TECHNICAL MEMORANDUM

DATE 20 December 2019 **Project No.** 19127573-452-TM-Rev0

TO Michel Groleau and Jamie Quesnel
Agnico Eagle Mines Limited

CC Jen Range

FROM Alison Snow and John Faithful **EMAIL alison_snow@golder.com**

MIXING ZONE BOUNDARIES IN MAMMOTH LAKE AND WHALE TAIL LAKE (SOUTH BASIN)

1.0 INTRODUCTION

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) are considering an expansion to the Approved Whale Tail Pit Project (Expansion Project) in Nunavut. As part of the mine development, treated effluent from the water treatment plants (WTP) and captured seepage through the Whale Tail dike are planned to be released to Whale Tail Lake (South Basin) during operations through diffusers. Treated effluent from the WTP is also planned to be released to Mammoth Lake during operations through diffusers. Mammoth Lake and Whale Tail Lake (South Basin) each have three diffusers (i.e., two summer diffusers and one winter diffuser).

This technical memorandum was generated in response to an information request from Environment and Climate Change Canada (ECCC) during the Technical Meeting and Pre-Hearing Conference held 29-30 October 2019 for Water Licence Amendment Applications No.: 2AM-WTP1826 and 2AM-MEA1526. The information request from ECCC in Commitment 9 from the Technical Meeting and Pre-Hearing Conference stated:

> *Provide additional details regarding the mixing zone boundary and clarify the size of the entire mixing zone for each receiver*

2.0 RESPONSE

To address Commitment 9, Golder Associates Ltd. (Golder) completed high resolution three-dimensional (3-D) modelling of Mammoth Lake and Whale Tail Lake (South Basin) that focused on the period of treated effluent discharge from the WTP. Treated effluent discharge from the WTP to Mammoth Lake is predicted to occur over a four-month period from June 2019 to September 2019 and over a 12-month period from June 2020 to May 2021. Treated effluent discharge from the WTP to Whale Tail Lake (South Basin) is predicted to occur over a 56-month period from June 2021 to January 2026. The 3-D models of Mammoth Lake and Whale Tail Lake (South Basin) accounted for simultaneous discharge of treated effluent from the WTP through two diffusers in June.

For both lakes, when treated effluent discharge from the WTP is required to be greater than 800 m^3/hour in June of each year of discharge (to a maximum of 1,600 m^3/hour), the flow was distributed evenly between two summer diffusers. When effluent discharge was predicted to be less than 800 m^3/hour in July, August, and September of each year of discharge, the flow was released through one of the summer diffusers. The third diffuser was for winter discharges and the winter diffusers were designed for much lower flows of 36 m^3/hour and 4 m^3/hour in

Golder Associates Ltd.
2800, 700 - 2nd Street SW, Calgary, Alberta, T2P 2W2, Canada T: +1 403 299 5600 F: +1 403 299 5606

Mammoth Lake and Whale Tail Lake (South Basin), respectively (Golder 2019).

For Mammoth Lake and Whale Tail Lake (South Basin), the 3-D model results match the downstream receiving environment model results (i.e., the GoldSim mass balance model results), except for the model results in June when treated effluent discharge from the WTP is predicted to be greater than 800 m^3/hour and the two summer diffusers are operating. This period of time (i.e., approximately 4 weeks per year) has been identified as having the greatest potential to exceed Canadian water quality guidelines (CWQG) and/or site-specific water quality objectives (SSWQO) in the near field at 100 m and 200 m from the diffusers.

In months other than June (i.e., July, August and September), the calculated dilution factors from the 3-D models required to meet CWQG and/or SSWQO at 100 m are either less than or within the range of dilution factors from the near-field mixing models of Mammoth Lake and Whale Tail Lake (South Basin) that were completed using the CORMIX model (Golder 2019). In Mammoth Lake and Whale Tail Lake (South Basin), dilution factors obtained from a single summer diffuser ranged from 28 to 292 and from 25 to 204, respectively.

To minimize the risk of potentially exceeding CWQG and/or SSWQO in June in Mammoth Lake and Whale Tail Lake (South Basin), Agnico Eagle proposes:

- Having mixing zone boundaries of 200 m from each of the summer diffusers (Table 1).
- Investigating adaptive management strategies when there is a higher likelihood of potential for exceedances at the mixing zone boundary, including splitting the effluent discharge from the WTP between Mammoth Lake and Whale Tail Lake (South Basin) (i.e., June 2020) and splitting the effluent discharge from the WTP between Whale Tail Lake (South Basin) and Mammoth Lake (i.e., June 2024 and June 2025).

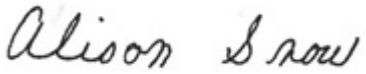
Table 1: Mixing Zone Sizes in Mammoth Lake and Whale Tail Lake (South Basin)

Receiving Environment	Approximate Volume of Mixing Zone (Mm^3)	Volume of Receiving Environment (Mm^3)	Approximate Volume of Mixing Zone to Receiver (%)
Mammoth Lake	0.87	6.29	14
Whale Tail Lake (South Basin)	1.9	11.8	16

Water quality concentrations of treated effluent at the end of pipe will not be acutely toxic during summer and winter discharges; water quality concentrations within the mixing zones during treated effluent discharge from the WTP are expected to be above CWQG and/or SSWQO for a short duration (i.e., approximately 4 weeks per year following freshet discharge). However, the elevated concentrations are not expected to impair the uses of the lake outside of the mixing zone boundaries during treated effluent discharge from the WTP.

3.0 CLOSURE

We trust that the above meets your requirements. If you have any questions, please contact the undersigned.



Alison Snow, MASc
Water Quality Modeller

John Faithful, BSc (Hons)
Principal, Senior Water Quality Specialist

AS/JF/jr

https://golderassociates.sharepoint.com/sites/113014/project files/5 technical work/stage-3_techmtg-phc/02_commitments/mixingzone/mixing_zone_tm/rev0/19127573-452-tm-mixingzoneboundaries-wts_mam-rev0.docx

References

Golder (Golder Associates Ltd.). 2019. Nearfield Mixing Modelling in Mammoth Lake and in Whale Tail Lake (South Basin). Prepared for Agnico Eagle Mines Limited. July 2019.