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ECCC File: 6100 000 012/015
NWB File: 2AM-MEL1631

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via email at: licensing@nwb-oen.ca

Richard Dwyer
Manager of Licensing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0

Dear Richard Dwyer:

**RE: 2AM-MEL1631 – Agnico Eagle Mines Limited – Meliadine Project – Water Licence Amendment Application**

Environment and Climate Change Canada (ECCC) has reviewed the information submitted to the Nunavut Water Board (NWB) by Agnico Eagle Mines Limited ('the Proponent') regarding the above-mentioned water licence amendment application.

ECCC provides expert information and knowledge to project assessments on subjects within the department's mandate, including climate change, air quality, water quality, biodiversity, environmental preparedness and emergencies. This work includes reviewing Proponent characterization of environmental effects and proposed mitigation measures. We provide advice to decision-makers regarding a Proponent's characterization of environmental effects, the efficacy of their proposed mitigation activities, and may suggest additional mitigation measures. Any comments received from ECCC in this context do not relieve the Proponent of its obligations to respect all applicable federal legislation.

The following comments are provided:

**1. Meliadine Lake water balance**

Reference(s)

- Meliadine Extension Water Balance and Water Quality Model – Technical Report (Lorax Environmental Services; February 28, 2022

Comment

Meliadine Lake water levels and water volume could be impacted by mine water withdrawals and discharges. Potential changes to lake water volumes should be predicted as they might have an impact on the lake's assimilation capacity and on water quality. Section 2.2.4 (Consumptive Freshwater Uses) of the Water Balance and Water Quality Model (WBWQM) states:

*Consumptive freshwater uses (e.g., paste plant, potable water, mill makeup, dust control, etc.) are supplied by withdrawal from Meliadine Lake, and are not included as direct inputs to the water balance model, as this additional water is already incorporated in various components of the mine water balance, such as seepage from placed tailings and paste backfill bleed water reporting to underground workings*.

Meliadine Lake appears as a component in Figure 2-3 (Water Management Flow Diagram - 2043), but it is not clear if lake volumes are being estimated in the WBWQM.

ECCC Recommendation(s)

ECCC recommends that the Proponent confirm if Meliadine Lake levels are modelled in the WBWQM. If so, the Proponent should explain how lake levels were modelled without incorporating the effects of water withdrawals by the mine. If not, the Proponent should clarify where mine impacts on the lake levels have been considered.

**2. Water Balance and Water Quality Model calibration**

Reference(s)

- Meliadine Extension Water Balance and Water Quality Model – Technical Report (Lorax Environmental Services; February 28, 2022)

Comment

The WBWQM provides estimates of water volumes and water quality for the different components including ponds, pits, the underground mine, surface runoff, interflow from waste, tailings and discharge. The accuracy of water volume estimates is important; overestimating the volume of water reporting to ponds will have implications for water management, treatment and discharge, and underestimating the volumes reporting to the ponds may impact any uses intended for that water (e.g. makeup water for the plant) and may result in consuming more freshwater than predicted. The accuracy of water quality estimates is also important as underestimating concentrations of metals and other parameters could lead to an inability to discharge the water or insufficient treatment capacity.

Calibration of the WBWQM involves adjusting model inputs to correspond with observed (measured) values. When discussing the calibration for Pond CP3, the Technical Report states in Section 3.7.2 (Calibration to Collection Pond Water Balances), "*The natural catchment runoff was also reduced by a factor of 0.5, which resulted in better water balance resolution, as well as reducing the modelled volumes in CP3, which resulted in a better fit to measured water quality (see Section 3.7.3).*" No rationale is provided for this adjustment, which makes it difficult to understand if the halving of runoff volume should be applied to other catchments, or why it is specific to CP3. It is also not clear if it was applied to other catchments.

Section 3.7.2 presents graphs with measured and modelled pond volumes over time and states, "*In general, the calibrated water balance model replicates measured pond volumes well, accurately tracking the increase in volumes due to pumped inputs, freshet and rainfall generated runoff, as well as the effect of pumped withdrawals.*" Although the increases/decreases of measured and modelled values generally follow, sometimes the actual values are off by as much as 50,000 $m^3$. Providing goodness-of-fit or another appropriate statistical measure would help determine if these discrepancies between modeled and measured values could impact overall mine water management.

ECCC Recommendation(s)

ECCC recommends that the Proponent:

- provide a rationale as to what might cause natural catchment runoff volume to be halved for CP3, and clarify if/how this rationale was applied to other catchments; and
- provide a statistical measure of fit between modelled and measured pond volumes, and discuss how the variance could impact mine water management.

**3. Water Balance and Water Quality Model results**

Reference(s)

- Meliadine Extension Water Balance and Water Quality Model – Technical Report (Lorax Environmental Services; February 28, 2022)
- Meliadine Extension In-pit Deposition Alternative WBWQM (Lorax Environmental Services Ltd.; December 16, 2022)
- Technical Memorandum Meliadine Extension Water Balance and Water Quality Model Update (Lorax Environmental Services Ltd.; January 12, 2023)

Comment

Results from the WBWQM include parameter concentrations for water in the different mine components, which can be used to inform water management strategies. The WBWQM and its updates report that certain water quality parameters will exceed water quality guidelines for certain pits and lakes during post-closure. For example, Section 4.3 (Post Closure) of the Update predicts post-closure concentrations above applicable guidelines in for certain mine related parameters of potential concern (POPCs). These include: arsenic at SP6, copper and selenium at CP7, ammonia at PUMP01, copper at WES04 and selenium at TIRI pit lake. Further updates to the WBWQM are planned during closure once more data is available from mine operations to confirm if the modelled exceedances still seem likely to occur. However, the proposed timeline for these updates to the model would not allow for management actions to be implemented to avoid exceedances should they still be predicted to occur.

ECCC Recommendation(s)

ECCC recommends that the Proponent:

- discuss possible management actions for POPCs that the WBWQM and updates have predicted to exceed guidelines; and
- propose timelines for further updates to the WBWQM that would allow sufficient time for those management actions to be put in place.

**4. Water Balance and Water Quality Model uncertainty**

Reference(s)

- Meliadine Extension Water Balance and Water Quality Model – Technical Report (Lorax Environmental Services; February 28, 2022)
- Meliadine Extension In-pit Deposition Alternative WBWQM (Lorax Environmental Services Ltd.; December 16, 2022)
- Technical Memorandum Meliadine Extension Water Balance and Water Quality Model Update (Lorax Environmental Services Ltd.; January 12, 2023)

Comment

As described in ECCC comment 2 (above), the accuracy of WBWQM estimates of water volumes and water quality are critical for planning mine management. Typically, model uncertainty can be evaluated using validation (I.e., withholding some of the measured data from calibration to see how well it can be modelled) or sensitivity analysis (varying model inputs within reasonable ranges to understand which inputs affect results the most). Neither of these methods are presented in the WBWQM, nor is there a discussion of the uncertainty associated with the model.

WBWQM uncertainty should be evaluated, particularly given the offsets on some of the water volume estimates presented in Section 3.7.2 (Calibration to Collection Pond Water Balances) and the overestimates of parameter concentrations presented in Section 4.4.1 (Source Term Calibration). Quantifying the uncertainty inherent in the model will help identify the range of different conditions under which the proposed water management plan may be effective.

ECCC Recommendation(s)

ECCC recommends that the Proponent evaluate the uncertainty of the WBWQM to provide an understanding of the range of possible results and how this may impact the planned mine water management.

## 5. In-pit deposition modelling

Reference(s)

- Meliadine Extension Water Licence 2AM-MEL1631 Amendment Main Application Document (Agnico Eagle Meliadine Division, January 2023)
- Memo to Nunavut Impact Review Board Additional Information – In-pit Deposition - Meliadine Extension Proposal (Agnico Eagle Mines Limited; May 23, 2023)
    - APPENDIX G-1: Meeting Notes In-pit Deposition and other Technical Comments – Meliadine Extension Proposal (Agnico Eagle; February 6, 2023)
- Appendix CC-3 Technical memorandum, Meliadine Extension In-pit Deposition Alternative WBWQM (Lorax Environmental Services; December 16, 2022)
- Meliadine Extension In-pit Deposition Alternative WBWQM (Lorax Environmental Services Ltd.; December 16, 2022)
- Technical memorandum, Meliadine extension – Predicted groundwater-surface water interation at post closure versus existing conditions
- Technical Memorandum Meliadine Extension Water Balance and Water Quality Model Update (Lorax Environmental Services Ltd.; January 12, 2023)

Comment

Depositing tailings and waste rock in mined out pits involves changes to mine water management as well as to source terms in the WBWQM. As described in ECCC comment 2 (above), the accuracy of WBWQM estimates of water volumes and water quality are critical for planning mine management.

Freshwater requirements during mine operations are met by withdrawing water from Meliadine Lake with some additional freshwater withdrawals from small lakes and ponds for dust suppression. Table 2.3-2 (Operations Freshwater Consumption Needs) of the Main Application Document details the freshwater volumes needed for the extension. In-pit tailings deposition would change the volume of water deposited with the tailings, as outlined in Topic 2 (Source Terms) of the Meeting Notes, “*the Meliadine mill currently operates a filter press in*

*which most process water is recirculated within the mill. On the other hand, under the in-pit deposition alternative, tailings would be deposited as a slurry.*"

It is not clear from where the extra process water needed to create a slurry of tailings would be sourced and if the volumes to be withdrawn from Meliadine Lake would be greater than those described in Table 2.3-2.

When pit lakes develop over deposited in-pit tailings, the tailings will be a continuous source of contaminants impacting the water quality in the pit lake above. Section 4 (Geochemical Source Terms) of the In-pit Deposition WBWQM states, "*The geochemical loadings from backfilled tailings slurry is driven by tailings consolidation. A diffusive flux term was not developed for tailings as this transport mechanism is only significant in the absence of advective flows, which will occur as a result of tailings consolidation.*" Modelled results from a pit at the Meadowbank mine have been used to estimate the consolidation water fluxes, which show a decrease following a power function where the consolidation water production rate diminishes to 30% of the initial value after 40 years. It is not clear how long tailings will take to consolidate, but eventually diffusive fluxes would contribute more than advective fluxes because they occur on a slower timescale. An estimate of diffusive fluxes would therefore be helpful to understand the chemical loadings to pit lakes in the long term.

Groundwater-surface water exchange for pit lakes was modelled and described in Table 2 (Predicted Groundwater-Surface Water Interaction at Pre-mining and Post-closure – Pit Lakes) of the Technical Memo. For most pits, surface water is predicted to discharge to groundwater but for three pit lakes (PUM02, PUM03 and WN01) groundwater is predicted to discharge to surface water. Water travelling upwards through the tailings or waste rock would in that case become enriched in metals and other parameters before reaching the lake bottom. It is not clear if these fluxes have been considered in the WBWQM.

Modelled parameter fluxes from in-pit deposition in the WBWQM incorporate estimates for many input parameters as in-pit deposition is still at the assessment stage. It will be important to monitor water quality at the interface between water and tailings or waste rock to verify the model predictions and to provide further model calibrations as required. The filling of pits is proposed to be staggered over time (Table 2-5 of the WBWQM Update (Open pit and underground mine water management schedule)), which should allow such monitoring to be initiated during operations.

<u>ECCC Recommendation(s)</u>

With regards to in-pit depositions modelling, ECCC recommends that the Proponent:

- clarify additional water quantities required to create slurry tailings as opposed to filter tailings, specify from where this water would be sourced and confirm whether greater water withdrawals from Meliadine Lake would be required;
- explain when tailings consolidation is expected to be complete, estimate the magnitude of diffusive fluxes from in-pit tailings and describe the contribution of consolidated tailings to the WBWQM source terms of groundwater discharge through in-pit tailings or waste rock into pit lakes; and
- describe a proposal for monitoring water quality at the interface between water and tailings or bedrock, including a proposed schedule. The monitoring plan should also discuss how the results will be used to verify model predictions and/or trigger further updates to the model.

## 6. Integration of Meliadine Extension project in Aquatic Effects Monitoring Program Design Plan

Reference(s)

- Aquatic Effects Monitoring Program Design Plan Meliadine Gold Mine Version 2_NWB (Agnico Eagle Mines Limited - Meliadine Division; December 1, 2022)
- Meliadine Extension Water Balance and Water Quality Model – Technical Report (Lorax Environmental Services Ltd.; February 28, 2022)
- Technical Memorandum Meliadine Extension Water Balance and Water Quality Model Update (Lorax Environmental Services Ltd.; January 12, 2023)
- Aquatic Effects Monitoring Program 2022 Annual Report, Meliadine Gold Mine (Azimuth Consulting Group Inc.; March 29, 2023)

Comment

The Aquatic Effects Monitoring Program (AEMP) monitors whether the aquatic environment is changing and whether such changes can be ascribed to potential mine related effects. The Design Plan describes the AEMP and is tailored to the aquatic environments where potential effects are possible, as well as including reference sites that are not expected to be impacted by the mine.

The AEMP Program Design has been updated for the Meliadine Extension project; however, the extension project has generally not been integrated into the Design Plan. Some examples of these oversights include:

- Section 2.1 Site Description: Though the extension project has operations lasting until 2043, the site description states, "*the Mine will be operational through 2027, followed by 10 years of closure activities to 2037 (Agnico Eagle, 2020).*"
- Section 2.2 Waste Rock and Tailings Management: Though rocks at the future Discovery pit location have predominantly tested as potentially acid generating (PAG) or metal leaching (ML) or uncertain with respect to PAG/ML, the text states, "*waste rock is not expected to contribute to low pH conditions or elevated metals concentrations in surface contact water that is eventually collected, treated and discharged to Meliadine Lake.*"
- In most places where the FEIS is referenced, there is no mention of the FEIS addendum.
- New monitoring locations for the Peninsula Lakes will be necessary as two of the three sampled Peninsula Lakes will be dewatered. This is acknowledged in Section 4.3.1 (Background), but no alternative monitoring station locations have been proposed.
- Water modelling for the FEIS addendum in the WBWQM and its update did not present predicted water quality for any of the AEMP monitoring stations so it would not be possible to compare measured concentrations against predictions, as recommended in Sections 4 (AEMP Study Design), 6.1.1 (Objectives), 6.1.4 (Data Analysis and Interpretation) and Table 8-1 (Examples of Action Levels and Responses).
- Section 6.2 Biological Monitoring in the Peninsula Lakes concludes, "*Biological studies will be included in future monitoring cycles if results of the water quality program indicate that the small lakes on the peninsula may be affected by mining activities.*" This does not account for a conclusion of the AEMP 2022 Annual Report Plain Language Summary "*Water quality in Lake B7 and Lake A8 has changed significantly for some parameters during operations. Sulfate and arsenic are the two parameters where the timing and magnitude of the change point to the mine as the underlying cause.*"

ECCC Recommendation(s)

ECCC recommends the Proponent integrate the Meliadine Extension project into the AEMP including referencing the FEIS addendum, its findings and results.

**7. Changes to analysis methods and descriptions in Aquatic Effects Monitoring Program Design Plan**

Reference(s)

- Aquatic Effects Monitoring Program Design Plan Meliadine Gold Mine Version 2_NWB (Agnico Eagle Mines Limited - Meliadine Division; December 1, 2022)
- Meliadine Gold Project, Nunavut, Aquatic Effects Monitoring Program (AEMP) Design Plan 6513-REP-03 Version 1 (Golder Associates; June 2016)

Comment

Certain modifications between versions 1 and 2 of the AEMP Design Plan seem to reduce clarity or provide less analysis of the data. These include:

- Data Analysis and Interpretation (Sections 5.1.4 & 6.1.4): Spatial patterns and visual temporal trends are to be analyzed for the parameters. In the previous version of the Design Plan, methods for assessing temporal trends included statistical tests, which are not subjective, not influenced by scales used for displaying data and can be helpful in identifying subtle trends.
- Study Design and Schedule (Section 5.3.2): No schedule is provided in this section. Although the timing of the benthic invertebrate study is included in Table 4-2 (Aquatic Effects Monitoring Program Design Plan for the Meliadine Lake Study), it would be helpful to have it here as well.
- Field Methods and Laboratory Analysis (Section 5.6.3): The description of parameters to be tested in fish tissue is "*moisture content and metals, including mercury.*" The previous version of the Design Plan included a table that listed which metals would be analyzed (Table 5-7: Proposed parameters to be Analyzed in Tissue Samples for the Meliadine Aquatic Effects Monitoring Program with Expected Achievable Detection Limits). The list helps clarify that all appropriate metals will be included in the analysis.
- Proposed Action Low Action Levels for Toxicological Impairment/Nutrient Enrichment for Meliadine Lake (Tables 8-2 & 8-3): An assessment criterion for benthic invertebrates is presently "*Statistically significant difference in Near-field total density or richness compared to Reference*", when previously the analysis included density of dominant taxa as well as total density and richness. Density of dominant taxa is relevant to evaluate possible changes in the benthic invertebrate community, particularly since evenness and similarity to reference communities are analyzed but not assessed.

A detailed design plan helps ensure that the necessary data is collected and properly analyzed to monitor for any changes to the aquatic environment.

ECCC Recommendation(s)

ECCC recommends that the Proponent justify the simplification of analyses and text between versions 1 and 2 of the AEMP Design Plan or re-integrate what was included in the previous version of the AEMP Design Plan.

## 8. Aquatic Effects Monitoring Program reference areas

Reference(s)

- Aquatic Effects Monitoring Program Design Plan Meliadine Gold Mine Version 2_NWB (Agnico Eagle Mines Limited - Meliadine Division; December 1, 2022)
- Aquatic Effects Monitoring Program 2022 Annual Report, Meliadine Gold Mine (Azimuth Consulting Group Inc.; March 29, 2023)

Comment

Reference areas monitored through the AEMP help identify local changes to the aquatic environment due to weather and other factors that are not related to the mine. For example, if changes to water quality were measured at near field sites but similar changes were noted in the reference areas, it might be possible to establish that the near field changes were not mine related. It is therefore critical to have reference areas beyond the geographical reach of the mine's influence.

Typically reference areas are located in different watersheds or upstream of the near field and mid field sites. In the AEMP Design Plan, the three reference areas used are all in Meliadine Lake. Two are downstream, located at the lake outflows. The third is in a bay that is not likely in a flow path potentially affected by discharges to Meliadine Lake. Section 4.2.2 (Study Areas) explains the choice of reference areas, "*Nearby reference lake(s) with similar morphology, fish assemblage, and accessibility that meets health and safety needs, were not identified during the baseline period when data was collected to support FEIS.*"

Total dissolved solids (TDS) loading to Meliadine Lake will continue for longer than predicted initially and the principal components of TDS are conservative and will accumulate in the lake to an extent. Although Meliadine Lake is very large (surface area 107 $km^2$), its chemistry could change over time due to mining, as has been the case at Lac de Gras in the Northwest Territories (surface area 569 $km^2$). This could be important to consider when reviewing reference area locations.

The AEMP 2022 Annual Report references data from Inuggugayualik Lake and Pipedream Lake, more than 250km away, to try to demonstrate regional trends. There are several confounding factors affecting the comparison including different ecoregions, geology and relative distance from Hudson's Bay. A closer reference site that is not downstream from the mine would provide more confidence in comparison results.

Since no nearby lakes were identified that were suitable for all components of the AEMP, consideration should be given to using different lakes for water chemistry and biological studies. This has already been initiated as Section 4.2.2 states, "*External reference area lakes may be added to the Lake Trout health assessment under the AEMP depending on findings of the Cycle 2 EEM (Azimuth, in prep).*"

ECCC Recommendation(s)

ECCC recommends that the Proponent demonstrate how the selected references sites within Meliadine Lake will remain suitable reference areas over a prolonged period with the mine Extension. Consideration should be given to alternate reference areas and/or modifications to the study design.

## 9. Closure of saline pond SP6 (Lake B7)

Reference(s)

- Meliadine Extension Water Licence 2AM-MEL1631 Amendment Main Application Document (Agnico Eagle Meliadine Division, January 2023)
- Prefeasibility Level Design of Water Management Infrastructures for Operation Phase, Meliadine Extension Project, Nunavut (Tetra Tech Canada Inc.; January 13, 2023)
- Meliadine Extension Water Balance and Water Quality Model – Technical Report (Lorax Environmental Services; February 28, 2022)

Comment

The Extension Project proposes to use Lake B7 as a saline water storage pond for approximately 18 years. The mine plan described in Section 2.3.7 (Lakes and Ponds Dewatering, Fishout, and Reflooding) of the Main Application document includes obtaining MDMER Schedule 2 listing for Lake B7, so it can be fished out and dewatered. Following this, the Pre-feasibility describes in Section 6.2 (Design of Water Collection Ponds), "*SP6 will be established within the drained Lake B7 together with the two perimeter dikes (Dike D-SP6North and D-SP6West).*" The Technical Report describes plans for operation and closure in section 5.1.2.2 (SP B7), stating "*The Saline Pond B7 is the primary saline contact water storage pond for the majority of the Operations phase once it is dewatered in 2025. All saline contact water collected in SP B7 is routed to the Waterline for discharge to Itivia Harbour up to end-2043. After this point, any remaining saline contact water will be routed to the remaining underground voids (Section 3.8), before SP B7 is allowed to fill with runoff from the surrounding catchments, including the small volumes of contact water from the TSF and WRSF1.*" Ultimately, "*SP B7 will drain into the Tiri Pit Lake*" (Section 3.9 (Post-closure flow paths) of the Technical Report).

Sediment at the bottom of SP6 will become enriched in salts from the contact with saline water over a prolonged period. If they are left in place uncovered at closure, the sediments will then become a source of salts and metals for the overlying water via diffusion. This enrichment would eventually reach Meliadine Lake through the connections with filled pits, lakes and streams. It is not clear if this source term is considered in the WBWQM.

Proposed guidelines against which to assess predicted lake water quality at closure are different for SP6 than for all other lakes. Section 4.2 (Parameter List and Screening Criteria) of the Technical Report specifies, "*For waterbodies included in the Schedule II application as part of the Meliadine Extension Project (e.g., B4, B7), model predictions were compared to generic water quality guidelines for the protection of terrestrial life, as the listed waterbodies will not support aquatic life.*"

Fish re-populate waters through migration or transportation by birds, so after closure SP6 may eventually become fish bearing. Guidelines for the protection of aquatic life are therefore the more appropriate guideline to assess potential effects following closure.

ECCC Recommendation(s)

ECCC recommends that:

- the Proponent clarify if the WBWQM incorporates diffusion fluxes of salts and metals from saline sediment at the bottom of SP6. If it does not, the magnitude of this source should be described in relation to other fluxes so its impact can be evaluated; and
- guidelines for the protection of aquatic life are used for SP6 to assess post-closure water quality.

## 10. Saline water disposal during closure

Reference(s)

- Meliadine Extension Water Balance and Water Quality Model – Technical Report (Lorax Environmental Services; February 28, 2022)
- Technical Memorandum Meliadine Extension Water Balance and Water Quality Model Update (Lorax Environmental Services Ltd.; January 12, 2023)

Comment

At closure, saline water stored on surface will have to be disposed of. Pond volumes are included in Tables 2-2 (Existing (end of 2020) collection ponds for Meliadine Mine) and 2-3 (Collection ponds for Meliadine Extension) of the Technical Report. Total saline water pond volumes are approximately 1.2 million cubic metres.

Section 3.8 (Closure and Post-Closure Assumptions) of the Technical Report states, "*All remaining saline contact water is pumped from SP B7 to the underground void spaces from October 2043 onwards. … It is assumed that once backfilled tailings and waste rock are accounted for, approximately 3 Mm3 of void space will be available to store saline water.*" The available underground void space that has been quantified is much greater than the holding capacity of the saline storage ponds, and it would be the preferred storage location as it is where the saline water originated. The section continues by presenting an alternative, "*If additional saline contact water is present, it can be routed to an open pit, if necessary, where the higher density water would be expected to stratify.*" The assumption that high density water would stratify in pit lakes is not considered in the WBWQM where lakes are considered to be fully mixed. Detailed modelling of water quality would be required before in-pit deposition of saline water.

ECCC notes that the WBWQM Update provides an alternative for saline water disposal as "*Waterline remains available for first two years of Active Closure (2044 and 2045).*" (Table 2-1 Meliadine Extension water balance and water quality model updates for Nunavut Water Board submission).

ECCC Recommendation(s)

ECCC recommends that the Proponent confirm if they are still considering disposing saline water in pits. If so, a description of what modelling would be done, data necessary for the modelling and proposed timelines should be provided.

## 11. Uncertainty in thermal modelling for Discovery WRSFs

Reference(s)

- Thermal Modelling of Meliadine Discovery WRSFs (Okane Consultants Inc.; December 2022)

Comment

Most of the waste rock at the Meliadine mine is classified as non-potentially acid generating and non-metal leaching (NPAG/NML). Waste rock associated with the Discovery Pit is different in that the majority has been classified as potentially acid generating or metal leaching (PAG/ML) or uncertain with respect to acid generation and metal leaching. Discovery Pit waste rock must therefore be stored in a manner to prevent development of acid drainage or metal leaching which would negatively impact water quality.

A thermal cover made of NPAG/NML waste rock is proposed for the Discovery waste rock storage facilities (WRSFs) to maintain waste rock within permafrost and prevent development of acid drainage and metal leaching. The WRSF will have an active layer at surface, where ground will thaw back each summer due to warmer air temperatures, therefore the thermal cover over the WRSF must be thicker than the active layer to ensure PAG/ML waste rock remains frozen. Thickness of the thermal cover was decided based on thermal modelling, "*The active layer is anticipated to be approximately 5 to 6 m and thus will be contained within the 6 m NPAG/NML cover system.*" (Section 5 (Conclusions)).

Uncertainty in the thermal model is not discussed. As currently described, the proposed cover thickness of 6 m is the same depth as the approximate minimum active layer. A sensitivity analysis (varying model inputs within reasonable ranges to understand which inputs affect results the most) to present possible ranges of active layer thickness could help evaluate under which conditions the proposed cover thickness would be sufficiently protective. No data are available to compare with model predictions since these WRSFs are yet to be constructed. If possible, comparing the model's performance without heating from exothermic reactions to freeze back data from WRSF currently on site would help increase confidence in the model results.

For a measure to prevent a possible problem as complex as generation of acid drainage and metal leaching, it might be relevant to include a safety factor in the design of the thermal cover thickness.

ECCC Recommendation(s)

ECCC recommends that the Proponent discuss the uncertainty in the Thermal Modelling of Meliadine Discovery WRSFs, through a sensitivity analysis or comparison to measured data at other WRSF. Additionally, the Proponent might consider including a safety factor in the design of the thermal cover thickness.

If you need more information, please contact Victoria Shore at Victoria.Shore@ec.gc.ca.

Original signed by

**Jody Small**

on behalf of Andrea McLandress, Regional Director
Environmental Protection Operations Directorate, Prairie Northern Region

cc: Eva Walker, Acting Head, Environmental Assessment North (NT and NU)