- Clarified that Agnico Eagle had evaluated the alternatives to the discharge from CP1, but had concluded that there are no reasonably feasible alternatives available to manage the excess water between now and freshet in May;
- Proposed an additional robust monitoring program for the 2020 discharge season (daily monitoring of flow volumes, weekly monitoring of field measurements and water chemistry at the end of pipe, monthly monitoring of field parameters and water chemistry at a total of three stations at the edge of mixing zone);
- In response to questions, Agnico Eagle expressed a willingness to give further consideration to the feasibility of the 21-day Daphnia magna survival and reproduction test as a potential alternative to the three-brood Ceriodaphnia dubia test;
- Proposed the establishment of a Working Group (KivIA, CIRNA, ECCC, NWB) that would receive the data from the proposed monitoring program and would be consulted about the development of thresholds for adaptive management as part of the monitoring process;
- Clarified that Agnico Eagle has already implemented contingency measures for Agnico Eagle to meet their existing monitoring program obligations in light of the operational and travel restrictions imposed under the public health measures implemented in response to the COVID-19 pandemic. Consequently, Agnico Eagle does not anticipate any logistical concerns related to compliance with the additional monitoring program associated with the proposed discharges from CP1 within the scope of the Amendment Application;
- Agnico Eagle did propose alternatives to the monitoring approach if additional limitations arise while the proposed monitoring program during discharge from CP1 is being carried out.

The Amendment Application and associated documentation filed by Agnico Eagle is available from the NWB's ftp site at the following link:

ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-MEL1631%20Agnico/1%20APPLICATION/2020%20Emergency%20Amendment/

The parties' written submissions about the Amendment Application are available from the NWB's ftp site at the following link:

ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-MEL1631%20Agnico/2%20ADMIN/3%20SUBMISSIONS/2020%20Emergency%20Amendment/

The Board's Decisions and Recommendations

Is the Amendment Application Required on an Emergency Basis?

Agnico Eagle acknowledged that, at the time the Amendment Application was submitted, the site conditions were not yet an emergency. However, Agnico Eagle provided evidence from third-party experts from Tetra Tech, who noted that, based on the current water levels in CP1, and the

volumes of water projected to be added to CP1 (reporting to CP1) during the upcoming freshet, if Agnico Eagle cannot discharge from CP1 as proposed in the Amendment Application, there could be *"significant, and in some cases irreversible adverse effects*."[6]

During the technical review of the Amendment Application, CIRNA and the KivIA acknowledged that in the immediate short term, discharge(s) from CP1 must occur on an emergency basis to prevent harm to the water management infrastructure on site, and in particular, damage to the dike structure DCP1 that supports containment of the water in CP1.

Although the *NWNSRTA* does not define what constitutes an "emergency" under the Act, the Board has considered the following factors to assess whether the Amendment Application is required on an emergency basis:

- The potential for harm or damage to human health or safety to occur if the Amendment Application is not dealt with on an urgent basis;
- The potential for harm or damage to the environment to occur if the Amendment Application is not dealt with on an urgent basis; and
- The potential for harm or damage to property to occur if the Amendment Application is not dealt with on an urgent basis.

The Board agrees with CIRNA and the KivIA that the evidence provided by Agnico Eagle makes it clear that unless discharges from CP1 take place prior to the upcoming freshet, permanent damage may occur to critical water management infrastructure. The Board is concerned that such damage could lead to the failure of containment of the water in CP1, which could result in harm or damage to the environment and harm or damage to human health or safety as well. Consequently, the Board has concluded that the amendments proposed in the Amendment Application are required on an emergency basis as set out in the *NWNSRTA*.

In considering the Amendment Application on an emergency basis, the NWB has not limited the scope of the amendment to only the discharges from CP1 necessary to draw down the pond to accommodate water volumes reporting to CP1 during freshet as recommended by the KivIA. Although the Board is hopeful that, prior to the freshet in 2021, Agnico Eagle will have submitted, and the NWB and interested parties will have reviewed and considered, a more permanent amendment to the Licence to better manage water volumes on-site, the Board also understands that there are many factors outside the control of the Board, Agnico Eagle and the interveners that could result in delays in the Board's processing of any future amendment application. The Board is concerned that factors such as continued limits on public gatherings and travel restrictions associated with the COVID-19 pandemic could have an impact on whether the amendments required to authorize discharges from CP1 during the 2021 freshet could be considered in a timely manner. In addition, Agnico Eagle provided evidence that if CP1 is not dewatered as proposed in

[6] Jamie Quesnel (Agnico Eagle) to Karen Kharatyan (NWB); RE: April 16, 2020 Teleconference Written Closing Remarks – Type A Licence No. 2AM-MEL1631 Emergency Amendment Application; April 16, 2020; and
Agnico Eagle's teleconference presentation entitled: "Meliadine Gold Mine – Emergency Amendment, NWB Technical Meeting", Slide # 12; April 16, 2020.

the Amendment Application by the end of October 2020, that the resulting high water levels in CP1 could damage the containment infrastructure over the course of the winter

Consequently, the Board has concluded that it is reasonable for the scope of Emergency Amendment No. 1 to include the entire 2020 summer discharge season, which is expected to be May 2020 through October 2020 and to include the activities required to discharge the Water from CP1 in order to protect the integrity of the water management infrastructure.

The Board's Recommendations Regarding Amendment No. 1

The Board commends Agnico Eagle's commitment to establish and work collaboratively with a specific Water Management Working Group (KivIA, CIRNA, ECCC, NWB) in order to discuss the monitoring progress and develop the adaptive management thresholds applicable to the discharges from CP1. However, the Board requires that the following preliminary adaptive management thresholds should be used until the final thresholds are developed by the Water Management Working Group during the Group teleconference to be scheduled tentatively within two weeks following the commencement of the discharge from CP1:

- If two consecutive end-of-pipe sampling events identify TDS concentrations equivalent to, or greater than, 3,500 mg/L, Agnico Eagle will increase sampling frequency; and
- If two consecutive edge-of-mixing-zone sampling events identify TDS concentrations equivalent to, or greater than, 75% of the interim target of 1,000 mg/L, Agnico Eagle will increase sampling frequency.

The Board notes that the first meeting of the Water Management Working Group will be tentatively within two weeks following the commencement of the discharge from CP1. The NWB expects that Agnico Eagle will provide a summary table with all monitoring results acquired prior to this and all next meetings, so that the Working Group can review the data and provide constructive feedback during each meeting. Additionally, the NWB expects that Agnico Eagle will provide adaptive management and mitigation options in advance of each meeting if either of the following occurs:

- There have been any instances of non-compliance with the effluent quality criterion of 3,500 mg/L MAC TDS, as measured at MEL-14, and/or
- There have been any instances of non-compliance with the interim TDS threshold as applied at the edge of the Mixing zone.

The Board notes that a specific monitoring program was developed for the 2020 Discharge and incorporated into the Emergency Amendment 1 under Schedule I, Table 3. This monitoring program was proposed by the Applicant and discussed with the intervening parties during the technical review/ teleconference. The Board notes that there were a few divergences of opinions regarding a number of monitoring strategies associated with the monitoring of Mixing Zone and Reference Areas. The Board is of the opinion that the weekly water quality sampling at the edge of the Mixing Zone and monthly sampling at the Reference Areas will be the most appropriate way to validate that the Effluent discharged during the 2020 Discharge season behaves as predicted

in the *WQMOP*, and specifically, is diluted to at least 1,000 mg/L TDS at the edge of the Mixing Zone, is fully assimilated within the receiving environment, and will not result in deleterious effects on aquatic life. At the same time, the Board advises that the sampling strategy presented in Table 3 of Schedule I may be further adjusted as per the NWB's direction based on the monitoring results' discussions with the Water Management Working Group.

Keeping the Community Informed

The Board also shares KivIA's concern that due to the processing of the Amendment Application in emergency circumstances, coupled with public health measures that limit the ability of community members to gather and engage in the regulatory process, that there has been a lack of opportunity for the exchange of information and community involvement in respect of the Amendment Application. Recognizing the concerns expressed by the KivIA that community members may perceive that these discharges from CP1 will adversely impact the quality of drinking water drawn from Meliadine Lake, the Board strongly recommends that Agnico Eagle consider how to ensure the public is informed about their planned discharges from CP1 over the course of the summer. Such measures could include posting information on Facebook or other social media platforms that are readily available to community members, and the information provided should include items such as plain language and translated summaries about:

- The progress of discharges from CP1;
- The overall current water quality baseline conditions in Meliadine Lake; and
- The updated water quality in Meliadine Lake as indicated by monitoring undertaken during the CP1 discharges in 2020.

Monitoring Contingencies

The NWB agrees with the KivIA that the following contingency measures should be implemented to ensure that robust monitoring continues even if the currently proposed laboratory analysis becomes unavailable due to public health measures implemented in response to the COVID-19 pandemic:

- Use of specific conductivity or TDS field measurements as a surrogate for laboratory measured TDS and the contributing ions (development of a statistical relationship between field measurements of specific conductivity and laboratory measured TDS); and
- Agnico Eagle should consult with the Water Management Working Group in respect of all monitoring and adaptive management measures implemented by Agnico Eagle over the course of the CP1 discharges in 2020.

Additionally, the Board appreciates Agnico Eagle's commitment to consider alternative monitoring approaches, such as installation of the remote monitoring stations at the edge of the mixing zone that would enable Agnico Eagle to continue to collect the necessary data, if limitations (*i.e.* ice cover on Meliadine Lake) arise while the proposed Monitoring Program applicable to the discharges from CP1 are being carried out.

Based on the information provided above, the Panel P15, by way of Motion No: 2020-01-P15-05 has acknowledged that the application for Amendment No. 1 to Water Licence No: 2AM-MEL1631 received on March 24, 2020 should be processed by the NWB on an emergency basis. Further, if the Minister consents to processing the Application for Amendment No. 1 on an emergency basis, the Panel P15 has, by way of Motion No: 2020-01-P15-06, authorized the issuance of these Reasons for Decision and the specified amendments to Water Licence No: 2AM-MEL1631 (Amendment No. 1) that are attached.

EMERGENCY AMENDMENT NO. 1

PART F: CONDITIONS APPLYING TO WASTE DISPOSAL AND MANAGEMENT

Insert Item 21:

The Discharge of Effluent from the Final Discharge Point at Monitoring Program Station MEL-14 shall be directed to Meliadine Lake through the Meliadine Lake Outfall Diffuser and shall not exceed the Effluent quality limits required under Part F, Item 3, except TDS that shall not exceed the following Effluent quality limits during the 2020 Discharge:

Parameter	Maximum Average Concentration	Maximum Concentration of Any Grab Sample
TDS (mg/L) (measured)	3,500	—

Insert Item 22:

The Licensee shall implement the Plan entitled *"Water Quality Management and Optimization Plan (WQMOP), Implementation Plan for Total Dissolved Solids"*, dated March 24, 2020, that was submitted as additional information with the March 24, 2020 Application for an amendment to Type "A" Water Licence No: 2AM-MEL-1631 to authorize the 2020 Discharge (the Amendment Application) that has been approved by the Board with the issuance of the Emergency Amendment No. 1. The Licensee shall submit to the Board for review an updated Plan, prior to starting the 2020 Discharge, to reflect all commitments made during the review of the Amendment Application.

PART I: CONDITIONS APPLYING TO GENERAL AND AQUATIC EFFECTS MONITORING

Insert Item 23:

The Licensee, in addition to the requirements as referred to in Part I, Item 6, during the 2020 Discharge, shall undertake the Water Monitoring Program provided in Table 3 of Schedule I.

Insert Item 24:

The Licensee shall submit to the Board for approval, within the 2020 Annual Report, an updated Aquatic Effects Monitoring Program (AEMP) to take into account the results of the monitoring of the receiving environment during the 2020 Discharge.

Insert Item 25:

The Licensee shall provide to the Board for review the 2020 Discharge Plume Delineation Study summary report as soon as all necessary data and results become available.

Schedule A: Scope, Definitions, and Enforcement

Insert:

"2020 Discharge" means the time-limited discharge (May 2020 – October 2020) of Effluent from the Final Discharge Point (Containment Pond 1 (CP1)) at Monitoring Program Station MEL-14 to Meliadine Lake through the Meliadine Lake Outfall Diffuser as indicated in the Amendment Application, dated March 24, 2020.

Schedule I: Conditions Applying to General and Aquatic Effects Monitoring

Insert:

Table 3 – Water Monitoring Program during the 2020 Discharge:

Station Locations	Description	Monitoring Parameters	Reporting Frequency
MEL-13-XX/ MEL-01-XX	Mixing zone in Meliadine Lake, minimum of three sampling locations within and/or at the edge of Mixing zone	(a) Field physico-chemical water column profile (temperature, specific conductivity); (b) Water quality monitoring: • Conventional; • Major ions and TDS; • Nutrients; • Total and dissolved metals.	Weekly during discharge or as per NWB's direction
		(c) Chronic toxicity tests with: • Pelagic crustacean – *Daphnia magna (21-day test)*; • Epibenthic/ Benthic Insect - *Hyalella azteca*; • Plant or Alga (duckweed, *Lemna minor*); • ELS fish – Rainbow Trout or Fathead minnow (7-day test).	Monthly during discharge
MEL-14	Water treatment plant from CP-1 (post-treatment), end of pipe in the plant before offsite release	(a) Water quality monitoring: • Conventional • Major ions and TDS • Nutrients • Total and dissolved metals	Weekly during discharge
		(b) Acute toxicity tests with: • *Daphnia magna* • Rainbow trout	Monthly during discharge

MEL-02-XX	Mid-field exposure area	(a) Water quality monitoring: • Conventional • Major ions and TDS • Nutrients • Total and dissolved metals (b) Chronic toxicity tests with: • Pelagic crustacean – *Daphnia magna (21-day test)*; • Epibenthic/ Benthic Insect - *Hyalella azteca*; • Plant or Alga (duckweed, *Lemna minor*); • ELS fish – Rainbow Trout or Fathead minnow (7-day test).	Monthly during discharge or as per NWB's direction
MEL-03-XX	Reference Area 1		
MEL-04-XX	Reference Area 2		
MEL-05-XX	Reference Area 3		

ll remaining terms and conditions of Type "A" Water Licence No: 2AM-MEL1631, issued on April 15, 2016, and approved on May 19, 2016, still apply.

This Licence Amendment No. 1 issued and recorded at Gjoa Haven, NU on April 29, 2020.

Lootie Toomasie
Chairperson
Nunavut Water Board

APPROVED BY: Daniel Vandal
Minister of Northern Affairs

DATE: 12/05/20

APPENDIX B: WATER QUALITY MANAGEMENT AND OPTIMIZATION PLAN

REPORT

Water Quality Management and Optimization Plan Progress Update Rev4a

Phase 3: Meliadine Mine Effluent Discharge Benchmarks for Total Dissolved Solids

Submitted to:

Agnico Eagle Mining Limited
Meliadine Mine Operations

Submitted by:

Golder Associates Ltd.
Suite 200 - 2920 Virtual Way, Vancouver, British Columbia, V5M 0C4, Canada

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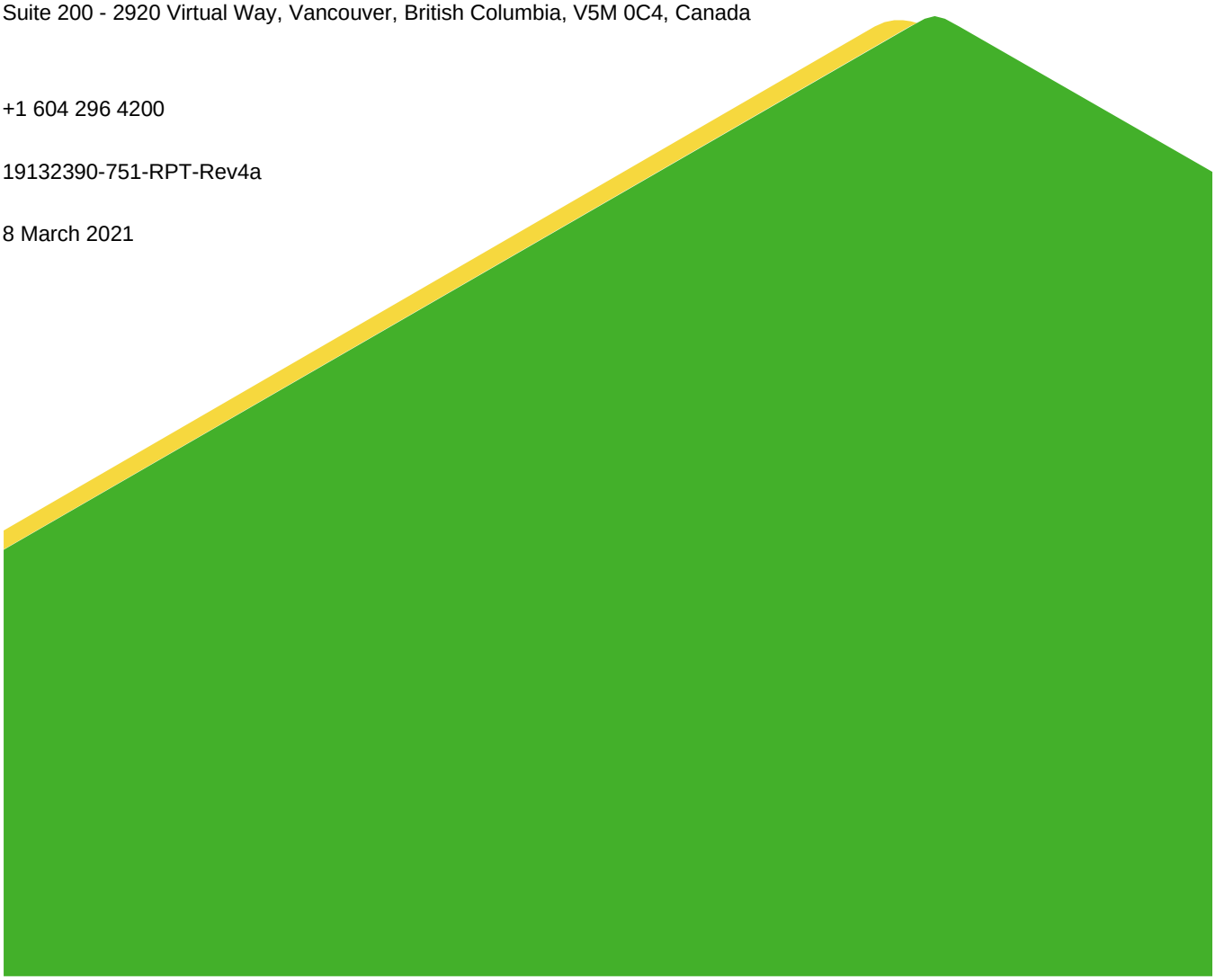
19132390-751-RPT-Rev4a

8 March 2021



Distribution List

1 eCopy: Agnico Eagle Mines Limited

1 eCopy: Golder Associate Ltd.

REVISION HISTORY

Version	Date Issued	Purpose	Revisions
Rev1	24 March 2020	Development of a Plan to support the submission of the Emergency Amendment to the Type A Water Licence (2AM-MEL1631)	Establish a Plan to build from existing work performed on TDS benchmarks, including the following: ■ Evaluation of site-specific toxicity data. ■ Integration with the framework discussed with regulators for developing interim water quality targets for TDS at end of pipe and in the receiving environment that reflect the site-specific mixture of ions, confirmed through standardized toxicity tests (acute and chronic toxicity testing) and evaluation of assimilative capacity. ■ Establishment of a process (monitoring study design) for validation of interim targets in summer 2020.
Rev2	2 June 2020	Updated to address the NWB's approval of Emergency Amendment 1	Updates included: ■ Added clarification and additional scope to the Water Quality Validation Study—The NWB approval states that "the Licensee, in addition to the requirement as referred to in Part I, Item 6, during the 2020 discharge, shall undertake the Water Quality Program provided in Table 3 of Schedule I." The supplemental detail for this study is provided in Section 3.0 of the WQ-MOP (Conduct Validation Study). ■ Additional scope for the Plume Delineation Study—The NWB approval states that "the Licensee shall provide to the Board for review the 2020 Discharge Plume Delineation Study summary report as soon as all necessary data and results become available." A detailed study design for the 2020 Discharge Plume Delineation Study has been included in Appendix B of the WQ-MOP, and a summary of program sampling requirements is included in Section 3.3 of the WQ-MOP. ■ Incorporate a Response Plan—The WQ-MOP now includes adaptive management recommendations. This includes the addition of chemical and toxicological endpoint thresholds that monitoring data collected at the end of pipe or at the edge of the mixing zone can be compared, as well as a list of management actions or protocols that could be implemented in response to non-compliance. ■ Provide Field Contingencies—The WQ-MOP now includes contingency plans that could be implemented if logistical complications (e.g., safety concerns due to ice-cover or COVID-19) arise during the required 2020 water quality sampling program.
Rev2a	21 August 2020	Updated to address questions from ECCC and KivIA on 11 August 2020	■ Inclusion of the Maximum Grab Concentration (MGC) for TDS for the discharge of 5,000 mg/L ■ Inclusion of a paragraph in the adaptive management section (Section 3.5) to discuss thresholds and their application based on sample timing at the end of pipe and edge of mixing zone
Rev3	24 August 2020	Updated to include in the application package of the Type A Water Licence Amendment (2AM-MEL1631)	■ Included similar updates to Rev2a, but incorporated results of Phase 2 validation monitoring into Phase 1 to support the application of the discharge limits (EQCs) and edge of mixing zone (SSWQO) benchmark to provide for the ongoing long-term protection of Meliadine Lake from unacceptable effects ■ Inclusion of a new standalone Adaptive Management section (Section 5)

Version	Date Issued	Purpose	Revisions
Rev4	13 November 2020	Updated to support the Type A Water Licence Amendment (2AM-MEL1631) technical review process	■ Incorporated the 2020 monitoring results for the discharge and from the receiving environment, including the supplemental testing studies, continuous in lake monitoring, and plume delineation studies ■ Included the Phase 3 component, which recommends the discharge limits (EQCs) and edge of mixing zone (SSWQO) benchmark for the long-term water management of CP1 discharge to Meliadine Lake so that Meliadine Lake is protected in the long-term from unacceptable effects
Rev4a	8 March 2021	Updated to incorporate monitoring data that were finalized following the Type A Water Licence Amendment (2AM-MEL1631) regulatory review process	■ Incorporates the final water quality and toxicity testing results for CP1 discharge (MEL-14) and edge-of-mixing zone (MEL-13-01, MEL-13-07, and MEL-13-10) samples as part of the 2020 monitoring results. These results have been added to Appendix B. These results represent the final set of monitoring data that were not available for Rev4 ■ Removal of details from the standalone Adaptive Management section (Section 5) and reference to the separate Adaptive Management Plan

PLAIN LANGUAGE SUMMARY

The Water Quality Management and Optimization Plan (WQ-MOP) was developed by Agnico Eagle Mines Limited (Agnico Eagle) to provide a procedure for determining acceptable discharge criteria and an in-lake monitoring benchmarks in Meliadine Lake. This process included three phases:

- Phase 1 – Develop total dissolved solids (TDS) discharge criteria and an in-lake monitoring benchmark for Meliadine Lake during the 2020 discharge season
- Phase 2 – Complete a detailed field study that included fish survival test with the discharge and aquatic organism growth and reproduction tests in the lake, and chemistry analysis of the discharge (one station) and the receiving environment (seven stations) on a regular basis
- Phase 3 – Develop long-term discharge criteria and an in-lake monitoring benchmark for Meliadine Lake that will be applicable to future operating conditions at the Meliadine Mine

Since March 2020, several versions of the WQ-MOP have been prepared. These versions allowed for updates to the WQ-MOP based on feedback and recommendations following review by the Nunavut Water Board (NWB), Kivalliq Inuit Association (KivIA), Environment and Climate Change Canada (ECCC), and Crown Indigenous Relations Northern Affairs Canada (CIRNAC), and results of the detailed field study.

The Phase 1 of the WQ-MOP recommended TDS discharge criteria up to 3,500 mg/L and in-lake monitoring benchmark, located at 100m from the discharge point, of 1,000 mg/L during the 2020 discharge season.

The detailed field program conducted as Phase 2 of the WQ-MOP provided information on the quality of the discharge from Collection Pond 1 (CP1) in 2020 and the influence of the discharge on Meliadine Lake. In 2020, 1,031,177 m^3 of water was discharged from CP1 to Meliadine Lake. The daily discharge volume ranged from 15 m^3 to 17,518 m^3, with a daily average of 8,522 m^3. The TDS concentrations in the discharge ranged from 1,340 mg/L to 3,100 mg/L. Full chemical analyses were conducted and all regulated parameters in the Water Licence remained below regulated discharge limits. Throughout the duration of the discharge, the release of the water went as planned and testing and continuous monitoring showed that there was no occurrence of harmful effects on the environment, fish, and other aquatic life.

Meliadine Lake comprises several in-lake monitoring stations: three monitoring stations 100 m from the discharge point, a mid-field station (approximately 6 km downstream of the discharge point), and three reference stations downstream from the discharge point near the lake outlet. Sampling at these stations commenced immediately after the initiation of discharge of CP1 water to Meliadine Lake on July 3, 2020, which occurred during ice-cover conditions. Discharge continued on a regular basis until October 4, 2020 after discharge was ceased. Sampling was completed weekly at the edge of the mixing zone and monthly at the mid-field and reference stations, except when access to the lake was unsafe, such as during ice melt. Full chemical analyses were conducted on these samples. All in-lake measurements at 100 m from the discharge point remained well below the interim benchmark of 1,000 mg/L.

Over the discharge season, TDS concentrations measured at the in-lake monitoring stations ranged from 30 mg/L to 115 mg/L. All measured parameters over the discharge period were below guidelines, except for dissolved zinc at one edge of mixing zone station on August 2 and one reference station on July 27. This elevated concentration at the edge of the mixing zone was attributed to analytical variability as it was within five times the detection limit and not correlated with the MEL-14 discharge, with corresponding zinc concentrations in the discharge and at the

other edge of mixing zone stations below guidelines. Concentrations of TDS at the mid-field and reference locations showed decreased further with distance from the diffuser. Throughout the duration of the discharge, water at the in-lake monitoring stations edge showed that harmful effects on the environment, fish, and other aquatic life were not occurring.

Additional monitoring under Phase 2 included the collection of measurements of water quality at different depths, collection of continuous conductivity measurements (using in lake monitoring systems) from a single depth at three monitoring stations 100 m from the discharge point over the discharge season, and on two occasion (in early summer and late summer) the collection of measurements of conductivity at different depths at 22 sampling stations located up to a distance of 250 m from the discharge point to understand how the discharge water is mixing in Meliadine Lake. These monitoring components determined that:

- During ice-cover conditions, specific conductivity measurements in the lake near the discharge point were at their highest.
- Water monitoring at different depths near the discharge point showed that the discharge can be identified at low concentrations during ice cover conditions and during periods of higher discharge rates, and other times, the discharge was well mixed.
- The in lake continuous monitoring stations showed that the discharge under ice moved predominantly from the discharge point in a west-north-east direction.
- During a higher discharge condition, higher conductivity was detected closer to the discharge point and at different water monitoring depths at all monitoring stations near the discharge point; under a lower discharge condition, a difference in conductivity across monitoring stations was not obvious.
- The submerged diffuser at the discharge point was able to effectively disperse the discharge into Meliadine Lake.

As a result of the water monitoring conducted under Phase 2, discharge under ice cover and open water conditions has been shown to remain within the TDS discharge criteria and the in-lake monitoring benchmark for Meliadine Lake, and showed that harmful effects on the environment, fish, and other aquatic life were not occurring. Monitoring confirmed that the submerged diffuser was able to effectively disperse the discharge into Meliadine Lake.

Based on the results of this detailed study, the following regulatory discharge limits and in-lake benchmark are therefore recommended for the long-term water management of CP1 discharge to Meliadine Lake:

- Water Licence regulatory limits: MAC of TDS of 3,500 mg/L and the maximum grab concentration (MGC) of TDS of 5,000 mg/L for discharge from MEL-14 to Meliadine Lake (i.e., EQC); and
- An in lake benchmark concentration of TDS of 1,000 mg/L to be achieved at the edge of the mixing zone in Meliadine Lake, which would also be consistent with the SSWQO for longer-term management of the receiving environment of Meliadine Lake.

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TABLES

APPENDICES

1.0 INTRODUCTION

The purpose of this Water Quality Management and Optimization Plan (WQ-MOP) update is to recommend discharge and receiving environment limits for total dissolved solids (TDS) as per Phase 3 of the WQ-MOP Rev2 for:

- the maximum average concentration (MAC) and maximum grab concentration (MGC) for discharge from CP1 to Meliadine Lake (i.e., effluent quality criteria; EQC); and
- the benchmark concentration to be achieved at the edge of the mixing zone in Meliadine Lake, which would also be consistent with the site-specific water quality objective (SSWQO) for longer-term management of the receiving environment of Meliadine Lake.

These recommendations are based on the results of the validation monitoring conducted in 2020 for the discharge and in the receiving environment (i.e., Meliadine Lake) as per Phase 2 of the approach detailed in the approved WQ-MOP Rev2 (Golder 2020b). As included in previous versions of the WQ-MOP (Rev1; Golder 2020a), this revision also describes the adaptive management thresholds associated with the management of water in CP1 that would trigger the implementation of measures to reduce the potential for the targets associated with discharge to Meliadine Lake to be exceeded. These thresholds are aligned with those included in the Adaptive Management Plan (AMP; Agnico Eagle 2021).

On 2 June 2020, the WQ-MOP Rev2 (Golder 2020b) was submitted to the Nunavut Water Board (NWB) as a requirement under NWBs Reason for Decision (NWB 2020) to approve Agnico Eagle Mines (Agnico Eagle) Emergency Amendment to their Type “A” Water Licence (No. 2AM-MEL1631), submitted 24 March 2020, for effluent discharges associated with the Meliadine Mine located in the Kivalliq Region of Nunavut. This amendment, along with the WQ-MOP Rev2, was approved with Minister’s consent on 12 May 2020 and discharges to Meliadine Lake were initiated on 5 June 2020. The objective of the WQ-MOP was to formalize a procedure for management of effluent discharges that follows a systematic and science-based framework for determining acceptable discharge quality conditions.

The WQ-MOP Rev2a (Golder 2020c) was submitted to NWB on 24 August in response to questions from Environment and Climate Change Canada (ECCC) and the Kivalliq Inuit Association (KivIA) during a Water Management Working Group (WMWG) meeting for the 2020 discharge. As a result, a MGC for TDS for the discharge of 5,000 mg/L was added, and further detail for adaptive management thresholds and activities was developed. The WQ-MOP Rev2a is provided in Appendix A.

The WQ-MOP Rev2a included a summary of the water management plan for the Mine associated with the Meliadine Lake discharge and proposed interim targets for TDS that were developed as per Phase 1 for the effluent discharge and for receiving environment conditions at the edge of the mixing zone during the emergency amendment. This plan also detailed monitoring studies to monitor discharge and receiving environment conditions of Meliadine Lake under the approved temporary (May to October 2020) amendment to Agnico Eagle’s Type “A” Water Licence (No. 2AM-MEL1631), which permitted the following:

- Authorization to temporarily discharge water from Containment Pond 1 (CP1) to Meliadine Lake that contains a maximum average concentration of TDS up to 3,500 mg/L, which exceeds the current limit described in Part F, Item 3 of the current Water Licence of 1,400 mg/L

Under the approved Water Licence Emergency Amendment, Meliadine Mine has been discharging from CP1 to Meliadine Lake since 5 June 2020. This discharge concluded on 3 October 2020. Water quality monitoring and toxicity testing described in detail in the approved WQ-MOP Rev 2a (Appendix A) was completed on 26 October 2020 (discharge terminated on 3 October 2020), with the sampling program operational for a period of just over 20 weeks. Results for the chemistry and toxicology components over the discharge period (between 3 June and 4 October 2020), including a post-discharge sample from MEL-14 collected on 26 October 2020, are summarized and interpreted in Appendix B. This post-discharge sample was collected for toxicity and limited chemistry testing because at this time the TDS concentration in MEL-14 was higher than the range of TDS concentrations tested during the 2020 discharge period; this testing provided additional evaluation of concentration response.

Within the WQ-MOP Rev2a (Appendix A), a three-phased approach was developed that included developing interim discharge and edge of mixing zone targets for TDS, designing and completing validation studies for the discharge and receiving environment, and finalizing the TDS benchmarks. At this time, Phase 1 (Develop Interim Targets) has been completed, which proposed TDS targets for the discharge and the edge of the mixing zone. These proposed targets were reviewed by the WMWG and, following responses to comments from ECCC and KivIA (Agnico Eagle 2020), as well as discussions through the WMWG, the following interim targets were agreed to:

- A MAC and a MGC of 3,500 mg/L TDS and 5,000 mg/L TDS, respectively, for the discharge
- An edge of mixing zone target of 1,000 mg/L TDS in the Meliadine Lake receiving environment at a radius of 100 m surrounding the in-lake diffuser

Phase 2 of the WQ-MOP (Conduct Validation Study) details the validation studies specific to the emergency amendment, which commenced in conjunction with the release of discharge from the Meliadine Mine to Meliadine Lake on 5 June 2020. Sampling for this phase is complete; however, final results for the fourth round and additional toxicity testing from MEL-14 are yet to be received. These results are expected to further support the recommendations from Phase 3. The scope of the Phase 2 validation studies is summarized in Section 3.0 and details on the data collected for water quality and toxicity testing completed in 2020 during and after the discharge period are provided in Appendix B.

Phase 3 (Finalize Meliadine Mine Benchmarks) as detailed in this version of the WQ-MOP involves incorporating the findings of Phase 1 into the assessment of results from the Phase 2 validation studies and confirming and setting the discharge limits (EQCs) and edge of mixing zone (SSWQO) benchmarks, which will provide for the ongoing long-term protection of Meliadine Lake from unacceptable effects (see Section 2.0 for details).

1.1 Report Structure

This updated WQ-MOP provided as part of the 2020 Water Licence Amendment application has been structured as follows:

- Benchmark Development (Section 2.0)
- Summary of Validation Study Components (Section 3.0)
- Finalization of Meliadine Mine Benchmarks for Longer-term Water Management (Section 4.0)
- Adaptive Management (Section 5.0)
- Conclusions (Section 6.0)
- Appendix A: WQ-MOP Rev2a

- Appendix B: 2020 Discharge Monitoring Results for Samples Collected Between June 2020 and October 2020
- Appendix C: 2020 Plume Delineation Surveys Conducted on 21 July 2020 and 13 August 2020
- Appendix D: *Ceriodaphnia dubia* Supplemental Toxicity Study

1.1 Concordance

As part of the approval of the Request for the Minister's Consent to Process Amendment No. 1 to NWB Water Licence Type "A" No: 2AM-MEL1631, five conditions were required to be met. These are list below, with reference to where they have been addressed in the WQ-MOP (Table 1).

Table 1: Concordance Table for Conditions Required in Response to the Minister's Consent to Process Amendment No. 1 to NWB Water Licence Type "A" No: 2AM-MEL1631

<table>
<tr><th colspan="2">Licence Condition</th><th rowspan="2">Corresponding Section in WQ-MOP</th></tr>
<tr><th>Item</th><th>Condition</th></tr>
<tr><td>Item 21</td><td>The Discharge of Effluent from the Final Discharge Point at Monitoring Program Station MEL-14 shall be directed to Meliadine Lake through the Meliadine Lake Outfall Diffuser and shall not exceed the Effluent quality limits required under Part F, Item 3, except TDS that shall not exceed the following Effluent quality limits during the 2020 Discharge:
<table>
<tr><th>Parameter</th><th>Maximum Average Concentration</th><th>Maximum Concentration of Any Grab Sample</th></tr>
<tr><td>TDS (mg/L) (measured)</td><td>3,500</td><td>—</td></tr>
</table></td><td>Section 1;
Section 4;
Appendix B</td></tr>
<tr><td>Item 22</td><td>The Licensee shall implement the Plan entitled "Water Quality Management and Optimization Plan (WQMOP), Implementation Plan for Total Dissolved Solids", dated March 24, 2020, that was submitted as additional information with the March 24, 2020 Application for an amendment to Type "A" Water Licence No: 2AM-MEL-1631 to authorize the 2020 Discharge (the Amendment Application) that has been approved by the Board with the issuance of the Emergency Amendment No. 1.

The Licensee shall submit to the Board for review an updated Plan, prior to starting the 2020 Discharge, to reflect all commitments made during the review of the Amendment Application.</td><td>This document

Revision History;
Appendix A</td></tr>
<tr><td>Item 23</td><td>The Licensee, in addition to the requirements as referred to in Part I, Item 6, during the 2020 Discharge, shall undertake the Water Monitoring Program provided in Table 3 of Schedule I.</td><td>Section 3</td></tr>
<tr><td>Item 24</td><td>The Licensee shall submit to the Board for approval, within the 2020 Annual Report, an updated Aquatic Effects Monitoring Program (AEMP) to take into account the results of the monitoring of the receiving environment during the 2020 Discharge.</td><td>Planned for Submission March 2021</td></tr>
<tr><td>Item 25</td><td>The Licensee shall provide to the Board for review the 2020 Discharge Plume Delineation Study summary report as soon as all necessary data and results become available.</td><td>Appendix C</td></tr>
</table>

2.0 PHASE 1: BENCHMARK DEVELOPMENT

The guiding principle for Phase 1 outlined in the WQ-MOP was that site-specific water quality benchmarks be developed that satisfy the following conditions:

- protective of the environment
- satisfy regulatory requirements
- based on science (rather than strictly on considerations of policy or precedent)
- customized to the site-specific conditions of water quality and quantity

Adoption of fixed numerical benchmarks, either as static discharge limits or generic water quality guidelines, is unlikely to satisfy some parts of the above guiding principle. TDS benchmarks can, however, be developed using a toxicity-based approach that satisfies all the above conditions. TDS represent a “soup” of multiple component ions, and the behavior of this mixture in the environment is influenced by the relative toxicities of the component ions and the ability of some ions (e.g., calcium) to ameliorate the toxicity of others. For effective regulation of TDS, an approach is required that considers the toxicological potential of the mixture, and the point of compliance for different types of responses.

From communications with ECCC, the conceptual approach presented in the WQ-MOP Rev2a was consistent with guiding principles and had three main components in the development of numerical targets:

- Discharge must not result in acute toxicity at the point of release
- Discharge must not result in unacceptable chronic toxicity at the edge of the mixing zone (a regulated boundary located 100 m around the diffuser) following initial dilution
- Discharge must not exceed the capacity of the receiving environment to accommodate long-term loadings of constituents (i.e., assimilative capacity)

For broader management of TDS in Nunavut, instead of promulgating an uncertain numerical value for TDS or its individual component(s), Agnico Eagle developed interim targets for managing TDS in the discharge and receiving environment (to apply at the edge of the mixing zone) that reflect the site-specific mixture of ions, confirmed through standardized toxicity tests and evaluation of assimilative capacity. As detailed in the WQ-MOP Rev2, a validation monitoring program was designed and implemented with the onset of discharge on 5 June 2020 to validate interim targets developed as part of the WQ-MOP and to provide data to inform development of firm discharge limits and receiving environment benchmarks (or EQCs and SSWQOs) for long-term application. The discharge limit and SSWQO benchmarks were then be applied to guide an adaptive management approach for managing site water.

Since the approval of the emergency amendment, and following consent from the Minister of Northern Affairs on 12 May 2020, monitoring data collected at the end of pipe and in the receiving environment (at the edge of the mixing zone) following the commencement of discharge on 5 June 2020 (i.e., Phase 2 of the validation framework) have been compared to interim discharge and edge of mixing zone limits applied at the end of pipe and in the receiving environment, respectively.

3.0 PHASE 2: Conduct Validation Study

In conjunction with the 2020 discharge to Meliadine Lake, as approved under Amendment 1 of the Mine's Type "A" Water Licence, supporting studies were conducted to monitor conditions and validate the science-based interim targets, as well as produce additional information on receiving environment assimilation (including plume delineation). This following section presents an overview of the monitoring studies completed as a condition under Amendment 1. A more detailed description of the discharge monitoring program is provided in the WQ-MOP Rev2a (Appendix A).

3.1 Validation during 2020 Discharge Event

The design of the approved validation study described in the WQ-MOP Rev2a (Appendix A) consisted of three components: water quality monitoring, toxicity testing, and plume delineation:

- **Water Quality Monitoring**—The surface water quality monitoring program was used to validate the near-field model predictions that TDS will be dispersed to less than 1,000 mg/L at the edge of the mixing zone, and to provide detailed chemical characterization of the effluent and receiving environment during the discharge, including an evaluation of the ionic composition of water used during the toxicity testing program. The water quality monitoring component was supplemented by the deployment of remote continuous logging sondes at the edge of the mixing zone stations 2 m above the lakebed. These sondes were used provide specific conductivity data at the edge of the mixing zone during the transition from ice cover to open water in Meliadine Lake when safe access to the lake was impossible.
- **Toxicity Testing**—The acute and chronic toxicity testing programs were conducted to confirm that the ionic composition measured in the discharge and the receiving environment during the surface water quality monitoring program were not at levels that would cause adverse biological effects. As described in detail in the WQ-MOP Rev2a (Appendix A) and summarized in Appendix B, Table B-1, the acute toxicity testing was conducted on the discharge to validate that the discharge is not acutely toxic. A suite of chronic toxicity tests was also conducted on discharge and receiving environment samples to validate that TDS concentrations measured at the edge of the mixing zone were not at levels that would cause chronic toxicity. As per commitments arising from responses to comments from ECCC and KivIA (Agnico Eagle 2020), as well as discussions through the WMWG, starting during the second monthly sampling event (see Appendix B; Table B-1 for details), chronic toxicity testing of the discharge was conducted monthly using a dilution series test design similar to that performed on the edge of mixing zone receiving environment stations.
- **Plume Delineation Study**—Plume delineation studies were conducted in mid and late summer (i.e., 21 July and 13 August 2020) to assess the vertical and horizontal extent of the effluent plume during seasonal periods that reflect the two distinct open water hydrological conditions in Meliadine Lake. The emphasis of these studies was on *in situ* specific conductivity profiling of the water column using a handheld meter with a sensor that will be lowered through the water column, with a subset of locations sampled for TDS. The relationship between field measured specific conductivity and laboratory measured TDS was established to validate the use of specific conductivity as a tracer of TDS in the receiving environment. The information retrieved confirmed model predictions related to effluent dilution and assimilation in the receiving environment, and that receiving environment monitoring stations were adequately characterizing conditions with respect to surface water chemistry and the potential for adverse biological effects.

An overview of the validation monitoring design that was conducted in 2020 is presented in Appendix B; Table B-1 and Figure B-1 depicts the locations of the selected monitoring stations. The plume delineation study is presented in Appendix C.

Starting in 2021, it is expected that the validation monitoring, with respect to discharge and edge of mixing zone locations and sampling frequency, will return to the monitoring design as required under the approved water licence.

3.2 Supplemental Toxicity Testing of CP1 Water

To supplement the toxicity testing completed for Phase 2 of the WQ-MOP, Agnico Eagle conducted complementary testing of water from CP1 in February 2020 to evaluate the potential for chronic toxicity of high TDS water.

The purpose of this CP1 supplemental testing was to:

- Evaluate the toxicity of CP1 water to a sensitive freshwater invertebrate (the crustacean, *C. dubia*) at concentrations higher than tested in 2019 chronic toxicity testing.
- Evaluate the concentration-response profile for both survival and reproduction endpoints to assist in the validation of the maximum average concentration for discharge from CP1 to Meliadine Lake (i.e., EQC) and the benchmark concentration to be achieved at the edge of the mixing zone in Meliadine Lake (i.e., SSWQO).
- Evaluate the sensitivity of TDS (and chloride) toxicity to manipulations of the original sample ionic composition, to provide insight into causation.

Additional details of the supplemental toxicity testing, including water chemistry measurements, raw toxicity test data and bench sheets, and statistical analyses are provided in Appendix D.

The *C. dubia* results from this supplemental testing confirm that mortality to a sensitive representative crustacean does not occur at or below the MAC 3,500 mg/L, despite the longer test duration relative to the standard 48-h *Daphnia magna* acute toxicity test commonly applied to evaluate acute toxicity. Additionally, *C. dubia* chronic toxicity (reproduction) did not occur in site-relevant mixtures until exposure concentrations of TDS are approximately double the SSWQO (i.e., double the 1,000 mg/L benchmark used to protect against chronic toxicity). The results are consistent with other testing of *C. dubia* reproduction in site water (conducted as part of the Phase 2 validation study) and confirm that the proposed EQC and SSWQO remain protective of their intended environmental protection goals.

The *C. dubia* survival endpoint is not routinely applied as a measure of acute toxicity under the MDMER or other effluent discharge regulations, as it is a chronic test, and more sensitive than the 96-h rainbow trout and 48-h *D. magna* tests commonly used to evaluate acute toxicity in undiluted effluent. As such, confirmation of the LC_{50} above 3,500 mg/L provides an additional margin of safety for the evaluation of acute toxicity.

4.0 PHASE 3: FINALIZE MELIADINE MINE BENCHMARKS

The Meliadine Mine discharged from CP1 to Meliadine Lake from 5 June 2020 to 3 October 2020, as approved under Amendment 1 of the Mine's Type "A" Water Licence. As such, water quality monitoring outlined in Appendix B; Table B-1 was completed on 26 October 2020, with the sampling program operational for a period of just over 20 weeks. Results reported for the chemistry and toxicology components over this period are summarized and interpreted in Appendix B.

Results represent the following monitoring as detailed in Table 2.

Table 2: Details of the Validation Monitoring conducted on the discharge and in the Receiving Environment during the 2020 Discharge associated with the Emergency Amendment

Validation Monitoring	Sampling Events / Duration
Water Chemistry	
MEL-14[a]	22 Sampling Events – 5, 7, 14, 15, 21, and 28 June; 5, 19, and 26 July; 2, 9, 13, 16, 23, 29 and 30 August; 5, 6, 13, 20, and 27 September; and 2 October 2020
Edge of Mixing Zone[b]	16 Sampling Events – 7[d] June; 12, 19, 22 and 29 July; 2, 9, 15, 19[e], 23, and 29 August; 5, 13, 20, and 27 September; and 4 October 2020
Mid-field Station[c]	7 Sampling Events – 7 June; 23 and 27 July; 18 and 22 August; and 7 and 12 September 2020
Reference Stations[c]	7 Sampling Events – 7 June; 22/25 and 27[f] July; 19[g] and 22/23 August; and 8[f] and 12 September 2020
Toxicity Testing	
MEL-14[a]	18 Acute Toxicity Tests – 7, 14, 21, and 28 June; 5, 12, 19, and 26 July; 2, 9, 16, 23, and 30 August; 6, 13, 20, and 27 September; and 2 October 2020 5 Chronic Toxicity Tests[a] – 20 July, 23 August, 12 September, and 3 October 2020
Edge of Mixing Zone	4 Chronic Toxicity Tests – 7[d] June, 23 July, 23 August, and 13 September
Mid-field Station[c]	4 Chronic Toxicity Tests – 6 June, 23 July, 22 August, and 12 September 2020
Reference Stations[c]	4 Chronic Toxicity Tests – 6 June, 25 July, 22/23 August, and 12 September 2020
Plume Delineation Studies	2 Events – 21 July 2020, and 13 August 2020
Remote Continuous Specific Conductivity and Temperature Monitoring	5 June 2020 to 4 October 2020[h]

[a] A post-discharge sample was collected from MEL-14 on 26 October 2020 to characterize elevated TDS; toxicity testing was conducted on this sample to address limitations in the TDS concentration exposure range tested in 2020.

[b] Due to melting ice conditions on Meliadine Lake (health and safety issue), weekly sampling events at the edge of the mixing zone during the weeks of 14 June, 21 June, 28 June, and 5 July were not conducted.

[c] Due to ice formation on Meliadine Lake (health and safety issue), the final monthly sampling event at the start of October was not conducted

[d] MEL-13-01 and MEL-13-07 only; edge of mixing zone station MEL-13-10 was not accessible due to unsafe local ice conditions during the first monthly sampling event (i.e., 7 June 2020)

[e] MEL-13-01 only

[f] MEL-03-02 only

[g] MEL-03-02 and MEL-04-05 only

[h] MEL-13-01 from 5 June to 29 August 2020

Detailed discussion of the results of this testing are provided in Appendix B.

The following represents the primary conclusions of this data analysis and interpretation of results:

- TDS concentrations measured in the discharge were less than the MAC of 3,500 mg/L in each of the weekly sampling events and ranged between 1,340 and 3,100 mg/L measured TDS (1,000 and 2,600 mg/L calculated TDS)
- The discharge was not found to be acutely toxic in 18 rounds of acute toxicity tests conducted with *D. magna* and Rainbow Trout, as the LC_{50} values were >100% discharge in each of the tests
- Sublethal toxicological effects were not identified during the chronic toxicity testing at MEL-14 with the exception of low-level chronic effects to one species in the post-discharge sample collected in October. The MEL-14 post-discharge sample at a measured TDS concentration of 2,740 mg/L (2,500 mg/L calculated TDS) indicated some chronic effects to *Lemna minor* frond count when compared to the laboratory controls. Although results from this test do not align with the previous rounds of testing (i.e., IC_{50} greater than 97% at TDS concentrations ranging between 1,700 and 1,850 mg/L measured TDS [1,200 and 1,400 mg/L calculated TDS]), the results continue to support that the TDS SSQWO of 1,000 mg/L remains protective.
- TDS concentrations measured at the edge of mixing zone stations were consistently less than the interim target of 1,000 mg/L
- The plume delineation studies demonstrated that there was a high assimilation rate and that TDS concentrations rapidly decrease in the receiving environment to concentrations below which adverse effects on biological receptors would be expected. The results of these studies were consistent with the 2018 plume delineation study completed as part of the AEMP/EEM (Golder 2019) and aligned with the hydrodynamic modelling of the east basin of Meliadine Lake (Tetra Tech 2020a)
- Consistent with the low TDS concentration results reported in the receiving environment, adverse toxicological effects were not identified during the monthly chronic toxicity testing programs

Based on the agreed upon site-specific benchmark derivation procedure outlined in the WQ-MOP Rev2a (Appendix A) and summarized in Section 2.0, the validation monitoring conducted to date supports the interim EQC and edge of mixing zone (SSWQO) targets because:

- Discharge with TDS concentrations ranging between 1,340 and 3,100 mg/L measured TDS (1,000 and 2,600 mg/L calculated TDS) did not result in acute toxicity to *D. magna* and Rainbow Trout
- TDS concentrations in samples from MEL-14 ranging between 1,700 and 2,740 mg/L measured TDS (1,200 and 2,500 mg/L calculated TDS) did not result in chronic toxicity for fathead minnow, *Hyalella azteca*, or *D. magna.* Some chronic effects to *L. minor* frond count at MEL-14 relative to the laboratory controls were observed at a measured TDS concentration of 2,740 mg/L (2,500 mg/L calculated TDS), however, no effects to the biomass endpoint were identified, and the test results continue to support the SSWQO as being protective. Furthermore, the effects to frond count observed in this test do not align with the previous rounds of testing where no effects (i.e., IC_{50} greater than 97%) were noted at TDS concentrations ranging between 1,700 and 1,850 mg/L measured TDS (1,200 and 1,400 mg/L calculated TDS)
- Discharge did not result in chronic toxicity at the edge of the mixing zone following initial dilution (i.e., at a 100 m radius surrounding the diffuser in Meliadine Lake)

- Discharges do not show potential to exceed the capacity of the receiving environment to accommodate long-term loadings of constituents (i.e., assimilative capacity), as indicated by the observations that effluent rapidly diluted to less than the interim edge of mixing zone target of 1,000 mg/L TDS during the sampling events
- *C. dubia* results from supplemental testing conducted in February 2020 (Section 3.2) confirm that mortality to a sensitive representative crustacean does not occur at or below the MAC 3,500 mg/L, despite the longer test duration relative to the standard 48-h *D. magna* acute toxicity test commonly applied to evaluate acute toxicity
- *C. dubia* results from the supplemental testing conducted in February 2020 (Section 3.2) confirm that chronic toxicity to a sensitive species and endpoint (reproduction) does not occur until exposure concentrations of TDS are approximately double the SSWQO

Based on these observations, and the testing completed on site in 2018 and 2019, the MAC (3,500 mg/L) and a MGC of TDS of 5,000 mg/L can be adopted as benchmarks (i.e., as EQCs) for managing the discharge. Additionally, monitoring efforts in 2020 as outlined in Table B-1 of Appendix B completed for the duration of the permitted temporary discharge of CP1, a TDS concentration of 1,000 mg/L can be adopted for the mixing zone target as a firm benchmark (and SSWQO) in Meliadine Lake. These benchmarks are considered appropriate for the long-term water management at the Site, which will not result in adverse effects to the use of Meliadine Lake and for the on-going protection of aquatic life.

Results of the validation monitoring collected in 2020 have been available to the Board during the technical review process; following each monthly monitoring event, results from the validation monitoring were collated, reviewed, and presented to the WMWG, which was represented by the NWB, KivIA, ECCC, and Crown Indigenous Relations and Northern Affairs Canada (CIRNAC). Key messages to the WMWG during the meetings included that the monitoring data collected in 2020 confirmed that the diffuser was working as designed, the water being released in Meliadine Lake was safe to the environment, fish, and other aquatic life, and that there was no evidence of a build-up (accumulation) of TDS in Meliadine Lake beyond the localized area of the diffuser (i.e., near-field area) as a result of the discharge.

5.0 ADAPTIVE MANAGEMENT

The thresholds and management responses developed for the WQ-MOP as required by NWB's (2020) Reason for Decision and described in the AMP (Agnico Eagle 2021) will apply to discharges beyond 2020. The thresholds and management responses associated with adaptive management are detailed in Table 3. The table identifies an operating level ranging from Normal Operating Conditions, to Caution, and At-Risk Conditions, the thresholds that trigger each level, and a list of management strategies and actions for consideration in response to mitigate and/or rectify the condition, if required.

Table 3: Surface Water Quality Adaptive Management Strategy for CP1 Discharge to Meliadine Lake

Adaptive Management Level	Threshold	Management Activity / Response /Action
Normal Operating Condition	Measured concentrations are less than the MAC discharge limit	■ Continue monitoring as per Water Licence requirements ■ Continue water management as per Water Management Plan ■ Continue management as per the Adaptive Management Plan
Caution	Two consecutive weekly end-of-pipe TDS concentrations equivalent to, or greater than, the MAC discharge limit,	■ Conduct a follow up sampling event to confirm trigger ■ Increase sampling frequency at end of pipe ■ Follow management activity options as per the Adaptive Management Plan
At Risk	Three consecutive weekly end-of-pipe TDS concentrations equivalent to, or greater than, the MAC discharge limit, or A single end-of-pipe TDS exceedance of the MGC discharge limit	■ Conduct a follow up sampling event to confirm trigger ■ Follow management activity options as per the Adaptive Management Plan

Water quality (i.e., TDS) and toxicity testing monitoring data collected in CP1 (representing the discharge) and at the edge of the mixing zone will be compared to the benchmarks as determined by Phase 3 of the WQ-MOP.

Adaptive management measures will be implemented if management thresholds are triggered. Since submission of the WQ-MOP Rev4, an AMP has been prepared with input from KivIA, CIRNAC, and ECCC (Agnico Eagle 2021). The AMP was submitted to the Nunavut Impact Review Board as a commitment for the Saline Effluent Disposal to the Marine Environment Proposal, with a copy to the NWB as a commitment for the renewal of Water Licence 2AM-MEL1631. The AMP outlines water management activities that will be taken to reduce discharge of contact water to Meliadine Lake and maximize use of the waterline.

6.0 CONCLUSIONS

This updated version of the WQ-MOP provides an evaluation of the water quality monitoring and toxicity testing data for discharge and the receiving environment (i.e., edge of mixing zone, and mid-field and reference locations) collected over the 2020 discharge period as per the Phase 2 (Conduct Validation Study) component of the WQ-MOP Rev2 and for the completion of Phase 3 (Finalize Meliadine Mine Benchmarks) to determine:

- the MAC and MGC for discharge from CP1 to Meliadine Lake (i.e., effluent quality criteria; EQC); and
- the benchmark concentration to be achieved at the edge of the mixing zone in Meliadine Lake, which would also be consistent with the SSWQO for longer-term management of the receiving environment of Meliadine Lake.

As a result of the comprehensive monitoring conducted under Phase 2, discharge under ice cover and open water conditions has been shown to remain within the interim EQC targets for TDS and not be acutely toxic or result in sub-lethal effects to aquatic biota. Further, the receiving environment has remained protected with no adverse effects identified to aquatic biota. Monitoring of the physico-chemical conditions and the water quality has confirmed the effectiveness of the diffuser in consistently dispersing the discharge, which has met edge of mixing zone requirements using the interim TDS target at the edge of the mixing zone and has further attenuated with distance from the diffuser. Therefore, Agnico Eagle recommends as per Phase 3 of the WQ-MOP, that the interim TDS targets for the discharge and receiving environment developed under Phase 1 be ratified as regulatory targets for TDS as EQC for discharge and SSWQO for the receiving environment that will be applicable to future operating conditions at the Meliadine Mine. Specifically:

- the MAC of TDS of 3,500 mg/L and the MGC of TDS of 5,000 mg/L for discharge from CP1 to Meliadine Lake (i.e., EQC); and
- the benchmark concentration of TDS of 1,000 mg/L to be achieved at the edge of the mixing zone in Meliadine Lake, which would also be consistent with the SSWQO for longer-term management of the receiving environment of Meliadine Lake.

Signature Page

Golder Associates Ltd.

Original signed

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John Faithful, BSc (Hons) PBiol
Principal, Senior Water Quality Scientist

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https://golderassociates.sharepoint.com/sites/117232/project files/5 technical work/6000_sswq_tds_benchmarks/6020_wq-mop/rev4a/final_address client comments/19132390-751_rpt_wqmop_meliadine_rev4a-cpr_db.docx

7.0 REFERENCES

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NWB (Nunavut Water Board). 2020. NWB Water Licence Type “A” No: 2AM-MEL1631 – Request for the Minister’s Consent to Process Amendment No. 1 on an Emergency Basis and Attached Reasons for Decision and Amendment No. 1 for the Minister’s Consideration. File No. 2AM-MEL1631/Emergency Amendment No. 1.

Tetra Tech. 2020a. Meliadine Lake Updated 3D Modelling of the Discharge Assessment. Technical Memorandum. Submitted to Agnico Eagle Mines. November 2020.

APPENDIX A

WQ-MOP Rev2a

REPORT

Water Quality Management and Optimization Plan

Implementation Plan for Total Dissolved Solids

Submitted to:

Agnico Eagle Mining Limited
Meliadine Mine Operations

Submitted by:

Golder Associates Ltd.

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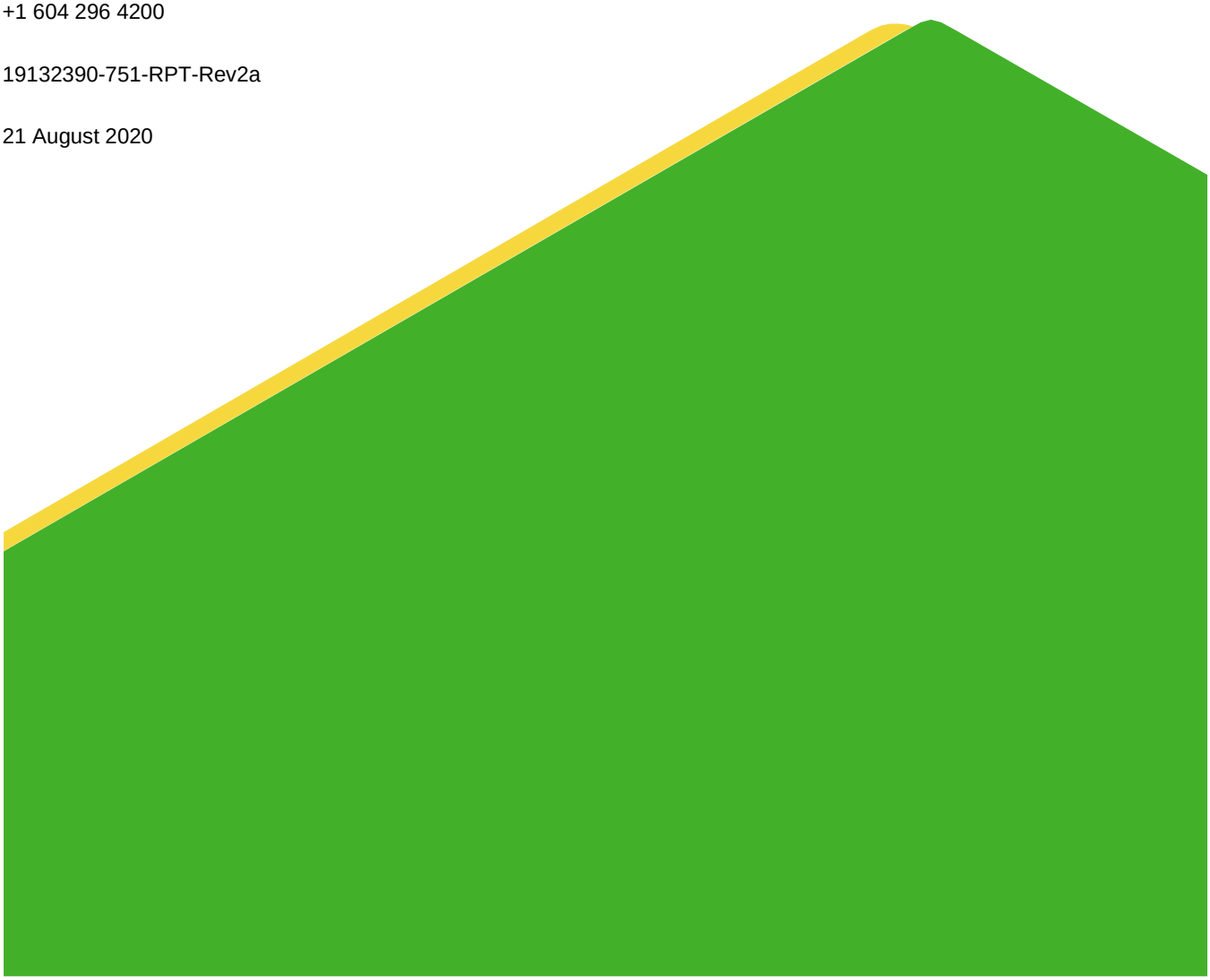
19132390-751-RPT-Rev2a

21 August 2020



Distribution List

1 eCopy: Agnico Eagle Mines Limited

1 eCopy: Golder Associate Ltd.

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TABLES

APPENDICES

1.0 INTRODUCTION

This report provides a Water Quality Management and Optimization Plan (WQ-MOP) for effluent discharges associated with the Meliadine Mine located in the Kivalliq Region of Nunavut. The objective is to formalize a procedure for management of effluent discharges that follows a systematic and science-based framework for determining acceptable effluent quality conditions.

The WQ-MOP presented herein is focussed on development of interim targets for total dissolved solids (TDS) for effluent discharge and receiving environment conditions at the edge of the mixing zone, but within a framework that can be extended to longer-term management of site water. Although currently specific to the Meliadine Mine, it is intended to align with a process that can be generalized to other Agnico Eagle Mines Limited (Agnico Eagle) projects in Nunavut.

On 24 March 2020, Agnico Eagle submitted an emergency request for an amendment to their Type "A" Water Licence (No. 2AM-MEL-1631), specifically seeking the following amendment:

- Authorization to temporarily discharge water from Containment Pond 1 (CP1) to Meliadine Lake that contains a maximum average TDS concentration up to 3,500 mg/L, which exceeds the current limit described in Part F, Item 3 of the current Water Licence of 1,400 mg/L

The emergency request issued by Agnico Eagle was based on the determination that the water storage capacity of CP1 would be exceeded if dewatering was not conducted prior to or in conjunction with the 2020 spring freshet. If the dewatering was not permitted, and the water storage capacity of CP1 was exceeded, this could represent a significant risk to site infrastructure, as well as human and environmental health. On 29 April 2020, the Nunavut Water Board (NWB 2020) recommended approval of Licence Amendment 1 for Agnico Eagle's Type "A" Water Licence, which permits the following:

- *The time-limited discharge (May 2020 – October 2020) of effluent from the Containment Pond 1 (CP1) into Meliadine Lake through the Meliadine Lake Diffuser (Monitoring Program Station MEL-14) and the Water discharge shall not exceed 3,500 mg/L for the Maximum Average Concentration (MAC) of the Total Dissolved Solids (TDS)*

The NWB's approval of Emergency Amendment 1 is contingent on conditions outlined in NWB's (2020) Reason for Decision. To respond to these conditions and requirements, the following have been addressed in this Updated WQ-MOP:

- **Water Quality Validation Study**—The NWB approval states that *"the Licensee, in addition to the requirement as referred to in Part I, Item 6, during the 2020 discharge, shall undertake the Water Quality Program provided in Table 3 of Schedule I.*" The scope for this study is provided in Section 3.0 of the WQ-MOP (Conduct Validation Study).
- **Plume Delineation Study**—The NWB approval states that "*the Licensee shall provide to the Board for review the 2020 Discharge Plume Delineation Study summary report as soon as all necessary data and results become available."* A detailed study design for the 2020 Discharge Plume Delineation Study has been included in Appendix B of the WQ-MOP, and a summary of program sampling requirements is included in Section 3.3 of the WQ-MOP.
- **Response Plan**—The WQ-MOP now includes adaptive management recommendations. This includes the addition of chemical and toxicological endpoint thresholds that monitoring data collected at the end of pipe or at the edge of the mixing zone can be compared, as well as a list of management actions or protocols that could be implemented in response to non-compliance.

- **Field Contingencies**—The WQ-MOP now includes contingency plans that could be implemented if logistical complications (e.g., safety concerns due to ice-cover or COVID-19) arise during the required 2020 water quality sampling program.

NWBs recommended approval of Amendment 1 received Minister's consent from the Honourable Daniel Vandal, Minister of Northern Affairs on 12 May 2020.

1.1 Site-Specific Benchmark Development Procedure

The guiding principle for the WQ-MOP is that water quality benchmarks should be developed that satisfy the following conditions:

- protective of the environment
- satisfy regulatory requirements
- based on science (rather than strictly on considerations of policy or precedent)
- customized to the site-specific conditions of water quality and quantity

Adoption of fixed numerical benchmarks, either as static discharge limits or generic water quality guidelines, is unlikely to satisfy some parts of the above guiding principle. TDS benchmarks can, however, be developed using a toxicity-based approach that satisfies all the above conditions. TDS represent a "soup" of multiple component ions, and the behavior of this mixture in the environment is influenced by the relative toxicities of the component ions and the ability of some ions (e.g., calcium) to ameliorate the toxicity of others. For effective regulation of TDS, an approach is required that considers the toxicological potential of the mixture, and the point of compliance for different types of responses.

From our communications with Environment and Climate Change Canada (ECCC), a conceptual approach has been developed that is consistent with the guiding principle, and that has three main components in the development of numerical targets:

- Effluent discharges must not result in acute toxicity at the point of release
- Effluent discharges must not result in unacceptable chronic toxicity at the edge of the mixing zone following initial dilution
- Effluent discharges must not exceed the capacity of the receiving environment to accommodate long-term loadings of constituents (i.e., assimilative capacity)

For broader management of TDS in Nunavut, instead of promulgating an uncertain numerical value for TDS or its individual component(s), we recommend development of interim targets for managing TDS in the effluent discharge and receiving environment (to apply at the edge of the mixing zone) that reflect the site-specific mixture of ions, confirmed through standardized toxicity tests and evaluation of assimilative capacity. Much of this information has already been collected for Meliadine Mine, and Agnico Eagle has designed a validation program to validate interim targets and provide data to inform development of effluent quality criterion (EQC) and site-specific water quality objective (SSWQO) benchmarks for long-term application (see Section 3.0). The EQC and site-specific water quality objectives (SSWQO) benchmarks can be applied to guide an adaptive management approach to processing of site water.

1.2 Phasing the Water Quality Management and Optimization Plan

As communicated to NWB by Agnico Eagle, the upcoming 2020 freshet season will result in accumulation of site water that exceeds the water storage capacity of the mine at CP1, requiring a managed release of site water to the environment. In anticipation of this condition, Amendment 1 was approved by NWB for Meliadine Mine's Type "A" Water Licence, allowing Meliadine Mine to dewater CP1 prior to or in conjunction with the 2020 freshet, avoiding "emergency" conditions. This decision received Minister's consent from the Honourable Daniel Vandal, Minister of Northern Affairs, on 12 May 2020.

The operational needs dictate a phased approach to the WQ-MOP, in which short-term needs for monitoring and validation are met, while remaining consistent with the overall WQ-MOP framework.

- **Phase 1: Develop Interim Targets**—Application of the general process described in Section 1.1, entailing review of literature and results of site-relevant toxicity testing, and subsequent establishment of science-based TDS targets, for use on an interim basis.
- **Phase 2: Conduct Validation Study**—In conjunction with the upcoming release of discharge from Meliadine Mine to Meliadine Lake commencing during freshet, Agnico Eagle will conduct supporting studies in 2020 to validate and/or refine the science-based interim targets and produce additional information on receiving environment assimilation. The scope for this study is provided in Section 3.0 of the WQ MOP (Conduct Validation Study).
- **Phase 3: Finalize Meliadine Mine Benchmarks**—Integrate the results of Phase 1 and Phase 2 to formalize the science-based interim targets as EQC and SSWQO benchmarks, with a framework for their implementation (e.g., adaptive management), that is applicable to future conditions at Meliadine Mine. Phase 3 will be submitted as part of the amendment application of the existing Meliadine Water Licence to the Nunavut Water Board.

This document emphasizes Phase 1 (Section 2.0) and Phase 2 (Section 3.0) of the WQ-MOP; sufficient detail is provided for the validation and plume delineation studies to indicate conformance with the Mine's monitoring requirements outlined in the NWB's (2020) Reason for Decision. Additional details of sample collection, handling, and chain-of-custody are being developed separately for use by the field crew and analytical laboratories.

2.0 PHASE 1: DEVELOP INTERIM TARGETS

2.1 Interim TDS Target for Effluent

This section presents the proposed interim target for effluent of 3,500 mg/L calculated TDS for the Meliadine Mine; the target is expressed as a Maximum Average Concentration (MAC). This target is proposed as an interim value, pending implementation of Phase 2 and Phase 3 of the WQ-MOP. The interim target of 3,500 mg/L calculated TDS was proposed following a review of site acute toxicity data collected for Meliadine Mine (Appendix A) and was approved (Amendment 1) on 4 May 2020 as the temporary (May 2020 to October 2020) TDS MAC permitted to be discharged from CP1 into Meliadine Lake at the Meliadine Mine Lake Outfall diffuser (Monitoring Program Station MEL-14).

As discussed in Appendix A, the toxicity of TDS across different site waters varies by ionic composition and the relative proportion of ions in the mixture. Low effect concentrations for acute endpoints (e.g., survival) have been reported in the literature for individual ions for select species, but these tests reflect exposure conditions accounting for a single ion, and not a balanced TDS mixture representative of most field conditions. Considering

this, the proposal of an interim target focussed on review of site-specific acute toxicity data collected for site-relevant mixtures (e.g., treated effluent, influent, Collection Pond water; Appendix A, Section A2.0).

The approved interim TDS target for effluent of 3,500 mg/L is supported by:

- No acute toxicity to *D. magna* or Rainbow Trout was observed with influent and effluent TDS concentrations of equal to or less than 5,420 mg/L (measured TDS concentrations of equal to or less than 4,925 mg/L)—details are provided in Appendix A.
- No mortality to other organisms has been observed in tests using Fathead Minnows or *C. dubia* in chronic exposures; as of January 2020, these tests covered calculated TDS concentrations up to 2,357 mg/L (measured TDS concentrations of 2,490 mg/L). Chronic test endpoints are not used in a regulatory context to evaluate the acute toxicity of the effluent, but the lack of mortality in chronic tests provides encouraging information.
- The record of acute toxicity depicted in Appendix A (Table A-4) provides evidence of the lack of acute toxicity even at high TDS concentrations. As of March 2020, nine acute toxicity tests have been conducted with calculated TDS concentrations above 3,500 mg/L. For this reason, some caution is recommended in the development of the interim TDS target for effluent. The no-effect concentration of 5,420 mg/L calculated TDS was therefore reduced by 30% and rounded down to the value of 3,500 mg/L.

Validation of the interim TDS target to demonstrate that the effluent is consistently not acutely lethal will be conducted through monitoring during the discharge period as presented in Section 3.0. Sensitive species that form the basis for the validation would include test species *D. magna* and Rainbow Trout, as these are the species used to assess compliance for acute lethality under the Metal and Diamond Mining Effluent Regulations (MDMER; Government of Canada 2002).

2.2 Interim TDS Target at the Edge of the Mixing Zone

An interim target of 1,000 mg/L (as calculated TDS) to apply in the receiving environment at the edge of the mixing zone is proposed for the protection against chronic toxicity to representative aquatic species. This interim target is intended to evaluate the condition (from Section 1.1) that effluent discharges must not result in unacceptable chronic toxicity at the edge of the mixing zone following initial dilution. The target is proposed as an interim value for use in the short-term, pending implementation of Phase 2 and Phase 3 of the WQ-MOP. The interim target of 1,000 mg/L in the receiving environment at the edge of the mixing zone was supported by the NWB (2020) in their Reasons for Decision related to the approval of Amendment 1 of the Type “A” Water Licence.

The proposed interim target was derived using methods described in Appendix A and summarized below:

- Characterization of the Meliadine TDS profile (Section A1.1)—water chemistry data collected at the Meliadine Mine were used to profile the anticipated water quality in the receiving environment, including composition of major component ions in the TDS mixture.
- Review of water quality benchmarks (Section A1.2)—review of TDS benchmarks developed for locations with a similar TDS composition to Meliadine Mine.
- Literature review (Section A1.3)—review of peer-reviewed literature to determine the threshold for chronic toxicity with a focus on TDS mixtures of similar composition to Meliadine Mine (i.e., dominance of chloride, sodium, and calcium ions).

- Review of site-specific chronic toxicity data (Section A1.4)—review of site toxicity data and corresponding TDS and major ion chemistry of treated effluent and influent samples for Meliadine Mine, as collected during routine and regulatory compliance toxicity testing.
- Weight of Evidence (Section A1.5)—integration of the above information to justify the interim target of 1,000 mg/L TDS to apply at the edge of the mixing zone.

The interim TDS target includes the following assumptions:

- Ambient water hardness should remain within the current range to ameliorate potential chloride toxicity (i.e., through demonstration of non-toxicity of chloride under site-relevant ranges of hardness).
- Additional site-specific validation of the TDS threshold should be conducted to confirm that the mixture of ions represented by the effluent and near-field exposure conditions does not result in acute or chronic toxicity. Such studies are planned, as discussed in Section 3.0.
- Effluent chemistry profiles, particularly with respect to the proportions of major ions, will remain generally consistent in the future.

There is already strong scientific evidence to support the interim target as protective of the aquatic community. The results of toxicity testing do not indicate that an exceedance above 1,000 mg/L TDS will result in harm to aquatic life but provide reasonable certainty of no harm up to 1,000 mg/L. The key lines of evidence are presented in Appendix A, and are supported by the following considerations:

- The Meliadine Mine effluent contains a balance of major ions that is advantageous for limiting the toxic potency of the TDS mixture (Section A1.5.1).
- The Snap Lake site, which applies the same TDS concentration as a SSWQO, provides similar ionic mixtures and biological communities (Section A1.5.2).
- The chronic toxicity data set for Meliadine Mine site water, which includes a battery of four sensitive aquatic species, supports the interim TDS target as a defensible no-effect concentration (Section A1.5.3).
- The ionic balance has been stable in Meliadine Mine water, such that an interim TDS target can be developed without requiring development of targets for individual component ions (Section A1.5.4).

2.3 Assimilation Capacity Evaluation

The ability of the receiving environment to assimilate the concentrations and loading of constituents in effluent is the last component of the WQ-MOP implementation. Consideration of assimilation capacity provides confidence that constituents will not gradually accumulate to concentrations that would degrade the receiving environment.

The approach to TDS management set out in the WQ-MOP is not expected to affect the quality, quantity, or flow of the waters in Meliadine Lake. TDS levels during and after the 2020 discharge will continue to be managed to minimize adverse effects of the licenced deposit of effluent on the aquatic ecosystem of Meliadine Lake, and discharges would continue to meet the stringent requirements set by the MDMER. Confidence in this conclusion comes from plume delineation surveys, preliminary dilution estimates from dispersion models, and consideration of the Meliadine Lake hydrology.

The evidence for sufficient assimilation efficiency in Meliadine Lake to accommodate the interim TDS target for effluent of 3,500 mg/L comes from:

- **Consistency with Previous Impact Assessment Outcomes**—Based on the predictions included in the Final Environmental Impact Statement (FEIS) for the Meliadine Mine Gold Project (Golder 2014), the one-time release of mine wastewater to Meliadine Lake under this amendment would not be expected to result in potential additional project effects. That is, water quality in the receiver and downstream environment would remain within the predictions included in the FEIS. For the FEIS assessment, a Maximum Allowable Concentration (MAC; referred to as the Maximum Allowable Effluent Concentration [MAEC] in the FEIS) of TDS in the discharge of 4,685 mg/L was calculated based on the approach applied in the province of Quebec (MDDEP 2007), where the mixing ratio in a lake is set to a value of 10 to 1. The calculation of the MAC is dependent on the background concentrations (BG) in the lake, the water quality criteria (WQG; the guideline), and the mixing ratio (MR), as established by the following equation:

  $$MAC = MR \times (WQG - BG) + BG.$$

  Where for TDS:

  MR = 10 (as per MDDEP)

  WQG = 500 mg/L (Guidelines for Canadian Drinking Water Quality [GCDWQ; HC 2010], aesthetic objective)

  BG = 35 mg/L

  Therefore:

  $$MAC = 10 \times (500 - 35) + 35 = 4,685 \text{ mg/L}$$

  This MAC is well above the proposed interim target of 3,500 mg/L proposed in this amendment.

- **Plume Delineation Results**—Under operating conditions, a plume delineation survey based on specific conductivity results was conducted in 2018 in the near-field region of Meliadine Lake as part of the Environmental Effects Monitoring (EEM)/Aquatic Effects Monitoring Program (AEMP). The EEM plume delineation study used field surveys of specific conductivity to evaluate effluent dispersion with distance from the diffuser. The study evaluated dilution factors at a series of monitoring stations up to, and extending beyond, 250 m from the diffuser, based on the specific conductivity of the effluent and the measured field values through the water column at each the stations. To account for background values, two scenarios were used:

  - Scenario A: near-field average specific conductivity for 2015 to 2016; and
  - Scenario B: near-field average specific conductivity for 2017

  An observed slight increase in specific conductivity between 2015 to 2016 (pre-construction) and 2017 (construction) was the impetus for considering the two scenarios.

  Observations from the survey indicated a minimum dilution factor of 53 at 50 m away from the diffuser, and a minimum dilution factor range of 56 (Scenario A) and 85 (Scenario B) at the edge of the 100 m mixing zone boundary (Table 1). This study was also useful because it served to validate the performance of the submerged diffuser, which had previously been assessed by Tetra Tech as part of their design (Tetra Tech 2017) and re-assessed in 2018 (Tetra Tech 2018). As part of their reassessment in 2018, Tetra Tech concluded that the predicted minimum dilution of 23:1 was achieved at the edge of the 100 m mixing zone and that water quality criteria were met. The minimum dilution factor was more than twice the mixing ratio of

10:1 that was used to derive the MAC in the 2014 FEIS; it was based on a multi-year modelling scenario[1] where the minimum dilution at 100 m at the end of the first year of discharge was 72:1. The latter ratio is consistent with earlier modelling work to support a conceptual diffuser in 2015 (Agnico Eagle 2015), which indicated that the minimum dilution factor was 65:1.

In summary, the range of dilution factors observed at 100 m distance from the diffuser (representing the edge of the mixing zone) determined from the EEM plume delineation study are greater than the minimum dilution factor (23:1) developed in the performance assessment of the diffuser completed by Tetra Tech in 2018 based on multi-year simulations. The dilution factors remain in broad agreement with Tetra Tech's assessment for the first year of discharge (72:1) and the early work completed by Golder (65:1).

Table 1: Dilution Factors in the Near-field Exposure Area at Meliadine Lake[(a)]

Sampling Station	Maximum Specific Conductivity in 2018 (µS/cm)	Dilution Factor – Scenario A	Dilution Factor – Scenario B
50-01	99.8	63	104
50-03	105.5	53	79
100-01	93.4	80	159
100-03	104	56	85
100-04	102.6	58	90
100-05	98.9	65	109
100-06	88.5	101	266
100-08	96.6	71	125

(a) Listed data represent a portion of the data listed in Table 2.4-10 of Golder (2019)

µS/cm = microsiemens per centimetre

The 2018 EEM plume delineation results suggest that the effluent concentration observed at the 100 m mixing zone boundary was less than 2% of concentrations observed at end of pipe. Furthermore, the survey results showed that the plume remained at depths of roughly between 3 and 7 m, indicating that the receiving water and the effluent discharged had similar densities and/or intense mixing. The measured data from 2018 showed that at the time of the survey, the plume was more distinct to the south-west of the diffuser, which indicates a preferential direction of plume advection during the time of survey. Changes in wind speed and direction including current direction and speed are key factors determining the plume dispersion direction on any given day.

- **Mixing Ratio Calculations**—Preliminary calculations of the MAC have been completed based on standard industry practices as well as the results of the near-field modeling completed by Golder, as shown in Table 2.

[1] The multi-year simulation included annual diffuser discharge to Lake Meliadine over the 14 year construction and operations timeline (Year -3 to Year 11). This scenario was included to assess the effects of water quality constituent build-up in the lake on the dilution factor.

Table 2: Calculations of Maximum Average Concentrations for TDS

Report	Guideline for Canadian Drinking Water Quality for TDS (HC 2010) (mg/L)	Assumed Meliadine Lake Average Background TDS Concentration (mg/L)	Assumed Mixing Factor	Maximum Average Concentration (mg/L)
2014[a]	500 mg/L	35 mg/L	10:1	4,685
2015[b]			65:1	30,260[c]
2018[d]			23:1	10,730[c]
2019[e]			56:1	26,075[c]

Notes:

(a) Golder 2014. Water and Sediment Quality Model – Meliadine Mine Gold Project, Nunavut. Appendix 7.4-A.

(b) Agnico Eagle (2015) (see Appendix E, Water Management Plan).

(c) Concentration of maximum average effluent TDS is conceptual only; effluent would **not** be discharged at TDS concentrations of this magnitude as it could result in acute toxicity at the point of discharge.

(d) Tetra Tech (2018).

(e) Golder. 2019. Appendix G – Field Data in the Near-field Exposure Area at Meliadine Lake Under the Plume Delineation Study, 2018.

For the preliminary calculations, the mixing ratio (MR) was established as:

- 2014—reflects approach applied by the province of Quebec (MDDEP 2007), where the mixing ratio in a lake is set a value of 10:1.
- 2015—reflects minimum mixing factor predicted by near-field modeling.
- 2018—reflects minimum mixing factor as modelled for diffuser design (Tetra Tech 2017, 2018).
- 2019—reflects minimum mixing factor calculated from observations of plume delineation survey at edge of the 100 m mixing zone.

TDS = total dissolved solids; mg/L = milligrams per litre.

Based on the model calculations and the observation of the plume delineation study, it is likely that the discharge of effluent with a TDS concentration at 3,500 mg/L, even at the lowest measured mixing ratio of 72, would result in negligible risk of sublethal toxicity at the edge of the mixing zone. This mixing potential at the edge of the mixing zone boundary limits the potential for a sublethal response.

Beyond the mixing zone, into the near- and far-field in Meliadine Lake, effluent will be carried by currents within the lake and further mixed with ambient water. The location of the effluent outfall diffuser is also within the expected main flow channel of the lake, which will act to convey and further disperse the effluent toward the lake outlet.

The assimilative capacity of the 100 m mixing zone will be validated through a detailed monitoring program, for which a conceptual design is provided in Section 3.0.

3.0 PHASE 2: CONDUCT VALIDATION STUDY

In conjunction with the 2020 releases that are planned to occur prior to or in conjunction with the freshet at Meliadine Mine and that have been approved under Amendment 1 of the Mine's Type "A" Water Licence, supporting studies are required to be conducted in spring/summer 2020 to validate the science-based interim targets and produce additional information on receiving environment assimilation (including plume delineation). This section presents the general conceptual design for the spring/summer 2020 monitoring study required as a condition under Amendment 1. The monitoring study will be undertaken both to assess conditions experienced in Meliadine Lake during the discharge event, and for use as a validation component of the WQ-MOP.

A discharge event to dewater Collection Pond 1 (CP1) has been approved by NWB and will occur at the Mine site in the spring/summer of 2020. TDS concentrations in the effluent will be elevated relative to the receiving environment during this discharge event, presenting an opportunity to conduct site validation for the interim TDS targets for the effluent and for the receiving environment at the edge of the mixing zone. These studies also provide the opportunity to collect additional information for the potential development of TDS EQC and SSWQO

benchmarks, for use in adaptive management. The conceptual design for the proposed validation would consist of three components: water quality monitoring (Section 3.1), toxicity testing (Section 3.2), and plume delineation (Section 3.3).

These three components are complimentary and will be conducted with the following primary objectives:

- **Water Quality Monitoring:** The surface water quality monitoring program will be conducted to validate the model predictions that TDS will be diluted to less than 1,000 mg/L at the edge of the mixing zone, to provide detailed chemical characterization of the effluent and receiving environment during the discharge, and to provide information on the ionic composition of water used during the toxicity testing program.
- **Toxicity Testing:** The acute and chronic toxicity testing programs will be conducted to confirm that the ionic composition measured in the effluent and the receiving environment during the surface water quality monitoring program are not at levels that would cause adverse biological effects. As described in detail in Section 3.2 and summarized in Table 3, acute toxicity tests will be conducted on the effluent and a suite of chronic toxicity tests will be conducted on receiving environment samples.
- **Plume Delineation Study**—The plume delineation study will be conducted to assess the vertical and horizontal extent of the effluent plume. This will primarily be assessed through *in situ* specific conductivity profiling of the water column using a handheld meter with a sensor that will be lowered through the water column, with a subset of locations sampled for TDS. The relationship between field measured specific conductivity and laboratory measured TDS will be established to validate the use of specific conductivity as a tracer of TDS in the receiving environment. The information retrieved will be used to confirm model predictions related to effluent dilution and assimilation in the receiving environment, and to confirm that receiving environment monitoring stations are adequately characterizing conditions with respect to surface water chemistry and the potential for adverse biological effects.

An overview of the conceptual design is presented in Table 3 and discussed in detail by component below.

Table 3: Conceptual Design for Proposed Validation of Interim TDS Limits for Effluent and Receiving Environment

Water Quality Monitoring Program			
Sampling Media	**Effluent**	**Mixing Zone**	**Receiving Environment** (beyond mixing zone)
Sample Timing	During effluent discharge and during collection of effluent samples for toxicity testing	During effluent discharge[(a)]	During effluent discharge[(a)]
Sampling Locations	MEL-14	3 stations at the edge of the mixing zone (MEL-01-01, MEL-01-07 and MEL-01-10)[(b)]	4 stations - 1 mid-field (MEL-02-05), 3 references (MEL-03-02, MEL-04-05, and MEL-05-04)
Number of Samples	Per regulatory and operational requirements	1 sample per station	1 sample per station
Frequency of Sampling	Weekly during discharge	Weekly during discharge or as per NWB's direction	Monthly during discharge or as per NWB's direction
Test Parameters	▪ Daily monitoring of effluent flow volumes ▪ Parameters as listed in Schedule I Group 2 of the 2AM-MEL1631 NWB Water Licence[(c)]	▪ Field physico-chemical water column profile measurements (temperature, specific conductivity, pH, DO) ▪ Parameters as listed in Schedule I Group 2 of the 2AM-MEL1631 NWB Water Licence[(c)]	▪ Field physico-chemical water column profile measurements (temperature, specific conductivity, pH, DO) ▪ Parameters as listed in Schedule I Group 2 of the 2AM-MEL1631 NWB Water Licence

Table 3: Conceptual Design for Proposed Validation of Interim TDS Limits for Effluent and Receiving Environment

Toxicity Testing Program			
Sampling Media	**Effluent**	**Mixing Zone**	**Receiving Environment** (beyond mixing zone)
Sample Timing	During effluent discharge	During effluent discharge[(a)]	During effluent discharge[(a)]
Sampling Locations	MEL-14	3 stations at the edge of the mixing zone (MEL-01-01, MEL-01-07 and MEL-01-10)[(b)]	4 stations - 1 mid-field (MEL-02-05), 3 references (MEL-03-02, MEL-04-05, and MEL-05-04)
Number of Samples	Per regulatory and operational requirements	1 composite sample per station	1 composite sample per station
Frequency of Sampling	Weekly during discharge	Monthly during discharge	Monthly during discharge or as per NWB direction
Test Parameters	Acute toxicity tests with: ▪ Rainbow Trout ▪ *Daphnia magna*	Chronic toxicity tests with: ▪ Pelagic crustacean (*Daphnia magna*) ▪ Epibenthic Invertebrate (*Hyalella azteca*) ▪ Macrophyte (duckweed) ▪ ELS fish (Fathead Minnow)	Chronic toxicity tests with: ▪ Pelagic crustacean (*Daphnia magna*) ▪ Epibenthic Invertebrate (*Hyalella azteca*) ▪ Macrophyte (duckweed) ▪ ELS fish (Fathead Minnow)
Plume Delineation Study			
Sampling Media	**Effluent**	**Receiving Environment** (within mixing zone and beyond)	
Sample Timing	During effluent discharge[(d)]	During effluent discharge[(d)]	
Sampling Locations	MEL-14	22 survey locations (see Appendix B) at distance intervals of 50 m from the diffuser, 100 m (i.e., edge of mixing zone), 175 m, and 250 m; potentially adjusted to include further afield samples if necessary[(e)]	
Frequency of Program	1 event during discharge	1 event during discharge	
Test Parameters	▪ TDS and major ions ▪ General parameters[(f)]	▪ Field physico-chemical water column profile measurements (temperature and specific conductivity) ▪ Water quality samples collected at a subset (a maximum of 10 stations) stations alongside profile measurements and analyzed for TDS, major ions, and general parameters[(f)]	

Notes:

(a) The timing of sampling for each program is expected to occur continuously during the discharge period as outlined in the sample frequencies listed above for each sample media and test type. However, sample timing will be dependent on safe access to the lake. The period of anticipated discharge will likely coincide with the transition period between ice covered and open water conditions on Meliadine Lake. If samples cannot be collected at the required time due to safety considerations, contingency measures may be implemented, as outlined in Section 3.4.

(b) Parameters as listed in Schedule I Group 2 of the 2AM-MEL1631 NWB Water Licence include Conventional Parameters (bicarbonate alkalinity, chloride, carbonate alkalinity, turbidity, conductivity, hardness, calcium, potassium, magnesium, sodium, sulphate, pH, total alkalinity, TDS, TSS, total cyanide, free cyanide, and weak acid dissociable [WAD] cyanide), Nutrients (ammonia-nitrogen, total Kjeldahl nitrogen, nitrate-nitrogen, nitrite-nitrogen, orthophosphate, total phosphorus, total organic carbon, dissolved organic carbon, and reactive silica), and Total and Dissolved Metals (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, tin, titanium, uranium, vanadium, and zinc).

(c) Mixing zone stations MEL-01-01 and MEL-01-07 are routinely sampled by the mine during the EEM/AEMP programs. MEL-01-10 represents a new sampling station. Further details on the selected mixing zone sampling stations are provided in Section 3.1.

(d) Sample timing will be dependent on boat access to the lake. The period of anticipated discharge will likely coincide with the transition period between ice covered and open water conditions on Meliadine Lake. Access of the lake will occur as soon as open water conditions permit safe boat access.

(e) The maximum spatial extent of plume delineation monitoring may be extended past 250 m should the proportion of effluent be estimated to contribute >10% of TDS at 250 m (estimated based on field specific conductivity measurements).

(f) General parameters = total and bicarbonate/carbonate alkalinity, turbidity, laboratory specific conductivity, hardness, laboratory pH, and total suspended solids.

ELS = early life-stage; TDS = total dissolved solids.