## Additional Clarification Requests, Agency Email May 14, 2019

Please find the following responses to the three (3) additional clarification questions provided in your May 14 email.

*1) It is stated in MMC-9.19 that "The infiltration into the WRSA that would drain laterally through the WRSA to the perimeter of the WRSA would be captured by the perimeter ditches and directed to a segregated runoff collection pond where it would be monitored, and if required, treated prior to the incorporation of the seepage from the WRSA into the overall water management system". In another place, it is mentioned that this segregated runoff collection pond is Collection Pond #3.*

- ***Question:*** *The Agency understands that due to potential for ARD in the low-grade ore stockpile (LGOS), a similar approach of a segregated collection pond would also be used for LGOS. This was mentioned during technical meetings on the draft response to IR#2. Please verify that this is accurate and if so, describe whether the same segregated collection pond (Collection Pond #3) would also be used for seepage and runoff from the LGOS.*
- **Response:** As noted by the Agency, Treasury Metals intend to manage the runoff and seepage from the low-grade ore (LGO) stockpile in a manner similar to waste rock storage area (WRSA). As discussed in the technical meetings, a perimeter ditch will be constructed around the LGO stockpile. The collected runoff and seepage will be directed to a segregated runoff collection pond where it would be monitored, and if required, treated prior to the incorporation of the runoff and seepage from the LGO stockpile into the overall water management system. Given the physical location of the LGO stockpile relative to the WRSA storage area, it would not be practical for the runoff and seepage from both features to be managed using the same pond. The runoff and seepage from the WRSA area will be managed through Collection Pond #3. A new pond will need to be constructed to manage the runoff and seepage from the LGO stockpile. The planned location for this pond (referred to as Collection Pond #4) is shown on the revised version of Figure 3.0.1.A, prepared in response to figure request #8.

*2) In Section 4.3.2.3 of the revised EIS (TSF Failure Modeling), the potential for a tailings dam breach is described under the conditions of a 100-year storm event. However, in Appendix GG (TSF Failure Modelling), the Environmental Design Storm that has been adopted for the TSF is the 1:1000 year, 24 hour storm event. MMC-13.3 states that the collection ditches will be designed "to accommodate an Environmental Design Storm Flood event (minimum of 1:20 year event)".*

- ***Question:*** *The use of the different probable scenarios (1:20, 1:100, 1:1000) that have been factored into the design of the project components (e.g. TSF, pit lake and collection ditches) is unclear. Please explain the distinction between the use of each* *probable scenario, and provide a summary (preferably in a table) on how each probable scenario has been factored into the design of various project components.*

- **Response:** The design of the Project uses different design probabilities based on the Project component considered, the operational needs and the potential consequence of exceeding the design probability. For example, the design objective for the runoff collection ditches is to collect the runoff from the site and convey the water to the water management system for use within the Project. The Environmental Design Storm (EDS) for the ditches is a 1:20 year event, which ensures sufficient capacity the capture of most storm events, while remaining sufficiently compact to convey the flows associated with lesser events. Table A provides a listing of the design probabilities used for the various Project components.

*3) In Section 6 of the revised EIS (April 2018), the calculations for greenhouse gas emissions are presented. The Agency understands that mobile equipment, backup generators, and natural gas heating were considered in the calculations. However, there is a lack of information regarding emissions from land use change (e.g. removal of vegetation and overburden, decay of stockpiled materials etc). Please provide an estimate of the emissions from land use change for all phases of the Project using the table below:*

- **Response:** In response to the request from the Agency, the indirect greenhouse gas (GHG) emissions associated with changes in land use through the life of the Project have been calculated. It should be noted that the none of the comparable mining project that have recently gone through review by the Agency included the indirect emissions from changes in land use, and only one of the recent assessment reports included any estimates for the land use change GHG emissions, and those were provided by Natural Resources Canada. The calculation methods for the emissions associated with land use change were adapted from those presented in the general guidance set out in "*2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other land Use*" (IPCC 2016). In calculating the emissions, the following was assumed:
    - The above-ground merchantable timber would be harvested in cooperation with the license holder for the Dryden Forest Management Unit. The carbon within this harvested timber will ultimately be released. It was assumed this would occur over a period of 20 years.
    - A portion of the below-ground biomass (25%) and the above-ground litter/deadwood (25%) would be burned as slash during the site preparation and construction phase. This would result in the emissions of carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$).

- A portion of the below-ground biomass (75%) and the above-ground litter/deadwood (75%) would be incorporated into the overburden stockpiles where it would be allowed to decay. The carbon in this biomass would be released to the atmosphere as methane ($CH_4$), with the decay assumed to over a period of 50 years.
- The draining of organic soils and wetlands during the life of the Project was assumed to result reduced uptake of carbon within the soils. This loss was assumed to occur annually in the form of $CO_2$.
- The draining of wetlands during the life of the Project is expected to result in the reduction of the annual $CO_2$ and $CH_4$ emissions.

The updated estimates of the greenhouse gas emissions for the site preparation and construction, operations, and closure phases are provided below in Tables B, C and D, respectively. For completeness, the tables include both the combustion GHG emissions and the indirect GHG emissions associated with changes in land use. As shown in the tables, the GHG emissions associated with changes in land use are smaller than the combustion emissions, but of the same order of magnitude. This is comparable to the findings for the only recent mining project where both direct combustion GHG emissions and the GHG emissions associated with land use changes were provided.

**Table A: Design Probabilities for Various Project Components**

| Structure / Analysis | Design Storm Event | Description | Cross-reference |
|---|---|---|---|
| Ditches | 1:20 year storm event | The perimeter runoff and seepage collection ditches will be constructed to accommodate an Environmental Design Storm (EDS) event (minimum of 1:20 year event) to ensure that water does not overflow the ditching and migrate off-site. As an additional contingency measure, during the site preparation and construction phase, the spoils from the construction of the perimeter ditch will be mounded into a berm on the outboard side of the ditch to further isolate the operations area from the environment. | MMC-13.3<br>TMI_894-FFH(2)-03 |
| TSF Spillway Invert | 125 mm / 24 hour event | The conceptual TSF design is described in Appendix D (2014) of the revised EIS (April 2018). Since Appendix D (2014) was produced, Treasury Metals has advanced the engineering of the Project, including design changes to the TSF. The two most notable changes to the TSF were: 1) the relocation of the TSF spillway to the western side of the TSF, such that any overflow from the TSF would be directed through the spillway towards the open pit instead of being released to the receiving environment; and 2) the use of a segregated minewater pond instead of the integrated management of minewater within the TSF as described in the original EIS.<br>Because the original spillway location presented in Appendix D (2014) discharged directly to the receiving environment, the elevation of the spillway invert was designed to accommodate the Environmental Design Storm (EDS) event, which is defined as the hydrological event that will be managed without release of untreated water to the environment. As described in Appendix D (2014), the TSF spillway was designed using a 125 mm / 24 hour storm event. This EDS was described as a 1:1,000 year, 24 hour event, based on Hogg and Carr (1985) as described in the response to TMI_120-SW(1)-34. Using the MTO data, however, the same EDS (i.e., 125 mm / 24 hour storm event) would represent a 1:100 year, 24 hour event. The current design for the spillway is to discharge to the open pit rather than to the receiving environment, reducing the need to design the spillway for as high a return period. Additionally, the change from an integrated minewater management plan as shown in Appendix D (2014) to a segregated minewater pond reduces the amount of water being managed within the TSF, and again reduces the need to design to as high a return period. | Appendix D (2014)<br>TMI_120-SW(1)-34<br>TMI_247-AM(1)-05 |
| TSF Spillway Capacity | Probable Maximum Flood (PMF) Event | The Inflow Design Flood (IDF) for the TSF was described in detail in the response to TMI_247-AM (1)-05. The Inflow Design Flood (IDF) is based on | Appendix D (2014)<br>TMI_247-AM(1)-05 |

**Table A: Design Probabilities for Various Project Components (continued)**

| Structure / Analysis | Design Storm Event | Description | Cross-reference |
|---|---|---|---|
| | | a "Very High" Hazard Potential Classification (HPC) for Property and Environmental Losses and is identified as being between the 1,000 year flood and the Probable Maximum Flood (PMF). The Inflow Design Flood (IDF) for the TSF has therefore been conservatively assigned as the Probable Maximum Flood (PMF).<br>The Probable Maximum Flood (PMF) for the TSF has been selected as the Probable Maximum Precipitation (PMP) occurring in the spring. By applying the PMP in the spring season will result in the addition of snowmelt to the Inflow Design Flood (IDF). The Probable Maximum Precipitation (PMP) for the site has been preliminarily identified as 435 mm in 24-hrs. A snowmelt element has been added to the stormwater modelling for the site to include runoff from snowmelt during the occurrence of the Probable Maximum Precipitation (PMP) to model Probable Maximum Flood (PMF) conditions. Adding the snowmelt component essentially converts snowpack, present within the containment area of the TSF to runoff. The Probable Maximum Precipitation (PMP) was assumed to occur in April, to model the Inflow Design Flood (IDF), and used the meteorological parameters for April, from station data for the Dryden area to assess potential snowmelt. The resultant snowmelt component of the Probable Maximum Flood (PMF), for the TSF impoundment area, was identified as a base flow of 0.9 $m^3/s$ that has been assigned to the stormwater model for spillway assessment.<br>Spillway capacity and the ability to effectively pass the Inflow Design Flood (IDF) is based on peak flow depth and the spillway width. | |
| TSF Failure Model | TSF volume: 8,242,364 $m^3$<br>1:100 inflow volume: 62,478 $m^3$ | An analysis of potential failures of the TSF were provided in Appendix GG to the revised EIS (April 2018). The overtopping failure (Breach Scenario 2), which looked at an overtopping failure caused by the local 100-year storm event inflow (62,478 $m^3$). For failure to have occurred it was assumed that the water level in the TSF is already high from previous rainfall. It should be noted that the maximum volume of water released from a highly unlikely breach of the TSF is based primarily on the storage capacity of the TSF and is largely independent of the modelled storm event. | Appendix GG (2015)<br>S. 4 revised EIS (April 2018)<br>TMI_247-AM(1)-05 |

### Table B: Project GHG Emissions, Site Preparation and Construction Phase

| Source Category | Project GHG Emissions (t/y)[1] | | | |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | $eCO_2$ |
| Mobile equipment [2] | 9,771 | 0.54 | 3.63 | 10,909 |
| Backup generators [3] | 0 | 0.00 | 0.00 | 0 |
| Natural gas heating [3] | 0 | 0.00 | 0.00 | 0 |
| Land use change [4] | 5,281 | 14.85 | 0.70 | 5,809 |
| Project Totals | 15,052 | 15.39 | 4.33 | 16,718 |

Notes:

The combustion emissions in the above table correspond to the values presented in Table 6.7.4.1-1 of the revised EIS (April 2018).

(1) Emissions are provided in units of tonnes per year ($10^6$ g/y)

(2) GHG emissions for mobile equipment are calculated on the basis of maximum activity levels, and continuous operations throughout the year.

(3) There will be no backup generators or mine heating during the site preparation and construction phase.

(4) The GHG emissions associated with land use change during the site preparation and construction phase include: a portion of the carbon in the harvested timber, emissions from the burning of slash, the reduction sequestration of carbon in drained forest and wetland soils, and the decrease in $CO_2$ and $CH_4$ emissions from drained wetlands.

### Table C: Project GHG Emissions, Operation Phase

| Source Category | Project GHG Emissions (t/y)[1] | | | |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | $eCO_2$ |
| Mobile equipment [2] | 10,377 | 0.58 | 3.86 | 11,585 |
| Backup generators [3] | 1,216 | 0.08 | 0.01 | 1,222 |
| Natural gas heating [2][4] | 1,589 | 0.03 | 0.03 | 1,598 |
| Land use change [5] | 1,215 | 215.49 | 0.14 | 5,784 |
| Project Totals | 14,397 | 216.18 | 4.04 | 20,189 |

Notes:

The combustion emissions in the above table correspond to the values presented in Table 6.7.4.1-2 of the revised EIS (April 2018).

(1) Emissions are provided in units of tonnes per year ($10^6$ g/y)

(2) GHG emissions for mobile equipment and mine heating are calculated on the basis of maximum activity levels, and continuous operations throughout the year

(3) GHG emissions for the backup generators are calculated assuming 1 hour of operations per month

(4) Mine heating emissions would not occur until the underground mine starts operations. Annual GHG emissions associated with mine heating would be lower than the values in the table as heating may not be required throughout the year.

(5) The GHG emissions associated with land use change during the operations phase include: a portion of the carbon in the harvested timber; emissions of $CH_4$ from the decay of buried roots, litter and deadwood; the reduced sequestration of carbon in drained forest and wetland soils; and the decrease in $CO_2$ and $CH_4$ emissions from drained wetlands.

**Table D: Project GHG Emissions, Closure Phase**

| Source Category | Project GHG Emissions (t/y)(1) | | | |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | $eCO_2$ |
| Mobile equipment (2) | 10,857 | 0.61 | 4.04 | 12,121 |
| Backup generators (3) | 0 | 0.00 | 0.00 | 0 |
| Natural gas heating (3) | 0 | 0.00 | 0.00 | 0 |
| Land use change (4) | 1,160 | 215.23 | 0.14 | 5,724 |
| Project Totals | 12,017 | 215.84 | 4.18 | 17,845 |

Notes:

The combustion emissions in the above table correspond to the values presented in Table 6.7.4.1-3 of the revised EIS (April 2018).

(1) Emissions are provided in units of tonnes per year ($10^6$ g/y)

(2) GHG emissions for mobile equipment are calculated on the basis of maximum activity levels, and continuous operations throughout the year.

(3) There will be no backup generators or mine heating during the site preparation and construction phase.

(4) The GHG emissions associated with land use change during the operations phase include: a portion of the carbon in the harvested timber; emissions of $CH_4$ from the decay of buried roots, litter and deadwood; the reduced sequestration of carbon in drained forest and wetland soils; and the decrease in $CO_2$ and $CH_4$ emissions from drained wetlands.