

Elk Valley Water Quality Plan

Technical Advisory Committee – Meeting #5 Notes

April 2-4, 2014 – Cranbrook, BC

Meeting Objectives

- Provide an update on the Elk Valley Water Quality Plan (EVWQP or “Plan”).
- Review and discuss the action items from Technical Advisory Committee (TAC) Meetings 3 & 4.
- Review and discuss the TAC technical advice received during and after TAC Meeting 4.
- Review and discuss the approach on Lake Koocanusa.
- Review and discuss the approach to address human health.
- Review and discuss the preliminary interaction of the ecological effects assessment and management scenarios.
- Review and discuss the approach to aquatic monitoring in the Elk Valley.
- Receive an update on the development of ecological effects assessment for selenium, cadmium, nitrate and sulphate.
- Review and discuss the approach to covers within the Plan.
- Receive an update on the EVWQP public consultation process.
- Discuss the incorporation of TAC advice into the Plan.
- Provide time for the TAC to have an open discussion on a topic of their choosing.
- Confirm the TAC workplan and next steps (for Meetings 6 to 7).

Meeting Summary

- **TAC Advice:** The TAC’s specific technical advice on the topics discussed at TAC Meeting 5 is summarized in two separate appendices¹ to this Meeting Summary, which are posted on the public website.
- **TAC Administration:** The TAC discussed a number of administrative items, including the documentation of TAC advice, Teck’s process for considering and incorporating TAC advice, options for summary documentation of the TAC process, the status of TAC action items, and the schedule for upcoming TAC meetings and working group meetings.
- **Public Consultation:** Teck provided an update on their public consultation process for the EVWQP. The TAC discussed the public input that was received during Phase 1 of the consultation process, and the planned activities and materials for the upcoming Phase 2 of the consultation process. TAC discussion focused on how the TAC process would be characterized in consultation materials. It was agreed that public consultation materials would note that the TAC is still reviewing elements of the Plan.
- **Lake Koocanusa – Selenium Loading and Concentrations:** The TAC Members for the U.S. Federal Government and the State of Montana gave a presentation on selenium loading and concentrations in Lake Koocanusa.
- **Lake Koocanusa – Monitoring Overview:** The TAC reviewed the existing environmental monitoring data for Lake Koocanusa, Teck’s monitoring plan for 2014, Teck’s proposed approach for Order Station “LK2”, and Teck’s overall approach for Lake Koocanusa within the EVWQP. Several TAC members expressed support for the 2014 monitoring plan and Teck’s proposal for Order Station “LK2”, which includes the continued monitoring of 3 sites in Lake Koocanusa downstream of the mouth of the Elk River. Teck noted that an upstream monitoring station would continue to be monitored as well. In a discussion on the

¹ Appendix A – TAC Technical Advice Received at TAC Meeting 5 and Appendix B – TAC “Technical Advice” Received After TAC Meeting 5.

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interpretation of existing monitoring data for Lake Koocanusa, several TAC members stated that there is currently insufficient data on Lake Koocanusa to conclude that no adverse effects from mine-related constituents are occurring in the reservoir.

- **Approach to Address Human Health:** The TAC reviewed and discussed Teck's approach to address human health in the EVWQP, which is composed of two parts: (1) evaluation of baseline conditions, and (2) human health effects assessment of current and future conditions. TAC discussion focused on Teck's well sampling program, the available data for the baseline evaluation, the process for screening constituents in or out of the human health effects assessment, and the assumptions and the data that would be used to inform human exposure values.
- **Aquatic Monitoring:** The TAC reviewed Teck's approach to aquatic monitoring in the Elk River watershed. The presentation gave an overview of the Regional Aquatic Effects Monitoring Program (RAEMP), and provided a summary of monitoring results from the 2012 monitoring program and additional studies completed in 2013.
- **Selenium Assessment:** Teck provided an update on their ecological effects assessment for selenium, and proposed ecologically protective selenium water quality concentrations for the Elk River and Fording River. One TAC Member emphasized that the interactive effects of the 4 order constituents and calcite should be considered in making estimates of population level effects. Teck confirmed this analysis would be completed as part of the interactive effects assessments and target setting for the Plan. Several TAC Members requested further information from Teck to do additional analyses of the ecologically protective values proposed by Teck.
- **Nitrate/Sulphate Assessment:** Teck provided an update on their ecological effects assessment for nitrate and sulphate, and proposed ecologically protective water quality concentrations for these constituents. TAC discussion touched on how effects would be assessed for tributaries to the Elk River and Fording River, the consideration of eutrophication in the assessment, and the consideration of potential changes to water quality (particularly water hardness) from the implementation of a management scenario. Several TAC members stated that they are comfortable with the proposed ecologically protective values for sulphate, but they needed some additional information and analysis for nitrate.
- **Cadmium Assessment:** Due to time constraints at the meeting, the TAC decided to forego the presentation on the cadmium assessment and instead receive a brief update from Teck on their progress with the assessment. This update included two key points: (1) a hardness-based approach will be used in the cadmium ecological effects assessment and (2) the proposed protective levels for cadmium are almost identical to the new Canadian cadmium water quality guideline (released in 2014).
- **Covers:** Teck provided an update on their approach to covers within the Plan. Teck stated that further evaluation of a range of cover types is required before they can be considered for water quality management, and that based on current information, covers have very limited potential to affect receiving water quality in the next twenty years, and therefore, for the purposes of the EVWQP, management scenarios will rely on treatment and diversion options to meet in-stream targets. Teck stated that they will continue to investigate ways to reduce the cost of cover construction and research the effectiveness of covers for improving water quality. Several TAC Members voiced an interest in seeing a strong Research & Development (R&D) commitment in the Plan in regards to geomembrane covers, such as a large scale pilot study. A TAC Member advised that the benefit of partial covers should be considered as a management option for the Plan.
- **Interaction of Effects Assessment and Management Scenarios:** Teck provided an update on their progress and next steps for defining water quality targets and developing a management scenario to meet target levels. The discussion focused on Teck's presentation of water quality modeling results scheduled for TAC meeting #6. Several TAC members voiced an interest in understanding the process of

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selecting a preferred management scenario. The discussion also focused on Teck's proposed ecologically protective water quality concentrations, and several TAC members noted that they would like to see some additional assessment of uncertainty and interactive effects in the development of these values for selenium and nitrate. Teck stated that they would like to work further with the TAC to get agreement on these values in advance of TAC Meeting 6.

Meeting Participants

At least one representative from each TAC member agency was present. The nine TAC members represent:

- Teck;
- the Ministry of Environment (BC);
- the Ministry of Energy and Mines (BC);
- the Environmental Assessment Office (BC);
- the Government of Canada represented by Environment Canada;
- the US Federal Government represented by US Geological Survey;
- Montana State Government represented by Department of Environmental Quality;
- the Ktunaxa Nation Council;
- an independent third-party qualified professional scientist.

Presentations and Discussions

Lake Koocanusa - Selenium Loading and Concentrations

The TAC Members for the U.S. Federal Government and the State of Montana gave a presentation on selenium loading and concentrations in Lake Koocanusa. The U.S. TAC members used a regression based model, the USGS LOADEST program, to estimate loads into the reservoir for the period between 1991-2012. The U.S. TAC members then presented their estimates for the reduction in selenium loads to Lake Koocanusa following the implementation of two Active Water Treatment Facilities, assuming a 100% efficiency of these plants. Based on the analysis, it was estimated that the implementation of two Active Water Treatment Plants could reduce the mass of selenium discharged into the reservoir by about 20%. The U.S. TAC members stated that to establish the response of the Reservoir to these loads, further spatial modeling is needed that considers the convection and/or diffusion mechanisms within the reservoir. The U.S. TAC members proposed that real time load monitoring of Lake Koocanusa be made publicly available as a way to validate that targets are being achieved.

Lake Koocanusa – Monitoring Overview

Teck gave a presentation on Lake Koocanusa. The presentation covered five topics:

1. Summary of existing environmental monitoring data collected within Lake Koocanusa (B.C., Designated Area), including sediment, surface water quality, plankton, and fish tissue data;

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2. Overview of the 2014 monitoring plan (Lake Koocanusa, BC), including surface water quality, benthic invertebrates, plankton, and fish tissue sampling;
3. Summary of additional data collected within Lake Koocanusa (by Montana State);
4. Proposed approach for Order Station “LK2”;
5. Overall Approach for Lake Koocanusa within the Plan.

(1) Based on a review of the existing environmental monitoring data in the Designated Area of Lake Koocanusa, Teck concluded:

- No sediment samples exceeded sediment benchmarks (BC Ministry of Environment (MOE) Sediment Quality Guideline, Canadian Council of Ministers of the Environment (CCME) Probable Effect Levels (PELs) or consensus-based Probable Effect Concentrations (PECs));
- Average concentrations of Order constituents of interest are less than MOE freshwater aquatic life guidelines;
- In the limited plankton data collected to date, no elements exceed dietary toxicity thresholds for fish;
- Average selenium concentrations in fish tissue are below MOE guidelines;
- A fraction of the fish tissue samples from Lake Koocanusa exceed MOE guidelines for selenium concentration, but this fraction is within the range of fish tissue samples from reference areas.

The TAC discussed sampling methodologies and discussed the conclusions that can be made from the current Lake Koocanusa dataset. It was noted that there is not a robust dataset for Lake Koocanusa at this point as the monitoring program is in its early stages.

(2) Teck gave an overview of the data to be collected in the 2014 Monitoring Program, which includes data on water quality, sediment quality, lake productivity, seston chemistry, plankton community structure, benthic invertebrate tissue chemistry, benthic invertebrate community structure, fish tissue chemistry and fish health. Several TAC members voiced general support for Teck’s Lake Koocanusa monitoring plan.

(3) Teck provided a summary of sediment, water quality, and fish tissue data collected by Montana Department of Environmental Quality. The TAC discussed the selenium concentration levels measured in Burbot tissue samples and that these concentrations are uncertain because the holding time for the Burbot biopsy samples were exceeded and percent moisture could not be measured for these samples (the measure of percent moisture in tissues is necessary to estimate selenium concentrations in tissues).

(4) Teck presented their proposal for the Lake Koocanusa Order Station “LK2”. Teck stated that given temporally limited surface water data within the Designated Area, they think it is premature to choose one site for the Order Station. Therefore, they propose to continue to monitor the 3 sites located downstream of the mouth of the Elk River for the LK2 station for the purposes of obtaining better understanding of the spatial variability among sites and depths. They will also retain at least one upstream monitoring station for the reservoir (i.e. North of the mouth of the Elk River). Teck stated that they plan to monitor at least monthly and potentially more frequently given the advice that they heard from the Ministry of Environment earlier in the meeting. The target would be evaluated according to a composite sample of the three downstream sites.

The TAC expressed general support for the continued monitoring of the three downstream sites for the Lake Koocanusa Order Station “LK2”, and the continued monitoring of an upstream site.

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(5) Overall Approach for Lake Koocanusa: Teck presented their overall approach for Lake Koocanusa within the planning process. They stated that the data to date has indicated no adverse effects in Lake Koocanusa, and that they believe that the BC Water Quality Guideline is protective and will meet the requirement of the Order to protect aquatic ecosystem health. Teck stated that they will develop a Plan to meet BC Water Quality Guidelines (WQGs) as long-term targets in Lake Koocanusa, including 2 µg/L selenium water quality concentration. Teck will also continue their aquatic monitoring program in Lake Koocanusa and will continue to cooperate with Montana on monitoring. These monitoring results will inform Teck's approach to adaptive management during implementation of the Plan.

Several TAC members stated that there is insufficient data to conclude that there are no adverse effects occurring from mine-related constituents in Lake Koocanusa. The BC Ministry of Environment, Environment Canada, the U.S. Federal Government, and the Montana State Government committed to further government-to-government discussions on the assessment of selenium and nitrate water quality concentrations that will be protective of aquatic ecosystem health.

Approach to Address Human Health

Teck presented their approach to address human health in the EVWQP. The approach includes two phases, beginning with the evaluation of current baseline water quality conditions from the perspective of human health and then assessing potential human health impacts.

For evaluation of current baseline water quality conditions, Teck stated that existing concentrations of constituents in surface water, fish, groundwater, and sediment in the Elk Valley will be compared with human health protective guidelines. Timing and frequency of exceedances of the guidelines will be characterized, and constituents having exceedances will be carried through to the second phase for assessment of potential effects. Additional screening will occur at the beginning of the second phase, based on development of pathway-specific benchmarks for multiple exposure pathways for surface water and groundwater. Pathway-specific benchmarks will be compared with estimates of average constituent concentrations in the Elk Valley. Consideration of average concentrations, as well as additive exposures and potential for other interactive effects, will be used to identify constituents and exposure pathways requiring more detailed assessment of potential adverse health effects.

The TAC discussed how the assessment would consider different levels of exposure to constituents within the Elk Valley population, and one TAC member emphasized that Teck should include an assessment of people with high levels of exposure. The TAC also discussed Teck's well-sampling program, which has identified 200 wells for sampling and has sampled 78 wells so far. Several TAC members requested further information on the well sampling program.

Aquatic Monitoring

Teck gave a presentation on their approach to aquatic monitoring in the Elk River Watershed. The 2012 Biological Monitoring Program report (also referred to as the 2012 AEMP Report) was distributed to the TAC as pre-reading for the presentation. The presentation gave an overview of the Regional Aquatic Effects Monitoring Program (RAEMP), and provided a summary of monitoring results from the 2012 monitoring program and additional studies completed in 2013.

The TAC discussed a 2013 study on periphyton at some length. This study undertook an assessment of similarities and differences between laboratories in the taxonomic identification of periphyton species. The study found that

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operating procedures were highly variable amongst labs and that the lab results had very little agreement in organism identification. Based on this study, Teck recommended that periphyton community evaluation should not be included in future monitoring programs. The TAC decided to return to the discussion of the value of monitoring periphyton community structure at the first meeting of the Monitoring Working Group.

Teck reported on their monitoring results of benthic invertebrate community assessments. Teck stated that of the 56 mine-affected areas sampled, about 20 areas were concluded to be adversely affected in the benthic invertebrate community assessment. None of these areas were along the Elk River. Generally, adversely-affected benthic invertebrate communities were located in discharge tributaries close to mining (e.g. Bodie, Cataract, Corbin, Kilmarnock, Swift, Porter, Thompson, Wolfram, Greenhills). The TAC discussed the sampling and analysis methodology used in the assessment of benthic invertebrate communities.

Teck presented the monitoring results for the selenium concentrations of 3 fish species sampled in 2012: Westslope Cutthroat Trout, Longnose Sucker and Mountain Whitefish. The presentation made the following conclusions:

- Trout captured in mine-exposed areas close to mine operations generally had selenium concentrations greater than reference benchmarks whereas trout captured further downstream were near or within range of reference. Very few Westslope Cutthroat Trout had selenium concentrations higher than the selenium effect threshold of 24.8 µg/g dw in ovaries and 15.5 µg/g dw in muscle.
- Mountain White Fish selenium tissue concentrations were generally higher than out-of-watershed based reference, regardless of proximity to mine operations. It was also noted that Whitefish are known to travel large distances (10s of kms).
- Longnose Sucker selenium tissue concentrations were higher in Goddard Marsh and Lower Elk Oxbow than the reference area.

Teck presented their monitoring results for selenium tissue concentrations in amphibians sampled in 2012. The study found no consistent patterns of high vs. low selenium concentrations in both reference and mine-exposed areas thus Teck concluded that amphibians are not a useful indicator for evaluating management actions, although they could continue to be monitored for other reasons.

Teck presented their monitoring results of selenium tissue concentrations in Red-winged Blackbirds and Spotted Sandpipers sampled in 2012. Teck presented the following key conclusions from the sampling study:

- Selenium concentrations in Red-winged Blackbird eggs were higher than reference 95th percentile at almost all mine exposed areas but were below the published effect benchmark for Red-winged blackbirds (22 µg/g dw).
- Selenium concentrations in Spotted Sandpiper eggs were higher than the reference 95th percentile at all mine exposed areas, and 8 of 41 eggs had selenium concentrations higher than the EC10 threshold range for embryo mortality among sensitive bird species (12-15 µg/g dw). All but one of these eggs was collected from nests around mine settling ponds.

Following the presentation, the TAC was asked for summary comments on the current monitoring program and plans for future monitoring. One TAC member noted that the program is still in its infancy, but that it is producing good information and trends could be better discerned with future monitoring. Another TAC member commented that the program is comprehensive. It was suggested that Teck should identify the monitoring needed to verify the assumptions that are informing the targets in the Plan.

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Selenium Assessment Update

Teck provided an update on the selenium ecological effects assessment. The presentation highlighted the feedback and subsequent analysis that has been made over the last two meetings of the TAC Toxicology Working Group in relation to the selenium bioaccumulation models and selenium toxicity thresholds. The presentation also included an overview of the proposed ecologically protective selenium water quality concentrations for fish, birds, and invertebrates with habitat in and around the Elk River and Fording River. The proposed values are:

- Fish reproduction (Brown Trout as most sensitive species) – applicable to Elk River: 19 to 36 µg/L
- Fish reproduction (Westslope Cutthroat Trout as most sensitive species) – applicable to Fording River: 52 to > 100 µg/L
- Juvenile fish growth (sensitive species) – applicable to Elk River: 49 µg/L
- Juvenile fish growth (WCT): >49 µg/L
- Bird reproduction (sensitive species): 46 to >100 µg/L
- Juvenile bird growth: 179 µg/L
- Invertebrate growth and reproduction: 99 µg/L
- Amphibian reproduction: Protective values not proposed because of limited toxicity data

A question was raised as to why the bioaccumulation rates presented are so much lower than in other places such as Waste Rock Creek (Kemess Mine, BC) where Dolly Varden experienced high reproductive effects at 100 µg/L. Teck clarified that the bioaccumulation relationships are site-specific and those developed for the Elk Valley are only applicable to the Elk Valley and can not be generalized to other areas.

One TAC member emphasized that the analysis to develop Teck's proposed ecologically protective selenium water quality concentrations did not incorporate any considerations of interactive effects on fish, birds, and invertebrates of all 4 Order constituents and calcite formation. Further, this TAC member stated that it is important to recognize the uncertainties in the analysis and evaluate whether these uncertainties indicate that protective levels are lower than the initial findings. Teck stated that it was not their intent to only look at effects on a constituent by constituent basis, but this is their first step, and once this step is complete and they have further information on future water quality concentrations under the management scenarios, then they will consider the interactive effects. They stated further that interactive effects are a difficult thing to predict given the absence of a standardized methodology, and asked the TAC for advice on the assessment of interactive effects.

Several TAC members asked for further information from Teck so that they could conduct additional analysis of the proposed ecologically protective selenium water quality concentrations.

Nitrate/Sulphate

Teck provided an update on the nitrate and sulphate ecological effects assessment. The presentation included follow-up on advice from the TAC and Toxicology Working Group and a discussion of ecologically protective

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water quality concentrations for nitrate and sulphate. The presentation proposed the following ecologically protective values:

- 9-12 mg/L NO₃ in the Fording River and 3 mg/L NO₃ (the BC Water Quality Guideline) in the Elk River, which are protective of the most sensitive site-specific end-point, *C. dubia* reproduction.
- 429 mg/L SO₄ where higher hardness levels occur in Elk and Fording Rivers.

A TAC member asked how the effects in tributaries are related to the proposed ecologically protective water quality concentrations, stating that the Ktunaxa Nation Council members have stated the importance of understanding the nature and extent of the effects in each tributary. Teck stated that they will consider water quality in tributaries when setting targets in the Elk River and Fording River that will be protective of aquatic life. Where possible, Teck will integrate potential effects in tributaries and rivers to estimate the combined effects to invertebrates, which are the most sensitive species for nitrate and sulphate. This information will be used to set targets that are protective of species that depend on invertebrates for their food supply.

The TAC members in the Toxicology Working Group stated that they are comfortable with the proposed ecologically protective water quality concentrations for sulphate, but they need some additional information and analysis for nitrate.

Cadmium

Due to time constraints at the meeting, the TAC agreed to forego the presentation on the cadmium assessment and to receive a brief update from Teck on their progress. Teck stated that the hardness-based approach and the Biotic Ligand Model (BLM) results are almost the same (see description of these approaches in the TAC 4 Meeting Record). Consequently, for defining an ecologically protective water quality concentration for cadmium in this process, they will use the hardness-based approach. Teck stated that the proposed protective levels for cadmium are almost identical to the new Canadian cadmium water quality guideline (released in 2014).

A TAC Member stated that the BLM should be validated. Teck agreed that the BLM could be validated during the implementation phase of the EVWQP (i.e. post July 2014) if the BLM model is required at some time in the future to support management decisions. The TAC Member stated further that cadmium concentrations do not seem to be an issue at the order stations, but that it will be helpful to look at cadmium concentrations in the tributaries.

Covers

Teck gave an update on the approach to covers within the Plan. The presentation included a review of previous TAC discussions on covers, an update of cover performance estimates, and an assessment of cover scenarios within the Plan. Teck stated that further evaluation of a range of cover types is required before they can be considered for water quality management, and that based on current information, covers have very limited potential to affect receiving water quality in the next twenty years, and therefore, for the purposes of the EVWQP, management scenarios will rely on treatment and clean water diversion options as the basis of the plan to meet in-stream targets. Teck stated that they will continue to investigate ways to reduce the cost of cover construction and research the effectiveness of covers for improving water quality.

Several TAC members emphasized the importance of implementing long-term sustainable water quality solutions as opposed to management actions that rely heavily on active water treatment facilities, which require continual operation and maintenance. It was further suggested that the Plan should make a strong commitment to

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research and develop long-term water quality solutions, such as implementing a large scale pilot project for geomembrane covers. Teck agreed that reducing reliance on water treatment is part of increasing the sustainability of the Plan in the future, and explained that the management actions outlined in the EVWQP to meet in-stream targets are not the actions that will be implemented in perpetuity. The management approach will be updated as more information is available on the effectiveness of alternative mitigation measures.

Interaction of Effects Assessment and Management Scenarios

Teck gave a presentation on their progress and next steps for defining water quality targets and developing a management scenario to meet in-stream water quality targets. Teck outlined the following five next steps for developing the Plan:

1. Finalize proposed long-term targets for each Management Unit;
2. Develop potential management scenarios to meet long-term targets;
3. Evaluate technical achievability, social, economic and implementation factors to derive short-term targets and both short-and long-term timelines;
4. Set medium term targets and time frames;
5. Define the adaptive management process, which will be the basis for periodic adjustment of the Implementation Plan, and will integrate ongoing monitoring, research and development, and periodic updates to the effects assessment.

The TAC discussed the information that would be brought forward over the remaining two TAC meetings, particularly in regards to the water quality modeling results of Teck's selected management scenario to achieve in-stream water quality concentration targets. Several TAC members requested that Teck show sufficient information to demonstrate the process of selecting a preferred management scenario and explain the rationale behind the selection of management actions.

The TAC also discussed Teck's proposed ecologically protective water quality concentrations, and it was stated that there is still work to be done to reach agreement on these values, particularly around assessing the uncertainties around the level of protection of these water quality concentrations.