed mixing zones to determine whether there is unreasonable interference with the recreational beneficial use should include a consideration of the following:

- Whether the discharge contains bioaccumulatives
- Whether the discharge will make harvest and consumption of aquatic organisms undesirable
- The frequency with which organisms are harvested in the vicinity of the mixing zone

## Other Western Region States

As demonstrated in the table below, items DEQ included in the proposed rule regarding unreasonable interference are common to the policies of neighboring states. While some states have explicit language regarding the various components contained here, other states are less overt in their requirements. None of the surrounding states omit any of these items entirely,

which demonstrates that our proposed rule language is consistent with both EPA guidance and the policies of other western region states.

	<b>Alaska</b>	<b>Colorado</b>	<b>Montana</b>	<b>Oregon</b>	<b>Washington</b>	<b>Utah</b>
Fish passage	√	√	√	√	√	√
Spawning, incubation, and rearing	√	I	√	√	I	√
ESA considerations	√	√	I	I	I	√
Acute toxicity	√	√	√	√	√	√
Drinking water supply	√	√	√	I	I	√
Contact recreation	√	√	√	I	I	√
Bioaccumulative pollutants	√	√	√	I	I	√

Notes: √ = explicit, I = implied; Endangered Species Act (ESA)

## Conclusion

DEQ believes the proposed rule language discussed in detail in this document will provide greater clarity and certainty to more precisely define what constitutes an unreasonable interference with beneficial uses as a result of a mixing zone authorization. DEQ believes the components of the proposed rule are all important in determining unreasonable interference and that the proposed language should be adopted by the state.

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