



Memo

To: Anges Simonfalvy; Kamil Sameer (GN) and Julie Anderson (Health Canada)

From: Colleen Prather; Jennifer Range (Agnico Eagle Mines Limited)

CC: NIRB

Date: January 19, 2023

Subject: Commitment 26 (GN-TRC-01) and Commitment 31 (HC-HHRA-04) – Meliadine Extension Proposal

The following information is provided in response to Commitments 26 and 31 made by Agnico Eagle as part of the Meliadine Extension Proposal.

Commitment Made (#26):

Agnico Eagle will provide with respect to the chronic air quality assessment in the Human Health Risk Assessment: 1) additional rationale on how and why people use the discrete receptor locations and why the selected toxicity reference values correspond to these uses; 2) details regarding the underlying assumptions which the toxicity reference values were derived; and 3) sensitivity analysis with risk estimates.

Commitment Made (#31):

Agnico Eagle will provide additional information regarding the dose-averaging approach for the chronic air quality assessment, with respect to receptor selection, exposure dose calculation, and selection of toxicity reference values, with this information being substance-specific and scenario-specific.

Response by Agnico Eagle:

Item 26-1, part A: Rationale and assumptions on how and why people use the discrete receptor locations is provided in response to Commitment 27:

- To summarize, adults and non-adults were assumed to be at the discrete receptor locations (e.g., cabins) for up to 30 days of the year and thus will be exposed to concentrations of Mine-related contaminants in air during the operations phase.

Item 26-1, part B: The rationale for the selected toxicity reference values was as follows:

- For PM₁₀ and PM_{2.5}, 24-hour and annual averaging periods predictions were developed for the Project. These predictions were assessed using 24-hour and annual TRVs.

Item 26-2: The assumptions on how the toxicity reference values were derived were as follows:

- Table 10.3-9 of the FEIS Addendum provides the basis for these TRVs.

Item 26-3 and 31: Alternative/sensitivity analyses were completed for the 24-hour and annual exposures as follows:

- The assessment with 24-hour averaging period predictions was separated from the annual averaging period predictions. The 24-hour predictions were assessed as acute exposures and not as chronic exposures.
- The annual averaging period predictions were evaluated as a repeated continuous exposure scenario without dose averaging (i.e., 30-day exposure in 30 days) and using a chronic TRV. This is consistent with Health Canada's guidance for less-than-chronic exposures (Section 2.2 in Health Canada 2016a). The FEIS Addendum provided the repeated intermittent exposure scenario (i.e., a total of 30 days exposure over the year).
- The requested calculations for all age groups were provided.

Conclusion of the sensitivity analysis is that there are no changes to the residual effects identified for human health.

Detailed calculations of the sensitivity analysis are provided below.

Detailed Sensitivity Results:

24-hour Acute Exposure Scenario

As stated in Section 10.3.7.4, the screening of 24-hour averaging period predictions against 24-hour health-based thresholds were provided in Table H-12-D-9a-f of the FEIS Addendum. From this screening, PM₁₀ and acrolein were retained as chemicals of potential concern (COPC). PM_{2.5} met the 24-hour air thresholds at all discrete receptor locations and scenarios. However, it was retained as a COPC as Health Canada (2016b) considers PM_{2.5} as a non-threshold substance.

The predicted 24-hour peak concentrations for the COPCs were applied as the exposure point concentrations to which receptors, at the discrete receptor locations, are exposed.

The selected acute toxicity reference values (TRVs) for PM_{2.5} and PM₁₀ were as presented in Table 10.3-9 in the FEIS Addendum: 27 µg/m³ for PM_{2.5} and 45 µg/m³ for PM₁₀. A TRV appropriate for assessing the 24-hour averaging period predictions of acrolein was not selected in the FEIS Addendum. For this commitment response, the TRV for acrolein was selected as the acute inhalation minimal risk level (MRL) of 0.003 pm (7 µg/m³), developed by the ATSDR (ATSDR 2007). The ATSDR acute inhalation MRL is a daily human exposure concentration below which adverse health effects are unlikely to occur at continuous (all day, every day) exposure of between 1 and 14 days. The LOAEL of 0.3 ppm was adjusted with an uncertainty factor of 100 for use of a LOAEL (10) and human variability (10) (ATSDR 2007).

The exposure parameters for the 24-hour exposure scenario are provided in Table 1.

Table 1: Exposure Parameters for the 24-hour Exposure Scenario

Parameter	Description	Units	HQ Calculation
			Acute Exposure Scenario
Conc.	Concentration of COPC	µg/m ³	24-hour maximum
EFh	Exposure frequency for hours	Hours	24
ATh	Averaging time for hours	Hours	24
EFd	Exposure frequency for days	Days	--
ATd	Averaging time for days	Days	--
TRV _{threshold}	Threshold inhalation Toxicity Reference Value	µg/m ³	Acute TRV
ADAF	Age-dependent adjustment factor	unitless	--

The hazard quotient (HQ) equation is:

$$HQ = \frac{Conc. \times \left(\frac{EFh}{ATh} \right)}{TRV_{threshold}}$$

A summary of the acute 24-hour HQs is provided in Table 2. The HQs were equal to or less than 1 at all receptor locations for all six scenarios.

The results of this 24-hour acute exposure scenario alternative analysis indicates that there are no risks of acute health effects to recreational users at the discrete receptor locations using the 24-hour averaging period predictions.

Table 2: Hazard Quotients for the 24-hour Exposure Scenario

COPC	Recreational User		
	Mine Site and AWAR (Receptor 1 to 22)	Park	Rankin Inlet (Receptors 1 to 3)
Scenario 1			
PM ₁₀	0.04 to 0.5	0.09	0.05 to 0.06
PM _{2.5}	0.04 to 0.4	0.09	0.04 to 0.05
Acrolein	0.01 to 0.1	0.03	0.01
Scenario 2			
PM ₁₀	0.05 to 1	0.1	0.09
PM _{2.5}	0.04 to 0.5	0.07	0.06 to 0.07
Acrolein	0.01 to 0.1	0.02	0.02
Scenario 3			
PM ₁₀	0.05 to 0.9	0.1	0.06 to 0.07
PM _{2.5}	0.04 to 0.4	0.1	0.05 to 0.06
Acrolein	0.01 to 0.09	0.03	0.01 to 0.02
Scenario 4			
PM ₁₀	0.04 to 0.3	0.07	0.04 to 0.05
PM _{2.5}	0.04 to 0.3	0.07	0.04
Acrolein	0.009 to 0.09	0.02	0.01
Scenario 5			
PM ₁₀	0.04 to 0.7	0.1	0.05 to 0.06
PM _{2.5}	0.04 to 0.4	0.09	0.05
Acrolein	0.01 to 0.1	0.02	0.01
Scenario 6			
PM ₁₀	0.02 to 0.2	0.04	0.02
PM _{2.5}	0.03 to 0.3	0.07	0.03 to 0.04
Acrolein	0.007 to 0.09	0.02	0.008 to 0.01

Based on a 24-hour averaging period. All HQs were less than the target of 1.

See Figure 10.3-2 in the FEIS Addendum for discrete receptor locations.

COPC = chemical of potential concern; AWAR = all-weather access road.

Repeated Continuous Exposure Scenario

As stated in Section 10.3.7.4, the screening of annual averaging period predictions against chronic annual health-based thresholds were provided in Table H-12-D-8 of the FEIS Addendum for NO₂ and SO₂ and in Table H-12-D-10a-f of the FEIS Addendum for the remaining indicator compounds. From this screening, diesel particulate matter (DPM) was retained as a COPC. NO₂, PM₁₀, and PM_{2.5} met the chronic annual air thresholds at all discrete receptor locations and scenarios. However, they were retained as COPCs as Health Canada (2016b,c) considers NO₂, PM₁₀, and PM_{2.5} as non-threshold substances.

The risk estimates for the repeated continuous exposure scenario were calculated using the exposure parameters in Table 3. The selected chronic toxicity reference values (TRVs) for NO₂, PM_{2.5} and PM₁₀ were as presented in Table 10.3-9 in the FEIS Addendum: 22.5 µg/m³ for NO₂, 8.8 µg/m³ for PM_{2.5} and 15 µg/m³ for PM₁₀.

Table 3: Exposure Parameters for the Repeated Continuous Exposure Scenario

Parameter	Description	Units	HQ Calculation
			Repeated Continuous Exposure Scenario
Conc.	Concentration of COPC	µg/m ³	Annual max.
EF _h	Exposure frequency for hours	Hours	24
AT _h	Averaging time for hours	Hours	24
EF _d	Exposure frequency for days	Days	30
AT _d	Averaging time for days	Days	30
TRV _{threshold}	Threshold inhalation TRV	µg/m ³	Chronic TRV

COPC = contaminant of potential concern; TRV = toxicity reference value.

All HQs for NO₂, PM_{2.5}, and PM₁₀ for repeated continuous exposure met the target HQ of 1 for recreational users at all locations and for all mining scenarios (Tables 4 and 5).

The results of sensitivity analysis indicates that there are no risks of chronic health effects to recreational users at the discrete receptor locations using the annual averaging period predictions. This is consistent with the results of the chronic air quality assessment presented in Section 10.3.7.4 of the FEIS Addendum.

Table 4: Hazard Quotients for the Chronic Repeated Continuous Exposure Scenario – NO₂

Scenario/COPC	Receptors SR_01 to SR-25
2021 Predictions – Scenario 1 (NO ₂)	0.03 to 0.1
2021 Predictions – Scenario 2 (NO ₂)	0.02 to 0.09
2021 Predictions – Scenario 3 (NO ₂)	0.02 to 0.07

Based on an annual averaging period. All HQs were less than the target of 1.

Table 5: Hazard Quotients for the Chronic Repeated Continuous Exposure Scenario - PM

COPC	Recreational User		
	Mine Site and AWAR (Receptor 1 to 22)	Park	Rankin Inlet (Receptors 1 to 3)
Scenario 1			
PM ₁₀	0.002 to 0.05	0.02	0.01
PM _{2.5}	0.002 to 0.04	0.01	0.01
Scenario 2			
PM ₁₀	0.003 to 0.09	0.02	0.01
PM _{2.5}	0.002 to 0.05	0.01	0.01
Scenario 3			
PM ₁₀	0.003 to 0.06	0.02	0.01
PM _{2.5}	0.002 to 0.04	0.02	0.01
Scenario 4			
PM ₁₀	0.002 to 0.04	0.01	0.01
PM _{2.5}	0.002 to 0.03	0.01	0.01

COPC	Recreational User		
	Mine Site and AWAR (Receptor 1 to 22)	Park	Rankin Inlet (Receptors 1 to 3)
Scenario 5			
PM ₁₀	0.003 to 0.05	0.02	0.01
PM _{2.5}	0.002 to 0.04	0.01	0.01
Scenario 6			
PM ₁₀	0.0009 to 0.02	0.005	0.004
PM _{2.5}	0.001 to 0.02	0.008	0.007

Based on an annual averaging period. All HQs were less than the target of 1.

See Figure 10.3-2 in the FEIS Addendum for discrete receptor locations.

COPC = chemical of potential concern; AWAR = all-weather access road.

Calculations for All Age Groups

As stated in Section 10.3.7.4, DPM was retained as a COPC for the chronic air quality assessment.

For the sensitivity analysis, the risk estimates were calculated using the exposure parameters in Table 6. The selected non-threshold TRV for DPM was as presented in Table 10.3-9 in the FEIS Addendum: 0.0003 (µg/m³)⁻¹.

Table 6: Exposure Parameters

Parameter	Description	Units	ILCR Calculation
Conc.	Concentration of COPC	µg/m ³	Annual max.
EFh	Exposure frequency for hours	Hours	24
ATh	Averaging time for hours	Hours	24
EFd	Exposure frequency for days	Days	30
ATd	Averaging time for days	Days	365
EDy	Exposure duration in years	Years	Infant = 0.5
			Toddler = 4.5
			Child = 7
			Teen = 8
			Adult = 4
ATy	Averaging time for years	Years	80
TRV _{threshold}	Threshold inhalation TRV	µg/m ³	--
TRV _{non-threshold}	Non-threshold inhalation TRV	(µg/m ³) ⁻¹	Inhalation Unit Risk (IUR)
ADAF	Age-dependent adjustment factor	unitless	Infant = 10
			Toddler = 5
			Child = 3
			Teen = 2
			Adult = 1

An example calculation for annual peak DPM concentration at Receptor 1 under Scenario 1 is shown below:

$$\begin{aligned}
 ILCR \text{ for DPM} = & \left(0.17076 \mu\text{g}/\text{m}^3 \times \left(\frac{24 \text{ hrs}}{24 \text{ hrs}} \times \frac{30}{365} \times \frac{0.5}{80} \right) \times (0.0003 [\mu\text{g}/\text{m}^3]^{-1} \times 10) \right) \\
 & + \left(0.17076 \mu\text{g}/\text{m}^3 \times \left(\frac{24 \text{ hrs}}{24 \text{ hrs}} \times \frac{30}{365} \times \frac{4.5}{80} \right) \times (0.0003 [\mu\text{g}/\text{m}^3]^{-1} \times 5) \right) \\
 & + \left(0.17076 \mu\text{g}/\text{m}^3 \times \left(\frac{24 \text{ hrs}}{24 \text{ hrs}} \times \frac{30}{365} \times \frac{7}{80} \right) \times (0.0003 [\mu\text{g}/\text{m}^3]^{-1} \times 3) \right) \\
 & + \left(0.17076 \mu\text{g}/\text{m}^3 \times \left(\frac{24 \text{ hrs}}{24 \text{ hrs}} \times \frac{30}{365} \times \frac{8}{80} \right) \times (0.0003 [\mu\text{g}/\text{m}^3]^{-1} \times 2) \right) \\
 & + \left(0.17076 \mu\text{g}/\text{m}^3 \times \left(\frac{24 \text{ hrs}}{24 \text{ hrs}} \times \frac{30}{365} \times \frac{4}{80} \right) \times (0.0003 [\mu\text{g}/\text{m}^3]^{-1} \times 1) \right)
 \end{aligned}$$

$$ILCR \text{ for DPM} = 4 \times 10^{-6}$$

All ILCRs for DPM met the target ILCR of 1 in 100 000 for recreational users at all locations and for all mining scenarios (Table 7).

Table 7: Incremental Lifetime Risks for Diesel Particulate Matter

Scenario	Recreational User During Life of Mine (i.e., 24 years)		
	Mine Site and AWAR (Receptor 1 to 22)	Park	Rankin Inlet (Receptors 1 to 3)
Scenario 1	9×10^{-7} to 4×10^{-6}	1×10^{-6}	1×10^{-6}
Scenario 2	7×10^{-7} to 5×10^{-6}	1×10^{-6}	1×10^{-6}
Scenario 3	8×10^{-7} to 3×10^{-6}	1×10^{-6}	1×10^{-6}
Scenario 4	6×10^{-7} to 3×10^{-6}	1×10^{-6}	9×10^{-7} to 1×10^{-6}
Scenario 5	8×10^{-7} to 3×10^{-6}	1×10^{-6}	9×10^{-7} to 1×10^{-6}
Scenario 6	7×10^{-7} to 2×10^{-6}	7×10^{-7}	7×10^{-7}

Based on an annual averaging period.

See Figure 10.3-2 in the FEIS Addendum for discrete receptor locations.

AWAR = all-weather access road.

The results of sensitivity analysis indicates that there are no risks of chronic health effects to recreational users at the discrete receptor locations using the annual averaging period predictions. This is consistent with the results of the chronic air quality assessment presented in Section 10.3.7.4 of the FEIS Addendum.

Based on the revised calculations presented above, there are no changes to the residual effects identified for human health.

References:

ATSDR. 2007. Toxicological Profile for Acrolein. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Accessed December 2022. Available at: <https://www.atsdr.cdc.gov/ToxProfiles/tp124.pdf>.

Health Canada. 2016a. Memorandum: A Primer for Evaluating Human Health Risk at Contaminated Sites for Chronic and Less-than-chronic Exposures to Chemicals. October 2016. Health Canada, Ottawa, ON.

Health Canada. 2016b. Human Health Risk Assessment for Ambient Nitrogen Dioxide. Water and Air Quality Bureau, Safe Environments Directorate, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, ON.

Health Canada. 2016c. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Air Quality. Health Canada, Ottawa, ON.