

Water Quality Standards Triennial Review— Issue Paper #4

Comparison of Idaho Aquatic Life Criteria for Certain Toxic Substances with Current EPA §304(a) Recommended Criteria—Acrolein, Ammonia, Cadmium, Carbaryl, Diazinon, and Selenium

Introduction

Under section 304(a) of the Clean Water Act, the US Environmental Protection Agency (EPA) is to develop and publish water quality criteria that reflect the latest scientific knowledge on the effects of a constituent concentration on aquatic species and/or human health. These criteria are published as recommendations to states and authorized tribes for use in setting their water quality standards. While EPA provides scientific recommendations to protect aquatic life, these do not substitute for the Clean Water Act or EPA's regulations, nor are they regulations themselves. As a practical matter, EPA uses recommended §304(a) criteria as one factor for determining whether to approve a state's water quality standards. Idaho water quality standards must be approved by EPA before they are applicable for Clean Water Act purposes.

While not the first set of rules adopted to protect aquatic life, Idaho adopted numeric criteria for toxic substances (IDAPA 58.01.02.210) in its water quality standards (WQS) on August 24, 1994. These toxics criteria were recommended by EPA and federally promulgated as the National Toxics Rule (NTR) in 1992. In 1996, EPA approved Idaho's adoption of the NTR criteria. EPA's approval was a federal action and, as such, EPA was obligated to consult with agencies administering the Endangered Species Act (ESA) if species listed as endangered or threatened under the ESA, or their critical habitat, may be affected. Therefore, EPA began informal consultation and preparation of their biological assessment. EPA's biological assessment was completed and turned over to the National Marine Fisheries Service – National Oceanic and Atmospheric Administration (NOAA) and the US Fish and Wildlife Service (USFWS) in 2000, thus initiating formal consultation (EPA 2000). NOAA finalized its biological opinion (BiOp) on May 7, 2014 (NOAA 2014). A companion BiOp from the USFWS was prepared on June 25, 2015 (USFWS 2015).

NOAA's 2014 and USFWS's 2015 BiOps concluded that several of Idaho's criteria, which EPA approved subject to subsequent consultation, would cause jeopardy to listed species and adverse modification of their habitat. These criteria were addressed during Idaho's 2014 triennial review and, aside from the criteria for selenium (discussed below), Idaho is awaiting publication of EPA-recommended criteria before progressing with WQS updates.

States must consider adopting new or updated Clean Water Act §304(a) criteria recommendations as part of their triennial review as described under 40 CFR 131.50(a). EPA has produced several new §304(a) recommendations that DEQ has not formally considered. As such, Idaho will review Numeric Criteria for Toxic Substances for Waters Designated for Aquatic

Life, Recreation, or Domestic Water Supply Use (IDAPA 58.01.02.210) in regards to acrolein, cadmium, carbaryl, diazinon, and selenium. Additionally, Idaho will review Surface Water Quality Criteria for Aquatic Life Use Designations (IDAPA 58.01.02.250) in regards to ammonia. Here we present these Idaho WQS in comparison with new or updated EPA §304(a) criteria recommendations.

Current Rules

Numeric Criteria for Toxic Substances for Waters Designated for Aquatic Life, Recreation, or Domestic Water Supply Use (IDAPA 58.01.02.210)

01. Criteria for Toxic Substances. *The criteria of Section 210 apply to surface waters of the state as follows.*

- a. Columns B1 and B2 of the following table apply to waters designated for aquatic life use.*
- b. Column C2 of the following table applies to waters designated for primary or secondary contact recreation use.*
- c. Column C1 of the following table applies to waters designated for domestic water supply use.*

[Note: the following is an excerpt of the full table of criteria showing only those criteria with a current EPA-recommended 304(a) criterion that Idaho has not adopted. Carbaryl and diazinon have been added for viewing purposes as they are not currently in the Idaho water quality standards.]

A		B Aquatic life		C Human health for consumption of:	
(Number) Compound	^a CAS Number	^b CMC (µg/L)	^b CCC (µg/L)	Water & fish (µg/L)	Fish only (µg/L)
		B1	B2	C1	C2
4 Cadmium	7440439	1.3 <i>i</i>	0.6 <i>i</i>	<i>h</i>	<i>h</i>
10 Selenium	7782492	20 <i>f</i>	5 <i>f</i>	29 <i>c</i>	250 <i>c</i>
17 Acrolein	107028			3.2 <i>c</i>	120 <i>c</i>
Carbaryl	63252				
Diazinon	333415				
Table Footnotes					
a. Chemical Abstracts Service (CAS) registry numbers which provide a unique identification for each chemical.					

b.	See definitions of Acute Criteria (CMC) and Chronic Criteria (CCC), Section 010 of these rules.
f.	Criterion expressed as total recoverable (unfiltered) concentrations.
i.	Aquatic life criteria for these metals are a function of total hardness (mg/L as calcium carbonate), the pollutant's water effect ratio (WER) as defined in Subsection 210.03.c.iii. and multiplied by an appropriate dissolved conversion factor as defined in Subsection 210.02. For comparative purposes only, the example values displayed in this table are shown as dissolved metal and correspond to a total hardness of one hundred (100) mg/L and a water effect ratio of one (1.0).

02. Factors for Calculating Hardness Dependent Metals Criteria. Hardness dependent metals criteria are calculated using values from the following table in the equations;

- a.** $CMC = WER \exp\{mA[\ln(\text{hardness})] + bA\} \times \text{Acute Conversion Factor}$.
- b.** $CCC = WER \exp\{mc[\ln(\text{hardness})] + bc\} \times \text{Chronic Conversion Factor}$.

[Note: the following is an excerpt of Section 210.02 relating to cadmium only.]

Metal	<i>mA</i>	<i>bA</i>	<i>mc</i>	<i>bc</i>	<i>aAcute Conversion Factor</i>	<i>aChronic Conversion Factor</i>
Cadmium	0.8367	-3.560	0.6247	-3.344	0.944 see footnote a	0.909

Note to table: The term "exp" represents the base e exponential function.

Footnotes to table:

a Conversion factors (CF) are from "Stephan, C. E. 1995. Derivation of conversion factors for the calculation of dissolved freshwater aquatic life criteria for metals. U.S. Environmental Protection Agency, Environmental Research Laboratory – Duluth." The conversion factors for cadmium and lead are hardness-dependent and can be calculated for any hardness (see limitations in Subsection 210.03.b.i.) using the following equations. For comparative purposes, the conversion factors for a total hardness of one hundred (100) mg/L are shown in the table. The conversion factor shall not exceed one (1).

Cadmium

Acute: $CF = 1.136672 - [(\ln \text{hardness})(0.041838)]$ NOTE: The cadmium acute criterion equation was derived from dissolved metals toxicity data and thus requires no conversion; this conversion factor may be used to back calculate an equivalent total recoverable concentration.

Chronic: $CF = 1.101672 - [(\ln \text{hardness})(0.041838)]$

Lead (Acute and Chronic): $CF = 1.46203 - [(\ln \text{hardness})(0.145712)]$

03. Applicability. The criteria established in Section 210 are subject to the general rules of applicability in the same way and to the same extent as are the other numeric chemical criteria when applied to the same use classifications. Mixing zones may be applied to toxic substance criteria subject to the limitations set forth in Section 060 and set out below.

...

- c.** Application of aquatic life metals criteria.

- i. For metals other than cadmium, for purposes of calculating hardness dependent aquatic life criteria from the equations in Subsection 210.02, the minimum hardness allowed for use in those equations shall not be less than twenty-five (25) mg/l, as calcium carbonate, even if the actual ambient hardness is less than twenty-five (25) mg/l as calcium carbonate. For cadmium, the minimum hardness for use in those equations shall not be less than ten (10) mg/l, as calcium carbonate. The maximum hardness allowed for use in those equations shall not be greater than four hundred (400) mg/l, as calcium carbonate, except as specified in Subsections 210.03.c.ii. and 210.03.c.iii., even if the actual ambient hardness is greater than four hundred (400) mg/l as calcium carbonate.

Surface Water Quality Criteria for Aquatic Life Use Designations (IDAPA 58.01.02.250)

[Note: the following is an excerpt of Section 250 relating to ammonia only.]

02. Cold Water. Waters designated for cold water aquatic life are not to vary from the following characteristics due to human activities:

...

- d. Ammonia. The following criteria are not to be exceeded dependent upon the temperature, T (degrees C), and pH of the water body:
- i. Acute Criterion (Criterion Maximum Concentration (CMC)). The one (1) hour average concentration of total ammonia nitrogen (in mg N/L) is not to exceed, more than once every three (3) years, the value calculated using the following equation:

$$CMC = \frac{0.275}{1 + 10^{7.204 - pH}} + \frac{39.0}{1 + 10^{pH - 7.204}}$$

- ii. Chronic Criterion (Criterion Continuous Concentration (CCC)).

(1) The thirty (30) day average concentration of total ammonia nitrogen (in mg N/L) is not to exceed, more than once every three (3) years, the value calculated using the following equations:

(a) When fish early life stages are likely present:

$$CCC = \left(\frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \bullet \text{MIN}(2.85, 1.45 \cdot 10^{0.021(25-T)})$$

(b) When fish early life stages are likely absent:

$$CCC = \left(\frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \bullet 1.45 \cdot 10^{0.021(25-T)}$$

- (2) *The highest four-day (4) average within the thirty-day (30) period should not exceed two point five (2.5) times the CCC.*
- (3) *Because the Department presumes that many waters in the state may have both spring-spawning and fall-spawning species of fish present, early life stages of fish may be present throughout much of the year. Accordingly, the Department will apply the CCC for when fish early life stages are present at all times of the year unless:*
- (a) *Time frames during the year are identified when early life stages are unlikely to be present, and*
- (b) *The Department is provided all readily available information supporting this finding such as the fish species distributions, spawning periods, nursery periods, and the duration of early life stages found in the water body; and*
- (c) *The Department determines early life stages are likely absent.*

03. Seasonal Cold Water. *Between the summer solstice and autumn equinox, waters designated for seasonal cold water aquatic life are not to vary from the following characteristics due to human activities. For the period from autumn equinox to summer solstice the cold water criteria will apply:*

...

- d. Ammonia. Concentrations of ammonia are not to exceed the criteria defined at Subsection 250.02.d*

04. Warm Water. *Waters designated for warm water aquatic life are not to vary from the following characteristics due to human activities:*

...

- d. Ammonia. The following criteria are to be met dependent upon the temperature, T (degrees C), and pH of the water body:*
- i. Acute Criterion (Criterion Maximum Concentration (CMC)). The one (1) hour average concentration of total ammonia nitrogen (in mg N/L) is not to exceed, more than once every three (3) years, the value calculated using the following equation:*

$$CMC = \frac{0.411}{1 + 10^{7.204 - pH}} + \frac{58.4}{1 + 10^{pH - 7.204}}$$

- ii. Chronic Criterion (Criterion Continuous Concentration (CCC)). Concentrations of ammonia are not to exceed the criteria defined at Subsection 250.02.d.ii.*

Discussion

Currently, Idaho does not have aquatic life criteria for acrolein, carbaryl, and diazinon, although EPA has issued new recommended aquatic life criteria for these toxics. Further, Idaho has not yet addressed guidance from EPA's most recent revised recommended criteria on ammonia, cadmium, and selenium.

Acrolein

Idaho does not have aquatic life criteria for acrolein. In 2003, EPA developed a risk assessment of the use of acrolein as an aquatic herbicide and its potential effects on listed salmon and steelhead evolutionary significant units (ESUs) for California and a portion of southern Oregon (Turner and Erickson 2003). EPA concluded that the aquatic herbicide use of acrolein would either not adversely affect or have no effect on the region's ESUs. EPA indicated they would produce similar analyses for listed salmon and steelhead ESUs that occur in Oregon, Washington, and Idaho (Turner and Erickson 2003), which have yet to be published. In 2009, EPA added acrolein to the §304(a) list of water quality criteria.

EPA §304(a) recommended criteria and Idaho WQS comparison.

Criteria Version	CMC (µg/L) ^a	CCC (µg/L) ^a
Idaho WQS	—	—
EPA §304(a)	3	3

a. See definitions of Acute Criteria (CMC) and Chronic Criteria (CCC) (IDAPA 58.01.02.010).

Carbaryl

Idaho does not have aquatic life criteria related to carbaryl. NOAA National Marine Fisheries Service issued a BiOp in 2009 on the effects of EPA's proposed registration of pesticide products containing the active ingredient carbaryl on endangered species, threatened species, and critical habitat that has been designated for those species. Although the proposed uses of carbaryl pesticide products may lead to individual fitness level consequences for Snake River spring/summer-run Chinook Salmon, exposure is not expected to occur at a frequency that would cause effects at the population level (NOAA 2009). In 2012, EPA added carbaryl to the §304(a) list of water quality criteria.

EPA §304(a) recommended criteria and Idaho WQS comparison.

Criteria Version	CMC (µg/L) ^a	CCC (µg/L) ^a
Idaho WQS	—	—
EPA §304(a)	2.1	2.1

a. See definitions of Acute Criteria (CMC) and Chronic Criteria (CCC) (IDAPA 58.01.02.010).

Diazinon

Idaho currently does not have aquatic life criteria related to diazinon. In 2005, EPA added diazinon to the §304(a) list of water quality criteria.

EPA §304(a) recommended criteria and Idaho WQS comparison.

Criteria Version	CMC (µg/L) ^a	CCC (µg/L) ^a
Idaho WQS	—	—
EPA §304(a)	0.17	0.17

a. See definitions of Acute Criteria (CMC) and Chronic Criteria (CCC) (IDAPA 58.01.02.010).

Ammonia

EPA updated recommended criteria for ammonia in 2013. The last revision to ammonia in Idaho WQS was in 2002 and was based on EPA's 1999 ammonia criteria. In addition to the presence and life-stage of aquatic species, EPA's 2013 recommended criteria for both acute and chronic concentrations vary with pH and temperature. Currently, Idaho's WQS vary with presence and life-stage of aquatic species as well as pH, but only the chronic criteria vary with temperature. Additionally, after considering the most recent scientific knowledge concerning the impact of ammonia exposure to mollusks, EPA recommended criteria that are more stringent than current Idaho WQS.

Example EPA §304(a) recommended criteria and Idaho WQS comparison.

[Note: In this example, criteria magnitudes for ammonia are expressed as total ammonia nitrogen (mg TAN/L) at pH 7 and 20 °C.]

Criteria Version	Criterion Duration	
	CMC ^a (1-hour average, mg TAN/L)	CCC ^a —When Fish Early Life Stages Present (30-day average ^b , mg TAN/L)
Idaho WQS	24	4.15 ^c
EPA §304(a)	17	1.9 ^c

a. See definitions of Acute Criteria (CMC) and Chronic Criteria (CCC) (IDAPA 58.01.02.010).

b. Rolling average for 2013 EPA criteria.

c. Not to exceed 2.5 times the criterion continuous concentration as a 4-day average within a 30-day period.

Criteria frequency: Not to be exceeded more than once in 3 years on average.

Cadmium

Idaho's current criteria for cadmium, both acute and chronic, were adopted in 2010 and are more stringent than the criteria EPA recommended in 2016. Cadmium toxicity is hardness-dependent; the following criteria comparison example is for a hardness of 100 mg/L.

EPA §304(a) recommended criteria and Idaho WQS comparison.

Criteria Version	CMC (µg/L) ^a	CCC (µg/L) ^a
Idaho WQS	1.3 ^b	0.6 ^b
EPA §304(a)	1.8 ^c	0.72 ^c

a. See definitions of Acute Criteria (CMC) and Chronic Criteria (CCC) (IDAPA 58.01.02.010).

b. Aquatic life criteria for these metals are a function of total hardness (mg/L as calcium carbonate) and the pollutant's water effect ratio (WER) as defined in Subsection 210.03.c.iii and multiplied by an appropriate dissolved conversion factor as defined in Subsection 210.02. For comparative purposes only, the example values displayed in this table are shown as dissolved metal and correspond to a total hardness of 100 mg/L and a water effect ratio of one (1.0).

c. Freshwater acute and chronic criteria are hardness-dependent and were normalized to a hardness of 100 mg/L as CaCO₃ to present representative criteria values. Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column (See Sabock 1993).

Selenium

In 2016, EPA issued an updated recommended §304(a) criterion for selenium that is fish tissue based, rather than based on water column toxicity—a first for aquatic life criteria.

The NOAA 2014 BiOp requires adopting protective criteria by 2018. In early 2017, Idaho initiated rulemaking to consider EPA's updated selenium criterion and is currently engaged in negotiated rulemaking to update this criterion.

EPA §304(a) recommended criteria and Idaho WQS comparison.

Criterion Version	Chronic					Short-term
	Egg-Ovary (mg/kg dw)	Fish Tissue (mg/kg dw)		Water Column (µg/L)		Water Column (µg/L)
		Egg-Ovary	Whole Body	Muscle	Water Lentic	Water Lotic
Idaho WQS	N/A	N/A	N/A	5 (4 day)	5 (4 day)	20 (Instantaneous)
EPA §304(a)	15.1	8.5	11.3	1.5 (30 day)	3.1 (30 day)	Intermittent exposure equation

Note: Intermittent Exposure Water Quality Criteria:

$$\frac{WQC_{30\text{-day}} - C_{bkgrnd} (1 - f_{int})}{f_{int}}$$

where $WQC_{30\text{-day}}$ is the water column monthly element, for either a lentic or lotic waters; C_{bkgrnd} is the average background selenium concentration, and f_{int} is the fraction of any 30-day period during which elevated selenium concentrations occur, with f_{int} assigned a value ≥ 0.033 (corresponding to 1 day).

References

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