Appendix B4

Meadowbank Dike Review Board Reports

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MDRB REPORT MEETING NO.17

August 6th, 2015

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

Email: bertin.paradis@agnico-eagle.com

Dear Mr. Paradis,

Report No 17
Meadowbank Mine Dike Review Board
Meeting July 27-30, 2015

1.0 INTRODUCTION

The meeting of the Dike Review Board was held on site as planned from July 27th to 30th. 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 operations with respect to the current Life of Mine (LOM), and to be informed of the growth prospects.

The activities covered those outlined in the agenda which is included as Attachment A. The list of attendees at the meeting is given in Attachment B.

Digital copies of some results of Central Dike instrumentation were transmitted prior to the meeting. Paper copies of the various PowerPoint presentations were provided by Agnico-Eagle Mines (AEM) during the meeting.

Copies of two technical memoranda and a letter report were also provided during the course of the meeting and a list of the same is included in Appendix C. A selection of photographs taken during the visits is to be found in Appendix D. Appendix E contains a copy of a memo transmitted by the Dike Review Board shortly after the meeting.

In the report which follows, the Board's recommendations are underlined.

2.0 MANAGEMENT AND OPERATIONS UPDATE

AEM provided an update on the mine status for information.

The currently projected life of mine (LOM) is now into the third quarter of 2018.

3.0 RESPONSE TO REPORT NO 16

The Board was advised on March 3rd, 2015, in a written format, of the responses to the previous report and is content that all items have been or are being addressed and hence no significant items are outstanding.

4.0 SITE VISITS

A single site visit was made in the afternoon of July 28th to the following sites:
South Camp dike, Bay-Goose Dike and overview of the Pit, East Dike and Portage Pit, Central Dike, Saddle Dams #2, #3 and #4, and the North Cell of the Tailings Storage Facility (TSF).

The Board was particularly interested in the area of apparent seepage at the toe of Central Dike and the water management installation.

The Board did not identify any conditions unknown to the Project staff.

5.0 2015 CONSTRUCTION

5.1 Construction progress review

A summary of construction progress was presented by AEM. It is noted that work on Saddle Dam #5 has been delayed until 2016 due to the higher than anticipated elevation of the foundation bedrock, which ensures the necessary confinement of the South Cell.

5.2 Saddle Dams #3 and #4

Work is well advanced on both structures with the embankment at a level to begin liner installation. The foundation on the upstream side is entirely on rock and the footprint of the key trench has been exposed, though final clean-up and surface treatment remain to be carried out. The Board's only concern is with the liner tie-in at the right abutment of SD#3. Badly jointed rock (Photos # 1 and #2) and an adjacent wide fault zone (Photo #3) exhibiting soft gouge material will require an appropriate detail to be developed. This may well be a field fit to be established jointly by AEM and Golder Associates (GAL). The Board requests documentation on the intended treatment of these features and the liner interface.

Current design for closure indicates that the South Cell spillway will be located on SD#3. The Board is of the opinion that this structure should be constructed on rock if at all possible, to ensure long term reliability. Thermal conditions in the vicinity of a spillway will be affected by water flow and this aspect should be included in the evaluation of the location.

5.3 Central Dike

The Board made note of the behaviour of the Non Potentially Acid Generating (NPAG) soapstone rockfill being placed in the Central Dike embankment (Photo #4). While the interest in using this material is understood due to the overall shortage of NPAG material there are limitations as to what can be done with the ultramafic soapstone. A high degree of crushing and/or grinding when exposed to vehicular traffic is evident. The GAL recommendation to place and compact the material in 1 m lifts rather than 2 m may not be appropriate, particularly if the

number of passes of the vibrating roller are not reduced. Placing in a 2 m lift, but with adequate watering and moderate compaction should be evaluated. The Board recommends the excavation of test pits, to a depth of at least 2 m, to verify the fabric and density of the compacted rockfill. At the current embankment elevation, the NPAG rockfill is confined on the upstream side by the bedding/transition zones for the liner (Photo #5) and on the downstream side by PAG rockfill. However, GAL has submitted the results of a study on the expanded use of soapstone in the upper part of the Central Dike embankment and it may be exposed on the outer face. The Board has reservations about this use given the paucity of information regarding material behaviour, physical characteristics and the lack of precedent. The Board provided additional commentary on the use of soapstone by way of a memo transmitted to AEM on August 4th, a copy of which is included in Appendix E.

5.4 Construction reporting

The Board is pleased to see the procedures for Construction reporting. Complete detailed, As-Built records are invaluable when attempting to interpret performance data or to focus on specific areas in case of the need for remedial works. The Board recommends that a summary of all non-conformance records with details of the resolution of each be incorporated into the reports.

6.0 CENTRAL DIKE REVIEW

6.1 Summary of events

- Water ponding downstream of Central Dike was observed in October 2014. At the time the water level in the South Cell was at elevation 108.5 m.
- Tailings deposition started on November 20th, 2014.
- Leakage increased substantially and proportionately with tailings deposition.
- The downstream water level rose during the winter until pumping was initiated on April 14th, 2015. At that time, the South cell was at el. 115.8 m and the downstream pond at el. 115.5 m
- The capacity of the installation was increased and put into service on May 24th, 2015.
- Substantial quantities of water are being captured and transferred back into the South cell.
- There is a general consensus that the leakage contains tailings water though the accumulated volume is likely predominantely a result of the freshet as the catchment extends onto the abutments (Photos #6 and #7).

6.2 Implications

The Board regards the leakage to be a serious concern and the following questions are raised:

i. Can the South Cell be filled as intended in a safe manner?
ii. Will the resulting situation be consistent with closure requirements i.e. freeze back and "walk-away"?

6.3 GAL Evaluation

GAL were advised of the situation in December and proceeded to conduct numerical modelling of the flow regimes through and under the Dike using 2-D SEEP-W software. Some results were transmitted in a memo dated March 18th and entitled "Central Dike seepage modelling update and designer assessment about the pond of water at the downstream toe". The conclusions in this memo were that:

- The 2-D modelling could be used to make an initial assessment;
- Stability of the dike was not threatened;
- The seepage was likely occurring in the bedrock;
- The reported hydraulic gradients were acceptable, however no mention was made of an assessment of flow rates or accumulated quantities.

6.4 Current AEM and GAL position

AEM and GAL formulated the view that the situation posed no immediate threat to the dike and that continued monitoring would permit the accumulation of additional data to better calibrate the model.

6.5 Board concerns

Based on the information presented at the meeting, the Board has the following concerns:

- The GAL memo report does not include output showing equipotential lines or flow lines. Only seepage hydraulic gradients are shown on the figures. Phreatic lines are shown but hydraulic gradients are also indicated in the embankment above these lines;
- No reference is made to the original design base case of August 2013;
- There is apparently a calibration of permeability values using piezometric levels but none related to the estimated flow rates;
- The permeability of bedrock is assumed by GAL to be uniform at a very low value thus the probability of a near surface fractured layer is not recognized or accounted for, contrary to the original design;
- There is no evidence in support of the inference that instability is not a concern;
- It is not clear from where the criteria of acceptable hydraulic gradients came.

Consequently, the Board requests that an updated version of the GAL report be prepared using all the currently (validated) available data and including the following:

i. What is the model design basis (August 2013 or other);
ii. What are the differences in the new model with respect to the rock boundary conditions;
iii. In proceeding with the history matched adjustment of hydraulic conductivity, demonstrate that this is consistent with the estimates of discharge which was around 10 l/s at the time of scenario #2;
iv. Present in detail the assessment of potential instability modes;
v. Present in detail an assessment of the potential piping modes. Note that piping risk is a function of flow velocity and not just hydraulic gradient;
vi. Draw conclusions as appropriate.

The Board recommends the following additional actions:

i. Conduct a “steady state” pumping test to determine the current inflow rate, as soon as possible (the Board would like to see the detailed plan for the test and the anticipated accuracy. A “steady state” test rather than a “draw down” or “recovery” test is proposed because of the indeterminate volume of water contained in the rockfill embankments of both the Central Dike and the West Road);
ii. Review with GAL all validated and corrected piezometric data to isolate those that show a response to the downstream pumping and that need to considered in future protocols for risk assessment. It seems that a reaction to pumping was detected as far away as the toe of the Stormwater Dike;
iii. Review with GAL all the thermistor data and search for any anomalies and temperature cycles that may reflect advective heat flow due to seepage;

iv. While admitting not to be expert in the WILLOWSTICK technology, the Board recommends that they be contacted and if they can present a convincing proposal, they be commissioned as soon as possible to identify any concentrated flow paths;
v. The "As-Built" records for the Central Dike and, in particular, the information relating to seepage observations in the cofferdam foundation and in the key trench, should be consulted to contribute to the WILLOWSTICK interpretation;
vi. The GAL seepage model should be updated with the new magnitudes of flow to be determined soon.

The Board regards the above mentioned work as an urgent matter and proposes a one day meeting in the first half of September with the date to be confirmed as soon as possible.

Given the evidence as presented, the Board is not convinced that the conceptual seepage model adopted by GAL is correct as it is based on zero defects and no departure from the original design. Other models that take into account potential defects and different boundary conditions may be more appropriate. Scenarios to be considered are:

- Failure of the till liner over the cofferdam;
- Seepage delivered through the crushed stone protective layer (Photo #8) that was placed on the LLDPE liner (See MDRB report #16);
- Defects in the LLDPE liner;
- Communication through preferential pathways in the till and bedrock foundation (note that the model uses average conductivity and that no upper more pervious bedrock layer is included in the latest model).

An evaluation of the possible "defect models" vs "no defect model" will be the focus of the September meeting.

Separately from the work addressing the seepage mechanism, its modelling and forecasts of future discharge, the Board recommends that an activity be initiated to identify and evaluate at a conceptual level the mitigation options.

If the projected flows can be safely managed then no short term mitigation is required. If this is not the case then a cut-off along the axis of the key trench may be required. The possible options include a grout curtain or a freeze wall. The latter may be a better match for the freeze back closure plan but both options will likely need a balanced head (i.e. no flow) condition for successful execution. This may pose a significant restraint on operations of the South Cell for the duration of cut-off installation.

The Central Dike seepage issue is of such concern with a short time frame and a number of interfaces that it merits a dedicated project manager.

7.0 TAILINGS STORAGE FACILITIES/INSTRUMENTATION REVIEW

Some errors in the formulae and parameters for the processing of instrument readings have been identified and corrected.

AEM reports that all structures of the Tailings Storage Facility (TSF) are behaving as intended. The Board suggests that the thermistor reading plots be enhanced by the inclusion of a temperature vs time plot to better illustrate the evolution of the temperatures.

8.0 TSF OPERATION UPDATE

AEM provided a summary of the tailings deposition over the past year, the numerical modelling to assist planning, and the proposed geometry of the deposition. The Board is pleased to see the growing capacity within AEM with respect to tailings engineering.

The Board also notes that the impact of the seepage issue at Central Dike on tailings planning needs to be assessed including the possible use of the Bay-Goose pit for water management and the need to be sensitive to the requirements of the Amaruq addition.

9.0 DEWATERING DIKES/INSTRUMENTATION REVIEW

The project advises that instrumentation data and inspections indicate that all the structures are performing safely and as intended. The Board agrees with this assessment.

10.0 PIT WALL STABILITY

AEM provided a summary of the monitoring and observations related to pit wall stability. The situation appears to be well under control.

Mining has ceased in the Bay-Goose Pit and only sectors A and E are being exploited in Portage Pit. Backfilling with waste rock is continuing in other areas. Some actions were required in pit E3 to ensure worker safety but this was identified and carried out in a timely fashion.

Rock conditions in the Vault pit have necessitated flatter pit slopes (south-east wall) than Portage and Bay-Goose but this was anticipated and wall stability is also acceptable.

Radar monitoring has proved to be a valuable tool, as at several other mine sites, and its use will continue.

11.0 ROCK STORAGE FACILITY SEEPAGE AND MILL SEEP INCIDENTS

The Board was advised of the management of these two issues. They are being handled effectively with capture of seepage at both locations. Monitoring is an ongoing exercise and adaptation to needs during operations and in the preparations for closure will be developed as appropriate.

12.0 CLOSURE PRE-FEASABILITY STUDY

The study, as presented, was limited to an LOM to the third quarter of 2017 with no consideration of the Amaruq addition. One of the primary criteria is to aim for a “walk away” status in 2040.

12.1 Rock Storage Facility

<u>The Board recommends that the AEM team becomes familiar with the research work that has been undertaken at the Diavik site prior to taking the next steps of the study.</u>

The instrumentation installations proposed by the team from the Research Institute on Mines and the Environment (RIME) may satisfy certain needs in the analysis of cover performance but in general are too shallow to give an overall picture of advective cooling in the rock pile.

12.2 Tailings Storage Facility

NPAG rockfill is proposed for the cover to maintain the tailings in a frozen state (active layer within the depth of the cover) and to direct run-off to drainage channels while preventing surface erosion. The Board sees a need to verify the long term durability of the ultramafic (soapstone) rock by laboratory testing for:

- Resistance to freeze/thaw cycles (moist state);
- Resistance to wetting and drying;

There is also a need to determine the thermal properties for numerical modelling of the cover performance.

As far as water management is concerned it may be of interest to examine the possibility of encouraging sheet flow rather than concentrating run-off in channels with their attendant maintenance issues.

As the goal is to achieve "walk away" status, the design criteria for the various structures should be appropriate. Statistically speaking, an extreme event is bound to happen in the time frame of perpetuity. Consequently, a 1:100 yr rainfall, inflow design flood, or earthquake is not adequate. The Board wishes to know what AEM proposes in this context.

12.3 Site wide water management

As mentioned above, 1:100 yr design criteria for rainfall and floods are not reasonable.

The guidelines established by the Canadian Council for Ministers of the Environment (CCME) for contaminants may not be accepted as closure criteria. This should be clarified.

The design should be sensitive to channel design and the anticipated active control and maintenance or lack thereof in the "walk-away" case.

12.4 Dewatering Dikes

After flooding of the pits, the dikes will be breached in selected locations to permit drainage and aquatic species migration. The excavation of the breaches will generate suspended solids and turbidity barriers will be required on both sides of any work area.

12.5 Landfill/Landform

The Board has no comments on the potential inclusion of landfill and landforms on the closure plans. Such structures, compared to dams, have diminished risk and requirements for closure. Hazardous Materials are to be dealt with separately.

12.6 Environmental and social responsibilities

The Board has no comments at this time on this section of the study.

12.7 Risks and Opportunities

The Board sees potential risk of regulatory changes. It also wishes to point out that there is no precedent for a walk-away approval.

In terms of opportunity, the Board sees merit in the evaluation of the "perpetual care " status option, as long term maintenance costs may be more economically attractive than up-front

capital costs associated with more severe design criteria for walk-away. It is worthy to note that in Saskatchewan shared responsibility has become acceptable.

13.0 AMARUQ PROJECT

This study was presented for information.

14.0 NEXT MEETING

The next meeting is tentatively set for early to mid September and a site visit could be in July 2016 (suggested dates are July 18-22 but this remains to be confirmed).

15.0 ACKNOWLEDGMENTS

The Board once again wishes to thank the personnel of AEM for their participation in the meetings, and for the excellent documentation and presentations made by AEM 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. 17

July 27th-30th, 2015

AGNICO EAGLE

Agnico Eagle Mines - Meadowbank Division

Meadowbank Dike Review Board

Meeting # 17 – July 27th to 30th, 2015

Meadowbank Mine Site, Nunavut

AGENDA

Monday, July 27th

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 #16** [AEM]

- Discussion with Board Members

14h30 **Summary of 2015 construction progress – (P3)** [AEM]

- (Central Dike Stage 4 - Saddle Dam 3, 4 and 5 Stage 1)

16h15 **Central dike - Instrumentation Review – (P4)** [AEM]

17h30 **Dinner (site cafeteria)**

Tuesday, July 28th

7h30 **Tailings Storage Facilities Instrumentation Review – (P5)** [AEM]

8h15 **Tailings Storage Facilities Operation – (P6) [**AEM]

- Review of integrated tailings deposition plan for North Cell and South Cell

9h30 **Site Visit - Tailings Storage Facilities**

- North Tailings Cell (SD1, SD2, Stormwater Dike, Diversion Ditches)
- Central Dike
- SD3, SD4, SD5
- North cell capping

11h30 **Lunch (site cafeteria)**

13h00 **Dewatering Dikes - BayGoose, South Camp, East & Vault Dikes Review– (P7)** [AEM]

- Update on Monitoring Program and Data Review of Dewatering Dikes
- Comments on Dikes Performance

14h15 **Reviews of Pits Wall Stability and Geomechanics – (P8)** [AEM]

- Wall stability in Goose, Portage and Vault Pits
- Monitoring program and results

15h15 **Mill and RSF seepage update – (P9)** [AEM]

15h45 **Coffee Break**

16h00 **Site Visit**

- Bay Goose, East and Vault Dike - Vault and Portage Pits
- Mill area, RSF Seepage,

18h30 **Dinner (site cafeteria)**

Wednesday, July 29th

7h30 **Closure Study Presentation – (P10)**

- TSF and RSF rehabilitation
- Water Management
- Environment
- Dike Breach

10h15 **Coffee Break**

10h30 **Closure Study Presentation (con't) – (P10)**

12h00 **Lunch (site cafeteria)**

13h30 **Amaruq – Presentation of the project – (P11)** [AEM]

15h00 **Coffee Break**

15h30 **Amaruq – Presentation of the project – (P11)** [AEM]

17h00 **Comments from the Review Board Related to Issued Documents and Reports and presentations**
(As-built Reports, Instruments Data)

17h30 **Dinner (site cafeteria)**

If required, the deliberation by the Review Board Members can start at the end of Wednesday

Thursday, September 30th

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 JULY 2015 MEETING
Held at the Meadowbank Mine site, Nunavut

Attendance		
Julie Bélanger	AEM	Engineering Superintendant
Kevin Buck	AEM	Environmental Superintendant
Jean Cayouette	AEM	Director, Mining Reclamation
Rebecca Cousineau	AEM	Geotechnical Supervisor
Stephane Frechette	AEM	Assistant Engineering Superintendant
Patrice Gagnon	AEM	Geotechnical Supervisor
Michel Groleau	AEM	Tailings and Water EIT
Michel Julien	AEM	VP Environment
Alexandre Lavallée	AEM	Dewatering Dikes and Rock Mechanics EIT
Thomas Lepine	AEM	Geotechnical Coordinator
Pierre McMullen	AEM	
Erica Voyer	AEM	Environmental Coordinator
Don Hayley		Dike Review Board
Norbert Morgenstern		Dike Review Board
Anthony Rattue		Dike Review Board

ATTACHMENT C

DOCUMENTS PROVIDED FOR THE MEETING

Technical Memoranda from AEM

July 8, 2015 Central dike-Performance overview

Technical Memoranda from Golder Associates

March 18, 2015 Central Dike seepage modelling update and designer assessment about the pond of water at the downstream toe (Doc 1500 1408445-MTA-Rev0);

July 24, 2015 Recommendations on the use of ultramafic rockfill on Central Dike above el. 133 m, Meadowbank Project; (Doc 1518 1528661 TME Rev A draft)

Letter Report from O'Kane Consultants Inc.

December 21, 2014 Agnico Eagle Mines-Meadowbank Project-Summary of modeling of potential cover systems for the North Cell Tailings Storage Facility

ATTACHMENT D

PHOTOGRAPHS

Photo #1 Saddle Dam 3, fractured rock of right abutment

Photo #2 SD3, steep rock face adjacent to fault zone

Photo #3 SD3, fault zone

Photo #4 Central Dike, ultramafic soapstone rockfill

Photo #5 Central Dike, bedding and transition zones that confine the soapstone fill

Photo #6 Central Dike, downstream toe, north catchment area extending to rock dump

Photo #7 Central Dike, downstream toe, south catchment area extending to haul roads

Photo #8 Central Dike, rockfill protection layer on LLPDE liner

APPENDIX E

Memo from MDRB, August 4th, 2015, “Use of ultramafic rockfill in the Central Dike embankment”.

Memo

To: Mr. Bertin Paradis and Mme. Julie Bélanger

From: Norbert Morgenstern, Don Hayley and Anthony Rattue

CC: Thomas Lepine

Date: August 4, 2015

Re: Use of ultramafic rock in the Central Dike embankment

As a result of discussions during the recent meeting of the MDRB (#17) and subsequent to in-depth reading of the Memorandum issued by Golder Associates (GAL) entitled "Recommendations on the use of ultramafic rockfill on central dike above elevation 133 m, Meadowbank Project", the Board wishes to transmit its concerns over the use of the soapstone rockfill.

It is understood that the ultramafic rock, primarily soapstone, constitutes one of the available non potential acid generating (NPAG) materials required for construction above water level. As mentioned by GAL in the memorandum, little or no information is available in the literature on the use of such material in construction or indeed of its physical properties. Only anecdotal evidence of the stability of rock dumps of this material at Meadowbank is offered as a demonstration of its potential suitability. However, its friable nature as observed in material when subject to vehicular traffic, demonstrates low crushing strength and poor abrasion resistance. Moreover talc is readily discernible in the crushed product and the very low frictional resistance of talc is well-known.

During the site visit, the Board observed that the use of soapstone in the embankment is currently limited to a zone of a few meters width on the upstream side, confined by the crushed stone bedding layers of the liner on one side and by more durable rockfill on the other. The sections used in the stability analyses presented in the memorandum indicate that substantial portions of the embankment of central dike may be constructed of the soapstone which would be exposed on the downstream face.

GAL has recommended that the layer thickness be reduced from 2 m to 1 m and that wetting prior to compaction de adopted with a view to obtaining greater density to reduce potential settlement.

The Board has the following comments.

1. A test pit should be excavated in the compacted fill to examine the fabric of the rockfill and the degree of crushing (mentioned during the debriefing).

2. Reduced layer thickness without a change in the number of passes of the compactor may well result in more particle crushing.

3. Resistance to freeze/thaw and wetting/drying cycles has to be demonstrated by laboratory testing (also mentioned during the debriefing).

4. Observed steep slopes in waste rock piles are a function of the angular blocks and the low stress levels.

5. The angle of shearing resistance is a combination of intrinsic material inter-particle friction (mineralogy) and dilatancy of the skeleton of larger particles. In the case of soapstone, and where observed on the outer face of rock piles, the latter is dominating as the pure friction can be very low. Consequently, the shear strength at high confining pressures, with particle crushing, will be much lower than the 37° used by GAL in the analyses.

6. Laboratory testing is urgently required to:
   - Evaluate freeze/thaw and wet/dry cycle resistance;
   - Determine shear strength properties at a range of confining stresses to be expected in the embankment;
   - Determine thermal properties for use both in the central dike and in the cover on the Tailings Storage Facilities (TSF).

The Board is working on the preparation of its report of the 17th meeting but felt that this memo was required to encourage an early start to the work that is required prior to adoption of an embankment section incorporating large volumes of ultramafic rock. The Board would be pleased to review and provide comments, as necessary, on any programme of laboratory testing that AEM and GAL may prepare in this regard.

Note that the material already placed and, as mentioned above, in a confined location may remain if the test pit indicates adequate density.

Prepared by

Anthony Rattue

Reviewed by

Norbert Morgenstern and Don Hayley

MDRB REPORT MEETING NO.17 – AEM RESPONSES

December 18, 2015

SUBJECT: RESPONSE TO REPORT No.17, MEADOWBANK DIKE REVIEW BOARD

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

FROM: Agnico-Eagle Mines, Meadowbank Division

The seventeenth meeting between the Meadowbank Dike Review Board (the Board) and Agnico-Eagle Mines Limited (AEM) was held from July 27th to 30th at the Meadowbank Site. The objectives were to review the progress of the works, the behaviour of the dikes, the operation of the Tailings Storage Facility (TSF), the pit slope stability, the ongoing planning for the expansion of the TSF, mine closure study advancement and an introduction to the Amaruq project. Field visits to the different structures were also conducted during this meeting. On August 6th, 2015, the Board provided a report letter (Report 17) with their comments from the above meeting.

This letter provides the response from AEM related to the board recommendations for Meeting No. 17.

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Bureau 202
Val d'Or, Quebec J9P 0E9
Tel: 819-825-3744

Baker Lake Office:
P.O. Box 540
Baker Lake, Nunavut X0C 0A0
Tel: 867-793-4610 Fax: 867-793-4611

AGNICO EAGLE
MEADOWBANK

1. 2015 construction

1.1 Saddle Dams #3 and #4 - Construction

MDRB Comment:

Work is well advanced on both structures with the embankment at a level to begin liner installation. The foundation on the upstream side is entirely on rock and the footprint of the key trench has been exposed, though final clean-up and surface treatment remain to be carried out. The Board's only concern is with the liner tie-in at the right abutment of SD#3. Badly jointed rock (Photos # 1 and #2) and an adjacent wide fault zone (Photo #3) exhibiting soft gouge material will require an appropriate detail to be developed. This may well be a field fit to be established jointly by AEM and Golder Associates (GAL). The Board requests documentation on the intended treatment of these features and the liner interface.

AEM answer:

Golder and AEM together decided to how to build the key trench in that specific area. To summarize, realignment of the path of the key trench has been done and tamrock drilling on the sharp bedrock has been realized also. A memo issued by Golder with all the details on that specific area can be found in the Appendix of this response. The SD3 as-built document will also include information about the design modification in that area and the construction steps followed. This area will be closely monitored to ensure it is performing well.

MDRB Comment:

Current design for closure indicates that the South Cell spillway will be located on SD#3. The Board is of the opinion that this structure should be constructed on rock if at all possible, to ensure long term reliability. Thermal conditions in the vicinity of a spillway will be affected by water flow and this aspect should be included in the evaluation of the location.

AEM answer:

AEM agreed that the structure should be built as much as possible in an area where the bedrock is close to the surface or exposed to minimize the thermal behavior of the spill way. A Specific design for the spillway will be created in the year 2016 and the possibility to push the structure towards the east will be evaluated.

1.2 Central Dike - Construction

MDRB Comment:

Soapstone…Placing in a 2 m lift, but with adequate watering and moderate compaction should be evaluated. The Board recommends the excavation of test pits, to a depth of at least 2 m, to verify the fabric and density of the compacted rockfill.

AEM answer:

Different test pits have been realized on the placed and compacted rockfill soapstone. After test pit excavation AEM and Golder agreed that 2m lifts was appropriate. Before placement of subsequent lifts the fine soapstone dust layer on the surface was removed and the surface scarified. The Central Dike as-built document will also include information about the test pits and investigation conclusions. The structures will be closely monitored to ensure the soapstone is performing well.

MDRB Comment:

… GAL has submitted the results of a study on the expanded use of soapstone in the upper part of the Central Dike embankment and it may be exposed on the outer face. The Board has reservations about this use given the paucity of information regarding material behaviour, physical characteristics and the lack of precedent. The Board provided additional commentary on the use of soapstone by way of a memo transmitted to AEM on August 4, a copy of which is included in Appendix E.

AEM answer:

A specific document has been prepared to answer that concern by the board. It has been sent separately from the current document. More laboratory testing to obtain a better understanding of the mechanical properties of the soapstone are currently ongoing. New information will be provided to the Board as soon as results available and the report issued.

1.3 Construction reporting

MDRB Comment:

The Board is pleased to see the procedures for Construction reporting. Complete detailed, As-Built records are invaluable when attempting to interpret performance data or to focus on specific areas in case of the need for remedial works. The Board recommends that a summary of all non-conformance records with details of the resolution of each be incorporated into the reports.

AEM answer:

AEM agrees with the recommendation of the board. An as-built report for the 2015 construction season will be built by AEM in collaboration with Golder. The report will include details of the "field fitting" components that had to be performed during the construction.

2. Central Dike Performance Review

All the comments from the MDRB members for the Central Dike performance have been or will be answered with the MDRB meeting #18 in the document entitled *"Response to MDRB Rpt No 18".*

3. TSF Instrumentation Review

MDRB Comment:

The Board suggests that the thermistor reading plots be enhanced by the inclusion of a temperature vs time plot to better illustrate the evolution of the temperatures.

AEM answer:

These graphs will be built to help the understanding of the evolution in time and cycle of the temperature in the structure. In fact, most of them have already been built by AEM. The relevant graphs will be presented to the board at our next meeting.

4. Closure PFS Study

4.1 Rock Fill Storage Facility (RSF)

MDRB Comment:

The Board recommends that the AEM team becomes familiar with the research work that has been undertaken at the Diavik site prior to taking the next steps of the study. The instrumentation installations proposed by the team from the Research Institute on Mines and the Environment (RIME) may satisfy certain needs in the analysis of cover performance but in general are too shallow to give an overall picture of advective cooling in the rock pile.

AEM answer:

AEM will contact the people who were involved in the closure concept and monitoring of the RSF at Diavik. We will then evaluate if more instrumentation is needed at greater depths in the Portage RSF.

4.2 Tailings Storage Facility (TSF)

MDRB Comment:

NPAG rockfill is proposed for the cover to maintain the tailings in a frozen state (active layer within the depth of the cover) and to direct run-off to drainage channels while preventing surface erosion. The Board sees a need to verify the long term durability of the ultramafic (soapstone) rock by laboratory testing for:

- *Resistance to freeze/thaw cycles (moist state);*
- *Resistance to wetting and drying;*

There is also a need to determine the thermal properties for numerical modelling of the cover performance.

AEM answer:

Some tests will soon be initiated with RIME to answer the questions of resistance to freeze and thaw cycles as well as resistance to wetting and drying. Triaxial testing on crushed soapstone is being conducted by Polytechnique University, with tests on both wet and dry material. The thermal properties for numerical modelling has been assessed by both O'Kane Consulting during their initial phases of the design study, as well as the RIME during their work on the test cells realized over the tailings and the Waste dump thermistors assessment.

MDRB Comment:

As far as water management is concerned it may be of interest to examine the possibility of encouraging sheet flow rather than concentrating run-off in channels with their attendant maintenance issues.

AEM answer:

AEM will evaluate with O'Kane Consulting the possibility of using a larger flow area for the RSF cover. The possible addition of the upstream raise infrastructure in the North Cell could in fact help the purpose of a "sheet flow" design as the tailings surface will probably already have the proper geometry for it.

MDRB Comment:

As the goal is to achieve "walk away" status, the design criteria for the various structures should be appropriate. Statistically speaking, an extreme event is bound to happen in the time frame of perpetuity. Consequently, a 1:100 yr rainfall, inflow design flood, or earthquake is not adequate. The Board wishes to know what AEM proposes in this context.

AEM answer:

AEM acknowledges the comment from the Board. We will consider this comment in the next phase of the development of the closure concepts and closure final plan. Further discussions with the Board about the closure concepts and criteria will occur in the coming years.

4.3 Site wide water management

MDRB Comment:

The guidelines established by the Canadian Council for Ministers of the Environment (CCME) for contaminants may not be accepted as closure criteria. This should be clarified.

AEM answer:

As presented to regulators in the AEM Water Management Plan and Water Quality Forecast Model, AEM will not breach the dikes until the water quality parameters meet Canadian Council of Ministers of the Environment (CCME) Guidelines for the Protection of Aquatic Life. For parameters that do not have CCME Guidelines, AEM will review the pit water quality and will compare against to background water quality of the lake, and decide if dike breaching can

proceed. AEM intends to maintain communication about the closure plan and criteria with the regulators during the development of the plan.

MDRB Comment:

The design should be sensitive to channel design and the anticipated active control and maintenance or lack thereof in the "walk-away" case.

AEM answer:

AEM agrees with the recommendation and will evaluate how the design should be adapt to answer correctly the current concern.

4.4 Dewatering Dikes

MDRB Comment:

After flooding of the pits, the dikes will be breached in selected locations to permit drainage and aquatic species migration. The excavation of the breaches will generate suspended solids and turbidity barriers will be required on both sides of any work area.

AEM answer:

AEM agrees that turbidity barriers will be required to perform these tasks. The addition will be made in the dike breaching concept and closure planning.

4.5 Risks and opportunities

MDRB Comment:

The Board sees potential risk of regulatory changes. It also wishes to point out that there is no precedent for a walk-away approval.

AEM answer:

AEM will continue to maintain regular communications about the closure plan and concepts with the regulators. Some concepts of the closure plan were presented during the renewal of the Water License in 2015 and also in the Meadowbank Annual Report. Comments from regulators about the closure were addressed during the renewal process of the water license.

AEM acknowledges the comment from the Board and understands that there is no precedent for a walk-away approval. We will consider this comment in the next phase of the development of the closure concepts and closure final plan, in order to evaluate different scenarios, but walk away will remain the closure objective for Meadowbank at this stage.

MDRB Comment:

In terms of opportunity, the Board sees merit in the evaluation of the "perpetual care " status option, as long term maintenance costs may be more economically attractive than up-front capital costs associated with more severe design criteria for walk-away. It is worthy to note that in Saskatchewan shared responsibility has become acceptable.

AEM answer:

AEM acknowledges the comment from the Board and will evaluate the option of involving the local work force in term of site monitoring during the closure and post closure period. AEM will also consider the evaluation of the "perpetual care" status option during the development of the closure concepts and closure final plan, in order to compare with the walk-away approval.

Best Regards

Geotechnical Engineering Team
Meadowbank Division
Agnico-Eagle Mines

MDRB REPORT MEETING NO.18

September 28th, 2015

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

Email: bertin.paradis@agnico-eagle.com

Dear Mr. Paradis,

Report No 18
Meadowbank Mine Dike Review Board
Meeting September 18, 2015

1.0 INTRODUCTION

The meeting of the Dike Review Board was held in the Montréal offices of Golder Associates (GAL) on September 18th. 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 investigation and studies relating to the seepage that has been observed to be ponding at the toe of the Central Dike since October 2014. The Board was informed of this situation in July 2015 (17th MDRB meeting) and questions were posed at that time as to whether:

i. the South Cell can be filled as intended in a safe manner?
ii. the resulting situation will be consistent with closure requirements i.e. freeze back and "walk-away"?

The activities covered those outlined in the agenda which is included as Attachment A. The list of attendees at the meeting is given in Attachment B.

Paper copies of the various PowerPoint presentations were provided by Agnico-Eagle Mines (AEM) and GAL during the meeting.

In the report which follows, the Board's recommendations are underlined.

2.0 PRIMARY OBJECTIVES

AEM and GAL summarized the primary objectives as addressing two issues:

1. Is there a need to grout the foundation of the Central Dike;
2. Can tailings deposition be resumed in the South Cell (retained by the Central Dike).

3.0 STUDY AND FIELD INVESTIGATION ACTIVITIES

In the report of the 17th MDRB, the Board expressed its concern over the seepage and the potential significance to the dike behaviour, and made the point that the issue should be addressed urgently due to impending resumption of tailings deposition planned for the winter 2015-2016. AEM and GAL have been responsive to this recommendation and the Board was pleased to note the thorough and systematic approach that is evidenced by the material presented at the 18th meeting. Following a review of the design basis, original site investigations and dike construction, the Board was given information on the activities that had proceeded in parallel on three fronts, as described briefly hereafter. The excellent team organization and technical development were apparent.

3.1 Design basis, investigation and construction

The presentation of these elements essentially covered information that had been transmitted to the Board at previous meetings dating back to April 2011.

The drilling and water pressure testing had indicated an upper layer of fractured rock with higher transmissivity (permeability) and a lower layer of sound rock with corresponding lower values of transmissivity. A natural blanket of glacial till, overlying the rock within the entire area of the arm of second Portage Lake, which the tailings storage facility (TSF) occupies, was deemed to provide a barrier to tailings migration through any pathways in the rock.

The design basis was presented at the April 2012 MDRB meeting. Seepage through the dike is controlled by a geomembrane on the upstream face with a connection to a centrally located cut-off trench. The trench was to be excavated down to rock and the need for local treatment and grouting was to be a field decision. For the most part, the trench was excavated to rock however; short sections were terminated on firm till. During construction, seepage was observed to emanate from the rock surface, particularly from the south end of the trench at the abutment, and locally from the areas of sand and gravel exposed within the till on the trench sides. This water was controlled with sump pumps.

The surface of the foundation bedrock was treated but no grout curtain was included. It was declared at the time that AEM would manage seepage reporting to the pit. However, the central location of the cut-off trench was chosen so as to permit remedial grouting, if required, from the crest of the embankment. If migration of tailings was the issue, then grouting at the dike toe was also seen to be a possible remedial action.

A filter blanket was included beneath the upstream face geomembrane, on both sides of the horizontal part of the geomembrane, and between the foundation till and the embankment rockfill downstream of the cut-off trench.

Stability and performance of the dike are to be independent of thermal conditions, i.e. assured whether thawed, or frozen in part or fully frozen.

3.2 Pumping tests

Pumping at the toe commenced in April 2015 during which time the tailings deposition in the South Cell continued. By the end of July, the head differential between the South Cell and the downstream pond had reached 11 m. At this time, freshet flow had ceased and the magnitude of the seepage inflow could be observed. Subsequent to the MDRB July visit and meeting, a

pumping test programme was developed and implemented. Tailings deposition was transferred to the North Cell, and both the South Cell elevation and the pond level were held sensibly constant for the test duration. The pump tests, of 2 to 10 days duration, gave flow rates of around 700 m^3/h and 780 m^3/h, for 10 m and 11 m differential head, respectively.

Sampling and laboratory testing for water chemistry was also carried out during a subsequent transfer of water from the South Cell to the Bay-Goose Pit. Using mass balance, a strategy will be developed to optimise the transfer of water to the abandoned pit while keeping a control on water chemistry and maintaining an adequate volume in the TSF for reclaim to supply mill operations.

3.3 Instrument readings

Thermistor strings and vibrating wire piezometers have been installed at 9 locations beneath the Central dike or at the toe of the same. Up to date results were presented.

At Stn. 465, a single installation at the D/S toe indicates frozen ground and measured piezometric pressures are therefore of no value.

At Stn. 545, P1 is located immediately D/S of the cut-off and P2 is at the dike toe. The full profile at the former is un-frozen whereas the ground is frozen down to elevation 95 m at the latter. At P1, the piezometers in the rock and the lower part of the in-situ till show little response to the South Cell or the D/S pond elevations and thus, if reliable, indicate free draining bedrock with outlet to Portage pit. However, the bottom piezometer indicates 2-3 m of suction and may not be reliable. The piezometer at mid depth in the till reacts strongly and started to do so when the cell water level exceeded el. 108 m. Note that 545-P1 was installed in one of the areas where till was left in the base of the cut-off trench. At P2, there is no response from any of the piezometers. In this case only the bottom piezometer reads a pressure head greater than its installation level. Also of potential interest is the fact that 545-P1 and 545-P2 are located on the downstream side of the projected alignment of the Second Portage Fault. The transmission of water pressures may be affected by the presence of this geological feature.

At Stn. 580, the P1 installation beneath the embankment is located D/S of the cut-off trench and U/S of the Second Portage Fault. The full depth profile is unfrozen. The deepest piezometer in rock reacts in parallel with the South Cell albeit with a 25 m head difference according to the readings. The upper piezometer in rock and the two piezometers in the in-situ till show little or no response. The piezometer in the fill reads a small negative (suction) pressure. The cut-off trench was taken to rock in this area but a sandy zone within the till was exposed in the trench side wall.

There are three installations at Stn. 650. P1 and P2 are located beneath the embankment and P3 is D/S of the West Road. P1 is unfrozen, P2 frozen down to elevation 95 m and P3 is frozen in the upper portion but only slightly below zero at depth. At P1, the piezometers in rock do not give reliable results (strong suction). The piezometers in till follow closely the D/S pond level. Note that till was also left in the bottom of the cut-off trench in this location. At P2, all three piezometers in rock follow a pressure profile between the D/S pond level and the South Cell level thus indicating artesian pressures. The piezometer in the till is likely frozen.
At P3, the reading of the lower piezometer in rock seems to be related to the South Cell water level albeit with a 40 m head difference, though given its location D/S of the West Road, it could be related to the D/S pond.

The single instrument location at Stn. 750 is situated beneath the embankment. The ground is unfrozen. There is no reaction from the piezometers in rock or the lower instrument in till; all indicating suction. The instruments in the middle of the in-situ till and in the embankment follow the D/S pond level though the unit in till indicates 2-3 m of artesian pressure. Once again, this location coincides with a zone of till in the base of the cut-off trench.

At Stn. 875, a single installation is located about 50 m D/S of the dike centreline. The profile is unfrozen. There are two piezometers, both situated in the bedrock. The upper one follows roughly the progress of the South cell, with a 2-3 m lower pressure head, and then responds to the D/S pond pumping with a 2-3 m artesian head relative to the latter. The lower unit started with lag of 10 m of head relative to the upper instrument but now reads almost the same value.

Thus the results from the instrumentation indicate possible communication both through the rock and through the pockets of till remaining beneath the cut-off trench.

3.4 Numerical seepage modelling

In order to interpret the observed seepage and piezometer readings, GAL has developed a 2-D numerical model based on SEEP-W software with the geometry being derived from the section at Stn. 650. Some results were presented to the Board at the July meeting. The model has since been further refined and calibrated to match the piezometer readings as close as possible. Parametric analyses have been carried out to attempt to also match the seepage flow rates that were measured in the pump tests.

For a model including a homogeneous in-situ till unit, the permeability has to be raised to $3x10^{-3}$ m/s and extrapolated across the entire base of the valley (300 m) to reach total flow rates similar to those measured. This is unlikely. A more pervious granular layer within the till would need a permeability of 10^{-2} m/s, also extrapolated over the full width, which also is unlikely. Till was left in the cut-off trench in two local areas and for these to contribute the full flow it would require a very open soil structure.

Simulated defects in the geomembrane or a lack of an upstream till face to the cofferdam would also not be sufficient by themselves to explain the measured seepage flow rate.

Other than including the two horizons in the bedrock, the model, due the 2-D format, did not include any concentrated flow paths or other heterogeneity which could be expected in a natural system.

The analyses were run for various stages in the South cell tailings deposition. Although the differential head will increase, the total seepage is shown to decrease as a result of the blanketing effect of the tailings.

The calculated exit gradients at the D/S toe justify the presence and/or extension of the filter blanket and weighting zone. Raising the D/S pond level to reduce the gradient is also shown by the model to be beneficial.

3.5 Willowstick geophysical testing

A team from Willowstick spent 10 days on site and conducted electro-magnetic geophysical surveys of the central Dike. An electrical current is created in the ground by judiciously placing electrodes upstream and downstream of the embankment. The current then sets up a magnetic field that can be measured with precise instruments. The physics of the exercise are such that

electrical current concentrates in the more conductive seepage flow paths beneath the basin and the dam abutments. The survey clearly showed the boundary of frozen and unfrozen soils around the basin as permafrost is highly resistant. Concentrated flow is evident in their data at the southern limit of the unfrozen foundation and, to a lesser extent, at the northern limit. The primary seepage path coincides generally with the area where seepage into the cut-off trench was observed.

The Board remarked that Felsenmeer, or frost shattered, in place bedrock, is common on the perimeter of lakes in permafrost regions and could reasonably be anticipated at the margin of the drained bay and at the abutments of Central Dike. The foundations of the Saddle Dams 3 and 4, visited in July, were highly fractured in some areas. More highly transmissive bedrock created in such a fashion may explain the zones revealed by the Willowstick survey.

4.0 MAJOR ADVANCES

In the view of the Board, the major advances since July are:

i. The seepage rates have been quantified by the testing;
ii. As long as internal erosion does not become an issue, seepage rate reduction is not required as management by pumping is deemed by AEM to be an acceptable solution;
iii. A model equivalence of the seepage mechanism has been developed by history matching that puts emphasis on pathways in the till. This is regarded mechanistically to be a worst case as erosion of the till foundation could be an outcome;
iv. The Willowstick survey was performed successfully and suggests that the bedrock pathways are dominant.

5.0 PATH FORWARD

i. Given the position adopted by AEM that pumping at flow rates of the order of magnitude of those measured is an acceptable operation, the Board concurs that grouting/sealing is not required. Even if a clearer image of the seepage pathways was to be developed, and target areas identified, the effectiveness of grouting in flowing water is questionable.
ii. While certainly giving useful pointers as to the location of the seepage pathways, the Board recommends that the anomalies identified by Wiilowstick be confirmed by drilling, core sampling, geo-camera borehole survey and water pressure testing. The boreholes should be equipped with thermistor strings and piezometers to complement the existing instrument layout.
iii. The Board agrees that tailings deposition in the South Cell can be resumed. The tailings deposition plan indicates spigotting from 2 to 5 locations all located along the central Dike with a view to maintain a tailings beach. As the Willowstick findings indicate flow concentration along the sides of the valley, the Board enquires whether spigotting from the sides of the basin could be implemented to reduce inflow from the supernatant pond. It may be recalled that the piezometer VWP 13265 at the Stormwater Dike responds to the water level in the South Cell and reacted to the pumping at the toe of the Central Dike. A communication through the bedrock is apparent and recharge of the bedrock aquifer could be reduced by strategic tailings placement. However, the pathways need to be confirmed before following this avenue.

iv. The Board agrees that back-pressure applied by raising the level in the collection pond at the D/S toe, would improve safety but it is not clear to what extent the design criteria will be met and whether the provision is adequate. The primary design criteria covering:
    a. Uplift
    b. Internal erosion
    c. Shear stability

    have to be declared and the requirements in terms of piezometric level, seepage gradient and seepage velocity established in order that an observational method be applied to monitor the acceptability of the pumping solution.

v. The Board also agrees that the inverse filter beneath the embankment and at the toe contributes to safety but the design details and method and timetable for execution needs to be worked out. Raising the pond level to apply back-pressure may not be consistent with trying to construct a filter blanket. The question to be asked is whether the inability to install the filter is important. To answer this question, the Willowstick hypothesis needs to be proven as soon as possible.

vi. The numerical analyses, while insightful, cannot give a definitive conclusion. There are many geological models that could be made consistent with the seepage back-analysis particularly if 3D and heterogeneous conditions are admitted. Nevertheless, the Board recommends that an attempt be made in the short term to reconcile the different possibilities to explain the seepage. Geological profiles and sections showing primarily water pressure test values and RQD values have previously been presented to the Board. A geological interpretation including rock types and structural features may already exist but, if not, development of such a tool may contribute to the understanding of the flow regime.

vii. The Board wishes to emphasize that the greatest risk is that of internal erosion within the till foundation. Seepage flow confined within the bedrock is unlikely to result in uncontrollable erosion. There is a need for an adequate monitoring system to determine whether or not the design criteria are being met. The best possible geological model will assist in selecting locations for instrumentation. While there may be an expectation that recharge will diminish with increased tailings deposition, this is not assured. Pump back volumes should be monitored and previsions made to increase the pumping rate if required. The design should declare whether or not there is an operational limit to the pump back process.

viii. Mitigative measures including the addition or extension of the filter blanket may indeed be appropriate but other options such as relief wells (with or without pumping) should be considered to reduce potential artesian pressures beneath the till layer and thus reduce the risk of uplift and piping at the toe.

ix. For a future meeting, the Board requests that discussions be held on the potential impact of operating a “leaky “dike on mine expansion and closure.

6.0 NEXT MEETING

The next meeting, a site visit, could be in July 2016 (suggested dates are July 18-22 but this remains to be confirmed).

7.0 ACKNOWLEDGMENTS

The Board once again wishes to thank the personnel of AEM and GAL for their participation in the meetings, and for the excellent documentation and presentations made 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. 18

September 18th, 2015

AGNICO EAGLE

Agnico Eagle Mines - Meadowbank Division

Meadowbank Dike Review Board

Meeting # 18 – September 18th, 2015

Golder Downtown Montreal Office, Quebec

AGENDA

Friday, September 18th 2015

8h30	**P1 – Welcome, Review of the Agenda, Opening remarks and purpose of the meeting** [AEM]
9h00	**P2 – Design Basis, Investigation and Construction** [GAL]
10h00	Coffee Breaks
10h15	**P3 – Pumping test and water sampling** [AEM]
11h00	**P4 – Update on Modelling and Instrumentation Results** [GAL-AEM]
12h00	Lunch
13h00	**P5 – Geophysics (preliminary results from investigation)** [AEM]
13h30	**P6 – Mitigation Plan** [GAL]
14h00	Deliberation by the Board Members
15h00	Preliminary Report by the Board Members

ATTACHMENT B

ATTENDANCE AT SEPT 2015 MEETING
Held in the Golder Associates offices in Montréal

Attendance		
Martin Beausejour	AEM	General Superintendant-Mine Operations, Meadowbank
Julie Bélanger	AEM	Engineering Superintendant
Michel Groleau	AEM	Tailings and Water EIT
Alain Hamel	AEM	Manager General Services
Michel Julien (by telephone)	AEM	VP Environment
Thomas Lepine	AEM	Geotechnical Coordinator
Bertin Paradis	AEM	General Manager-Meadowbank
Michael Angelopoulos	GAL	Geoscientist
Annie Beaulieu	GAL	Geotechnical Division Manager
Grant Bonin	GAL	Mining Geotechnical Engineer
Yves Boulianne	GAL	Geotechnical Engineer
Dan Walker	GAL	Geotechnical Division Manager
Don Hayley		Dike Review Board
Norbert Morgenstern		Dike Review Board
Anthony Rattue		Dike Review Board

MDRB REPORT MEETING NO.18 - AEM RESPONSES

AGNICO EAGLE
MEADOWBANK

April 1, 2016

SUBJECT: RESPONSE TO REPORT No.18, MEADOWBANK DIKE REVIEW BOARD

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

FROM: Agnico-Eagle Mines, Meadowbank Division

The eighteenth meeting between the Meadowbank Dike Review Board (the Board), Agnico-Eagle Mines Limited (AEM) and Golder and associate (GAL) was held on September 18th 2015 at Golder downtown Montreal office. The objective was to present the work that has been undertaken since the meeting 17 for the Central Dike situation. On September 18th 2015, the Board provided a report letter (MDRB Meeting No 18 report) with their comments from the above meeting.

This letter provides the response from AEM related to the board recommendations for Meeting No. 18.

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AGNICO EAGLE
MEADOWBANK

1. Central Dike

MDRB Comment:

Given the position adopted by AEM that pumping at flow rates of the order of magnitude of those measured is an acceptable operation, the Board concurs that grouting/sealing is not required. Even if a clearer image of the seepage pathways was to be developed and target areas identified, the effectiveness of grouting in flowing water is questionable.

AEM answer:

Agnico Eagle, Meadowbank Division, agreed with the above statement. Meadowbank has successfully control/pumped the water accumulation at the downstream of the Central Dike and is no planning to perform grouting.

MDRB Comment:

While certainly giving useful pointers as to the location of the seepage pathways, the Board recommends that the anomalies identified by Willowstick be confirmed by drilling, core sampling, geo-camera borehole survey and water pressure testing. The boreholes should be equipped with thermistor strings and piezometers to complement the existing instrument layout.

AEM answer:

Meadowbank has conducted an investigation campaign in November 2015 in the vicinity of the 2 anomalies found with the geophysical survey. Core logging/sampling, acoustic televiewer survey and packer testing program have been completed followed by an instrumentations program. The geotechnical program has been conducted by SNC Lavalin while the instrumentation campaign has been completed by AEM. A total of 4 holes have been drill with a diamond drill operated by Orbit Garant. 3 boreholes have been drilled at the primary anomaly around station 825 (boreholes CD-801, CD-825 and CD-850). The fourth hole (CD-595) has been drilled at the secondary anomaly around station 600. SLI has been retained also to perform the core logging and to assist AEM in the installation of the instrumentation. SLI similarly did the interpretation of the acoustic image following the televiewer survey. A full report from SNC Lavalin summarizing results from the campaign should be available soon in is final version. Next step for AEM will be to make a comparison study in between the As-Built of the Central Dike, localize geology and the results of the campaign.

It is at the moment rational to say that the drilling campaign confirmed the localization of the main flow pathway is underneath the structure. Most of the flow is occurring in geological structure that could be interpreted as major fault in the bedrock formation. These structure acts as piping

system in the bedrock aquifer between the South Cell Tailing pond and the D/S of the Central Dike.

MDRB Comment:

The Board agrees that tailings deposition in the South Cell can be resumed. The tailings deposition plan indicates spigotting from 2 to 5 locations all located along the central Dike with a view to maintain a tailings beach. As the Willowstick findings indicate flow concentration along the sides of the valley, the Board enquires whether spigotting from the sides of the basin could be implemented to reduce inflow from the supernatant pond. It may be recalled that the piezometer VWP 13265 at the Stormwater Dike responds to the water level in the South Cell and reacted to the pumping at the toe of the Central Dike. A communication through the bedrock is apparent and recharge of the bedrock aquifer could be reduced by strategic tailings placement. However, the pathways need to be confirmed before following this avenue.

AEM answer:

AEM have optimized the tailings deposition plan in accordance with the latest founding. It has been decided to emphasis the tailings deposition in the south side of the valley depositing from the south corner of the Central Dike. Impact on the pumping rate at the D/S of the dike has been notified soon after the beginning of the placement.

MDRB Comment:

The Board agrees that back-pressure applied by raising the level in the collection pond at the D/S toe, would improve safety but it is not clear to what extent the design criteria will be met and whether the provision is adequate. The primary design criteria covering: a. uplift, b. Internal erosion, c. Shear stability, have to be declared and the requirements in terms of piezometric level, seepage gradient and seepage velocity established in order that an observational method be applied to monitor the acceptability of the pumping solution.

AEM answer:

AEM will continue to work with Golder to insure that the current design criteria in relation with the seepage velocity, seepage gradient and piezometric reading converge with the current mitigation measure. In light of the results from the Geophysical survey combine with the drilling investigation, it is however more clear now that the mechanism of seepage will probably not affect the seepage gradient for the till component.

MDRB Comment:

The Board also agrees that the inverse filter beneath the embankment and at the toe contributes to safety but the design details and method and timetable for execution needs to be worked out. Raising the pond level to apply back-pressure may not be consistent with trying to construct a filter blanket. The question to be asked is whether the inability to install the filter is important. To answer this question, the Willowstick hypothesis needs to be proven as soon as possible.

AEM answer:

Following time frame restriction and the need to raise the water level at the D/S of the structure before the deposition start again in the South Cell, AEM decided to cancel the placement of the filter system. Likewise, AEM believe that the reduction of the water level needed at the D/S to be able to performed placement of the filter system could had jeopardize the stability of the structure during time of construction. In synergy with the founding of the drilling investigation campaign at the emplacement of anomalies found during the geophysical survey, we believe that blanket of aggregates at the D/S would not have such a great impact on the stability due to the mechanism of the seepage.

MDRB Comment:

The numerical analyses, while insightful, cannot give a definitive conclusion. There are many geological models that could be made consistent with the seepage back-analysis particularly if 3D and heterogeneous conditions are admitted. Nevertheless, the Board recommends that an attempt be made in the short term to reconcile the different possibilities to explain the seepage. Geological profiles and sections showing primarily water pressure test values and RQD values have previously been presented to the Board. A geological interpretation including rock types and structural features may already exist but, if not, development of such a tool may contribute to the understanding of the flow regime.

AEM answer:

AEM have undertaken such analysis. The investigation campaign held last November will help the understanding in between the geological interpretation and the current seepage mechanism occurring at the dike. The board member will be updated at the next MDRB meeting during the 2016 year on the founding of the analysis.

MDRB Comment:

The Board wishes to emphasize that the greatest risk is that of internal erosion within the till foundation. Seepage flow confined within the bedrock is unlikely to result in uncontrollable erosion. There is a need for an adequate monitoring system to determine whether or not the design criteria are being met. The best possible geological model will assist in selecting locations for instrumentation. While there may be an expectation that recharge will diminish with increased tailings deposition, this is not assured. Pump back volumes should be monitored and previsions made to increase the pumping rate if required. The design should declare whether or not there is an operational limit to the pump back process.

AEM answer:

The localization for new instrumentations that have been installed in November 2015 has been chosen in function of the results from the Geophysical survey. A total of 15 piezometers and 4 thermistors have been installed. With this addition, the totals of piezometers in the structure and in direct foundation of the structure have now reached a number of 41 (including the piezometers and thermistors placed directly at the D/S toe of the dike).

AEM have also implemented an automatic acquisition system for the instrumentations of Central Dike. The system is the same as the one at Baygoose Dike and has been installed and commissioned by GKM. This system, using VDV software, allowed us to have almost a real time monitoring of the structure.

AEM installed a mag-flowmeter in the discharge pipe going to South Cell TSF. The flowmeter data are recorded on the network via telecom system and reading is done twice a day in order to follow daily pumped volume. The pump capacity is two times bigger than the maximum flow predicted by the Golder seepage model (GAL, 2015).

MDRB Comment:

Mitigative measures including the addition or extension of the filter blanket may indeed be appropriate but other options such as relief wells (with or without pumping) should be considered to reduce potential artesian pressures beneath the till layer and thus reduce the risk of uplift and piping at the toe.

AEM answer:

AEM acknowledge the comment of the board and will have a look at it in the months to come as such a system.

MDRB Comment:

For a future meeting, the Board requests that discussions be held on the potential impact of operating a "leaky "dike on mine expansion and closure.

AEM answer:

AEM acknowledge the comment of the board and will have a look in the months at the impact of the current situation on possible future expansion and closure of the TSF.

Best Regards

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