Elk Valley Water Quality Plan
Technical Advisory Committee – Meeting #3 Notes - FINAL

November 25-26, 2013 – Cranbrook, BC

Meeting Summary

- The Technical Advisory Committee (TAC) reviewed the draft meeting notes' appendices from Meeting 2 (held on October 29-30, 2013) that summarized their "technical advice" on Teck's Work Package #2a - *Methods for the Assessment of Ecological Effects for a Range of Water Quality Concentrations.*
- A number of Elk Valley Water Quality Plan (EVWQP) scope and process questions raised by TAC members at previous meetings were discussed and clarified.
- The Ministry of Environment made a presentation on when site-specific water quality objectives (SSWQOs) are developed and the methods available to calculate them. Teck made a presentation on their calculation of SSWQOs for selenium, cadmium, sulphate and nitrate using the background concentration method. Through this method, Teck identified that SSWQOs for selenium, cadmium, sulphate and nitrate in the Elk and Fording Rivers would be equivalent to the BC Water Quality Guidelines.
- Teck gave an overview presentation of the Water Quality (WQ) Planning Tool / Model (referred to as TAC Work Package #6a). A primary objective of the WQ Planning Model is to assess different management strategies that may be considered in the development of the EVWQP. However, the model is only part of the process for understanding management strategies – monitoring and adaptive management will also be very important in evaluating the effectiveness of management strategies during the implementation of the EVWQP. At its core, the model is an empirically-based water quality mass balance model with two main inputs: geochemical source terms and hydrology. TAC discussion focused on the empirical method for calculating geochemical source terms, the method for estimating flow in sub-watersheds where monitoring data is not available, the calibration factors used in the model to simulate historical water quality data, and the potential benefits of using a mechanistic modeling approach as opposed to an empirical one.
- Teck gave presentations on the mitigation measures that they are considering for the EVWQP: (1) water treatment (2) clean and mine-affected water management (3) covers (referred to as TAC Work Package #5). Later in the planning process, these mitigation measures will be bundled together to make alternative management scenarios, which will be evaluated through the Water Quality Planning Model in terms of their effectiveness at reducing water quality concentration levels. TAC discussion focused on the effectiveness of these mitigation measures, the potential water quality side-effects of the water treatment technologies, and the assumptions that will be used to incorporate the mitigation measures into the Water Quality Planning Model.
- The TAC's specific technical advice on Work Package #5 and #6a is summarized in two separate appendices[1], which is appended onto this Meeting Summary.

[1] *Appendix A – TAC Technical Advice Received at TAC Meeting #3* **and** *Appendix B – TAC "Technical Advice" Received After TAC Meeting #3.*

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Agenda – Day 1 (November 25, 2013)

8:30 Overview and Update

9:00 Review of Technical Advice from TAC Meeting #2

9:30 Site Specific Water Quality Objectives

10:30 General Overview – Water Quality Planning Model

11:00 Water Quality Planning Model – Geochemistry Inputs

12:00 Lunch

1:00 Water Quality Planning Model – Geochemistry Inputs continued

3:15 Water Quality Planning Model – Hydrology Inputs

5:00 Adjourn

Agenda – Day 2 (November 26, 2013)

8:00 Overview and Review from Day 1

9:00 General Overview of Approach to Management Scenarios

9:30 Mitigation Measures – Water Treatment

10:30 Mitigation Measures – Water Management, Covers, R&D

12:00 Lunch

1:00 Specific Representative Management Scenarios

3:00 Incorporating Mitigation Measures into the WQ Planning Model

3:45 TAC Workplan and Next Steps

5:00 Adjourn

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.

Work Package #5 – Management Scenarios

This TAC work package provided information on the mitigation measures that Teck is considering in the development of the Elk Valley Water Quality Plan (EVWQP). Teck is considering three main types of mitigation measures, which are described in more detail below. Later in the planning process, these mitigation measures will be bundled together to make alternative management scenarios, which will be evaluated through the Water Quality Planning Model in terms of their effectiveness at meeting candidate water quality concentration targets.

(1) Water Treatment
Water treatment removes constituents of concern from mine-affected waters. Many water treatment technologies are available and Teck has narrowed down the list of potential water treatment technologies through conducting technology pilot studies. They are currently building an Active Water Treatment Facility at their Line Creek Operations that uses Fluidized-bed Reactor (FBR) technology. Other technologies that they are considering in the development of the Plan and that are technically ready in the near term include: reverse osmosis, thermal brine treatment, and electro dialysis reversal.

(2) Water Diversion (both mine-affected and clean water)

Mine-affected water diversion is the practice of redirecting mine-affected water from its natural flow path to a treatment system to remove unwanted constituents before release to the watershed. The first mine-affected water management system, the Line Creek Operations Dry Creek Diversion, in is the detailed design stage for construction, which is scheduled to commence in 2014.

Clean water diversion is the practice of diverting clean water to prevent it from entering waste rock piles.

As part of an overall water management strategy, Teck has built and operated two gravity flow clean water diversions (Fording River Operations Kilmarnock Creek and Greenhills Operations Swift Creek).

Gravity flow diversions utilize the natural downhill gradient to intercept and move water to a specific location(s). Teck experience to date is water diversions can be very effective in keeping clean water clean and preventing additional unwanted constituents from being introduced into that water, however, there are several construction and maintenance challenges associated with these types of diversions that would need to be addressed in future applications.

An alternate to a gravity flow diversion approach is the pump and pipe method. This method has several advantages and some disadvantages that will need to be weighed against the challenges associated with gravity flow diversions.

All water diversions require intake structures where water is stored temporarily and can be released in a controlled fashion to a gravity flow diversion or pipe diversion. When designing intake structures for water management systems in mountainous terrain, the engineering design complexity is site specific. With variable flow volumes occurring within and between years (e.g., low flow periods and flood events) the volume of water captured is an important consideration in water quality and engineering design.

(3) Covers

Placing a cover on waste rock piles can reduce the net percolation of water into the pile. Net percolation refers to the water that is released from soil into the groundwater flow system. Reducing water infiltration into a waste rock pile can reduce the discharge of constituents of concern from the pile. The two types of covers that are being

considered for the Elk Valley Water Quality Plan are the 'existing' cover, which is the revegetation requirements under current reclamation plans, and the geomembrane covers. The existing cover can reduce net percolation to 47% of mean annual precipitation and the geomembrane can reduce net percolation to 1%-5% of mean annual precipitation. An implementation challenge of geomembrane covers is that they can not be constructed on steep slopes. To implement these covers in the Elk Valley, the waste rock piles would have to be re-sloped.

Work Package #6a – Water Quality Planning Model Methods

The Water Quality Planning Model is designed as a regional planning and assessment tool, which estimates concentrations of water quality constituents of interest at selected locations in the Elk Valley. At its core, the Model is a water quality mass balance model that is supported by two elements:

- an empirical hydrology model; and
- empirical geochemical source terms derived from monitoring data collected from the Elk Valley.

The Model has been developed using a commercially available, general purpose simulation software platform called GoldSim (GoldSim Technology Group 2010), and it has been constructed using an empirical approach. An empirical approach was selected as the most appropriate approach to represent current level of understanding of the geochemical processes and conditions that occur within the waste rock spoils and other mine features at a regional scale. A first principles mechanistic model may be developed by Teck in the future, but Teck does not think such a model is required to support the development of the EVWQP.

Model outputs consist of simulated concentrations of substances, including nitrate, selenium, cadmium and sulphate. Outputs are in the form of time-series that can be either representative of historical or estimated future conditions.

Key inputs to the Model include surface water flows, geochemical source terms and operational mine information (such as rate and placement of waste rock). The surface water flows were generated either using monitored data (where data of sufficient quality and length were available) or from empirical estimates based on the application of representative hydrographs to ungauged watersheds or watersheds for which limited good quality flow data were available.

The geochemical source terms were derived from observed water quality monitoring data collected downstream of representative source material and considered in combination with known rock volumes and surface water flows. The empirical release rates are expressed as either a load per unit waste rock volume per time period (e.g., mg/m3/year) or, where the release is limited by solubility constraints, a constant concentration that applies to waters draining from the mine features in question.

To date, efforts in support of the EVWQP have focused primarily on the construction, calibration and validation of the Model through the simulation of historical conditions. Moving forward, the Model will be used to examine how different water management scenarios might be used to achieve in-stream water quality targets to be developed as part of the EVWQP.