October 10th, 2017

Mr. Luc Chouinard
General Manager
Agnico–Eagle Mines, Meadowbank Division
Baker Lake Office

Email: luc.chouinard@agnico-eagle.com

Dear Mr. Chouinard,

Report No 22
Meadowbank Mine Dike Review Board
Meeting September 4-7, 2017

1.0 INTRODUCTION

The meeting of the Dike Review Board was held on site as planned from September 4th to 7th. The Board is comprised of three members, Mr. D. W. Hayley, Dr. N. R. Morgenstern and Mr. D. A. Rattue. Dr. Morgenstern was unable to attend this meeting but has subsequently examined the documentation provided and has contributed to the present report.

The objectives were to review the status of the design, construction and operation of water and tailings retention structures at Meadowbank, and adaptation of the facilities to accommodate the production of the Amaruq project. A visit to the latter site was also included in the activities.

The activities covered those outlined in the agenda which is included as Appendix A. The Board made two field visits during the meeting, namely: a first, by helicopter to the Amaruq site but also an overview of the Meadowbank site facilities, and a second, by vehicle and on foot to observe conditions at Stormwater Dike, Central Dike, the Saddle Dams, and the Bay-Goose Dike above the push-back of Portage Pit.

The list of attendees at the meeting is given in Appendix B.

Paper copies of the various PowerPoint presentations were provided by Agnico-Eagle Mines (AEM), Golder Associates Limited (GAL) and SNC-Lavalin Inc. (SLI) during the meeting. Digital versions were also supplied at the end of the meeting to facilitate archiving.

A selection of photographs taken during the visits is to be found in Appendix C.

In the report which follows, the Board has included a section to give greater visibility to the major issues and following on with other matters. The recommendations are underlined in the text.

2.0 MANAGEMENT AND OPERATIONS UPDATE

AEM provided an update on the mine status for information.

The currently projected life of mine (LOM) for the Meadowbank and Vault pits is still into the third quarter of 2018 including the push-back of the Portage Pit. Construction of infrastructure to support the Amaruq pits is well advanced with the access road and temporary camp.

3.0 KEY ISSUES

As a result of the meeting No 22, the Board wishes to highlight the following issues. These are described in more detail in subsequent sections.

3.1 Central Dike

The Board still has concerns over the performance of Central Dike, though conditions are apparently stable at this time.

A void interpreted from the investigations and the instrument installation program merits further field work.

The Trigger Action Response Plan for the dike needs revision but should be implemented as soon as possible.

3.2 Amaruq

Though no additional information was provided at this time, the site visit enabled the Board to better appreciate site conditions for the Whale Tail Dike and Diversion Channel. Potential construction difficulties should not be underestimated, and robust and adaptable construction techniques will be essential to permit the fast-track program to succeed.

4.0 RESPONSE TO REPORTS NOS 19 and 20

A summary of the responses to the Board Reports was presented during the meeting. The Board is content that all items have been or are being addressed and hence no significant items are outstanding.

5.0 DEWATERING DIKE PERFORMANCE

Over the twelve-month period since the previous meeting, no unanticipated behaviour has been observed in any of the dewatering dikes i.e. East Dike and Bay-Goose as well as South Camp Dike and Vault Dike. The performance has been similar to last year. Piezometer and temperature readings vary according to seasonal cycles. Some piezometers may indicate a rise during freshet. However, the plots for others show a slow steady rise during the late winter period and a decline in the spring. This phenomenon may be due to seasonal freezing of the ground in the area downstream of the dike toe which inhibits seepage flow release, followed by pressure dissipation as the ground thaws.

Additional instruments have been installed in the vicinity of the North Channel of the Bay-Goose Dike in order to improve monitoring capabilities during the push back of sector E5 of Portage

Pit. Blast vibration monitoring has shown that the limit of peak particle velocity in the vicinity of the dike (50 mm/s) has been respected with maximum measured values in the 33 to 38 range.

6.0 STORMWATER DIKE

6.1 Introduction

The site team noted the first signs of cracking on the crest of the Stormwater Dike in August 2016. These subsequently spread and widened and indicated a deep-seated movement. It was concluded by AEM and GAL that the deformation originated in the sediments in the dike foundation. Stability analyses led to the decision to construct a rockfill berm at the toe. The movements are deemed to be the result of thaw settlement in the sediments and till foundation that was exposed to freezing conditions from the time of construction of the dike until pond raising initiated a thaw process.

6.2 2017

As the South Cell pond level rises (131 m in September 2016, 137 m in September 2017) inundating a greater length of the Stormwater Dike footprint (Photo #1), additional thaw settlement could be expected. This effect has materialized and additional movements and cracking have been observed since July 2017. Settlement at the downstream side of the crest has attained 70 cm (Photo #2), though it is noted that the deformation on the upstream side is considerably less and the integrity of the Coletanche liner is not jeopardized. Furthermore, the tailings deposited in the North Cell adjacent to the liner are now frozen. The area influenced by cracking now extends from Stn. 10+425 to Stn. 11+050. Additional prisms mounted on large boulders (Photo #3) and wire extensometers have been added to complement those installed in 2016.

6.3 Board Observations

The Board judges that:

- the deformation is adequately monitored but monitoring needs to be continued;
- the mechanism is reasonably well understood;
- continuation of movements is to be expected;
- now that most of the toe length is submerged, additional water level rise is likely to be less influential than the effect of time and the available heat flux from the pond water;
- the formation of a tailings beach along the downstream side of the Stormwater Dike would be useful in limiting the heat flux and eventually permitting freeze-back in the area.

In the previous report the Board recommended filling the cracks on the crest with bentonite to prevent ingress of rainwater, it would be advisable to continue this operation for the recent cracks. The finer cracks could be filled with bentonite but the wider ones could be treated with a bentonite-sand mixture to reduce shrinkage. This action would reduce the risk of pressures in the back scarp that could accelerate deformation.

Survey prisms have been installed on large boulders as may be appreciated from photo #3. The results indicate a tendency for the blocks to undergo local movement due to freezing of the crest and subsequent thaw. This limits their ability to represent true crest movements at these times. Evolution during the summer season may be adequately monitored but the evaluation of apparent movements in the spring and fall requires judgement.

As noted previously, the instruments P13265 and T147-1 were destroyed by the berm construction in 2016. The Board's recommendation to replace these instruments has been acted upon.

The thermistor chain SWD-02 installed at the downstream toe confirms that the till foundation is still frozen at mid-depth and that a talik exists in the bedrock. The piezometric level in rock at depth is some 7 m below the pond elevation, indicating a strong downward gradient and a potential source of the groundwater that appears in the seepage collection pond downstream of Central Dike.

The instruments installed in borehole SWD-03 confirm the presence of frozen till in the foundation with an underlying talik and also the downward piezometric gradient.

7.0 CONSTRUCTION PROGRESS

Construction activities at the Meadowbank Tailings Storage Facility in 2017 consisted of Stage 3 raises to the Central Dike, and Saddle Dams 3, 4 and 5 to bring the crest level to 145 m. At SD-3, SD-4 and SD-5, the limits of the foundation excavation covered the requirements for an eventual raise to el. 150 m.

The works were carried out by the same Contractors as in previous years however; more use was made of mine haulage equipment which was available this year.
The Board considers that:

- the work was well managed;
- appropriate field adaptation was made to the SD-3 axis to avoid the adjacent quarry;
- an appropriate approach was used in dealing with ground ice and allowing it to remain under the downstream shell.

As SD-3 will likely not be covered by a tailings beach, a protective layer of till and rockfill has been placed over the LLDPE liner. The Board recommends that the placement of additional rockfill be considered in order to encourage freeze-back of the foundation at the upstream toe and thus limit the potential for under-seepage.

8.0 CENTRAL DIKE INVESTIGATIONS

Significant seepage emanates from the toe of Central Dike with flow rates that increased in proportion to the head difference between the South Cell pond elevation and the downstream toe until such time as the deposition of tailings resulted in a blanketing effect. However, the seepage rates have not declined to the extent predicted by the numerical models.

In report No. 19, the Board expressed its concern over the situation despite the fact that the pumping equipment mobilized was able to evacuate the inflow to the seepage collection pond. The location of seepage pathways and the potential for erosion of foundation materials or joint fillings are the major unknowns.

AEM and GAL have been responsive to these concerns. Geotechnical investigations and the installation of additional instruments have been carried since the meeting in September 2016.

The Board is favourably impressed by the exercise that has been carried out to evaluate the measured hydraulic conductivities along with the rock cores and optical/acoustic televiewer images for joint and crack delimitation. An excellent presentation of this analysis was given to the Board. The work permits an appreciation of the role that the fractured rock plays in the transmissivity of the different rock formations.

The geotechnical drilling revealed an apparent void in borehole 700-P1 at the interface of the embankment fill and the foundation. This merits further investigation to confirm the presence of a void and its extent. The borehole location is along a line parallel to the second portage fault and passing through the area where overburden was left in the base of the cut-off trench. The potential for erosion cannot be discounted for the moment, despite the fact that no adverse reaction has been observed in the piezometer measurements. The high conductivities, including the void detected in the foundation, highlight the vulnerability of the situation.

Note that visual observation of the toe of the Central Dike cannot be made due to the presence of the pond as shown in Photo #6. Maintaining the pond at el. 115 m provides useful back pressure to control seepage and the Board concurs with this approach.

The Board suggests that geophysical specialists be consulted to ascertain whether Ground Penetrating Radar (GPR) and/or resistivity surveys could be expected to give useful results in the conditions (rockfill) at the location of hole 700-P1. Subsequent drilling would focus on any anomalies revealed by such surveys.

9.0 CENTRAL DIKE PERFORMANCE

The Board had been previously advised (Teleconference Meeting No. 20) of the appearance of chemical/bacteriological deposits in the seepage collection pond at the Central Dike toe (Photos #4 and #6). The comprehensive monitoring, both visual and by instrumentation, is on-going. The situation seems to be basically stable given the boundary conditions of south cell pond rise and continued tailings deposition.

There are still some anomalous instrument readings, particularly the unexplained high suction values. The Board requests that piezometer readings taken at the time of installation be re-examined to attempt to gain an understanding of the low-pressure values. Apparently, the piezometer filters are of the sintered metal variety (not ceramic). Unless the piezometers were installed in an inverted position, it is possible that de-saturation occurred during installation and/or during the curing of the cement grout which surrounds the instruments. Piezometric values that clearly do not represent field conditions could be removed from the instrument plots, though readings should continue to be taken in case the saturation is re-established.

The plausible instrument readings, including the recent installations, indicate a basically stable situation.

Chemical analysis of seepage water continues. The turbidity values in the downstream pond have varied up to a maximum value of 38NTU. Total suspended solids (TSS) are usually in the 0-10 mg/L range with an average of about 5 mg/L which is inferior to the south cell pond water value of about 15 mg/L. Metal concentrations are also lower than in the South Cell.

A depression in the sub-aqueous tailings surface was observed in July, from aerial reconnaissance, adjacent to SD-4. As the bedrock in this area is suspected to provide one of

the avenues for the seepage flows, the tailings deposition points were managed in such a way as to encourage blanketing by tailings. Despite rising pond levels, a gradual decrease in seepage flows is noted.

The temperature measurements still indicate a talik beneath the West Road in the vicinity of instruments 875-P3 and 975-P3. The potential for seepage flow to the Portage Pit (Photo #5) exists but flow captured by the in-pit pumping is apparently inferior to the quantity pumped from the seepage collection pond at the dike toe.

AEM has set out an action plan that is commensurate with the orange alert level which is maintained for the moment. This plan is outlined on pages 115 to 120 of the presentation P6-Central Dike Update submitted to the Board. The Board concurs with the action plan but questions the need to carry out additional 2D and 3D numerical analysis. Plotting of piezometric values along the presumed potential seepage pathways, including the oblique second Portage Fault alignment, may be more revealing than seepage modelling.

10.0 TRIGGER ACTION RESPONSE PLAN

In addition to the above-mentioned action plan, AEM and GAL have prepared a Trigger Action Response Plan (TARP) to ensure timely response to adverse changes in the Central Dike performance.

The Board views the plan as being a good start and one that addresses the major concerns. However, it is a work in progress. The alert notification needs some revision for certain scenarios. Given the ongoing orange alert status, the application of the TARP should be immediate and priority effort should be given to the required revisions.

11.0 TAILINGS STORAGE FACILITY OPERATION

11.1 South Cell

The Board was provided with an update of the tailings deposition plan for the South Cell. Until such time as approval for In-Pit-Deposition is obtained, the South Cell continues to accommodate the full mine production and constitutes the basin from which reclaim water is drawn.

The planning and operations continue to be State-of-the-Art. Deposition parameters, slope angles, densities etc., are updated on a year-to-year basis in the use of the software planning tool calibration and previsions.

A strategy of minimizing the south cell pond elevation while ensuring adequate water reclaim is part of the exercise. Consequently, seepage water is no longer pumped back into the South Cell but directed to the Bay-Goose Pit (Photo #8).

The Board recommends continuation of a deposition plan to encourage beaching along the SD-4 to SD-3 shoreline (Photo #7).

In view of the need to optimize tailings deposition that not only provides beaches along the geomembrane lined structures but also blankets suspected seepage entry points, a review of

the design criteria would be timely to ensure that all participants in the operation are working as efficiently as possible towards a common goal.

11.2 North Cell

The north cell is now dormant but monitoring continues. Temperature conditions beneath the Saddle dams indicate general cooling in near surface locations such that the now frozen ground contributes to limit seepage flow. Freezing of the tailings is also noted in all areas with the exception of locations in or near the pond boundaries as would be expected.

12.0 PIT SLOPE STABILITY AND PUSH BACK OF PORTAGE PIT

An appropriate high-quality review of the pit slope design is being carried out.

The monitoring by AEM continues to be of good standard including the use of radar for early indication of any movement. Rock falls continue to occur particularly in the ultramafic formations in Portage Pit A. Mining will cease in this area at the end of 2017.

As far as Portage Pit E is concerned, where push-back is on-going (Photo #9), instability of the Ultramafics is also noted but overall pit slope performance is judged to be good. In-place inclinometers and Time Domaine Reflectometer cables have been added to the instrumentation. Reliability of the inclinometers is considered marginal possibly due to inadequate grout installation of the casing. A Trigger Action Response Plan has been developed for the operation of this pit.

Good pit wall stability is reported for the Vault and Phaser Pits.
Ice walls are observed at some locations with accumulation depending on water source and orientation, particularly on the north facing wall of Goose Pit, where less control of surface water is exerted compared to the mining period.

13.0 AMARUQ

13.1 Introduction

The Board was given an update on the Amaruq project planning but, no presentations were made on the design work for the actual mine site as this was covered in meeting No 21 held in July 2017.

13.2 In-pit tailings deposition

Ore from the Amaruq pits will be processed at Meadowbank and consequently the capacity for tailings disposal is also required at this location. Given the concern with the under-seepage at Central Dike, the preferred option for the Amaruq operation will be in-pit disposal in the mined-out Portage and Goose Pits. Approval is still required but studies are ongoing to demonstrate the feasibility. Two presentations were made to the Board relating to Consolidation of the Tailings (pit volume required) and to predictions of ground water impact.

13.3 Tailings Consolidation and Water Balance

The study methodology for tailings deposition and consolidation is satisfactory for this stage of the evaluation of tailings and water mass balance. Additional work will be required to verify the minimum depth of water cover at closure to prevent re-suspension of particles due to wave effect and ice-formation. The Board has no further comments or recommendations to make at this time.

13.4 Hydro geological contaminant transport model

This study also constitutes a good approach that is adequate for the current level of study. The Board concurs with the recommendations for future work (parameter and geometry refinement for the model) and note that the provision of sampling wells for calibration has been included. This is obviously a long-term exercise with progressive up-date of parameters being required. This will continue into the period of monitoring post mine closure. Similar comments can be made related to the thermal modelling of conditions post-closure.

14.0 SITE VISITS

14.1 Amaruq by helicopter

After a general flight over the Amaruq site, stops were made on both banks of the Whale Tail Dike and at the proposed location for the Diversion Channel.

A general comment from the Board after having viewed the site is that despite the limited size of the dike and channel, construction difficulties may be under-estimated. This reinforces the previous recommendations that the dike and channel configuration, cross-sections, and construction methods all be selected for robustness and the ability to accommodate field adjustments. This is particularly important given the fast track planning and the possible inability to carry out more intensive site investigations prior to making commitments for construction equipment and imported materials.

14.2 Meadowbank site

A visit by vehicle was undertaken to appreciate the current status of the 2017 construction work, the condition of the Stormwater Dike and the downstream seepage collection pond at Central Dike. A brief stop was also made at a point overlooking the Portage Pit push-back area.

For the Stormwater Dike, the Board was able to better appreciate the extent of the cracking and deformations. As mentioned in the above text, filling of the new cracks is warranted. The instrumentation (monuments and simple extensometers) may be rudimentary but will suffice as long as diligent visual observation is also part of the monitoring program.

At the downstream toe of Central Dike, the current turbidity level was noted and it is readily apparent that little detailed observation of local flows is possible. Rockfill baffles across the pool may assist observation during the summer period but would be of little use during the winter and would exacerbate ice accumulation. Consequently, reliance has to be placed on frequent monitoring of pumping flow rates and the results of water sampling. A rapid determination of turbidity and/or TSS is obviously part of the procedure.

15.0 PRESENTATION BY MICHEL JULIEN

A discussion was held on the Terms of Reference (TOR) of the MDRB and Independent Reviews in general for AEM. It was agreed that a review of the TOR is justified. Succession planning was also discussed.

The position of Engineer of Record (EOR), a hot topic in the industry, was also reviewed. The approach by AEM would be that the EOR would be part of the internal management team but with the requisite authority to provide independent advice.

16.0 NEXT MEETINGS

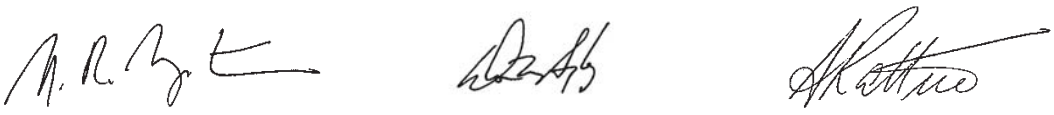
The Board anticipates that there may be a need to hold conference calls in the coming months on the Amaruq project and on the evolution of the TSF South Cell performance.

No date has been suggested for the next site meeting but early September is viewed as an appropriate time. The Board awaits instruction from AEM in this regard.

17.0 ACKNOWLEDGMENTS

The Board once again wishes to thank the personnel of AEM for the organization of logistics and for their participation in the meetings, and for the excellent documentation and presentations made by AEM, GAL and SNC-Lavalin which contributed to the efficiency and effectiveness of the proceedings.

Signed:



Norbert R. Morgenstern, P.Eng. Don W. Hayley, P.Eng D. Anthony Rattue, P.Eng.

ATTACHMENT A

AGENDA FOR BOARD MEETING NO. 22

September 4th to 7th, 2017

AGENDA

DAY 1 - SEPTEMBER 4TH 2017

15:30 **P1- Welcome, Review of the Agenda** – [AEM]

16:00 Review of Answers to MDRB Report #19 & 20 [AEM]

16:30 Break

17:00 Site Safety Induction

17:30 **P2 - Overview of Dewatering Dike Performance** – [AEM]

18:30 Dinner

AGENDA

DAY 2 - SEPTEMBER 5TH 2017

07:30	**P3 - Stormwater Dike Update** – [AEM
08:15	**P5 - Central Dike – Field Investigation & TARP** – [GAL] *(part 1)*
09:45	Break
10:00	**P6 - Central Dike – Instrumentation, Performance, Action Plan –** [AEM] *(part 1)*
12:00	Lunch
12:30	**Mine Site Tour**
16:00	**P6 - Central Dike – Instrumentation, Performance, Action Plan –** [AEM] *(part 2)*
08:15	**P5 - Central Dike – Field Investigation & TARP** – [GAL] *(part 2)*
19:00	Dinner

AGENDA

DAY 3 - SEPTEMBER 6TH 2017

07:30	**P7 - Tailings Storage Facilities - Operation** – [AEM]
08:30	**P8 - Tailings Storage Facilities – Instrumentation Review** - [AEM]
09:00	Break
09:15	**P4 - Summary of 2017 Construction Progress (SD3, SD4, SD5)**
09:30	**P9 - Reviews of Pits Wall Stability and Geomechanics** – [AEM]
10:00	**Mine Site Tour**
12:00	Lunch
13:00	**P10 - Amaruq – Project Update–** [AEM]
13:30	**P12 - In-Pit Deposition – Consolidation, Water Balance & Quality –** [SNC]
14:30	**P13 - In-Pit Deposition – Hydrogeological Contaminant Transport Model –** [SNC]
15:30	Break
15:45	**Bonus 1 – Debriefing of the site tour**
18:00	**Bonus 2** – **Independent Review, Engineering record & Liability**
18:30	End of the meeting

AGENDA

DAY 4 - SEPTEMBER 7TH 2017

07:30	**Deliberation by the Board Members**
09:30	**Preliminary Report by the Board Members**
11:00	Meeting Closure
11:05	Lunch
12:00	Approximate Time of Departure

ATTACHMENT B

ATTENDANCE AT SEPTEMBER 2017 MEETING
Held at the Meadowbank Mine site, Nunavut

Attendance		
Michel Julien	AEM	VP, Environment
Patrice Gagnon	AEM	Geotechnical Engineer
Michel Groleau	AEM	Geotechnical Coordinator
Alexandre Lavallée	AEM	Geotechnical EIT
Thomas Lepine	AEM	Technical Specialist, Env. Management
Pier-Eric McDonald	AEM	Water Engineer
Pierre McMullen		Engineering Superintendent
Yves Boulianne	GAL	Geotechnical Engineer
Dominic Tremblay	SNC-Lavalin	Project Manager
Guillaume Comeau	SNC-Lavalin	Project Manager, Hydrogeology
Anh-Long Nguyen	SNC-Lavalin	Water Treatment Engineer
Don Hayley		Dike Review Board
Anthony Rattue		Dike Review Board

ATTACHMENT C

PHOTOGRAPHS

Photo #1 Stormwater dike

Photo #2 Location of new depression. 70cm max settlement on D/S (left)

Photo #3 Typical survey prism mounted on large boulder

Photo #4 Central Dike. Portage Pit to the left of photo.

Photo #5 Wall of Portage Pit downstream of Central Dike

Photo #6 Seepage collection pond at toe of Central Dike

Photo #7 South Cell of TFS

Photo #8 Goose Pit

Photo #9 Push-back in Portage Pit E5