Final Implementation Guidance for Idaho's Human Health Water Quality Criteria for Arsenic

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Prepared by
Beth Spelsberg, India Southern, and Chantilly Higbee
Idaho Department of Environmental Quality
Water Quality Division
1410 N. Hilton St.
Boise, ID 83706

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Abbreviations, Acronyms, and Symbols

µg	microgram
AU	assessment unit
BAF	bioaccumulation factor
BCF	bioconcentration factor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
DEQ	Idaho Department of Environmental Quality
DMA	dimethylarsinate
DWS	domestic water supply
EPA	United States Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GPS	Global Positioning System
IDFG	Idaho Department of Fish and Game
IPDES	Idaho Pollutant Discharge Elimination System
kg	kilogram
L	liter
MCL	maximum contaminant level
mg	milligram
MMA	monomethylarsonate
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RPTE	reasonable potential to exceed
SDWA	Safe Drinking Water Act
TL-BAF	trophic level weighted bioaccumulation factor
TMDL	total maximum daily load
WBAG	Water Body Assessment Guidance
WDE	Washington Department of Ecology
WLA	waste load allocation
WQBEL	water quality-based effluent limits

Executive Summary

This document is intended to assist the Idaho Department of Environmental Quality (DEQ) in maintaining and implementing a consistent statewide approach for implementing the Idaho human health water quality criteria for arsenic. This document does not create a right or benefit, substantive or procedural, enforceable at law or equity by any party against DEQ, its employees, or any other person. This document does not substitute existing requirements of the Clean Water Act (CWA), federal regulations, or Idaho's "Water Quality Standards" (IDAPA 58.01.02). The recommendations in this guidance are not binding; DEQ may consider other approaches consistent with the CWA, federal regulations, and Idaho's water quality standards. DEQ may change or update this guidance in the future.

Arsenic is a naturally occurring element, released into the environment through natural processes such as geothermal, erosion, forest fires, or through human activities such as mining. Arsenic is classified into three main groups: (1) inorganic (typically the most toxic form), (2) organic, and (3) arsine gas. Once arsenic is released into the environment, it cannot be destroyed, but can change forms (for example, from inorganic to organic). The extent of arsenic adsorption to suspended solids and sediments in the water column or stream bed strongly depends upon the temperature, humic content, sediment type, pH of the water, and species of arsenic. In surface waters, arsenic is transported in the water column but also will bind to particles in the water or sediment on the bottom of lakes or rivers.

Unlike other metals such as mercury and selenium, arsenic is not highly bioaccumulative. Due to the lack of evidence for a strong relationship between fish tissue and water column levels of arsenic, DEQ believes that the rule and implementation principles in the rule, including the use of a trophic level weighted bioaccumulation factor (TL-BAF) and a dual tissue/water column criterion, will account for changing or increasing arsenic conditions.

To protect recreational uses, the criterion for consumption of fish only (Fish Only) is a dual element criterion consisting of a fish tissue element and a water column element where the fish tissue element takes precedence, or supersedes, the water column element if adequate data are present. To protect Idaho's domestic water supply use, the criterion for consumption of fish and water (Fish and Water) is a single element, water column criterion. All waters in Idaho, with a single exception, are to be protected for a recreational use and only a subset of Idaho waters are designated for domestic water supply; therefore, the recreational use will nearly always be the more sensitive use to be protected.

Table A. Dual-element human health criteria for arsenic.

Metal	Water and Fish	Fish Only
Arsenic (inorganic)	10 µg/L water column	4.3 µg/L water column 8.0 µg/kg fish tissue

Notes: microgram per liter (µg/L); microgram per kilogram (µg/kg)

Fish tissue concentration is compared to the criterion based on an average or composite of a *minimum* of five individual fish of the same species, collected from the same water body within the same calendar year, defined as January 1–December 31. When available, game fish species representative of the size and species that may be *legally harvested* within the water body should be used. If game fish are not available, other species may be used. The fish tissue criterion can only be used if no new activity or discharge occurs that contributes arsenic to the water body within the prior 90 days.

In developing effluent limits for waters designated for recreation, the fish tissue element may be translated to a water column value using a site-specific TL-BAF based on the ratio of total recoverable inorganic arsenic in fish tissue to dissolved inorganic arsenic in the water column. The site-specific translation is not a site-specific criterion, it is a translation of the fish tissue element to an applicable water column target using both the fish tissue criterion and a site-specific TL- BAF. The translation directly incorporates the fish only fish tissue criterion for recreational waters of 8.0 µg/kg but may result in a water column value greater or less than the statewide water column element depending on the site-specific conditions. If the translated criterion exceeds the water and fish criterion (10 µg/L) in waters also designated for domestic water supply (DWS), then the water and fish criterion would apply instead of the translated fish only criterion, as the more stringent use criterion applies.

Using this guidance, DEQ will implement the criterion across programs, including but not limited to, collecting samples and interpreting results and assessing fishless waters and fish tissue sample size and monitoring requirements. For Idaho Pollutant Discharge Elimination System permits, DEQ acknowledges the challenges a fish tissue criterion presents in the context of water quality-based permitting and recommends engaging early with the agency when developing a sampling and analysis plan before any sampling or monitoring activities occur.

1 Introduction

States must develop criteria that protect designated beneficial uses and are based on sound science (Clean Water Act [CWA] § 303©(2)(A); 40 CFR 131.11(a)). Additionally, states are required to adopt criteria for toxic pollutants for which the United States Environmental Protection Agency (EPA) has published recommended criteria under CWA § 304(a) and where the discharge or presence of those pollutants in the affected waters could reasonably be expected to interfere with designated uses adopted by the state (CWA § 303(c)(2)(B)). States have the discretion to adopt the EPA's criteria recommendations, EPA's recommendations modified to reflect site-specific conditions, or criteria based on other scientifically defensible methods (CWA 40 § 131.11(b)(1)(ii)). DEQ developed the human health water quality criteria for arsenic according to CWA § 303(c) and the federal regulations implementing the CWA, 40 CFR 131, et seq.

In May 2016, EPA entered into a consent decree with Northwest Environmental Advocates to reconsider EPA's 2010 approval of Idaho's human health criteria for arsenic. In September 2016, EPA disapproved Idaho's human health criteria of 10 micrograms per liter (µg/L) arsenic for both consumption of fish only and consumption of water and fish. The consent decree required that EPA propose new human health criteria for arsenic by November 15, 2018, and that EPA either approve Idaho's submittal of revised human health criteria for arsenic or promulgate federal criteria by July 15, 2019. In June 2018 and again in June 2022, the court granted the Unopposed Motion to Modify Consent Decree, ultimately extending the November 15, 2018, and July 15, 2019, deadlines to November 15, 2023, and November 15, 2024, respectively.

In 2018, the Idaho Department of Environmental Quality (DEQ) initiated negotiated rulemaking, which is a public process with stakeholder engagement. This rulemaking enabled Idaho to begin the process to adopt human health criteria for arsenic under state-negotiated rulemaking, and if approved, would prevent federal promulgation of criteria for Idaho by EPA. During the negotiated rulemaking process, eight meetings were held between April 2018 and November 2020. On December 9, 2020, a preliminary draft rule was posted on DEQ's website. Five additional meetings were held between December 2020 and November 2021, for a total of 13 negotiated rulemaking meetings. Stakeholders and members of the public participated by attending the meetings, reviewing DEQ's presentations and supporting information, and submitting comments. Key information was posted on DEQ's website and distributed to persons who participated in the negotiated rulemaking. All comments received during the negotiated rulemaking process were considered by DEQ when making decisions about the rule's development. In May 2022, the rule was presented to the DEQ Board and approved. It was then reviewed and approved by the Idaho Legislature during the 2023 session.

1.1 Purpose

This document provides guidance to DEQ staff, the regulated community, and the general public for implementing the statewide human health water quality criteria for arsenic and applies only to surface waters in Idaho. The criteria reflect the latest Idaho-specific arsenic surface water and fish tissue monitoring data. The criteria were developed by using a TL-BAF, which is the preferred method in EPA's *Methodology for Deriving Water Quality Criteria for the Protection of Human Health* (EPA 2000).

The final criteria are expressed both in terms of concentrations of total recoverable inorganic arsenic in fish tissue (fillet or muscle) and dissolved inorganic arsenic in the water column. DEQ developed this guidance, based upon Idaho's "Water Quality Standards" (IDAPA 58.01.02) and the resulting criteria developed from the negotiated rulemaking.

The implementation principles outlined in this guidance ensure that all of Idaho surface waters will be adequately protected for recreational uses, and any waters designated for domestic water supply (DWS) will be adequately protected as source water for public drinking water systems.

1.2 Human Health Water Quality Criteria for Arsenic

Human health criteria are designed to protect both recreational (Fish Only) and domestic water supply (Fish and Water) uses. Recreational uses include swimming, boating, and fishing while the domestic water supply use allows for waters to be used as untreated raw water for public drinking water. (Table 1). Although all Idaho waters are expected to meet recreational uses, (IDAPA 58.01.02.101.01), only certain water bodies identified in IDAPA 58.01.02.110-160 are designated for DWS. Regarding frequency and duration, human health toxics criteria must not be exceeded based on an annual arithmetic mean concentration (IDAPA 58.01.02.210.03.d.ii).

The criteria in IDAPA 58.01.02.210 is provided below. Section 4 discusses each part of the criteria in detail.

Table 1. Criteria for protecting human health (Table 2, IDAPA 58.01.02.210.01.b).

Criteria for Protection of Human Health (based on the consumption of:)						
Compound	CAS Number	Carcinogen?	Water & Fish (µg/L unless otherwise specified)		Fish Only (µg/L unless otherwise specified)	
Inorganic Compounds/Metals						
Arsenic	7440382	Y	10	c, d, j	4.3; 8.0 µg/kg fish tissue	c, k

Footnotes:

c. Inorganic forms only.

d. Criterion expressed as total recoverable (unfiltered) concentrations.

j. This criterion is based on the drinking water Maximum Contaminant Level (MCL).

k. For Fish Only exposure to inorganic arsenic, the human health criterion is:

Fish Tissue (µg/kg wet-weight)	Water Column (µg/L)
8.0	4.3

Fish tissue element is based on total recoverable inorganic arsenic in muscle or fillet. The fish tissue element supersedes the water column element provided at least ninety (90) days have passed since any new activity or discharge has occurred within the water body. Fish tissue element will be applied in accordance with Subsection 210.03.e.

Water column element is based on dissolved inorganic arsenic in water.

Subsection 210.03.e.

e. Application of the fish tissue element of the arsenic criterion for human health.

i. The fish tissue element for total recoverable inorganic arsenic is based on a single measurement using sufficiently sensitive methods.

ii. The single measurement must be made on a sample that is an average or composite of a minimum of five (5) individual fish of the same species, collected from the same water body within the same calendar year. When available, game fish species representative of the size and species that may be legally harvested within the water body are preferred. Results from multiple sample events may be averaged or composited provided they represent the same species collected from the same water body within the same calendar year.

iii. Not to be exceeded; the Department will evaluate all representative fish tissue data to determine compliance with this criterion element.

i**v.** For purposes of determining water column targets for the development of effluent limits, TMDL targets, or water column targets for fishless waters, the fish tissue element may be translated to a water column value using a site-specific bioaccumulation factor (BAF) based on the ratio of total recoverable inorganic arsenic in fish muscle or fillet tissue to dissolved inorganic arsenic in the water column using the following equation:

$$\boldsymbol{WC_T}(\mu \boldsymbol{g}\ /\boldsymbol{L}) = \frac{\mathbf{8.00}\ \mu \boldsymbol{g}\ /\boldsymbol{kg}}{\boldsymbol{BAF_{SS}L}\ /\boldsymbol{kg}}$$

Water Column Translation Calculation.

Where:

WC_T (µg/L) is the translated water column value; and

BAF_{SS} L/kg is the site specific BAF calculated consistent with 210.03.e.v.

In fishless waters, surface water and fish tissue from the immediate downstream waters may be used for bioaccumulation modeling. In the absence of sufficient fish tissue data, the water column element is the applicable criterion element in fishless waters.

v. When translating the fish tissue element to a water column value, the following procedures will be followed.

(1) Data used to translate the fish tissue element must be based on current conditions and consistent with Subsections 210.03.e.i. and ii.

(2) Whenever practical, fish tissue samples must be representative of the game fish species present within the water body and include game fish of legally harvestable size. In the absence of suitable game fish species, other resident fish species may be used.

(3) Water column samples must be representative of the annual average concentration of dissolved inorganic arsenic at the site.

(4) BAFs are calculated as a trophic-level weighted BAF or other scientifically defensible method for deriving protective BAF.

2 Background

2.1 Sources of Arsenic in the Environment

Arsenic is a naturally occurring element found in the earth's crust. Arsenic is released into the environment through natural processes such as volcanic activity (including geothermal, as occurs in a number of Idaho waters), erosion, forest fires. Arsenic is also released through human activities such as pesticide application, mining, smelting wastewater, disposal of sewage sludge, coal burning power plants, manufacturing processes, urban runoff, atmospheric deposition, and waste from poultry farms (ATSDR 2007a; Gorny et al. 2015).

Arsenic in surface water typically originates from mining activities and the natural weathering of soil and rocks. Arsenic is present in more than 200 minerals, primarily as arsenate and arsenic sulfides and occasionally as arsenites, oxides, and elemental arsenic (Faria et al. 2023). Arsenic is generally found at higher concentrations in igneous and sedimentary rocks, such as sandstones, shales, and phosphorites, than in other rock types and is also commonly associated with sulfide deposits. Clays, sedimentary iron, and manganese oxides can also be rich in arsenic (Ghosh et al. 2022; CLU-IN 2022; NRC 1977). Arsenopyrite is the most common sulfide mineral and is generally associated with gold mining (Faria et al. 2023). A large part of arsenic from mining originates from leaching of abandoned mine tailing and fly ash waste piles. Significant amounts of arsenic are also contained in liquid effluents from gold cyanidation milling processes (ATSDR 2007a).

2.2 Species of Arsenic

Arsenic forms can be classified into three main groups: (1) inorganic (typically the most toxic form), (2) organic, and (3) arsine gas. The most common valence states of arsenic are As(0) (metalloid arsenic), As(III) (arsenite), As(V) (arsenate), and As(-3) (arsine gas) (ATSDR 2009). Arsenite and arsenate are the inorganic forms of arsenic. Arsenite is 60 times more toxic than arsenate because of its propensity to react with lipids, proteins, and other cellular components causing higher cellular uptake (Ventura-Lima et al. 2011; Khosravi-Darani et al. 2022). Arsenite is also highly soluble and mobile in aquatic systems (Khosravi-Darani, et al. 2022; Brusseau and Artiola 2019).

Due to the high toxicity of inorganic arsenic, and its prevalence as the common oxidation state in both ground and surface waters, both EPA and Idaho developed human health criteria for inorganic arsenic rather than total arsenic.

2.2.1 Effects of Physical and Chemical Properties on Speciation of Arsenic

Once arsenic is released into the environment, it cannot be destroyed, but can change forms (for example, inorganic to organic) or attach to or separate from particulates (Chung et al. 2014; ATSDR 2007b). Arsenic can be transformed by various reactions in the environment, including oxidation-reduction reactions, ligand exchange, precipitation, and biotransformation. These reactions are influenced by the oxidation-reduction potential, dissolved oxygen, pH, metal sulfide and sulfide ion concentrations, iron concentrations, temperature, salinity, and the distribution and composition of biota. (ATSDR 2007a; Zhang et al. 2022; Gorny et al. 2015; Shah et al. 2008). The combination of these environmental factors and rates of transformation determines the ratio of arsenic species in the environment.

The extent of arsenic adsorption to suspended solids and sediments in the water column or stream bed depends strongly upon the temperature, humic content, sediment type, and pH of the water and the arsenic species. In acidic and neutral waters, arsenate is more readily adsorbed, while arsenite is weakly adsorbed. Arsenite is present predominantly as arsenous acid (H_3AsO_3) at environmental pH (between 6.5 to 9) and is not strongly adsorbed to suspended solids and sediments in the water column (Gorny et al. 2015; EPA 2022a). Arsenate is predominantly present as dihydrogen arsenate (H_2AsO_4) and hydrogen arsenate ($HAsO_4^{2-}$) in most waters, which is considerably more adsorptive than arsenous acid. Sediment-bound arsenic may be released back into the water by chemical or biological interconversions of arsenic species, especially in high pH waters (pH >9) (ATSDR 2007a; Gorny et al. 2015).

2.3 Arsenic in Surface Water

In aquatic systems, inorganic arsenic occurs primarily as arsenate and arsenite (Brusseau and Artiola 2019). In oxygenated waters (such as rivers), arsenate is the predominate form, while in reducing conditions (e.g., groundwaters), arsenite predominates (ATSDR 2007a; Rahman et al. 2012; WHO 2019). Products of methylation, monomethylarsonate (MMA), and dimethylarsinate (DMA) can also be present and are the main organic forms of arsenic in freshwater (ATSDR 2007a).

In surface waters, arsenic is transported in the water column but also will bind to particles in the water or sediment on the bottom of lakes or rivers. Ultimately, most arsenic is adsorbed from water onto sediments or soils—especially clays, iron oxides, aluminum hydroxides, manganese compounds, and organic material (Gorny et al. 2015; ATSDR 2007a). Arsenic can also move from water and sediment into biofilm (attached algae, bacterial, and associated fine detritus), and then into invertebrates and fish (ATSDR 2007a). Under these conditions, arsenate and arsenic can undergo biomethylation to less harmful arsenic compounds. The uptake of arsenic from the water column into fish tissue is further discussed in section 2.5.

2.3.1 Background Arsenic Levels in Idaho

Elevated arsenic levels in Idaho groundwaters are well documented and are naturally occurring (CLU-IN 2022; DEQ 2023). From 2019 to 2021, DEQ conducted a probabilistic monitoring study to measure total and inorganic arsenic levels in paired surface water column and fish tissue samples and inorganic and total arsenic levels in surface waters throughout Idaho to derive an Idaho-specific inorganic arsenic human health criteria (Figure 1). Results of the monitoring study showed an average concentration of 1.63 µg/L of inorganic arsenic present in water column samples. Of the inorganic arsenic found, an average of 0.20 µg/L was arsenite with results as high as 1.87 ug/L, and 1.44 µg/L was arsenate with results as high as 20.80 ug/L.

An analysis of water quality portal data for inorganic arsenic in surface waters across Idaho from 2012 to 2022 showed average concentrations of 6.42 µg/L of total arsenic, and an average of 1.36 µg/L of inorganic arsenic in Idaho waters. Inorganic arsenic concentrations ranged from 0.47 µg/L to 2.07 µg/L (National Water Quality Monitoring Council 2022).

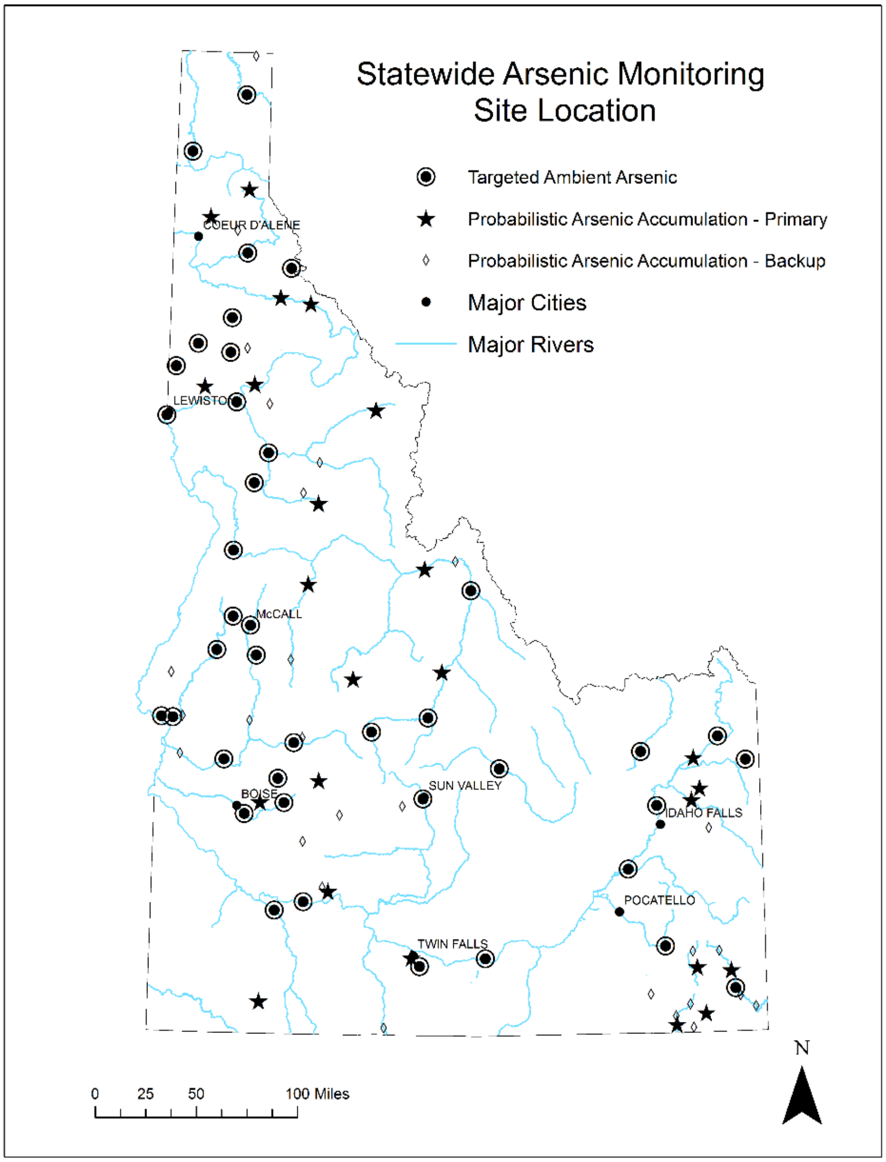

Figure 1. Map of Idaho arsenic monitoring study sites.

2.4 Effects of Arsenic on Human Health

The EPA classified inorganic arsenic as a Group A human carcinogen (EPA 2021a; IRIS 2017; NTP 2021). Acute oral exposure to inorganic arsenic can affect the digestive tract, respiratory system, central nervous system, cardiovascular system, and liver, and cause hematological effects and peripheral neuropathy. Acute exposure may also result in death. Chronic oral exposure to elevated levels of inorganic arsenic can result in gastrointestinal effects, anemia, peripheral neuropathy, skin lesions, hyperpigmentation, as well as liver and kidney damage (EPA 2021a; IRIS 2017).

Chronic exposure to arsenic at a dose lower than 0.04 milligrams per kilograms per day (mg/kg/day) can increase occurrences of cancer (e.g., skin, bladder, lung, kidney, and liver) and have noncancerous effects on various physiological systems such as the cardiovascular, pulmonary immunological, neurological, and endocrine systems (ATSDR 2007a; IDWR 2002).

2.5 Bioaccumulation and Biotransformation of Arsenic in Fish Species

Aquatic organisms accumulate, retain, and transform arsenic species internally when exposed through diet and other sources such as water and sediments (Williams et al. 2006; Zhang et al. 2022; EPA 2003, 2000; Rahman et al. 2012). Bioaccumulation is the net accumulation of a chemical by an aquatic organism as a result of uptake from all environmental sources, including water, food, and sediment, and is measured as the final result of competing rates of chemical uptake and elimination (EPA 2003, 2000; Arnot and Gobas 2006). Rates of arsenic uptake and bioaccumulation depend on a variety of factors, such as aquatic setting (marine, estuarine, freshwater), organism type (fish, invertebrate), species, age, trophic status within the aquatic food chain, exposure concentrations, history of exposure, route of uptake, environmental pH, dissolved organic matter, and phosphorus content (Williams et al. 2006; Shah et al. 2008; Ghosh et al. 2022; Zhang et al. 2022). Arsenic does not appear to biomagnify through aquatic food chains; inorganic arsenic seems to diminish at high trophic levels due to the ability of organisms to biotransform and eliminate this form of arsenic (ATSDR 2007a; Williams et al. 2006; EPA 2003; Ghosh et al. 2022, Morrison et al. 2023*).*

Fish can take up arsenic from the water column across diffusion barriers into the blood and internal organs (e.g., through the gills and skin) or through assimilating contaminated food sources (Zhang et al. 2022; Ghosh et al. 2022; Rahman et al. 2012). Benthic species, such as algae and invertebrates, and benthic feeding fish often accumulate the most arsenic due to the exposure through arsenic accumulated in sediments (Cui et al. 2020; Ghosh et al. 2022; Rahman et al. 2012). Predatory fish may bioaccumulate metals from the surrounding water and from feeding on other fish, particularly benthic feeding species (Ghosh et al. 2022; ATSDR 2007a).

Once inside the organism, inorganic arsenic may metabolize into organic forms (Ghosh et al. 2022; Shah et al. 2008). Transformation pathways of inorganic arsenic are complex and are influenced by various environmental and organismal factors. However, a simple model of biotransformation of inorganic arsenic involves two types of chemical reactions: (1) the reduction of pentavalent arsenic (arsenate) to trivalent arsenic (arsenite) by glutathione (GSH) and (2) the oxidative methylation of trivalent to methylated pentavalent metabolites (MMA and DMA) with further transformation to arsenocholine (AsC) and arsenobetaine (AsB) (Chen et al. 2018; Cui et al. 2021; ATSDR 2007a). Arsenic species can accumulate in tissues or be eliminated from the body through excretion, molting, or passage to reproductive cells (Figure 2).

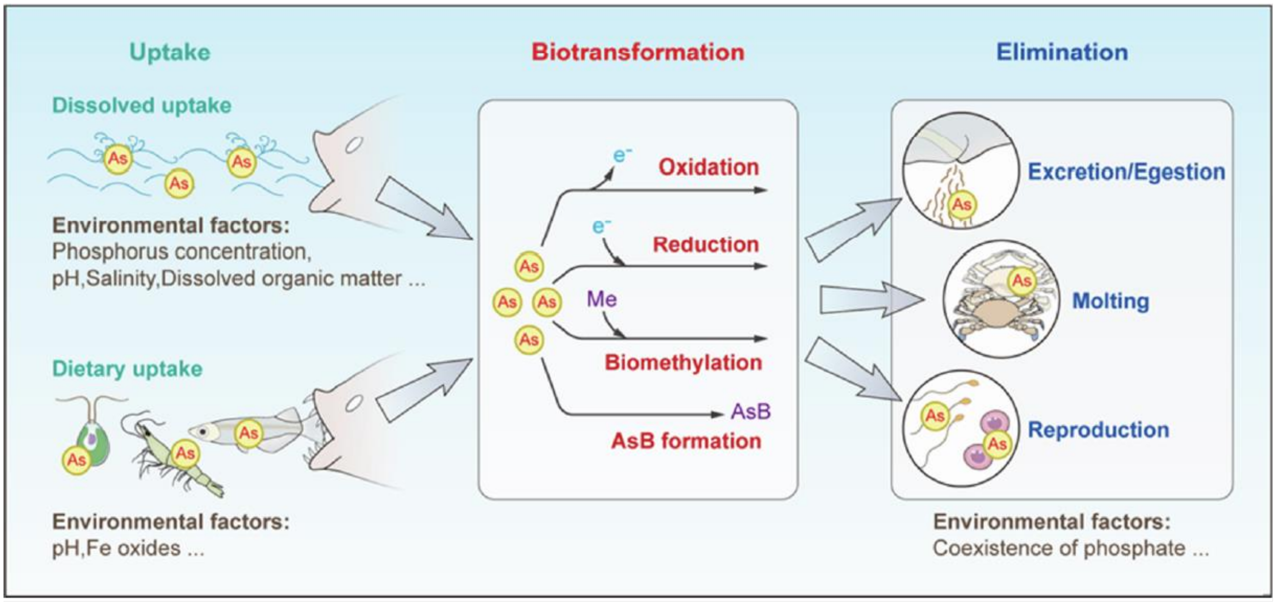

Figure 2. Uptake, biotransformation, and elimination pathways of arsenic (Zhang et al. 2022).

2.5.1 Uptake of Inorganic Arsenic

In 2019, DEQ conducted a probabilistic monitoring study to investigate the relationship of total and inorganic arsenic levels in paired water column and fish tissue samples to develop an Idaho-specific bioaccumulation factor for human health criteria. The study found that fish tissue and water column levels of arsenic were weakly related, and the relationship was not statistically significant (p-value = 0.56) (DEQ 2020; Morrison et al 2023).

Due to the lack of evidence for a strong relationship between fish tissue and water column levels of arsenic, DEQ believes the rule and its implementation principles, including the use of TL-BAF and a dual tissue/water column criterion, will account for changing or increasing arsenic conditions. Unlike other metals, such as mercury and selenium, arsenic is not highly bioaccumulative. In fact, lower trophic level species are more likely to have elevated levels of inorganic arsenic than those at higher trophic levels (Morrison et al. 2023; Ghosh et al. 2022; ATSDR 2007a; Williams et al. 2006; EPA 2003). Little concern exists that small, incremental changes in water chemistry would result in drastic changes in fish tissue.

During negotiated rulemaking, stakeholders and DEQ considered whether new inputs or activities within a watershed would reach equilibrium quickly or would take a long time to manifest. The group decided to use a set buffer period after new or increased discharges. Research has shown varying lengths of time to achieve site equilibrium based on various environmental parameters and organism traits (EPRI 2008, 2011). Laboratory studies have shown that equilibrium for arsenic is close to 60 days in Rainbow Trout and Catfish, with arsenic levels beginning to decrease by 50% between days 60 and 90 (EPRI 2011, 2008). However, field conditions have many variables that can affect the rates of assimilation and elimination. DEQ has determined that a 90-day period after new activity or discharge should be sufficient to evaluate effective inorganic arsenic levels in fish tissue for protecting human health.

In IDAPA 58.01.02.010.65, *new activity* or discharge is defined as follows:

> …an activity or discharge that has not been previously authorized. Existing activities or discharges not currently permitted or licensed will be presumed to be new unless the Director determines to the contrary based on review of available evidence. An activity or discharge that has previously taken place without need for a license or permit is not a new activity or discharge when first licensed or permitted.

3 Bioaccumulation Factor

Bioaccumulation "is a process in which a chemical substance is absorbed in an organism by all routes of exposure as occurs in the natural environment, i.e., dietary and ambient environmental sources" (Arnot and Gobas 2006; EPA, 2000). A bioaccumulation factor represents the relationship of the concentration of a pollutant in the tissue of fish to the concentration in water and is often expressed as a ratio.

The lack of a strong relationship between water column and fish tissue levels of arsenic demonstrates the complexity in uptake routes and metabolism of arsenic, and a significant portion of arsenic found in fish could also be sourced through diet, not solely through absorption via the water column. Idaho's water quality standards specify that DEQ will use a TL-BAF or bioconcentration factor (BCF) to derive human health criteria (IDAPA 58.01.02.210.05.b.ii). BCFs only consider the uptake of chemicals by exposure through the water column, while BAF includes both dietary contributions and direct uptake from the environment (e.g., diffusion across the gill surface) (Mackay et al. 2013; Arnot and Gobas 2006; EPA 2003, 2000). Both EPA and DEQ prefer field-based BAFs derived by collecting paired tissue and water column data over other estimates of bioaccumulation (e.g., BCFs) when determining human health criteria (EPA 2003).

National average BAFs for a given chemical and TL may not provide the most accurate estimate of bioaccumulation for certain water bodies in the United States. At a given location, the BAF for a chemical may be higher or lower than the national BAF, depending on the nature and extent of site-specific influences. In addition, the fish consumption habits of the local human population will guide the selection of the target species for which the investigator develops site-specific BAFs (EPA 2000). The bioaccumulation potential of a chemical can be affected by various site-specific physical, biological, and chemical factors.

Bioaccumulation factors for the Idaho human health criteria for arsenic were calculated from the Idaho probabilistic paired water column and fish tissue study (DEQ 2019). For each fish tissue sample (composite of five individuals), a corresponding water column sample was taken from the same location. BAFs were then calculated for each fish species and paired water column sample. BAFs are more representative of contaminant uptake by organisms from a variety of sources but do not capture the bioaccumulation potential of different species of fish. One way to reduce the variability between species BAFs, is to calculate each BAF by TL. More specifically, calculation by TL helps to account for broad physiological differences, such as lipid content or life stage, among organisms that may influence bioaccumulation (EPA 2003).

3.1 Trophic-Level Weighted BAF

A TL-BAF can be calculated by assigning fish to trophic level by species and using the BAFs at each TL and as a relative consumption proportion for each TL. To calculate a TL-BAF for arsenic human health criteria in Idaho, BAFs were calculated from the Idaho arsenic accumulation in fish tissue study (DEQ 2020).

For each species DEQ sampled, TL assignments were made based on a synthesis of information found in Simpson and Wallace (1982), Wallace and Zaroban (2013), Sigler and Zaroban (2018), and FishBase (Frose and Pauly 2000). A geometric mean was calculated from individual sample BAFs by TL (Table 2). TL2 fish are those fish that mostly consume TL1 organisms (primary producers such as algae and aquatic plants). TL3 fish are those fish that primarily consume TL2 organisms (aquatic invertebrates and TL2 fish). TL4 fish are predatory fish that primarily consume TL3 organisms (large aquatic invertebrates, other fishes).

Table 2. TL assignments for calculating Idaho-specific TL-BAF and geometric mean of calculated bioaccumulation factors by TL.

Trophic Level	Species	Rationale	Bioaccumulation Factor (L/kg)
2	Bridgelip Sucker	Herbivorous	2.99
3	Brook Trout, Channel Catfish, Common Carp, Cutthroat Trout, Longnose Dace, Mottled Sculpin, Mountain Whitefish, Rainbow Trout, Redside Shiner	Primarily invertivores, or opportunistic invertivore/piscivore where invertebrates make up a large component of diet	1.82
4	Brown Trout, Largemouth Bass, Northern Pikeminnow, Smallmouth Bass	Primarily piscivores, or diet composed mostly of large invertebrates and fishes	0.27

Although Idaho fish consumption surveys did not specify consumption rates by species or by TL, it is possible to calculate a TL-BAF by using the proportions of TL-specific consumption rates from the national fish consumption rate survey and applying those proportions to Idaho's fish consumption rate. TL-specific consumption rates were based on the proportion of the 90th percentile of TL-specific consumption of freshwater and estuarine fishes to the total consumption rate from the national estimated fish consumption study and assigned to each TL (Table 3; EPA 2014; DEQ 2021).

Table 3. TL-specific consumption rates from the national fish consumption study.

Trophic Level	National Consumption Rate (grams/day)	Proportion
2	7.6	0.36
3	8.6	0.40
4	5.1	0.24
Total	21.3	1.0

Source: EPA 2014. *Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations*.

Using Equation 1, a TL-BAF can be calculated using BAFs from the Idaho sampling data and TL-specific proportions from the national fish consumption rate.

$$\boldsymbol{TL\ BAF = [(BAF_{TL2})(P_{TL2}) + (BAF_{TL3})(P_{TL3}) + (BAF_{TL4})(P_{TL4})]}$$

Equation 1. TL-BAF calculation.

Where:

TL-BAF= trophic level weighted BAF.
BAF_{TLi} = geometric mean of BAFs calculated for all samples for species assigned to TL_i.
P_{TLi} = proportion of national fish consumption rate for TL_i fishes.

This calculation results in a TL-BAF of 1.87 L/kg, representing the TL- BAF (

Equation 2):

$$\boldsymbol{TL\ BAF = [(2.99\ L/kg)(0.36) + (1.82\ L/kg)(0.40) + (0.27\ L/kg)(0.24)] = 1.87\ L/kg}$$

Equation 2. Result for statewide TL-BAF calculations.

4 Criteria Overview

The following section contains an overview of the recreational (fish only) and DWS (fish + water) use criteria. The Fish Only criterion has two elements, fish tissue and water column; while the Fish & Water use criterion is a single water column criterion based on the Safe Water Drinking Act (SWDA) maximum contaminant level (MCL).

4.1 Recreational Use Criteria

To protect recreational uses, the Fish Only criterion for consumption of fish only is a dual element criterion consisting of a fish tissue element and a water column element where the fish tissue element takes precedence, or supersedes, the water column element if adequate data are present. Due to the uncertainty associated with bioaccumulation of inorganic arsenic, this two-part criterion provides a direct measure of the exposure route to be protected by allowing direct comparison of the fish tissue. In addition, it provides a water column criterion that can be used when sufficient fish tissue data (section 4.1.1) might not be available or obtainable.

For this guidance, *water body* is defined as an assessment unit (AU) (IDAPA 58.01.02.10.109). Surface water in Idaho is divided into 2,641 water body units, codified in IDAPA 58.01.02.109–160. A water body unit may be divided, or split, based on information that shows distinct differences within a water body unit, such as changes in land use, local geography, or ecosystem. Idaho currently has 5,676 state AUs (and 232 tribal AUs). These AUs are listed in the *Integrated Report, Appendix A* (DEQ 2022b).

4.1.1 Fish Tissue Element

The fish tissue element of the Fish Only criterion of 8 µg/kg is a direct measure of the concentration of inorganic arsenic in fish tissue that would provide protection for consumers at the Idaho-specific fish consumption rate and cancer risk factor and is the tissue concentration that the water column concentration is intended to protect (Appendix A).

Fish tissue concentration is compared to the criterion based on an average or composite of a *minimum* of five individual fish of the same species, collected from the same water body within the same calendar year, defined as January 1–December 31. When available, game fish species representative of the size and species that may be *legally harvested* within the water body should be used. Species that are not legally harvestable at the time of sampling, or are protected species, should not be collected. All *fishing rules* set by Idaho Department of Fish and Game (IDFG) should be followed (IDFG 2023).

The appropriate permits from IDFG (e.g., the *scientific sampling permit*) for sampling must be obtained before sampling and should be included in the sampling plan submitted to DEQ. The permit request may include sampling purpose, sampling area, species, sampling method, disposition, and type of samples required. It may take 6 weeks or more for permit approval; and some species of fish, depending on location may not be allowed for sampling. Contact IDFG for more information about sampling permits.

Game fish, defined by rule, are fish routinely pursued by recreational anglers and can be consumed. According to IDFG, the following are fish considered game fish[1]: Brook, Brown, Cutthroat, Golden, Lake (Mackinaw), Rainbow (including Steelhead), Splake and Sunapee Trout; trout hybrids (e.g., Tiger Trout); Atlantic, Chinook, Coho, and Kokanee Salmon; Arctic Grayling; Whitefish; Cisco; Crappie; Perch; Bass; Catfish; Bullhead; Sunfish; Northern Pike; Tiger Muskie; Walleye and Sauger; and Burbot (Ling) (*Idaho Fishing Seasons & Rules*).

[1] The fish on the threatened or endangered species list are not included.

The fish tissue element can only be used if no new activity or discharge occurs that contributes arsenic to the water body within the prior 90 days.

In the absence of game fish species, other resident fish species may be used. The absence of a minimum of five fish of a single species is considered insufficient fish tissue data, and the water column element (4.3 µg/L) would be the applicable element of the criterion. Results from multiple sample events may be averaged or composited if they represent the same species collected from the same water body within the same calendar year.

Multiple species also may be used to evaluate compliance with the criterion, but each sample must contain a minimum of five individuals, and each species sample must be evaluated independently of each other. For example, if five Rainbow Trout and five Mountain Whitefish were collected at a site, that site would have two samples. If the Rainbow Trout sample exceeded the fish tissue element, while the Mountain Whitefish sample did not, the criterion would still be considered exceeded. More than five individuals may compose a sample, which can mean multiple sampling events that collect the same species over a calendar year will be evaluated for compliance with the criterion. Multiple sampling events over a calendar year may more accurately capture an annual average value of inorganic arsenic in fish tissue. For example, if during spring sampling five rainbow trout were caught, summer sampling caught six rainbow trout, and fall sampling caught three rainbow trout, all specimens (of the same species and more than the minimum of five individuals), would be averaged and evaluated against the criterion as one value as the annual arithmetic mean.

Fish tissue samples should target harvestable game fish species or other fish species that are commonly consumed by the general public. If a sufficient number of fish are unavailable, the water column element of the criterion at 4.3 µg/L is the applicable criterion element. If a sampling plan is developed and the applicant wants to use fish tissue data to ensure compliance with the fish tissue criterion, and suitable game fish are *not* available, according to the rule, other resident fish species may be used; however, ample evidence showing the absence game fish species should be presented by the permit applicant.

4.1.2 Water Column Element

Since fish tissue data are not always available or obtainable, DEQ included a water column element in the Fish Only criteria. The calculated water column element of 4.3 µg/L dissolved inorganic arsenic is based on the Idaho-specific TL-BAF and is the applicable criterion element when sufficient fish tissue data are not available. Although uncertainty exists about the relationship of inorganic arsenic concentrations in the water column and fish tissue (Morrison et al. 2023; DEQ 2020), most measures of the central tendency of inorganic arsenic BAFs in the Idaho inorganic arsenic monitoring study are in the range of 1 to 2 L/kg (DEQ 2020); the TL-BAF of 1.87 L/kg falls within this range (Equation 2). The resulting water column element of 4.3 µg/L based on the TL-BAF of 1.87 L/kg would protect the recreational use when fish tissue data are unavailable or unobtainable. Appendix A explains criteria developed during rulemaking.

When sampling to monitor for compliance with the criterion, water column samples must represent the annual average concentration of dissolved inorganic arsenic at the site. No minimum number of samples is required in the rule, however the samples will need to have seasonal variation as much as logistically possible and will be evaluated as an arithmetic annual mean for compliance. The sampling plan will be reviewed by DEQ to ensure it's a representative sample.

4.2 Domestic Water Supply Criterion

Waters designated for DWS must protect humans from harmful levels of inorganic arsenic ingested through both drinking water and fish tissue consumption. According to Idaho's water quality standards, the domestic water supply designation should meet water quality appropriate for use as untreated raw water for public drinking water:

> Water quality appropriate for use as untreated raw water (as defined under IDAPA 58.01.08, "Idaho Rules for Public Drinking Water Systems") for public drinking water. (IDAPA 58.01.02.100.03).

The Water and Fish water column criterion of 10 ug/L is taken from the SWDA MCL for arsenic (EPA 2022b). Waters meeting the DWS water quality criteria also meet SWDA standards, which protect public drinking water systems.

Compliance with the Water and Fish water column criterion is based on an annual arithmetic mean. While no minimum number of samples is required, the mean should represent annual average conditions at the site (i.e., represents seasonal variation). A water body would meet the criteria for Water and Fish exposure to inorganic arsenic if the water column concentration does not exceed 10 µg/L. However, as in all waters in Idaho, the more restrictive criteria apply to a water body. The aquatic life criteria for arsenic are much higher, at 340 µg/L for acute, and 150 µg/L for chronic aquatic life exposures; in water bodies with recreational or DWS designations, the human health criteria would be the more restrictive and applicable criteria.

If a water column translation of the fish only criterion is conducted in a designated DWS stream and the resulting water column value is greater than 10 ug/L, then the DWS criteria is the more sensitive use that must be protected.

All waters in Idaho, with only one exception, are to be protected for a recreational use and only a subset of Idaho waters are designated for domestic water supply; therefore, the recreational use will nearly always be the more sensitive use to be protected. There are no water bodies in the state designated for DWS only, so the DWS criterion will only be the more restrictive criteria when a water column translation (section 4.3) of the fish only criterion is conducted for a total maximum daily load (TMDL) or an Idaho Pollutant Discharge Elimination System (IPDES) permit in a designated DWS stream, and the resulting number is greater than 10 µg/L. In this case, the DWS criterion of 10 µg/L would be the applicable criterion to calculate effluent limits or TMDL targets as it would be considered the more restrictive use criteria.

4.3 Water Column Translation

In developing effluent limits or TMDL targets for waters protected for recreational use, the Fish Only fish tissue element may be translated to a water column value. The translation may also be appropriate for non-Clean Water Act applications such as remedial actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). However, these are not CWA applications of the criteria, and the application would need to work with the appropriate authorities under CERCLA or state regulations (42 U.S.C. §9601 et seq.) The translation is determined using a site-specific TL-BAF based on the ratio of total recoverable inorganic arsenic in fish muscle or fillet tissue to dissolved inorganic arsenic in the water column. The site-specific translation is not a site-specific criterion, it translates the fish tissue element to an applicable water column target using both the Fish Only fish tissue criterion and a site-specific TL-BAF. Site-specific TL-BAF calculations for arsenic will be evaluated and used on a case-by-case basis. DEQ recommends working with the DEQ regional or state office when developing a sampling methodology. Sampling should be conducted to reflect bioaccumulation processes affected by the upstream water. Both fish tissue and water column samples must meet the requirements of IDAPA 58.01.02.210.03.e.v. DEQ also recommends working with a DEQ regional office scientist when developing a sampling methodology. IDAPA 58.01.02.210.03.e.v.4 for arsenic states "BAFs are calculated as a tropic-level weighted BAF or *other scientifically defensible method for deriving protective* BAF." If an applicant proposes an alternative method for deriving a protective BAF other than a TL-BAF, they should submit the method rationale for evaluation to DEQ before sampling.

The translation directly incorporates the fish tissue element of the criterion for recreational waters of 8.0 µg/kg but may result in a water column value greater or less than the statewide water column element depending on the site-specific conditions. The translated value becomes the applicable element for the specific application (e.g., permit, TMDL, fishless water). If the translated criterion exceeds the water and fish criterion (10 µg /L) in waters also designated for DWS, then the water and fish criterion would apply instead of the translated fish only criterion, as the more stringent use criterion applies (Appendix C).

4.3.1 Water Column Translation Data Requirements

To conduct a water column translation, a site-specific TL-BAF must be calculated. An applicant for a water column translation needs the following:

- Data identifying available fish species at the site, including historical presence data and a fish biologist consultation with appropriate experience and background, such as a DEQ or IDFG regional biologist.
- Sampling and quality assurance/quality control (QA/QC) plan
- Paired fish tissue and water column concentrations of inorganic arsenic from all available representative TL (TL2, TL3, TL4) legally harvestable fish species in the water body

Data used to translate the fish tissue element must be based on current conditions. Sampling for a water column translation should develop translation in a spatial and temporal manner consistent with criteria development (e.g., consider annual variation) and collect fish tissue data for TLs 2, 3, and 4. As described in the rule and this guidance, when available, game fish species should be collected and used to develop a TL-BAF; however, other resident nongame fish species may need to be used for the lower TLs. In the absence of a representative TL fish, or the inability to legally harvest the TL, as confirmed by fish biologist consultation or DEQ and IDFG data, default TL values from the statewide study should be used (Table 4).

In fishless waters, surface water and fish tissue from the immediate downstream waters may be used for bioaccumulation modeling for a target water column value. In the absence of sufficient fish tissue data (IDAPA 58.01.02.210.03.d), the statewide water column element is the applicable criterion element (section 4.1.2).

Permit applicants seeking to develop a site-specific water column translation should consult with DEQ before sampling activities to ensure the appropriate sampling targets and TL-BAF water column translation.

4.3.2 Calculating a Site-Specific Water Column Translation

1. Once paired fish tissue and water column inorganic arsenic data have been procured, calculate BAFs for each species using Equation 3. Each fish tissue sample must be an average or composite of at least five individuals of the same species from the same target water body with paired water column samples collected in the same year. If the minimum number of individuals for a sufficient fish tissue is not available for a species (minimum of five individuals), the sample cannot be used for calculating a site-specific TL-BAF; however, the default BAFs in Table 4 may be used.

$$\mathbf{BAF_{iAs}} = \left(\frac{[\mathbf{iAs}]_{\mathbf{Fish}}}{[\mathbf{iAs}]_{\mathbf{Water}}}\right)$$

Equation 3. Translation BAF calculation.

Where:

$\mathrm{BAF_{iAs}}$= sample BAF for inorganic arsenic in L/kg
$[\mathrm{iAs}]_{\mathrm{Fish}}$ = concentration of inorganic arsenic in fish in µg/kg
$[\mathrm{iAs}]_{\mathrm{Water}}$ = concentration of inorganic arsenic in water, in µg/L

2. Assign each species to a TL. Use TL assignments from Table 4 or another scientifically defensible method, such as stable isotopic analysis, or consultation with a DEQ. For missing TLs, the default TL-BAFs should be used. If more than one species exists at a TL, take the geometric mean of the BAFs of that TL. For example, if there are samples of Longnose Sucker (TL2), Rainbow Trout (TL3), Lake Whitefish (TL3), Cutthroat Trout (TL3), and Sauger (TL4), take the geometric mean of the three TL3 BAFs before proceeding. Five fish from a single species per TL is sufficient.
3. Use Equation 4 to calculate the site-specific TL-BAF. If a TL was missing during sampling plan development, after confirmation by DEQ, use the default TL-BAF from Table 4.

$$\boldsymbol{TL\ BAF = [(BAF_{TL2})(0.36) + (BAF_{TL3})(0.40) + (BAF_{TL4})(0.24)]}$$

Equation 4. Translation TL-BAF calculation.

Where:

TL-BAF = trophic level weighted BAF in L/kg

BAF_{Tli} = geometric mean of BAFs calculated for all samples for species assigned to Tl_i in L/kg; and the proportion of national fish consumption rate for Tl_i fishes (Table 3)

Table 4. TL assignments for calculating TL-BAF.[a]

Trophic Level	Species	Rationale	Default Trophic Level Bioaccumulation Factor (L/kg)
2	Sucker[b] (Utah, Largescale, Longnose, Mountain)	Herbivorous	2.99
3	American Shad, Arctic Grayling, Bear Lake Whitefish, Black Bullhead, Blue Catfish, Bluegill, Bonneville Cisco, Brook Trout, Brown Bullhead, Channel Catfish, Common Carp[b], Cutthroat Trout, Crayfish, Golden Trout, Lake Whitefish, Longnose Dace[b], Mountain Whitefish, Pumpkinseed, Pygmy Whitefish, Splake Trout, Sculpin[b], Sunapee Trout, Rainbow Trout, Redside Shiner[b]	Primarily invertivores, or opportunistic invertivore/piscivore where invertebrates make up a large component of diet	1.82
4	Atlantic Salmon, Black Crappie, Brown Trout, Burbot, Chinook Salmon, Coho Salmon, Green Sunfish, Lake (Mackinaw) Trout, Largemouth Bass, Northern Pike, Sauger, Smallmouth Bass, Kokanee Salmon, Tiger Trout, Walleye, White Crappie, Yellow Perch	Primarily piscivores, or diet composed mostly of large invertebrates and fishes	0.27

a. Contact DEQ for any species outside of this list.
b. These species are not listed game fish. TL assignments were based on information from Sigler and Zaroban (2018), and Fishbase (www.fishbase.se). Additional data or site-specific species information maybe available to determine TL for fish at a sampling location.

Use

4. Equation 5 to calculate the water column translation based on the fish tissue criterion of 8 µg/kg, resulting in a water column criterion for dissolved inorganic arsenic:

$$\boldsymbol{WC_T\left(\frac{\mu g}{L}\right) = \frac{8.00\mu g/kg}{BAF_{SS}L/kg}}$$

Equation 5. Water column translation calculation.

Where:

WC_T (µg/L) = translated water column value

BAF_{SS} L/kg = site-specific BAF calculated consistent with IDAPA 58.01.02.210.03.e.v.

4.3.3 Example Water Column Translation Calculation

In this section, an example calculation of the water column translation is provided. For the following paired fish tissue and water column samples, the BAFs for each TL are calculated as fish tissue (in µg/kg) divided by water column (in µg/L), per step 1 in section 4.3.2:

Table 5: Trophic level (TL) BAFs for select species.

Species	Specimen Count	Trophic Level	Fish (µg/kg)	Water (µg/L)	Resulting BAF (L/kg)
Bridgelip Sucker	5	2	2.3	0.608	3.78
Mountain Whitefish	5	3	2.0	0.583	3.43
Pumpkinseed	5	3	9.4	0.583	16.12
Rainbow Trout	5	3	0.2	0.649	0.31
Brown trout	5	4	0.8	0.608	1.32

After taking the geomean of the three TL3 species BAFs, the following BAFs were obtained for each TL:

Trophic Level	Resulting BAF (L/kg)
2	3.78
3	2.57
4	1.32

To calculate a site-specific TF- BAF, the above TF-BAFs are inserted into Equation 4 (step 3, section 4.3.2), resulting in a TL-BAF of 2.71 L/kg:

$$\boldsymbol{TL\ BAF = [(3.78L/kg)(0.36) + (2.57L/kg)(0.40) + (1.32L/kg)(0.24)] = 2.71\ L/kg}$$

Using the site-specific TL-BAF, the site-specific water column element of 2.95 µg/L is calculated shown below:

$$\boldsymbol{WC_T\left(\frac{\mu g}{L}\right) = \frac{8.00\ \mu g/kg}{2.71\ L/kg} = 2.95\ \mu g/L}$$

5 General Implementation Considerations

Implementation consideration scenarios are found in Appendix B.

5.1 Fish-Tissue Monitoring and Assessment

DEQ recommends engaging early with the agency to develop a sampling and analysis plan before any sampling or monitoring activities occur. Before developing Idaho-specific arsenic criteria, DEQ completed an extensive water column and fish tissue monitoring project and developed the quality assurance project plan (QAPP) *Arsenic Monitoring to Support Human Health Criteria Adoption* (DEQ 2019). DEQ recommends referring to this QAPP when developing a plan for arsenic criteria monitoring. A sampling plan should include, at minimum, the following information:

- Determine which AU will be sampled
- Location of planned sample site, including Global Positioning System (GPS) coordinates, satellite imagery if possible
- Analysis of resident game fish species present at study site
- Planned dates of sampling activity
- Field collection protocol
- QA/QC plan

The sampling and analysis plan should include a description of the intended use of the data (e.g., translation for fishless water, or effluent limit development) as this may affect the sampling location and timing. DEQ encourages permittees in proximity to other permittees or facilities with the same water body to develop cooperative fish tissue monitoring programs in lieu of facility-specific monitoring. If parties are interested in developing a cooperative program, contact DEQ. For those facilities that opt to not participate in the cooperative program, facility-specific ambient fish tissue monitoring may still be required.

5.1.1 Recommended Species

To protect human health through the consumption of fish, legally harvestable game fish are the recommended species for determining compliance and for monitoring and assessment. In the absence of game fish, other resident fish species may be used for monitoring and assessment. Game fish are listed in section 4.1.1 and defined as fish routinely pursued and consumed in the evaluated water body.

When developing a plan to target species for monitoring, DEQ recommends working with DEQ and IDFG regional fisheries biologists to determine which species of fish are most prevalently caught and consumed within the target area. Take care when sampling to avoid recently stocked populations of game fish as they have a relatively short period of exposure to ambient conditions. Fish in residence for at least 90-days are assumed to meet the conditions for uptake of ambient arsenic. IDFG provides a comprehensive list of hatcheries and details of locations *where fish are stocked* on a statewide basis and *how to identify stocked fish*. Often hatchery fish have a clipped adipose fin but not always. When developing a monitoring plan, research the location and timing of stocking and avoid those areas and times if possible.

5.1.2 Analytical Methods

Fish tissue and water column samples must be analyzed for inorganic arsenic using sensitive analytical methods that provide sufficient detection limits to quantify inorganic arsenic at levels necessary for the proposed application. For example, EPA method 1632, which was used for developing the statewide criteria, has a method detection limit of 0.003 µg/L for water samples (EPA 1998). For the analysis, the skin of the fish tissue sample was removed to develop the statewide fish tissue criterion.

Other analytical methods may be used for the assessment if the method can report concentrations of inorganic arsenic below the applicable criterion. Include these methods in the sampling plan submitted to DEQ for approval before implementation.

5.1.3 Spatial Considerations

The spatial extent of a sampling or monitoring plan must be defined and factors that may affect arsenic variability throughout the site must be identified so they can be considered in the sampling plan design (EPA 2021b).

When sampling a site, GPS coordinate locations should be taken for the downstream and upstream limits of the site, or the beginning and end of where the samples were taken. For water column sampling, the goal is downstream of a discharge and as close as reasonable to the discharge that is representative and considers mixing between the discharge and the receiving water body. The location of water column sampling should also be recorded on a GPS device.

When sampling for fish tissue, consider which fish in the site are targeted for recreational fishing and may be consumed. For water column sampling, the flow characteristics of the water body sampled, along with the locations where fish are feeding and spawning, should be considered. Attempt to sample all habitat types to appropriately characterize the range and distribution of arsenic concentrations at a site. Adjust monitoring plans to include species of fish found in the small stream segment and consider the relationship of upstream sources to downstream habitats (EPA 2018).

Sampling reaches should be identified based on existing fish habitat, known presence of fish, and proximity to discharge. The determination of this reach should be clearly described in the sampling plan. Lengths of a sampling reach may vary based on site parameters but maintain consistency between each sample site. Idaho's *Beneficial Use Reconnaissance Program (BURP) Field Manual* (DEQ 2017a) defines a reach for streams as 30 times the full bank width or a minimum of 100 meters long. Large rivers may utilize a different method. Upstream and downstream ends should be established and marked using a GPS device.

The level of spatial representation of sampling to implement the arsenic criteria for human health depends on how the data are to be used—whether monitoring results will be used to develop effluent limits for IPDES permits, or to determine compliance with water quality standards for the Integrated Report, IPDES permits, TMDLs, or remediation efforts. In flowing waters, spatial representation is generally ensured by sampling well-mixed portions of the stream (i.e., sampling from the thalweg and avoiding confluences or other obvious lateral inputs) (DEQ 2020).

5.1.4 Temporal Considerations

According to IDAPA 58.01.02.210.3.e.v.3, "water column samples must be representative of the annual average concentration of dissolved inorganic arsenic at the site." When building a sampling plan, take sampling frequency and quantity into consideration for sites where the water column may have seasonal changes, such as spring melt/runoff.

A fish tissue sample is a composite of a *minimum* of five individual fish of the same species over a calendar year. Since a single sample can be composed of five or more individuals of a species over a calendar year, it may be beneficial to incorporate multiple sampling events in the sampling plan. Particularly for developing TL-BAF water column translations, a more annual representative sampling plan may be needed.

For a TMDL or IPDES permit, develop a sampling plan to determine how many samples will be taken and how often to satisfy the requirements in the rule. For nonpoint source activities, one sample taken yearly that does not exceed criteria may be enough to satisfy the criteria, but frequency requirements are evaluated on a case-by-case basis by the permit writer.

6 Fishless Waters

Fishless streams are defined as the streams, or stream reaches:

- With insufficient instream habitat and/or flow to support a population of one or more fish species on a continuing basis
- Where fish are naturally absent due to ephemeral, intermittent, or persistent low flows
- Streams that lack a permanent connection to downstream fish-bearing waters

If a water body does not support fish because of unnatural conditions, such as presence of pollutants, then the water column element is the applicable criterion (section 4.1.2).

In waters that meet the definition of fishless, the water column element may be used, or surface water and fish tissue from the immediate downstream waters may be used for bioaccumulation modeling for site-specific water column translation (section 4.3). To determine that a water body is fishless, the site should have accompanying research and field data that is less than 5 years old. DEQ recommends using either electrofishing or environmental DNA of the site to collect comprehensive data for all species to help determine presence or absence of fish (DEQ 2022a). In the absence of sufficient fish tissue data, the water column element is the applicable criterion. When fish tissue samples are not available immediately downstream from the project location, or several tributaries contribute to the system before fish availability, the water column element is the applicable criterion (section 4.1.2).

Fishless Waters

Fish immediately downstream from the activity can only be used for bioaccumulation modeling to develop a site-specific water column translation.

The following factors are considered in any sampling plan aimed at understanding bioaccumulation dynamics in a downstream water affected by upstream sources:

- Variation (e.g., low-to-high exposure depending on location and time) in fish arsenic exposure from other waters in addition to the upstream fishless water
- Spatial variability of arsenic concentrations in surface waters and fish tissue
- Timing and location of sampling of water and fish to be representative of this variability

7 Identifying Impairments for Integrated Report

The process of assessing whether a water body fully supports beneficial uses is governed by IDAPA 58.01.02.054. DEQ uses the *Water Body Assessment Guidance* (DEQ 2016a) as a guide to make assessment decisions. Under IDAPA 58.01.02.054, data used for assessing compliance with the arsenic criteria in the Integrated Report should represent the AU assessed. When evaluating arsenic data to determine compliance with criteria for the Integrated Report, DEQ assessors use the following approach (DEQ 2022b):

- For contact recreational use criteria, if fish tissue data from at least five individuals of the same species within the same calendar year are available, compare the fish tissue data results to the applicable tissue criterion element (fish only). If the fish tissue value is less than the criterion, the AU is not listed as impaired. If any fish tissue sample, as defined in IDAPA 58.01.02.210.03.d and described in this guidance, exceeds the criterion, the AU is listed as not full support/impaired.
- If fish tissue data is not available, compare water column data to the water column criterion element. If the annual arithmetic mean of the water column data exceeds the criterion, the AU is listed as not full support/impaired.
- If a water column translation was performed, and the arithmetic mean of the water column samples taken exceed the translated value during monitoring or routine sampling, the AU is listed as not full support/impaired.

If a water body exceeds the applicable criterion, the water body will be listed on the CWA § 303(d) list according to evaluation standards established in the *Water Body Assessment Guidance* (DEQ 2016a). For waters designated for contact recreation, DEQ uses data less than 5 years old to determine a water body is not fully supporting when there are any exceedances of the appropriate criteria. For DWS, DEQ evaluates existing and readily available surface water data (e.g., from DEQ or US Geological Survey) to identify any exceedance of criteria values.

8 Antidegradation

Idaho's antidegradation policy maintains the existing quality of Idaho waters. The objective of Idaho's antidegradation rule (IDAPA 58.01.02.051) is to review point source discharge activities and provide the necessary level of protection. The implementation of the policy is addressed in IDAPA 58.01.02.052 and in the *Idaho Antidegradation Implementation Procedures* (DEQ 2019b). The statutory policy on antidegradation consists of three tiers of protection as required by federal rule (Idaho Code § 39-3603). Each level, or tier, has its own requirements for protecting water quality. Tier I is the minimum level of protection and requires that existing uses be met. Tier II is the middle level of protection and ensures degradation is "necessary to accommodate important economic or social development" (IDAPA 58.01.02.051.02). Degradation is not prohibited, but it must be necessary and justified. Tier III is the highest level of protection, reserved for waters of outstanding character (outstanding resource waters), defined as "high quality water, such as water of national and state parks and wildlife refuges and water of exceptional recreational or ecological significance, which has been designated by the legislature" and subsequently listed in IDAPA 58.01.02.010.72. No degradation of water quality is permitted in these waters.

Antidegradation review is triggered by an application for a new or reissued permit or license, including IPDES discharge permits or any federally permitted or licensed activity (e.g., Army Corps of Engineers CWA § 404 dredge and fill permits, and Federal Energy Regulatory Commission [FERC] licenses) where a § 401 water quality certification is required.

9 Clean Water Act § 401 Water Quality Certifications

The CWA § 401 water quality certification process is triggered when a discharge to waters of the state subject to CWA jurisdiction is proposed, and a permit or license is required for the activity. Some of the major federal licenses and permits subject to § 401 include the following:

- CWA § 402 and § 404 permits issued by EPA or the Army Corps of Engineers
- FERC licenses for hydropower facilities and natural gas pipelines
- Rivers and Harbors Act Section 9 and 10 permits.

The Idaho § 401 certification process is detailed in the 2021 *Idaho Section 401 Certification Guidance* (DEQ 2021b). For certifications with possible arsenic discharge, it is possible that during the § 401 certification process, a project proponent may be required to monitor fish tissue concentrations and/or dissolved inorganic arsenic in receiving waters. The water column translation may not be used where collecting fish tissue data before the certification request is not feasible. In that case, the certification writer should use the statewide water column or fish tissue criteria.

Most activities that are permitted under the § 404 program and certified by DEQ are not likely to be considered degrading because of their short-term duration and the understanding that arsenic increases resulting from temporary discharges will eventually equilibrate. Unlike other metals, such as mercury and selenium, inorganic arsenic is not highly bioaccumulative. Little concern exists that small, nonlasting changes in water chemistry would result in significant changes in fish tissue.

Some in-water work, including dredging projects, may be considered degrading, and DEQ may require the applicant to use the Sediment Evaluation Framework, perform a pilot test characterization of the proposed discharge, or perform other actions to determine whether degradation will occur. The certification writer will use best professional judgement when making such a determination, and the decision will be explained in the certification.

When an affected water body is unassessed, the applicant has the option to voluntarily acknowledge that the water body may be considered high quality and agree to the agency implementing Tier II protection. If the applicant does not believe the water body is high quality, DEQ must use information available to make a determination.

All relevant information available will be used to determine the appropriate level of antidegradation protection, including new information generated during the application process to specifically address the question of whether the water is high quality. New information may come from DEQ, other agencies, organizations, companies, or individuals. According to IDAPA 58.01.02.052.08(a)(ii), DEQ may ask the applicant to gather information to help with this determination.

10 TMDL Process

For AUs placed on the CWA § 303(d) list as Category 5 waters due to exceedances of arsenic criteria, development of a TDML is required. The TMDL process for arsenic will follow and be as consistent as possible with existing federal and Idaho's *Guidance for the Development of Total Maximum Daily Loads* (DEQ 1999). TMDLs for arsenic are prepared using a standard process: subbasin assessment, loading analysis, and implementation plan. The following sections discuss arsenic-specific considerations for the TMDL process.

10.1 Subbasin Assessment

The subbasin assessment is the initial section of the TMDL that describes the elements necessary to characterize the watershed. Typical TMDLs focus on source identification and pollutant control efforts in the watershed.

Present physical and biological characteristics, such as native arsenic deposits and formations should be included in this section. Fishery identification (including anadromous use and other native/nonnative species caught for recreational uses) is required, and regional IDFG offices should be consulted for fish species information for specific water bodies. Cultural characteristics should also be summarized, including the location of point and nonpoint sources in the watershed. Potential sources of arsenic to water bodies in Idaho include the following:

- Direct discharges of arsenic from water point sources
- Runoff from current or legacy mining sites or mining wastes, and other waste disposal sites, such as landfills
- Sediments that may have arsenic contamination or hot spots resulting from past discharges or historical placer mining activities.
- Geologic or *naturally occurring* arsenic in soils

10.2 Loading Analysis

Loading analysis estimates a water body's pollutant load capacity, margin of safety, and allocations of load to pollutant sources defined as the TMDL in EPA regulations (DEQ 1999; 40 CFR 130.2). Load capacity is the maximum quantity of a pollutant a water can receive and still meet water quality standards. Federal regulations allow that "loads may be expressed as mass per unit time, toxicity, or other appropriate measures" (40 CFR 130.2(I)). TMDL targets and subsequent load and waste load allocations (WLAs) for arsenic are based on statewide water column or fish tissue criteria or site-specific water column criteria, where applicable. Arsenic TMDLs are expected to lead to attainment of the relevant criteria when the water column arsenic targets are achieved. Natural background contributions, which are likely present for arsenic, are considered part of the load allocation but are often treated separately because they represent a part of the load not subject to control.

Seasonal variations are also typically included in TMDL determinations. For example, one TMDL applies during the summer and another TMDL applies during the winter. These variations enable a translation between the end-point for the TMDL (expressed as a fish tissue concentration of arsenic) and the arsenic loads to the water (expressed in water column loads). TMDL writers should reasonably consider the relative contribution of each source as one factor in developing allocations. Under current guidance, when a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on the assumption of reductions in the nonpoint sources, the TMDL should provide reasonable assurance that nonpoint source control measures will achieve expected reductions. This concept is also reflected in the definition of a TMDL, which allows for less stringent WLAs when best management practices or other nonpoint source controls make more stringent load allocations practical (40 CFR 130.2(i)).

11 Idaho Pollutant Discharge Elimination System

The CWA prohibits point source activities that discharge pollutants to waters of the United States unless a permit is obtained. DEQ has authority to issue CWA § 402 discharge permits in Idaho through the IPDES Program. Several guidance documents are available on IPDES Program implementation.

To meet the state's EPA-approved standards as required in the CWA § 301(b)(1)(C) and Idaho IPDES regulations (IDAPA 58.01.25), permit writers develop water quality-based effluent limits (WQBELs) if reasonable potential to exceed (RPTE) standards have been demonstrated.

Effluent data requirements recommended for toxics or hazardous pollutants are found in section 3.3 of EPA's *Technical Support Document for Water Quality-based Toxics Control* (EPA 1991). Other IPDES monitoring guidance should be used to identify appropriate monitoring requirements for RPTE determinations and IPDES permitting. These resources can be used to assess whether the discharge has the RPTE water quality criteria and cause or contribute to an instream excursion above the water column fish tissue elements for arsenic criterion. Because arsenic monitoring data (effluent and ambient water column and fish tissue) in Idaho is scarce, IPDES permitting strategies are expected to evolve as additional monitoring data become available. Effluent limits in IPDES permits are designed to control all pollutants or pollutant parameters (i.e., conventional, nonconventional, or toxic pollutants) that are or may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard including state narrative criteria for water quality (IDAPA 58.01.25.103).

Through the permitting process, a permittee may be required to monitor fish tissue or water column concentrations in the receiving water body, in addition to monitoring the effluent for total recoverable arsenic (i.e., where DWS is a protected use), and/or dissolved inorganic arsenic (i.e., where recreation is a protected use). Conversion of dissolved criteria to total for permitting purposes is a common and established procedure, conversion factors are detailed in IDAPA 58.01.02.210.02.

IPDES regulations require permit writers to assess the impact of discharges on downstream water quality and address situations where the discharge will cause, have the reasonable potential to cause, or contribute to an excursion above downstream water quality standards. Recommended permit conditions for effluent limits depend on whether the sources will cause or contribute to a violation of the water quality criteria. To determine if inorganic arsenic has the potential to cause a water quality violation, several sources of information and methods can be used such as site visits, historical information, or monitoring data if available. The permit must contain effluent limits to control all pollutants that have a RPTE water quality criterion (IDAPA 58.01.25.302.06.i):

> Effluent limitations in a permit must control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which the Department determines are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any water quality standard, including narrative criteria for water quality.

Similar to other parameters, certain facilities that have very little potential to discharge arsenic may not include arsenic as a pollutant of concern during the permit development process. Examples include facilities that discharge noncontact cooling water without additives. This determination may be based on available data, surrogate facility monitoring (e.g., if another facility for an industrial company uses the same processes and available arsenic monitoring data indicate no arsenic is discharged), other literature information, or best professional judgment in the absence of such information.

The other situation where a facility may receive special consideration is when the sole source of arsenic in the effluent occurs from the intake water, and the facility discharges to the intake source water body. In this case, the facility should consult with its permit writer to consider options for regulatory relief (e.g., intake credit in IDAPA 58.01.25.303.07). Typically, where a pollutant of concern is present in the effluent, the permit will require monitoring.

11.1 Reasonable Potential to Exceed

To meet the state's EPA-approved standards as required in the CWA § 301(b)(1)(C) and Idaho IPDES regulations (IDAPA 58.01.25), permit writers develop WQBELs if RPTE standards have been demonstrated.

If arsenic is a pollutant of concern, a permittee can determine if an RPTE exists for the arsenic human health criteria by using representative fish tissue or water column data collected as prescribed in section 4.1. Where representative fish tissue data cannot be obtained, or in fishless waters, the water column element of the criterion is applicable and is the basis for determining RPTE and deriving effluent limits.

The RPTE process is used to determine necessity of effluent limitations for arsenic. For facilities with the potential to discharge arsenic, the permit writer will use best professional judgement to determine the level of RPTE analysis required.

11.2 Establishing Permit Conditions

Each permit includes sections to characterize the effluent and receiving water body. The permit writer follows the IPDES guidance documents to establish permit conditions (DEQ 2017b) according to the "Rules Regulating the Idaho Pollutant Discharge Elimination System Program" (IDAPA 58.01.25), and other applicable IPDES guidance. As part of the permit development process, the RPTE process is used to determine necessity of effluent limitations for arsenic. To determine RPTE, federal regulations require accounting for existing controls on point and nonpoint sources of arsenic, the variability of arsenic in the effluent, background conditions, and, where appropriate, the dilution of the effluent in the receiving water. The process involves the following steps:

1. If the permit is for a new or increased discharge, arsenic will need to be monitored until equilibrium is reached. This means the water column element criteria will apply until such time equilibrium has been achieved.
2. Assess the reliability of available water quality data, both water column and fish tissue concentrations, as available. If arsenic data are not available, then the facility is required to monitor arsenic during the next permit cycle. If arsenic data are available, these data should be used to calculate the RPTE.
3. Determine the RPTE using available fish tissue monitoring data. If fish tissue data are available, those data are compared against 8 µg/kg. If water column data is used, then those data are compared against 4.3 µg/L. If fish tissue concentrations exceed this threshold, then RPTE is present for all significant dischargers. If the fish tissue concentrations are below the threshold, then no RPTE is present. Less stringent permit conditions may be specified.
4. If fish are present in the receiving water, but sufficient fish tissue data is not available, or in fishless waters, collect water column data to compare to the statewide water column criteria to determine RPTE.

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Appendix A. Formulas Used to Develop the Arsenic Rule

Trophic-Level Weighted BAF

A TL-BAF uses TL-specific proportions from the national fish consumption rate.

$$\mathbf{TL\ BAF} = [(\mathbf{BAF_{TL2}})(\mathbf{P_{TL2}}) + (\mathbf{BAF_{TL3}})(\mathbf{P_{TL3}}) + (\mathbf{BAF_{TL4}})(\mathbf{P_{TL4}})]$$

TL- BAF calculation.

Where:

TL-BAF = trophic level weighted BAF
BAF_{TLi} = geometric mean of BAFs calculated for all samples for species assigned to Tl_i P_{TLi} = proportion of national fish consumption rate for Tl_i fishes

Thus, using the geometric mean BAFs and TL consumption rate proportion inputs from Table 2 and Table 3 (Section 3.1 of document) , resulting in a TL-BAF of 1.87 L/kg:

$$\mathbf{TL\ BAF=[(2.99\ L/kg)(0.36)+(1.82\ L/kg)(0.40)+(0.27\ L/kg)(0.24)]=1.87\ L/kg}$$

Results for TL BAF calculations.

Human Health Water Quality Criteria for Arsenic

The HHC calculation calculates an ambient water quality criterion for the exposure to inorganic arsenic through fish consumption using the equation factor inputs in the table below.

$$\mathbf{AWQC = RSD} * \left(\frac{\mathbf{BW}}{\mathbf{(FI *BAF)}}\right) * \mathbf{1,000\ \mu g/mg}$$

Fish Only ambient water quality criterion calculation.

Where:

$AWQC_{FO}$ = ambient water quality criterion, fish only exposure
RSD = risk-specific dose (mg/kg-day) derived from a cancer slope factor (chemical specific value) and a target incremental cancer risk
BW = human body weight (kg)
FI = fish intake (kg/day)
BAF = bioaccumulation factor (L/kg)
1,000 µg/kg mg = a conversion factor to convert criteria in units of µg/L

Equation factors used in human health criteria calculation for arsenic.

Exposure Factors	
Target Incremental Cancer Risk	$1x\ 10^{-5}$
Body Weight	80 kg
Fish Intake	0.0665 kg/day

Chemical Specific Factors	
Inorganic Arsenic Cancer Slope Factor	1.5 $(mg/kg\text{-}day)^{-1}$
TL-Weighted BAF	1.87

The fish intake value was derived from an Idaho tribal fish consumption survey conducted in 2015. The Nez Perce Tribe, Group 2 (near coastal, estuarine, freshwater, and anadromous finfish and shellfish) mean consumption rate of 0.0665 kg/day has been applied (EPA 2016). Mean body weight was taken from the 2015 EPA human health exposure inputs for human health ambient water quality criteria (EPA 2015a).

Fish Tissue Criterion

The Fish Only exposure equation above produces a water column concentration. However, this equation can be transformed to provide a fish tissue concentration by removing the BAF term. This fish tissue criterion value is a direct measure of the concentration of inorganic arsenic in fish tissue that would provide protection for consumers at the Idaho specific fish consumption rate and cancer risk factor, and is the tissue concentration that the water column concentration is intended to protect.

$$\mathbf{AWQC_{FO} = RSD * \left(\frac{BW}{(FI)}\right) * 1{,}000\ \mu g/mg}$$

Fish tissue criterion calculation.

Where:

- $AWQC_{tissue}$ = fish tissue criterion for inorganic arsenic in muscle, or fillet, tissue on a wet weight basis
- RSD = risk-specific dose based on a target incremental cancer risk of 1×10^{-5} and a cancer slope factor for inorganic arsenic of 1.5 $(mg/kg\text{-}day)^{-1}$
- BW = mean adult body weight of 80 kg
- FI = fish consumption rate of 0.0665 kg/day
- 1,000 µg/kg mg = conversion factor to convert criteria in units of µg/kg

The calculated fish tissue criterion of 8.0 µg/kg is a direct measure of the exposure of Idaho fish consumers to inorganic arsenic. It is a scientifically sound calculation based on Idaho-specific exposure factors for fish consumption and will ensure fish tissue concentrations do not expose consumers to inorganic arsenic in fish tissue that would lead to an increased risk of cancer beyond the selected target incremental cancer risk factor.

Appendix B. Example Scenarios for Applying Human Health Criteria for Arsenic.

1) **Recreational use waters with fish.**
   a) *Water column data available and fish tissue data available.*
      i) The water column criterion element is met, and the fish tissue criterion element is met.
         (1) Continued collection of water column data (not fish tissue data) can be used to demonstrate continued compliance.
      ii) The water column criterion element is not met, and the fish tissue criterion element is met.
         (1) Continued collection of fish tissue data can be used to demonstrate continued compliance, or a water column translation value can be developed using a site-specific TL-BAF and continuing compliance demonstrated using water column data.
      iii) The water column criterion element is met, and the fish tissue criterion element is not met.
         (1) Water body is not in compliance with the recreational use criterion element.
      iv) The water column criterion element is not met, and the fish tissue criterion element is not met.
         (1) Water body is not in compliance with the recreational use criterion element.
   b) *Water column data available, fish tissue data has not been sampled.*
      i) The water column criterion element is met.
         (1) Continued collection of water column data (unless fish tissue is sampled) can be used to demonstrate continued compliance
      ii) The water column criterion element is not met.
         (1) Water body is not in compliance with the recreational use criterion element unless fish tissue is sampled and the fish tissue element is met
2) **Waters with both DWS and recreational uses where fish are present and available.**
   a) *Water column data available and fish tissue data available.*
      i) The DWS water column criterion is met, the recreational use water column criterion element is met, and the fish tissue criterion element is met.
         (1) Continued collection of water column data (not fish tissue data) can be used to demonstrate continued compliance with both the DWS and recreational use criterion elements.
      ii) The DWS water column criterion is met, the recreational use water column criterion element is not met, and the fish tissue criterion element is met.
         (1) Water body is in compliance with the recreational use criterion element.
         (2) Continued collection of water column data to demonstrate continuing compliance with DWS criterion element,
         (3) ***And*** continued collection of fish tissue data can be used to demonstrate continued compliance with recreational criterion element, or a water column translation value can be developed using a site-specific BAF and continuing

compliance with the recreational use element demonstrated using water column data.

iii) The DWS water column criterion is met, the recreational use water column criterion element is not met, and the fish tissue criterion element is not met.
   (1) Water body is not in compliance with the recreational use criterion element, the more restrictive use and applicable criterion.
   (2) Continued collection of water column data to demonstrate continuing compliance with DWS criterion element.

iv) The DWS water column criterion is not met, the recreational use water column criterion element is not met, and the fish tissue criterion element is met.
   (1) The water body is not in compliance with DWS criterion element,
   (2) And continued collection of fish issue data can be used to demonstrate compliance with recreational criterion element or collect fish tissue data to develop a water column translation value using a site-specific TL-BAF. The value cannot exceed the water column element for DWS.

v) The DWS water column criterion is met, and the recreational use water column criterion element is not met.
   (1) Water body is not in compliance with the recreational use criterion.
   (2) Continued collection of water column data to demonstrate continuing compliance with DWS criterion element,
   (3) ***And*** collection of fish tissue data can be used to determine compliance with the recreational criteria.
      (a) If fish tissue criterion element is met, continued collection of fish tissue data can be used to demonstrate continued compliance with recreational use criterion element, or a water column translation value can be developed using a site-specific BAF and continuing compliance demonstrated using water column data.
      (b) If fish tissue criterion element is not met; water body is not in compliance with the recreational use criterion element.

vi) The DWS water column criterion is not met, and the recreational use water column criterion element is not met.
   (1) The water body is not in compliance with DWS and recreational criterion element,
   (2) ***And*** collection of fish tissue data can be used to determine compliance with the recreational use criterion element.
      (a) If fish tissue criterion element is met, continued collection of fish tissue data can be used to demonstrate continued compliance with recreational use criterion element, or a water column translation value can be developed using a site-specific BAF and continuing compliance demonstrated using water column data.
      (b) If fish tissue criterion element is not met; water body is not in compliance with the recreational use criterion element.

3) Fishless recreational use waters.

a) *Fishless water column data available and downstream fish tissue data are available or can be collected.*
   i) The water column criterion element is met, and the fish tissue criterion element is met.
      (1) Continued collection of water column data (not fish tissue data) can be used to demonstrate continued compliance.
   ii) The water column criterion element is not met, and the fish tissue criterion element is met.
      (1) Continued collection of fish tissue data can be used to demonstrate continued compliance, or a water column translation value can be developed using a site-specific BAF and continuing compliance demonstrated using water column data.
   iii) The water column criterion element is not met, and the fish tissue criterion element is not met.
      (1) Water body is not in compliance with the recreational use criterion element.

Appendix C. Water Column Translation Criterion Decision Tree