The Technical Advisory Committee (TAC) for the Elk Valley Water Quality Plan (the "Plan") held their 5th meeting on April 2-4, 2014. This document is a record of the technical advice received at this meeting, and is Appendix A to the Meeting Notes.

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 #5.

Summary Table

Category	#	Description of "Technical Advice" from Mtg	Rationale
Monitoring	**A5-1**	For the purposes of comparing current conditions to BC Water Quality Guidelines, undertake more frequent sampling (5 samples per 30 days rather than monthly sampling) until it can demonstrated that it is not required during the critical period (ascending & descending of the high concentration periods).	This is consistent with the averaging period recommended in the BC water quality guidelines protocol.
	A5-1b	**Description of Related Alternate (or Addn) Advice:** A robust analysis should be carried out to understand when and where the critical period exists in the reservoir, recognizing it may occur at different times than in the Elk River peak (potentially), and perhaps at different spatial locations in the reservoir depending on the pool elevation and associated operation. Additionally, the procedure for how the 5 samples in 30 days are to be evaluated should be better clarified (i.e., when, where, and how) by MOE. In particular, it should be noted what constitutes exceedence of a guideline, whether spatial averaging can be employed so that the guideline (or target) can be exceeded at one location in the reservoir but not in another, and whether any margin of safety will be incorporated reflecting the typical inter-annual variance of observed water-quality data within the reservoir.	The monitoring design should reflect an appropriate interpretation of the 5 in 30 guidance by MOE. For example, a number of strategies could be employed to evaluate compliance. A liberal approach would be to allow the full mixing and dilution of the Kootenay River (i.e., spatial averaging) such that guideline would be exceeded in the Elk Arm but not after full mixing. A conservative approach might argue all points in the reservoir should remain below the guideline or proposed water quality target. Such details require adequate definition up-front as it could have great implications on the target-setting activities throughout the rest of the Elk River watershed.
Lake Koocanusa	**A5-2**	When presenting the trace element data collected from bottom sediments in Lake Koocanusa, the size fraction of the particles should be presented. For example, sample meta data should specify if the sediment sample represents a non-sieved sample or a sample that excluded all particles larger than 80 micrometers. This distinction should be made when comparing trace element sediment data in both tablar and graphic formats.	In many situations, particle size can have a large impact on trace element concentration. Smaller particle size fractions can have a larger trace element concentration on a mass per mass basis compared with larger sized particles.
Lake Koocanusa	**A5-3**	When sampling in Lake Koocanusa, assess (or note) receiving water conditions (i.e. river vs. lake) when samples are collected at the stations above the confluence of the Elk River. This could be done as simplistically as noting flow velocity (or lack thereof), or as sophisticated as measuring the velocity profile with an ADCP.	In order to provide context for the reservoir monitoring, it is important to understand conditions under which a sample was collected. Some sites may transition between those that are riverine and lentic, and may not be entirely useful analysis of trends and interpretation of data. In this regard,

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			an ideal compliance point would be a location that was always lentic, is fully mixed (laterally and vertically), and is absent of "transitional" effects.
Lake Koocanusa	**A5-4**	Develop a conceptual site model (CSM) for Lake Koocanusa that describes the sources and releases of COPCs, the other stressors in the lake, the environmental transport and fate of COPCs, the ecological and human health effects of COPCs, the potentially-complete exposure pathways, and the ecological receptors and human populations potentially at risk due to exposure to COPCs. Utilize the CSM to identify assessment endpoints for Lake Koocanusa (e.g., survival, growth, and reproduction of benthic fish species), to develop effects hypotheses (i.e., how are the effects on ecological receptors or human health associated with exposure to COPCs likely to be expressed), and to select the measurement endpoints that will provide the most relevant information on the status of the assessment endpoints. The effects hypotheses should include hypotheses regarding the effects of individual COPCs, the effects of COPC mixtures, and the effects of multiple stressors (i.e., interactive and cumulative effects hypotheses; e.g., COPCs, water level alterations, etc.).	A CSM provides a basis for describing the scope of the study area, identifying physical and chemical stressors, evaluating the transport and fate of COPCs, evaluating the effects of the various COPCs and COPC mixtures, identifying potentially complete exposure pathways, identifying ecological receptors, and developing effects hypotheses that link the stressors and receptors. In turn, the CSM supports identification of the measurement endpoints that are most appropriate for evaluating effects on each ecological receptor group. This information will provide the reader with a basis for evaluating the adequacy of the data and information that are assembled to evaluate effects in the lake, now and in the future. The CSM must consider such stressors as flow regulations, reservoir drawdown, COPC concentrations, suspended sediments, deposited sediments, and others.
Lake Koocanusa	**A5-5**	Consider conducting laboratory bioaccumulation tests for benthic invertebrates to augment or replace the field collected data.	Information on the levels of selenium (and other bioaccumulative chemicals of potential concern [COPCs] e.g., Hg) in benthic invertebrates from Lake Koocanusa is required to evaluate the bioavailability of selenium that is released to the lake and to confirm water/sediment bioaccumulation factors (BAFs) calculated using data from elsewhere in the watershed. See also Appendix B Item #B5-4
Human Health	**A5-6**	Develop a conceptual model to assess potential risk to groundwater (i.e., look at the source, fate and transport of constituents of concern). Use the model to identify the areas where an investigation of the hydraulic connectivity between surface and groundwater is needed to understand potential threats to groundwater and respond accordingly to achieve the overall goal of protecting groundwater (as included in the Order. Specific recommendations related to a detailed groundwater assessment include:	The Order includes a goal of protecting groundwater and human health. The proposed approach to date has included monitoring of wells, however, a more comprehensive assessment is needed to identify and understand the movement of groundwater, the potential for contamination and to develop the appropriate response measures to achieve the goal of protecting drinking water sources.

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		• Recommend adding the assumed fate for contaminants beyond when they have reached the water table. Also consider adding health consequences and toxicity to humans as a result of drinking contaminated groundwater. • Recommend using a case study of potential contamination, using the toxicity and numerical groundwater modelling, to assess the movement and fate of chemical constituents. Consider adding a scenario of a vulnerable aquifer in a community that uses that aquifer as their municipal water supply source and relating effects to long-term human toxicity • Recommend to reference the publicly available data that were used to assess baseline groundwater quality and groundwater quantity information. • Recommend to describe the limitations of these datasets (e.g, the WELLS database is incomplete due to the voluntary nature of well log submission, thus, there are most definitely additional existing wells). • The assessment of water quality data should be focused on baseline water quality of vulnerable aquifers with high consequence wells (i.e., municipal supply wells). • Recommend to highlight the locations of all known community drinking water supply wells on the Hydrogeology map sheets comparing risks and consequences (i.e., community drinking water supply wells vs. a well serving a single dwelling) • Recommend to show locations of mapped/delineated well capture zones/time of travel estimates on the Hydrogeology maps • Recommend installing monitoring wells up-gradient of community drinking water supply wells, and other high consequence receptors (i.e., wetlands, fish-bearing receiving waters)	The conceptual groundwater model should support these goals through improved understanding of groundwater migration pathways between potential pollutant sources and the receiving waters, and the surface water and groundwater interactions. The basis and data sources for conceptual model development should be documented and described, including discussion of key limitations and data gaps. Interpretation of groundwater monitoring results and the development of future monitoring plans should be conducted within the framework of the conceptual groundwater model. This advice is supported by the Interior Health Authority (IHA).
Human Health	**A5-7**	While preliminary screening assessment of wells is a good first step, there is a need to assess the sources, fate and transport of constituents of concern in order to achieve the long term goal of protecting groundwater. This information will inform monitoring needs and identify additional next steps in the assessment.	To protect the long term use of drinking water sources in the area, the source, fate, and transport of constituents of concern that are now being found in wells in Sparwood for example, needs to be determined. This is related to #A-7, the interaction between surface and groundwater needs to be assessed in order to protect drinking water sources.

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			The conceptual groundwater model should be used to help design monitoring plans that can assess and verify migration pathways and pollutant sources. This advice is supported by the Interior Health Authority (IHA).
Human Health – Baseline Evaluation	**A5-8**	Explicitly identify data gaps and data quality issues in the results of the baseline assessment and the potential effects assessment. Clearly describe how data quality issues have been addressed and how censored data have been treated in the analyses.	The information needed to conduct a comprehensive (i.e., valley-wide) assessment of effects on human health associated with exposure to COPCs is likely not available. For this reason, it is important to fully identify data requirements and identify gaps in the existing data set. This will facilitate the evaluation of uncertainty in the assessment and help to focus subsequent data collection efforts. In addition, it is important to describe how data quality issues have been addressed in the uncertainty section. Finally, treatment of censored data has the potential to influence the results of the assessment. Therefore, it is essential to fully describe all of the underlying assumptions and treatment methods related to censored data.
Human Health	**A5-9**	Develop a CSM that describes the sources and releases of COPCs, identifies the COPCs that are relevant for assessing effects on human health (i.e., based on the results of the baseline assessment), the environmental transport and fate of COPCs, the potential effects of COPCs on human health, the potentially-complete exposure pathways, and the human populations potentially at risk due to exposure to COPCs. Utilize the CSM to identify assessment endpoints for human health, to develop effects hypotheses (i.e., how are the effects on human health associated with exposure to COPCs likely to be expressed), and to select the measurement endpoints that will provide the most relevant information on the status of the assessment endpoints. The effects hypotheses should include hypotheses regarding the effects of individual COPCs and the effects of COPC mixtures (as relevant for human health assessment).	A CSM provides a basis for describing the scope of the study area, identifying physical and chemical stressors, evaluating the transport and fate of COPCs, evaluating the effects of the various COPCs and COPC mixtures, identifying potentially complete exposure pathways, identifying human populations potentially at risk, and developing effects hypotheses that link the stressors and human populations. In turn, the CSM supports identification of the measurement endpoints that are most appropriate for evaluating effects on human health. This information will provide the reader with a basis for evaluating the adequacy of the data and information that are assembled to evaluate effects on human health, now and in the future.
Human Health –	**A5-10**	For the human health effects assessment, consider an adult and child consumer with high exposure levels to the constituents of potential concern.	

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Effects Assessment			
Human Health – Effects Assessment	**A5-11**	For the human health effects assessment, when assessing the exposure to constituents of potential concern, especially selenium, consider the background levels of intake in relevant to the Elk Valley (as opposed to just the average Canadian or BC background intake levels).	The background levels of Se in human populations can vary depending primarily on where their food is grown. For example, local sources of food may have higher levels of Se in food than those coming from other geographic locations. IHA has recommended that this be considered.
Human Health – Baseline Evaluation	**A5-12**	Contaminants should not be screened out based on comparisons to reference site concentrations. The contaminants should only be screened out from the screening level assessment if there is no evidence that human health guidelines are near limits or are exceeded. However, a different criterion applies for screening contaminants out of monitoring programs. In this case, contaminants should remain as a contaminant of concern if any of the following apply: • the contaminant is being released from the mining operations, • Observed values are within 20% of guideline, • Observed values exceed a guideline, • There is evidence that the amount in the environment is increasing.	The information about contaminant loading, fate and transport in the Elk Valley is not fully understood. Therefore, contaminants need to be continually monitored to better understand these processes and the impacts of contaminants on source water. This advice is supported by the Interior Health Authority (IHA).
Human Health	**A5-13**	Consider the inclusion of an inhalation pathway for human health associated with particulate (dust) when Lake Koocanusa is drawn down.	Stakeholders in and around Lake Koocanusa have asked the Department to provide insight regarding potential health risks to humans with respect to dust inhalation. Lake Koocanusa shoreline, and presumably some proportion of sediment, contributes to frequent dust issues. As such, an inhalation pathway is present and should be addressed.
Human Health – Baseline Evaluation	**A5-14**	Include fish in the Upper Fording River in the baseline evaluation (in the event that the fishery would be re-opened at some future point).	
Human Health	**A5-15**	Depending on the timeline to stabilize some constituents in the Plan, may need to re-evaluate some constituents based on trending information where concentration levels are approaching a guideline/benchmark value.	(Same rationale as A-12): The information about contaminant loading, fate and transport in the Elk Valley is not fully understood. Therefore, contaminants need to be continually monitored to better understand these processes and the impacts of contaminants on source water.

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Human Health	**A5-16**	Continue the evaluation of risks to human health annually during implementation of the Plan.	
Human Health – Baseline Evaluation	**A5-17**	Include summary statistics for baseline data review to evaluate if the three-year period is adequately capturing historical maxima.	
Human Health – Baseline Evaluation	**A5-18**	Use the same time period for the ecological and human health baseline data reviews.	HH WG Recommendation
Human Health – Baseline Evaluation	**A5-19**	For the human health baseline review, document the hierarchy of guidelines and specific data that is used.	HH WG Recommendation
Human Health – Baseline Evaluation	**A5-20**	For the baseline review of fish, consider that water quality concentrations of some substances have been increasing every year (e.g. at some locations, selenium water quality concentration is increasing by 8%/year). This would mean that fish samples from early in the 2011-2013 period were exposed to lower selenium water quality concentrations over their lifetime than current water quality concentrations.	HH WG Recommendation
Human Health	**A5-21**	Consider whether background levels for selenium in the Alberta population are more appropriate than BC background levels.	HH WG Recommendation
Human Health	**A5-22**	Document all assumptions for exposure pathways and exposure values.	HH WG Recommendation
Human Health – Effects Assessment	**A5-23**	For pathways, consider: – irrigation with surface water pathway; – dietary sources specific to the Elk Valley; – consumption of surface water and associated sediment that may get stirred up while swimming; – pathways of specific relevance to First Nations: o consumption of large mammals (e.g. elk, deer, moose) o consumption of non-game fish (as well as game fish)\ o foods harvested from riparian zone.	HH WG Recommendation
Human Health –	**A5-24**	Use the cancer risk of $1x10^{-6}$ vs. $1x10^{-5}$. Both the Interior Health Authority and the Ministry of Health use a cancer risk of $1x10^{-6}$	HHWG Recommendation.

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Effects Assessment			
Human Health – Effects Assessment	**A5-25**	Where appropriate, consider the daily food intake of First Nations adults and children separately from the daily intake of the average population.	HH WG Recommendation
Human Health – Effects Assessment	**A5-26**	As the results come in for the human health assessment, consider how these results may affect water quality target derivations and provide this information to the working group and the TAC.	HH WG Recommendation
Human Health – Effects Assessment	**A5-27**	Document the data gaps in the human health assessment and explain if and how these will be addressed through the monitoring program currently being implemented by Teck.	Data collected through Teck's aquatic effects monitoring program and groundwater monitoring program can potentially inform human health assessment if appropriate protocols are used. See: • British Columbia Ministry of Environment. 2012b. Water and air baseline monitoring guidance document for mine proponents and operators. Victoria, BC (CA): • Ministry of Environment. 194p. Accessed on-line at http://www.env.gov.bc.ca/wat/wq/wq_procedure.html, and • Health Canada. 2004. Canadian handbook on health impact assessment: Volume 3: The multidisciplinary team. Ottawa, ON (CA): • Health Canada, Minister of Health, Chapter 8, Food Issues in Environmental Impact Assessment. 32p.
Monitoring	**A5-28**	Develop a CSM for the entire study area that describes the sources and releases of COPCs, the other stressors in the ecosystem, the environmental transport and fate of COPCs, the ecological effects of COPCs, the potentially-complete exposure pathways, and the ecological receptors potentially at risk due to exposure to COPCs.	A CSM provides a basis for describing the scope of the study area, identifying physical and chemical stressors, evaluating the transport and fate of COPCs, evaluating the effects of the various COPCs and COPC mixtures, identifying potentially complete exposure pathways, identifying ecological receptors, and developing effects hypotheses that link the stressors and receptors.

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Monitoring	**A5-29**	In the Synthesis Report for the State of the Aquatic Environment, identify where the information collected and the analyses conducted support or don't support the bioaccumulation modelling results, the associated benchmarks, and the conclusions on the population level effects. The report should also indicate where additional monitoring is needed to help verify the assumptions informing the derivation of targets for the constituents of concern.	Proposed benchmarks for substances of concern (specifically selenium) have a number of uncertainties associated with their derivation. For example, the Level 1 benchmark for Westslope Cutthroat Trout will have a level of effect associated with it. How confident can we be that the predictions are correct and how can the monitoring data help verify the modelling predictions (i.e., help validate modelling)? Linkages between the predictions and actual results should be made where applicable.
Monitoring - Selenium	**A5-30**	For the Spotted Sandpiper 2013 Monitoring Study, do a power analysis for the purposes of evaluating whether the data refutes the selenium toxicity threshold in Harding et al. (2007).	none provided
Selenium *Ecological Effects Assessment*	**A5-31**	Develop a two-step model (water to benthos | benthos to fish) and compare against one step and multi-step models	TOX WG Recommendation 2-1 (completed)
Selenium *Ecological Effects Assessment*	**A5-32**	Code periphyton data points by seasonality and by location (e.g. tributary and mainstem) and show on plots	TOX WG Recommendation 2-2 (completed)
Selenium *Ecological Effects Assessment*	**A5-33**	Recommend a combined lentic – lotic periphyton model, if stats bear it out (e.g. diagnostic plots, r2, std error, slopes intercepts, analysis of covariance)	TOX WG Recommendation 2-3 (completed)
Selenium *Ecological Effects Assessment*	**A5-34**	Recommend piecewise model for the water – periphyton model.	TOX WG Recommendation 2-4 (completed)
Selenium *Ecological Effects Assessment*	**A5-35**	Recommend dropping the following periphyton outlier datapoints for the bioaccumulation models: a) 4 high datapoints *(Fording River oxbow, Clode pond, Goddard Marsh were considered distinctly lentic and a different mgt issue, also different sampling used)* b) 4 lower periphyton points at higher Se water levels	TOX WG Recommendation 2-5 (completed)

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		(confounding factors from calcite and bryiophytes were believed to have under predicted actual selenium concentrations)	
Selenium *Ecological Effects Assessment*	**A5-36**	Recommend a piecewise model for the invertebrate – amphibian model and excluding the low invertebrate outlier datapoints associated with Se < 2mg/kg, which were considered unrealistically low.	TOX WG Recommendation 2-6 (completed)
Selenium *Ecological Effects Assessment*	**A5-37**	Recommend to not carry forward with an invertebrate – amphibian bio-accumulation model, at this time, given limited toxicity data, and feeding uncertainty.	TOX WG Recommendation 3-1 (agreed to)
Selenium *Ecological Effects Assessment*	**A5-38**	Recommend not differentiating WCT size effects into the bio-accumulation model, given low expected significance of effect and uncertainty with the unbalanced datasets.	TOX WG Recommendation 3-2 (agreed to)
Selenium *Ecological Effects Assessment*	**A5-39**	Recommend a sensitivity analysis be carried out for the RWBL – Invertebrate model using the 2005 Harding bird egg samples (using different moisture contents).	TOX WG Recommendation 3-3 (completed)
Selenium *Ecological Effects Assessment*	**A5-40**	Recommend a one-step model using bird egg concentrations (sandpiper) vs. Se Aq be developed to review and better understand potential effects.	TOX WG Recommendation 3-4 (agreed to)
Selenium *Ecological Effects Assessment*	**A5-41**	Recommend using the full dose-response relationship for the most sensitive taxa (C. dubia) to evaluate effects in a manner analogous to using the dose response for Brown Trout in the selenium effects assessment.	TOX WG Recommendation 3-5 (agreed to)
Cadmium *Ecological Effects Assessment*	**A5-42**	For toxicity studies used to calculate the geometric means, recommend a sensitivity test for the binning of D. magna studies	TOX WG Recommendation 2-8 (completed)
Nitrate *Ecological Effects Assessment*	**A5-43**	Test whether there is any evidence that the pooled slope hardness relationship asymptotes after 180 mg/L $CaCO_3$.	TOX WG Recommendation 2-9 (completed)

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Nitrate *Ecological Effects Assessment*	**A5-44**	For amphibians, undertake a sensitivity assessment whether hardness normalization makes a difference for nitrate effects or not	TOX WG Recommendation 2-10 (completed)
Nitrate *Ecological Effects Assessment*	**A5-45**	For nitrate, in conducting the hardness adjustment of toxicity data from the literature, perform an analysis using the following methods: (1) for toxicity data collected at a test hardness of greater than 182 mg/L $CaCO_3$, instead of assuming a flat relationship at increased hardness, use the combined (pooled) slope estimate for fish/invertebrates to adjust the effect benchmark to a site-relevant value; and (2) rather than adjust to background hardness of 160 mg/L $CaCO_3$, calculate adjusted values for a range of hardness conditions representative of the reaches in the Fording River and Elk River. Determine whether this analysis would influence the selection of an ecologically protective value for each reach.	TOX WG Recommendation 3-6 (completed)
Nitrate *Ecological Effects Assessment*	**A5-46**	Recommend leaving off plants/algae in the SSD for nitrate, since they are not a sensitive taxa and will likely affect the lower end of the distribution.	TOX WG Recommendation 2-11 (completed)
Sulphate & Nitrate *Ecological Effects Matrices*	**A5-47**	Recommend the evaluation of using both Level 1 and Level 2 (toxicity thresholds) for the most sensitive species to define protective values to understand the implications on the effects assessment	TOX WG Recommendation 3-7 (completed)
Management Scenarios	**A5-48**	Recommend consideration of partial covers and a deeper evaluation as to the potential benefits (and earlier sequencing of partial covers) prior to excluding these mitigation measures from the EVWQP.	Partial covers over mine waste rock dumps could potentially reduce loadings sufficiently to positively influence water quality within the timeframe of the planning window.
Ecological Effects Matrices	**A5-49**	Recommend using the terminology "Level 1 & 2 Toxicity Thresholds" rather than "Ecologically Protective Values" to characterize water quality concentrations that are meant to be protective of sensitive endpoints.	