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via: licensing@nwb-oen.ca

**RE: Meadowbank Type "A" Water License Renewal**

Environment Canada (EC) has reviewed the information regarding the above-mentioned project proposal and is submitting comments on mitigation measures as well as other matters of importance to the project proposal as requested by NWB. EC's specialist advice is provided pursuant to the *Canadian Environmental Protection Act 1999*, the pollution prevention provisions of the *Fisheries Act*, the *Migratory Birds Convention Act* (MBCA), and the *Species at Risk Act* (SARA).

EC has reviewed the submission and is making comments regarding completeness and initial technical assessment. For further clarification on any aspect of the submission, please contact me at (867) 975-4982 or John.Price@ec.gc.ca.

Sincerely,

John Price
Environmental Assessment Officer

Attached – EC's Comments

cc: Dave Fox, A/Head, Environmental Assessment North (NT & NU), EPOD-PNR, EC
Michael Mohammed, Senior Environmental Assessment Coordinator, EPOD-PNR, EC

## Environment Canada's Technical Review Comments and Recommendations

| TC# | Reference | Section | Proponent's Conclusions | EC's Comments | EC's Recommendation(s) |
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| EC-01 | Draft Water Licence | Section E.6 | | This clause needs rewording to reflect when an action plan would actually be implemented. CCME guidelines may not always be the best objective (noting that not all parameters have guidelines) so further detail on setting objectives for dike breaching would be appropriate. | "The Water Management Plans shall include an action plan *to be implemented* if predicted reflooded pit water quality indicates treatment is necessary. The dike will not be breached until the water quality in the reflooded area meets CCME Water Quality Guidelines for the Protection of Aquatic Life, *baseline concentrations, or appropriate site specific water quality objectives.* Subject to Board approval, if water quality parameters are above CCME guidelines, a site specific risk assessment must be conducted *to identify water quality objectives that are protective* of the aquatic environment. |
| EC-02 | | E7 | | Wording changes suggested. | "The Licensee shall submit a Water Quality Model for pit reflooding as part of the Water Management Plan which shall be re-calibrated as necessary, and *updated* at a minimum of once every two (2) years *during Operations*. The results and implications of the predictive model shall be reported to the Board." |
| EC-03 | | E8 | | Deletion is acceptable with the amendments to E6 and E7 | |
| EC-04 | | Section F.2 and F.3. | The 2013 AEMP reports water chemistry for the Meadowbank Lakes. Total Dissolved Solids (TDS) in Third Portage Lake and Second Portage Lake | The expiring licence does not include discharge criteria for major ions. At this point in the mine life further effluent discharge is not planned, but there may be operational changes that occur with mine expansion. Consideration should be given to adding TDS, nitrate, and SO4 to the regulated criteria. | EC suggests further discussion on the addition of TDS, nitrate, and sulphate discharge criteria. |
| EC-05 | | F14 | | The proposed rewording would require all liquid wastes whether hazardous or otherwise, to be removed. Reword. | "The licencee shall remove from the project site, all *solid and liquid* hazardous Wastes…" |
| EC-06 | | F23 | Change discharge limit for Pb to 0.1mg/L | Agree for land discharges; add soil testing to closure plan for discharge areas. | |
| EC-07 | | F23 | Narrow applicability to fuel storage locations | Agree; if only applicable to fuel sites then do not need to test for ammonia and cyanide. | Remove ammonia and cyanide |
| EC-08 | | F24.b. | No change proposed. | The MMER does not include *the Daphnia* | EC recommends that the Daphnia bioassay test be |

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| | | | | *magna* bioassay as a regulated test, and EC suggests that the Daphnia test be moved to the monitoring section of the licence rather than kept as a regulated criteria. EC notes that there have been periodic fails of the Daphnia test, and it is important to gain an understanding of what is causing those failures. | included in Schedule I rather than in Section F. |
| EC-09 | | I1. | | The AEMP clause wording should be updated. Delete consultation from main clause. The list is also awkward and could be improved. | "…shall conduct the AEMP and CREMP as approved by the Board" – now that they are developed do we need to list consultation?<br>The AEMP shall include:<br>a. Comprehensive receiving environment monitoring to identify changes to the aquatic environment associated with mine activities;<br>b. linkage between monitoring results and adaptive management response;<br>c. Monitoring of lake productivity;<br>d. sampling and analysis plans; and<br>e. (as is) |
| EC-10 | | J6. | | | "if practicable" rather than "if possible". |
| EC-11 | | Definitions: | | Update CCME guideline – delete "Freshwater" | |
| EC-12 | | | | Should the operations landfill definition have the reference to year 9 removed as there may be a mine life extension? | |
| EC-13 | | Schedule 1<br>Table 1<br>Group 1 | | Delete ammonia (redundant to ammonia-Nitrogen as dependent on pH and ambient temperature); add nitrite. Any hits on total CN should trigger analysis of free CN and WAD CN, or these could be added to the list. Add phosphorus and orthophosphate to track discharge loadings. | |
| EC-14 | | Schedule 1<br>Table 1<br>Group 2 | | Add WAD CN | |
| EC-15 | | Schedule 1<br>Table 1<br>Group 4 | | Remove CN (not needed here). If adding TPH, oil and grease will be redundant. | |
| EC-16 | | Schedule 1 | | MMER should be clarified to say "acute toxicity | |

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| | | Table 1 Group 4 | | (Rainbow Trout and *Daphnia magna*)" – the licence requirement is written to include the daphnia as a non-acutely toxic test as well as the trout, so either list both, or neither.<br>Add line "Acute lethality" and specify the two tests (trout and daphnia). | |
| EC-17 | | Schedule 1 Table 2 | | Keep Vault Pit Lake separate as ST-26 with monthly frequency during flooding. | |
| EC-18 | Appendix B4 Groundwater Monitoring Plan | 3.3 Pit Wall Seeps | The report indicates that one method for groundwater sampling that will be used at Meadowbank is sampling directly from pit wall seeps. | EC notes that although this method would provide a water sample, the sample could contain a mixture of both groundwater and lake water, not will not be a true representative groundwater sample. | EC recommends that it be acknowledged during reporting that any samples taken from the pit walls are not true groundwater samples and that any conclusions drawn from these samples take into account that an undetermined portion of the sample is likely to be lake water. |
| EC-19 | | 4.2 Quality Assurance/Quality Control | The QA/QC procedures include methods for data handling and methods for collecting duplicate samples. However, this section does not include mention of either trip blank or field blank samples as part of the QA/QC procedures. | | EC recommends that both trip and field blanks be included in the groundwater monitoring plan. |
| EC-20 | Appendix B5 Quality Assurance/Quality Control (QA/QC) Plan, Version 2 July 2014 | Section 2.1.4 Preservation | Table 2-1 outlines sampling requirements including preservatives. Preservatives are added to the sample bottles by the laboratory, or added by the technician after filling, as directed by the analytical laboratory. | The QA/QC plan is to be prepared according to the 1996 guidance document *Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "A" Licensees in Meeting SNP Requirements and for Submission of a QA/QC Plan* (INAC and the NTWB). Table 2-1 is not in agreement with the guidelines (Appendix 1) for a number of parameters with respect to bottle type, time of filtering, or preservatives. | |
| EC-21 | | Section 2.2.4 Table 2-1 | Table 2-1outlines sample handling and volumes. | EC notes that some of the protocols vary from those recommended by the EC lab. | The following vary and should be reviewed:<br>• Volume required for ammonia-N and TKN should be 250 mL rather than 125 mL; if particulates in sample then 1000 mL.<br>• Holding time for chlorine is 6 hours rather than 48; should be analyzed in the field.<br>• pH should be analyzed in the field.<br>• Preservatives used for sulphides analysis should be shown (AcZn + NaOH) |

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| EC-22 | | Section 2.2.5 Field Duplicates and blanks | One field duplicate, one filter blank and one field blank are collected for a) every 10 samples (i.e. duplicate samples are taken for 10% of the samples), b) each sampling event or c) once per year as shown in Table 2.2. | | Field and trip (travel) blanks as well as duplicate field samples should be collected at a frequency of 5-10% of the total number of samples, and this should be shown as a minimum level of QA/QC sampling effort. EC questions if this would be the case with the option of having only annual field duplicates for mine facilities and attenuation ponds.<br><br>Also, trip blanks should be periodically done at all sampling sites; this is a way to check contamination from sample bottles, caps and preservatives during transport, storage and analysis. |
| EC-23 | Appendix B6 Water Quality and Flow Monitoring Plan | Figure 2-2 | The figure indicates that monitoring will take place at sample station ST-16 to monitor runoff and seepage from the Portage Waste Rock Storage facility, however, it unclear from the figure that if similar monitoring strategy is to be undertaken for the Vault Waste Rock Storage Facility. | | EC recommends that seepage and runoff from the Vault Waste Rock Storage Facility be collected and monitored if not already being done. |
| EC-24 | | 3.3.2.1 CREMP Threshold and Trigger Levels | A brief overview of how both threshold and trigger levels were developed is provided in the report. | It would be helpful to include the list of the final values that were developed for these triggers and thresholds. | EC recommends inclusion of the specific threshold and trigger levels in the report as these don't appear to be included in either the AEMP or the Water Management Plan. |
| EC-25 | Appendix B17 – 2013 Water Management Report and Plan | 3.3 – Pit Reflooding Operation | Once the south cell of the tailings storage facility becomes operations and ceases use as an attenuation pond the Goose pit will serve as the attenuation pond for water originating in the Portage Pits. This water will start the reflooding process for the Goose Pit and once flooding is complete for both the Goose Pit and the Portage Pit, the dikes will be breached to Third Portage Lake. | Although the report indicates that the dikes will not be breached until water quality meets the CCME criteria, the potential water quality in the Goose Pit is of concern. Contingency and potential treatment measures should be thoroughly evaluated as the water quality is expected to be above CCME criteria. | EC recommends that water chemistry and hydrologic dynamics of the Goose Pit attenutation pond be closely monitored and that contingency measures, and potential treatment options be evaluated, such as treatment of water prior to deposition in Goose Pit. |
| EC-26 | B18 Ammonia Management Plan | Section 1 | Section 1.0, Introduction, identifies two sources of ammonia at the mine site that can contribute to the mobilization of ammonia in the groundwater or surface runoff: (i) Blasting of ammonium-nitrate (AN) explosives, and (ii) Cyanidation | Estimating the total loading of ammonia/nitrogen to the receiving environment is an important component of an ammonia management plan. EC notes that the Ammonia Management Plan for this project is lacking estimates of ammonia/nitrogen loading. | EC recommends that the *Ammonia Management Plan* be updated to include the following additional information:<br>• Estimate of ammonia/nitrogen loading to all mining infrastructure designed to contain mine water and mine waste. |

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| | | | process used in gold mining operations. Section 3.2, Ammonia Pathway, describes a closed loop system during the operation of the Tailings Storage Facility (TSF) in which the mill effluent provides an ammonia loading to the TSF reclaim water, which is then pumped to the mill for re-use. The plan states that there will be no discharge of reclaim water to the environment during this period.<br><br>The ammonia concentration is expected to gradually increase in the TSF reclaim pond over time. It is forecast to increase to 111 mg N/L in the North Cell by 2016 and 119 mg N/L in the South Cell by 2018. By comparison, the water licence limit and the CCME guideline are 16 and 0.86 mg N/L, respectively. Eventually, the contents of the reclaim pond will be transferred to the pits (beginning in 2015, according to the *Water Quality Forecasting Update for 2013-2025*).<br><br>The Ammonia Management Plan describes pathways by which blasting residuals and product may be mobilized. The largest potential source of ammonia in mine water will be from explosive residue from blasting. From the description provided, it appears that ammonia mobilized from these sources will be captured either in an attenuation pond or in the TSF. | Such loading estimates should be calculated for both project infrastructure and the receiving environment. Further, EC notes that, in addition to the two sources of ammonia identified in the Ammonia Management Plan (ie. AN explosives and cyanidation process), a third potential source of ammonia for this project is sewage. | These estimates should include consideration of the cyanidation process, the use and management of explosives, and sewage management.<br>• Estimate of ammonia/nitrogen loading to the receiving environment in relation to this project. Loading calculations should account for deposits to receiving water bodies, as well as any seepage or runoff associated with project activities. |
| EC-27 | Appendix B10 - Operational ARD/ML Testing And Sampling Plan Version 2 (Nov.2013) | 2.3: RSF Design | The Proponent states that "*RSFs are designed to minimize the potential for ARD and ML. The Portage RSF is constructed to encapsulate PAG waste rock inside a layer NPAG material as a control measure for ARD.* | If the PAG material is not far inside the NPAG material, it may not provide effective encapsulation for the PAG material, | EC recommends that the proponent state how far inside or the thickness of the NPAG that will provide encapsulation for the PAG material. Also, EC recommends that the proponent state the final height of the RSF above ground. |
| EC-28 | | | The Proponent states that there will be | Table 2-1 lists the anticipated ARD/ML | EC recommends that the proponent provide its |

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| | | 3.1.2 QA/QC (Page 12) | "…q*uarterly analysis of a minimum of 75 duplicate samples by an accredited external lab for full ABA to verify the onsite lab's accuracy with these determinations and confirm correlations. This includes samples of Iron Formation (IF), Intermediate Volcanic (IV) and Ultramafic (UM) rock types."* | potential of waste rock types at Meadowbank Mine with "All pits tailings", "Portage and Goose IF and QZ" showing high potential to generate ARD; however no samples from the Quartzite (QZ) unit were selected for analysis in external Lab full ABA for verification. | rationale for not selecting Quartzite (QZ) samples for external lab full ABA when it was shown that it has a high potential to generate ARD. |
| EC-29 | | 3.3.1 Waste Rock Sampling (page 14) | The Proponent states "*Composite samples are not to be used because they confuse the data and render it more difficult for use in model creation or comparison."*<br><br>TABLE A.1: shows the Summary of ARD/ML Potentials of Meadowbank Waste Types | In Table A.1 it is not readily clear why there were no metal leaching (ML) tests (Not Analyzed (N/A)) for the Lake Sediment and Q waste types when the percentage of PAG is 73 and 86 respectively. Using MMER metal exceedance as a yardstick to interpret kinetic test leachate results may not be appropriate because the kinetic test is defined as an analysis to determine change and rate of metal leaching. It is likely that over time the concentration of metals in the leachate will increase therefore using MMER exceedance at the time of test to determine metal leaching may underestimate the ability of the waste type to leach metals.<br>AEM stated earlier (**3.3 FIELD METHODS; 3.3.1 Waste Rock Sampling** page 14) that "*Composite samples are not to be used because they confuse the data and render it more difficult for use in model creation or comparison".* However, the proponent used composite samples for the Vault and Portage/Goose IV samples. | EC recommends that the proponent provide an explanation why composite samples were used for the kinetic tests when the proponent has earlier said that composite samples will not be used because it would confuse the data. |
| EC-30 | Appendix B17 – 2013 Water Management Report and Plan | 3.3 – Pit Reflooding Operation | Once the south cell of the tailings storage facility becomes operations and ceases use as an attenuation pond the Goose pit will serve as the attenuation pond for water originating in the Portage Pits. This water will start the reflooding process for the Goose Pit and once flooding is complete for both the Goose Pit and the Portage Pit, the dikes will be breached to Third Portage Lake. | Although the report indicates that the dikes will not be breached until water quality meets the CCME criteria, the potential water quality in the Goose Pit is of concern. Contingency and potential treatment measures should be thoroughly evaluated as the water quality is expected to be above CCME criteria. | EC recommends that water chemistry and hydrologic dynamics of the Goose Pit attenutation pond be closely monitored and that contingency measures, and potential treatment options be evaluated, such as treatment of water prior to deposition in Goose Pit. |

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| EC-31 | Appendix B17 Water Management Report and Plan, Version 1; March 2014 | Table 4.1: Comparison of originally predicted pit water quality versus SNC (2014) modelled water quality | As per Table 4.1, Comparison of Originally Predicted Pit Water Quality Versus SNC (2014) Modelled Water Quality, water quality forecasting indicates that both Portage Pit and Goose Pit will exceed the CCME guidelines for ammonia by 2025.<br><br>Based on current water quality and the 2013 water balance, the report identifies that ammonia and copper may require removal treatment in order for the pit water quality to meet CCME criteria in 2025.<br><br>The report identifies several recommendations. | It is not clear from Table 4.1 whether forecasting was done for the interval between 2015 and 2025. Another time point forecast would help to assess the various recommendations.<br><br>In addition, the Proponent should comment on whether they expect the pits to stratify and stay stratified after closure. | In order to better understand how pit water quality will change over time, EC recommends conducting additional water quality forecasting for the interval between 2015 and 2025.<br><br>EC also recommends including a discussion regarding whether pit stratification is expected and, if so, for what duration. |
| EC-32 | Appendix B18 Ammonia Management Plan, Version 1; Feb. 2013 | Section 2.1.1 Explosive Storage | Section 2.1.1, Explosive Storage, states "*Storage of explosive products will be located at the mine site emulsion plant area. The explosive products arrive by barge at the Baker Lake marshalling area. They are then transported by ground to the emulsion plant located at the Meadowbank mine site.*<br><br>*The emulsion plant area is located approximately four kilometers north of the mine plant and camp site, and is accessible from the*<br><br>*All Weather Private Access Road (AWPAR). This area consists of an emulsion plant for the preparation of bulk emulsion explosives, two buildings for the storage of AN, and four explosive magazines along the access road to the plant.*<br><br>*Explosive products at the storage facilities are packed in sea containers, which limit the possibility of spillage. The products are only removed from these* | | EC recommends this plan is updated to include a discussion on the use of secondary containment to minimize the loss of ammonia during use, storage, transport, and handling of explosives for this project. |

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| | | | *containers at the mine site emulsion plant area. Surface areas are graded to collect water runoff within the storage facilities."* | | |
| EC-33 | Ammonia Management Plan, Version 1; Feb 2013 | Section 3.3: Monitoring | Section 3.3, Monitoring, states that '"*Concentrations of ammonia, nitrate and nitrite are parameters that are monitored on a monthly basis as part of this sampling campaign of the TSF reclaim water at station ST-21.*<br><br>*In the Water Quality Forecasting for the Portage Area 2012-2025 Report (610756-0000-4OER-0002), a maximum ammonia concentration in the TSF reclaim water is evaluated in order to meet the CCME guidelines for the Protection of Aquatic Life in the Portage and Goose Island Pits once flooding activities are completed. If this concentration is exceeded before the end of the flooding operation, measures could be undertaken to lower the ammonia concentration, as well as nitrate and nitrite if required, in the TSF reclaim pond prior to the transfer of TSF reclaim water to the pits.*<br><br>*Ammonia treatment technologies that could be further investigated if the need arises, include:*<br>*i) Biological nitrification / denitrification during the summer months.*<br>*ii) In-situ volatilization of ammonia during the summer months.*<br>*iii) Ammonia removal by snow making*." | Given the problems with trying to do snowmaking at Ekati's Misery site, EC has concerns with attempting ammonia removal by snow making. In addition, the in-situ volatilization of ammonia during the summer months could result in air quality issues. | EC recommends that further ammonia treatment options are explored. |
| EC-34 | Appendix B20 - Tailings Storage Facility: Operation, Maintenance and Surveillance | 6.2.3 Seepage Monitoring (page 42) | The proponent states "*If the anomalous seepage measurement is confirmed, a detailed review of the effects of the increased seepage should be carried out based on the specific inspection and design or remedial actions should be implemented if determined necessary by the Engineering Superintendent also an increased monitoring frequency to assess* | Please note that seepage is defined under MMER as effluent, and as such whenever seepage is detected during inspection it will need to be managed as effluent from the mine site that should be discharged through a final discharge point (FDP). | EC recommends that the manual should include how seepages would be managed by collecting the seepage, pumped to a treatment facility, treated if necessary and discharged through a designated FDP, given that it is an effluent from the mine site. |

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| | Manual, Version 3 (Sept. 2013) | | *progression of anomaly."* | | |
| EC-35 | Appendix B21 - Mine Waste Rock And Tailings Management Plan, Version 1 (March 2014). Updated Mine Waste Rock And Tailings Management Plan 2013 | 6.2 Waste Rock Facility Management (page 47) | The Proponent states **"***the cover material would be coarse to allow the development of convective cooling during winter, and insulation through trapped air within voids during summer. Given the high evaporation rate and low annual average precipitation at the site, the average annual infiltration into the pile is expected to be low".* | 1. If the coarse nature of the cover material allows convective cooling air to flow through during winter to encourage freezing as noted by the proponent, it should be noted though that the oxidation of sulphide is an exothermic reaction that may generate enough heat to thaw out the zone of the pathway which the convective air flows through and as such may not stay frozen hence potential initiation of ARD.<br><br>In addition, it is arguable that the same porous nature that allowed convective air during the winter will also allow convective air during the summer that will provide the oxygen necessary for the oxidation of sulphide once there is enough moisture present.<br><br>2. The Proponent further states that *Most of the waste rock (90%) from the Vault deposit is NAG and water quality modeling concluded that the Vault RSF is not expected to require capping. As a precautionary measure, any PAG material encountered at Vault will be capped with NAG waste rock as dumping proceeds.* | 1. EC requests further detail on the predicted thermal behavior of the waste rock pile, with supporting information from other such facilities in the North.<br><br>2. EC requests clarification on how the PAG material will be capped within the Vault RSF to be able to isolate the PAG material such that any infiltration through the uncapped part of the RSF will not migrate and access the PAG material under the cap. |
| EC-36 | Appendix B22 Operation and Maintenance Manual: Sewage Treatment Plant, Version 4; April 2013 | Section 3.4: Normal Operational and Maintenance Procedures | Section 3.4, Normal Operational and Maintenance Procedures, states that "*Food and other kitchen grease are removed from the sewage in the kitchen via a grease trap. The grease trap is manually cleaned to keep this material out of the sewage treatment plant influent and the recovered grease co-disposed with the mill tailings (TSF) or placed in the camp incinerator."* | EC notes that manufacturers warn against the incineration of kitchen grease because it leads to destruction of the refractory insulation and shortens the life expectancy of the equipment. In addition, the grease contributes a high level of energy to the incineration system which could lead to incomplete combustion of material. Incomplete combustion is linked to the generation of pollutants, including dioxins and furans. | EC recommends that the Proponent revise this plan to remove the option of incinerating grease. |