September 22, 2021

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 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 through the state. The Department of Environmental Quality (Department) is going through a multi-year negotiated rulemaking process to establish new human health water quality criteria for arsenic (As). The arsenic water quality criteria values are used to set cleanup/remedial objectives, total maximum daily loads (TMDLs), and requirements for Idaho Pollution Discharge Elimination System (IPDES) permits. Thus, these criteria are very important to the regulated community and are of direct interest to, and have direct impact on, the IACI membership.

Introduction

IACI has been a regular participant in the negotiated rulemaking meetings and submitted a number of comment letters to the Department addressing numerous aspects of the human health criteria. At the August 18, 2021 negotiated rulemaking meeting the discussion focused on:

- The need for a water column criterion for the recreational (fish only) beneficial use and using a calculated tropic level (TL) weighted bioaccumulation factor (BAF) to derive such a criterion. The Department proposed a concentration of 4.3 micrograms per liter (μg/L) of inorganic arsenic (*i*As) as a water column criterion which would be superseded by fish tissue measurements.
- How to account for incidental ingestion of water that might contain *i*As.
- Changes in arsenic concentrations in water and how that "flux" would be reflected in fish tissue concentrations.
- Aspects of "implementation" of the criteria.

IACI has the following comments on these topics.

Comments

1. Recreational (Fish Only) Beneficial Use: Use of Trophic Level-Weighted BAF to Calculate a Water Column Criterion

The Department has proposed using a TL weighted BAF to derive a water quality criterion for inorganic arsenic. This calculation involved the following steps:

(a) Classification of the TL of the fish sampled in the Department's comprehensive study per information found in several sources.
(b) A geometric mean was calculated by individual sample BAFs by TL.
(c) TL specific consumption rates were based on the proportion of the 95th percentile of TL-specific consumption of freshwater + estuarine fishes to the total consumption rate from the national estimated fish consumption study as presented in *EPA. 2014. Update of Human Health Ambient Water Quality Criteria*.

IACI, in our previously submitted comments, has discussed the difficulty in deriving a meaningful biologically-based BAF.[1] The findings of the 2019 Idaho study are consistent with information from the literature: the relationship between *iAs* concentrations in the surface water and fish tissue is not statistically significant and highly variable across fish species and sizes. IACI recognizes that the Department believes it needs to include a water column-based human health water quality criterion (HHWQC) for recreational waters in a proposed rule for *i*As, as the U.S. Environmental Protection Agency (EPA) has not updated and revised their process or guidance for developing/setting water quality criteria for chemicals in which traditionally-derived BAFs are problematic.

The proposal by the Department incorporates the following elements:[2]

- The Department uses a TL-weighted BAF derived using a procedure that is consistent with the BAFs used by the Department to derive HHWQC for other compounds
- This approach is also consistent with EPA's derivation of BAFs when setting national HHWQC.
- The TL-weighted BAF used in the proposed rule also has the advantage of using Idaho-specific fish tissue and water column data collected by the Department in 2019. IACI again commends the Department for collecting the comprehensive state-wide dataset and employing those data to derive a TL-weighted BAF.
- The calculation utilizes EPA national fish consumption rates by tropic level.

As discussed in previous IACI comments, the best representation of the relationship between the concentration of *i*As in the water column and fish tissue is determined using regression analysis. Consistent with the BAF used in the proposed rule, regression analysis can be used to define the relationship between water and tissue concentrations of *i*As for each of the trophic levels used by DEQ to derive its TL-weighted BAF. The results of the TL-specific regression analyses are presented in the figures below. The TL-specific BAFs are 1.36 liters per kilogram (L/kg), 0.31 L/kg and -0.6 L/kg for TLs 2, 3 and 4, respectively.

Figure 1
Tropic Level 2 Regression Analysis.
(next page)

[1] See: IACI's August 21, 2020 comment letter, pages 15-17, including Table 7 and Figure 4; and IACI's July 14, 2021 comment letter, page 2.
[2] Idaho Department of Environmental Quality. 2021. Rulemaking Document 58-0102-1801, Arsenic Human Health Criteria, Discussion Paper #3. August 13, 2021.

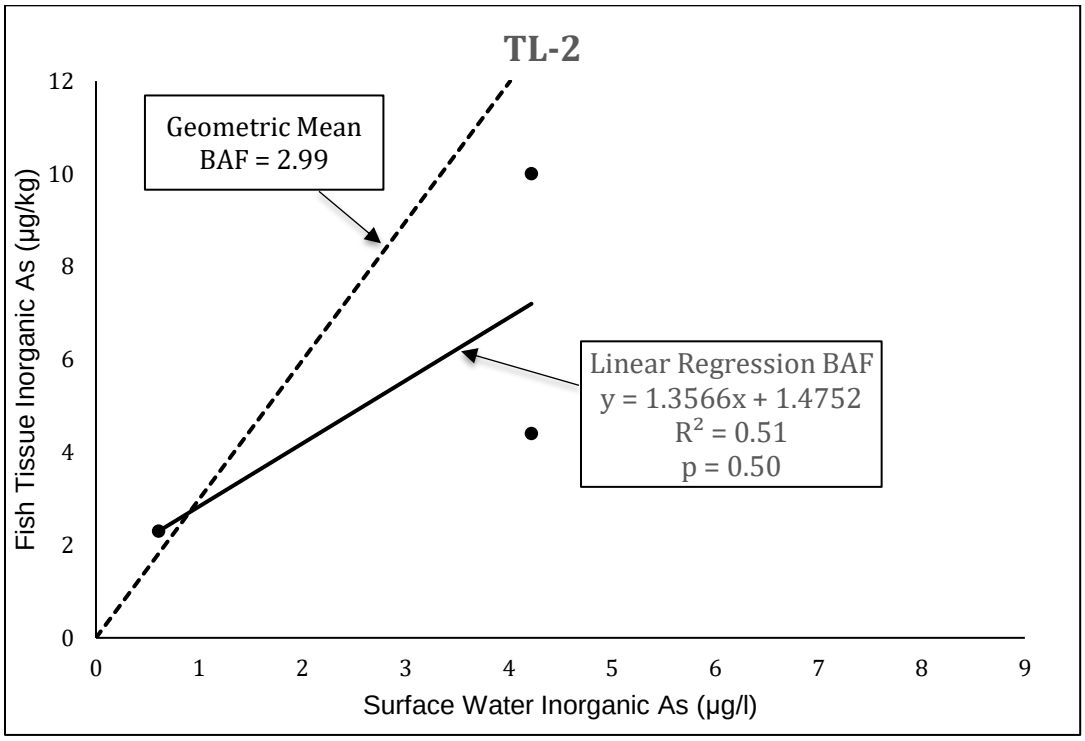


Figure 2
Tropic Level 3 Regression Analysis

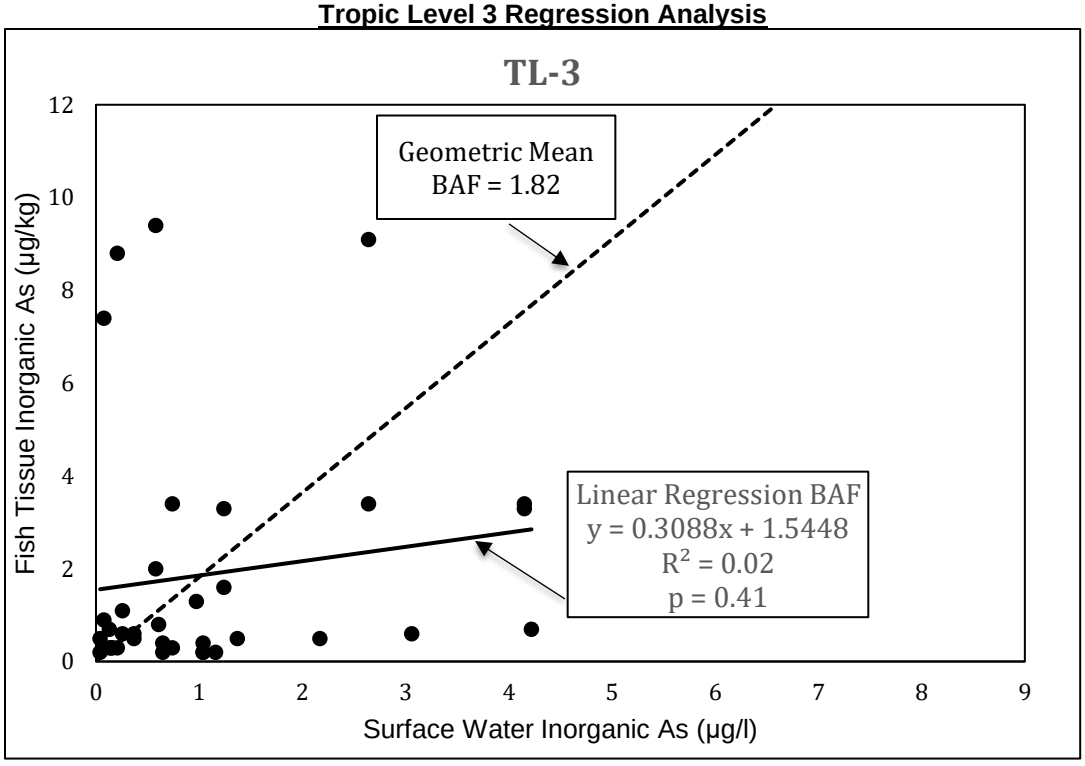
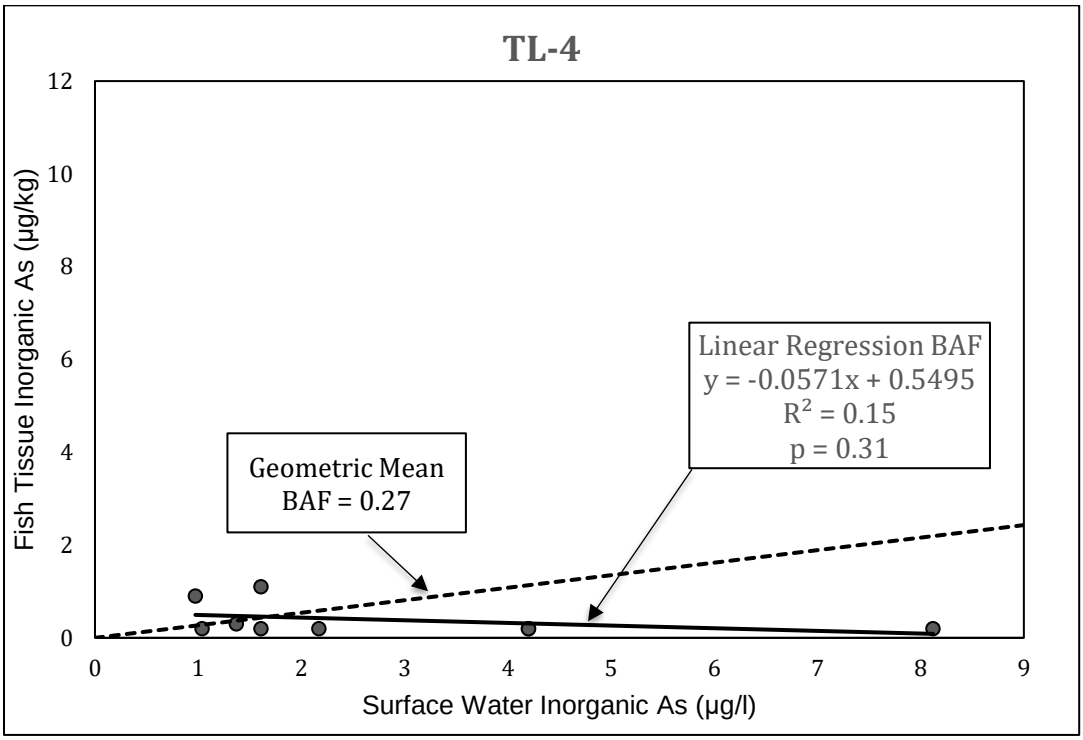


Figure 3
Tropic Level 4 Regression Analysis



While none of the TL-specific regressions are statistically significant (p>0.05), the slope of regression equations is the best representation of *i*As bioaccumulation by Idaho fish,showing both the TL-specific BAFs using regression analysis (solid lines) and the TL-specific BAFs based on the geometric mean of individual paired sample points (dotted lines). The relationship between *i*As concentrations in water and tissue represented by the BAF derived based on the geometric mean of all paired samples within a trophic level can be plotted as a line assuming that the y-intercept is equal to 0. As can be seen in Figures 1,2, and 3, the BAFs based on regression analysis better fit the measured data. This is in particular true at higher concentrations of *i*As in surface water, where the geometric mean BAFs substantially overpredict measured *i*As concentrations in fish tissue.

The TL-specific regression-based BAFs can be incorporated in the process used by the Department to derive the TL-weighted BAF in the proposed rule and by EPA to derive national HHWQC to derive an Idaho-specific TL-weighted BAF of 0.6 L/kg as shown below.

TL-based BAF = $(BAF_{TL2}\ x\ P_{TL2}) + (BAF_{TL3}\ x\ P_{TL3}) + (BAF_{TL4} x\ P_{TL4})$

Where:
TL-Based BAF = The trophic level weighted BAF;
BAF_{TLi} = the regression-based BAF for all species assigned to trophic level *i*; and
P_{TLi} = the proportion of the national fish consumption rate for TLi.

Substituting the regression-based TL-specific BAFs shown above and the national fish consumption rate proportions used by the Department and EPA to derive TL-weighted BAFs results in a TL-weighted BAF of 0.61 L/kg.

TL-based BAF = [(1.36 L/kg x 0.36) + (0.31 L/kg x 0.4) + (-0.06 L/kg x 0.24)] = 0.61 L/kg).

Using this weighted BAF of 0.61 L/kg leads to a water column criterion of 13 µg/L as calculated below:

$$HHWQC = RSD\ x\ \frac{BW}{FCR\ x\ BAF}\ x\ CF$$

HHWQC = Human Health Water Quality Criterion;
RSD = risk-specific dose for cancer effects (acceptable cancer risk level divided by cancer slope factor, CSF), assuming an acceptable cancer risk level of $1x10^{-5}$ and CSF of 1.5 kg-day/mg;
BW = body weight of 80 kg;
FCR = fish consumption rate of 0.0665 kg/day;
BAF = TL-weighted bioaccumulation factor of 0.61 L/kg; and
CF = unit conversion factor of 1,000 µg/mg.

$$HHAWQC = \frac{1x10^{-5}}{1.5}\ x\ \frac{80}{0.0665\ x\ 0.61}\ x\ 1{,}000 = 13\ \mu g/L$$

If the decision is made that the proposed rule must contain a water column criterion for recreational use waters, IACI believes the trophic level weighted BAF based on regression analyses and resulting WQC of 13 µg/L represents the most scientifically defensible use of the comprehensive Idaho paired tissue and water dataset. This approach is also consistent with the process the Department and EPA have used to derive BAFs when setting HHWQC for other compounds.

The Department is also proposing a Water & Fish Consumption Criterion of 10 µg/L. Adopting a Fish Only criterion of 13 µg/L would thus be consistent with the pattern seen in all of Idaho's other HHWQC, where the Fish Only criterion is the same as, or higher than, the Water & Fish criterion. Such consistency can be an important facet of regulatory defensibility.

2. Recreational (Fish Only) Beneficial Use: Incidental Ingestion

At the August 2021 Rulemaking meeting, EPA expressed concern about the possibility that use of a fish tissue criterion for recreational use waters could result in the *i*As water column concentration reaching a level that poses an unacceptable risk via incidental ingestion of surface water while recreating (e.g., swimming, boating, wading).

EPA's Exposure Factors Handbook (EFH) provides information about the amount of water incidentally ingested while swimming and the amount of time spent swimming.[3] That information can be combined with the *i*As cancer slope factor and bodyweight assumptions used by the Department to derive *i*As HHWQC to estimate the potential incidental ingestion risk associated with the concentrations of *i*As measured by the Department in Idaho surface waters.

Table 3-7 of EPA's EFH lists median (a mean is not provided in the table) and 95th percentile incidental water consumption rates for adults of 28 and 92 ml/person-hour, respectively. Table 16-1 of the EFH reports mean and 95th percentile time spent swimming for an adult of 45 and 181 minutes/month, respectively. Combining central tendency estimates of ingestion and time swimming results in a daily estimate of incidental ingestion of water while swimming of 0.0007 L/day (28 ml/hour x 1.5 minutes/day x 1 hour/60 minutes x 1 L/1000 ml = 0.0007 L/day). Combining 95th percentiles for incidental ingestion and time swimming results in an incidental ingestion rate of 0.009 L/day (92 ml/hour x 6 minutes/day x 1 hour/60 minutes x 1 L/1000 ml = 0.009 L/day). The geometric mean iAs water column concentration measured as part of the 2019 sampling program is 0.7 ug/L and the maximum concentration is 8.12 ug/L.

The central tendency and upper percentile potential risks associated with the geometric mean concentration of 0.7 ug/L are $9x10^{-9}$ and $1.2x10^{-7}$, respectively[4]. Using the maximum measured *i*As

[3] U.S. EPA. 2011. Exposure Factors Handbook 2011 Edition. EPA/600/R-09/052F. For updates see: https://www.epa.gov/expobox/about-exposure-factors-handbook

[4] Central tendency/geometric mean iAs concentration potential risk = [0.0007 mg/L] x [0.0007 L/person-day] / [80 kg/person] x [1.5 kg-day/mg] = $9.2x10^{-9}$.
95th percentile/geometric mean iAs concentration potential risk = [0.0007 mg/L] x [0.009 L/person-day] / [80 kg/person] x [1.5 kg-day/mg] = $1.2x10^{-7}$.

concentration of 8.12 ug/L the central tendency and upper percentile potential risks are $1.1x10^{-7}$ and $1.4x10^{-6}$, respectively[5]. All sets of estimated risks based on measured *i*As concentrations are well below the Department's HHWQC allowable risk of $1x10^{-5}$, even when using exceptionally conservative assumptions (i.e., the maximum measured *i*As concentration and 95th percentile exposure and toxicity assumptions). Under those assumptions *i*As concentrations in the water column would need to reach about 60 ug/L to equal the Department's allowable risk level of $1x10^{-5}$. When more realistic combinations of exposure assumptions are used, the *i*As concentration in surface water would need to approach and even exceed 1,000 ug/L. IACI is not aware of any conditions that would lead to ambient waters having such concentrations of *i*As.

In summary, these evaluations indicate that incidental ingestion poses a negligible risk and is not a pathway that calls into question the health protectiveness of the Department's proposed use of combined water column and fish tissue criteria for recreational waters.

3. Arsenic Flux in Water and Fish Tissues

Arsenic speciation studies have revealed that most arsenic in fish muscle is found as organic arsenobetaine; researchers have proposed that fish transform *iAs* into organic arsenic species found in tissue.[6] Experimental exposure studies suggest that fish rapidly incorporate *iAs* in their tissues. Once absorbed from the gastrointestinal tract, *iAs* species (AsIII and AsV) are widely distributed throughout the body, where AsV is reduced to AsIII, which is in turn methylated (as DMA or MMA; organic forms of As) in the liver.[7] Inorganic arsenic concentrations in carp (*Carassius auratus)* and tilapia (*Oreochromis spp)* muscle tissue reached steady state after 10-15 days of dietary exposure in the laboratory and then remained constant for the duration of the experiment (22-32 days).[8]

4. Implementation: Sampling of Fish and Showing Compliance with the Criteria

IACI has the following recommendations and comments for implementation of a fish tissue criterion:

Sample size. IACI supports defining a fish-tissue sample as a single composite or average concentration based on a minimum of five individuals from a single species. Fish can be composited or the average of the individual results from the analyses of five fish can be used to represent the *i*As concentration of the sample. The smallest individual is to be no less than seventy-five percent (75%) of the total length (size) of the largest individual. IACI recommends that guidance on fish sampling clearly emphasize a preference for individuals of a size that would normally be consumed by humans (e.g., minimum size of 20 cm).

As an alternate sample size, for locations that may have difficulty in capturing multiple individuals of the same species, the Department may want to consider using the average from the average concentration for five individuals from two different species, where there are at least two individuals for each species. This would still be representative of typical harvesting and consumption by anglers The individual fish from each species can be composited or analyzed individually and then averaged for reporting.

Fish Species Sampled. IACI believes that fish species captured and analyzed should, by preference, be gamefish. However, the implementation needs to recognize that fish sampling may not result in

[5] Central tendency/maximum iAs concentration potential risk = [0.0081 mg/L] x [0.0007 L/person-day] / [80 kg/person] x [1.5 kg-day/mg] = $1.1x10^{-7}$.95th percentile/maximum iAs concentration potential risk = [0.0081 mg/L] x [0.009 L/person-day] / [80 kg/person] x [1.5 kg-day/mg] = $1.4x10^{-6}$.
[6] Tanamal, C. et al. 2021. Health Risk Assessment of Inorganic Arsenic Exposure Through Fish Consumption in Yellowknife, Northwest Territories, Canada. Human and Ecological Risk Assessment, 27 (4) 1072-1093.
[7] McIntyre, D.O. and T.K. Linton. 2012. Arsenic. In: *Fish Physiology, Volume 31B: Homeostats and Toxicology of Non-Essential Metals* (Eds. C.M. Wood, A.P. Farrell, C.J. Brauner), pp 297-349. London: Academic Press.
[8] Cui, D., P. Zhang, H. Liu, Z. Zhang, Y. Song, Z. Yang. 2021. The dynamic changes of arsenic biotransformation and bioaccumulation in muscle of freshwater food fish crucian carp during chronic diet-borne exposure. Journal of Environmental Sciences 100: 74-81.

the capture of gamefish and it may be necessary to collect and analyze non-game species in such instances.

Fish Collection. Fish samples should be collected near the discharge or downstream within the same water segment/reach as the discharge point. Samples should be gathered within a four (4) week period to allow for difficulties that might occur during sampling.

Fish Tissue Analysis. The analysis should be for total *iAs* of the fillet or muscle. The analytical method (and sample size) needs to provide sufficient detection limits to quantify *iAs* concentrations to determine compliance with the fish tissue criterion.

Fishless Waters. The water column criterion is the applicable criterion in the absence of fish.

Summary

IACI recognizes that existing EPA guidance and methodology does not incorporate deriving water quality criteria where there is not a significant relationship between water column and fish tissue concentrations as is needed for certain designated uses. The Department, using standard and consistent calculation methodology, has derived a water column concentration from the extensive 2019 study to satisfy the EPA methodology. IACI believes a more scientifically defensible incorporation of the 2019 Idaho data in the TL-weighted BAF process is available: regression-based BAFs are the best representation of the relationship between the concentration of *i*As in the water column and fish tissue. The 2019 data can be combined with the Department's classification of fish into TLs to derive TL-specific BAFs and an overall TL-weighted BAF that uses the results of the TL-specific regression analyses. The result is a TL-weighted BAF of about 0.6 L/kg and water column criterion of about 13 µg/L. IACI believes this TL-weighted BAF and resulting WQC is more scientifically defensible than the TL-based BAF derived using the geometric mean of individual sample point BAFs proposed by the Department.

Using methodology and exposure information from EPA, the risk from incidental ingestion of *iAs* in water is inconsequential and does not need further analysis.

Sampling of water column and fish tissues should provide a valid "real time" characterization of arsenic in the environment that can be used to determine compliance with the criteria. IACI has also provided some specifics as to the fish sampling itself. Further discussions are needed on how such sampling would be incorporated into IPDES permits and the role of a periodic state-wide sampling program (*iAs* in water and fish tissues) in providing the assurance needed that the criteria are being met and designated uses protected.

We appreciate the opportunity to submit these comments. Please let us know of any questions you have.

Sincerely,

Alex LaBeau
President

cc: Alan Prouty, Chair
IACI Environment Committee