# Final
# Written Findings for the Site-Specific Water Column Selenium Standard for Lake Koocanusa, MT

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# 1.0 INTRODUCTION

On December 11, 2020, the Board of Environmental Review (board), voted to adopt the Department of Environmental Quality's (department) proposed selenium water quality standard for Lake Koocanusa into state law and determined the proposed standard was no more stringent than federal guidelines. Therefore, there was no requirement for the completion of written findings as described in MCA 75-5-203. The multi-part standard includes fish tissue and water column components with the following numeric values: 15.1 mg/kg dry weight (dw) egg/ovary, 11.3 mg/kg dw muscle, 8.5 mg/kg dw whole body, and 0.8 µg/L total dissolved selenium in Lake Koocanusa and 3.1 µg/L in the Kootenai River mainstem. See ARM 17.30.632. The frequency and duration of the fish tissue standards are instantaneous measurements, not to be exceeded. The water column standard is computed as a 30-day average and shall not be exceeded more than once in three years, on average.

The standards were adopted into state law on December 25, 2020, and codified in ARM 17.30.632. The water quality standards were approved by the U.S. Environmental Protection Agency (EPA) on February 25, 2021. Petitions were filed to the board by Teck Coal Limited (Teck) on June 30, 2021, and by Lincoln County on October 14, 2021, with both petitions calling for a review of the stringency determination for the site-specific water column standard for Lake Koocanusa in ARM 17.30.632(7)(a). On February 25, 2022, the board reversed its previous stringency determination and determined that the site-specific water column standard for Lake Koocanusa is more stringent than comparable federal guidelines. The department will, therefore, comply with MCA 75-5-203 by making the written findings set forth in 75-5-203(2), MCA. Presented in this document are the written findings supporting ARM 17.30.632(7)(a) required under MCA 75-5-203(2) and MCA 75-5-203(3).

# 2.0 WRITTEN FINDINGS

The purpose of this document is to complete the written findings described in MCA 75-5-203 for the site-specific water column selenium standard for Lake Koocanusa. The document has been structured to address each statutory requirement individually. MCA 75-5-203 states that the written findings must be based on the record. Citations to the board's rulemaking record on the matter are included with the prefix "RR" followed by the page number, and the full record can be found on the DEQ Standards website at https://deq.mt.gov/files/Water/WQPB/Standards/pdf/BER_Record.pdf

<u>75-5-203(2)(a) The proposed state standard or requirement protects public health or the environment of the state</u>

**Selenium Toxicity**

The selenium water quality standard for Lake Koocanusa is necessary to protect aquatic life from the toxic effects of selenium (**RR_000001**). The water quality standard is a multi-part standard comprised of egg/ovary, muscle or whole body, and water column components (**RR_000074**). The multi-part water quality standard accounts for diet as the primary pathway of selenium exposure (**EPA, 2016; RR_000317**). EPA (2016) states that traditional methods for predicting toxicity on the basis of exposure to water column concentrations do not work for selenium because the behavior and toxicity of selenium in aquatic systems is highly dependent on site-specific factors (**RR_000310**). Therefore, the protection of the egg/ovary

selenium concentration levels are the foundational basis of the federal EPA guideline (EPA, 2016). From the egg/ovary tissue the other fish tissue (muscle and whole body) standards and water column standard were derived (EPA, 2016). The most influential step in selenium bioaccumulation in the food web is the uptake of dissolved selenium into particulate selenium at the base of the food web and this can be characterized as the Kd. This is operationally defined as the concentration of selenium in particulate material divided by the concentration in the water column (**Presser and Luoma, 2010; RR_001111**). As selenium is further transferred through the food chain, a variety of toxic effects can manifest with the most well-documented being reproductive teratogenesis and larval mortality of egg- laying vertebrates (**EPA, 2016; RR_000328**). While selenium is an essential nutrient, a narrow margin exists between the amount of selenium required by an organism and the amount that can cause toxicity with egg-laying vertebrates being more sensitive to selenium than mammals (**EPA, 2016; RR_000327-RR_00329)**. For Lake Koocanusa, larval survival of egg-laying vertebrates, specifically fish, were determined to be the most sensitive endpoint (**RR_000093**). Presser and Luoma (2010) describe some of the effects in fish being larva and fry survival and growth and deformity (**RR_002945**). EPA (2016) outlines a variety of lethal and sublethal deformities that can occur in developing fish exposed to selenium where those fish with deformities can die shortly after hatching or their overall fitness is reduced to a level whereby their rate of survival is less than normal young fish. EPA (2016) further states that the percentage of deformed adults observed during surveys will likely underestimate the underlying percentage of deformed young (**RR_000329**). Biologists with Fish Wildlife and Parks (FWP) have corroborated this for the Lake Koocanusa system, stating that selenium affects fish at the reproductive level which can be challenging to detect beyond sampling selenium concentrations in egg/ovary tissues and that as a result of the sampling methods used in routine FWP fish surveys adult fish are preferentially captured and they would not expect to see deformities in surviving adult fish in their sampling (**RR_002146**). At the center of many technical discussions in the process of standards setting for Lake Koocanusa was the topic of a lag time before effects are fully realized in fish tissues (**RR_004233**). EPA (2016) notes that in a system with new inputs, concentrations in fish tissue can take years to be detected at stable concentrations in a lentic system (**RR_000417**).

**Selenium Inputs and Scientific Approach**

Jenni et al. (2017) reports annual selenium loads entering Lake Koocanusa have increased from 2,600 kilograms (kg) in 1992 to over 13,000 kg in 2012, representing more than a fivefold increase over 20 years (**RR_002844**). Presser and Naftz (2020) show a continuing increase in selenium concentrations for decades recorded at Highway 93 on the Elk River, British Columbia, a tributary to Lake Koocanusa. The Canadian data presented in Presser and Naftz (2020) shows concentrations below 1 μg/L in 1985 with a steady increasing trend to over 8 μg/L by 2020 (**RR_001146**). Furthermore, Presser and Naftz (2020) show cross sectional areas of Lake Koocanusa with selenium concentrations greater than1 μg/L increasing from 2016-2019 (**RR_001170-001171**). The Lake Koocanusa Monitoring and Research Group and Selenium Technical Subcommittee that guided the department's work, was established, in part based on the increasing levels of selenium entering Lake Koocanusa.

In 2013 the British Columbia Minister of Environment issued a Ministerial Order (**RR_003994-RR_004002**) under the Environmental Management Act to remediate water quality effects of past mining activities and to guide environmental management of future mining activities in the Elk Valley, including the Canadian portion of Lake Koocanusa (**RR_000080**). The Order led to the Elk Valley Area Based Management Plan (ABMP) and established a Technical Advisory Committee (TAC) with agencies from Canada and the United States participating (**RR_000087**). That work taking place in Canada, eventually led to the formation of the bi-national Lake Koocanusa Monitoring and Research Working Group that

brought together Montana and British Columbia regulatory agencies and stakeholders. Jenni et al. (2017) describes the establishment of the Lake Koocanusa Monitoring and Research Working Group in 2015 by Montana DEQ and British Columbia Ministry of the Environment and Climate Change Strategy (BC-ENV) to address current and future water quality concerns in the Lake Koocanusa watershed and to work towards joint solutions for managing potential selenium contamination including the development of a site-specific selenium criteria for the protection of aquatic life and wildlife (**RR_002844**). The department co-led the Lake Koocanusa Monitoring and Research Working Group engaging a diverse group of stakeholders, first nation governments, federal agencies, and industry. A Selenium Technical Subcommittee was established comprising leading experts in the field of selenium toxicology from both the United States and Canada (**RR_005231**). Members of the Selenium Technical Subcommittee were identified and invited to participate. This made up a team of bi-national selenium experts, most with careers of over 20 years of expertise in selenium toxicity – collectively over 200 years of direct work with selenium. Member affiliations of the Selenium Technical Subcommittee include: state and provincial co-chairs, tribal and First Nations, federal agencies (EPA, U.S. Fish and Wildlife Service, U.S. Geological Survey), academia (University of Saskatchewan) and an Industry Consultant. The Selenium Technical Subcommittee undertook the following steps to guide the ultimate standards decision: identifying objectives, peer-reviewed conceptual model framework, supplemental targeted data collection by U.S. entities, BC-ENV, and Teck, a peer-reviewed Lake Koocanusa ecosystem model report and supplemental peer-reviewed data and model results, and recommendations on the standard based on the model results. The department worked over many years soliciting feedback from stakeholders and the collective knowledge of the selenium experts throughout the development of a site-specific selenium standard for Lake Koocanusa. (**RR_002109**).

The department followed federal guidance for developing a site-specific water column standard for Lake Koocanusa. The process followed is defined in EPA (2016) Appendix K: Translation of a Selenium Fish Tissue Criterion Element to a Site-Specific Water Column Value (**RR_001035-001078**). The water column component is translated from the fish tissue component utilizing the mechanistic Presser and Luoma (2010) bioaccumulation modeling approach and tailoring it to the Lake Koocanusa ecosystem (**RR_002514**). The department worked with the U.S. Geological Survey (USGS) to complete the modeling effort **(RR_002514; RR_000119-RR_000127)**. The outcome of that work was the peer-reviewed Presser and Naftz (2020) report which utilized the Presser and Luoma (2010) ecosystem model and calibrated it to the Lake Koocanusa ecosystem (**RR_002971-003017**). The final interpretative report was subject to the USGS rigorous scientific protocols for peer-review (**RR_002134**). The department worked with this scientifically peer-reviewed and published model, the associated peer-reviewed report and dataset, and peer-reviewed interactive spreadsheets including different modeling scenarios for the derivation of a site-specific water column standard for Lake Koocanusa (**RR_001175; RR_004062**).

The Presser and Naftz (2020) peer-reviewed report, dataset, and interactive spreadsheets with various modeling scenarios all provided the rationale and food web modeling structure for the quantitative derivation of a site-specific guideline for Lake Koocanusa (**RR_004062**). Model predictions from the peer-reviewed work for a range of protective dissolved selenium concentrations were specific to the EPA national guideline of 8.5 mg/kg whole body criterion element. Modeling assumptions used for modeled scenarios were guided by the goals defined by the Selenium Technical Subcommittee and are summarized here as:

- Consideration of ecologically significant species and those important to stakeholders,
- Protection of ecosystems during maximum dietary exposure (i.e., feeding within a benthic food web),

- Protection of 100% of the fish species in the reservoir assuming a reproductive endpoint from reproductively mature females that are feeding in an ecosystem that functions as a lentic reservoir, and
- Long-term protection for fish in all parts of the reservoir during all phases of reservoir operation, all Se loading profiles, and all water years (**Presser and Naftz 2020; RR_002980**

**Derivation of Site-Specific Water Column Standard**

The collective scientific expertise of the Selenium Technical Subcommittee guided the development of Lake Koocanusa's site-specific water column Se standard, from data collection to the final recommendations for ecosystem-scale modeling factors (**RR_000124**). Based on the Presser and Naftz (2020) modeling work, the recommendations by the Selenium Technical Subcommittee, Lake Koocanusa Working Group, and the professional judgement of DEQ staff, the final model selected by the department utilizes the EPA recommended whole body guideline of 8.5 mg/kg, the trophic fish model with a 100% aquatic insect diet, 60% bioavailability, and the Kd selected at the 75$^{th}$ percentile which results in a protective water column value of 0.8 µg/L (**RR_000127**). This model was one of the options put forward in the peer-reviewed interactive spreadsheets (Jenni and Schmidt, 2020) that accompanied the Presser and Naftz (2020) report. Specifically, this correlates with the "W6 TFM L3" model listed in Jenni and Schmidt (2020). This model was selected by the department to protect all fish including those piscivores (bull trout and burbot) that may be consuming prey fish with a 100% aquatic insect diet (**RR_004060; RR_004065**). For modeling, Presser and Naftz (2020) characterized the fish species in the reservoir with a 100% insectivore diet as rainbow trout, westslope cutthroat trout, redside shiner, and longnose sucker (**RR_001166**). The adopted 8.5 mg/kg dw fish tissue standard in ARM 17.30.632 is the same value that was used in modeling that led to the site-specific water column standard (**RR_002532**). The department then reviewed the full range of model results provided in the interactive and peer-reviewed spreadsheet and made a risk decision to select at the 75$^{th}$ percentile of the Kd distribution resulting in a protective dissolved selenium concentration of 0.8 µg/L (**RR_004065**). This level of protection meets the protection goals defined for Lake Koocanusa (**RR_002354**). The standards are consistent with the best available science for selenium toxicity and will protect the selenium-sensitive aquatic life in this watershed (**RR_000069**).

With water column concentrations currently near 1 µg/L, data available at the time of rulemaking showed there have been 9 individual fish found with concentrations greater than 15.1 mg/kg dw spanning three species. Moreover, the downstream Kootenai River in Idaho has been listed impaired due to selenium found at high levels in fish tissue. Water quality standards are set to protect the beneficial use (to prevent impacts) and to protect downstream uses (**RR_001538**).[1]

<u>75-5-203(2)(b) The state standard or requirement to be imposed can mitigate harm to the public health or environment and is achievable under current technology</u>

The water column selenium standard for Lake Koocanusa of 0.8 µg/L can mitigate harm to the environment and is achievable under current technology.

[1] Following rulemaking, the 2020 fish tissue data was made publicly available by Fish Wildlife and Parks and posted to the Lake Koocanusa Monitoring and Research Working Group wiki website. Fish egg/ovary data through 2020 show 17 individual fish spanning four species at levels at or above 15.1 mg/kg dw. EPA has indicated that levels at or above 15.1 mg/kg dw in egg/ovary tissue can have toxicological effects on the fish at the reproductive level.

As explained above, the water column selenium standard for Lake Koocanusa is necessary and can mitigate harm to aquatic life in Lake Koocanusa. The site-specific water column standard for Lake Koocanusa is achievable under current technology. EPA (2016) states that two main anthropogenic activities are known to cause increased mobilization of selenium into the aquatic environment. Those two activities include mining of metals, minerals and use of fossils fuels and irrigation of selenium rich-soils (**RR_000320**). The department found no public or private entities discharging to Lake Koocanusa with Montana Pollutant Discharge Elimination System (MPDES) permit effluent limits for selenium. There are no permitted sources of selenium in the Kootenai Watershed (**RR_001213**). This watershed does not have the same selenium rich geologic strata that are found in areas such as the Elk Valley, BC (**RR_001213; RR_002400; RR_002519**). Even if selenium was found in the watershed, this standard is site-specific and only applicable to permits discharging directly to Lake Koocanusa (**RR_002415**). There are no pending discharge permit applications nor has the department heard of any future permits for Lake Koocanusa. FWP's Murray Springs Fish Hatchery (MTG130001) is the only currently permitted facility discharging directly into Lake Koocanusa and selenium is not a pollutant of concern and that permit contains no effluent limits for selenium. There are no other general or individual permits authorizing discharges to or around Lake Koocanusa. The only hard rock permit near Lake Koocanusa is the McGilvary Rock quarry (OP#00167) which is inactive.

Current treatment technologies for activities around Lake Koocanusa include best management practices (BMPs) such as: measures that prevent storm water from coming into contact with pollutants; measures that minimize impervious surface area and retain runoff where it can be treated through infiltration; and measures that provide riparian buffers and reduce erosion to protect surface water from direct site runoff that may contain pollutants. Additionally, mines and industrial sites must document potential pollutants in a storm water pollution prevention plan (SWPPP) and provide adequate control measures to avoid impact to water quality. Existing and future land disturbing and industrial operations are already subject to storm water permitting requirements and BMPs to avoid impacts to surface water and no owner/operator/permittee should incur substantially different or increased treatment costs as a direct result of the site-specific water column standard for Lake Koocanusa. There is no evidence to suggest this site-specific standard will result in increased treatment costs for owners and operators of activities or facilities that discharge to surface water (**RR_002497**).

This standard is achievable under current technology. There are no current or planned point source dischargers to Lake Koocanusa with selenium as a pollutant of concern. Based on evidence in the record there is no significant geological source of selenium in Montana contributing to selenium concentrations in Lake Koocanusa and the two main anthropogenic activities that cause selenium mobilization to the aquatic environment (mining and irrigation of selenium-rich soil) do not occur on or around Lake Koocanusa. However, if there were a need for treatment in the future, this would be achieved through one of the current technologies listed by EPA which include reverse osmosis, iron reduction/precipitation, active biological treatment, aerobic wetlands, and/or biochemical reactors or anaerobic wetlands. It is more likely that any contribution of selenium related to or arising from land disturbing activities would be addressed through BMPs required under applicable General Permits such as the General Permit for stormwater discharges associated with construction activity (MTR100000), the Multi-Sector General Permit for storm water discharges associated with Industrial Activity (MTR000000), or the General Permit for Sand and Gravel Operations (MTG490000).

75-5-203(3) The written finding must reference pertinent, ascertainable, and peer-reviewed scientific studies contained in the record that forms the basis for the department's conclusion.

The department referenced the following pertinent, ascertainable, and peer-reviewed scientific studies contained in the record. Full citations are listed in the reference section:

- EPA (2016)
- Jenni et al. (2017)
- Presser and Luoma (2010)
- Presser and Naftz (2020) and accompanying peer-reviewed database and interactive spreadsheets by Jenni and Schmidt (2020)

EPA (2016) and Presser and Luoma (2010) address selenium toxicology. Jenni et al. (2017), Presser and Luoma (2010), Presser and Naftz (2020) address model development. Jenni et. al. (2017), Presser and Naftz (2020) and accompanying peer-reviewed database and interactive spreadsheets address model development specifically to the Lake Koocanusa ecosystem.

75-5-203(3) The written finding must also include information from the hearing record regarding the costs to the regulated community that are directly attributable to the proposed state standard or requirement.

The department has reviewed permits and activities on and around Lake Koocanusa and determined that this standard is achievable for Montana point source dischargers as there are no point source dischargers with selenium as a pollutant of concern. There is no cost to the regulated community directly attributed to the Lake Koocanusa selenium standard. The regulated community is within Montana because this is a site specific water column standard for Lake Koocanusa, Montana that only applies within Montana's borders. The only potentially affected dischargers are those discharging to Lake Koocanusa, Montana.

No Montana permittee will incur additional costs to treat wastewater for selenium as a direct result of the adoption of ARM 17.30.632(7)(a). Larger land development activities, such as surface mining and construction are already subject to general discharge permit requirements including implementation and maintenance of best management practices (BMPs). The department foresees no additional or different treatment requirements associated with these land disturbing activities directly attributable to the adoption of ARM 17.30.632(7)(a). Available treatment technology and economic cost of treatment can be further considered in future use attainability determinations and in variance development (**RR_002964**).

# 3.0 PUBLIC INVOLVEMENT

As part of the original rulemaking, MAPA provides for public review and comment of the proposed rule. That public comment period was held from October 9 to November 23 in 2020 with a public hearing held on November 5, 2020. During that time, commenters had an opportunity to provide comment on the rulemaking package, including the Board of Environmental Review's stringency determination. A subset of commenters did comment on that, and the board provided a response during the response to comment.

Public comment on the department's draft written stringency findings will be received between April 4 and May 4, 2022. A public hearing will be held on April 26, 2022. Public notice will be published in the local newspapers in Libby, Troy, and Eureka to promote local awareness and participation in the public comment period.

# 4.0 CONCLUSION

The rulemaking record provides sufficient evidence to support the 0.8 μg/L site-specific water column standard in ARM 17.30.632(7)(a) as necessary to protect the environment. The site-specific water column standard for Lake Koocanusa will not have a substantial economic impact on the regulated community. There will be no additional costs to the regulated community directly attributable to ARM 17.30.632(7)(a) and the standard is achievable under current technology. These findings will be made a part of the rulemaking record. These findings will be complete upon DEQ's response to substantive comments on ARM 17.30.632(7)(a) received from the public during the public comment period.

# 5.0 REFERENCES CITED

Jenni, K.E., Naftz, D.L., and Presser, T.S., 2017, Conceptual Modeling Framework to Support Development of Site-Specific Selenium Criteria for Lake Koocanusa, Montana, U.S.A., and British Columbia, Canada, U.S. Geological Survey Open-File Report 2017–1130, https://doi.org/10.3133/ofr20171130

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U.S. EPA, 2016, Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater-2016. PA 822-R16-006. U.S. Environmental Protection Agency, Office of Water, Washington D.C