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Technical Memo

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File:	Lupin Gold Project – 129500081	Date:	August 14, 2019

Reference: 2AM-LUP1520 Technical Meeting Commitment Number 3 and 4 Responses – Waste Rock Information from Lupin Mine Tailings Containment Area

Introduction

Lupin Mine Incorporated (LMI), a wholly owned subsidiary of Mandalay Resources is requesting the renewal and amendment of their existing Type "A" Water Licence No: 2AM-LUP1520, to allow for Final Closure and Reclamation of the Lupin Mine Project (Lupin). The Nunavut Water Board (NWB or Board) Water Licence Application No. 2AM-LUP1520 Technical Meeting was held June 6-7, 2019 in Kugluktuk and Appendix D of the June 18, 2018 Pre-Hearing Conference Decision Report outlines the agreed upon List of Commitments (Commitments). Stantec Consulting Ltd. (Stantec) was retained by LMI to support the responses to select commitments and this technical memo provides the responses to fulfill Commitments No. 3 and No. 4, pasted below, which relate to historical data analysis regarding acid rock drainage (ARD) potential of waste rock at the Lupin Tailings Containment Area (TCA).

3	LMI	CIRNAC	LMI to go through records and provide historical data analysis regarding ARD potential of tailings dams and roadways, etc. and to indicate whether, based on the historical information, the additional study in line #4 will/will not be provided	15-Aug-19	Summary of historical data in a Technical Memo
4	LMI	CIRNAC	Based on the results of #3 above, if required ARD Potential (rock characterization, and potentially including geochemical and pathway analysis) to be conducted at the TCA dams.	15-Nov-19	Technical Memo

Stantec reviewed historical information from the Lupin TCA for information pertaining to materials testing for the waste rock used in the construction of earthen dams in the TCA. More specifically, the review focused on any chemical data describing the potential of the TCA waste rock to generate ARD. This memo contains a brief description of the information reviewed and presents the data to fulfil the commitments listed above.

Historical Information

The primary documents used for the review are the following:

- URS. 2005. ARD/ML Assessment of Waste Rock at Lupin Mine
- Golder. 2017. Updated Phase I and II Environmental Site Assessment
- Price, W.A. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. Draft Report prepared for MEND. MEND Report 1.20.1

The URS (2005) memo includes the results of acid/base accounting (ABA) work that was conducted at various sites at Lupin, including ten sites that are well distributed through the TCA dams as shown on Table 1. The memo presents data on total sulfur percentage and the ratio of neutralization potential values to maximum potential acidity values (NP/MPA). Typically, NP/MPA values less than one indicate likely ARD generation, values between one and two indicate the uncertain potential for ARD, and values greater than two indicate likely non-ARD (Price, 2009). Of the ten samples from the Lupin dams, one displayed a NP/MPA value less than one, five displayed values between one and two, and four displayed values higher than two. Only one of the samples that had NP/MPA values less than two had a total sulfur percentage significantly higher than 0.3%. The URS memo concluded overall that “the bulk of the waste rock at Lupin is not expected to generate acid in the foreseeable future. This is supported by observational evidence which indicates that the waste rock has shown no evidence of acid generation after surface weathering for up to approximately 25 years.”

Table 1 – 2005 TCA Waste Rock Results

Sample	Description	pH	Total Sulfur	NP	MPA	NP/MPA
		NA	%	mg $CaCO_3$/kg	mg $CaCO_3$/kg	NA
50058	Dam 4	8.6	0.31	12	9.7	1.24
50059	Dam 5	8.6	0.51	14	15.9	0.88
50060	Dam 6	8.3	0.07	9	2.2	4.11
50061	Dam 1c	9.4	0.03	11	0.9	11.73
50062	Dam 1b	9.5	0.17	9	5.3	1.69
50063	Dam 1a	9.5	0.03	10	0.9	10.67
50064	Dam 2	8.6	0.31	10	9.7	1.03
50073	L Dam, south	8.6	0.19	10	5.9	1.68
50074	L Dam, north	8.6	0.24	12	7.5	1.6
50075	J Dam	9	0.15	15	4.7	3.2

Reference: **2AM-LUP1520 Technical Meeting Commitment Number 3 and 4 Responses**

Conclusions

The work conducted in 2005 sampled ten waste rock sites located throughout the TCA dams. Based on a preliminary analysis of the extent of waste rock material in the TCA dams from aerial photos, and assumptions related to waste rock density (≈2 kg/m^3) and the depth (0.5 m) of waste rock material on the face of the TCA dams, a total TCA waste rock weight of approximately 100,000 tons was calculated. Based on direction from Price (2009), a minimum number of eight samples is recommended to characterize that amount of waste rock material. It is Stantec's position that the 2005 data set adequately represents the characteristics of the waste rock used in the construction of the dams and fulfills Commitment No.3 from the Lupin Technical Meeting.

Additionally, the results of the Golder (2017) assessment indicated that in the sampled waste rock, sulfide concentrations were significantly less than total sulfur, indicating the majority of the sulfur was present in the oxidized sulfate form. As only one of the TCA waste rock sampling sites indicated significant potential for ARD generation in 2005 and the waste rock has been exposed to weathering action for decades (oxidizing the sulfide since the early 1990s), as noted in Commitment No.3 there is no need to proceed to the geochemical modeling mentioned in Commitment No.4.

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