

## **APPENDIX I**

### **SITE HYDROLOGY CHARACTERIZATION**

# Memorandum CCL-MM-1

**Date:** January 12, 2005

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**To:** Roca Mines Inc. – Scott Broughton P.Eng.

**From:** Clearwater Consultants Ltd. - Peter S. McCreath (pmccreath@shaw.ca)

**Subject:** Max Molybdenum Property – Site Hydrology Characterization

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Roca Mines Inc. (Roca) has acquired an option to earn a 100% interest in the Max Molybdenum property in southeastern British Columbia. This memorandum presents a preliminary evaluation of the site hydrology including annual and short duration precipitation, temperatures, snowpack, and evaporation.

## 1. Introduction

The Max Molybdenum site is located about 60 km south of Revelstoke at Longitude 117° 36' W and latitude 50° 38' N. The site, within the southeast-northwest-trending Trout Lake valley, is on the northeast side of Trout Mountain within the area known as the Interior Wet Belt. Elevations around the property range from about 800 m to more than 2500 m for the surrounding mountain peaks.

## 2. Site Hydrology

### 2.1 Precipitation

A meteorological station was established near the site area in 1980 by Klohn Leonoff Ltd. on behalf of Newmont Mines Limited as part of the studies for the (then) Trout Lake Mine. Data from this station was only available for parts of two years (1980 and 1981). A preliminary evaluation of hydrologic parameters applicable to the Max Molybdenum Project area has been developed based on regional data including precipitation, snow surveys, temperature and evaporation. The Trout Lake Mine station data was included in the evaluation. Table 1 summarizes the closest regional climate stations and the average precipitation including rainfall and snowfall reported at each station for data up to the year 2002.

**Table 1 – Regional Climate Stations**

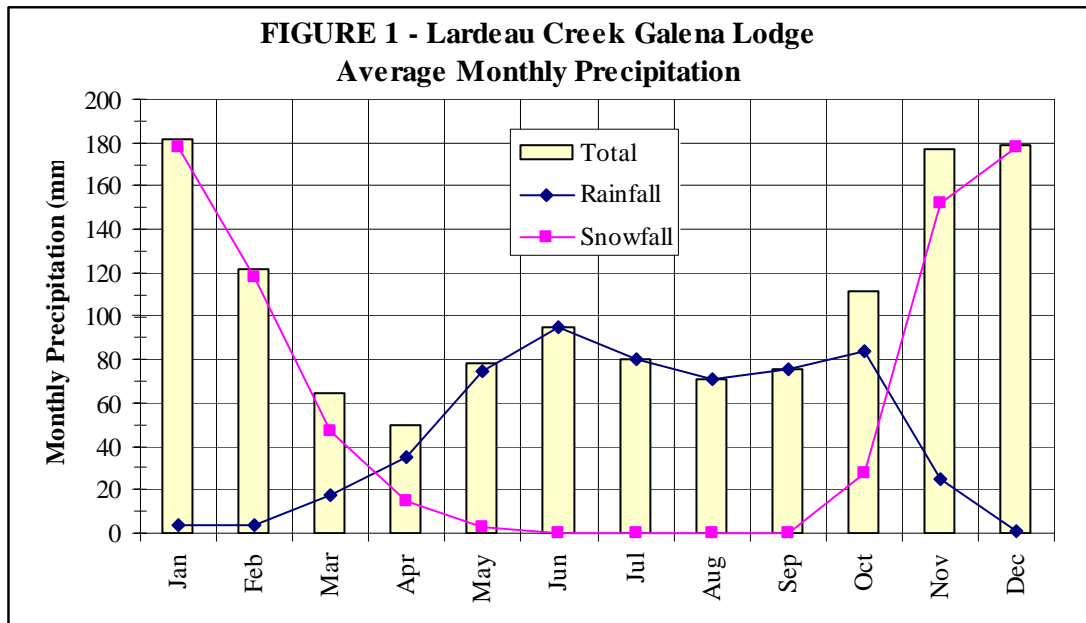
Station	Station Number	Years of Record	Elevation (m)	Distance from Site (km)	Average Rainfall (mm)	Average Snowfall (mm)	Avg. Total Precipitation (mm)
Trout Lake Mine	n/a	1980-81	1000 +/-	0	n/a	n/a	n/a
Lardeau Creek Galena Lodge	1144582	1989-02	1097	14 ENE	565.9	718.1	1284.1
Bugaboo Creek Lodge	1171105	1972-02	1494	65 ENE	393.6	524.2	917.7
Bobbie Burns	1170R01	1981-02	1370	60 NE	370.5	543.2	913.7
Duncan Lake Dam	1142574	1963-02	549	65 SE	567.3	224.3	791.6
Gerrard	1143120	1935-56	716	25 SE	395.0	416.8	811.8
Sidmouth	1177290	1947-61	430	30 NW	605.0	466.3	1071.4
Lardeau	1144580	1961-80	550	70 SE	478.0	197.9	675.9

Table 2 summarizes average monthly rainfall, snowfall and total precipitation reported for the four active regional stations closest to the site. Based on the proximity to the site, the Lardeau Creek Galena

Lodge station should be representative of site conditions. Figure 1 shows monthly rainfall, snowfall and total precipitation for the Lardeau Creek station.

**Table 2 – Average Monthly Precipitation**

Month	Lardeau Ck Galena Lodge			Bugaboo Creek Lodge			Bobbie Burns			Duncan Lake Dam		
	Rain	Snow	Total	Rain	Snow	Total	Rain	Snow	Total	Rain	Snow	Total
January	3.8	177.6	181.4	2.6	101.0	103.6	2.1	125.8	127.9	24.8	74.3	99.1
February	3.9	118.0	121.9	3.1	84.2	87.3	4.2	76.3	80.5	29.6	32.1	61.7
March	17.2	47.2	64.3	3.5	63.0	66.5	7.4	55.9	63.3	38.6	12.4	51.0
April	35.1	15.0	50.0	11.7	30.4	42.2	22.2	20.1	42.3	41.4	4.2	45.6
May	75.0	3.1	78.1	45.4	6.5	51.8	44.3	3.2	47.4	49.7	3.3	53.0
June	95.2	0.0	95.2	65.6	2.0	67.6	58.2	0.3	58.5	61.7	0.4	62.1
July	80.0	0.0	80.0	69.8	0.0	69.8	65.6	0.0	65.6	50.8	1.6	52.4
August	70.7	0.0	70.7	70.2	0.0	70.2	64.2	0.0	64.2	53.1	-0.9	52.2
September	75.2	0.3	75.6	55.9	3.4	59.4	46.4	0.6	47.0	54.2	-2.8	51.4
October	84.0	27.5	111.5	50.9	28.1	79.0	46.5	29.8	76.4	55.2	4.0	59.2
November	24.8	151.9	176.7	14.4	101.6	116.0	9.2	119.4	128.6	67.5	26.0	93.5
December	1.0	177.7	178.7	0.6	103.9	104.5	0.1	111.7	111.9	40.7	69.6	110.3
<b>TOTAL</b>	<b>565.9</b>	<b>718.1</b>	<b>1284.1</b>	<b>393.6</b>	<b>524.2</b>	<b>917.7</b>	<b>370.5</b>	<b>543.2</b>	<b>913.7</b>	<b>567.3</b>	<b>224.3</b>	<b>791.6</b>



The above data indicate that the site area will experience about 1284 mm total precipitation each year on average consisting of about 56% snowfall and 44% rainfall depending on local elevations. Snowfall occurs predominantly from November through March with rainfall dominating from May to September. April and October are transitional months that will experience both rainfall and snowfall.

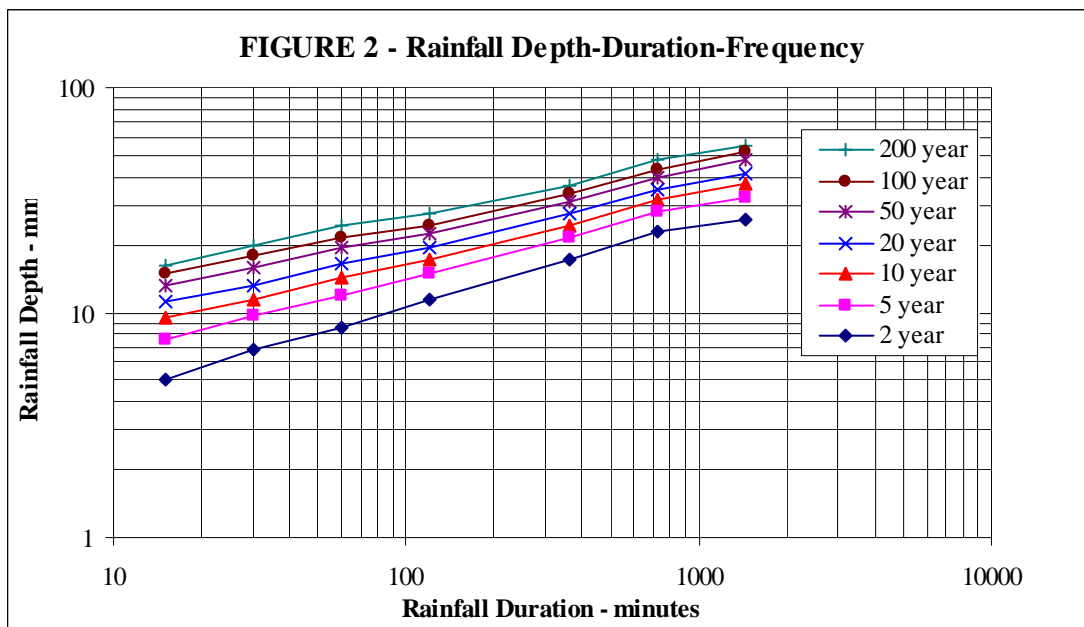
The Duncan Lake Dam climate station located about 65 km southeast of the site provides the longest continuous period of record for the regional stations. Lardeau Creek averages about 56% more annual precipitation than Duncan Lake based on the common 129 months of data. Frequency analysis was carried out for the annual total precipitation at Duncan Lake Dam and increased by a factor of 1.56. The results of the frequency analysis applicable to the Max Molybdenum site area are shown in Table 3.

**Table 3 – Frequency Analyses**

Return Period (years)	Annual Total Precipitation (mm)	Maximum Daily Rainfall (mm)	Maximum Snowpack (mm water)
2	1220	26.0	590
5	1380	33.2	700
10	1470	37.8	750
20	1550	42.1	800
50	1640	47.6	850
100	1710	51.7	880
200	1770	55.8	905

The average maximum daily rainfall reported for the two stations are essentially the same for the 13 common years of record. The results of frequency analysis of the Duncan Lake Dam maximum daily rainfall are shown on Table 3 and assumed applicable to the site area.

Based on relations presented in the Rainfall Frequency Atlas for Canada, estimates were made of the rainfall depth-duration-frequency relation for the site for rainfall durations less than 24 hours. The results are shown in Figure 2.



Based on data in the Rainfall Atlas and using the Hershfield statistical method, preliminary estimates of Probable Maximum Precipitation (PMP) depths for durations from one hour to 24 hours were made as follows:

- One hour duration PMP = 80 mm
- 6 hour duration PMP = 110 mm
- 24 hour duration PMP = 170 mm

## 2.2 Snowpack Variation

There are a number of sites within area 02D of the provincial snow survey network. The Ferguson station is located within about 10 km of the site area at an elevation of 880 m, has been measuring snowpacks since 1938, and was assumed representative of site conditions. The data are summarized in Table 4 and suggest that, on average, maximum snowpacks occur typically in early April each year and may persist into late June. A maximum snowpack water equivalent of 881 mm was recorded on March 29, 1999. Table 3 shows the results of frequency analysis carried out on the maximum snowpack water equivalent each year.

**Table 4 – Snowpack Variation**

Date	Snowpack Water Equivalent (mm)		
	Number	Average	Maximum
Jan-01	22	257	409
Feb-01	30	414	616
Mar-01	50	525	796
Apr-01	64	564	881
May-01	56	439	773
May-15	35	254	640
Jun-01	15	80	322
Jun-15	3	20	61

## 2.3 Temperatures

Table 5 summarizes average monthly temperatures recorded at the Lardeau Creek Galena Lodge station from 1989 to 2002. Freezing temperatures have been recorded for all months of the year except July.

**Table 5 – Monthly Temperatures**

Month	Temperatures (°C)		
	Mean Daily	Mean Daily Maximum	Mean Daily Minimum
January	-7.0	-4.5	-9.5
February	-4.2	-0.8	-7.7
March	-0.4	4.3	-5.2
April	4.0	9.2	-1.2
May	8.4	14.8	1.9
June	11.9	18.5	5.5
July	15.4	22.7	8.0
August	15.2	22.6	7.8
September	10.7	17.3	4.0
October	3.5	7.3	-0.4
November	-2.6	-0.3	-4.8
December	-7.7	-5.4	-10.0
Annual	3.9	8.8	-1.0

## 2.4 Evaporation

Three complete and three partial months of pan evaporation data were reported by Klohn Leonoff (1982) for the Trout Lake station (approximate elevation 1000 m) in 1980 and 1981. The Duncan Lake Dam station (elevation 549 m) has reported lake evaporation data since 1968. Table 6 summarizes the available data.

**Table 6 – Evaporation**

Month	Duncan Lake Dam		Trout Lake Site	
	Measured	Adjusted	Pan	Lake
May	88.7	77.3	60 *	42
June	99.8	86.9	85.0	59.5
July	106.0	92.3	102.0	71.4
August	89.1	77.6	149.0	104.3
September	52.5	45.7	78 *	54.6
October	25.0	21.8	18.9	13.2
<b>TOTAL</b>	<b>461.1</b>	<b>401.7</b>	<b>492.9</b>	<b>345.0</b>
	Note 1	Note 2	Note 3	Note 4

Notes per Table 6

1. Lake evaporation reported for Duncan Lake Dam 1968-1990, elevation 549 m
2. Lake evaporation adjusted to elevation 1000 m (10% decrease per 1000 m)
3. Six months of pan evaporation data. \* values estimated from available data.
4. Lake evaporation estimated using 0.7 pan coefficient.

The Duncan Lake data were adjusted for an elevation of 1000 m as shown on the Table. The reported and estimated Trout lake pan evaporation data were converted to lake evaporation using a pan coefficient of 0.7. Table 6 indicates that annual lake evaporation at the Max Molybdenum site area may be in the range of 350 mm to 400 mm per year with maximum rates of about 100 mm per month in July/August. Potential evapotranspiration losses from vegetated areas may be equal to lake evaporation rates. Evaporative losses from disturbed ground may range from 30% to 60% of lake evaporation rates.

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