2AM-MEL1631 Water Licence Amendment

Technical Meeting Commitment 13

Submitted to:

Nunavut Water Board

Submitted by:

Agnico Eagle Mines Limited – Meliadine Division

December 11, 2020

At the technical meeting for amendment to Meliadine Type A Water Licence (2AM-MEL1631), Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) requested additional information on the water modeling reports. They issued these additional questions as Commitment 12 (copied below). This document provides the response to those questions and meets the requirements of Commitment 13.

Questions Made by Interested Party (Commitment 12):

1) Differences between Lower and Upper Bound Models

CIRNAC is concerned by the significant differences presented between the SNC and Golder models. In addition to TDS levels under consideration in this amendment application, these differences may have significant implications on water management systems for the mine site as a whole.
CIRNAC is concerned that the root cause of the elevated TDS in 2019 is has not been clearly identified. As such it is unclear if:

- *sources of elevated TDS will continue in future as occurred in 2019*
- *if flushing to date has reduced source term potential for future releases*
- *if all reasonable measures have been undertaken to mitigate elevated TDS at the source,*

CIRNAC questions the use of the 2019 /2020 monitored data and its extrapolation based on the extreme wet year as appears to have been done by SNC as it likely misrepresents and overstates future conditions.

2) Model Clarifications

CIRNAC would appreciate AEM providing additional details and clarification on the SNC model including:

- *additional details and description of the assumptions underlying SNC's Appendix 3 Upper Bound calculations*
- *a tabular summary of all differences in assumptions between the two models*
- *a breakdown and descriptions of the sub areas that make up "the rest of site" as modelled for 2019/2020 and as modelled for remainder of LOM*
- *runoff assumptions used for flow and load concentrations from the "rest of site" sub areas as modelled for 2019/2020*
- *runoff assumptions used for flow and load concentrations from the "rest of site" sub areas as modelled for remainder of LOM*
- *clarification of some of SNCs memo statements including:*
    - *Section 3.1 Water Balance 4th paragraph - that the increased loads are due to " For 2020, no adjustment was required. The runoff coefficient considered at the site were adjusted in the TDS upper bound model to match the trends observed in the monitored water elevation in CP1"*
    - *Section 3.2 first bullet states " the updated model considers a higher TDS loads than the lower bound model, specifically from disturbed area around the site (i.e. WRSF, site, etc) and from the Tailing Storage Facility" – CIRNAC notes that AEM has stated no water is released from the Tailings Storage Facility area*

- *Section 3.2 second paragraph notes that minimum water remaining in CP1 during winter is assumed at 1000m3 – given this small quantity of impacted water, it would seem reasonable to manage it separately and thus reduce the need for discharging these high TDS waters at the start of the discharge season*
- *Section 3.2, page 4, 5th bullet states that:*
  - *the rest of site is (TSF, landfarm, ore pad, landfill, catchment area around CP1, P-Areas) and*
  - *that "This data suggest that the higher runoff volume was flushing out accumulated salts contained in the pore water in the WRSF, the TSF and other sectors on the site" and*
  - *that "The TDS loads from CP3, CP4, CP5 and CP6 ponds (in 202 and rest of LOM) represents in total about 60% of the total TDS load reporting to CP1*

3) Impact of Upper Bound Forecast Model on Other Aspects of Site Water Management

Given these statements and the data contained in Table 3.1, it appears that the incremental elevated loads in 2019 came from the rest of site area and is not attributable to increase precipitation but rather unexpected quantities or elevated source terms.

- *additional discussion of the implications of the SNC upper bound forecast on other aspects of the site water management systems that were designed and operated based on the FEIS forecast Golder water balance (for example effect on water treatment requirements, sludge generation, pond storage capacities etc.,)*

Agnico Eagle's Response (Commitment 13):

1) Differences between Lower and Upper Bound Models

The lower bound model (Golder 2020) and the upper bound model (SNC 2020) were developed using the same framework and connection of ponds as described in the lower bound model report. To develop the upper bound model, the water quantity and source term TDS reporting to CP1 were calibrated using the monitored data from 2019 and 2020, including:

- Monitored water level in CP1
- Monitored discharge volume from CP1
- TDS concentration measured at CP1 and the other ponds.

In addition, the model was updated to account for cryo-concentration due to ice sheet formation in CP1. This approach was applied to forecast water elevations and concentrations for 2021 to 2028.

The upper bound model provides forecasted results that are more inline with the monitored data observed in 2019 and 2020 and a more conservative estimate of the TDS in CP1 for the Life of Mine (LOM). Data from 2019 represent a year of high flushing (i.e., there were three high rain events which contributed to a total summer rainfall equal to the rainfall in a 1:100 wet year) and large quantities of water that needed to be stored on-site. The ponds and infrastructure at the Meliadine site were designed in consideration of extreme precipitation and runoff. Specifically, ponds CP2, CP3, CP4, CP5, and CP6 were designed to manage water from their catchment areas for 3/7 of a 1:100 wet year spring freshet or a 1:1000 return 24-hour extreme rainfall. CP1 was designed to contain water from the entire site for a 1:100 wet year spring freshet, or a 1:2 mean year spring freshet plus a 1:1000 return 24-hour extreme rainfall (Water Management Plan).

Data from 2020 represent the year after a high-precipitation year and when large quantities of water on-site were still being stored and managed. These conditions were carried forward in the upper bound forecast to account for continued source of TDS (rather than a depleted TDS source over time), and future years when multiple, high rain events and flushing of the site may occur again. The use of measured data to forecast future conditions is a valid approach. It is possible that subsequent wet and dry years could occur again, so inclusion of that variability is required in order to develop a realistic upper bound prediction.

The lower bound model provides a forecast that was based on a limited supply of TDS (i.e., assumed source terms would be depleted over time), and future years that did not account for the high-rain events observed in 2019. The lower bound model provides a lower bound prediction as based on the assumptions included in the model (e.g., a depletion of source terms over time, if that occurs as modelled).

The lower bound and upper bound model results provide an expected range of future TDS concentrations in CP1.

As required by the Water License, the forecasting model shall be updated at least every two years following commencement of operations (2AM-MEL1631, Part E, Item 12).

> *The Licensee shall submit a revised Water Management Plan on an annual basis to the Board for review, following the commencement of Operations. The Plan shall include a Water Balance and Water Quality Model updated at a minimum of every two (2) years following commencement of Operations.*

It is standard practice to calibrate the model with the monitored data. This is a similar approach that is used at the Meadowbank and Amaruq sites where the annual calibrated model and data are provided to NWB and reviewed by interveners as part of the Annual Reports.

2) Model Clarifications

The upper bound model was developed based on the following assumptions:

- The same source terms reporting to CP1 in the lower bound model were used.
- The "rest of site" mentioned in upper bound model refers to these source terms coming from the tailings storage facility (TSF), the landfarm, the laydown area, and other areas where contact runoff water is not captured by ponds CP3, CP4, CP5 and CP6
- The following monitored data were used to help calibrate the model for 2019 and 2020:
    - TDS concentrations from CP1, CP3, CP4, CP5 and CP6
    - Water level in CP1

  - o Discharge volume from CP1
  - o Transfer volume from CP3, CP4, CP5 and CP6
- An average precipitation was considered for the rest of the LOM (2021 onward), using the same values as the lower bound model.
- Cryo-concentration was assumed in the winter months. For winter 2019 to 2020, the ice thickness in CP1 was adjusted to match the monitored TDS concentration. For the rest of the LOM, the ice thickness was adjusted to obtain a minimum volume of approximately 1,000 m^3 in CP1 in the winter.
- The other assumptions made for the lower bound model were applied to the upper bound model.

The upper bound model was first calibrated to obtain a model that closely reflected the monitoring data observed during the wet year observed in 2019 and the dry year observed in 2020. To do so, the runoff coefficient of source terms reporting by gravity to CP1 were adjusted to match the water level monitored in CP1. The average monthly TDS concentration in the runoff stream reporting to CP1 was also adjusted to obtain a similar monitored TDS concentration. Calibrating a model (which is a tool commonly used for planning purposes) with measured data (which represents actual site conditions) is standard practice. It is through these steps that the model can become more accurate and aid in future planning needs and forecasting of potential conditions.

For the rest of the LOM, the following input parameters were adjusted to assess the upper bound model:

- Within the main footprint area of the mine site, landcovers assigned as natural in the lower bound model were adjusted to low or high disturbed areas, based on recent surveys and site photos.
- Runoff quality from high disturbed areas, which was assumed to improve by 25% each year in the lower bound model, was kept constant through the LOM.
- The loading terms from the tailings facility and waste rock facilities were adjusted based on recent monitored data.

The lower bound model did not capture the higher TDS concentration monitored in the 2019 and 2020 in CP1. The upper bound model is calibrated against the monitored data for these years and provides a more conservative forecast of the TDS for the LOM. 2019 was a wet-year year with high construction activities on site, while 2020 was a drier year with construction activities still ongoing. Agnico Eagle is expecting that the TDS in CP1 shall fluctuate between the upper and lower bound model; the exact concentration will depend greatly on the rainfall event which in turn, based on the monitoring data, influence proportionally the TDS loadings to CP1. To further validate our model, the latest TDS measurements from CP1 (November 1 = 3,120 mg/L; November 15 = 4,000 mg/L; December 2 = 5,500 mg/L) are aligned with the upper bound predictions. Based on these recent data, it is projected that water in CP1 next open-water season will be between 1,400 and 3,500 mg/L TDS. Agnico Eagle is committed to update annually the water balance and water quality forecast model at Meliadine. Each update shall provide a clearer understanding of the behavior of the different loading terms reporting to CP1 over the years.

3) Impact of Upper Bound Forecast Model on Other Aspects of Site Water Management

There is no effect on the design of the infrastructure related to the upper bound model. As we have been stating from the start, the 1,400 mg/L TDS is a highly restrictive EQC and our evidence shows there is no effect on the receiving environment with the proposed MAC of 3,500 mg/L.

The lower and upper bound water balance and water quality models are used to support pre-design work for additional site water management infrastructure and to forecast future conditions. As mentioned above, Agnico Eagle is expecting that the TDS concentration in CP1 will fluctuate between the upper bound and lower bound model projections.

Conclusion

Based on all the evidence that has been provided, and the additional information from the upper bound model, there are no significant implications on the infrastructure. As mentioned during the Emergency Amendment process, there was significant implications to the infrastructure due to the highly restrictive EQC of 1,400 mg/L TDS.

Also, the modelled case included in the FEIS (Agnico Eagle 2014) considered a higher quantity of water and TDS concentration that was projected for this upper bound model. The model from the FEIS was developed to meet the guidelines for completing an impact assessment, but also to inform early design of proposed infrastructure. The design of site water management infrastructure was developed based on site-specific data and on detailed engineering designs (e.g., Tetra Tech 2018).

References:

Agnico Eagle (Agnico Eagle Mines Limited). 2014. Final Environmental Impact Statement (FEIS) - Meliadine Gold Project, Nunavut from: ftp://ftp.nirb.ca/02-REVIEWS/ACTIVE%20REVIEWS/11MN034-Agnico Eagle%20MELIADINE/2-REVIEW/09-FINAL%20EIS/FEIS

Golder (Golder Associates Ltd). 2020. Meliadine Site Water Balance and Water Quality Model. Appendix A of the Meliadine Type A (2AM-MEL1631) Water Licence Amendment Application. August 2020.

SNC. 2020. Assessment of Water Balance and Forecast around CP1. Submitted as Attachment 03 in response to technical comments for the Meliadine Type A (2AM-MEL1631) Water Licence Amendment Application. November 2020.

Tetra Tech. 2018. Design Report for CP3, CP4, CP Berms, Berm 2, Channel 3 and Channel 4, Meliadine Project, Nunavut. Submitted by Agnico Eagle Mines Limited to the Nunavut Water Board. June 2018.