Idaho Association of Commerce & Industry
Employers Advocating Economic Opportunity in Idaho®

February 28, 2023

Via email paula.wilson@deq.idaho.gov

Ms. Paula Wilson
Idaho Department of Environmental Quality
1410 North Hilton
Boise, ID 83706

Dear Ms. Wilson:

The Department has requested comments on *Draft No. 1 – Implementation Guidance for Idaho's Human Health Water Quality Criteria for Arsenic*. The Idaho Association of Commerce and Industry (IACI) is the leading trade association of Idaho businesses and represents hundreds of employer members of all sizes engaged in diverse commercial and industrial enterprises throughout the state. IACI participated in the process that the Department undertook to develop a new arsenic human health water quality criterion. We now offer comments on Draft No. 1 of the Implementation Guidance. This implementation guidance document is of direct interest of the IACI membership as the criterion will be used to set cleanup/remedial objectives, total maximum daily loads (TMDLs), and requirements for IPDES permits.

General comments and recommendations are presented below. Attached is a Word file of the Draft Implementation Guidance that incorporates some of the changes described in these the general comments as well as some editorial changes. All of the changes to the attached Draft Implementation Guidance are presented in redline-strikeout. Additionally, some comments are embedded in the text of the Word file. Those are shown in *highlighted yellow italics*.

General comments and recommendations are presented sequentially, as they occur in the Draft Implementation Guidance.

Section 1: Introduction

Section 1.1, page 1. The description of the dual tissue and water column recreational human health criteria (HHC) was modified in the attached file to better capture how the data collected by Idaho created the need for such a dual criterion.

Section 2: Background

Section 2.1, page 2. As described in Section 2.3.1, naturally occurring elevated background levels of arsenic are well documented in Idaho. We recommend moving most or all of the discussion of naturally occurring background levels in Idaho from Section 2.3.1 to Section 2.1. It is important for readers to realize that the sources of elevated levels of arsenic in Idaho environments may be natural as well as anthropogenic. Also, some additional consolidation of the two paragraphs on page 2 might help organize better the discussion of natural and anthropogenic sources. Finally, to the extent that the Department has information on anthropogenic sources in Idaho, that information would be more useful than generic sources.

Section 3: Bioaccumulation Factor

Section 3, page 6. BAFs can be estimated using other methods besides a ratio of tissue to water. See edits in the attached file that expand the description of a BAF to make it more universal.

Section 3, page 9. The discussion on page 8 refers to the absence of data on TL of consumed species from the Idaho fish consumption rate study and that, therefore, the TL apportionment from the national fish consumption rate study was used to calculate the TL-weighted BAF. The national study includes fresh and estuarine waters. Consequently, the national TL2 consumption rate includes a variety of estuarine and nearshore shellfish (e.g., shrimp, crab, lobster) that comprise a substantial portion of TL2 species consumed. Such species are not present in Idaho. Thus, it is likely that by using the national TL apportionment, the proportion of TL2 species consumed from Idaho waters is overestimated. This fact may warrant a footnote in the guidance as this TL apportionment may be relevant to site specific inorganic arsenic human health criterion. A paragraph was inserted at the end of Section 3 (page 9) of the attached file to describe this possibility.

To further discuss the TL apportionment, the Department should look more closely at species-specific fish consumption rate information collected during the Idaho fish consumption survey. While the Draft Implementation Guidance is correct that the final Idaho fish consumption survey reports do not provide TL-specific or species-specific consumption rates, it is likely that as part of conducting the fish consumption survey, respondents were asked about the species of fish they report consuming. If that information is available, the Department could assign TLs to each species and develop Idaho-specific TL proportions. We recommend the Implementation Guidance make clear that such Idaho-specific proportions (or proportions specific to an individual receiving water body, if such are available) can be used when developing a site-specific TL-weighted BAF in additional to using site- and TL-specific BAFs.

Section 4: Human Health Water Quality Criteria for Arsenic

Section 4.1. It is difficult to understand which parts of the text in this section represent the pending rule language and which parts are text of the Draft Implementation Guidance. Consider presenting the actual pending rule language in a format that clearly distinguishes the pending rule from the Draft Implementation Guidance text.

Section 4.2. This section presents the derivation of the dual tissue and water column criteria. It includes discussion of the tissue criterion superseding the water column criterion when fish data are available to demonstrate compliance with the HHC. Consistent with the pending rule, that discussion clearly indicates that to demonstrate compliance with the fish tissue criterion, a 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 and, when available, game fish species representative of the size and species that may be legally harvested within the waterbody are preferred. That discussion occurs in several places reinforcing the rule language. While the discussion also refers to the tissue criterion superseding the water column criterion, the conditions and sampling necessary to demonstrate compliance with the dual criterion are not as clearly presented. We recommend including a separate section that describes how a stakeholder can demonstrate compliance with the pending HHC under various scenarios.

For example, we recommend that for waters designated for only recreational use, a receiving water is considered to be in compliance with the pending HHC if:

- (a) the water column criterion is met, no fish data are available, and continued collection of water column data (not fish tissue data) can be used to demonstrate continued compliance;
- (b) the water column criterion is met, and the fish tissue criterion is met, continued collection of water column data (not fish tissue data) can be used to demonstrate continued compliance;
- (c) no water column data are available, but the fish tissue criterion is met, continued compliance can be demonstrated continued collection of fish tissue data or water column data (assuming the latter meet the water column criterion); and
- (d) the water column criterion is not met but the fish tissue criterion is met, continued collection of fish tissue data can be used to demonstrate continued compliance, or a site-specific water column criterion can be developed using a site-specific BAF and continuing compliance demonstrated using water column data.

We also recommend that a similar compliance section be developed for water designated for both recreational use and public drinking water supply.

Sections 4.2.3 and 5. The discussion at the conclusion of these sections about the data needed to develop a site-specific BAF needs to be expanded and clarified. For example, the Implementation Guidance refers to "site-specific BAFs" and the "…geometric mean BAF from paired tissue and water samples…" and doesn't discuss TL-weighted BAFs. Does that mean that a site-specific BAF can be the ratio of the geometric mean of BAFs of representative of gamefish species and is not TL-weighted? Assuming that is the Department's intent, the second bullet at the end of Section 4.2.3 refers to providing the Department inorganic arsenic concentrations of "all" representative gamefish species in the assessment unit. Collecting 5 individuals of "all" representative gamefish species may not be practical. Additionally, the pending rule refers to a single sample of a minimum of 5 individuals of the same species. We recommend the sampling requirements described in this section be consistent with the intent of the pending rule and be limited to a single sample of representative gamefish species.

If the Department's intent is for the site-specific BAF to be TL-weighted, then this section needs to address situations where all the information necessary to develop a TL-weighted BAF is not available or cannot be collected. For example, what if the only gamefish of the size and species that may be legally harvested are from a single TL? How should the other TLs be treated when calculating the TL-weighted BAF? Additionally, as discussed above (see comment on Section 3, page 9) we recommend that derivation of site-specific TL-weighted BAFs include flexibility to modify the proportion that each TL comprises of the overall fish consumption rate.

Section 6: General Implementation

Sections 6.1.3 and 6.1.4. Much of the discussion in these sections seems related to general considerations for collecting fish tissue and water column samples and not focused on gathering the water column and/or fish tissue data necessary to demonstrate compliance with the pending rule or to develop a site-specific BAF. We recommend this section be revised to clearly state that the goal of such sampling it to collect water column or fish tissue data, or both, downstream of a discharge, as close as practicable to the discharge, that are representative of the contribution of the discharge once it has been fully mixed with the receiving water. Such sampling requirements have been included as conditions in discharge permits for other compounds by EPA and other agencies and can be used by the Department to inform the content of these sections. Additionally, the protocol the Department used to collect State-wide paired fish tissue and water column samples provides valuable guidance for these sections.

Section 7: Fishless Waters

Section 7. This section refers to limiting collection of fish tissue to no more than 3 miles downstream of a discharge in fishless waters. The basis of the 3-mile distance should be provided. One other approach is for a description of where fish are found in relation to the discharge and how stream conditions, fish habitat, etc. provide information that demonstrates that monitoring fish tissues from this location can demonstrate compliance with the criterion.

We also recommend that this section be expanded to include discussion of how the Department's preference, but not requirement, that gamefish species of a size that can be legally harvested be used to assess inorganic arsenic in fishless waters. For example, non-gamefish species or gamefish species that are not of legally harvestable size may be present closer to a discharge than gamefish species of legally harvestable size. The Implementation Guidance could clarify that if the former have tissue concentrations that meet the fish tissue criterion, then the fishless water is in compliance with the inorganic arsenic criterion.

We appreciate the opportunity to provide these comments to the Department.

Sincerely,

Alex LaBeau, President

Attachment; IACI – Implementation Guidance

Draft No. 1- Implementation Guidance for Idaho's Human Health Water Quality Criteria for Arsenic

Water Quality: Docket No. 58-0102-2201- Pending Rule

State of Idaho
Department of Environmental Quality

DATE ***(to be added later)***

Acknowledgments

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Abbreviations, Acronyms, and Symbols

BAF	Bioaccumulation Factor
BCF	Bioconcentration Factor
CWA	Clean Water Act
DEQ	Idaho Department of Environmental Quality
DWS	Domestic Water Supply
EPA	US Environmental Protection Agency
HHC	Human Health Criteria
IDFG	Idaho Department of Fish and Game
IPDES	Idaho Pollutant Discharge Elimination System
LA	Load Allocations
L/kg	Liters per Kilogram
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MRL	Method Reporting Limit
PQL	Practical Quantitation Level
RPTE	Reasonable Potential to Exceed
SDWA	Safe Drinking Water Act
TL-BAF	Trophic Level Weighted Bioaccumulation Factor
TMDL	Total Maximum Daily Load
QAPP	Quality Assurance Project Plan
RPTE	Reasonable Potential to Exceed
µg/L	Micrograms per Liter
WBAG	Water Body Assessment Guidance
WDE	Washington Department of Ecology
WLA	Waste Load Allocation
WQBEL	Water Quality Based Effluent Limits
WQS	Water Quality Standards

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Executive Summary

This document is intended to assist the Idaho Department of Environmental Quality (DEQ) in maintaining and implementing a consistent state-wide approach for implementation of the Idaho's 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 vs. DEQ, its employees or any other person. This document does not substitute for existing requirements of the Clean Water Act (CWA), federal regulations, and the Idaho water quality standards (WQS). The recommendations in this guidance are not binding; DEQ may consider other approaches consistent with the CWA, federal regulations, and the WQS. DEQ may change this guidance in the future.

DEQ will use this guidance to implement this criterion across programs. This includes, but is not limited to, providing guidance for sample collection and interpretation of results, including assessment of fishless waters, as well as fish tissue sample size and monitoring requirements. Regarding the Idaho Pollutant Discharge Elimination System (IPDES) permits, DEQ acknowledges the challenges a fish tissue criterion presents in the context of water quality-based permitting.

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1 Introduction

States must develop criteria that protect designated beneficial uses and are based on sound science (CWA Section 303(c)(2)(A), 40 CFR 131.11(a)). Additionally, States are required to adopt criteria for which EPA has published recommended criteria under section 304(a) (CWA Section 303(c) (2)(B)). States have the discretion to adopt the EPA's criteria recommendations, the EPA's recommendations modified to reflect site-specific conditions, or criteria based on other scientifically defensible methods. Idaho DEQ developed the human health water quality criteria for arsenic in accordance with Section 303(c) of the Clean Water Act (CWA) and the federal regulations implementing the CWA, 40 CFR Part 131.

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 µg/L arsenic for both consumption of fish only and consumption of fish & water. 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, the Court granted the Unopposed Motion to Modify Consent Decree, extending the November 15, 2018, and July 15, 2019, deadlines to November 15, 2022, and November 15, 2023, respectively. This rulemaking enabled Idaho to begin the process to adopt human health criteria for arsenic under state rulemaking and may prevent federal promulgation of criteria for Idaho by EPA.

1.1 Purpose

This document provides guidance to DEQ staff, the regulated community, and the general public for implementing the arsenic statewide and site-specific human health water quality criteria for arsenic in Idaho and applies only to surface waters in Idaho. The criteria reflect the latest Idaho-specific arsenic surface and fish tissue monitoring data. Those data indicate that inorganic arsenic accumulation in fish tissue is not strongly correlated with the concentration of inorganic arsenic in the water column. Therefore, to assure that public health is protected and exposure to inorganic arsenic from consumption of fish remains acceptable, the final criterion for inorganic arsenic is expressed both in terms of an allowable fish tissue (i.e., fillet or muscle) concentration and an allowable water column concentration. The allowable water column concentration was developed using a trophic level weighted bioaccumulation factor (TL-BAF). DEQ developed this implementation guidance, based upon Idaho's "Water Quality Standards" (IDAPA 58.01.02).

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

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), erosion, forest fires, or through human activities such as pesticide application, improper disposal of arsenic-containing waste chemicals, agricultural applications, mining, and smelting (CLU-IN, 2022; Chung et al., 2014; ATSDR, 2007a). Anthropogenic sources of arsenic releases to water include mining, nonferrous metals, smelting, wastewater, dumping 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 the natural weathering of soil and rocks. 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). 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: inorganic, organic, and arsine gas. Inorganic arsenic is typically the most toxic form. The most common valence states of arsenic are As(0) (metalloid arsenic), As(III) (arsenite), As(V) (arsenate), and As(-3 oxidation state) (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 & Artiola, 2019). The main organic arsenic species in freshwater are monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA) (ATSDR, 2007a).

Due to the relatively high toxicity of inorganic arsenic compared to other species of arsenic, and its prevailing presence in both ground and surface waters, the human health criteria for arsenic have been derived using inorganic arsenic data in Idaho surface waters.

2.2.1 *Effects of Physical and Chemical Properties on the Speciation of* Arsenic

Once arsenic is released into the environment, it cannot be neutralized or destroyed. It can only change its form 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, as well as 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 absorption is strongly dependent upon the temperature, humic content, sediment type, and pH of the water and the species of arsenic. 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 environmental 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, & Artiola, 2019). In oxygenated waters (such as rivers), arsenate is the predominate form, while in reducing conditions (such as in groundwaters), arsenite predominates (ATSDR, 2007a; Rahman, et al. 2012; WHO, 2019). Products of methylation, monomethylarsonate (MMA), and dimethylarsinate (DMA), can also be present (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 as 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 detrital material), 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 1.4.1

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, IDEQ conducted a study to measure total and inorganic arsenic levels in water column samples at 24 surface water sites throughout Idaho. Results showed an average of 1.63 µg/L of inorganic arsenic and 1.87 µg/L of total arsenic present in water column samples taken. Of the inorganic arsenic found, an average of 0.20 µg/L was found as arsenite, and 1.44 µg/L as arsenate, with results as high as 1.87 ug/L of arsenite and 20.80 ug/L of arsenate being found. This demonstrates the predominance of elevated levels of arsenate compared to arsenite in surface waters sampled in Idaho.

An analysis of available Water Quality Portal surface water total arsenic and inorganic arsenic data across Idaho from 2012–2022 showed an average of 6.42 µg/L of arsenic, and an average of 1.36 µg/L of inorganic arsenic. Arsenic had the greatest spread (sd±30.97), with a low

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concentration of 0.02 µg/L and a high of 1470.0 µg/L. Inorganic arsenic concentrations ranged from 0.47 µg/L to 2.07 µg/L (National Water Quality Monitoring Council, 2022).

2.4 Effects of Arsenic on Human Health

The EPA has classified inorganic arsenic as a Group A human carcinogen (EPA, 2021a; IRIS, 2017; NTP, 2021). Acute oral exposure to inorganic arsenic can result in devastating effects on the digestive tract, respiratory system, central nervous system, cardiovascular system, as well as the liver. 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, and liver and kidney damage. (EPA, 2021a; IRIS, 2017).

Acute exposure to arsenic can result in negative gastrointestinal effects, hematological effects, and peripheral neuropathy. Chronic exposure to arsenic in concentrations lower than 0.04 mg/kg/day can cause an increased occurrence of other health effects such as cancer (skin, bladder, lung, kidney, and liver) as well as having non-cancerous 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 to it 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 depends 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; moreover, the concentration of inorganic arsenic seems to diminish at higher trophic levels due to the ability for organisms to biotransform and eliminate this form of arsenic (ATSDR, 2007a; Williams et al. 2006; EPA, 2003; Ghosh et al., 2022).

Fish can take up total dissolved arsenic directly from the water column across diffusion barriers into the blood and internal organs (such as through the gills and skin), or across gastrointestinal membranes from 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 exposure to arsenic present in sediments (Cui et al., 2020; Ghosh et al., 2022; Rahman et al., 2012).

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There are multiple arsenic uptake pathways. Arsenic is sufficiently similar to some biomolecules to share their uptake pathways. For instance, arsenate is the predominant species in oxic waters, and shares transport pathways with phosphate, even substituting for phosphate in adenosine triphosphate (ATP), a cellular energy compound (Zhang, et al., 2022).

Once inside the organism, inorganic arsenic can be metabolized 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: the reduction of pentavalent arsenic (arsenate) to trivalent arsenic (arsenite) with glutathione (GSH), and the oxidative methylation of trivalent to methylated pentavalent metabolites (MMA and DMA), and 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 (see Figure 2).

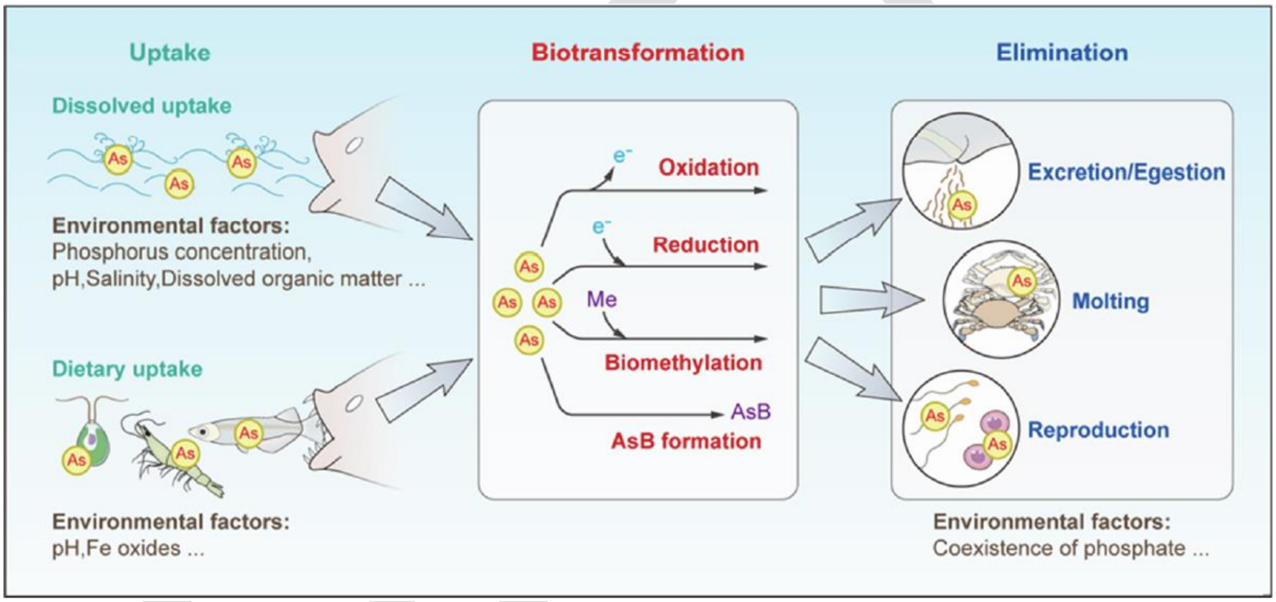

Figure 1: Uptake, biotransformation, and elimination pathways of arsenic. Taken from Zhang et al., 2022.

2.5.1 Relationship of water-to-fish tissue and 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. The study found that fish tissue and water column levels of arsenic were weakly related and statistically non-significant (DEQ, 2019).

Due to the statistically insignificant relationship between fish tissue and water column concentrations of inorganic arsenic, DEQ believes that the proposed rule and implementation principles outlined above, including dual tissue and water column criteria accounts for changing or increasing arsenic conditions. Unlike other metals such as mercury and selenium, arsenic is not highly bioaccumulative. Therefore, there is little concern that small, incremental changes in water chemistry would result in drastic changes in fish tissue.

During negotiated rulemaking, stakeholders and DEQ considered the question of whether new inputs or activities within a watershed would reach equilibrium (or a steady state) quickly or would take a long time to manifest. The decision during negotiated rulemaking was to not use the term steady state as a requirement to utilize fish tissue data; instead, using a set buffer period after new or increased discharges. Research has shown varying lengths of time to achieve "steady state" based on various environmental parameters and organism traits (EPRI 2008, 2011). Lab studies have shown steady states for arsenic are 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. Thus, DEQ has determined that a 90-day period after new activity or discharge should be sufficient to evaluate inorganic arsenic levels in fish tissue for the protection of human health.

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 between the concentration of a chemical in the tissue of fish to the concentration in the water and is often calculated as the ratio of the tissue to water concentration.

The lack of a statistically insignificant relationship between water column and fish tissue levels of arsenic demonstrates the complexity in uptake routes and metabolism of arsenic in the foodweb. Idaho WQS specify that DEQ will use a trophic level weighted bioaccumulation factor or bioconcentration factor (BCF) to derive HHC (IDAPA 58.01.02.210.05.b.ii). *(Review the final draft for consistent use of acronyms and that those are defined when first used. This appears to be the first use of HHC.)* However, BCFs only consider the uptake of chemicals by exposure through the water column, while BAFs include both dietary contributions as well as direct uptake from the environment (such as diffusion across the gill surface (Mackay et al., 2012; Arnot and Gobas, 2006; EPA, 2003, 2000). Therefore, both EPA and DEQ prefer field based BAFs derived by collecting paired tissue and water column data over other estimates of bioaccumulation (such as BCFs) when determining HHC (EPA, 2003).

National average BAFs for a given chemical and trophic level may not provide the most accurate estimate of bioaccumulation for certain waterbodies 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 trophic level-weighted BAFs (EPA 2000). *(The remainder of this paragraph has already been discussed in Section 2.5. Consider consolidating the two sections.)*

The bioaccumulation potential of a chemical can be affected by various site-specific physical, biological, and chemical factors:

- water temperature and dissolved oxygen concentration;
- sediment-water disequilibria;
- organism health, physiology and growth rate;
- food chain structure;
- food quality; and
- organic carbon composition.

The preferred approach to derive site-specific BAFs is by utilizing tissue and water column data collected at the site of interest.

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 (generally comprised of a composite of 5 individuals of the same species), an inorganic arsenic BAF was calculated using Equation 1:

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

Equation 1: Equation for calculating a bioaccumulation factor (BAF).

Where:

$\mathrm{BAF_{iAs}}$ is the sample BAF for inorganic Arsenic in L/kg;
$[\mathrm{iAs}]_{\mathrm{Fish}}$ is the concentration of inorganic Arsenic in fish in µg/kg; and
$[\mathrm{iAs}]_{\mathrm{Water}}$ is the concentration of inorganic Arsenic in water, in µg/L

One way to reduce the variability associated with BAFs is to calculate the values by trophic level (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).

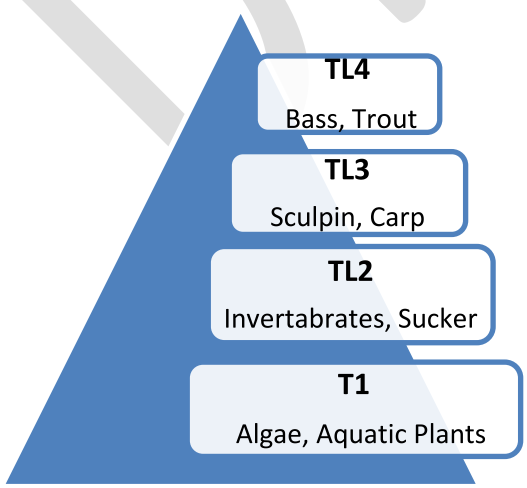

Figure 2: Trophic Level and Examples

3.1 Trophic Level-Weighted BAF

A TL- weighted BAF can be calculated by assigning fish species to a TL.

TL2 fish are those fish that mostly consume TL1 organisms (primary producers such as algae, aquatic plants, etc.). TL3 fish are those fish that primarily consume TL2 organisms (such as aquatic invertebrates, TL2 fish, etc.).

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TL4 fish are predatory fish that primarily consume TL3 organisms (large aquatic invertebrates, other fishes).

For purposes of calculating a TL-weighted BAF for arsenic HHC in Idaho, TL assignments were made based a synthesis of information found in Simpson and Wallace (1982), Wallace and Zaroban (2013), Sigler and Zaroban (2018), and FishBase (Frose & Pauly, 2000). A geometric mean was calculated from individual sample BAFs by TL (Table 1).

Table 1: Trophic level assignments for calculation of a trophic level weighted bioaccumulation factor, and the geometric mean of calculated bioaccumulation factors (BAFs) by trophic level.

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-weighted BAF by using the proportions of TL-specific consumption rates used by USEPA when developing national recommended HHC from a 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 + estuarine fishes to the total consumption rate from the national estimated fish consumption study as presented in Table 2 (EPA 2014; see page 6 of EPA 2015 *Update of Human Health Ambient Water Quality Criteria: Benzene 71-43-2* [*https://downloads.regulations.gov/EPA-HQ-OW-2014-0135-0165/content.pdf*] for an example).

Table 2: Trophic level-specific consumption rates from the national fish consumption study.

Trophic Level	National Consumption rate, g/d	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.*

A TL-weighted BAF was calculated using Equation 2 using TL-specific proportions from the nation fish consumption rate survey.

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

Equation 2: Equation for calculating trophic-weight bioaccumulation factor.

Where:

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

Thus, using the geometric mean BAFs (Table 1) and trophic-level consumption rate proportion (Table 2) inputs from above, the TL-weighted BAF was calculated using Equation 2, resulting in a TL-weighted BAF of 1.87 L/kg:

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

Equation 3: Results of calculations for TL BAF

The resulting TL-weighted BAF of 1.87 L/kg likely overstates accumulation of inorganic arsenic in fish consumed by Idahoans, because it assumes that 36% (about one third) of fish consumed in Idaho are TL2 species that have a relatively high BAF, compared to TL3 and TL4. That national TL2 fish consumption rate includes shrimp, crab and other commonly consumed shellfish that are not present in Idaho waters. Bridgelip sucker is the only species identified as TL2 in the Idaho paired tissue and water dataset used to derive the TL-weighted BAF. If bridgelip suckers, or other TL2 species, make up less than 36% of the fish consumed from Idaho waters, the Idaho-specific TL-weighted BAF will be lower than the BAF of 1.87 L/kg used to translate the fish tissue criterion to a water column criterion.

4 Human Health Water Quality Criteria for Arsenic

A robust negotiated process for this rulemaking was initially conducted under docket 58-0102-1801. At the request of the Office of the Administrative Rules Coordinator and as a procedural requirement, a new docket number was generated for this proposed rulemaking, docket 58-0102-2201. Eight public rulemaking 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 receiving email notifications, attending the meetings, reviewing DEQ’s presentations and supporting information, and submitting comments to the proposed rule.

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 regarding the development of the rule. At the

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conclusion of the negotiated rulemaking process, DEQ submitted the draft rule to the Division of Financial Management for review. The negotiated rulemaking record, which includes the negotiated rule drafts, documents distributed during the negotiated rulemaking process, and the negotiated rulemaking summary, is available at *https://www.deq.idaho.gov/public-information/laws-guidance-and-orders/rulemaking/water-quality-docket-no-58-0102-1801/* .

4.1 Pending Rule

The pending rule includes the rule as initially proposed along with revisions in Subsections 58.01.02.210.01.b., Footnote k, and 210.03.e.

Table 3: Criteria for Protection of Human Health

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 Containment Contaminant Level (MCL).

k.[1] 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 which contributes arsenic 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.

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[1] Footnote k is not effective for CWA purposes until the date EPA issues written notification that the revisions in Docket No. 58-0102-2201 have been approved.

Subsection 210.03.d[2].

ii. Frequency and duration for human health toxics criteria. Criteria in Table 1 above, Subsection 210.01, are not to be exceeded based on an annual arithmetic mean concentration.

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 waterbody 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:

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

Equation 4: 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 from 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.

[2] Subsection 210.03.e. is not effective for CWA purposes until the date EPA issues written notification that the revisions in Docket No. 58-0102-2201 have been approved.

(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 waterbody 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.

4.2 Recreational Use Criteria Calculation

(This paragraph describes the overall goal of HHC and different beneficial uses. It refers to more than just recreational use. Consider moving this first paragraph to the introduction of Section 4.) Human health criteria are set to protect humans from exposures through both recreational uses, such as swimming, boating, or fishing, as well as domestic water supply use. The latter is intended to protect public drinking water supply source waters. Although all Idaho waters are expected to meet recreation uses, only certain water bodies identified in rule are designated for DWS. Frequency and duration for human health toxics criteria are not to be exceeded based on an annual arithmetic mean concentration (IDAPA 58.01.02.210.03.d.ii[3]).

The fish only exposure for recreation beneficial use, is a dual-element criterion consisting of a fish tissue criterion and a water column criterion, with the fish tissue criterion superseding the water column criterion. . Due to the uncertainty associated with bioaccumulation of inorganic arsenic, this two-part criterion provides a direct measure of the exposure pathway that is intended to be protected by allowing direct comparison of the concentration of inorganic arsenic in fish tissue to the allowable concentration in fish tissue (8 ug/kg). In addition, it provides a water column criterion that can be used when sufficient fish tissue data might not be available or obtainable.

The water column HHC to protect public health from exposure to inorganic arsenic through fish consumption is calculated using the equation (Equation 5) and inputs shown in Table 4 below.

$$\mathbf{AWQC_{FO} = RSD * \left(\frac{BW}{(FI * BAF)}\right) * \frac{1000\mu g}{mg}}$$

Equation 5: Equation for calculating Fish Only ambient water quality criterion.

Where:

(This abbreviation Is not in the list at the beginning of the document.) $AWQC_{FO}$ = ambient water quality criterion, fish only exposure;

[3] Subsection 210.03.d.ii. is not effective for CWA purposes until the date EPA issues written notification that the revisions in Docket No. 58-0102-2201 have been approved.

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); and
1000 µg/mg = a conversion factor to convert criteria in units of µg/L

Table 4: 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 rate 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 kilograms per 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, 2015).

(The information in this paragraph has already been discussed in Section 3. Consider deleting the paragraph and citing Section 3 in the above paragraph for the source of the BAF. Also for consistency, need to add the source of the cancer slope factor.) The TL-weighted BAF was calculated from the geometric mean from BAFs calculated from the Idaho probabilistic fish accumulation study and applying the TL-specific consumption proportions from the national fish consumption study. 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 (EPA, 2014 & 2016; DEQ, 2016).

4.2.1 Fish Tissue Criterion

The Fish Only exposure equation presented in Equation 5 produces a value for the water column concentration. However, Equation 5 can be transformed to provide a fish tissue concentration by removing the BAF. 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 allowable risk level and is the tissue concentration that the water column concentration derived in Equation 5 is intended to protect.

$$\mathbf{AWQC_{tissue}} = \mathbf{RSD} \times \left(\frac{\mathbf{BW}}{(\mathbf{FI}\,)}\right) * \mathbf{1000}\ \mathbf{\mu g/mg}$$

Equation 6: Equation for fish tissue criterion calculation.

Where:

$AWQC_{tissue}$ = the fish tissue criterion for inorganic arsenic in muscle, or fillet, tissue on a wet weight basis;
RSD = the risk-specific dose based on a target incremental cancer risk of 1 x 10^{-5} and a cancer slope factor for inorganic arsenic of 1.5 $(mg/kg\text{-}day)^{-1}$;
BW = the mean adult body weight of 80 kg;
FI = the fish consumption rate of 0.0665 kg/day; and
1000 µg/mg = a 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 greater than the target allowable incremental cancer risk.

When utilizing fish tissue for the criterion, a 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. A calendar year is defined as January 1 – December 31. When available, game fish species representative of the size and species that may be legally harvested within the waterbody are preferred. The smallest individual sampled should be no less than 75% of the total length (size) of the largest individual.

The fish tissue criterion can only be utilized if there has not been a new activity or discharge that contributes arsenic to the waterbody in 90 days.

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. Fish tissue samples should target gamefish species or other fish species that are commonly consumed by the general public. *(The next sentence is inconsistent with the pending rule and the rest of this paragraph, both of which state that gamefish species are preferred but not required. Recommend deleting the sentence.)* ~~If sufficient gamefish data are unavailable, or if gamefish species are not available, the water column criterion of 4.3 µg/L should be the applicable criterion.~~ If a monitoring plan is developed in which applicant would like to utilize fish tissue data to develop a water column value and suitable game fish are *not* available, then according to the proposed rule other resident fish species can be used. However, DEQ recommends utilizing downstream gamefish for the calculation (see section 5 on Fishless Waters). The purpose of the rule is to protect human health, so utilizing nongame fish would not clearly indicate that human health is protected through the consumption of fish tissue, though based on the Idaho-specific paired fish tissue and water column data, non-gamefish species tend to have higher concentrations of inorganic arsenic than gamefish species, suggesting that if non-gamefish species have inorganic arsenic concentrations that meet the fish tissue criterion, gamefish species are also likely to have acceptable concentrations.

4.2.2 Water Column Criterion

Because fish tissue data are not always available or obtainable a water column criterion of 4.3 µg/L based on a TL-weighted BAF was developed and is the applicable criterion when sufficient fish tissue data are not available. Although there is much uncertainty regarding the relationship of inorganic arsenic concentrations in the water column and fish tissue, most measures of the central tendency of inorganic arsenic BAFs are in the range of 1 to 2 L/kg *(The statement about the range of BAFs needs a citation.)*; the TL-weighted BAF of 1.87 L/kg falls within this range (see equation 3). Therefore, the resulting water column criterion of 4.3 µg/L based on the TL-BAF of 1.87 L/kg would be protective of the recreation use when fish tissue data are unavailable or unobtainable.

4.2.3 Water Column Translation

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 concentration using a site-specific 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:

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

Equation 77: 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. (from rule).

In fishless waters, surface water and fish tissue from 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.

(See comment letter recommending revisions to the discussion of deriving site-specific BAFs.)

Translation of the fish tissue criterion to a water column value should be based on the geometric mean BAF from paired tissue and water samples from gamefish species present at a given site. To calculate site-specific BAFs, DEQ will be provided the following:

- Information or data to identify gamefish species present at the site.
- Paired fish tissue and water column concentrations of inorganic arsenic from all representative gamefish species in the assessment unit.

Translating the fish tissue element of the criterion to a water column value results in a more accurate and specific interpretation of the criterion. If a site-specific water column translation is conducted, resulting in a water column below 4.3 µg/L, the translated water column value would supersede the applicable water column criterion element. However, if the translation results in a water column level higher than 10 µg/L in an area designated for DWS, then the location would be exceeding the DWS criteria and should be evaluated for that.

4.3 Domestic Water Supply (DWS) Criterion

Waters designated for DWS need to protect humans from harmful levels of inorganic arsenic through both drinking water and fish tissue consumption. As in all waters in Idaho, the more restrictive criteria will apply. In the case of arsenic, the more restrictive use may be recreation depending upon the fish tissue concentration and there are no waterbodies in the state that are designated for DWS only. The Water & Fish criterion of 10 ug/L is taken from the Safe Water Drinking Act (SWDA) Maximum Contaminant Level (MCL) for arsenic (EPA, 2022b). Idaho WQS defines the DWS use as:

> "*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)

DEQ interprets this to mean that protection of the DWS use requires that any public water system using surface waters as source water does not need to provide additional treatment prior to delivery through a public water system. Therefore, if inorganic arsenic concentrations in the source water are less than the SDWA MCL, the DWS use would be protected since the water system would not need to provide additional treatment to remove inorganic arsenic.

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

A waterbody would meet the criteria for Water & Fish (DWS) exposure to inorganic arsenic if the water column concentration does not exceed 10 ug/L. If a water column translation (section 4.3) is conducted for a TMDL or an IPDES permit in a designated DWS stream, and the resulting number is over 10 ug/L, then DWS use is the more sensitive and 10 ug/L should be used as the criteria to calculate effluent limits or TMDL targets.

5 Site Specific Options

Site-specific criteria are criteria relevant to a given localized site and that reflect local environmental conditions. Importantly, site-specific criteria for a water body do not alter its designated uses. Site-specific criteria can be used to address several specific situations, such as when *(Deleted the first example as it is not relevant to human health criteria.)* the physical/chemical characteristics of a site alter the bioavailability or toxicity of a pollutant, or the state/tribe wants to establish a criterion equal to "natural background" levels. For example, DEQ has developed site specific criteria for selenium for the protection of aquatic life (IDAPA 58.01.02.287).

(See comment letter recommending revisions to the discussion of deriving site-specific BAFs.)
Site specific BAF calculations will be evaluated on a case-by case basis. To calculate site specific BAFs, all interested parties should provide data including paired fish tissue (total recoverable inorganic arsenic) and water column (dissolved inorganic arsenic) for all representative gamefish collected in the assessment unit in question. The sampling methodology, sampling plan, and results must be reviewed and approved by DEQ.

6 General Implementation for Human Health Criteria

6.1 Fish-Tissue Monitoring and Assessment

It is recommended to engage very early with DEQ when developing a sampling and analysis plan and submit it for review and approval prior to undertaking any sampling or monitoring activities. Prior to development of Idaho-specific arsenic criteria, DEQ completed an extensive water column and fish tissue monitoring project in which a *Quality Assurance Project Plan* (QAPP) was developed (DEQ, 2019). It is recommended to refer to this QAPP when developing a monitoring plan for arsenic criteria monitoring.

A fish-tissue sample is defined as a single composite or average concentration based on a minimum of five individuals from a single species, where the smallest individual is not less than seventy-five percent of the total length of the largest individual. A sample can be composited or averaged from fish collected over a single calendar year and can be combined from within the same assessment unit or immediately adjacent assessment units, depending on location and length (see section 7.1.3). Fish tissue samples should target gamefish species or other fish species that are commonly consumed by the general public. If sufficient gamefish data are unavailable, or if gamefish species are not obtainable, the water column criterion should be the applicable criterion.

6.1.1 Recommended Species

Gamefish commonly harvested for human consumption are recommended species for use in site-specific criteria calculation, as well as for monitoring and assessment activities. There is potential for other fish species to be used for monitoring and assessment, but it is recommended to contact DEQ prior to sampling to evaluate the applicability of the use of such a species for criteria calculation or monitoring assessment.

Game fish are defined as those fish that are routinely fished for in the water body being evaluated. According to Idaho Department of Fish and Game (IDFG) the following are those fish that are considered game fish: Brook, Brown, Bull, Cutthroat, Golden, Lake (Mackinaw), Rainbow (including Steelhead), Splake and Sunapee Trout; trout hybrids (e.g. Tiger Trout); Atlantic, Chinook, Coho, Kokanee, and Sockeye Salmon; Arctic Grayling; Whitefish; Cisco; Crappie; Perch; Bass; Catfish; Bullhead; Sunfish; White Sturgeon; Northern Pike; Tiger Muskie;

Walleye and Sauger; and Burbot (Ling). Crayfish are also defined as game fish (Idaho Fish and Game, 2022-2024 Season & Rules).

When developing a plan to target species for monitoring, it is recommended to work with DEQ and IDFG Regional Fisheries Biologists to determine which species of fish are most prevalently caught and consumed within the target area. In addition, regionally stocked populations should not be targeted for monitoring because they would represent only a relatively short period of exposure to ambient conditions. IDFG provides a comprehensive list of where and when fish are stocked on a statewide basis (*https://idfg.idaho.gov/fish/stocking*).

6.1.2 Sampling Assessment

Fish tissue samples must be analyzed for total inorganic arsenic using sufficiently sensitive analytical methods that provide sufficient detection limits to quantify inorganic arsenic in tissue at levels necessary for the proposed application. For example, for determining compliance with the fish tissue criterion, a sufficient fish tissue sample should have an MDL ≤ 8.0 µg/kg; for calculating site-specific BAFs and translation of the fish tissue criterion to a water column value, a sufficient fish tissue sample should have an MDL ≤ 0.05µg/g and a MRL or PQL ≤ 0.2 µg/g *(Unclear as to what these MDLs and units refer. Please check and clarify.).*

Other scientifically defensible methods may be utilized for the assessment, (e.g., EPA Method 1632) as long as the method can detect inorganic arsenic at or below the criterion. These methods need to be included in the sampling plan submitted to DEQ for approval prior to implementation.

6.1.3 Spatial Considerations

(See comment letter recommending revision of this section.) The spatial extent of a sampling or monitoring plan will need to be defined and factors that may affect arsenic variability throughout the site need to be identified so they can be considered in the design of the sampling plan (EPA, 2021). When sampling a site, Global Positioning System 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. Confluence areas should be avoided whenever possible.

When targeting fish tissue, some fish species (e.g., salmonids) migrate to upstream areas to spawn or feed. When sampling fish, consideration should be given to which fish in the site are targeted for recreational fishing and consumption. For water column sampling, the different flow characteristics of the site that is being sampled, along with the locations where fish are feeding and possible arsenic uptake, should be taken into consideration. Attempts should be made to sample all habitat types to appropriately characterize the range and distribution of arsenic concentrations at a site (EPA, 2021).

It may still be possible to sample such species on their way up stream; or it may be necessary to monitor smaller order stream segments of a larger stream network to get closer to arsenic inputs. Monitoring plans may need to be adjusted to consider the species of fish found in the small stream segment, and it is important to consider the relationship of upstream sources to downstream habitats (EPA 2018).

Any single sample location will be considered representative of a larger stream segment and need to be sampled within the same assessment unit (AU). Interpreting spatial representation to implement the arsenic criteria for human health depends on how the data are to be used and whether monitoring results will determine compliance with water quality standards for the Integrated Report and TMDL development, or for development of effluent limits and determining compliance with IPDES permits. 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).

6.1.4 Temporal Considerations

(See comment letter recommending revision of this section.) According to the proposed rule, "water column samples must be representative of the annual average concentration of dissolved inorganic arsenic at the site". There is not a set number of samples required according to rule, but for the permits such as an IPDES or TMDL, a sampling plan would need to be developed and approved for how many samples would be taken and how often to satisfy the requirements in the permit. For example, if a reasonable potential to exceed analysis was conducted for a permit or site and was determined that arsenic is a pollutant of concern, one sample that meets criteria may not be enough data to ensure that human health is being protected. However, for non-point source activities, one sample taken yearly that does not exceed criteria may be enough to satisfy the criteria.

When sampling is conducted, sampling frequency should be taken into consideration for sites in which the water column may have seasonal changes, such as spring melt/runoff.

7 Fishless Waters

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.

In stream reaches where fish are naturally absent due to low flow conditions, surface water and the associated fish tissue measured downstream at the first occurrence of a continuous fish population may be used for bioaccumulation modeling if sampling is conducted in a manner that reflects bioaccumulation processes present in the upstream water.

The following factors will be considered in any sampling plans 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.

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- Variability, both spatial and seasonal, of arsenic concentrations in surface waters and fish tissue.
- Timing and location of sampling of water and fish to be representative of this variability.

For this document, and Idaho's arsenic aquatic life criterion, 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, or;
- where fish are naturally absent due to ephemeral, intermittent or persistent low flows, or;
- streams that lack a permanent connection to downstream fish-bearing waters

This criterion also includes streams that lack habitat to support fish, such as lack of gravel for spawning, barriers, or lack a food source. If a water body does not support fish because of unnatural conditions, such as presence of pollutants, then the water column criteria will need to be used.

To determine that a water body is fishless, the site should have accompanying research and field data that is less than 5 years old. It is recommended using either environmental DNA or electrofishing the site to collect comprehensive data for all species (DEQ 2022). *(Meeting the water column criterion when fish tissue data are not available has already been stated. Consider deleting the next sentence.)* ~~When fish tissue samples are not available, water column criterion must be met.~~

In a fishless water body, provided at least ninety (90) days have passed since any new activity or discharge has occurred within the water body, fish-tissue samples from the game fish species representative of the size and species legally harvested with the waterbody inhabiting nearby, most proximate downstream waters, at the first occurrence of a continuous fish population may be used to assess compliance with the arsenic criterion. Case-by-case analysis will need to be conducted if the site is not intermittent and if the most proximate fish population is more than **3 miles downstream**. If considering this method, DEQ suggests using the most current data from DEQ and Idaho Fish and Game to determine which downstream water body closest to the site supports fish communities.

When fish tissue samples are not available and the nearest downstream water is more than three miles or there are several tributaries contributing to the system prior to fish availability, the water column criterion must be met to protect human health in fishless streams.

8 Antidegradation

Antidegradation is a policy aimed at maintaining the existing quality of Idaho waters. The objective of Idaho's antidegradation rule (IDAPA 58.01.02.051) is to review activities that may be potential point sources of pollution. The statutory policy on antidegradation is found in

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Idaho's "Water Quality Standards" (IDAPA 58.01.02) and consists of three tiers of antidegradation protection (IDAPA 58.01.02.051), as required by federal rule. The implementation of the policy is addressed in IDAPA 58.01.02.052.

Antidegradation policy assigns jurisdictional water bodies (i.e., Waters of the United States) one of three levels of protection. 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. It requires water quality be maintained so the existing uses of the water are supported. 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. No degradation of water quality is permitted in these waters.

By Idaho rule, 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. For IPDES permits, the antidegradation analysis is integrated into the permit. A water quality certification is not associated with these permits.

The §401 water quality certification process is triggered whenever there is potential for a point source discharge to waters of the state that are subject to Clean Water Act jurisdiction and a permit or license is required. For §404 dredge and fill permits and FERC licenses, the antidegradation analysis is integrated into the §401 water quality certification decision process.

The antidegradation analysis occurs as follows:

> Step 1: Antidegradation review, wherein DEQ must identify the pollutant(s) of concern associated with the project, identify the status of the water body in meeting its beneficial uses, and determine what level (tier) of protection the affected water body must receive.
>
> Step 2: DEQ defines the conditions within the permit or certification that must be met in order for the water body to receive the level of protection that was identified in Step 1.
>
> Step 3: The antidegradation analysis is subject to public comment.

Antidegradation policy is implemented in a water body-by-water body approach. The most recent EPA-approved Integrated Report and supporting data are the primary resources for DEQ to determine use support during an antidegradation review. DEQ may require the applicant to provide information, including data, that enables DEQ to make a tiering decision, and/or to demonstrate that the activity will comply with the state's antidegradation policy.

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Just because arsenic data may be used to identify the support status of a water body, the project or activity may not necessarily be required to limit arsenic inputs.

If the water receiving the discharge is of high quality, proposed degradation is evaluated to determine if it can be minimized or avoided. If degradation cannot be avoided, the activity is evaluated to determine if it is necessary and important to the social or economic health of the affected public. DEQ must ensure the activity will not cause or contribute to impairment of the beneficial use(s) and/or there won't be a violation of water quality criteria if the activity is permitted. In some instances, DEQ may determine that the degradation is below a significance threshold as identified in IDAPA 58.01.02.052.08.a. If less than 10% of the cumulative assimilative capacity for a receiving water body is used by the proposed new or increased activity, then the activity will not require a more in depth analysis and justification.

For additional information on antidegradation and its implementation in Idaho, see the *Idaho Antidegradation Implementation Procedures*. Note that while all waters of the state are protected for a variety of uses (including water supply, wildlife habitat, and aesthetics), the antidegradation implementation process applies only to the aquatic life and recreation beneficial uses. It is possible (and common) for a water body to receive different tiers of protection for these respective uses (e.g., Tier I for aquatic life and Tier II for recreation).

8.1 Unassessed waters

In instances where the affected water body is unassessed, the applicant has the option to voluntarily acknowledge that the water body is considered high quality. In this case, the water body receives Tier II protection. If the applicant does not believe the water body is high quality, DEQ must use information available at the time to make a determination. If no information is available, or if existing information is not sufficient to make a decision about the water body status, DEQ will determine what information is needed to make such a decision. DEQ may require an applicant to collect information. For §401 certification conditions, if the applicant cannot provide information sufficient for DEQ to make a certification decision (which includes the antidegradation tiering decision), DEQ may deny certification. This is because DEQ must be able to conclude that the activity will comply with the applicable requirements of Sections 301, 302, 303, 306, and 307 of the Clean Water Act, the Idaho Water Quality Standards (WQS) (IDAPA 58.01.02), and other appropriate water quality requirements of state law.

It is important for the applicant to coordinate early with DEQ and the federal permitting authority, where applicable, to identify information gaps that will need to be addressed, and the time and resources that are necessary to collect that information. Where dredge and fill projects will result in the placement of dredged materials in jurisdictional waters, the applicant may be required to use the *Sediment Evaluation Framework*. Where dredging projects will result in upland disposal of dredged sediments, the material must be characterized and disposed of in accordance with state and federal rules. These processes can be costly and time-consuming, so it is important to determine what is required for sediment disposal before initiating the regulatory process. Early pre-application meetings are highly encouraged.

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8.1.1 Exemptions

There are exemptions to Idaho's antidegradation policy for restoration projects and emergency actions.

9 Identifying Impairments for Integrated Report

The process of assessing whether a water body fully supports designated, presumed, and existing beneficial uses is governed by IDAPA 58.01.02.054. DEQ uses the *Water Body Assessment Guidance* (WBAG) (DEQ, 2016) as a guide in making 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 being assessed. When evaluating arsenic data to determine compliance with criteria in the Integrated Report, DEQ assessors will use the following approach:

- For contact recreation use criteria, if fish tissue data from at least five individuals of the same species are available, where the smallest individual is no less than 75% of the total length (size) of the largest individual, compare the fish tissue data results to the applicable tissue criterion element (Fish Only). If the average tissue concentration is less than the criterion, the AU will not be listed as impaired.

- If fish tissue data are not available, compare water column data to either: (a) site-specific water column criteria, if one has been derived for the water body; or (b) the appropriate statewide water column criterion. If the annual average water column concentration is less than the criterion, the AU will not be listed as impaired.

If a waterbody exceeds the fish tissue criterion, or the applicable water column criterion if fish concentrations are not available, the waterbody will be listed on the 303(d) list according to evaluation standards established in the WBAG (DEQ, 2016). For waters designated for contact recreation, DEQ uses data less than 5 years old and 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 data to identify any exceedance of criteria.

10 TMDL Process

The TMDL process for arsenic will follow and be as consistent as possible with existing federal and Idaho guidance for the *Development of Total Maximum Daily Loads* (1999) and its successors.

Water body or assessment units throughout Idaho should be placed in only one of the five distinct categories:

Category 1. Attaining the water quality standard and no use is threatened

Category 2. Attaining assessed designated uses; no use is threatened

Category 3. Insufficient or no data and information to determine if any designated use is attained

Category 4. Impaired or threatened for one or more designated uses but does not require the development of a TMDL for one of three reasons:

a. TMDL has been completed
b. Other pollution control requirements are reasonably expected to result in the attainment of the standard in the near future (for example, reductions in atmospheric deposition under the Clean Air Act)
c. Impairment is not caused by arsenic as a pollutant. These waters are deemed to be impaired based on physical conditions, such as poor habitat or hydrologic modifications. If the available data are insufficient to determine whether impairment is caused by regional or local mercury sources, the water should be included in Category 5 as requiring a TMDL.

Category 5. The water quality standard is not attained. Placing waters into Category 5 is appropriate when a TMDL is required to address an impairment caused by arsenic. This category constitutes the Section 303(d) list of waters impaired or threatened by a pollutant(s) for which one or more TMDL(s) are needed.

The TMDL analysis establishes water quality targets and load capacities, estimates existing pollutant loads, and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards. It also identifies implementation strategies, including reasonable time frames, approach, responsible parties, and monitoring strategies necessary to achieve load reductions and meet water quality standards.

For Assessment Units identified as impaired and needing TMDLs for arsenic, TMDL targets and subsequent load and wasteload allocations (WLA) will be based on statewide water column criteria or site-specific water column criteria, where applicable. A TMDL for arsenic will be compromised of a calculation of the maximum amount that a water body can receive and still meet the water quality criteria for arsenic. The TMDL allocates the calculated amount of arsenic to the various pollutant sources discharging to the water body. If no dischargers exist at the time the TMDL is written, WLA may be provided for potential future discharges. These portions of the TMDL assigned to point sources are WLAs and the portions assigned to nonpoint sources and background concentration of the pollutant are load allocations (LAs). The calculation must include a margin of safety to ensure that the water body can be used for the purposes designated in the water quality standards, to provide for the uncertainty in predicting how well pollutant reduction will result in meeting the standards, and to account for seasonal variations. A TMDL will also include a reserve for growth to accommodate expanded or new discharges in the future. (DEQ 2017)

When a TMDL is developed, it may protect both the aquatic life and recreation uses, but it will be written for the more sensitive of the two uses. Usually, the aquatic life use is the more sensitive use. However, the water column human health criteria for arsenic are lower than the criteria for aquatic life and may be the more protective criterion.

11 Idaho Pollutant Discharge Elimination System Permits

The Clean Water Act mandates that point source activities that discharge pollutants to Waters of the United States must receive a permit. DEQ has authority to issue discharge permits in Idaho and does so through the IPDES program. Several guidance documents are available regarding IPDES program implementation.

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

Effluent data requirements recommended for toxics or hazardous pollutants in section 3.3 of EPA's *Technical Support Document for Water Quality-based Toxics Control* (1991) and 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 causes, has the RPTE to cause, or contributes to an instream excursion above the water column element for arsenic criterion.

It is possible that through the permitting process, a permittee may be required to monitor fish tissue concentrations in receiving waters, in addition to monitoring of total recoverable arsenic (i.e., in cases where DWS is a protected use), and/or dissolved inorganic arsenic (i.e., where recreation is a protected use).

Limitations must control all pollutants or pollutant parameters (either conventional, non-conventional or toxic pollutants) which are determine are or may be discharged at a level which 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 (40 CFR 122.4(d)(1)(i).

To determine if inorganic arsenic has the potential to cause a water quality violation, several sources of information and methods can be utilized. Such as site visit, historical information, or monitoring data if available. For a point source from a facility that will be seeking an IPDES permit, communication with the facility and reviewing the permit application to identify pollutants that may be discharged by the faculty and impact the receiving water.

IPDES regulations require permit writers to assess the impact of discharges to evaluate downstream water quality. 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.*

If arsenic is a pollutant of concern a permittee can determine if they have a reasonable potential to exceed arsenic human health criteria by either using the water column criterion or by collecting fish tissue samples from representative gamefish species. When using fish tissue data to determine the RPTE, the following process should be followed for existing permitted dischargers where no new or increased discharge is proposed:

- Document resident gamefish species, and collect representative gamefish tissue and water column data using analysis methods with sufficient detection limits.
- If fish tissue samples in the receiving water exceed the tissue criterion of 8 µg/kg, then it will be determined whether there is RPTE inorganic arsenic criteria to human health and arsenic effluent limits may be required.
- If no fish tissue samples in the receiving water exceed the fish tissue concentration, and no increased discharge of arsenic is proposed in the permit, then it will be determined that there is no RPTE for the inorganic arsenic criterion, and arsenic effluent limits will not be required.

11.1 Establishing Permit Conditions

Each permit includes sections wherein the effluent and receiving water body are characterized. The permit writer must determine whether WQBELs are required using a three-step process:

- Identify pollutants of concern in the discharge.
- Identify critical conditions of the effluent and receiving waters.
- Identify mixing zone applicability, analysis, and conditions.

Where a WLA for inorganic arsenic has been established through the TMDL process, the permit and its conditions must align with the allocation. Effluent limits must also be consistent with Idaho’s Antidegradation Policy.

11.2 New Discharges or Increased Existing Discharges

For new dischargers or for dischargers proposing increased discharge:

- Document resident gamefish species and collect representative gamefish tissue and water column data using analysis methods with sufficient detection limits.
- If fish tissue samples in the receiving water exceed the tissue criterion of 8 µg/kg, then it will be determined that there is RPTE inorganic arsenic criteria for human health and arsenic effluent limits may be required.
- If no fish tissue samples in the receiving water exceed the fish tissue concentration, the permittee will be required to either calculate RPTE based on the water column criteria

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or provide annual monitoring of fish tissue to demonstrate compliance with the fish tissue criterion. After two years of annual fish tissue monitoring, a site-specific water column effluent limit can be derived provided there are sufficient fish tissue data. If sufficient fish tissue data have not been collected, the water column criterion becomes the applicable criterion.

When RPTE exists, effluent limits can be based on either the water column criterion, or by calculating site specific water column criteria as outlined above. In the absence of sufficient fish tissue data, the water column criterion is the applicable criterion. TMDL targets WLAs can be derived either using the water column criterion or by calculating site specific water column criteria as outlined above.

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Appendix A.

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