AGNICO EAGLE

MELIADINE DIVISION

Meliadine Mine – Meliadine Extension FEIS Addendum – In-pit Deposition Alternative

DECEMBER 2022

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1 INTRODUCTION

1.1 Context

Agnico Eagle Mines Limited (Agnico Eagle) operates the Meliadine Mine, located 25 km North of Rankin Inlet in the Kivalliq region of Nunavut. The Project Certificate issued in 2015 included approval of a multi-phase approach to development, including mining of Tiriganiaq deposit using open pit and underground mining methods and mining of the Pump, F Zone, Discovery and Wesmeg deposits using open pit methods. The Meliadine Extension proposes to include underground mining and associated saline water management infrastructures at the Pump, F Zone, and Discovery deposits, development of a new portal and associated infrastructures in the Tiriganiaq-Wolf mining area. Agnico Eagle is proposing an alternative to the base case mine plan of Meliadine Extension to place tailings and waste rock in open pits. All the open pits are located within the existing areas of disturbance at the mine site, previously assessed by NIRB through the 2014 FEIS and currently being assessed through the 2022 FEIS Addendum of Meliadine Extension.

The in-pit deposition alternative will result in no significant modification of the mine site footprint or intensification of mining activity, instead it would result in reduced surface disturbance for the construction of mine waste storage facilities such as the Tailings Storage Facility (TSF) and Waste Rock Storage Facilities (WRSFs) and reduced water use from Meliadine Lake for open pit flooding at closure.

During the NIRB Technical Meeting in Rankin Inlet (November 23-25, 2022), Agnico Eagle committed to provide the framework for Meliadine in-pit deposition studies that follows the methodology from the Meadowbank submission to NIRB following a meeting with Environment and Climate Change Canada (ECCC), Crown–Indigenous Relations and Northern Affairs Canada (CIRNAC), and Natural Resources Canada (NRCan) on November 25 (Commitment No. 40). The in-pit deposition framework was developed to include Kivalliq Inuit Associate (KivIA) technical comment KivIA-TC-08 and KivIA-TC-09 (as presented under former Commitment 15, replaced by Commitments 40, 41, 42), in which KivIA requested that Agnico Eagle provide a Technical Memorandum to evaluate the in-pit tailings and waste rock deposition as part of the NIRB assessment. Commitment 40 was completed on November 26, 2022. The federal government intervenors NRCan, ECCC, and CIRNAC provided comments on Commitment 40 and agreed with Agnico Eagle's approach for the in-pit deposition methodology (Commitment No. 41).

The purpose of this document is to address Commitment No. 42, which consists of providing results from the in-pit deposition alternative assessment for Meliadine Extension as part of the NIRB technical review process.

Storage of saline water in the open pits is not covered under this assessment as it is part of Agnico Eagle's approved Adaptive Management Plan (AMP) and a current approved practice at the Meliadine Mine at TIR02 open pit. Furthermore, as discussed in a meeting with NRCan, ECCC, and CIRNAC on November 25, 2022, Agnico Eagle considers that tailings in-pit deposition represents the worst-case scenario of this alternative for the purposes of an FEIS. However, as per Commitment No. 19, Agnico Eagle will provide a thermal assessment of TIR02 under the Water Licence Amendment process with the NWB.

The justification of the proposed alternative for in-pit tailings and waste rock deposition and its description are presented in Section 2 and 3, respectively, followed by the description of the existing environment components at Meliadine Mine in Section 4. The review of the predicted impact on the Valued Ecosystem Components (VECs) previously identified in the Meliadine Final Environmental Impact Statement (FEIS) (Agnico Eagle 2022) is then presented in Section 5.

The assessment was completed on VECs potentially affected by the in-pit deposition. The assessment has been organized into 3 main categories: permafrost; water quantity and quality; and fish and fish habitat. This review includes a short description of the potential impacts of the alternative new components, the physical expansion of previously permitted components and the incremental impact of increased activity, as well as the proposed mitigation or monitoring. This predicted impact review is completed for the different in-pit tailings and waste rock deposition alternative phases; the operation and closure/post-closure phases.

A high-level overview of proposed monitoring for this alternative is presented in Section 6 of the document.

1.2 Objective of the Assessment

Consistent with the Meadowbank in-pit tailings evaluation (SNC 2018) submitted to NIRB, the objective of this assessment is to review the predicted impacts of in-pit deposition within the proposed open pits included in the 2022 FEIS Addendum. This review evaluates changes by the proposed in-pit deposition alternative to the 2022 predicted environmental impacts on the VECs identified in the 2022 FEIS (Agnico Eagle 2022) and, if required, proposes mitigation measures to ensure that residual impacts will remain within the predictions for Meliadine Extension.

2 JUSTIFICATION OF THE IN-PIT DEPOSITION ALTERNATIVE

In the 2014 FEIS, Lake B7 was to be converted in the Tailings Storage Facility (TSF) for slurry deposition. Since the approval of the 2014 FEIS, Agnico Eagle has continued to evaluate alternative options for tailings deposition to ensure that best practices are followed and to ensure appropriate long-term planning to optimize the site footprint. For instance, dry stack was proposed as part of the Type A Water Licence (2AM-MEL1631) where a decision was made to change from slurry tailings to dry-stack tailings (Agnico Eagle 2015). In 2016, Agnico Eagle obtained authorization to construct and operate the TSF and to depose dry stack tailings in the TSF under Type A Water Licence No. 2AM-MEL1631.

For the Meliadine Extension, the dry-stack TSF will continue and Lake B7 will be dewatered to allow for saline water storage. As an alternative to the dry stacking method, Agnico Eagle is assessing the potential for in-pit deposition to improve the current economics and mine planning, reduce overall freshwater consumption during closure reflooding, while using existing Meliadine Mill for ore processing facilities, within an area that has previously been impacted. Moreover, in-pit deposition would reduce the surface area impacted by the project by reducing the footprint of the TSF. Moreover, Agnico Eagle is approved for in-pit deposition at the Meadowbank Mine and has proven success with this method. As part of the Meadowbank in-pit tailings assessment, the Meadowbank Mine Dike Review Board supported the use of early in-pit tailings deposition as it has advantages with respect to health and safety, quality of life, water, air, capital cost, technology, natural hazards, and adaptability.

Agnico Eagle is also looking at placing waste rock in mined out (exhausted) open pits. In-pit deposition would improve the current economics and mine planning and reduce overall freshwater consumption during closure reflooding. Moreover, in-pit deposition would reduce the surface area impacted by the project by reducing the footprint of the WRSF. Moreover, Agnico Eagle is approved for waste rock in-pit deposition at the Meadowbank Mine and has proven success with this method.

Agnico Eagle is committed to pro-active tailings and waste management strategies by evaluating relevant technology developments in tailings and waste management.

3 DESCRIPTION OF THE IN-PIT DEPOSITION ALTERNATIVE

Agnico Eagle is proposing to dispose of tailings and waste rock in mined-out open pits as an alternative to the base case mine plan of Meliadine Extension. All the open pits considered for potential in-pit deposition of tailings and waste rock are within the footprint of the assessed and approved Meliadine Mine.

The open pits were designated to receive tailings based on no connection with underground mine workings. The open pits considered for in-pit tailings and waste rock deposition are presented in Table 3-1. The maximum volume of tailings or waste rock that can be placed is defined by the overburden/bedrock contact elevation and the spill point as per the following considerations:

- Backfill must remain below minimum overburden/bedrock contact along the open pit wall.
- A minimum water cover of at least 8 m must be maintained to allow for re-establishment of aquatic habitat.

The spill point and minimum overburden/bedrock contact elevation are listed in Table 3-1. The final backfill elevation in most open pits is below the theoretical maximum as defined by the above criteria.

These assumptions result in 52 Mt of waste rock and 17 Mt of tailings being backfilled. This constitutes 31% of open pit waste rock and 34% of TSF tailings that would be produced by the Meliadine Extension. The in-pit deposition volumes included under this assessment are conceptual and considered suitable for the purposes of an environmental assessment for Meliadine Extension. Specific volumes would be refined as plans for in-pit deposition are advanced by Agnico Eagle.

Table 3-1: In-pit Backfill Tonnage and Volume for Meliadine Extension Alternative

Open Pit ID	Waste Type	Spill Point (masl)	Overburden Bedrock Contact (masl)	Backfill Elevation (masl)	Waste Rock Backfill (t)[1]	Tailings Backfill (t)[1]	Backfill Volume (m^3)
Discovery	Waste Rock	67	56	15.5	8,485,173	-	4,242,587
FZONE01	Waste Rock	56	47	44.5	8,944,336	-	4,472,168
FZONE02	Waste Rock	53	47	44.0	1,010,086	-	505,043
FZONE03	Waste Rock	52	46	43.3	1,186,095	-	593,048
PUMP01	Tailings	55	47	40.0	-	309,697	187,695
PUMP02	Waste Rock	55	47	44.0	466,002	-	233,001
PUMP03	Tailings	59	49	31.0	-	770,571	467,013
PUMP04	Waste Rock	50	42	41.5	567,019	-	283,510
TIR01	Waste Rock	58	50	47.4	12,369,689	-	6,184,845
TIR02/04	Waste Rock	64	53	10.5	5,041,791	-	2,520,895
TIR03	Waste Rock	58	50	49.0	1,559,697	-	779,849
WES01	Tailings	58	50	50.0	-	3,861,938	2,340,568
WES02	Waste Rock	59	50	34.8	9,275,423	-	4,637,712
WES03	Waste Rock	59	50	49.0	3,232,050	-	1,616,025
WES04	Tailings	62	57	40.5	-	48,970	29,679
WES05	Tailings	64	47	36.5	-	3,556,987	2,155,750
WN01	Tailings	59	44	32.0	-	8,863,314	5,371,705
				Total	**52,137,361**	**17,411,477**	**36,621,093**

1 = Tonnage of waste rock and tailings calculated using dry density of 2.0 t/m^3 and 1.65 t/m^3, respectively.
Reference: Lorax (2022b).

Backfill volumes incorporated into the current Water Balance and Water Quality Model (WBWQM) exercise (refer to Section 4.2.2.1) are generally below maximum values to ensure post-closure water quality remains within water quality guidelines defined in the Aquatic Effects Management Plan (AEMP). There may be opportunity to increase backfill volumes while remaining below guidelines (i.e., CCME, SSWQO and future Water Licence as per 2AM-MEL1631 part E item 16) or criteria related to closure, which could be explored through future model sensitivities.

Based on Agnico Eagle's experience with the Meadowbank Mine in-pit tailings deposition, it is assumed that the alternative of tailings in-pit deposition at Meliadine Mine will require the continued use of water management infrastructure, plus additional infrastructure such as:

- Installation of a slurry and reclaim water piping (located within the footprint of the assessed Meliadine Mine (2014 FEIS);
- If required, reclaim water barge; and
- If required, tailings thickener and reclaim water treatment plant at closure.

If Agnico Eagle decides to execute and implement tailings and waste rock in-pit deposition as part of the mine plan, the best available practices will be followed.

The in-pit deposition of tailings would use the subaqueous deposition method. A water cover with a sufficient thickness to prevent resuspension of the tailings due to waves and wind will be maintained over the tailings during in-pit deposition and at closure. Once the water is of sufficient quality, water management infrastructure will be breached/dismantled to discharged water directly to the receiving environment; this plan is unchanged from the currently approved Meliadine Mine closure concept.

In-pit deposition at Meliadine will incorporate Agnico Eagle's existing experience at Meadowbank and the development of specific water and waste management strategies updates to the water balance, water quality model and development of a tailings deposition plan to ensure optimal and safe operation during in-pit deposition. Water transfer will be required between the open pits to maintain an adequate water level. Transfer of water from Meliadine Lake into the open pits will also be required to maintain the adequate water level over the tailings.

Based on the 2014 FEIS and 2022 FEIS Addendum for Meliadine Extension, it is assumed that freshwater consumption for the purposes of milling additional ore and for the proposed in-pit deposition alternative would be within the limits prescribed in the 2014 FEIS.

In-pit tailings and waste deposition are currently presented as an alternative for Meliadine Extension. Agnico Eagle is of the opinion that advanced discussions on the feasibility of this alternative should be part of the Water Licence Amendment with the NWB. When Operations decide to proceed, Agnico Eagle will provide 90 days notice to the NWB.

4 DESCRIPTION OF THE ENVIRONMENT

Valued Ecosystem Components and Valued Social Economic Components (VSECs) to assess Meliadine Extension related effects, based on their role in the ecosystem and value placed on them by humans for traditional use and cultural purposes, are consistent with those presented in the 2014 FEIS. For the 2018 and 2020 FEIS Addenda, VECs and VSECs applicable to the proposed activities of those applications also followed the VECs and VSECs established for the 2014 FEIS. The VECs and VSECs for this Application include the following:

Table 4-1: Valued Ecosystem Components and Valued Social Economic Components for Meliadine Extension

VEC		VSECs
Air Quality/Emissions	**Hydrogeology and Groundwater Quality**	Population Demographics
Climate and Meteorology	**Hydrology**	Traditional Activities and Knowledge
Noise	**Freshwater quality and sediment quality**	Economic Development and Opportunities
Soils and Terrain (Permafrost)	**Freshwater Fish and Fish Habitat**	Education and Training
Vegetation	Freshwater plankton and benthos	Individual and Community Wellness
Wildlife (focus on caribou)	Marine Environment	Community Infrastructure and Public Services
Upland Birds	Marine Wildlife	Governance and Leadership
Raptors	Ecological Health	Non-traditional Land and Resource Use
		Public and Worker Safety
		Cultural, Archaeological, and Paleontological Resources

Note: Only **bold** VECs may change the original assessment predictions as a result of in-pit tailings deposition activities.

The potential impacts on the 2014 FEIS VECs based on the alternative for in-pit tailings deposition activities have been reviewed. The result is that only the following VECs may change from the original assessment predictions or may require additional mitigation as a result of the in-pit tailings deposition activities: Permafrost, Water Quantity, Quality and Groundwater, and Fish and Fish Habitat. The description of these VECs as well as the general environment characteristics for Meliadine presented in the following subsections are based on the 2014 FEIS, and the 2018, 2020, and 2022 FEIS Addenda.

4.1 Permafrost

The reader is referred to Section 6.3.2 of the 2022 FEIS Addendum for Meliadine Extension Permafrost and Permafrost Terrain Existing Environment.

4.2 Water Quantity and Quality

4.2.1 Water Quantity

The reader is referred to Section 7.3.2 of the 2022 FEIS Addendum for Meliadine Extension Hydrology including Water Quantity Existing Environment.

4.2.2 Water Quality

4.2.2.1 Surface Water

The reader is referred to Section 7.4.2 of the 2022 FEIS Addendum for Meliadine Extension Hydrology including Water Quality Existing Environment.

4.2.2.2 Groundwater

The reader is referred to Section 7.2.2 of the 2022 FEIS Addendum for Meliadine Extension Hydrogeology and Groundwater Quantity and Quality Existing Environment.

4.3 Fish and Fish Habitat

The reader is referred to Section 7.5.2 of the 2022 FEIS Addendum for Meliadine Extension Fish and Fish Habitat Existing Environment.

5 IMPACT ASSESSMENT

5.1 Methodology

The review of the predicted environmental impacts has been prepared only for the VECs applicable to the in-pit deposition and that could be potentially affected by the in-pit tailings deposition activities. These predicted environmental impacts have been compared to the potential impacts identified in the Meliadine Extension FEIS Addendum (Agnico Eagle 2022).

Appendix 1 includes the review of the environmental assessment impact matrices with regards to the in-pit deposition alternative.

The sources of impact for the proposed in-pit deposition modification are:

- Construction phase:
  - Installation of pipelines to bring the tailings from the mill to each of the open pits; and
  - If required, construction of a water treatment plant (to be operated in the first years of closure, until water quality criteria are met).
- Operation phase:
  - Deposition of tailing in six open pits: PUMP01, PUMP03, WES01, WES04, WES05 and WN01; and
  - Deposition of waste rock in eleven open pits: Discovery 01, F ZONE01, F ZONE02, F ZONE03, PUMP02, PUMP04, TIR01, TIR02/04, TIR03, TIR04, WES02, WES03.
- Closure and Post-closure phase:
  - If required, treatment of water in the open pits until water quality meets Water Licence (future), CCME or SSWQO criteria; and
  - Once the water quality in the open pits respects the requirements of the Type A Water Licence 2AM-MEL1631 (future licence), the water management infrastructure will be decommissioned.

As mentioned, six open pits were designated to receive tailings based on no connection with the underground mine workings and eleven to receive waste rock. Since permafrost degradation is accelerated with in-pit tailings deposition compared to waste rock due to increased latent heat, the thermal model was completed for in-pit tailings deposition (worst-case scenario) and is presented in Section 5.2.

To assess the potential effects on water quantity and quality of in-pit deposition of waste rock and tailings, a water balance and water quality model was completed. The operations phase was assessed qualitatively and a model was run for the active closure and post-closure phase considering climate change (RCP4.5). The WBWQM included all the open pits considering tailings and waste rock deposition using the 2022 FEIS application base case model with certain modifications to incorporate backfill placement.

Geochemical source terms for tailings and waste rock in-pit deposition were developed. Two source terms are developed for waste rock backfill: an initial flush which represents rinsing of water-soluble parameters during active flooding of the mine open pits with Meliadine Lake water in the first years of active closure; and long-term diffusive flux of constituents from waste rock pore water into the overlying open pit lake. Tailing porewater geochemistry from the 2014 FEIS and the tailings consolidation flows from the Meadowbank Mine tailings in-pit deposition consolidation model (SNC 2018) were used to assess long-term water quality in open pit lakes backfilled with tailings and downstream receptors. The model results were focused on the active closure and post-closure mine phase (Sections 5.3.1 and 5.3.2).

To assess groundwater water quality impacts to the receiving environment, a groundwater analysis was performed by evaluating seepage fluxes and travel times for each of the open pits that were designated to receive tailings, since the tailings porewater source terms have higher concentrations than waste rock porewater source terms. Discovery waste rock source terms have higher concentrations than the Meliadine waste rock, therefore Discovery open pit seepage fluxes and travel times were also calculated. Finally, a contaminant transport model was undertaken to the open pit identified as having the highest seepage flux and shortest seepage travel time to the receiving environment (Section 5.3.2.2).

5.2 Permafrost

The alternative for in-pit deposition with tailings or waste rock will occur during operation. As the open pits will be filled with water and tailings, the pre-existing permafrost created during mining operations will degrade and will lead to a negligible impact. This impact will affect the permafrost within the open pits in operations, but also in closure and post-closure.

A pre-feasibility level thermal evaluation of in-pit tailings deposition for the Meliadine Extension was completed and comprised two phases of numerical modelling. The first phase of thermal modelling focused on establishing the relationship between waterbody surface area size on the long-term talik depth beneath the waterbody at Meliadine Extension. The second phase of thermal modeling explored timeframes for talik development beneath prototypical open pits at Meliadine Extension where in-pit tailings deposition may occur. Both two-dimensional (2D) axisymmetric and 2D cross-section planar model domain geometries were assessed to consider circular- and elongated-shaped water bodies, respectively (Lorax 2022a).

The thermal modelling showed that for mean annual waterbody temperatures of +4°C and +1°C, open taliks form in the long-term under circular waterbodies when the waterbody radius exceeds 240 m and 325 m, respectively. For elongated waterbodies under these same temperature conditions, open taliks form when the waterbody half-width across its short axis is about 120 m and 185 m, respectively.

The second phase of thermal modeling explored timeframes for talik development beneath WES05 and WN01 as they were considered representative of the range of open pits at Meliadine Extension which have generally circular or elongated areal footprints, respectively. The main findings from simulations on WES05 (circular) and WN01 (elongated) open pits, are summarized in Table 5-1.

Table 5-1: Summary of Thermal Modelling Results

Open Pit	Development of Open Talik (years after open pit closure[1])			
	Warm Tailings (+1°C)		Cold Tailings (-1°C)	
	Water Cover (+2°C)	Dry Cover (-7°C)	Water Cover (+2°C)	Dry Cover (-7°C)
WES05	62	62	390	Not formed
WN01[2]	5	NA[3]	20	NA[3]

1 = Open pit closure is the time after the in-pit tailings deposition has been completed.

2 = Open pit situated in an existing open talik (Lake B5), therefore the time of development of open talik is to re-open the talik

3 = Dry cover placement was not undertaken because its planned footprint intersects the existing Lake B5, and is assumed that a water cover would be the preferred tailings cover for open pit WN01

It should be noted that the thermal model considered the maximum capacity of each open pit to receive tailings. The maximum tailings backfill elevation for WES05 and WN01 is 47.0 and 42.0 masl respectively. As shown in Table 3-1, the backfill elevation for WES05 and WN01 is of 36.5 and 32 masl respectively (deeper water column, reduced tailings thickness), which can delay the development of open talik.

In the 2014 FEIS, the flooding of open pits at closure was assessed as a primary effect pathway as this will result in the creation of a talik beneath the pit lake (talik may be closed or open depending on the depth of the open pit and the size of the pit lake that is formed). If an open talik is formed beneath the pit lake, the lake will become either a regional discharge point, or a regional recharge point, for the sub-permafrost groundwater system. If an open talik is formed, a hydraulic connection will exist between the pit lakes and the sub-permafrost groundwater system, and therefore can result in a potential for constituent transport from the pit lakes into the groundwater system. It was then concluded that although many of the pit lakes will have the requisite geometry and dimensions to develop open taliks in the long term, downstream cumulative effects resulting from the development of an open talik beneath the pit lakes are assessed through the water quality results within the pit lakes (Section 5.3.2).

In conclusion, the comparison to what was originally predicted, the proposed in-pit tailings deposition alternative is predicted to have the same or less impact to the permafrost in operation, closure/post-closure. Appendix 1, Table 1 presents the environmental assessment impact matrices on permafrost impacts and proposed mitigation measures.

5.3 Water Quantity and Quality

5.3.1 Water Quantity

5.3.1.1 Operation Phase

The qualitative evaluation of in-pit deposition during operations showed the following results:

- Freshwater usage will remain within the limits assessed in the 2014 FEIS and 2022 FEIS Addendum.
- The reduced footprints of the WRSFs and TSF would result in decreased runoff from these facilities.
- CP1 water, surface contact water, and runoff would be used to satisfy mill process water make-

up requirements, with any excess water treated, as required, and discharged to the environment (i.e., Itivia Harbour as main priority or Meliadine Lake).

Water quantity predictions would also be calibrated to monitoring data and would be used to continue to guide water management at site.

5.3.1.2 Closure and Post-closure Phase

The results of the WBWQM showed that in-pit deposition results in lower volume of water required to flood the open pits in active closure. Open pit flooding would be completed with 5 years of pumping from Meliadine Lake with a total of 34 Mm^3. The 2022 FEIS model required 90.7 Mm^3 over 7 years of pumping. The in-pit deposition results in a 63% reduction in Meliadine Lake water during active closure. Table 5-2 presents the annual balance of water from Meliadine Lake.

Table 5-2: In-pit Deposition Water Balances in Active Closure Phase

Year	Meliadine Lake Pumped (m^3)	% Total	Surface Contact Water (m^3)	% Total
2044	12,610,653	29%	4,832,634	11%
2045	11,434,329	26%	4,263,743	10%
2046	6,568,915	15%	478,814	1%
2047	3,341,715	8%	354,950	1%
2048	12,610,653	29%	4,832,634	11%
2049	0	0%	0	0%
2050	0	0%	0	0%
Total	**33,955,612**	**77%**	**9,930,141**	**23%**

Reference: Lorax (2022b).

Modelling indicates that all open pits will maintain at least 8 m of water cover throughout the full post-closure period as presented in Table 5-2. The model shows that approximately 9.9 Mm^3 will report to the open pits via gravity drainage from the surrounding catchments, and precipitation and contribute to open pit flooding.

Table 5-3: Water Cover Depth Over In-pit Deposition and Average Annual Discharge Volumes for the 2051-2100 Period

Open Pit	2051-2100			
	Minimum Level (m)	Backfill Elevation (m)	Water Level above Backfill (m)	Average Closure Overflow (m^3)
TIR01	57.8	47.4	10.4	424,476
TIR03		49.0	8.8	
WES01		50.0	8.8	
WN01	58.7	32.0	26.7	135,595
TIR02/04	63.8	10.5	53.3	176,386
FZONE01	55.8	44.5	11.3	1,374,376
FZONE02	52.8	44.0	8.8	37,775
FZONE03	51.8	43.3	8.5	13,479
PUMP01	54.8	40.0	14.8	48,187
PUMP02	54.8	44.0	10.8	7,924
PUMP03	58.8	31.0	27.8	11,071
PUMP04	49.9	41.5	8.4	137,030
WES02	58.8	34.8	24.0	56,894
WES03	58.8	49.0	9.8	152,276
WES04	61.5	40.5	21.0	162
WES05	63.8	36.5	27.3	44,867
Discovery	66.8	15.5	51.3	31,445

Reference: Lorax (2022b).

In conclusion, in-pit deposition will result in less surface contact water to manage during operations and less freshwater usage from Meliadine Lake during active closure. As a result, the proposed in-pit tailings deposition modification is predicted to have the same or less impact to water quantity in operation, closure/post-closure as compared to the 2014 FEIS and 2022 FEIS Addendum.

Refer to Appendix 1, Table 2 for the complete environmental assessment impact matrices on water quantity.

5.3.2 Water Quality

5.3.2.1 Surface Water

5.3.2.1.1 Operation Phase

Water quality will be monitored during operations to update the water quality forecast model. The tailings in the open pits will be deposited under water and a water cover with a sufficient thickness to prevent resuspension of the tailings due to waves and wind will be maintained over the tailings during in-pit tailings deposition.

5.3.2.1.2 Closure and Post-closure Phase

The water quality predictions for in-pit deposition were compared against water quality guidelines adopted in the 2020 AEMP (Agnico Eagle 2021) as a screening tool to identify parameters of potential concern (POPCs) during active closure and post-closure.

Waste Rock in-pit deposition

Water quality predictions were generated for 11 open pits to be backfilled with waste rock. The open pits were modelled to receive between 0.46 and 12.4 Mt of waste rock (Table 3-1). Flooding of the backfilled open pits with Meliadine Lake water during active closure will result in a one-time flushing of water-soluble constituents from waste rock surfaces into the overlying pit lakes. Among the open pits modelled, Discovery open pit and FZONE03 open pit have concentrations of Ammonia, Arsenic, Copper, and Selenium predicted above AEMP guidelines during active closure. In general, effects are predicted to be of short duration, and pit lake quality is predicted to improve as the open pits flood. Upon completion of open pit flooding, concentrations of the POPCs are predicted to remain below AEMP guidelines for the remainder of active closure and post-closure for all the open pits and receiving lakes.

Tailings in-pit deposition

Water quality predictions are generated for 6 open pits that are backfilled with tailings. The backfill tonnage varies from approximately 0.05 to 8.9 Mt (Table 3-1). The rate of tailings consolidation drives the volume of water released to the overlying pit lake is a function of time and the initial volume of tailings. In general, the impact of tailings on water quality is predicted to be more pronounced for open pits with limited catchment areas. In general, once the open pits are fully flooded, consolidation of tailings is expected to release porewater to the overlying pit lake for the remainder of mine closure. As the consolidation load from tailings decreases over time, the rate at which POPCs are released from tailings into the pit lake decays. For example, model predictions for mine related parameters at WES05 open pit remain below their respective AEMP guidelines during post-closure. Concentrations of Ammonia, Arsenic, Copper, and Selenium are predicted to plateau by the end of the model horizon.

Receiving Lakes

Model predictions for mine-related POPCs during post-closure are below their respective AEMP guidelines in all mine pits and receiving lakes. The maximum post-closure predictions for key mine related POPCs (Ammonia, Arsenic, Copper, and Selenium) are presented in Table 5-4 for the waste rock and tailings backfilled open pits.

Table 5-4: Maximum Post-Closure Predicted Concentrations Compared to AEMP Guidelines

Open Pit ID	Backfill Type	Parameter and AEMP Guideline (mg/L)			
		NH_3-N	As	Cu	Se
		0.58*	***0.025***	***0.002-0.004*****	***0.001***
Discovery01	WR	0.11	0.015	0.0012	0.00043
FZONE01	WR	0.21	0.0080	0.0016	0.00048
FZONE02	WR	0.24	0.0044	0.0014	0.00087
FZONE03	WR	0.26	0.0046	0.0015	0.0010
PUMP01	Tailings	0.20	0.0050	0.0030	0.00041
PUMP02	WR	0.23	0.0041	0.0015	0.00089
PUMP03	Tailings	0.29	0.012	0.0023	0.00027
PUMP04	WR	0.20	0.0037	0.0023	0.00060
TIR01	WR	0.011	0.0040	0.0021	0.00055
TIR02/04	WR	0.41	0.0101	0.0012	0.00041
TIR03	WR	0.017	0.00066	0.00091	0.000073
WES01	Tailings	0.0060	0.00048	0.0011	0.00010
WES02	WR	0.20	0.0070	0.0012	0.00075
WES03	WR	0.25	0.015	0.0013	0.00087
WES04	Tailings	0.12	0.0055	0.0019	0.00031
WES05	Tailings	0.49	0.021	0.0019	0.00031
WN01	Tailings	0.018	0.00069	0.00091	0.000081

* = Ammonia guideline assumes pH 8 and temperature 15°C (2020 AEMP).

**= Copper guideline is hardness dependent.

In conclusion, in-pit deposition will result in an initial flush of constituents that would be for short duration and these loading sources are proportional to the amount of backfill into the mine open pits. Model predictions for mine related POPCs during post-closure are below their respective AEMP guidelines in all open pits and receiving lakes. As a result, the proposed in-pit tailings deposition modification is predicted to have the same or less impact to water quality in operation, closure/post-closure, as compared to the 2014 FEIS and 2022 FEIS Addendum.

Refer to Appendix 1, Table 3, for the complete environmental assessment impact matrices on surface water quality.

5.3.2.2 Groundwater

Seepage fluxes and travel times

Contaminants within the tailings pore water could diffuse to the environment following closure due to concentration gradients between the tailings pore water and the water column above the tailings. To evaluate this, a pre-feasibility level groundwater evaluation of in-pit tailings deposition for the Meliadine Extension was completed by using fundamental analytical equations to determine groundwater travel times and seepage fluxes from each open pit considered for tailings backfill under the presumption that open taliks form. In presuming open taliks form, the analysis provides a conservative worst-case scenario for groundwater loadings to receptors (Lorax 2022a).

Seepage fluxes were calculated for advective flow through a porous medium. The gradient used to drive seepage fluxes from the backfilled open pits was determined using the difference in elevation between the backfilled open pit water cover elevation and Meliadine Lake and travel pathway lengths specific to each open pit. In cases where the open pits were transected by highly permeable faults, the seepage flux through the fault was limited by the hydraulic conductivity of the tailings.

For open pits that are intersected by faults, the fastest groundwater travel time was associated with the fault flow path, while the slowest travel time is associated with the flow path which lies fully (or partially) in competent bedrock. For open pits not directly intersected by faults, a single travel time was calculated, representing the flow path that begins in competent bedrock and then follows either a competent or faulted bedrock pathway thereafter.

The main findings from the groundwater analysis are presented in the following table.

Table 5-5: Summary of Groundwater Analysis and Open Pit Suitability for Tailings Deposition

Open Pit	Tailings Backfill Volume (m^3)	Total Seepage Loss (m^3/d)	Fastest Travel Time (years)	Groundwater Point Total (Travel Time/Seepage Loss)	Groundwater Outcome Rank
PUM01	375,218	0.011	18,900	1,793,562	1
WES04	126,226	0.009	7,000	790,970	2
PUM03	1,027,283	0.027	12,600	470,147	3
WES01	2,340,568	0.032	920	28,953	4
WN01	7,162,482	0.060	590	9,881	5
WES05	2,936,368	1.24	14	27	6

Based on the seepage fluxes and travel times computed for the open pits, a simplified scoring scheme was developed to rank the suitability of the open pits for tailings deposition. This ranking was predicated on conservative worst-case scenario for groundwater loadings to Meliadine Lake. Depending on how these facilities are operated and closed, open talik formation under the backfilled open pits could be limited or avoided altogether, essentially eliminating potential interaction between the open pits and the deeper groundwater system.

For reference, annual baseline runoff to Meliadine Lake was reported to be 84,700,000 m^3/yr in the 2014 FEIS (Agnico Eagle 2014). The volumetric seepage flux to Meliadine Lake from WES05 (453 m^3/yr or 1.24 m^3/d) amounts to 0.0005% of the annual runoff to the lake.

Deposition of waste rock in the Discovery open pit is also being considered as a waste management option. Since Discovery waste rock source terms have higher concentrations than the Meliadine waste rock, Discovery open pit seepage fluxes and travel times were also calculated. In the case of Discovery open pit, the nearest downgradient receiver is Lake CH6.

Based on this parameterization of the groundwater flow path, the contact water flux from Discovery open pit is estimated to be 0.63 m^3/d and take approximately 300 years to travel to CH6. This travel time does not include the time for an open talik to form underneath the open pit.

Table 5-6: Summary of Groundwater Analysis for Waste Rock Deposition at Discovery

Open Pit	Waste Rock Backfill Volume (m^3)	Total Seepage Loss (m^3/d)	Fastest Travel Time (years)	Groundwater Point Total (Travel Time/Seepage Loss)
Discovery	4,242,587	0.63	300	476

For reference, annual baseline runoff to CH6 was reported to be 1,240,000 m^3/yr in the 2014 FEIS (Agnico Eagle 2014). The volumetric seepage flux to CH6 from the Discovery amounts to <0.02% of the annual runoff to the lake.

Contaminant transport

Numerical modeling of contaminant transport to Meliadine Lake was undertaken for the WES05 open pit, which through the previous analysis was identified as having the highest seepage flux (1.24 m^3/d) and shortest seepage travel time to Meliadine lake (14 years). A backfilled open pit source concentration of 100 mg/L was used to represent a generic parameter of concern, allowing results to be scaled to tailings porewater source term concentrations. Key results from the WES05 flow and transport models are summarized in Table 5-7 and discussed below.

Table 5-7: Simulated Flow and Transport Model Results for WES05 Open Pit

Simulated Result	Units	WM-D Flowpath	WM-B Flowpath	Total
Volumetric Flux	m^3/d	1.02	0.16	1.18
Constant Source Concentration	mg/L	100	100	n/a
First Arrival Time (10 mg/L)[1]	yr	8.5	2,930	n/a
First Arrival Time (50 mg/L)[1]	yr	14.5	3,9750	n/a
Max. Conc. Arrival time (98 mg/L)[1]	yr	25	>5,000	n/a
Steady State Mass Flux	kg/yr	37.5	5.8	43.3

1 = Does not include time for open talik to form underneath backfilled open pit.

It should be noted that transport years do not include the time for an open talik to form underneath the backfilled open pits. According to the thermal analysis, the earliest that an open talik would form beneath the WES05 open pit under a wet cover conditions is 62 years.

As expected from the mathematical analysis, plume migration along the WM-D flow path is reasonably fast. As defined by the 10 mg/L concentration contour, first arrival of the plume occurs 8.5 years after the start of the simulation (opening of the talik), or 71 years if the time of talik development is considered as per thermal model results. The arrival time of the 50 mg/L plume (i.e. 50% of the source concentration) is 14.5 years and 25 years for the 100 mg/L (76.5 and 87 years respectively if time of talik development is considered). This illustrates the effect of dispersion on the plum. The arrival time of the 50% concentration is essentially consistent with arrival time computed in the mathematical model (14 years) which only considered advective flow. The model simulates significantly slower plume migration along the WM-B flow path (Lorax 2022a).

For in-pit tailings deposition, estimated tailings and porewater chemistry derived by Lorax (2022b) were compared to average groundwater quality (samples collected from underground diamond drillholes) to identify PCOCs for the groundwater flowpath to Meliadine Lake. For in-pit waste rock deposition, the source term for Discovery waste rock porewater, also developed by Lorax (2022b), was used for comparison. The waste rock porewater source term has overall lower concentrations than the tailings porewater source term with exception to fluoride and to a minor degree, zinc. Only fluoride and arsenic are higher in the waste rock porewater source term than in groundwater. Therefore, from a geochemical loading perspective, flooded mine tailings represents a poorer case than flooded waste rock.

Potential long-term loads to Meliadine Lake from tailings backfilled into WES05 were computed by scaling the numerical transport simulation results for the 100 mg/L generic source term to the PCOC concentration and are presented in Table 5-8. Since the backfilled WES05 open pit represents the worst case for seepage fluxes and travel times, all other open pits examined in the mathematical analysis would be expected to produce smaller loads.

Loading rates from the backfilled WES05 open pit and to Meliadine Lake show that it takes around 100 years before the loading rates stabilize at their maximum value (37.5 kg/yr) along the WM-D flowpath and about 30,000 years towards their maximum level (5.8 kg/yr) along the WM-B flowpath. The combined loading rates and cumulative loads to Meliadine Lake from both WM-D and WM-B flowpaths are essentially stable at 37.5 kg/yr until ~3,000 years. Ultimately, the steady-state loading rate to Meliadine Lake from the backfilled WES05 open pit is 43.3 kg/yr in about 30,000 years.

Table 5-8: Simulated Flow and Transport Model Results for WES05 In-pit Tailings Deposition

PCOC	Source Concentration (mg/L)	Short-Term Maximum Load to Meliadine Lake (t = 100 years) (kg/year)	Long Term Steady-State Load to Meliadine Lake (t >30,000 years) (kg/year)
Generic Parameter	*100*	*37.5*	*43.3*
Cyanide	0.76	0.285	0.33
Cyanide (WAD[1])	0.05	0.01875	0.022
Fluoride	0.12	0.045	0.052
Ammonia Nitrogen	85.5	32.0625	37.0
Total phosphorus	0.175	0.065625	0.076
Arsenic	3.58	1.3425	1.55
Cobalt	0.0962	0.036075	0.042
Copper	0.061938	0.02322675	0.027
Selenium	0.014	0.00525	0.006

1 = Weak Acid Dissociable

As shown in the above table, loads are not anticipated to result in observable changes to water quality in Meliadine Lake. As mentioned, annual baseline runoff to Meliadine Lake was reported to be 84,700,000 m^3/yr in the 2014 FEIS (Agnico Eagle 2014). The volumetric seepage flux to Meliadine Lake from WES05 (450 m^3/yr or 1.18 m^3/d) amounts to 0.0005% of the annual runoff to the lake. Even with the addition of other open pit volumetric seepage fluxes (50 m^3/yr or 0.14 m^3/d), the proportion of combined open pit seepage fluxes to annual runoff to the lake remains below 0.0006%. As reference, in the approved 2014 FEIS, greater seepage fluxes and travel times were estimated from the TSF (through possible open talik under Lake B7) to Meliadine Lake and was concluded that any changes to the Meliadine Lake water quality were expected to be negligeable.

The diffusion of the contaminant is expected to be extremely slow, therefore potential impacts are considered negligible. In conclusion, the proposed in-pit tailings deposition modification is predicted to have the same or less impact to the groundwater in operation, closure/post-closure, as compared to the 2014 FEIS and the 2022 FEIS Addendum.

Refer to Appendix 1, Table 3, for the complete environmental assessment impact matrices on groundwater quality.

5.4 Fish and Fish Habitat

Considering that pit Lakes that have received tailings or waste rock will be designed to sequester contaminants of potential concern at depths so that they are biologically unavailable to higher trophic levels, that all diversion dikes will be kept intact as a barrier between open pits and surrounding lakes until the open pit water meets acceptable concentrations for release to the environment, and that predictions suggest that water quality in the open pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses, no significant impact on fish and other aquatic organisms is expected. Based on the fact that re-flooding will be carried out in accordance with guidelines and methods described in the 2014 FEIS (Agnico Eagle 2014), residual impacts are considered to be non-significant for fish and other aquatic organisms.

In conclusion, the comparison to what was originally predicted, the proposed alternative for in-pit tailings deposition is predicted to have the same or less impact to the Aquatic organisms and habitat in operation, closure/post-closure.

Refer to Appendix 1, Table 4, for the complete environmental assessment impact matrices on fish and fish habitat.

6 MONITORING

With the proposed in-pit tailings and waste rock deposition, no significant changes are expected to arise for the monitoring programs in place at Meliadine. During tailings or waste rock deposition in the open pits, Agnico Eagle intends to maintain the monitoring programs in place and continue to comply with the Project Certificate No.6 and Type A Water Licence No. 2AM-MEL1631 requirements, to ensure the protection of the receiving environment.

Water quality monitoring will be completed in accordance with the Water Quality and Flow Monitoring Plan, which is part of the AEMP and is closely associated with the Water Management Plan, which is intended to monitor large-scale changes in physical and biological variables, will be extended to evaluate potential impacts from all mine related sources in the receiving environment and to serve as the most important monitoring program for evaluating short term and long term potential impacts to the aquatic environment. The Mine Waste Management Plan and Water Management Plan will be updated for the proposed in-pit tailings or waste rock deposition alternative and submitted to the NWB. The Groundwater Management Plan, which is presented within the Water Management Plan, will also be updated. When Operations decide to proceed, Agnico Eagle will provide 90 days notice to the NWB.

Monitoring changes related to the proposed in-pit tailings deposition modification will be updated and submitted through the revision of the applicable management plans and submitted for approval to the NWB.

7 REFERENCES

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SNC (SNC Lavalin). 2018. Environmental Impact Study Review – Meadowbank In-Pit Tailings Deposition. February 2018.

APPENDIX 1: ENVIRONMENTAL ASSESSMENT IMPACT MATRICES - IN-PIT TAILINGS DEPOSITION ALTERNATIVE

Appendix 1: Review of Predicted Impacts of Meliadine In-pit Tailings or Waste Rock Deposition on potentially affected VECs.

The following tables present a review of the predicted impacts for the Meliadine proposed in-pit tailings deposition alternative on the previously identified valued ecosystem components (permafrost, water quantity, water quality, and fish/fish habitat) during operation and closure/post-closure (Tables 1 – 4). This review includes impacts of new components, the physical expansion of previously permitted components and the incremental impact of increased activity.

For all previously permitted activities, the proposed mitigation/monitoring is unchanged from current protocols. For new components, all proposed mitigation/monitoring is based on existing protocols, since all activities are similar to the ones previously permitted.

Table 1 – Predicted Impacts to Permafrost

Valued Component	Project Phase	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – Meliadine Extension Alternative
Permafrost	Construction and Operation	Degradation of permafrost during in-pit deposition.	Assessment and prediction of permafrost degradation during in-pit deposition. Continue monitoring of permafrost with available thermistors.	Minor
Permafrost	Closure and Post-closure	Flooding of pits that received tailings or waste rock at closure may result in the creation of a talik beneath the pit lake. The talik may be closed, or it may be open, depending on the depth of the pit and the size of the pit lake that is formed. If an open talik is formed beneath the pit lake, the lake will become either a regional discharge point, or a regional recharge point, for the sub-permafrost groundwater system. If an open talik is formed a hydraulic connection will exist between the pit lakes and the sub-permafrost groundwater system. There will be the potential for constituent transport from the pit lakes into the groundwater system.	Monitor pit lake water quality.	Primary

Table 2 – Predicted Impacts to Fresh Water Quantity

Valued Component	Project Phase	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – Meliadine Extension Alternative
Hydrology	Construction and Operation	Fresh water consumption will be the same or higher to ensure that tailings disposed inside the pits will remain under water cover.	Mitigation: Ensure that all surface water from CP1 will be diverted to pits in order to limit freshwater consumption. Monitoring: Monitor Reclaim Water and freshwater consumption. Monitor water level and tailings elevation inside the pits.	Minor
Hydrology	Construction and Operation	In-pit seepage water.	Mitigation: None. Monitoring: Monitoring groundwater level around the mine site with the existing piezometer network.	Minor
Hydrology	Closure and Post-closure	Less freshwater consumption will be used for reflooding after in-pit-deposition compared to original closure scenario.	Mitigation: Pit flooding will be achieved by combination of seepage, in pit runoff, precipitation and pumping of water from Meliadine Lake. Monitoring: Reflooding volumes will be carefully monitored. Optimize the mine plan and adjust tailings and waste rock volumes (respecting water quality objectives) to further reduce freshwater needs during active closure to reflood the pits.	Minor

Table 3 – Predicted Impacts to Water Quality

Valued Component	Project Phase	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – Meliadine Extension Alternative
Water Quality (surface)	Construction and Operation	Potentially acid generating tailings deposits after being exposed to air.	Mitigation: Keep tailings deposits and beaches under a sufficient water cover to limit acid generation. Monitoring: Monitor water cover and change deposition points if required.	Minor
Water Quality (surface)	Construction and Operation	Reclaim water is stored inside pits during in-pit tailings deposition.	Mitigation: None Monitoring: Monitor surface water quality inside pits.	Minor
Water Quality (surface)	Closure and Post-closure	Pit Lake water released to the environment	Mitigation: All diversion dikes will be kept intact as a barrier between open pits and surrounding waterbodies until the pit water meets acceptable concentrations for release to the environment. If required, water will be treated if it is unacceptable for discharge to the receiving environment. Monitoring: Water quality will be monitored and managed until pit water is acceptable to be mixed with surrounding lake water.	Primary
Water Quality (surface)	Closure and Post-closure	Water quality in flooded pits that have received tailings or waste rock may be higher than objectives and reconnection of drainages may affect downstream water and sediment quality.	Mitigation: Water quality predictions suggest that water quality in the pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses. Monitoring: Water quality in the pits will be monitored continuously during the flooding process. Pit lake quality will be monitored before breaching dikes or decommissioning water management infrastructure.	Primary
Water Quality (groundwater)	Closure and Post-closure	Pit Lake water moves into underlying talik to impact underlying deep regional groundwater. Trapped reclaim water in tailings pore water will be slowly released upward after tailings consolidation and laterally in the surrounding groundwater through diffusion process.	Mitigation: Downward contaminant transport limited to diffusion. Assessment of contaminant transport potential with hydrogeological modeling and simulations. Monitoring: Water quality monitoring in pit lake, implementation of monitoring wells network at talik area and between pits and lakes.	Minor

Table 4 – Predicted Impact to Fish and Fish Habitat

Valued Component	Project Phase	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – Meliadine Extension Alternative
Fish and Fish Habitat	Closure and Post-closure	Water quality concentrations in flooded pits that have received tailings or waste rock may exceed objectives, and if reconnected to preconstruction flow paths may affect downstream water and sediment quality, affecting fish health and habitat quality.	Monitoring: Pit Lakes will be designed to sequester contaminants of potential concern at depths so that they are biologically unavailable to higher trophic levels. All diversion dikes will be kept intact as a barrier between open pits and surrounding lakes until the pit water meets acceptable concentrations for release to the environment. Water quality will be monitored and managed until pit water is acceptable to be mixed with surrounding lake water. Mitigation: Predictions suggest that water quality in the pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses. Sufficient water cover will be maintained over the tailings. Other mitigation options to be determined if required during detailed engineering phase.	Primary