The Technical Advisory Committee (TAC) for the Elk Valley Water Quality Plan (the "Plan") held their 2nd meeting on October 29-30, 2012. This document is a record of the technical advice that was received after this meeting.

The TAC process is structured around a review of work packages submitted to the TAC in advance of their meetings by Teck. These work packages relate to the analytical process that Teck is undertaking to inform decisions around the selection of water quality targets, management scenarios, and any additional monitoring and studies that will be included in the Plan. The advice in this table relates primarily to work packages that were reviewed and discussed at TAC Meeting #2.

The focus of TAC Meeting #2 was a review of Work Package #2a, which includes an overview of the approach being taken to assess potential ecological effects to aquatic ecosystems and species from a range of water quality concentrations for selenium, cadmium, sulphate and nitrate. Almost all of the technical advice recorded in this table is related to Work Package #2a. At the meeting, the TAC also briefly discussed and provided advice on Work Package # 7, which outlined Teck's approach for the protection of human health. Work Package #7 is scheduled to be presented and discussed at TAC Meeting 4 (planned for February 2014).

Summary Table

Category	#	Description of Post Mtg 2 "Technical Advice"	Rationale
Selenium Work Plan **Work Package 2a** *Methods for Ecological Effects Assessment*	**B2-1**	**Page 4, Top Paragraph:** It seems premature to rule out invertebrates as a potentially sensitive taxa in the ecological effects matrix. At a minimum, an explicit analysis of this pathway should be included in the ecological effects matrix and depending on the details of the toxicity testing (to be provided by Teck) where effects were observed, additional studies may be necessary. *For additional context refer to Brix letter (dated Nov 6, 2013)*	The recent study by Conley et al. (2013) suggests that some invertebrates (e.g., mayflies) are comparable in sensitivity to vertebrates. Some of the toxicity testing performed with mayflies also suggests they may be sensitive to Se at instream concentrations (see NO_3/SO_4 workplan).
	B2-2	Effects on burbot utilizing lentic habitats in Lake Koocanusa associated with exposure to selenium need to be evaluated as part of the overall ecological effects assessment for selenium. *For additional context refer to MacDonald letter (dated October 31, 2013)*	Burbot in Lake Koocanusa represent a key resource for KNC members and others. Therefore effects on this species needs to be evaluated.
	B2-2a	**Description of Related Alternate (or Additional) Advice:** Environment Canada feels this advice is pretty open-ended, but supports burbot as an important receptor to be monitored.	
Nitrate/Sulphate Work Plan **Work Package 2a** *Methods for*	**B2-3**	The potential for adverse effects on primary productivity in tributaries, Fording River, Elk River, and Lake Koocanusa associated with releases of nitrate from mine-related activities, in conjunction with releases of nutrients from mining and other sources, needs to be evaluated. Such an evaluation cannot be limited to the locations identified explicitly in the order for water quality target development. *For additional context refer to MacDonald letter (dated October 31, 2013)*	

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Ecological Effects Assessment	**B2-3a**	**Description of Related Alternate (or Additional) Advice:** • The Montana and U.S. Govt. are in agreement with this advice for Lake Koocanusa (e.g., Appendix A2-11). However we do not think the analysis should be constrained only to nitrate. Rather we recommend the following additional related constituents: inorganic phosphorus, ammonia, and ammonium.	Primary productivity is thought to be governed by Liebig's law of the minimum, i.e., the resource in shortest supply will limit its potential. In this regard nitrate, ammonia/ammonium, and inorganic phosphorus should be all considered concomitantly with respect to increasing the primary productivity of Lake Koocanusa.
	B2-4	The evaluation of the ecological effects of nitrate and sulfate under current conditions must consider maximum exposures as well as average exposures to these substances. In conducting such assessments, it is important to recognize that the results of monthly water sampling represent the average concentration of the chemical of potential concern (COPC) for that month. Average COPC concentrations must be determined based on the results of five water samples collected within a 30-d period *For additional context refer to MacDonald letter (dated October 31, 2013)*	
Cadmium Work Plan **Work Package 2a** *Methods for Ecological Effects Assessment –*	**B2-5**	**Page 11, 2nd Paragraph** Teck should consider using test organisms/methods that are sensitive to contaminant concentrations near the WQG in their testing program. *For additional context refer to Brix letter (dated Nov 6, 2013)*	Given the site waters will be a mixture of contaminants it is not clear how any observed toxicity can be associated with Cd. Additionally, 3 of the 4 taxa to be used in testing for the NO_3/SO_4 program are not particularly sensitive to Cd, especially using the short-term chronic tests described in the workplan. Even for Hyalella, the 14-d test design described in the workplan is unlikely to be as sensitive as the 42-d test design that generated the toxicity data that is currently driving the Cd WQG.
	B2-6	It is critical that Teck properly validate the Cd BLM developed for this site. To do this, Teck will need to conduct experiments in which site waters with varying water chemistry (reflecting both spatial and temporal variability) are spiked with concentrations of Cd and toxicity testing is performed with a sensitive organism/endpoint. I would avoid the 7-d test with Ceriodaphnia test for this validation as the YCT food (a source of DOC with low binding affinity) will confound results (this is likely why C. dubia are apparently relatively insensitive to Cd). Instead, I recommend either a 14 or 28-d Hyalella test (preferable) or the 21-d test with Daphnia magna for this validation study. The critical issue in test organism/endpoint selection is that it is comparable in sensitivity to the Cd WQG	I understand that previous efforts to develop chronic BLMs from existing acute BLMs have generally relied on adjusting LA_{50}s (i.e., effectively extrapolating to an $LA_{10/20}$) rather than log K's for metals. Conceptually of course this makes sense and an increase in intrinsic sensitivity is highly likely to explain some of the differences between acute and chronic toxicity. However, there is increasing evidence that multiple transport proteins are involved in metal uptake with different transporters dominant over the range of concentrations involved in acute toxicity versus chronic

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		and therefore critically evaluating whether the BLM can predict how transport proteins involved in Cd uptake at these concentrations are interacting with the environment. *For additional context refer to Brix letter (dated Nov 6, 2013)*	toxicity (i.e., low versus high affinity transporters). This is certainly the case for Zn (Hogstrand et al. 1998, Qui et al. 2005), and Cd is often considered a Zn analog. Hence the conditional log K's derived by Playle et al. (Playle and Dixon 1993, Playle et al. 1993) based on exposures with 6 $\mu g\ l^{-1}$ Cd, are not necessarily relevant to organisms exposed to Cd concentrations an order of magnitude lower, near the WQG. Of course, differences in the log K_{gill}-Cd will influence how the BLM predicts interactions with other water quality parameters and hence is important to understand. This issue highlights the need for some sort of field validation program to test the reliability of the chronic Cd BLM.
	B2-7	The potential for adverse effects on aquatic organisms in tributaries, Fording River, Elk River, and Lake Koocanusa associated with releases of cadmium from mine-related activities must be evaluated. Such an evaluation cannot be limited to the locations identified explicitly in the order for water quality target development. *For additional context refer to MacDonald letter (dated October 31, 2013)*	
	B2-7a	**Description of Related Alternate (or Additional) Advice:** • The U.S. and MT Govt. generally support this comment but recommend additional monitoring of cadmium in Lake Koocanusa be completed before determining whether a comprehensive effects analysis (i.e., like the one described for selenium in A2-4) is required.	Insufficient data currently exist to assess cadmium levels in Lake Koocanusa. Since it is a pollutant of concern, continued monitoring is needed within the designated area (including the reservoir) to form a more robust understanding of its importance.
Work Package 2a *Methods for Ecological Effects Assessment* – **Overall Approach**	**B2-8**	Recommend that a cumulative effects assessment consider a broader list of COPCs in order to better understand the potential effects on all water uses from point and non-point sources. *For additional context refer to MacDonald letter (dated October 31, 2013)*	There are numerous point and non-point sources of COPC in the Elk River Watershed. Releases of COPCs from these sources can result in impairment of water quality conditions in receiving waters. Because mixtures of COPCs can cause additive or greater effects on aquatic organisms, it is necessary to consider a broader range of COPCs in the cumulative effects assessment.
Protection of	**B2-9**	Potential effects on human health associated with exposure to selenium from dietary sources needs to be evaluated. This evaluation should rely	

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Human Health **Work Package 7**		primarily on measured (rather than modeled) tissue selenium data and should identify uncertainties in the analysis associated with data gaps and other factors. The results of the LCOII human health risk assessment should be used as a primary basis for this work. *For additional context refer to MacDonald letter (dated October 31, 2013)*	

References (if provided)

Brix, K. V., J. S. Volosin, W. J. Adams, R. J. Reash, R. G. Carlton and D. O. McIntyre (2001). "Effects of sulfate on the acute toxicity of selenate to freshwater organisms." Environ. Toxicol. Chem. **20**(5): 1037-1045.

Brix. 2013. Letter to Michael Harstone (*TAC Facilitator of Compass Resource Management*) from Kevin Brix (dated November 6, 2013). *Independent scientist on the TAC (from University of British Columbia)*.

Conley, J. M., D. H. Funk, D. H. Hesterberg, L. C. Hsu, J. Kan, Y. T. Liu and D. B. Buchwalter (2013). "Bioconcentration and biotransformation of selenite versus selenate exposed periphyton and subsequent toxicity to the mayfly *Centroptilum triangulifer*." Environ. Sci. Tech. **47**: 7965-7973.

Hogstrand, C., N. Webb and C. M. Wood (1998). "Covariation in regulation of affinity for branchial zinc and calcium uptake in freshwater rainbow trout." J. Exp. Biol. **201**: 1809-1815.

MacDonald, D. 2013. Letter to Lynn Kriwoken (*TAC Chair from MOE*) from Donald MacDonald (dated October 31, 2013). MacDonald Environmental Services Ltd (MESL). *Representative on the TAC for Ktunaxa Nation Council.*

Misra, S., D. Peak and S. Niyogi (2010). "Application of XANES spectroscopy in understanding the metabolism of selenium in isolated rainbow trout hepatocytes: insights into selenium toxicity." Metallomics **2**: 710-717.

Playle, R. C. and D. G. Dixon (1993). "Copper and cadmium binding to fish gills: modification by dissolved organic carbon and synthetic ligands." Can. J. Fish. Aquat. Sci. **50**: 2667-2677.

Playle, R. C., D. G. Dixon and K. Burnison (1993). "Copper and cadmium binding to fish gills: estimates of metal-gill stability constants and modelling of metal accumulation." Can. J. Fish. Aquat. Sci. **50**: 2678-2687.

Qui, A., M. Shayeghi and C. Hogstrand (2005). "Molecular cloning and functional characterization of a high-affinity zinc importer (*Dr*ZIP1) from zebrafish (*Danio rerio*)." Biochem. J. **388**: 745-754.

Wood, C. M. and M. Grosell (2008). "A critical analysis of transepithelial potential in intact killifish (*Fundulus heteroclitus*) subjected to acute and chronic changes in salinity." J. Comp. Physiol. B **178**: 713-727.