



Technical Review Memorandum

TO Phyllis Beaulieu
Manager of Licensing
Nunavut Water Board

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FROM David Abernethy
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Nunavut Regional Office

SUBJECT Water License #2AM-MEA0815, Agnico-Eagle Mines Ltd.,
Meadowbank Gold Project, Water Quality Monitoring and
Management Plan for Dike Construction and Dewatering

DESCRIPTION

Agnico-Eagle Mines Ltd. (AEM) submitted a proposed *Water Quality Monitoring and Management Plan for Dike Construction and Dewatering at the Meadowbank Mine* to the Nunavut Water Board (NWB) on July 18, 2008 to satisfy Part D, Item 11 of the above-mentioned water license.

COMMENTS / RECOMMENDATIONS

Upon review of this plan, the following comments / recommendations are provided to the NWB for consideration in the approval of the plan.

A. Preliminary Comments

1. Despite the submission of this plan and any subsequent approval, AEM should be advised that they must comply with Section 36 of the *Fisheries Act* as well as the applicable *Metal Mining Effluent Regulations*.
2. The submitted plan addresses water quality monitoring objectives associated with dike construction and dewatering, being applicable from mid-2008 to early 2009. According to the August 1, 2008 *Meadowbank Gold Project East Dike Technical Specifications* prepared by Golder Associates, the East Dike, along with the West Channel Dike, is designed to allow dewatering of the northwest arm of Second Portage Lake. Dewatering dikes are required to isolate open pit mining activities from

Second Portage Lake, Third Portage Lake, and Vault Lake, which are known to hold gold ore deposits.

Due to the construction of additional water retention dikes throughout the project's development (i.e., West Channel Dike, Goose Island Dike, and Vault Dike), AEM should submit diagrams that reference water quality monitoring locations, dewatering locations, and construction timetables for all water retention dikes.

B. Section 1, Introduction

1. INAC concurs that the monitoring of total suspended solids (TSS) is important to determine the potential for environmental impacts due to dike construction and dewatering.

C. Section 4, Receiving Environment Suspended Sediment Triggers for the Protection of Fish and Fish Habitat at Meadowbank

1. Short Term Maximum and Maximum Monthly Mean TSS thresholds above background concentrations are presented as triggers for the protection of fish and fish habitat. These thresholds are consistent with those set by Part D, Item 15 of the license. Therefore, INAC concurs with the TSS thresholds identified in this plan.
2. Due to the need for a timely response to any potential TSS problems, AEM proposed that a relationship be developed between turbidity and TSS that will allow the use of turbidity as a surrogate for TSS. This relationship will be consistent with the recommendations of DFO's report on effects of sediment on fish and their fish habitat (2000). AEM states that this relationship will be developed during the construction phase and that in order to establish the relationship with confidence, data will be generated across a range of TSS levels by collecting samples from both inside and outside silt curtains. Until this site-specific TSS-turbidity relationship is developed, AEM plans to use 2007 monitoring data gathered from the All Weather Private Access Road to establish an initial relationship. This is inconsistent with the DFO report which references the development of site-specific relationships.

INAC is not opposed to the method of monitoring TSS through a relationship with observed turbidity results. Once a site-specific relationship has been developed, the results should be submitted to the NWB and INAC Water Resources Division.

- AEM should provide the site-specific relationship established between TSS and turbidity for Second Portage Lake and all other water bodies associated with dike construction and dewatering at the Meadowbank Project prior to the occurrence of these activities.

D. Section 5, Water Quality Monitoring and Management Plan for Dike Construction – Standard Operating Procedure

1. The proposed Standard Operating Procedure (SOP) for Dike Construction contains “key elements.” A complete version of this SOP should be provided.
2. The SOP indicates that AEM will conduct routine water quality sampling for nutrients and metals (total and dissolved) on a weekly basis. AEM should provide a mitigation strategy which includes action triggers should the sampled parameters exceed background levels and/or CCME Guidelines for the Protection of Aquatic Life.
3. Stations for routine water quality monitoring will be established approximately 50 metres beyond the silt curtains. Item 3 of the SOP makes reference to Figure 1 for a visual representation of these stations which are labeled W, NE, and SE with crossed circle markers. The proposed SOP also states that not all stations will be sampled every event. For consistency and comparison purposes, sampling should be conducted from all locations for every event.
4. Items 7 and 8 of the SOP provide triggers for the shutdown of dike construction based on Short Term Maximum and Maximum Monthly Mean TTS thresholds. After any shutdown, a report should be submitted to the NWB and INAC Water Resources Division summarizing the cause of the shutdown and include, as a minimum, the date and time of shutdown, sample monitoring results, and a mitigation strategy to prevent reoccurrences. These reports should be provided 30 days after each shutdown event.
5. When applicable, the results of follow-up monitoring of benthic communities referred to in Item 9 of the SOP should be provided to the NWB and the INAC Water Resources Division with reference to the previous year’s significant sediment plumes that triggered the follow-up monitoring program.. Also, significant sedimentation plume should be defined.
6. Item 10 of the plan indicates that throughout dike construction activities, sediment deposition rates will be monitored using sediment traps in three (3) high value shoal areas that are in close proximity to the construction

area. Results will be compared across monitoring points and to existing literature on the effects of deposited sediment. A description of the sediment traps that will be used and their positioning (i.e., manufacturer's model, location, and depth) should be communicated in the SOP.

7. The SOP should include water sample collection protocols. It is understood that samples will be collected at routine monitoring stations established outside of silt curtains. The depths of sample collection points should be made known.

Turbidity monitoring procedures practiced at the Diavik Diamond Mine outlined in the Rescan November 2005 *A418 Dike Turbidity Monitoring Program Report* should be considered by AEM. Section 2.3 of this program states that "...daily turbidity profiles were taken at each monitoring station using a calibrated Hydrolab Datasonde Multiprobe 4a. Turbidity was measured at 1 metre intervals and recorded in a hand held data-logger after the turbidity sensor had stabilized. At the completion of the profile, the results were reviewed on a logger to determine the depth at the highest turbidity occurred. Discrete TSS samples were collected at these depths. The maximum turbidity value and corresponding depth were recorded on standardized field sheets."

8. Calibration frequency of monitoring instruments should be provided in the SOP.

E. Section 6, Water Quality Monitoring and Management Plan for Dewatering Discharges

1. On Page 13, Paragraph 1, pH and aluminum are identified as key parameters (in addition to suspended sediment) during dewatering. AEM should provide a mitigation strategy that will be implemented if samples of these parameters exceed background levels and/or CCME Guidelines for the Protection of Aquatic Life.
2. On Page 13, Paragraph 1, Item 2, it is noted that silt curtains will be deployed around intake barge(s) in order to prevent silt-laden water from entering the intake (if necessary). The type of silt curtain that will be deployed should be stated in the plan (i.e., manufacturer and model type).
3. On Page 13, Paragraph 1, Item 3, it is noted that dewatering discharge points will be located in an area of Third Portage Lake where there is deep, low-value habitat. AEM should explain how it will determine "low-value habitat."

4. The submitted plan should include a map/diagram that references barge intake locations, discharge points, and water sampling monitoring locations.
5. The TSS/turbidity relationship should be developed prior to any dewatering discharge activity. This information should be forwarded to the NWB and INAC Water Resources Division. As a Quality Control measure, AEM should sample for TSS on a weekly basis at various monitoring stations and measure against turbidity to ensure the relationship is as previously determined.
6. Details of the type of monitoring instrumentation and calibration frequency should be provided in the SOP.
7. The proposed SOP for Dewatering Discharges contains “key elements.” A complete version of this SOP should be provided.
8. Item 1 of the SOP states that routine monitoring will involve measuring TSS/turbidity in the intake barge(s) once per day. INAC recommends that the same frequency of sample collection practiced during dike construction be applied to the intake barge (i.e., routine TSS monitoring will include three (3) monitoring events per day, approximately every six (6) hours...)
9. INAC concurs with the TSS/turbidity management thresholds to be applied to the intake pipe during dewatering as stated in Item 2.
10. Item 5 of the SOP notes that the turbidity of water within the receiving environment will be recorded “regularly”. INAC concurs with the ice-up protocol.
11. Item 10 of the SOP provides a trigger for the shutdown of dewatering discharges based on the 30-day moving average Intake Monthly Mean. After any shutdown, a report should be submitted to the NWB and INAC Water Resources Division, within thirty (30) days, summarizing the cause of shutdown and include, at a minimum, the date and time of shutdown, sample monitoring results, and a mitigation strategy to prevent reoccurrences.
12. Item 11 of the SOP should define “significant sediment plumes.” The triggers for monitoring should be included in the definition.
13. AEM has provided a methodology for comparisons of raw turbidity data to Intake Short-Term Maximum and Intake Monthly Mean Value TSS thresholds. INAC is generally supportive of this proposal. However, the mean value should be an average of all samples taken in a defined period.

Regular interval sampling is recommended. The use of weighted values does not appear to be part of the procedure to establish site-specific relationship between TSS/turbidity as per DFO (2000) nor are weighted values considered for the EC or BCMELP Guidelines.

14. The SOP should include water sample collection protocols, i.e., sample depths.
15. Water elevations within the East Dike should be monitored at a daily minimum during dewatering discharges to ensure that the water level will not drop beyond a point that could result in dike destabilization. Diavik Diamond Mines Inc. monitored water elevations within the A154 pit and did not allow the volume of water to drop by more than 400 millimeters per day¹. This was considered necessary to allow for safe pore water dissipation and stabilization within the dike's till foundation. AEM should note within its plan whether a daily draw-down limit has been set.
16. The SOP flowcharts provided by AEM were useful during the review and should be incorporated in the final plan.

F. Protocol to Monitor and Maintain Water Levels in Third Portage Lake, Second Portage Lake, and Wally Lake within Natural Variation

1. On Page 11, Section 4.2, it is stated that water flow within the outlets of Third Portage Lake will be monitored through the development of a stage-discharge relationship(s) that is correlated to observe water levels. A manual flow measurement program consisting of a defined measurement location within each outlet will be established in order to construct the stage-discharge relationship required to convert the measured Third Portage Lake levels to discharge rates.

INAC recommends that once this stage-discharge relationship(s) is developed, AEM should revise its protocol to include the details of the relationship. This can be submitted as part of the final plan.

2. A map/diagram that references all water elevation and flow monitoring stations should be provided as part of this plan.

G. Email of August 22, 2008; Re. Meadowbank East Dike Construction TSS and Turbidity Issue Update

1. The above-mentioned email addressed to INAC and Environment Canada representatives from Larry Connell of AEM provided notification that

¹ Diavik Diamond Mines Inc. *A418 Dewatering Program Report*. December 2006.

turbidity and TSS levels monitored in Second Portage Lake were above the thresholds identified in Part D, Item 15 of the license and AEM's proposed plan triggers. According to Figure 2 of the plan (flowchart), construction operations should be shutdown when the 7-day moving average TSS is greater than the accepted maximum monthly mean TSS concentration. This flowchart indicates that dike construction will "shutdown" unless the cause is known. This email states that "despite implementing some mitigative measures, the East Dike work area continues to be a source of sediment to Second Portage Lake. It is not stated if the cause is "known".

AEM should shutdown dike construction activities until the cause of elevated TSS concentrations has been determined. A final report should be submitted to the NWB and INAC Water Resources Division summarizing what triggered the shutdown and include, at a minimum, the date and time of shutdown, sample monitoring results, and a mitigation strategy to prevent reoccurrences.

2. With regard to AEM's proposal to use coagulants and flocculants to enhance the settling rate of sediment in the water column, discussion on this matter must include DFO and the NWB. Consideration and rationale for this action must consider the accumulation of flocculants on the lake bottom with respect to, as a minimum, the effects on fish habitat and the benthic community.

Should you have any questions regarding the information provided feel free to contact me at 867-975-4555 or AbernethyD@inac-ainc.gc.ca.

Regards,
David W. Abernethy

Cc. Kevin Buck, Manager of Water Resources
Bernie MacIsaac, Manager of Field Operations