Appendix B2

Meadowbank Dike Review Board Reports

November 16th, 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 develope 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. 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 Stormwater Dike was envisaged as a short term structure dividing the TSF into two compartments with the North Cell perimeter being closed and filled first, followed by construction of Central Dike to create the South Cell to progressively achieve essentially

balanced tailings levels across Stormwater dike. However, in the intervening period, the downstream toe area was exposed to ambient air temperatures. 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 initially within a non-permafrost "talik" zone. Depending on the porosity of the downstream embankment shell, convective air currents would enhance the potential for freezing of the foundation. 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 an 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. A class B 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 (RSF) 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 develope 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 seepage reduction. 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.

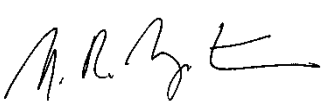
12.0 NEXT MEETINGS

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

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

12h30 **Check in, room assignments and site H&S orientation, lunch** *(arrival time can vary; depending on charter route)*

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]

- Discussion with Board Members

14h30 **Summary of 2016 construction progress – (P3)** [AEM]

- (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)**
- Closure schedule update – 0h30
- South Cell TSF landform - 1h00
- RSF rehabilitation – 1h00

10h00 **Coffee Break**

10h15 **Closure Study Presentation (con't) – (P10)**
- Water Management & WTP – 0h30
- Dike Breach update – 0h30

11h15 **Amaruq – Project Update – (P11)**
- 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 – Taillings 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

Attendance		
Julie Bélanger	AEM	Engineering Superintendant
Jean Cayouette	AEM	Director, Mining Reclamation
Luc Chouinard	AEM	Asst General Manager Meadowbank
Rebecca Cousineau	AEM	Geotechnical Supervisor
Patrice Gagnon	AEM	Geotechnical Supervisor
Michel Groleau	AEM	Tailings and Water EIT
Alexandre Lavallée	AEM	Dewatering Dikes and Rock Mechanics EIT
Thomas Lepine	AEM	Geotechnical Coordinator
François Petrucci	AEM	Project Manager, Amaruq
Getahun Haile	SNC-Lavalin	Senior Geotechnical Engineer
Yohan Jalbert	SNC-Lavalin	Geotechnical Engineer
Don Hayley		Dike Review Board
Norbert Morgenstern		Dike Review Board
Anthony Rattue		Dike Review Board

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

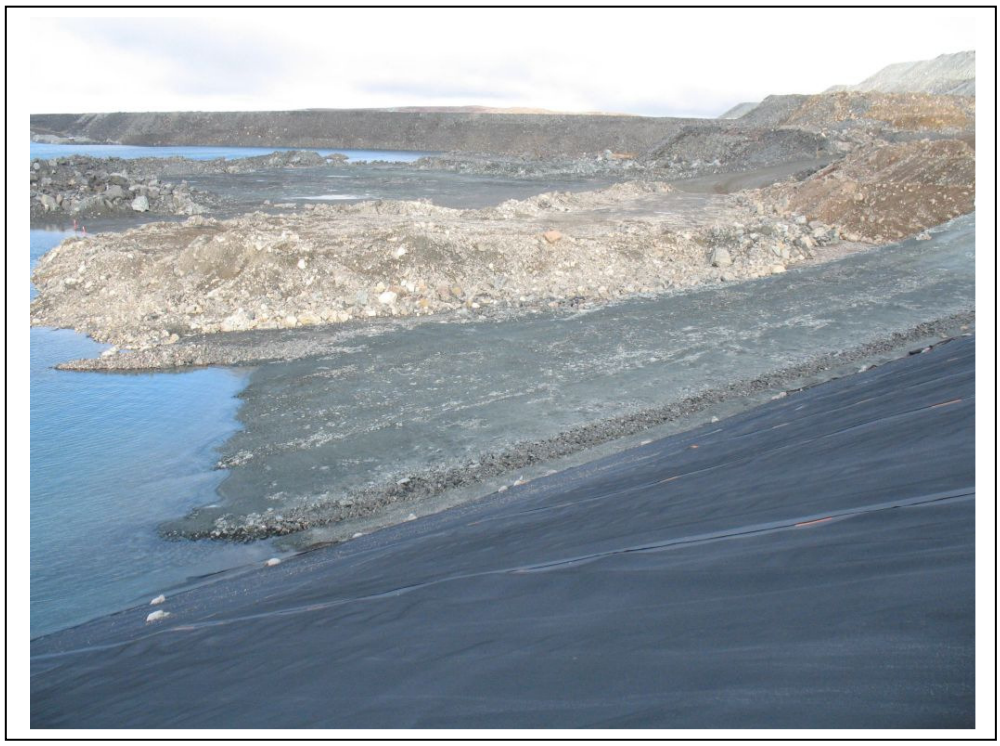


Photo no. 6 Rockfill Cover on Central Dike Key Trench

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

March 7, 2017

SUBJECT: RESPONSE TO REPORT No.19, MEADOWBANK DIKE REVIEW BOARD

TO: Norbert R. Morgenstern, D. Anthony Rattue, and Don W. Hayley

FROM: Agnico-Eagle Mines, Meadowbank Division

The nineteenth meeting between the Meadowbank Dike Review Board (the Board) and Agnico-Eagle Mines Limited (AEM) was held between September 19th and 22nd 2016 at the Meadowbank mine site. The objective was to present the work that has been undertaken since the Meeting No.18. On November 16th 2016, the Board provided a report letter (MDRB Meeting No.19 report) with their comments from the above meeting.

This letter provides the response from AEM related to the board recommendations for Meeting No.19.

93, Rue Arseneault bureau 202 Val d'Or, Québec, Canada
Tel:819.759.3555 agnicoeagle.com

AGNICO EAGLE
MEADOWBANK

4.0 STORMWATER DIKE

MDRB Comment

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.

AEM answer

Due to a snow storm that occurred shortly after the MDRB meeting, the cracks could not be filled in 2016. AEM will grade the surface and fill in the cracks with fine material in spring 2017 as soon as everything thaws.

MDRB Comment

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. 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.

AEM answer

AEM and GAL were unsuccessful to find more records on the earthworks details of the foundation of Stormwater Dike performed in the 2009-2010 construction seasons. The only information available so far is what can be found on the various drawings. AEM will continue to investigate.

AEM has the as-built of the SWD rise to final elevation 150m. This report was presented during the MDRB # 14 but it is covering only the abutments and not the area of concern. AEM proceeded to interview the principal supervisors involved during the 2009-2010 construction seasons. Golder is working on putting all information together to have a better idea of the sequence of events during construction.

MDRB Comment

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

- *Drilling and sampling with an 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.

AEM answer

An investigation campaign was held at SWD in the beginning of 2017 to answer the Board recommendations. Two holes were drilled through the buttress to assess the foundation material conditions and gather samples. The campaign successfully cored through the till and bedrock but unfortunately failed to recover any of the soft sediment (lakebed sediments) even though cold brine was used to drill. The thickness of the soft sediment layer confirmed by drilling is less than a meter. Two thermistors were installed through the buttress from the natural ground elevation of the lakebed sediments to deep bedrock. Another hole was drilled on the upstream side through tailings, lakebed sediments, till and bedrock. No soft sediments were recovered. A thermistor was also installed in this hole. Laboratory testing of the sampled materials is underway and a complete report will be issued by GAL once all testing is completed.

AEM has installed survey monuments on the dike crest (downstream side) over the entire length of SWD. AEM has also installed a shack to allow readings of the prisms during winter. This set up allows the total station to be warm enough to read every prism in one session. Currently AEM is collecting data. No movement is observed so far.

AEM is currently working with GAL to establish design criteria to investigate the movement mechanisms and to validate the support provided by the buttress. GAL will be examining the question of the membrane integrity as well as the role of the future pond rise on the extent of the deformation. AEM will update the Board once the work with GAL is complete.

5.0 CENTRAL DIKE INSTRUMENTATION AND INVESTIGATION

MDRB Comment

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.

AEM answer:

AEM is currently working with GAL to update the actual seepage model to:

- Confirm the seepage mechanism
- Evaluate the seepage flow through time regarding the deposition plan developed by AEM
- Assess consequence of the seepage flow on the potential expansion of the Meadowbank TSF, and
- Assess consequence of the seepage flow on the closure of the mine.

In the first phase of this project, the available data was reviewed and integrated in a 3D-plot model to review the seepage flowpath assumption and identify the critical section in regards to seepage flow and dike stability. A 2D seepage model oriented parallel to the flow path was built along the key geological units and instrument locations. The Central Dike stability was reassessed and the seepage model will be updated in the following weeks. The findings of this study lead AEM to plan an instrumentation campaign in June 2017 to confirm certain assumptions of the model and reassess the stability analysis and seepage model with additional instrumentation data.

A comprehensive TARP will be developed following the update of the seepage model and stability analysis and it will be reassessed after field investigation.

MDRB Comment

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.

AEM answer

As mentioned previously, GAL is currently working to update the Central Dike seepage model and stability analysis. A 3D plot of the South Cell was produced by GAL which presents:

- Geological information
- Flowpath location
- Geological survey results (RQD, hydraulic conductivity and televiewer observations)
- Hydraulic head, and
- Temperature

The analysis of this 3D plot lead GAL to the calibration of the seepage model to reassess the seepage mechanism. At the end of March 2017, GAL will present to the Board the results of the seepage model, the stability analysis, the content of the future field investigation and the study planned to reevaluate the closure strategy of the South Cell.

In addition, as previously shown, AEM continues to evaluate in-pit disposal through a pre-feasibility mandate with SNC-Lavallin.

6.0 PIT WALL STABILITY AND GEOMECHANICS

MDRB Comment

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.

AEM answer

In November 2016, Tetra Tech was mandated to perform a field investigation campaign, including four boreholes with multiple in-situ tests in the Portage pit E push-back area. Tetra Tech was also mandated to complete a stability analysis of the proposed push-back, including finite element deformation analysis in the vicinity of the Bay Goose dike. A technical memo was issued on December 2016 and a full report will follow in 2017. Results of the deformation analysis indicated that the displacement across the dike is small and is not expected to affect its integrity.

As part of the monitoring of the slope of the Pushback, an instrumentation program consisting of six holes containing piezometers and thermistors is planned for the month of May. The rationale for this late installation is to wait for the Mine operation to have lowered at least 2 benches in order to protect the instruments from vibrations and flying rocks. In the meantime, a deep inclinometer was installed behind the pit wall (at the toe of the BayGoose Dike) to monitor movement during the first benches and establish an early baseline for the future.

As a standard procedure since 2011, all blasts located near the dikes are closely monitored. AEM is installing, on the crest of the dike, at least two Minimate blast monitors (geophones) to record blast vibrations of the cutoff wall.

7.0 AMARUQ

MDRB Comment

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.

AEM answer

A geotechnical investigation program will take place in March 2017 to answer all the uncertainties related to the design choice of the Whale Tail Dike. 27 boreholes will be drilled with chilled brine and then geotechnical logging will be performed to evaluate the bedrock quality below the dike foundation and to determine the hydraulic conductivity of the rock mass for grout curtain design. Televiewer surveys (optical and acoustic) and water packer tests will be carried out by the contractor personnel on site in the boreholes.

Following this geotechnical investigation, SNC will update the seepage and hydrogeological analysis of the Whale Tail Dike to develop the cutoff wall and select the best applicable construction technique.

MDRB Comment

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.

AEM answer

As of now, two options are considered for design of the Whale Tail Dike. The base case consists of a rockfill structure with CSB cutoff wall. In case the preferred design will not be feasible due to delays on the beginning of the dike construction, a cutoff wall option adapted to construction under winter conditions will also be designed as a contingency plan. The concept of using a secant piles wall was selected as the mitigation measure during a meeting held on December 16th between AEM and SNC-Lavalin.

Recent experience on site reveals the presence of ice in the core of two eskers blasted for the Amaruq Road construction. Following these observations, AEM decided to extend the geotechnical investigation to assess the esker material quality and quantity planned to be used for the Whale Tail Dike construction.

7.3 Other structures

MDRB Comment

Other structures including the seepage control dike at the Rock Storage Facility (RSF) 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.

AEM answer

AEM will review and ensure that the designer of the infrastructure is well aware of the design criteria when designing the water management structures to the detailed engineering level.

8.0 TAILINGS STORAGE FACILITY EXPANSION TO ACCOMMODATE AMARUQ

MDRB Comment

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 develope 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.

AEM answer

A study has been started with SNC-Lavalin in order to gather all the required information to develop the best in-pit tailings deposition methodology and to meet the required environmental criteria at an effective cost along with optimized closure plan.

The main objective of this mandate is to develop and evaluate the In Pit deposition in the Portage & Goose Pits at a pre-feasibility level to support a Meadowbank FEIS Addendum and Type A Application and future life of mine (LOM) decisions. As part of the mandate, different components will be evaluated: field investigations, hydrogeological modelling, numerical simulations and infrastructure design, and geotechnical and groundwater monitoring programs.

9.0 OTHER PRESENTATIONS

9.1 2016 Construction Progress

MDRB Comment

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 favorably.

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 seepage reduction. 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.

AEM answer

The erosion protection layer question will be reviewed in detail with GAL before the beginning of the next construction campaign.

9.2 TSF Instrumentation Review

MDRB Comment

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.

AEM answer

The instrumentation graphs will be corrected and adapted to include the requested information before the next MDRB meeting.

MDRB Comment

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.

AEM answer

AEM appreciates the comment and will continue to consider this recommendation. Until further notice, AEM will continue pumping the area and will complete an evaluation of the water quality.

9.3 TSF Operations

MDRB Comment

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.

AEM answer

AEM recognizes the slumping of the tailings beaches with the analysis of the bi-annual bathymetries. The software supplier will be contacted to see if any newer version could incorporate such phenomena into

modelling. However AEM notes that the period of time where the reclaim pond is free from an ice cover limits the number of bathymetries that could be done per year. Also during winter time, the access on the ice cover is risky due to thin layers of ice surrounding the tailings pond. Due to the difficulty to build a proper data base, AEM concluded that the integration of the slumping effect of the tailings beach will be challenging and does not plan to integrate it into to the tailings deposition modeling.

10.0 CLOSURE STUDIES

MDRB Comment

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.

AEM answer

We recognize that the criteria used by one of our consultants for the design of post closure emergency spillways at the TSF was not in line with the current closure walk away objective. The design criteria of these infrastructures (1:100 yr.) will be increased to better fit long term post closure requirement.

MDRB Comment

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.

AEM answer

AEM contacted Diavik to get their input on various geotechnical points. Discussion was very open and other information exchanges will take place in the future. The research project was done by the University of Waterloo and not all the results are published yet.

MDRB Comment

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.

AEM answer

AEM appreciates the comment and will include the influence of thaw consolidation to the next phase of the design.

MDRB Comment

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.

AEM answer

While AEM recognizes that current design criteria for diversion channels need to be further confirmed and are most likely incompatible with post-closure conditions, it prefers to wait before committing to anything specific at this time. The future of the existing facilities is still unclear and may vary greatly from their current configuration if the Amaruq project reaches its projected size. Also, given the complexity of the identification of the criteria that could apply at closure in the context of the different uncertainties (such as climate change), and the huge effort required to make these structures compatible with post-closure conditions, it is in AEM best interest to proceed carefully with this discussion. Discussions will be held with the Board and consultants over the upcoming years regarding design criteria and closure.

11.0 OTHER ISSUES

11.1 Technical documentation

MDRB Comment

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.

AEM answer

AEM agrees with the Board's comment. Agnico Eagle recognizes the importance of proper data management for its high risks infrastructures. This issue is currently being looked at the corporate level to make sure that information pertaining to our facilities is well collected, protected, and is accessible when needed. This goes well beyond as-built; it involves all information related to site investigation, design and monitoring. This notion of transferability of information and succession planning will be key topics in the coming years at all AEM sites.

11.2 Engineer of Record

MDRB Comment

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.

AEM answer

AEM agrees with the Board's comment. The upcoming new MAC Tailings Guidelines (3rd edition) to be issued in May 2017 will include explicitly the notion of EoR. AEM has been part of the formation of the MAC proposed definition and is therefore very keen in its future implementation at all AEM sites.

The proposed draft definition is the following:

> *The Owner has the responsibility to identify and retain a competent Engineer of Record (EoR), who confirms that a tailings facility has been designed and constructed, and is being operated in accordance with applicable guidelines, standards and regulatory requirements.*

Interestingly, the Meadowbank engineering team is probably the best example of an in-house team that is currently acting as EoR. It will be important in the coming months that this notion is further formalized internally to make sure the responsibilities and authority inherent with this role are clearly understood by everyone. For AEM, it is essential that the ownership role the company has on the performance of its own tailings infrastructures be fully recognized and supported by the development of solid in-house teams ensuring this ownership responsibility is being managed properly.

11.3 Consultant Participation at Review Board Meetings

MDRB Comment

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.

AEM answer

During the next meeting, consultants will be more involved for the presentations, either on site or through Webex to be able to answer some of the Board questions or concerns during the meeting.

Best Regards

Geotechnical Engineering Team
Meadowbank Division
Agnico Eagle Mines