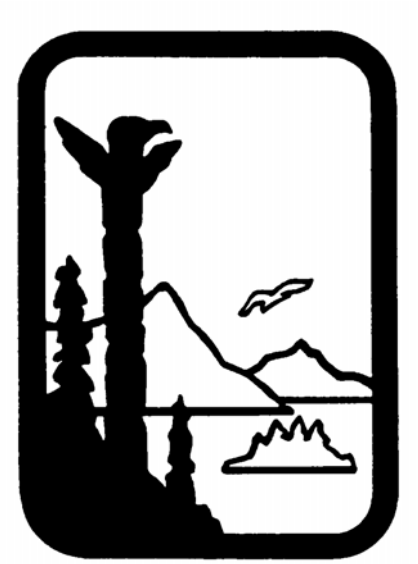
STATE OF ALASKA

DEPARTMENT OF ENVIRONMENTAL CONSERVATION



IMPLEMENTATION GUIDANCE: 2006 MIXING ZONE REGULATION REVISIONS

As amended through February 3, 2009

Sarah Palin
Governor

Larry Hartig
Commissioner

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I. PURPOSE

This guidance to Department of Environmental Conservation (DEC) wastewater discharge staff reflects **revisions** to regulations for mixing zones in 18 AAC 70.240 as amended through March 23, 2006. It focuses on changes made to the regulations and does not provide comprehensive guidance for all mixing zone regulations and procedures.

II. INTRODUCTION

A mixing zone is an area in a waterbody surrounding, or downstream of, a discharge where the effluent plume is diluted by the receiving water within which specified water quality criteria may be exceeded. DEC will approve, approve with conditions or deny a mixing zone application in a discharge permit or certification based on the following considerations and requirements:

In determining whether to authorize a mixing zone, DEC must consider:

- the characteristics of the receiving water
- the characteristics of the effluent
- the effects, including cumulative effects of multiple discharges, along with nonpoint sources of pollution on the uses of the water
- any measures that would mitigate potential adverse effects to aquatic resources
- any other relevant factors

In order to authorize a mixing zone DEC must find that the:

- effluent will be treated to remove, reduce and disperse the pollutants using the most effective, technologically and economically feasible, and at a minimum consistent with statutory and regulatory treatment requirements
- designated and existing uses of the waterbody as a whole will be maintained and protected
- overall biological integrity of the waterbody will not be impaired
- mixing zone is as small as practicable

To obtain a mixing zone approval, the mixing zone cannot:

- result in an acute or chronic toxic effect in the water column, sediments, or biota outside the boundaries of the mixing zone
- create a public health hazard that would preclude or limit existing uses of the waterbody for water supply or contact recreation
- preclude or limit established processing activities, commercial, sport, personal-use, or subsistence fish and shellfish harvesting
- result in a reduction in fish or shellfish population levels
- result in permanent or irreparable displacement of indigenous organisms
- adversely affect threatened or endangered species except as authorized under the Endangered Species Act
- form a barrier to migratory species or fish passage

- contain pollutants that bioaccumulate, bioconcentrate, or persist above natural levels in sediments, water, or biota
- present an unacceptable risk to human health from carcinogenic, mutagenic, teratogenic, or other effects
- settle to form objectionable deposits
- produce floating debris, oil, scum and other material in concentrations that form nuisances
- result in undesirable or nuisance aquatic life
- produce objectionable color, taste, or odor in aquatic resources harvested from the area for human consumption
- cause lethality to passing organisms
- exceed acute aquatic life criteria beyond a smaller initial mixing zone surrounding the outfall

Mixing zones in spawning areas of lakes, streams, rivers or other flowing fresh waters:

- will not be authorized in a spawning area of any of the five species of anadromous Pacific salmon, or allowed to adversely affect the capability of an area to support spawning.
- will not be authorized in a spawning area for Arctic grayling, northern pike, lake trout, brook trout, sheefish, burbot, landlocked coho salmon, Chinook salmon or sockeye salmon, or anadromous or resident rainbow trout, Arctic char, Dolly Varden, whitefish or cutthroat trout. There are a limited number of exceptions to this general prohibition. (see Section IX of this Guidance for conditions that must be met). Mixing zones in spawning areas:
- are not prohibited for the renewal of a mixing zone authorization where spawning was not occurring at the time of initial authorization (see Section IX).
- Exceptions to the general prohibition in spawning areas may be authorized for resident and nonsalmon anadromous species, if
    - the mixing zone does not contain pollutants that exceed criteria for the growth and propagation of fish, shellfish, other aquatic life and wildlife, and will not affect the future capability of the area, or
    - the applicant has submitted a mitigation plan approved by the Alaska Department of Fish and Game (ADF&G) (see Section IX).

III. BURDEN OF PROOF

DEC's decision to authorize a mixing zone is based on available evidence provided by the applicant and other credible sources. "Available evidence" is defined in 18 AAC 70.990(5) as

> "all relevant and applicable data and information the applicant has or can obtain, and all relevant and applicable data and information available to the department from other sources; "available evidence" does not include data and information that the collection or preparation of which, in the department's determination, is not practicable."

State Water Quality Standards in 18 AAC 70.240(a) clearly place the burden of proof on the applicant to submit a complete application with all the evidence necessary to fulfill the requirements in the regulations before a mixing zone can be authorized. Materials provided by applicants and DEC findings made on the basis

of the evidence provided in the application, will be available for review in the public record for the certification or permit.

IV. PROTECTION OF USES

There are several provisions in the mixing zone regulations that protect uses of the waterbody, generally or specifically. The uses described are usually "designated," "existing," and established," uses. Definitions for designated, existing, and established uses can be found in 18 AAC 70.020, 18 AAC 70.990(24), and 18 AAC 70.240(c)(4)(C).

An example of an established use is: "a mixing zone must not preclude or limit established processing activities or established commercial, sport, personal-use, or subsistence fish and shell fish harvesting" (see 18 AAC 70.240(c)(4)(C)).

Mixing zone authorizations are considered on a case by case basis which generally requires local knowledge of water uses. Information must be provided on the types of subsistence and personal use harvest for the waterbody to support any additional mixing zone conditions that may be needed to ensure protection of these uses. ADF&G Division of Subsistence can provide information on subsistence and personal use. Division of Subsistence has an online database but it may not be comprehensive. Online data and contact information can be found at http://www.subsistence.adfg.state.ak.us/.

Three steps ensure that the best available knowledge is used in the application for a mixing zone:

- Review of the ADF&G Subsistence online data base;
- Contact with the Regional Office of the ADF&G Subsistence Division; and
- As part of the permit application process, collect additional information on local uses from the permit applicant and from the public during the public comment period for the permit or certification.

Site-specific information may indicate that a mixing zone, as proposed, may negatively impact uses in the waterbody as a whole or may otherwise not meet one or more regulatory provisions. The Department will, working with State fisheries biologists and other appropriate experts as needed, consider whether any additional conditions are necessary to ensure compliance with 18 AAC 70.240. Such conditions could include prohibiting the mixing zone entirely; limiting the percentage of critical receiving water flow assumed to be available for mixing and dilution (see Section XI of this Guidance); or posing additional restrictions on size, placement, or in-zone quality.

Changes outside the range of natural variability in baseline condition for key habitat parameters (e.g. temperature, dissolved oxygen, macroinvertebrate assemblages) in the vicinity of the mixing zone will be considered when evaluating a proposed mixing zone for compliance with 18 AAC 70.240(c)(3) and 240(c)(4)(D).

V. BIOACCUMULATING COMPOUNDS

Consideration of the adverse effects of a pollutant will include any available evidence of sublethal chronic effects and the potential of the pollutant to persist or bioaccumulate (18 AAC 70.240(d)(1)). For the purposes of this evaluation, the following definitions are found in 18 AAC 70.990:

- "bioaccumulation" means the ability of a substance or chemical to be taken up by an organism either directly from exposure to a contaminated medium or by consumption of food containing the substance or chemical;
- "bioconcentration" means the ability of a substance or chemical to be absorbed from water through gills or epithelial tissue and concentrate in the body of an organism; and
- "persist" means the ability of a substance or chemical not to decay, degrade, transform, volatilize, hydrolyze, or photolyze.

A list of bioaccumulating common compounds of potential concern can be found in Appendix A. It is important to recognize that effluents may contain other toxic pollutants not included in Appendix A that may bioaccumulate (or whose transformation products may bioaccumulate) to harmful levels as well, and these effects should also be considered under 18 AAC 70.240(d)(1).

VI. THREATENED AND ENDANGERED SPECIES & ESSENTIAL FISH HABITAT

DEC cannot independently approve any adverse effect or a "no effect" ruling for an Endangered Species Act (ESA) listed species under the mixing zone regulations. When considering adverse effect to threatened and endangered species as required under 18 AAC 70.240(c)(4)(F), effects must be evaluated by USFWS, NOAA or other federal action agency to determine whether adverse effects may be likely to occur as determined under the ESA regulations. Any adverse effects allowed as "incidental take" must be approved through either

- ESA section 7 consultation by a federal action agency (e.g. EPA consultation on a NPDES permit); or
- ESA section 10 incidental take permit issued by the USFWS or NOAA Fisheries. A section 10 permit generally requires a Habitat Conservation Plan. This is the responsibility of the applicant.

The Endangered Species Act (ESA) generally gives consultation authority to the U.S. Fish and Wildlife Service (USFWS) for freshwater species and to National Marine Fisheries Service (NOAA Fisheries) for species in marine and estuary habitats.

Essential Fish Habitat has been designated for all marine waters and brackish waters, and fresh water habitats of anadromous Pacific salmon. NOAA Fisheries administers EFH and may recommend conservation measures for these areas.

VII. HUMAN HEALTH

18 AAC 70.240 (d)(2) requires the applicant to demonstrate that the mixing zone does not present an unacceptable risk to human health. To determine health risk, the department may require an applicant to perform a site-specific analysis based on exposure pathways, including exposure duration of affected aquatic organisms in the proposed mixing zone, patterns of fisheries use, and consumption of water, fish, or shellfish in the area. The risk assessment method should follow guidelines found in *Technical Support Document for Water Quality-Based Toxics Control.* 1991. EPA/505/2-90-001. (EPA, 1991; available at http://www.epa.gov/npdes/pubs/owm0264.pdf and relevant technical updates to this reference.)

For carcinogens, the acceptable risk under 18 AAC 70.025 is based on a lifetime incremental cancer risk level of 1 in 100,000 for exposed individuals. For non carcinogens, an acceptable risk is based on the reference dose (RfD) obtained from the EPA's Integrated Risk Information System (IRIS) or other DEC-approved toxicological data source developed consistent with EPA risk assessment methodology hierarchy for selecting data sources.

VIII. FISH SPAWNING AREAS

18 AAC 70.240(e)-(j) establish specific prohibitions and requirements for mixing zones in fish spawning areas in freshwaters. Mixing zones that are proposed in spawning areas for species listed in 18 AAC 70.240(e) and .240(f), based on the exemptions in 18 AAC 70.240 (g) and (i), must also meet all other provisions in 18 AAC 70.240. The findings necessary for a decision regarding a mixing zone in a spawning area are diagramed in Appendix C.

For the purpose of implementing the mixing zone regulations found in 18 AAC 70.240, spawning areas are considered to be areas within lakes, streams, rivers, or other flowing fresh waters that offer suitable habitat for fish spawning and where spawning adults, incubating eggs, or alevins are present. In identifying and managing spawning areas under these regulations, the temporal and spatial aspects of spawning habitat and spawning fish, egg, and alevin presence, the proposed activity, and potential impacts will be considered in such a manner that the continued long-term use and availability of spawning habitat in the waterbody is properly protected.

As indicated in Appendix C, the agency with authority to determine the location and time of spawning areas and to approve mitigation plans depends on location of the waterbody as indicated below:

- ADF&G has authority over waters in Special Areas listed in AS 16.20 and waters in the *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes*; or
- DEC has authority over all other waters. The department normally defers to local habitat biologists in when determining the location and time of fish spawning areas and the appropriateness of proposed mitigation measures.

The ADF&G and DEC will consider all pertinent and available evidence, including local knowledge.

Any proposed mitigation measures must be reviewed by ADF&G using the procedures described in Appendix B**.** Mitigation plans must comply with state mitigation policies in the Anadromous Waters Catalog and 5 AAC 95.900. In addition, mitigation plans must meet the following conditions in order to comply with mixing zone provisions:

- The mixing zone must not include bioaccumulative and/or persistant pollutants to which early life stages of the relevant species and their prey are sensitive at levels that would result in significant adverse effects which are prohibited under 18 AAC 70.240(d)(1).
- Changes outside the range of natural variability in baseline condition for key habitat parameters (e.g. temperature, dissolved oxygen, macroinvertebrate assemblages) in the vicinity of the mixing zone must not be allowed to affect the overall habitat conditions (i.e. biological integrity) in the waterbody under 18 AAC 70.240(c)(3) and 240(c)(4)(D).
- Post-authorization monitoring should be performed on a limited set of appropriate indicators (e.g., macroinvertebrate and biodiversity indices) that will sensitively detect spawning habitat degradation, with specific, pre-established thresholds that trigger remedial action under 18 AAC 70.240(h).

The exemption to the prohibition in 18 AAC 70.240(i) regarding the re-authorization of a mixing zone allows facilities to continue to operate in places where fish started spawning after a mixing zone was authorized. This is the only exemption that applies to the spawning areas for the five species of anadromous Pacific salmon. In order to qualify for this exemption, the applicant must provide evidence that a thorough search of available knowledge of fish spawning activity in the waterbody was conducted prior to initial authorization of the mixing zone. This evidence could include the information described in Appendix B under "Information to support spawning area location and time determinations." As per AAC 70.240 (j), it is the responsibility of DEC and the ADF&G habitat biologists to determine the location and time of spawning. Lack of evidence because there was no assessment of spawning activity prior to the initial authorization is not sufficient to demonstrate an absence of spawning and would not qualify for this exemption.

Monitoring is usually required for mixing zones authorized in a spawning area. The department may require the applicant to conduct monitoring of effluent, ambient water quality, and a limited list of key spawning habitat indicators agreed to in consultation with ADF&G, Division of Habitat fisheries experts. A monitoring program should properly account for baseline conditions, natural variability and establish threshold levels that trigger remedial actions under 18 AAC 240(h).

IX. COMPUTER MODELS

Mixing zone models are tools used to predict how substances mix upon discharge to a receiving water. Department staff primarily use the CORMIX and PLUMES mixing zone models. However other models, if approved by the department, may be used to determine mixing zone characteristics. Alternative methods approved by the DEC must be comparable to CORMIX and PLUMES in terms of sophistication and ability. The CORMIX and PLUMES models are most accurate for near field dilution determinations, but are also capable of providing estimates of farfield dilution. Both CORMIX and PLUMES provide graphic representation

of the plume size and associated dilutions. When using the models for far field determinations, modeling results may not be reliable when a plume reaches a boundary such as a river bank. Both models require site specific hydrologic data about the discharge and receiving waters (see http://www.cormix.info/ and http://www.epa.gov/waterscience/standards/mixingzone/files/VP-Manual.pdf.) Model runs will be retained as a part of the administrative record for a permit.

X. INITIAL MIXING/ACUTE ZONE

Compliance with 18 AAC 70.240(d)(8) of the Water Quality regulations is assumed if **one** of the following methods is used to limit the size of the zone in which acute aquatic life criteria are exceeded:

1. The initial discharge velocity is 3 m/s or greater; and the mixing zone is no larger in any direction than 50 times the discharge length scale (i.e. the square-root of the cross-sectional area of the largest port).
2. Acute aquatic life criteria are met within a distance from the outfall that is no greater than
    - 10% of the distance to the boundary of the mixing zone;
    - 50 times the discharge length scale; and
    - 5 times the local water depth.
3. A drifting organism reaches the acute mixing zone boundary (i.e. the zone in which aquatic life criteria are exceeded) in 15 minutes or less.
4. A drifting organism does not receive harmful exposure when evaluated by a valid toxicological analysis approved by the department.

Other methods may be used but any method used to determine compliance must be comparable to those recommended in the EPA's Technical Support Document in terms of sophistication and ability.

For additional information on how these methods are implemented see *Technical Support Document for Water Quality-Based Toxics Control.* 1991. EPA/505/2-90-001

XI. FLOW CALCULATIONS FOR STREAMS AND RIVERS

A mixing zone must not create either a chemical or physical barrier to passing fish or other migratory organisms. This may require reserving part of the critical design flow for fish passage and not using all of the low flow volume for the mixing zone.

Low flows should be calculated using methods of

- Ashton and Carlson, *Determination of Seasonal, Frequency and Durational Aspects of Streamflow with Regard to Fish Passage Through Roadway Drainage Structures* (1984);
- Carlson, *Seasonal, Frequency and Durational Aspects of Streamflow in Southeast and Coastal Alaska* (1987); or
- Other appropriate regional regression flow model approved by the department.

The criteria design flows in 18 AAC 70.240(*l*)(2) are the default method of determining the appropriate low flow for a mixing zone. Historic river and effluent flow will initially be used to design a mixing zone with

sufficient dilution capacity during critical low-flow periods as designated in 18 AAC 70.240(*l*)(2). Other methods approved by the department may be used if the discharge can be coordinated with the flow of the receiving water. The actual flow data collected concurrent with the discharge may also be used under 18 AAC 70.240(*l*)(1) following methods approved by the department, and that provide protection comparable to that intended by the flows specified under 18 AAC 70.240(l)(2).

XII. WATER RIGHTS FOR MIXING ZONES

Permittees should consider obtaining water rights to guard against withdrawals by other water users that reduce receiving water volumes so as to impact their mixing zone and ability to continue to discharge. Although not required to obtain a discharge permit, DEC permitting staff will advise mixing zone applicants that they should contact DNR to obtain water rights.

XIII. REFERENCES

Meylan, W.M., Howard, P.H., Boethling, R.S. et al., 1999, *Improved Method for Estimating Bioconcentration/Bioaccumulation Factor from Octanol/Water Partition Coefficient*, Environ. Toxicol. Chem. 18(4): 664-672.

United States Environmental Protection Agency (EPA), December 2004a, *Region 9's Preliminary Remediation Goals*.

_____, August 2004b, *Persistent, Bioaccumulative, and Toxic (PBT) Profiler*, Office of Pollution Prevention and Toxics, http://www.pbtprofiler.net/.

_____, July 2004c, *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance, Dermal RiskAssessment)*, interim, Office of Emergency and Remedial Response, Washington, D.C., EPA/540/R/99/005.

_____February 2000, *Appendix to Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment Status and Needs*, Office of Water, Washington D.C., EPA-823-R-00-002.

APPENDIX A
BIOACCUMULATIVE COMPOUNDS

Table A-1: List of Most Common Compounds of Potential Concern for Bioaccumulation

Organic compounds are identified as bioaccumulative if they have a bioaccumulation criteria factor (BCF) equal to or greater than 1,000 or a log Kow greater than 3.5. Inorganic compounds are identified as bioaccumulative if they are listed as such by United States Environmental Protection Agency (EPA) (2000). Those compounds in Table X of 18 AAC 75.345 that are bioaccumulative, based on the definition above, are listed below.

Aldrin	DDT	Lead
Arsenic	Dibenzo(a,h)anthracene	Mercury
Benzo(a)anthracene	Dieldrin	Methoxychlor
Benzo(a)pyrene	Dioxins and furans	Nickel
Benzo(b)fluoranthene	Endrin	PCBs
Benzo(k)fluoranthene	Fluoranthene	Mirex
Cadmium	Heptachlor	Pyrene
Chlordane	Heptachlor epoxide	Selenium
Chrysene	Hexachlorobenzene	Silver
Copper	Hexachlorocyclopentadiene	Toxaphene
DDD	Indeno(1,2,3-c,d)pyrene	Zinc
DDE	Octachlorestyrene	

Because BCF values can relatively easily be measured or estimated, the BCF is frequently used to determine the potential for a chemical to bioaccumulate. A compound with a BCF greater than 1,000 is considered to bioaccumulate in tissue (EPA 2004b).

For inorganic compounds, the BCF approach has not been shown to be effective in estimating the compound's ability to bioaccumulate. Information available, either through scientific literature or site-specific data, regarding the bioaccumulative potential of an inorganic site contaminant should be used to determine if the pathway is complete.

The list was developed by including organic compounds that either have a BCF equal to or greater than 1,000 or a log octanol-water partitioning coefficient (Kow) greater than 3.5 and inorganic compounds that are listed by the EPA as being bioaccumulative (EPA 2000). The BCF can also be estimated from a chemical's physical and chemical properties. A chemical's octanol-water partitioning coefficient Kow along with defined regression equations can be used to estimate the BCF. EPA's Persistent, Bioaccumulative, and Toxic (PBT) Profiler (EPA 2004a) can be used to estimate the BCF using the Kow and linear regressions presented by Meylan et al. (1996). The PBT Profiler is located at http://www.pbtprofiler.net/. For compounds not found in the PBT Profiler, DEC recommends using a log Kow greater than 3.5 to determine if a compound is bioaccumulative.

APPENDIX B

Guidance for Mitigation Plans for the Authorization of Mixing Zones in Spawning Areas

Application and Evaluation Process

ALASKA
Department of
Environmental
Conservation

Introduction

The State of Alaska adopted revisions to the Alaska Water Quality Standards (18 AAC 70) mixing zone regulations in March of 2006. A mixing zone is an area in a waterbody surrounding, or downstream of, a discharge where the effluent plume is diluted by the receiving water within which specified water quality criteria may be exceeded. The state regulations establish the conditions under which a mixing zone would be authorized. These regulations include a number of provisions designed to protect aquatic life and designated uses of the waterbody as a whole. The mixing zone regulations address effluent treatment, acute toxicity, aquatic organism migration, and bioaccumulation. In addition to these general conditions, the regulations prohibit the authorization of a mixing zone within the spawning areas of anadromous Pacific salmon[1], land-locked salmon, other anadromous fishes, and resident fish. Mitigation plans may be used to grant an exception to the prohibition for the anadromous and resident fish listed in 18 AAC 70.240(f), but may **not** be used to authorize a mixing zone in spawning areas of anadromous Pacific salmon. All options for locating a mixing zone outside a spawning area should be exhausted prior to submission of a mitigation plan. Locating a mixing zone in a spawning area should only be considered as a last option.

The mitigation plan guidance provided here is applicable only for applications to the Department of Environmental Conservation (DEC) for an exclusion from the prohibition of mixing zones within spawning habitat. DEC permit staff will be responsible for determining compliance with mixing zone requirements outside of the mitigation review.

This guidance provides DEC and the Alaska Department of Fish and Game (ADF&G) procedures and criteria to use in evaluating mitigation plans for a mixing zone in a spawning area for fish listed in 18 AAC 70.240(f). These procedures are intended to ensure that approved mitigation plans will comply with both the Clean Water Act (CWA) and the state mitigation policies described below. The guidance also describes information that applicants must provide to support determinations as to the location and time of a spawning area under 240(e) and 240(f), and the information needed and conditions that apply to mitigation plans under 240(g) for mixing zones in spawning areas of land-locked salmon, anadromous fishes other than Pacific salmon, and resident fish.

Spawning area determination policy

For the purpose of implementing the mixing zone regulations found in 18 AAC 70.240, spawning areas are considered to be areas within lakes, streams, rivers, or other flowing fresh waters that offer suitable habitat for fish spawning and where spawning adults, incubating eggs, or alevins are present. In identifying and managing spawning areas under these regulations, the temporal and spatial aspects of spawning habitat and spawning fish, egg, and alevin presence, the

[1] The five species of anadromous Pacific salmon are defined as Chinook salmon, coho salmon, sockeye salmon, pink salmon, and chum salmon.

proposed activity, and potential impacts will be considered in such a manner that the continued long-term use of the waterbody and availability of spawning habitat is properly protected.

Mixing zone regulations

Spawning areas referenced in 18 AAC 70.240(g) are not necessarily the same as areas specified as important for spawning within the "Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes" developed under AS 16.05.871 – 16.05.901 (referred to as the Anadromous Waters Catalog). Spawning areas as referred to in the mixing zone regulations are considered discrete "areas" where fish actually spawn, and may be contained within or outside of the spatial boundaries of waters identified in the Anadromous Waters Catalog. Mixing zone regulations refer to spawning timing as well as location. The spatial and temporal aspects of a "spawning area" are referred to in 18 AAC 70.240(j), which states that "when determining whether to authorize a mixing zone under (e), (f), or (g) of this section, the department [Department of Environmental Conservation] will make that determination . . . (2) in conformance with the determination of the Department of Fish and Game, acting under AS 16.05.871 – 16.05.901, of the location and time of a spawning area within waters included in the *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes*, adopted by reference in 5 AAC 95.011, or . . ." (emphasis added).

The mixing zone regulations also protect spawning areas not included in the Anadromous Waters Catalog as determined under 18 AAC 70.240(j)(3), which states the department will make a spawning area determination "after consultation with the Department of Fish and Game, as to what the Department of Fish and Game considers the location and time of a spawning area not within waters described in (1) or (2) of this subsection."

Mixing zones in spawning areas are generally prohibited for (1) Arctic grayling, (2) northern pike, (3) lake trout, (4) brook trout, (5) sheefish, (6) burbot, (7) landlocked coho salmon, chinook salmon, or sockeye salmon; or (8) anadromous or resident rainbow trout, Arctic char, Dolly Varden, whitefish, or cutthroat trout" (18 AAC 70.240 (f)) unless an exemption is granted. The regulations allow two exemptions to the prohibition. An exemption is allowed if the discharge "does not contain pollutants at concentrations that exceed the criteria for growth and propagation of fish, shellfish, and other aquatic life and wildlife established in 18 AAC 70.020 (b)(1)-(12)", and "will not adversely affect the capability of the area to support future spawning, incubation and rearing activities,". An exemption is also allowed if the applicant submits and the state approves a mitigation plan. The development of a mixing zone within spawning habitat and the submittal of a mitigation plan should be used as the last available option. Development of a mitigation plan cannot be considered as an alternative to meeting all of the other regulatory mixing zone requirements.

Mitigation plans, along with other information provided by the applicant, must provide reasonable evidence that the discharge would protect the use of the waterbody for growth and propagation of fish and shellfish (18 AAC 70.240(c)). A mitigation plan must also be consistent with all other provisions of the mixing zone regulation in 18 AAC 70.240. The mitigation plan must adhere to the mitigation policy contained within the regulations for authorizing activities

within special areas (Critical Habitat Areas, Refuges, and Sanctuaries) managed by the ADF&G under (5 AAC 95.900) and waters contained in the Anadromous Waters Catalog (5 AAC 95.011) for all waters.

Mitigation policies

Mitigation within special areas is found in the following regulations:

> 5 AAC 95.900. Mitigation of damages
>
> (a) Each permittee shall mitigate any adverse effect upon fish or wildlife, or their habitat, which the commissioner determines may be expected to result from, or which actually results from, the permittee's activity, or which was a direct result of the permittee's failure to
>
> (1) comply with a permit condition or a provision of this chapter; or
>
> (2) correct a condition or change a method foreseeably detrimental to fish or wildlife, or their habitat.
>
> (b) Mitigation techniques must be employed in the following order of priority:
>
> (1) avoid an impact altogether by not taking a certain action or parts of an action;
>
> (2) minimize an impact by limiting the degree of magnitude of the action;
>
> (3) rectify the impact by repairing, rehabilitating, or restoring the affected environment;
>
> (4) reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action;
>
> (5) compensate for the impact by replacing or providing substitute resources or environments.
>
> (c) The duty to mitigate in (a) of this section does not apply to unavoidable adverse effects upon fish or wildlife populations, or their habitat, arising from an overwhelming force of nature with consequences not preventable by due and reasonable precautions.
>
> (d) The commissioner will, in his or her discretion, specify, by permit amendment, additional provisions for mitigating damage to fish and wildlife populations, and their habitat.
>
> (e) Notwithstanding the expiration or revocation of a permit, a permittee is responsible for the obligations arising under the terms and conditions of the permit, and under the provisions of this chapter.

The Anadromous Waters Catalog describes mitigation as follows:

> If the Commissioner determines that the proposed use or activity may have an adverse impact on fish or fish habitat, applicants may be required to employ appropriate measures to mitigate the adverse impacts in order to obtain a permit. For example, the department may require the applicant to utilize methods of operation or construction sequencing of a project that minimize the effects on fish migration, spawning, or rearing, or restrict work in the impacted area to certain “seasonal windows” when fish are less likely to be adversely impacted. Compensatory mitigation shall be considered only if all other mitigation measures do not adequately mitigate such adverse impacts. In those instances where the

adverse impact to fish or fish habitat is unavoidable, the department, in its discretion, may withhold permit authorization.

The mitigation measures may include one or more of the actions listed below:

1. Avoid the impact altogether by not taking a certain action or parts of an action.
2. Minimize the impact by limiting the degree or magnitude of the action and its implementation.
3. Rectify the impact by repairing, rehabilitating, or restoring the impacted environment.
4. Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the proposed use or activity.
5. Compensate for the impact by replacing or providing substitute resources or environments.

The application of the mitigation steps described within the Anadromous Waters Catalog is at the discretion of the ADF&G Commissioner for project approval under AS 16.05.871. However, an approved mitigation plan is required by the DEC in order to obtain an exemption from the prohibition on authorizing a mixing zone in spawning areas under 18 AAC 70.240(g).

The Anadromous Waters Catalog and special area permit regulations outline and define the mitigation sequence used to evaluate proposed development projects or other actions. Actions that are technically and economically feasible for each mitigation step must be included in the plan before actions in later mitigation steps will be considered.

This document describes the information that should be contained within a mitigation plan submitted as part of the application for authorization of a mixing zone within spawning areas. This guidance also describes how the information should be evaluated for each stage of the mitigation sequence to ensure the protection of aquatic life, and provides a consistent review framework. Since each situation is unique, the exact content within a mitigation plan will vary with the proposed effluent discharge and site specific characteristics of the waterbody.

The five mitigation steps are a sequential process. For each step, the applicant must provide the information necessary to evaluate whether they have complied with the mitigation step and citations or sources by which the information can be evaluated; or, the applicant must explain why such documentation is not necessary. The feasible terms and conditions for each mitigation step must be included in the mitigation plan before the subsequent mitigation steps will be considered. For example, a description of compensatory mitigation may not be necessary if potential impacts have been sufficiently minimized and there is little risk of unanticipated direct impacts.

General information required in a mitigation plan

Information to support spawning area location and time determinations

Information on the relevant fish community composition and life history is necessary in order to determine the location and timing of fish spawning. In addition to the Anadromous Waters Catalog, information sources include regional, state and federal fish biologists, state and federal species distribution maps or publications, local knowledge[2], and peer-reviewed publications. The applicant should provide a description of the fish present within the waterbody of the proposed discharge, spawning habitat requirements, spawning timing, incubation, and post incubation dispersal.

The Anadromous Waters Catalog and atlas can be used to identify areas important for the spawning of anadromous rainbow trout (Steelhead trout), Arctic char, Dolly Varden, whitefish, sheefish, or cutthroat trout, but generally does not provide information on spawning habitat locations at a scale useful for this application. The Anadromous Waters Catalog is not all inclusive in that some areas for spawning of anadromous fish may not have been identified in the Catalog, but would still be protected under the mixing zone regulations if there is sufficient evidence of spawning activity. Data specific to non-anadromous fish species (e.g. grayling), including resident populations of fish that also exhibit anadromous life cycles (e.g. Dolly Varden and rainbow trout) will not be found in the Anadromous Waters Catalog. Contacting the regional federal or state fish biologists may provide additional, more specific information. Data for non-anadromous fish species also may be found in the Fish Distribution Database being developed by the ADF&G(http://www.sf.adfg.state.ak.us/SARR/surveys/FishSurv_ims.cfm).

Rarely are all spawning locations within a waterbody known to local biologists, and short-term surveys may not be adequate due to the variability in population or stock numbers, water clarity, survey timing, or environmental conditions (discharge, water temperature, etc.). Specific spawning locations should be identified using field surveys conducted over multiple years, information obtained from regional biologists, consideration of local knowledge, and water temperature data, since spawning timing and incubation rates are linked to stream and lake water temperatures. The physical spawning habitat requirements of the relevant fish species can be obtained through literature descriptions. The physical characteristics often include descriptions of water depth and velocity, locations of upwelling or downwelling, substrate size distribution, aquatic plant distribution, location relative to lakes or ponds, and water temperature. Physical waterbody characteristics that approximate the spawning habitat characteristics of the target fish species can be used to target field work to verify fish spawning areas.

Other information required for mitigation plans

[2] Local knowledge can be used as supporting information to identify species distribution and spawning locations but should not be used exclusively to determine the absence of fish or fish spawning areas.

Within the mitigation plan the applicant should summarize the steps taken to meet all of the mixing zone requirements, including those designed to protect aquatic life. These include demonstration of adequate treatment (18 AAC 70.240 (c)(1)), and showing that the effluent does not contain pollutants that "bioaccumulate, bioconcentrate, or persist above natural levels in sediments, water, or biota to significantly adverse levels"(18 AAC 70.240 (d)). Discharges of bioaccumulative and/or persistent pollutants may impact sensitive early life stages of the relevant species and their prey and may result in a potentially significant exposure period during non-mobile juvenile life stages. Within the mitigation plan the applicant must show that they considered and minimized the potential for any secondary effects to the chemical or physical characteristics necessary for successful spawning. For example, a discharge with high biological or chemical oxygen demand, leading to reduced dissolved oxygen concentrations within spawning gravels, could cause algal or aquatic plant blooms that result in lower dissolved oxygen concentrations and changes in upwelling, water flow, flushing flows, or natural water temperatures. The applicant should also address the potential for toxicity to be altered by chemical changes following discharge.

Monitoring

DEC will require the applicant to conduct monitoring to ensure that the mitigation plan for establishment of a mixing zone in spawning habitat fully complies with 18 AAC 70.240. The applicant must develop a monitoring plan in cooperation with state fish or habitat biologists and submit it with the mitigation plan. The monitoring plan must be designed to evaluate changes in key chemical, physical, and biological characteristics within and adjacent to the mixing zone relative to reference conditions. The goal of the monitoring plan should be to identify any unacceptable spatial and temporal aspects of changes to key physical, chemical, or biological characteristics due to a mixing zone authorized in spawning habitat. Sampling locations and sampling duration must be sufficient to identify the spatial and temporal aspects of changes to these key characteristics. The degree, area, and duration of impact will be evaluated by DEC to ensure that designated uses of the water body are maintained and to evaluate the need for site rehabilitation or restoration.

The monitoring plan may be hierarchical beginning with qualitative measures and progressing to quantitative measures of aquatic structure and function. By using this approach, a low cost qualitative approach can be used to evaluate sites with low potential for impacts. This may include only narrative descriptions of site conditions accompanied by photographs. For sites with greater potential for impacts, sites that support a resource of greater value, or where qualitative measures indicate negative changes, more detailed quantitative measures of the physical, biological, and chemical characteristics of the site should be included.

Stream or lake characteristics need to be compared with conditions at the site prior to the discharge, and monitoring should include an unimpacted reference location so that project-related impacts can be differentiated from natural variability. Sampling must be initiated prior to project construction and operation in order to collect baseline data and to characterize natural variability at the discharge and reference location(s). Monitoring design must support sensitive

detection of project-related impacts to key physical, chemical, and biological habitat indicators within an appropriate period. For example, monitoring of fish populations is highly unlikely to detect project-related impacts within the permit period, whereas monitoring of physical or chemical habitat indices, periphyton standing crop, or benthic invertebrate community, where biological indices are available, are more likely to enable detection of impacts.

Sampling frequency and duration of the monitoring plan should be part of the mitigation plan. Sampling frequency should be able to document natural variability, and vary with the degree of potential impact and the parameter under consideration. For projects with low potential impact, qualitative sampling may only be conducted once a year or seasonally. For those projects with a higher potential for impact, quantitative measures should be conducted at a frequency applicable for the specific parameter. For example, the sampling frequency for dissolved oxygen should be sufficient to record daily and seasonal low values (high water temperature and low primary production). These times may occur during early or late mornings or in mid-winter for ice-covered lakes when respiration usually exceeds oxygen production through photosynthesis. Monitoring at some level should be continued throughout the life of the project and should include triggers for additional monitoring requirements and/or corrective action. This is particularly important for those projects that require continuous maintenance to mitigate impacts to spawning (see Step 4 below). For example, for wastewater facilities that require continued maintenance for proper treatment, monitoring should be a requirement for the life of the project. A quality assurance/quality control project plan should be included as part of the monitoring plan that describes sampling methods, analytical methods, precision and accuracy levels, and identifies field personnel and contract laboratories. The applicant should propose a schedule for reporting results of monitoring to the DEC.

Conditions for each of the mitigation steps described below must be exhausted before moving on to the next step.

Step 1. Avoid the impact altogether by not taking a certain action or parts of an action.

The applicant must describe the steps taken to avoid the need to develop a mixing zone within spawning habitat. Spawning habitat and proposed site development and discharge locations should be shown on maps or aerial photographs. Potential facility siting and discharge locations should be compared with spawning habitat within the waterbody. Impacts to spawning habitat can be avoided by locating the discharge and mixing zone in non-spawning areas. Potential spawning habitat impacts can also be avoided by timing discharges to occur when spawning fish, eggs or alevins are not present. When using timing to avoid discharging during spawning activity, applicants must show that the discharge will not cause changes that will preclude or significantly limit future use of the area for spawning, incubation, or rearing. A discharge that is timed to avoid spawning must also comply with all other general mixing zone regulations as determined by DEC staff. For example, the discharge may not cause lethality to passing organisms, cause a migration barrier, or result in a reduction to fish population levels, and must maintain and protect the designated uses within the waterbody as a whole.

The applicant should also show that they are avoiding spawning habitat by not enticing spawning fish into the mixing zone. The discharge may include the construction of additional open water channels or ponds. The discharge may augment flow in existing channels or change the temperature regime. In these cases, blockage of fish migration into the constructed mixing zone should be considered.

The authorization of the Talkeetna Wastewater facility provides an example of how the need for a mixing zone authorization was avoided. Physical limitations resulted in locating the treatment facility adjacent to the Talkeetna River. Discharge was proposed for a side channel of the Talkeetna River that supports chum salmon spawning habitat. Therefore, the authorization of a mixing zone was not possible. A mixing zone was avoided by applying additional treatment. Additional treatment was accomplished through the construction of an artificial wetland channel. The wetland channel increased filtration and biological uptake of nutrients and other pollutants. However, since the additional treatment is only functional seasonally, wastewater is stored throughout the winter and discharged through the wetland channel only during the growing season. Water quality monitoring of the discharge and receiving channel was incorporated into the authorization to evaluate treatment effectiveness.

Step 2. Minimize the impact by limiting the degree or magnitude of the action and its implementation.

The biotic and physical data provided in order to avoid potential impacts also can be used to demonstrate how the applicant has minimized potential impacts. In addition to maximizing treatment prior to discharge, minimization can occur by limiting the discharge time or timing, reducing the portion of spawning habitat influenced, and limiting the number of potential fish species affected. The mitigation plan should show that the discharge location limits the potential impact to the smallest number of fish species, limits the physical area likely to be affected, and limits the amount of time the discharge overlaps with active spawning and incubation.

The mixing zone size can be decreased by stream flow and turbulence. The size of the mixing zone will be larger, and potentially impact a greater amount of spawning habitat in a small stream relative to a stream with larger flows. Backwater sloughs and side channels often provide spawning habitat but may have lower flow rates, frequency of flushing flows, and potential for mixing, compared to main channel sites. The amount of flow within side channels also can change over years in dynamic channels as flows migrate across the channel. Therefore, reviewers should consider the long-term stability of flows. Similarly, where discharge timing is optional, discharge should avoid times of low stream flow or thermal stratification. The longitudinal, lateral, and vertical size of the mixing zone should be minimized relative to available spawning habitat. The mitigation plan must demonstrate how the mixing zone size has been minimized to impact the smallest amount of spawning habitat for the shortest amount of time.

Minimization also can be accomplished by restricting the discharge of specific pollutants to times when biotic effects will be minimized. Fish may be most sensitive to the detrimental effects of pollutants during fertilization or early in the developmental process. Potential impacts can be minimized by avoiding the discharge of pollutants during these more sensitive periods.

Step 3. Rectify the impact by repairing, rehabilitating, or restoring the impacted environment.

The applicant should provide plans for the restoration of sites that will be impacted by short-term construction or anticipated operational impacts. Restoration plans must also be submitted to address potential impacts identified through project monitoring.

The mitigation plan or the wastewater discharge permit application should contain a financial commitment statement and identify a source of funding that would be used to rectify any changes to the physical or chemical habitat or biotic community identified through post-project monitoring. Mixing zone projects that are likely to cause short-term impacts to spawning habitat should contain a site restoration plan. Where possible, site restoration plans should be developed using methods that have been implemented effectively at other locations. Restoration should result in a return of biological structure and function to the pre-disturbance condition.

Step 4. Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the proposed use or activity.

The mitigation plan must identify those project features that will require a maintenance and operation plan. The maintenance plan should identify who is responsible, who will be conducting the work, frequency, and reporting requirements. The operation plan should identify not only normal operations of the mitigation structures and facilities, but how emergencies will be handled. For example, how will floods, droughts, freezing, ice flows, ice dams, overflow, excessive bedload, fuel spills, power outages and other emergencies affect the discharge and what are the contingency plans for these types of emergencies. The mitigation plan should show that the maintenance and operation plan has considered these types of emergencies and how any additional potential impacts to spawning habitat will be avoided, minimized, or rectified.

The maintenance and operation plan should identify the process that will be used to modify project operation and correct for unanticipated events.

Step 5. Compensate for the impact by replacing or providing substitute resources or environments.

For Clean Water Act purposes, compensatory mitigation may only be considered as a remedy when unanticipated impacts are determined through monitoring and cannot be rectified.

Compensatory mitigation may not be used as a mechanism to accommodate direct substantive impacts to the receiving water. However, for some types of projects, the treatment options and discharge locations are limited and all impacts cannot be avoided (see Step 2). For example, potential sites for the development of a wastewater treatment plant must be located in proximity to cities or villages, which limits possible discharge locations.

Compensatory mitigation options should be described within the mitigation plan, and must be present when there is a risk of substantive adverse impacts. Compensatory mitigation must be for the affected waterbody and the affected fish species and life stage. Proposed mitigation projects should address lost spawning and incubation habitat. Options that restore or rehabilitate only rearing habitat within the waterbody can be considered when spawning habitat is clearly not limiting.

Off-site compensatory mitigation in other waterbodies cannot be considered applicable for mixing zones in spawning areas. State mixing zone regulations require that "designated and existing uses of the waterbody as a whole will be maintained and protected and the overall biological integrity of the waterbody will not be impaired" (18 AAC 70.240(c)(2)). Therefore, mitigation proposals must be within the affected waterbody or show that designated uses and biological integrity are maintained.

Potential mitigation options could include removing natural migration barriers, evaluating and treating non-point-source physical and chemical impacts to spawning habitat, creating additional spawning habitat, or the removal or treatment of other sources of cumulative impacts to spawning habitat. The removal of natural migration barriers can provide access to historic spawning habitat or allow for natural dispersion of juvenile fish from spawning areas to rearing and overwintering habitats. For some waterbodies, there may be additional unregulated non-point source impacts to spawning habitat that could be addressed as mitigation. These could include treatment of runoff from roads or parking areas or eliminating chronic sediment sources from unnaturally exposed bank and riparian soils.

Other options include projects directed toward preserving water quality by developing local ordinances or regulations that protect riparian or stream habitats. These could include ordinances that protect riparian vegetation which could indirectly protect or restore spawning habitat by reducing long-term impacts due to sedimentation or changes in stream temperatures. Funding for unidentified compensatory mitigation is not acceptable.

When possible, the proposed compensatory mitigation should use established methods, site design plans and subsequent evaluations. For example, the construction of spawning habitat should reference other sites where similar methods have been employed and identify how success of those projects was evaluated.

Monitoring the implementation and effectiveness of compensatory mitigation measures

Regardless of the mitigation proposed, an evaluation process must accompany any proposed compensatory mitigation actions. The evaluation must identify project objectives, methods that

will be used to accomplish the objectives, and the measures that will be used to document project success. These criteria should be agreed upon prior to mitigation plan approval as well as actions to be taken should compensatory mitigation not meet the project objectives. Compensatory mitigation monitoring plans should clearly define project objectives. Objectives should be measurable outcomes. For example, compensatory mitigation may be designed to reduce non-point source pollution from a stream ford. In this case, objectives could include reducing stream water turbidity during storm events at a stream ford location. Pre-project data would need to be collected to document turbidity prior to project construction. The project objective would be accomplished by constructing a bridge, vegetating the stream banks, and using vegetated drainage ditches and the riparian vegetation to treat road runoff. In this case, differences in stream water turbidity could quantify project effectiveness.

Using this same example, the compensatory mitigation plan would describe the methods to be used to treat storm water runoff, divert traffic to the bridge site, and restore channel geometry and bank vegetation. Project monitoring would include evaluating implementation: determining whether the project was constructed as designed, propagation and survival of bank vegetation, elimination of the stream ford, and project effectiveness: no change in stream water turbidity above and below the crossing location during storm events. Monitoring should be developed to determine whether project success or failure was due to project design and/or construction.

The frequency and duration of the monitoring should be described. Sampling frequency should be based upon the variability in the parameter under consideration, and duration should include frequent short-term and less frequent long-term monitoring. For example, stream water turbidity may be measured during the rising limb of all storm events where precipitation exceeded 0.5 inches during the first 3 years following project construction, and then only during one storm event during the next 2 years. Bank stability and the survival of vegetation may be monitored annually for the first 5 years and then only every other year for the next 10 years.

The monitoring plan should clearly identify the actions to be taken if the project is not successful. This may include only minor modifications to the original design or other alternative compensatory mitigation options, and/or thresholds that may trigger 18 AAC 70.240(m), requiring the department to terminate, modify, or deny renewal of the permit or certification authorizing the mixing zone.

APPENDIX C: DECISION TREE FOR MIXING ZONES IN SPAWNING AREAS

1. Is the mixing zone in a spawning area?

The location and time of a spawning area and mitigation standards are determined by:
18 AAC 70.240(j)

Dept. of Fish and Game (ADF&G) for Special Areas listed in AS 16.20 and waters in the *Anadromous Waters Catalogue*

Dept. of Environmental Conservation (in consultation with ADF&G) for all other water

YES

2. Was the mixing zone previously authorized where spawning was not occurring?
18 AAC 70.240(i)

YES
Mixing zone must comply with other provisions
18 AAC 70.240(a) thru (f) and .240(k) thru (m)

NO
Mixing zone must comply with other provisions
1*8 AAC 70.240(a) thru (f) and .240(k) thru (m)*

NO

3. Are there Pacific salmon species present?
I8 AAC 70.240(e)

YES

4. Is there discharge during spawning?
18 AAC 70.240(j)

YES
Mixing zone prohibited.

NO
Go to 6, next page.

NO

5. Are there adverse effects to present and future capability of an area to support salmon spawning, incubation, or rearing?

YES
Mixing zone prohibited.

NO
Mixings Zones must comply with other provisions of
18 AAC 70. 240

6. Are any of the following species spawning?

Arctic grayling; northern pike; lake trout; brook trout; sheefish; burbot; landlocked coho salmon, Chinook salmon, or sockeye salmon; or anadromous or resident rainbow trout, Arctic char, Dolly Varden, whitefish, or cutthroat trout.

18 AAC 70.240(f)

YES

7. Are aquatic life criteria exceeded, or will there be adverse effects to the capability of the area to support future spawning, incubation, and rearing?

18 AAC 70.240(g)(1)

YES

8. Do you have a mitigation plan approved by ADF&G, or DEC? (See question 1.)

18 AAC 70.240(g)(2), (g)(3) or (g)(4)

YES

Mixing zone must comply with other provisions

AAC 70.240(a) thru (f) and .240(k) thru (m)

NO

Mixing zone prohibited

NO

Mixing zone must comply with other provisions

18 AAC 70.240(a) thru (f) and .240(k) thru (m)

NO

Mixing zone must comply with other provisions

18 AAC 70.240(a) thru (f) and .240(k) thru (m)