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May 15, 2014

File: L020-01-07

Angela Love
Regulatory Officer
Mackenzie Valley Land & Water Board
Box 2130
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Yellowknife NT X1A 2P6

Dear Ms. Love:

**Gahcho Kué Project Mackenzie Valley Land and Water Board Public Hearing
– Undertaking #4 - Effluent Quality Criteria Report – Ammonia Calculation**

Undertaking 4:

De Beers Canada Inc. to provide to the MVLWB with the equations used as well as the rationale for the calculation of the ammonia EQC. Please clarify the apparent inconsistencies in the discussions at the top of page 36 of the EQC Report and the discussion on ammonia in Section 3.2.1. Due May 15, 2014.

Response:

The text on page 36 of the Effluent Quality Criteria (EQC) Report (De Beers 2014) "*Ammonia was, therefore, treated as a non-conservative parameter when setting EQC*" refers to how ammonia was treated in the receiving environment (the south basin of Lake N11) when calculating EQC. The apparent inconsistent text in Section 3.2.1 (De Beers 2014), "*Total ammonia in the WMP was treated as a conservative parameter in the site water quality model*", indicates that no biological or chemical transformations were applied to ammonia in the water management pond (WMP), so ammonia concentrations in the operational discharge may be less than predicted (i.e., reasonable worst-case ammonia concentrations).

The Mackenzie Valley Land and Water Board (MVLWB) specifically asked for the equations and rationale for the ammonia EQC derivation. Steps for the derivation are provided below:

Step 1.

Calculate the acute (20.9 mg N/L [USEPA 2013]) and chronic (4.1 mg N/L [CCME 1999]) water quality objectives (WQO) to be applied at the edge of the mixing zone.

Step 2.

Apply the equations specified in Section 3.1.1 of the EQC Report (De Beers 2014) to derive the waste load allocation, long-term average, average monthly limit (AML), and daily maximum limit (DML) for ammonia. Equations 5 and 6 (page 36, De Beers 2014) are specific to ammonia due to its rapid conversion to other nitrogenous forms in the presence of dissolved oxygen (which is what was meant by "treated as a non-conservative parameter when setting EQC"). As such, EQC for ammonia were calculated differently than, for example, chloride, a parameter that acts conservatively in the water column.

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Calculations were completed using the Canadian Council of Ministers of the Environment (CCME) chronic Water Quality Objective (WQO) (the lower of the chronic and acute WQOs). Equation 6 implicitly assumes that ammonia will not accumulate in Lake N11. A test was completed using C_{IN} (i.e., average baseline concentration of ammonia in Lake N11) equal to 3.5 mg N/L, the maximum predicted concentration at the edge of the mixing zone assuming no conversions or transformations (Appendix E, Table E4 [De Beers 2014]), rather than the baseline concentration of 0.018 mg N/L. This test represents a scenario where ammonia accumulates in the lake.

Step 3.

Compare the EQC derived in Step 2, including the accumulation test scenario, against the acute WQO of 20.9 mg N/L. If the EQC were greater than the acute WQO, the AML and DML were set equal to 21 mg/L, which protects against acute effects (Section 3.2.1, De Beers 2014). Keeping with the MVLWB Water and Effluent Quality Management Policy's waste minimization objective (MVLWB 2011), the proposed AML was adjusted to 10 mg/L, which is consistent with the DML:AML ratio of 2:1. Therefore, the final proposed EQC were: AML = 10 mg N/L, and DML = 21 mg N/L.

Sincerely,



Veronica Chisholm

References:

- CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines, 1999. Canadian Environmental Quality Guidelines Summary Table, with updates to 2013. Winnipeg, MB, Canada. Available at: <http://st-ts.ccme.ca/>. Accessed October 2013.
- De Beers (De Beers Canada Inc.). 2014. Effluent Quality Criteria Report – Version 2 for the Gahcho Kué Mine. Submitted to the Mackenzie Valley Environmental Impact Review Board, Yellowknife, NWT. April 2014.
- MVLWB (Mackenzie Valley Land and Water Board). 2011. Water and Effluent Quality Management Policy. Yellowknife, NWT, Canada.
- USEPA (United States Environmental Protection Agency). 2013. Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater 2013. Office of Water (4304T). EPA-822-R-13-001. Washington, DC, USA.