SELENIUM STANDARDS
LAKE KOOCANUSA & KOOTENAI RIVER
2023 UPDATE

FAQ'S

WHAT IS SELENIUM?

Selenium (Se) is a naturally occurring element that is present in sedimentary rocks, shales, coal, and phosphate deposits and soils. Selenium is a micro nutrient, essential for biological processes to occur for humans and animals. Although selenium is essential micro nutrient, it can become toxic at concentrations just above what is nutritionally required.

WHAT IS THE EFFECT ON FISH?

The toxicological effects of selenium are most commonly observed at the reproductive level for fish. Some examples of this are reduced viable egg production and reduced growth or survival of fry. This can lead to eventual population declines.

WHAT IS A SITE-SPECIFIC STANDARD?

Site-specific water quality standards are derived using data from a specific waterbody or region. In this case, Lake Koocanusa. EPA acknowledges in their 2016 Se criteria that the way selenium bioaccumulates and moves up the food chain is dependent on site-specific conditions. Therefore, EPA provided guidance for the development of site-specific selenium standards which DEQ followed for Lake Koocanusa.

SELENIUM STANDARDS

In 2020, Montana adopted updated selenium standards for Lake Koocanusa and the Kootenai River in northwest Montana. The standards were developed in accordance with the 2016 EPA national criteria and are fish tissue based to account for dietary exposure of selenium.

Table 1. Selenium standards for Lake Koocanusa and the Kootenai River.

Selenium Standards	Lake Koocanusa	Kootenai River
Dissolved selenium (µg/L)	0.8	3.1
Egg/ovary (mg/kg dw)	15.1	15.1
Muscle (mg/kg dw)	11.3	11.3
Whole body (mg/kg dw)	8.5	8.5

A MULTI-YEAR LONG PROCESS

Six years of coordination with an engaged working group led to Montana's adoption of selenium standards for Lake Koocanusa codified in ARM 17.30.632.

2010	2012	2013	2014-2015	2016	2015-2020
MOUC - Flathead Valley Coordinated efforts began between BC & MT to address transboundary water quality	**Lake Koocanusa listed as threatened for selenium**	**BC Ministerial Order** Remediate water quality effects of past BC mining activities and guide environmental management of future mining activities in the Elk Valley, including Lake Koocanusa	**Lake Koocanusa Monitoring & Research Working Group (LKMRWG)** Bi-national working group established to address selenium Selenium Technical Subcommittee (SeTSC) was established and comprised of experts from across the US and Canada	**EPA updates national selenium criteria** Updated national criteria are fish tissue based to account for dietary exposure as the primary selenium pathway in aquatic systems	**MT & BC collaborative selenium standard and modeling development** • Conceptual Model Framework published (2017) • Targeted data collection (2015-2019) • SeTSC established protection goals for Lake Koocanusa (2019) • Ecosystem Scale Modeling complete (2020)

BI-NATIONAL COORDINATION

DEQ has maintained an innovative collaboration with the British Columbia Ministry of Environment & Climate Change Stragegy (BC-ENV) to address rising selenium levels in Lake Koocanusa. In 2015 the LKMRWG determined selenium to be the top priority and subsequently formed the Selenium Technical Subcommittee (SeTSC) to guide the selenium work. The SeTSC is comprised of leading experts in selenium from across the US and Canada.

Lake Koocanusa Monitoring & Research Working Group (LKMRWG)

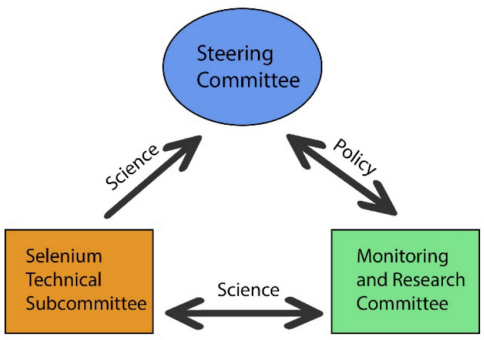


Figure 1. Structure of the Lake Koocanusa Monitoring and Research Working Group.

Steering Committee

DEQ & BC-ENV

Monitoring and Research Committee (MRC)

Co-chairs: DEQ & BC-ENV

Participants: US Federal Agencies (EPA, USACE, USGS, USFWS, USGS), US tribal nations (CSKT, KTOI), BC First Nations (KNC), MT FWP, IDFG, Teck Coal Ltd, environmental groups (US & BC), and Lincoln County elected officials

Selenium Technical Subcommittee (SeTSC)

Co-chairs: DEQ & BC-ENV

Participants: EPA, USFWS, USGS, University of Saskatchewan, Environmental Consulting (rep. Teck Coal Ltd.), US tribal governments, and BC First Nations

SELENIUM STANDARDS
LAKE KOOCANUSA & KOOTENAI RIVER
2023 UPDATE

FAQ'S

WHAT FISH ARE SENSITIVE?

White sturgeon, listed as an Endangered Species, is the known most sensitive species to selenium and is found in the Kootenai River. Rainbow and westslope cutthroat trout are among the species with greater sensitivity. Burbot, cyprinids, and sucker species have also been identified as vulnerable species to selenium in Lake Koocanusa.

WHAT MODEL WAS USED?

DEQ used the same selenium bioaccumulation model (Presser and Luoma (2010)) that EPA used for the development of the nationally recommended selenium criteria but included site-specific data. DEQ used the Presser and Naftz (2020) Lake Koocanusa modeling publication as a foundation for standard setting. Protection goals for Lake Koocanusa were defined by the SeTSC in 2019.

WHY 0.8 VS. 1.5?

The EPA nationally recommended criteria for lakes is 1.5 µg/L. The modeling results showed that 15% of conditions in Lake Koocanusa would be protected by a standard of 1.5 µg/L which is not protective of aquatic life. The 0.8 µg/L was developed following guidance by leading selenium experts and is protective of approximately 75% of conditions in the reservoir, which is considered protective of the aquatic life.

FISH TISSUE DATA

Since 2008, Fish Wildlife and Parks (FWP) and DEQ have been working collaboratively to collect fish tissue samples in Lake Koocanusa for selenium analysis. Egg/ovary tissue is the most indicative of toxicological effects of selenium. Montana adopted EPA's recommended egg/ovary recommended criteria of 15.1 mg/kg dry weight (dw).

At current water column concentrations at approximately 1 µg/L on average, some species have egg/ovary selenium concentrations above 15.1 mg/kg dw. Therefore, the water column concentrations must be lower to bring the fish tissue concentrations of all species below the standard.

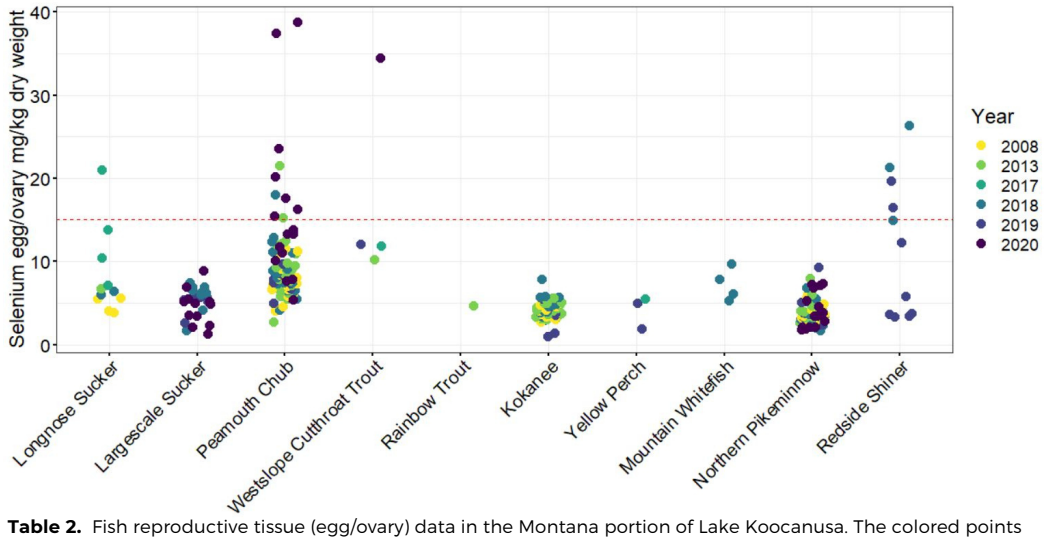


Table 2. Fish reproductive tissue (egg/ovary) data in the Montana portion of Lake Koocanusa. The colored points represent years (2008-2020). The horizontal line represents the MT standard and EPA recommended egg/ovary criteria of 15.1 mg/kg.

SELENIUM MODELING

DEQ partnered with the United States Geological Survey (USGS) to use the EPA recommended Presser and Luoma (2010) bioaccumulation model for developing a site-specific water column standard for Lake Koocanusa. Modeling conclusions were released as part of peer-reviewed work by Presser and Naftz (2020) including a report and data release. The report provided the foundation from which DEQ developed a protective water column standard in coordination with British Columbia selenium experts on the SeTSC.

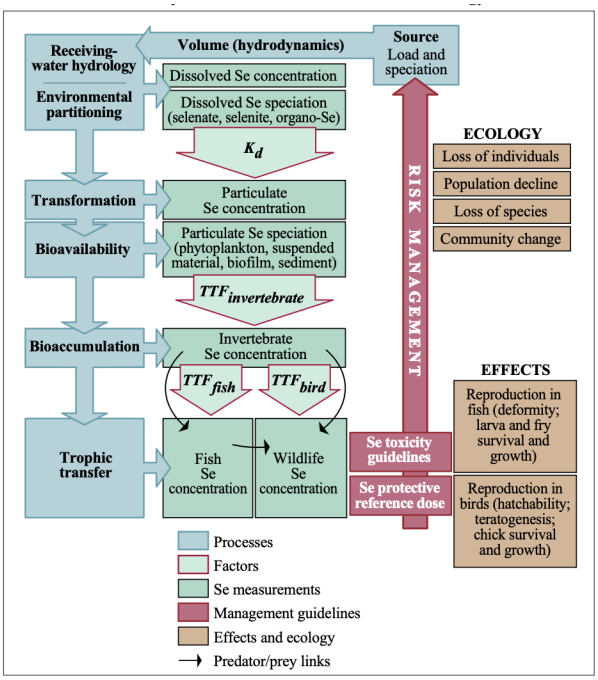


Figure 3. Conceptual illustration of the Selenium Ecosystem Scale Model (Presser and Luoma, 2010).

SELENIUM STANDARDS
LAKE KOOCANUSA & KOOTENAI RIVER
2023 UPDATE

SELENIUM SOURCE

The source of elevated selenium in Lake Koocanusa originates from the Elk Valley, British Columbia (BC). The selenium is leached from vast overburden piles, a by-product of historic and present day mining operations, into nearby surface and groundwater. Selenium concentrations have been recorded at a Canadian Federal long-term monitoring station located just upstream of the confluence of the Elk River and Kootenay River, BC. This monitoring station shows increasing levels of selenium over time (Figure 5).

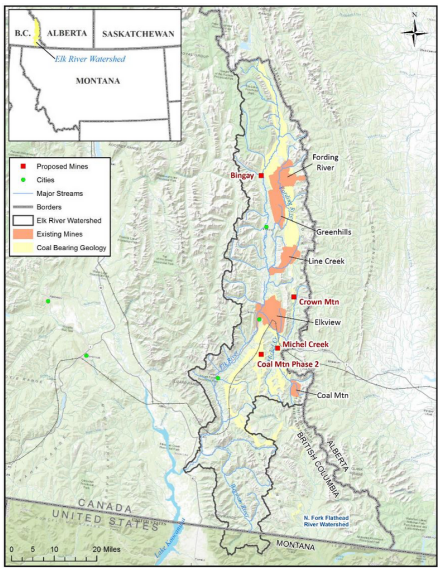
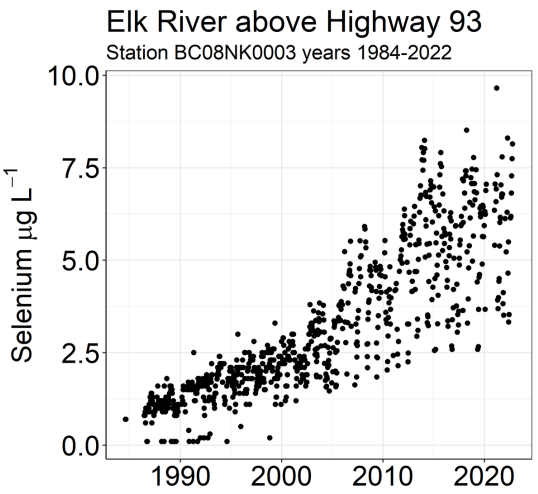


Figure 4. Lake Koocanusa and the Kootenai/Kootenay River Basin. Orange areas represent existing coal mine operations (USGS, 2017).



https://aquatic.pyr.ec.gc.ca/WQMSDOnlineNationalData2019/en/Home/Details/BC08NK0003

Figure 5. Data publicly available from a long term Canadian federal monitoring station for selenium water column concentrations on the Elk River (2 miles upstream of Lake Koocanusa) for years 1984-2022.

MacDonald (2009) calculated selenium loadings to Lake Koocanusa and concluded that approximately 95% of selenium loads come from the Elk River with minimal contributions from the Kootenay and Bull River.

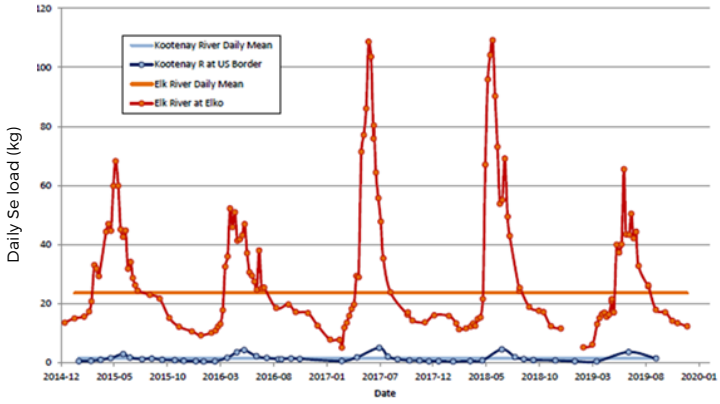


Figure 6. 2016-2019 calculated daily selenium loadings to Lake Koocanusa from the Kootenay and Elk Rivers. The red line represents Elk River and blue line represents Kootenay River. The values were calculated by BC-ENV and incorporate scaled flow values and include some uncertainty, therefore, are not direct measurements of load or water quality and quantity. Figure provided by BC-ENV.

LAKE KOOCANUSA WATER DATA

While selenium water quality data has been collected since the 1980s in BC (Figure 5) it has only been sampled in the Montana portion of Lake Koocanusa since 2013. Current water quality sampling is conducted in partnership with the U.S. Army Corps of Engineers (USACE) and the U.S. Geological Survey (USGS).

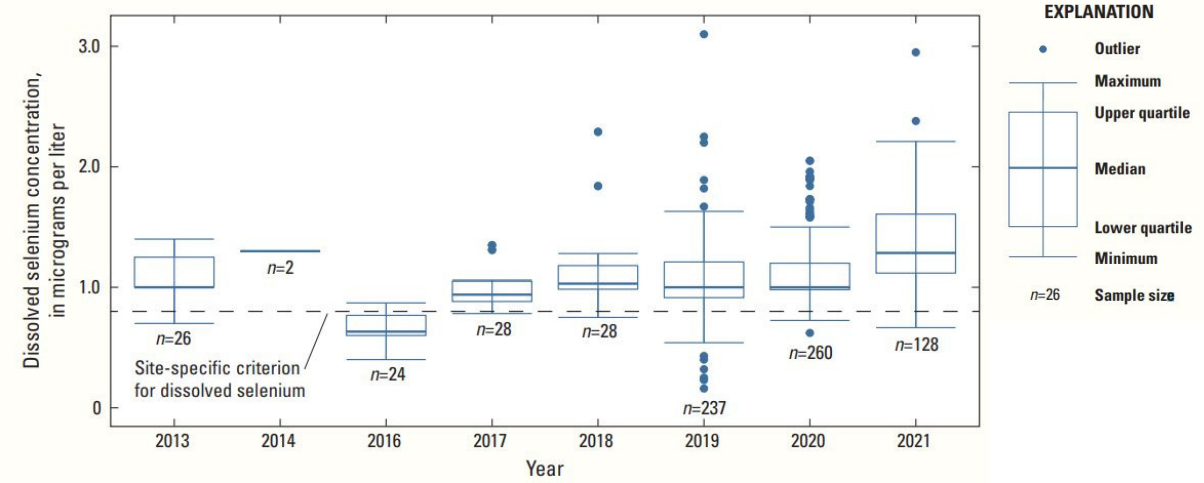


Figure 7. Dissolved selenium concentrations measured in Lake Koocanusa by the USGS, USACE, MTDEQ, and Teck Coal at sites around the international border from 2013-2021. Figure is from USGS (2022).

SELENIUM STANDARDS
LAKE KOOCANUSA & KOOTENAI RIVER
2023 UPDATE

A COLLABORATIVE PROCESS

Lake Koocanusa Monitoring and Research Working Group

A transparent collaborative effort with bi-national, multi-stakeholder input on selenium standard development since 2015.

Technical

A Selenium Technical Subcommittee comprised of leading selenium experts held over 30 meetings to coordinate on multi-year data collection, defining protection goals for Lake Koocanusa, discuss modeling decisions, and more. The final modeling was completed by the USGS. Multiple technical reports were completed including two peer-reviewed and published USGS reports, multiple data releases, a DEQ technical support document (DEQ, 2020), and a State of the Lake report and data compilation. All reports and data releases are publicly available.

Public Outreach

Extensive public outreach beginning in 2015 has included numerous public presentations and panels, access to technical meetings, fact sheets, and a public website housing data, meeting minutes, reports, sampling plans, and more.

Montana Administrative Procedures Act (MAPA)

Through development and adoption of the selenium water quality standards, DEQ met all MAPA requirements including consultation with the Water Pollution Control Advisory Council (WPCAC), the Board of Environmental Review (BER) procedures, public notices through the Montana Administrative Record (MAR) and newspapers, and a robust public comment period.

Legislative

Presentations, updates, and timelines were provided to the Environmental Quality Council (EQC), the Water Policy Interim Committee (WPIC), and the HJ 37 special committee comprised of WPIC and EQC legislators.

Next Steps

DEQ continues to collaborate with US and Canadian partners regarding selenium in Lake Koocanusa and the Kootenai River. Ongoing monitoring efforts are primarily carried out by USGS and MT FWP.

FOR MORE INFORMATION

DEQ Standards & Modeling

https://deq.mt.gov/water/Programs/sw

Public Wiki housing meeting minutes, presentations, data, reports, and more

http://lakekoocanusaconservation.pbworks.com/w/page/100633354/FrontPage

USGS Selenium Lake Koocanusa

https://www.usgs.gov/centers/wyoming-montana-water-science-center/science/describing-water-quality-lake-koocanusa

REFERENCES

McDonald, 2009, Survey of Selenium in Water, Zooplankton and Fish in Lake Koocanusa, British Columbia, prepared by Spirogyra Scientific Consulting for British Columbia Ministry of Environment on behalf of the Elk Valley Selenium Task Force, Cranbrook, British Columbia.

Montana Department of Environmental Quality. 2020. Derivation of a Site-Specific Water Column Selenium Standard for Lake Koocanusa, Montana. Helena, MT: Montana Dept. of Environmental Quality.

Presser, T.S., and Luoma, S.N., 2010, A methodology for ecosystem-scale modeling of selenium: Integrated Environmental Assessment and Management, v. 6, no. 4, p. 685–710.

USGS, 2017, Jenni, K.E., Naftz, D.L., and Presser, T.S., Conceptual Modeling Framework to Support Development of Site-Specific Selenium Criteria for Lake Koocanusa, Montana, U.S.A., and British Derivation of a Site-Specific Water Column Selenium Standard for Lake Koocanusa – Section 7.0 September 2020 FINAL 45 Columbia, Canada, U.S. Geological Survey Open-File Report 2017–1130, https://doi.org/10.3133/ofr20171130.

USGS, 2020, Presser, T.S., and Naftz, D.L. Understanding and documenting the scientific basis of selenium ecological protection in support of site-specific guidelines development for Lake Koocanusa, Montana, U.S.A., and British Columbia, Canada: U.S. Geological Survey Open-File Report 2020–1098, 40 p., https://doi.org/ 10.3133/ ofr20201098.

USGS, 2022, Selenium in the Kootenai River Basin, Montana dn Idaho, United States, and British Columbia, Canada: U.S. Geological Survey Fact Sheet 2022-3033, 4 p., https://doi.org/10.3133/fs20223033