TECHNICAL MEMORANDUM

Date: **March 15, 2019**

To: **Christine McLean c/o Matthew Nefstead**

From: **Rina Freed, PhD., P.Eng.**

Subject: **SEA Review of Mount Polley Monitoring Data – EMA Permit 11678**

1 Introduction

Following a breach of the Mount Polley tailings facility in August 2014, Mount Polley Mining Corp. (MPMC) obtained a temporary permit in 2015 to discharge mine waters to Quesnel Lake via Hazeltine Creek. On April 7, 2017, the BC Ministry of Environment (ENV) issued an amended permit allowing direct discharge to Quesnel Lake for about 5 years. Concerned Citizens of Quesnel Lake (CCQL) appealed the April 2017 permit amendment. CCQL have retained Source Environmental Associates Inc. (SEA) to review the amended ENV discharge permit 11678. SEA's expert report was submitted by CCQL to the BC Environmental Appeal Board in January 2019. This report identifies additional issues of concern with the technical memorandum submitted by Golder Associates on January 11, 2019 titled "Evaluation of measured water concentrations related to EMA Permit 11678". SEA reviewed the package provided with 5 attachments.

This memo outlines concerns with the monitoring completed and why the monitoring may not be indicative of the presence of impacts. This report is provided at a high level to outline concerns; further details will be provided at the hearings. The previous reports on monitoring (i.e. the CEMP) were found to be inadequate. While, the January 2019 memo provided is an improvement, SEA remains concerned that the additional monitoring data analyzed and compiled lacks adequacy to assess impacts for a number of reasons. At a high level, SEA is concern with identified exceedances of the model predictions, exceedances of permit limit and the lack of identification of the plume centreline at the 100 m IDZ.

It is important to understand the locations of the sampling.

- Influent to treatment – E19
- Effluent from treatment – HAD-3
- Background, near field – QUL-2a
- Background, far field – QUL-18
- 100 M IDZ – QUL-58

SEA is concerned with an excerpt from the January 2019 memo included below:

> The cases where measured concentrations in Quesnel Lake were higher than applicable guidelines or model predictions are explained in a previous memoranda[3, 4]. For constituents such as total chromium, copper, iron, phosphorus and zinc, the background concentrations (QUL-2a) were higher than predicted, resulting in individual samples that exceeded whole-lake predicted concentrations.
>
> At the end-of-pipe (HAD-03), all measured concentrations were below Permit 11678 limits and model predictions except for the 95th percentile total copper and maximum dissolved aluminum and cadmium. As shown in Figure 13, water quality guidelines continued to be met in the lake.

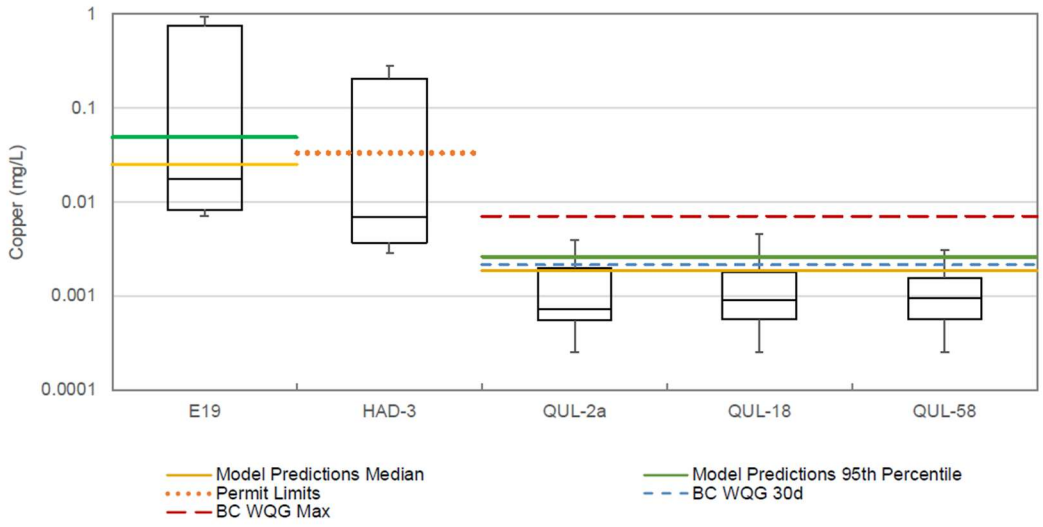

Figure 13: Observed (box plots) and Predicted (lines) Concentration of Copper

SEA is concerned that permit limits have been exceeded for T-Cu, D-Al, D-Cd and water quality guidelines were not met at the true 100 m IDZ (at the centreline of the plume). Measured data were higher than predictions due to high background concentrations. This means the receiving environment is sensitive to these parameters (and appropriate water treatment should be employed).

Figure 13 shows the total copper exceedance of model predictions prior to “treatment” at E19; exceedance of the permit limit at the effluent (HAD-3); and the exceedance of the BC WQG (30 d) in the receiving environment. The water quality guidelines do not “continue to be met in the lake” as shown in Figure 13. While the exceedance of the BC WQG for copper above (chronic) may be related to background, it is not clear what change the effluent is having on the 100 m IDZ maximum plume value. SEA expects that given the two orders of magnitude difference in the discharge effluent and the receiving environment, a change in water quality at the 100 m IDZ is to be expected. Very little dilution is expected to be available when the background

condition is already at the water quality guideline. Further comments on the lack of identification of the plume and/or the centreline of the plume are included below.

2 Issues of Concern

1. **Lack of Plume Centerline Data at QUL-58**
   SEA remains concerned with the lack of data to 1) identify the plume presence/extent and 2) identify the maximum centerline of the plume. In the January 2019 submission there was no information provided on how the plume presence was identified when samples were taken. Given the huge fluctuations in dilution factors reported, it is expected that sampling for some COCs was within the plume to a greater extent than other samples. There is no common parameter measured to assess this (i.e. compare a standard COC low in background data used to identify the plume (i.e. sulphate) in all the samples collected on the same day). This does not appear to have been done as a simple QA/QC measure.

   It is important to understand how the plume was "detected" at QUL-58. There is no data or graphics to show the plume sampling and extent. An excerpt from the January 2019 memo is included below that acknowledges constraints in detecting the plume and maintaining a consistent sample location. Given this statement, SEA concludes there is little-to-no basis for claiming the samples are representative of the key monitoring data required, the 100 m IDZ value at the centerline of the plume.

> A post-audit of the near-field modelling presented in Golder (2015) was completed by calculating dilution based on these monitoring data and comparing against model predictions. Since the QUL-58 station is approximately 100 m from the diffuser discharge, dilution calculated using HAC-12 data to represent mixed effluent water quality can be compared directly to predicted dilution at 100 m. When the plume is detected, QUL-58 is sampled from the plume centreline at approximately 100 m from the diffuser. However, logistical constraints in detecting the plume and maintaining a consistent sample location mean samples collected at QUL-58 may not be along the centreline.

2. **Model Verification**. SEA is concerned with the apparent lack of "model verification" completed for the near-field and far-field dilution models. Verification of a model is a step beyond calibration of the model that implies appropriate data has been collected to verify the model, i.e. from the plume centerline. One data set should be used for model calibration and a second data set should be used for model verification. In this case there is no dataset for the plume dilution at the 100 m IDZ (as the plume extent and centerline is not identified). There appears to be no real data available to justify the term "verification" at Mount Polley; the work done for Mount Polley is nothing like the work done to verify model dilution and dispersion with river-based effluent dispersion (such as the Gibraltar Mine discharge plume characterization in the Fraser River).

It is essential that the professional generate a map of the plume from the data collected and show the data with-respect-to the centerline of the plume. It is evident that the plume is not sampled consistently as the dilution factors calculated by parameters are highly variable. For parameters that are very low in the baseline water quality, there is no reason for highly variable dilution factors except that multiple samples were taken at different locations as the boat moved (and the plume location was uncertain) during sampling events.

3. **Median Dilution Factor and Centerline of Plume.** SEA is concerned with the characterization of dilution factors in the Golder January 2019 submission. Given the circumstances, and not knowing how far off the centerline of the plume is from the sample, it is appropriate to make use of the minimum dilution factor measured. Unfortunately, this work focuses on the "median" dilution factor (see excerpt below). That might be acceptable if there was evidence that the professionals had taken the step of detecting the plume extent and identifying the centerline of the plume.

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In general, dilution calculated from observed water quality is within the range predicted by the near-field model, or higher. It is expected that observed dilution would exceed predicted dilution because:

- The near-field model incorporates conservative assumptions, which tend to result in under-estimation of dilution at the edge of the IDZ.
- The specific climate and wind conditions leading to minimum dilution predictions may not have been encountered in the post-audit data.
- The minimum dilution predicted by the near-field model is along the plume centreline; if sampling at QUL-58 is not along the centreline, the calculated dilution will be over-estimated.
- Similarly, if all samples are not collected at exactly the same point, there will be differences in the dilution factor calculated for each set of parameters. This is a logistical limitation of the post-audit because samples are collected by Kemmerer sampler from a boat situated 50 m above and 100 m away from the diffusers. Sample locations are determined in the field by measuring in-situ profiles to detect the plume. Separate casts are required to collect adequate sample volumes for ions, metals and nutrients. Consequently, each subsample will have been collected at a slightly different distance off the plume centreline due to movement of the boat, as well as drift of the Kemmerer, during sampling.

Given the sampling constraints described above, this analysis focuses on the median dilution calculated for any given date rather than on results for individual parameters.

Given the problems with the plume centerline identification, the minimum dilution factors determined should not be disregarded as they are closer to the true dilution factor than samples taken farther from the plume centerline. SEA notes that very low values were

measured at times (dilution factor less than 10, Attachment 2, Table 1). While there was no discharge at this time, the values are still important as other times of the years there could be a similar (or lower) amount of dilution (i.e. winter). It appears that the minimum values were not treated appropriately. This may show a bias to disregard important data for invalid reasons.

4. **Implications of High Baseline Concentrations for COCs**. SEA is concerned with COCs with high baseline concentration and no centerline plume data at the 100 m IDZ. In these cases is appears there is a high uncertainty the IDZ limit is met. SEA notes that water treatment is needed as effluent concentrations are not significantly different from influent concentrations for many COCs with relatively high concentrations in baseline (i.e. copper).
   SEA notes that the data presented, and arguments made in attachment 4 (pages 3-5) are concerning. While the remaining capacity for dilution may not have been exceeded on the days that happen to have been sampled, there is a clear indication that zero remaining dilution (and likely an exceedance) has occurred on other days. SEA is concerned with the presentation of materials (i.e. individual days) and conclusions presented for cases with background data near the water quality guidelines (Phosphorous, Copper, Zinc).

5. **Selenium Exceedances**. Data shows selenium is exceeded (Table 1, main report) compared to the modelling predictions. SEA is concerned with this exceedance and the implications for Quesnel Lake. Attachment 4, Figures 1 and 4, show very little remaining dilution capacity for selenium and this implies the possibility of exceedances give the earlier problems identified with identifying the centerline of the plume at the 100 m IDZ. The discussion provided (Golder, January 2019) for “individual days” is not protective or conservative and could be miss-leading; there is expected to be a high degree of variation in the dilution at the IDZ plume centerline and this could be much lower than the current results reported on “individual days”. For example, there were days when the dilution factor was measured to be less than 10 (see above). Under these conditions, it is expected that water quality exceedances would be noted given the lack of water treatment for selenium (and many other COCs of concern).

6. **Dissolved Aluminum and Treatment Process**. As seen in the graph below, the box plot shows the range of dissolved Aluminum concentrations observed in the effluent. The effluent is at times higher than the EMA permit limit (0.75 mg/L). It is not clear what caused the exceedance or what has been done to avoid further exceedances. It is suspected that the treatment process adds aluminum to assist with coagulation/flocculation to remove suspended sediments. SEA notes the apparent need for further post-treatment and removal of the dissolved load.

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Fasken Martineau DuMoulin LLP

Reference No. 18107730-002-TM-Rev0-20000
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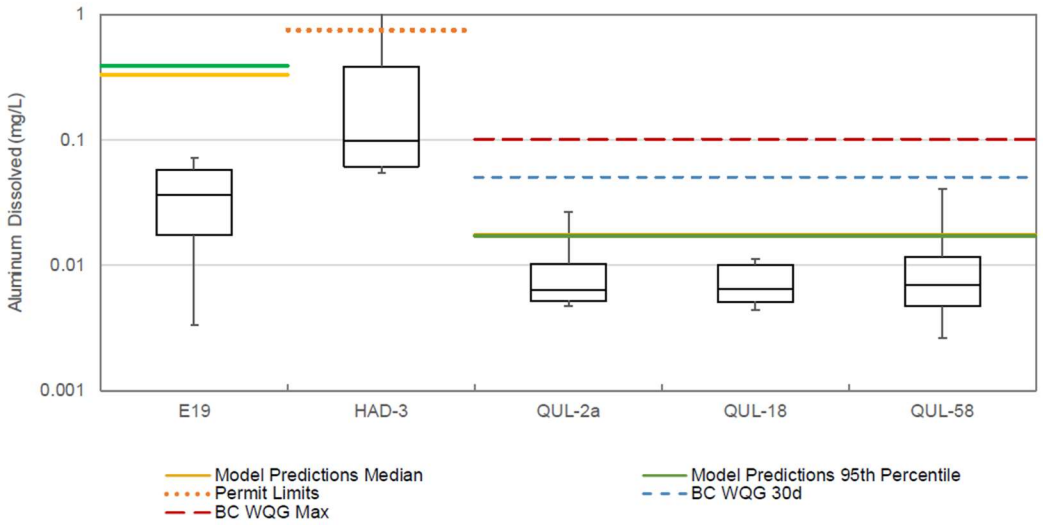

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