North American Metals Council
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November 23, 2020

Via E-Mail

Ms. Sandy Scherer, Paralegal
Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT USA 59620-0901

Re: "Derivation of a Site-Specific Water Column Selenium Standard for Lake Koocanusa" (Montana Department of Environmental Quality, September 2020)

Dear Ms. Scherer:

The North American Metals Council (NAMC)[1] Selenium Working Group (SWG)[2] (NAMC-SWG is pleased to submit these comments regarding the Montana Department of Environmental Quality's (MT DEQ) recently released document titled: "Derivation of a Site-Specific Water Column Selenium Standard for Lake Koocanusa" (MT DEQ 2020). NAMC-SWG played a key role in generating data for, and supporting the development and derivation of the U.S. Environmental Protection Agency's (EPA) (2016) Water Quality Criteria for Se, and draft Implementation Guidance (*e.g.*, EPA 2017; now rescinded).

This submission provides our high-level comments and supporting rationale related to key aspects of the above-mentioned document. We have drawn from information provided by

[1] NAMC is an unincorporated, not-for-profit group formed to provide a collective voice for North American metals producers and users (*i.e.*, the North American "metals industry") on science- and policy-based issues that affect metals in a generic way. NAMC members include trade associations as well as individual companies.

[2] The NAMC-SWG (http://www.namc.org/selenium.html) is engaged in technical research on issues pertaining to selenium (Se). Activities include the development of water quality and tissue-based standards for Se, the implementation of such standards, the development of effects thresholds, and the identification of analytical methods pertinent to such standards. As part of its ongoing efforts, the NAMC-SWG develops papers on these topics and shares them publicly on its website or through the peer-reviewed scientific literature.

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our membership, Montana public notices, and the U.S. Geological Survey (USGS) study report (Presser and Naftz 2020). Information was also accessed from the comprehensive evaluation prepared by David DeForest (2020) and comments provided by Joe Beaman (EPA), both of whom are Lake Koocanusa Selenium Technical Subcommittee (SeTSC) members.

Our comments focus on the basis for the derivation and scientific defensibility of the water-based Selenium Standard for Lake Koocanusa, specifically, 0.8 µg/L (MT DEQ 2020). We have specific concerns related to the use and misapplication of models and model input data that ultimately yield an overly conservative Standard for the lake.

1. Model Used to Develop the Water-Based Standard

The MT Selenium Standard (MT DEQ 2020) is based on modeling work that was, to a large degree, developed using the Presser and Luoma (2010) framework. Our main concerns regarding the use of this framework are outlined below. The model was developed prior to, and published in, 2010. As such, the science has evolved into approaches that incorporate site-specific data. While all components of the model framework allow for consideration of site-specific data, the only site-specific data incorporated into the model were the k_d values (see below).[3] Consequently, the model failed to incorporate site-specific Se data for invertebrates and fish. Yet the latter data are the most critical, since the water-based Selenium Standard is back-calculated from a fish tissue-based criterion (MT DEQ 2020, EPA 2016).

The following outlines the evidence supporting this position:

- The Presser and Luoma (2010) model relied on the following equation to derive its water-based Selenium Standard:

  $$C_{fish} = C_{water} \times k_d \times TTF^4_{invert} \times TTF_{fish} \times 0.001$$

  Where: C_{water} = Se concentration in water (µg/L);
  C_{fish} = Se concentration in fish tissue (dry weight) (mg/kg dw);
  k_d = ratio of Se concentration in particulates and water (L/kg dw);

[3] k_d is the ratio of Se concentration in particulates and water.

[4] TTF = trophic transfer factor.

TTF_{invert} = ratio of Se concentration in invertebrates and particulates;
TTF_{fish} = ratio of Se concentration in fish and invertebrates; and
0.001 = conversion factor to convert from µg to mg.

- The above equation can be modified to include more trophic levels, such as prey fish consumed by piscivorous fish, and can be modified to include relative dietary fractions (*e.g.*, 50 percent benthic invertebrate, 50 percent prey fish), as well as bioavailability fractions.

- The water-based Selenium Standard of 0.8 µg/L derived for Lake Koocanusa (MT DEQ 2020) was determined by calculating the value of C_{water}, utilizing the EPA whole-body fish tissue Se guideline of 8.5 mg/kg dw (EPA 2016) as the input for C_{fish}, and relying on assumed inputs for TTF values reported in Presser and Luoma (2010). We support the use of the 8.5 mg/kg dw whole-body fish tissue as appropriately conservative; we do not, however, support the use of the generic TTFs used in the model. Site-specific TTFs should be used.

- The model consistently overestimated Se concentrations in fish tissue, even in the most conservative model scenario and using site-specific inputs. A generic multi-step modeling approach has too much uncertainty to support, by itself and without validation, recommendations for a site-specific, water-based Selenium Standard for Lake Koocanusa.

2. Use of Site-Specific Data

The lentic water criterion (national) published by EPA (2016) is 1.5 µg/L. Criteria other than those proposed by EPA (EPA 2016), should be based on site-specific data versus laboratory data. EPA language reads: "The fish egg (or ripe ovary) Se criterion of 15.1 mg/kg dw supersedes (*i.e.*, is given priority over) the Se criteria for muscle or whole body tissue and for surface water concentrations." EPA's intent is that site-specific adjustments are allowed, however, they should only be based on site-specific data. The data used by USGS in their model (Presser and Naftz 2020) did not incorporate site-specific data, with the exception of k_d values. Additionally, assumptions about the bioavailability of Se as inputs to the USGS model (Presser and Naftz 2020) were made simply as model-fitting or sensitivity analyses, which were not supported by actual bioavailability measures.

TTF values reported for the original Presser and Luoma (2010) model were based on previous research and were not specific to Lake Koocanusa. Upon reassessment of the model, it was determined that the TTF values assumed in the model were significantly higher than site-specific TTFs (*e.g.,* the site-specific median value for zooplankton was determined to be 0.52, whereas the model assumed a value of 1.5). Validation of the model revealed that even when using site-specific TTF values, the model consistently overestimates Se concentrations in fish tissue. This fact may be due to k_d values that overestimated Se exposure in Lake Koocanusa or perhaps Se exposures by fish were overestimated (*e.g.,* the default whole-body fish TTF is "too high"). Even when using site-specific k_d and TTF values, the model predicted muscle and whole-body Se concentrations that, on average, were a factor of 2.9 greater than what was observed. Checking model predictions of fish tissue Se concentrations against the reported data from the site in question (in this case, Lake Koocanusa) is critical.

3. The Nature of the Modeling Approach Applied

The modeling approach applied is basically a model sensitivity exercise rather than a predictive exercise. The USGS model (Presser and Naftz 2020) significantly overpredicts Se concentrations in observed fish tissue.

Specifically, many of the model calculations utilize input variables (*i.e.*, TTFs) that are distinctly different from the site data, particularly pertaining to non-cyprinid fish. The argument that the site data are too variable is not valid, particularly when 99.8 percent of the above-mentioned data illustrate that fish species present are below conservative effects thresholds. It should be noted that the data used to generate the Presser and Luoma (2010) model were also site-specific (versus generic) data.

The following outlines the evidence supporting this issue:

- Additional support that EPA's lentic criterion of 1.5 µg/L is conservatively protective is provided by the evaluation of alternative model inputs and the model validation relative to empirical fish tissue Se data. Even the least conservative model scenario evaluated (*i.e.*, use of the 50th percentile k_d and site-specific invertebrate TTFs) consistently over-predicted measured fish Se concentrations. This conservative model translated the whole-body fish Se criterion of 8.5 mg/kg dw to surface water Se concentrations of:

  - 1.4 µg/L for piscivorous fish (*i.e.*, 100 percent fish diet);

- 1.5 µg/L for fish with a 100 percent insect diet;
- 2.1 µg/L for fish with a 50 percent insect and 50 percent zooplankton diet; and,
- 3.3 µg/L for fish with a 100 percent zooplankton diet.

- Based on the above results, EPA's lentic criterion of 1.5 µg/L would be protective of all of the fish species in Lake Koocanusa, as well as white sturgeon in the Kootenai River downstream of the Libby Dam. Current surface water monitoring data for the forebay and in the river downstream of the dam indicate that the Se concentrations are similar. Egg Se concentrations in white sturgeon collected from the Kootenai River from 2015 to 2019 have ranged between 3.0 to 5.7 mg/kg Se dw (mean = 4.1 mg/kg Se dw; n = 38) (*i.e.*, a factor of 2.1 below the threshold for effects for the most sensitive species). For the aforementioned white sturgeon, even the maximum egg Se concentration is just 38 percent of EPA's egg Se criterion of 15.1 mg/kg dw.

4. Defensibility of Applying a Standard Lower than EPA's (2016) Lentic Criterion

There is a very large fish tissue database for Lake Koocanusa. Of the more than 1,200 individual samples of non-cyprinid fish species in the lake, only three measurements have exceeded the EPA (2016) egg-ovary criterion of 15.1 mg/kg Se dw.[5] These include two ovary and one muscle Se measurement. No exceedances of the whole-body Se criterion have been observed or reported. The site-specific field data suggest that current water concentrations do not result in aquatic risk.

The following outlines the evidence supporting this:

[5] The model does not consider species-specific thresholds, yet, when available, sensitivity of local species plays an important part of developing site-specific criteria. DeForest (2020) recommends the following hierarchy: (1) species-specific; (2) intra-genus surrogate; and (3) criteria.

- EPA's fish tissue Se criteria (EPA 2016) are conservative and protective of fish in Lake Koocanusa. These criteria are based on the fifth percentile of genus mean EC10s, which is extrapolated to a concentration less than the white sturgeon EC10 (ten percent effect concentration endpoint in toxicity tests). There is less uncertainty in the egg Se criterion (which supersedes the muscle and whole-body Se criteria), due to differences in muscle-to-egg and whole body-to-egg relationships among species, but conservatism in the criteria calculation method ensures that the muscle and whole-body Se criteria are still protective.

- With the exception of cyprinids, there have been only three exceedances of a fish tissue criterion based on more than 2,800 measurements in individual fish within Lake Koocanusa. No whole-body Se concentrations have exceeded EPA's whole-body Se criterion. Based on evaluations of ovary Se concentrations and ovary maturity discussed for cyprinids and mountain whitefish, there is uncertainty in some of the ovary Se data for other fish species (*e.g.,* the potential to overestimate egg Se concentration due to immature ovaries). Most ovary Se concentrations, however, fall well below EPA's egg Se criterion, so this uncertainty is unimportant for most of the cases.

- Three cyprinid species -- northern pikeminnow, peamouth chub, and redside shiner -- have had the highest ovary Se concentrations in Lake Koocanusa, and these concentrations have exceeded EPA's egg/ovary Se criterion. As reported in the northern pikeminnow study (EcoTox *et al*. 2020), the elevated ovary Se concentrations are associated with immature ovaries as samples were not collected at the time of spawning. A similar pattern appears to have been observed in peamouth chub. Recent studies with redside shiner have yielded more information on Se bioaccumulation in redside shiner eggs and effects, specifically, the effect level is unbounded, as follows: egg/ovary > 28 mg/kg Se dw, whole body >13.5 mg/kg Se dw. These data on cyprinids in Lake Koocanusa, coupled with EPA's conclusion that cyprinids are not uniquely sensitive, based on evaluations of data from sites in the United States with high Se concentrations, indicates that it is unlikely that cyprinids in the lake are uniquely sensitive to Se and, in fact, may be relatively insensitive. Since

the above-mentioned data for redside shiner are now available, they should be used and incorporated into the model.

5. Concern about Analytical Capability of Commercial Laboratories

The ability of commercial analytical laboratories to measure reliably Se at the proposed water-column standard of 0.8 µg/L is a very important consideration in its application for the following reasons:

- The proposed Standard would currently be one of the lowest, if not the lowest, regulatory aqueous benchmark;
- The Standard is less than one tenth the current Practical Quantitation Limit (PQL)[6] of 10 µg/L, determined by EPA (2009) (*see* Gilron and Downie 2016) and near the Method Detection Limits (MDLs) of EPA-approved methods for Se;
- There is increased variability/measurement uncertainty as measurements approach a laboratory's MDL; and
- Establishing a standard near the MDL of available methods will lead to uncertain or inaccurate compliance determinations.

It is common for recovery criteria at the quantitation limit to be wider than those of other quality control parameters (*e.g.*, matrix spikes). Therefore, to minimize uncertainty in the determined sample concentration and the risks of either false compliance or non-compliance, the achieved quantitation limit should be significantly lower than the regulatory limit (*i.e.*, best practice is typically for the quantitation limit to be no more than one fifth of the regulatory standard). Reliably determining compliance with the proposed Lake Koocanusa Selenium

[6] The PQL is a measure of a laboratory capacity's sensitivity (in other words, accuracy). The PQL is defined as "the lowest achievable level of analytical quantitation during routine laboratory operating conditions within specified limits of precision and accuracy" (50 Fed. Reg. 46904, 1985). EPA uses the PQL to estimate or evaluate the minimum concentration at which most laboratories can be expected to measure reliably a specific chemical parameter during day-to-day analyses.

Standard would require a quantitation limit of 0.16 µg/L Se. This will be very difficult for most laboratories to achieve.

Summary

In summary, the modeling efforts used as the basis for the Lake Koocanusa Selenium Standard have a number of scientific and practical challenges, specifically: (1) the input parameters (with the exception of k_d values) do not incorporate site-specific data; (2) there are sufficient site-specific field data[7] to calculate a water-based Selenium Standard, and therefore, protective for aquatic biota resident in Lake Koocanusa; and (3) appropriate model validation pertaining to Se in fish tissue was not conducted and is critical to the establishment of the water-based standard.

With the historical data collected, there is a unique opportunity to derive a state-of-the-art Selenium Standard for Lake Koocanusa and to lead the science. Furthermore, it is unlikely that most laboratories would have the capability of meeting the low quantitation limit required for practical application of this Standard. The current proposed approach will not be viewed as valid by the scientific community.

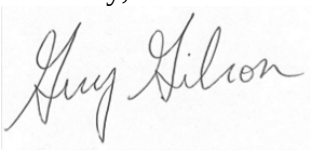
We fully concur with the evaluation and conclusion of DeForest (2020) and recommend the adoption of a lentic value of 1.5 µg/L, which, in addition to being appropriately protective, is consistent with EPA's (2016) national water-based criterion. We believe it would be prudent for this value to be adopted at this point in time, recognizing that it can be reviewed in three years as part of EPA's triennial review process, should monitoring or other data indicate that a lower Selenium Standard is justified.

[7] There are sufficient co-located water and fish tissue Se data to develop a bioaccumulation model that could be used to derive a site-specific standard. This is consistent with the site-specific approach outlined in Appendix K of EPA's criteria document (EPA 2016).

NAMC-SWG supports the need for reasonable and scientifically defensible effluent limits that consider Best Available Technology–Economically Achievable and acceptable risk.

Thank you for the opportunity to provide these comments.

Sincerely,



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