

October 7th, 2016

Mr. Bertin Paradis
General Manager
Agnico-Eagle Mines, Meadowbank Division
Baker Lake Office

Email: bertin.paradis@agnico-eagle.com

Dear Mr. Paradis,

Report No 19
Meadowbank Mine Dike Review Board
Meeting September 19-22, 2016

1.0 INTRODUCTION

The meeting of the Dike Review Board was held on site as planned from September 19th to 22nd. The Board is comprised of three members, Mr. D. W. Hayley, Dr. N. R. Morgenstern and Mr. D. A. Rattue. All three members were in attendance.

The objectives were to review the status of the design, construction and operation of water and tailings retention structures with respect to the current Life of Mine (LOM), and to be informed of the additional growth prospects.

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, to acquaint themselves with the situation at Stormwater Dike, and a second, to observe conditions at Central Dike, the Saddle Dams, the Tailings Storage Facility (TSF) partial cover, the Rock Storage Facility (RSF), and the Bay-Goose Dike above the future push-back of Portage Pit.

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

Prior to the meeting, the Board had been advised of cracking observed on the crest of the Stormwater Dike. Extracts of a PowerPoint presentation on this subject were transmitted on September 15th. Paper copies of the various PowerPoint presentations were provided by Agnico-Eagle Mines (AEM) 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 adopted a variation on previous reports by giving 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) is still into the third quarter of 2018. However, an opportunity to optimise mill feed through a push-back in the Portage Pit is being studied. This could provide bridging to the opening of the Amaruq development.

With respect to the latter, the Board is pleased to be informed of AEM's vision for future activities in Nunavut, including the success in identifying a viable resource at AMARUQ and the strategy to develop an integrated mining facility centered on the Meadowbank infrastructure.

3.0 RESPONSE TO REPORTS NOS 17 and 18

The Board was advised on December 18th, 2015 and April 1st, 2016, in a written format, of the responses to the reports Nos. 17 and 18 and is content that all items have been or are being addressed and hence no significant items are outstanding.

4.0 STORMWATER DIKE

4.1 Introduction

The site team noted the first signs of cracking on the crest of the Stormwater Dike on August 24th. These have subsequently spread and widened and indicate a deep seated movement. It was concluded by AEM and Golder Associates (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.

4.2 Site visit

On arrival to the mine site, the Board was taken to the dike to observe the current status. The extent of the cracking can be appreciated from Photos nos. 1 and 2 in Appendix C. The toe berm is well advanced as shown in Photo no. 3.

4.3 Board Observations

The Board judges that the site response to the situation was correct but creep movements are likely to continue albeit at a reduced rate. To prevent ingress of rainwater, it would be advisable to fill the cracks with a deformable clay type of material. This action would reduce the risk of pressures in the back scarp cracks that could accelerate deformation.

The Board did not have access to the As-Built records for this dike and is unclear on the extent of foundation stripping and preparation prior to embankment construction. It appears that sediments were permitted to remain in the lowest part of the foundation on the downstream side as an expediency to advance the construction. The justification was that the dike was planned to serve for a period of three years before being encapsulated in tailings on both the upstream and the downstream sides. Note that sediments were removed under the footprint of the upstream shell due to potential negative impact on the integrity of the geomembrane liner. The Board recommends that the Project clarify the As-Built conditions from available records.

The Board holds the view that permafrost began to aggrade into the lakebed sediments when they were exposed following dewatering prior to construction. These sediments were within a

non-permafrost “talik” zone. As the permafrost aggraded, under the downstream toe of the new dike, segregated ground ice would be expected to form in the fine grained lakebed sediments now supporting the downstream shell of the dam. The recent South Cell pond raising has now submerged this area. This new pond is a heat source that has initiated degradation of the frozen ground condition. The decreased shear resistance led to the initiation of shear movements in the thawed and thawing sediments. Moreover, creep displacements can be expected to continue through the ice in the warm permafrost and along the frozen-unfrozen interface.

The Board recommends verifying the causes and establishing supporting evidence for the mitigation measures by:

- Drilling and sampling with HQ size triple core barrel using chilled brine as a drilling fluid;
- Logging the core for ice content;
- Measuring shear strength in the laboratory by consolidated undrained triaxial tests with pore pressure measurement;
- Installing thermistors to determine the temperatures in the foundation (it is noted that the instruments P13265 and T147-1 have been destroyed by the berm construction). Replacement of this deep (about 60m) instrument is recommended as it provides useful data on permafrost response from both above and below the old talik zone;
- Establish design criteria for both investigating the mechanisms and validating the role of the buttress support with due regard for the currently envisaged service life (around 10 years before encapsulation by the tailings) and the tolerable deformations;
- Establish serviceability criteria for membrane integrity;
- Install survey monuments on the dike crest (downstream side) over the full length;
- Evaluate the role of future pond rise on the potential for extension of the deformation.

5.0 CENTRAL DIKE INSTRUMENTATION AND INVESTIGATION

5.1 Introduction

Central Dike which forms the eastern limit of the Tailings Storage Facility (TSF) at Meadowbank is located, for the most part, in the bed of Second Portage Lake. This area was drained initially to permit mining in the adjacent Portage Pit. The lakebed was a Talik and, during the dewatering, cofferdam construction and Central Dike construction, inflow was noted to be emanating from the bedrock. Flow volumes, as the ground water level was gradually drawn down, were entirely manageable.

In 2014, when the dike crest level reached 132 m, tailings deposition was transferred from the North Cell of the TSF to the South Cell which is retained by Central Dike and Saddle Dams SD3, SD4 and SD5. Seepage into the basin at the downstream toe of Central Dike increased in proportion to the rise in pond level in the South Cell.

5.2 Studies

Desk-top studies were undertaken by GAL to replicate the seepage flows and pore pressures, to verify the dike stability and to attempt to predict the eventual flow volumes for higher pond levels. It was deemed advantageous to maintain a “back pressure” by holding the downstream pond elevation at 115 m to reduce the hydraulic gradient. The Board concurred with this decision but recommended that additional investigations be carried out to determine the likely pathways for seepage.

Willowstick were engaged to carry out geophysical soundings to detect seepage paths. The apparently successful campaign led to additional recommendations to further the investigations by drilling in the likely locations of the flow paths. The results of this work were made available early in 2016.

5.3 Site visit

A site visit permitted the Board to appreciate the pumping installations that have been operated of late (photo no. 4) and to learn of plans to install electrically powered pumps to facilitate the control of flow rates and thus the pool elevation. The pool depth is sufficient to submerge the points of inflow. No concentration of suspended sediments was in evidence at the time of the visit nor has any been noticed by the site team outside of freshet run-off period. However, the pond water is not completely clear as can be noted from photo no. 5. The leakage appears to be managed effectively at present.

5.4 September 2016 Presentations and Board Observations

A presentation was made to the Board of the evolution of pumping rates, piezometric levels and thermistor temperature measurements.

The Board has concerns over the following aspects of this situation:

1. One of the piezometer readings (545-P1) exceeds what can be considered as a design basis level with artesian pressures surpassing the elevation of the current downstream berm at elevation 120 m (in the footprint of future raise to a crest elevation of 150 m). No specific action appears to have been taken. The Board recommends that a Trigger Action Response Plan (TARP) protocol be applied to all relevant observations in the routine monitoring and that data gathering and plots reflect the trigger limits.
2. The Board remains concerned about the large under seepage flow rates, notwithstanding the increased tailings deposition, and the limited understanding of the role of the dominant pathways. The situation is aggravated by some new observations, namely:
 - a. The appearance of a sinkhole on the surface of the tailings beach indicating a possible loss of tailings to the embankment fill or foundation;
 - b. The ingress of fine sand under local gradient into the drill casing at Borehole 595;
 - c. Large open structures in the bedrock;
 - d. High conductivities;
 - e. Heterogeneous till cover, and;
 - f. Complex frozen ground conditions not fully understood with respect to containment

The Board concludes that uncertainty remains with respect to future performance as the hydraulic gradient increases. Note that numerical analyses indicated that increasing hydraulic gradient would be partially offset by tailings accumulation.

Consistent with the observational method, which has been invoked for dealing with this issue, a contingency plan needs to be developed in the event that managing the discharge, as currently planned (pumping back into the South Cell pond), becomes untenable. Although one scenario could indeed be a linear increase of flow with hydraulic head, the possibility of dramatic change of transmissivity through erosion of fine sand under the increasing hydraulic head cannot be ignored. The reliance on pumping merits that a risk analysis be carried out.

Insight would be improved by:

1. Integrating all geological information onto a single 3-D plot;

2. Constructing a seepage model that reflects the current understanding of pathways and temperature boundary conditions (Likely needs a 3-D study but 2-D oriented obliquely to the dike axis along geological units and features may also be used);
3. Using the most appropriate model, project the flow rates with increasing head to be used as a basis for ongoing evaluation (TARP levels);
4. Predict pore pressures and determine impact on dike stability;
5. Evaluate the need for additional instruments (one or more piezometers in the area between 545 and 875 and between 745 and 750 for example).

Golder, as Engineer of Record (EOR) should be part of this work, as planned.

The Board notes that early in-pit disposal of tailings is an attractive mitigation measure.

6.0 PIT WALL STABILITY AND GEOMECHANICS

The Board was advised of the site experience with pit wall instability, monitoring and management. The Board is impressed by the diligent monitoring, including the use of radar, and the timely reactions that are being taken to keep personnel and equipment out of the danger zones when movement and incipient rock fall has been detected. This constitutes good practice.

The Board identified, as already known to the project, a special concern with respect to the proposed push-back in Portage Pit adjacent to the Bay-Goose Dike where tolerable wall performance is restrained by the proximity of the dike. The Board was advised of the geology, hydro-geology and the current status of the design.

Given the potentially serious implications to dike integrity of rock deformation and wall instability, the Board recommends a deformation analysis and the installation of Time Domain Reflectometers (TDR) and Inclinometers beyond the push-back boundary to guide the stability evaluation during excavation. The thermal and pore pressure boundary conditions should also be monitored with the aid of thermistor strings and piezometers installed in the same region. It would also be instructive to install a geophone base on bedrock near the dike toe as well as on the dike crest.

7.0 AMARUQ

7.1 Introduction

The Board was first introduced to the Amaruq project at the July 2015 meeting (MDRB No17) with a brief presentation given for information. Since that time, studies have advanced and it is understood that the Board will play a more active role in the review. The Amaruq project site is located 72 km North West of Meadowbank and requires an additional 64 km of road beyond the Vault Pit site. Ore from Amaruq will be transported to the Meadowbank process plant. At this meeting (MDRB No19), the Board was advised on the project layout and on the water management options and the currently favoured strategy which has been specified in the permitting documents. The class A water licence is needed in the First Quarter of 2017 to maintain the envisaged schedule.

7.2 Whale Tail Dike

With the preferred water management strategy, the Whale Tail Dike is required to isolate the northern extremity of Whale Tail Lake to allow dewatering and open pit development. The dike will serve to raise the level of Whale Tail Lake from the natural elevation of 152.5 m to 156 m, thus permitting diversion of the flows through a channel to Mammoth Lake.

Investigations were carried out at the site of the dike in 2015 and 2016. However, based on the observation of some potentially adverse foundation conditions, including strongly foliated rock and weathered rock, particularly on the right (East) abutment, the Board is of the opinion that the current site characterization is of limited value. The following information is urgently required:

- The geological setting (overburden and bedrock stratigraphy);
- A profile along the dike axis with geotechnical properties and rock conductivity;
- Permafrost characterization including the location of the boundary between the on-land frozen zone and the lakebed talik;
- Identification of fill sources;
- Design criteria including operating scenarios and closure strategy.

The Board notes the time constraints for obtaining this information, developing an optimal design and obtaining approval to meet the project schedule.

The Board recommends a design strategy that is based on a robust, predictable cut-off construction technology that is executable in the schedule and adaptable to conditions as exposed during the work. Sequential construction technologies such as pressure grouting should be avoided, if possible, due to the lesser ability to predict the duration and the influence on other activities. The methods to be evaluated could include secant drilled piles. Thermosyphons may be considered on the abutments but time may not permit freezing of the lakebed talik by this procedure to effect a cut-off. Due to the potential impact on the overall mine development and safe operation, cost should not be the dominant metric in selecting the dike design and construction methods.

An esker which borders the Whale Tail Lake (western shore) was mentioned as a source of granular fill. The Board cautions that eskers in permafrost regions may contain ice in the core beyond the active zone depth which could reduce the available quantities. Investigations should penetrate beyond shallow surface test pits.

7.3 Other structures

Other structures including the seepage control dike at the Rock Storage Facility and the Diversion Channel were also briefly described. Engineering is preliminary and was carried out for permitting. Again, design criteria should be compiled and agreed upon before embarking on the detailed design as a means to, amongst other things, streamline the design procedure.

8.0 TAILINGS STORAGE FACILITY EXPANSION TO ACCOMMODATE AMARUQ

The Board was impressed with the scope and depth of the Multiple Accounts Analysis (MAA) carried out to evaluate the tailings options and with the quality of the information utilized.

The Board is in agreement with the conclusion that In-Pit Disposal (IPD) is the preferred option for the way forward. The Board wishes to point out that In Pit Disposal would be recognized as

a Best Available Technology (BAT) and has precedence in the Northwest Territories and the Yukon. Moreover, IPD is a valuable asset going forward to implement AEM's Nunavut Vision.

In addition, as noted above, IPD is also likely to be the most attractive mitigation measure if continuing operation of the South Cell of the existing TSF proves to be excessively risky.

The Board recommends that AEM develop the case for IPD in a comprehensive manner and proceed with seeking approval. Optimisation of IPD with respect to water management should be evaluated as part of the proposal, including the role of tailings thickeners to reduce water volumes, and chemical issues etc.

9.0 OTHER PRESENTATIONS

9.1 2016 Construction Progress

A comprehensive presentation was given of the work carried out on the Central Dike and Saddle Dams SD3, SD4 and SD5 to raise their crest elevations to 143 m. The construction has been carried out by the same contractors as in previous years and, in general, the weather also contributed to a successful season.

Laboratory studies have been carried out on the Ultramafic Soapstone being used as part of the rockfill. This work has indicated that the soapstone is more resistant to weathering than might be construed from the poor resistance to abrasion that is noted on working surfaces subject to truck traffic. Consequently, its use on the outer slopes of dikes and rock storage piles is now viewed more favourably.

The Project team raises questions with respect to the erosion protection layer that has been specified by GAL to protect the till backfill of the key trench at the upstream toe of the dikes (photo no. 6). The Board shares this concern, not so much from a cost angle but, from the amount of mechanical activity on the membrane coupled with the flow path through the crushed stone and rockfill that conveys full pond pressure everywhere over the liner and in particular over any imperfections. This prevents the tailings blanket from contributing to reduce seepage. The protection has been designed in the same manner as a rip-rap zone on a dam face subjected to wave attack (photo no. 7), with filter and transition zones to protect the underlying till. However, the Board questions whether the potential for harm exceeds the implied value of the detail and recommends review of this detail with GAL.

9.2 TSF Instrumentation Review

A comprehensive review of the instrument data was given. All appears to be in order with no adverse trends to be noted.

The Board requests that additional information be provided on the graphical plots to aid in assimilation of the data. It would be useful to include:

- Stratigraphy (fill, overburden and rock levels);
- Alert levels;
- Evolution over time of the readings.

As the foundation at Saddle Dam 1 is now frozen, and the weight of tailings will preclude any liner heave, the Board recommends that consideration be given to ceasing pumping at the downstream toe, to backfilling the toe drain trench and allowing water to build up in the

embankment fill. This water will freeze and surface drainage will take place in the direction of Third Portage Lake.

9.3 TSF Operations

The Board continues to be pleased to see the good use being made of MUCK 3D to plan and back analyse the tailings deposition. Some sensitivity to sub-aqueous beach modeling has been identified. It could be improved by recognizing that the mode of deposition is likely to be a sequence of delta accumulation at the head of the slope followed by slumping. It is also to be noted that the model does not permit a distinction to be made between the densities of sub-aerial and sub-aqueous deposits. The latter will not have the same ice inclusion.

9.4 Dewatering Dikes

The instrumentation data and visual inspections have not revealed any adverse behaviour over the period since the last on-site Board meeting.

10.0 CLOSURE STUDIES

The Board is still concerned that clarity of closure objectives (walk-away or perpetual care) has not been achieved. The design criteria associated with these objectives need to be defined. The Board recommends that AEM clarify its position on this front and convey it to their consultants to ensure that all designs are oriented in the direction to meet closure strategy.

The RSF model studies have advanced from last year but, many uncertainties in this area need understanding. The simulations are matched to various thermistor measurements some of which are quite shallow and barely reflect conditions in the Ultramafic rock cover. Observation of the outer surface of the RSF reveal great variability in the gradation of the rockfill to the extent that some areas may well experience convective air flow and cool much more rapidly than areas where the fine rockfill precludes such air flow. Greater reliance will eventually have to be placed on the field measurements rather than the result of numerical modeling.

The Board wishes to reiterate its suggestion that AEM makes acquaintance with the results of the studies into the thermal behaviour of the Diavik rock piles.

As far as the plans for upstream raises on the TSF are concerned, the Board notes the apparent need to evaluate the influence of thaw consolidation on the sub-base of the rockfill raise and the stability thereof. Furthermore, thaw settlement could also affect the integrity of the geotextile that is to be incorporated in the raise. The preliminary designs do not seem to take account of ice inclusions in the tailings. The irregular surface of the partial rock cover on the North cell is indicative of the variable spacial distribution of ice. It is also indicative of the future need for regrading the surface to ensure drainage of precipitation and snowmelt. In fact, infiltration is inevitable and the thermal modelling needs to include its effect.

Design criteria for the diversion channels around the TSF and RSF, and for the breach channels through the water retention dikes need to be confirmed. Flow rates and wave heights associated with a 1:100 yr storm frequency may be incompatible for closure in perpetuity.

11.0 OTHER ISSUES

11.1 Technical documentation

There is a need to assess the completeness and retrievability of all technical documents as would be appropriate at audit level. It should be possible for someone not involved in the work to re-construct the history of each structure. This goes beyond the preparation of As-Built reports which usually only summarise the pertinent data. This should be approached at a corporate level to ensure consistency among the various mine projects. The situation at Stormwater Dike is an example where, at least to date, a detailed historic of the foundation preparation has yet to be established.

11.2 Engineer of Record

There is a need to clarify the role and responsibility of the Engineer of Record (EOR) on matters that concern safety. The Mount Polly tailings dam failure has focused the importance of clearly identifying the long-term responsibilities of a dam design engineer. Again, this is an issue to be examined at corporate level as different companies have different approaches.

11.3 Consultant Participation at Review Board Meetings

Despite the quality of the presentations given by AEM personnel, there are, on occasions, questions and discussion on points for which the respective Consultant is better equipped to respond. The Board recommends that arrangements be made to include the Consultants, by Webex if needs be, at appropriate moments in future meetings.

12.0 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 mid summer or early fall have typically been chosen. The Board awaits instruction from AEM in this regard.

13.0 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 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. 19

September 19th to 22nd, 2016



Agnico Eagle Mines - Meadowbank Division
Meadowbank Dike Review Board
Meeting # 19 – September 19th to 22nd, 2016
Meadowbank Mine Site, Nunavut

AGENDA

Monday, September 19th

Arrival with Nolinor flight, approx. 12h30

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| 12h30 | Check in, room assignments and site H&S orientation, lunch (<i>arrival time can vary; depending on charter route</i>) |
| 13h30 | Welcome, Review of the Agenda and Highlights of the Meeting – (P1) [AEM] |
| 13h45 | Meadowbank Mine Operations and Management Update – (P2) [AEM] |
| 14h15 | Review of Answers to MDRB Report #17 & #18 [AEM] <ul style="list-style-type: none">· Discussion with Board Members |
| 14h30 | Summary of 2016 construction progress – (P3) [AEM] <ul style="list-style-type: none">· (Central Dike Stage 5 - Saddle Dam 3, 4 and 5 Stage 2) |
| 16h15 | Tailings Storage Facilities Instrumentation Review – (P4) [AEM] |
| 17h30 | Dinner (site cafeteria) |

Tuesday, September 20th

- 7h30 **Central Dike Instrumentation & Investigation – (P5) [AEM]**
- Instrumentation update – 1h00
 - SNC Investigation – 1h00
 - Water volume and quality – 0h30
- 10h00 **Coffee Break**
- 10h15 **Tailings Storage Facilities Operation – (P6) [AEM]**
- Review of integrated tailings deposition plan for North Cell and South Cell
- 11h30 **Lunch (site cafeteria)**
- 12h30 **Site Visit - Tailings Storage Facilities**
- North Tailings Cell (SD1, SD2, Stormwater Dike, Diversion Ditches, Capping)
 - Central Dike
 - SD3, SD4, SD5
 - Portage and Vault Pits
- 15h30 **Coffee Break**
- 15h45 **Reviews of Pits Wall Stability and Geomechanics – (P7) [AEM]**
- Wall stability in Goose, Portage and Vault Pits
 - Monitoring program and results
- 16h30 **Dewatering Dikes - BayGoose, South Camp, East & Vault Dikes Review– (P8) [AEM]**
- Update on Monitoring Program and Data Review of Dewatering Dikes
 - Comments on Dikes Performance
- 17h00 **Mill and RSF seepage update – (P9) [AEM]**
- 17h30 **Comments from the Review Board Related to Issued Documents and Reports and presentations**
(As-built Reports, Instruments Data)
- 18h00 **Dinner (site cafeteria)**

Wednesday, September 21st

7h30	Closure Study Presentation – (P10) <ul style="list-style-type: none">· Closure schedule update – 0h30· South Cell TSF landform - 1h00· RSF rehabilitation – 1h00
10h00	Coffee Break
10h15	Closure Study Presentation (con't) – (P10) <ul style="list-style-type: none">· Water Management & WTP – 0h30· Dike Breach update – 0h30
11h15	Amaruq – Project Update – (P11) <ul style="list-style-type: none">· Project update - 0h30
11h45	Lunch (site cafeteria)
13h15	Amaruq – Site water management – (P12) [AEM]
14h00	Amaruq – Whale Tail and Mammoth Dike designs – (P13) [AEM]
15h00	Coffee Break
15h15	Amaruq – Whale Tail and Mammoth Dike designs (con't) – (P13) [AEM]
16h15	Amaruq – Tailings storage Facility Extension – (P14) [AEM]
18h00	Dinner (site cafeteria)

Thursday, September 22nd

7h30	Deliberation by the Board Members
9h30	Preliminary Report by the Board Members
11h00	Meeting Closure
12h00	Approximate Time of Departure

ATTACHMENT B

ATTENDANCE AT SEPTEMBER 2016 MEETING

Held at the Meadowbank Mine site, Nunavut

[illegible]

ATTACHMENT C

PHOTOGRAPHS



Photo no. 1 Cracking on Stormwater Dike Crest



Photo no. 2 Crack width



Photo no. 3 Construction of Stormwater Dike Toe Buttress



Photo no. 4 Central Dike Toe Area and Pump Installations



Photo no. 5 Pond at Toe of Central Dike



Photo no. 6 Rockfill Cover on Central Dike Key Trench



Photo no. 7 Construction of Key Trench Protection at Saddle Dam SD5