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## ***Memorandum***

**To:** Emilie Hamm **From:** SLR Consulting (Canada) Ltd.

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**Company:** Government of Yukon  
Assessment and Abandoned Mines

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**cc:** Patricia Randell **Date:** June 23, 2016

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**Subject:** ***FINAL - MOUNT NANSEN MINE  
AMP MONTHLY ASSESSMENT – APRIL 2016***

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### **1.0 INTRODUCTION**

The following summarizes the April 2016 assessment of the Adaptive Management Plan (AMP) Events, as outlined in the *Mount Nansen Water Quality and Quantity Adaptive Management Plan* (SLR, May 2015):

- AMP Event 1 - Degraded Water Quality in Dome Creek Downstream of Mill Area
- AMP Event 2 - Changes in Water Quality in the Seepage Pond
- AMP Event 3 - Changes in Seepage Pond Inflows/Volume Outside of Historic Norms
- AMP Event 4 - Degraded Water Quality in Dome Creek Downstream of Mine Facilities
- AMP Event 5 - Degraded Water Quality in Victoria Creek at Mine Access Road
- AMP Event 6 - Degraded Water Quality in Pony Creek Downstream of Mine Area

The following Events are not included in this monthly assessment:

- AMP Event 7 - Changes in Pit Water Level Elevation outside of Historic Norms
  - Information required to do a complete evaluation of the water level (*i.e.*, barometric compensation data) was not available at the time of producing this report. Due to pit-wall stability concerns, repairs to the data logger in the pit could not be completed. The data logger will be repaired once a pit-wall stability and safety assessment is completed and the pit is deemed safe for access. However, the top of the pond was surveyed on November 3, 2015, and the pond water had an elevation of 1181.071 masl, which is lower than the 5<sup>th</sup> percentile (1181.79 masl) of the 2010 – 2013 water levels of the Brown-McDade Pit. This suggests that at this time, the AMP has the potential to be triggered.
- AMP Event 8 - Changes in Groundwater Quality Downgradient of the Brown-McDade Pit
  - During the spring 2015 field visit it was noted that these wells had been damaged. It was anticipated that they would be repaired in the fall 2015,

however further investigations (via camera footage) showed that the extent of the repair was greater than initially assessed (sand at the bottom of the well requires that the well be redeveloped). The repair will be conducted when conditions allow. Additionally, as per the Mt. Nansen AMP, a minimum of four data points are required to complete a trend line development. This assessment will be carried out when sufficient sampling data are available, post well repair.

- AMP Event 9 - Degraded Water Quality in Brown-McDade Pit
  - Assessment of this AMP is carried out on an annual basis and was last reported on in the August 2015 AMP assessment.

## 2.0 AMP EVENT 1 – DEGRADED WATER QUALITY IN DOME CREEK DOWNSTREAM OF MILL AREA

### 2.1 Description

The water quality in Dome Creek downstream of the Mill Area is currently affected by surface water runoff and seepage inflows from the Mill Area. The water quality in Dome Creek in this area is measured monthly, when flowing, at WQ-DC-D1b with the exception of spring. At this time, an additional sample is collected during freshet. Water quality data in Dome Creek at WQ-DC-D1b has only been collected since 2012.

A summary of the AMP thresholds for Event 1 is provided in Table 1.

**Table 1: Summary of AMP Event 1 Thresholds**

| Indicators   | Location  | Thresholds   | Frequency |
|--|-----------|--|-----------|
| Sulphate<br>Total and Dissolved Arsenic<br>Total Cadmium<br>Total Zinc | WQ-DC-D1b | <ul style="list-style-type: none"> <li>• Monitoring results above the Management Threshold for Dissolved Arsenic (0.15 mg/L), for Total Cadmium (0.02 mg/L) or for Total Zinc (0.3 mg/L); or,</li> <li>• A statistically significant (0.05) increasing trend in the monitoring results from WQ-DC-D1b. For the purposes of AMP trend line development, data for station D1b from 2012 on will be used for the trend analysis.</li> </ul> | Monthly   |

### 2.2 AMP Event 1 – Data Review

Assessment under the AMP of the relevant water quality data from WQ-DC-D1b was carried out using the April 2016 water quality data. As the WQ-DC-D1b monitoring site has been frozen since early November, this report represents the first assessment of AMP 1 since October 2015. The results of the assessment are summarized in Table 2.

**Table 2: Summary of AMP Event 1 Assessment**

| Indicators        | Trigger Activation | Results  |
|-------------------|--------------------|--|
| Sulphate          | No                 | <ul style="list-style-type: none"> <li>Decreasing non-significant trend in concentrations.</li> </ul>  |
| Total Arsenic     | No                 | <ul style="list-style-type: none"> <li>Decreasing non-significant trend in concentrations.</li> </ul>  |
| Dissolved Arsenic | No                 | <ul style="list-style-type: none"> <li>April (average) dissolved arsenic concentration of 0.02 mg/L was well below the Management Threshold of 0.15 mg/L</li> <li>Increasing trend in dissolved arsenic concentrations but not statistically significant.</li> </ul> |
| Total Cadmium     | No                 | <ul style="list-style-type: none"> <li>April (average) total cadmium concentration of 0.0004 mg/L was well below the Management Threshold of 0.02 mg/L.</li> <li>Statistically significant decreasing trend in total cadmium concentrations.</li> </ul>              |
| Total Zinc        | No                 | <ul style="list-style-type: none"> <li>April (average) total zinc concentration of 0.1 mg/L was below the Management Threshold of 0.3 mg/L.</li> <li>Statistically significant decreasing trend in total zinc concentrations.</li> </ul>                             |

### 2.3 Follow-Up Action Required

No AMP triggers were activated at WQ-D1-b under AMP Event 1 during the April 2016 assessment. Therefore no follow up is required at this time.

## 3.0 AMP EVENT 2 – CHANGES IN WATER QUALITY IN THE SEEPAGE POND

### 3.1 Description

The Seepage Pond at the toe of the tailings impoundment collects shallow groundwater seepage from the tailings area. The seepage collected in the pond is continuously pumped to Dome Creek. The discharge from the Seepage Pond is a primary source of contaminants to Dome Creek including sulphate, arsenic, iron, manganese and cadmium.

The water quality in the Seepage Pond is measured monthly, at the Seepage Pond outlet pipe, WQ-SEEP, with the exception of spring. At this time, an additional sample is collected during freshet. For the assessment of triggers during this period, the bi-weekly concentrations were averaged for the month. The average monthly value was carried forward and assessed as per the AMP Protocol. Water quality samples are analyzed for a full suite of parameters including total suspended solids, cyanide species, nitrogen species, sulphate, hardness, total and dissolved metals.

A summary of the AMP thresholds for Event 2 is provided in Table 3.

**Table 3: Summary of AMP Event 2 Thresholds**

| Indicators   | Location | Thresholds   | Frequency |
|--|----------|--|-----------|
| Sulphate<br>Total and Dissolved Arsenic<br>Total Cadmium<br>Total and Dissolved Iron<br>Total and Dissolved Manganese<br>Total Zinc<br>Total and WAD Cyanide | WQ-SEEP  | <ul style="list-style-type: none"> <li>Monitoring results at WQ-SEEP above the reference EQS for Dissolved Arsenic (0.15 mg/L), Total Iron (1.0 mg/L) or Total Cadmium (0.02 mg/L), Total Manganese (0.5 mg/L), Total Zinc (0.3 mg/L), Total Cyanide (0.3 mg/L), WAD Cyanide (0.1 mg/L); or,</li> <li>Three consecutive monitoring results at WQ-SEEP greater than the upper 95<sup>th</sup> percentile of the reference period (2008 to 2013); or</li> <li>A statistically significant increasing trend (0.05) which, when extrapolated forward one year, would result in values greater than the 95<sup>th</sup> percentile. For the purposes of AMP trend line development, data for station WQ-SEEP from 2008 and on will be used for the trend analysis.</li> </ul> | Monthly   |

**3.2 AMP Event 2 – Data Review**

Assessment under the AMP of the relevant water quality data from WQ-SEEP was carried out using the April 2016 water quality data. The results of the assessment are summarized in Table 4.

**Table 4: Summary of AMP Event 2 Assessment**

| Indicators    | Trigger Activation | Results   |
|---------------|--------------------|---|
| Sulphate      | No                 | <ul style="list-style-type: none"> <li>April (average sulphate concentration (540.5 mg/L) was below the 95<sup>th</sup> percentile threshold value of 822.6 mg/L.</li> <li>Statistically significant increasing trend in sulphate concentrations but not estimated to reach the threshold value for another 5 years.</li> </ul>                     |
| Total Cyanide | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.057 mg/L) was well below the EQS threshold value of 0.3 mg/L.</li> <li>Total cyanide (average) concentration in April was below the 95<sup>th</sup> percentile threshold value of 0.076 mg/L.</li> <li>Increasing trend, although not statistically significant.</li> </ul> |
| WAD Cyanide   | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.011 mg/L) was below the EQS threshold value (0.1 mg/L).</li> <li>WAD Cyanide concentrations have been below the 95<sup>th</sup> percentile threshold (0.035 mg/L) since Jan 2010.</li> <li>Statistically significant decreasing trend.</li> </ul>                           |

| Indicators          | Trigger Activation | Results  |
|---------------------|--------------------|--|
| Total Arsenic       | Yes                | <ul style="list-style-type: none"> <li>The average arsenic concentration in April (0.102 mg/L) was above the 95<sup>th</sup> percentile threshold value of 0.057 mg/L, and was part of five consecutive exceedances (December 2015, January, February, March and April 2016).</li> <li>Statistically significant increasing trend.</li> </ul>  |
| Dissolved Arsenic   | Yes                | <ul style="list-style-type: none"> <li>April (average) concentration (0.074 mg/L) was below the EQS threshold value of 0.15 mg/L.</li> <li>Dissolved arsenic concentrations have been above the 95<sup>th</sup> percentile threshold value of 0.035 mg/L for 12 months in a row (May, June, July, August, September, October, November, December 2015 and January, February, March, and April 2016).</li> <li>Statistically significant increasing trend in dissolved arsenic concentrations, estimated to reach the 95<sup>th</sup> percentile threshold value (0.035 mg/L) in less than 1 year.</li> </ul> |
| Total Cadmium       | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.00030 mg/L) was well below EQS threshold of 0.02 mg/L.</li> <li>April (average) concentration (0.00030 mg/L) was below the 95<sup>th</sup> percentile threshold of 0.00117 mg/L.</li> <li>Statistically significant decreasing trend.</li> </ul>   |
| Total Iron          | Yes                | <ul style="list-style-type: none"> <li>April (average) concentration (16.9 mg/L) is well above the EQS threshold of 1.0 mg/L and concentrations have been since at least 2008.</li> <li>April (average) concentration is below the 95<sup>th</sup> percentile threshold of 20.8 mg/L.</li> <li>Increasing trend, although not statistically significant.</li> </ul>  |
| Dissolved Iron      | Yes                | <ul style="list-style-type: none"> <li>April (average) concentration (14.65 mg/L) was above the 95<sup>th</sup> percentile threshold of 9.67 mg/L, and is part of seven consecutive exceedances (October, November, December 2015 and January, February, March and April 2016).</li> <li>Statistically significant increasing trend estimated to reach 95<sup>th</sup> percentile threshold value (9.67 mg/L) in less than 1 year.</li> </ul>  |
| Total Manganese     | Yes                | <ul style="list-style-type: none"> <li>April (average) concentration (5.5 mg/L) was well above EQS threshold of 0.5 mg/L and has been since 2008.</li> <li>April (average) concentration was below the 95<sup>th</sup> percentile threshold value of 9.2 mg/L and has been since Feb 2010.</li> <li>Statistically significant decreasing trend.</li> </ul>   |
| Dissolved Manganese | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (5.3 mg/L) was below the 95<sup>th</sup> percentile threshold value of 8.8 mg/L.</li> <li>Statistically significant decreasing trend.</li> </ul>  |

| Indicators | Trigger Activation | Results   |
|------------|--------------------|---|
| Total Zinc | Yes                | <ul style="list-style-type: none"> <li>• April (average) concentration (0.031 mg/L) was below the EQS threshold of 0.3 mg/L.</li> <li>• April (average) concentration was above the 95<sup>th</sup> percentile threshold value of 0.031 mg/L, and is part of eight consecutive exceedances (September, October, November, December 2015 and January, February, March and April 2016).</li> <li>• Statistically significant increasing trend estimated to reach 95<sup>th</sup> percentile threshold value in less than 1 year.</li> </ul> |

### 3.3 Follow-up Action Required

The above noted changes in water quality in the Seepage Pond, as measured at WQ-SEEP, have been previously documented in various reports including *Mount Nansen – Assessment of Zinc Concentrations in the Seepage Pond* (SLR 2015) and *Mount Nansen 2013 Annual Surface Water Quality Review* (SLR 2015). As a result of those reports, additional work is being carried out to investigate the sources of the changing water quality in the Seepage Pond, including sulphate, total zinc, total and dissolved arsenic, and total and dissolved iron. Some of the recommendations for proposed study/investigations included:

- A detailed hydrogeological and geochemical assessment of the water quality trend in seepage water and groundwater to fully assess the changing conditions in the Seepage Pond and upgradient in the tailings area, and evaluate potential impacts to ongoing attenuation processes.
- The development of a contingency plan for the potential treatment of Seepage Pond water should the concentrations reach a point where treatment is required.

## 4.0 AMP EVENT 3 - CHANGES IN SEEPAGE POND INFLOWS/VOLUME OUTSIDE OF HISTORIC NORMS

### 4.1 Description

The Seepage Pond at the toe of the tailings impoundment collects shallow groundwater seepage from the tailings area. The seepage collected in the pond is continuously pumped to Dome Creek. The maximum design operating level of the Seepage Pond is 1078.1 masl. The pond water levels are measured daily, during open water, via a staff gauge. The discharge pumping rate is measured daily via an inline flowmeter (H-SEEP) installed in 2012 and routinely checked using timed volumetric measurements. Assessment of the water level and water level rate of change triggers occur during the open water season only, while assessment of the pumping rate occurs year round.

The environmental consequence of changes in the Seepage Pond inflows/volumes above historic norms is the potential exposure of aquatic and terrestrial resources, and human users to increased levels of contaminants in the downstream receiving environment in Victoria Creek due to increased seepage from the tailings impoundment area. In addition, as a result of higher than normal seepage inflows, there is a concern related to the stability of the dam structure.

A summary of the current AMP information for Event 3 is provided in Table 5.

**Table 5: Summary of AMP Event 3 Thresholds**

| Indicators   | Locations | Thresholds   | Frequency |
|--|-----------|--|-----------|
| Seepage Pond pumping rate<br>Seepage Pond water level<br>Seepage Pond water level rate of change | H-SEEP    | <ul style="list-style-type: none"> <li>Four consecutive average weekly results greater than the upper 95<sup>th</sup> percentile or lower than the lower 5<sup>th</sup> percentile of the 2012 to 2013 data record on a year round basis for the pumping rate and during open water for the water level and water level rate of change; or</li> <li>A statistically significant (0.05) increasing or decreasing trend in the monitoring results on a year round basis for the pumping rate and during open water for the water level and water level rate of change. For the purposes of AMP trend line development, data from 2012 on will be used for the trend analysis.</li> </ul> | Daily     |

**4.2 AMP Event 3 – Data Review**

Assessment under the AMP of the relevant water level and discharge data from H-SEEP was carried out using the April 2016 data. Seepage Pond water level and water level rate of change was not assessed this month because the Seepage Pond was not ice free until April 20<sup>th</sup>. The Seepage Pond water level and water level rate of change components of AMP Event 3 will be assessed and reported in the May monthly assessment, and in the open-water season months thereafter. The results of the assessment are summarized in Table 6.

**Table 6: Summary of AMP Event 3 Assessment – H-SEEP**

| Indicators                              | Trigger Activation | Results  |
|---|--------------------|--|
| Seepage Pond pumping rate               | Yes                | <ul style="list-style-type: none"> <li>Throughout April, the average weekly Seepage Pond pumping rates (128.43 to 195.17 L/min) did not exceed the upper 95<sup>th</sup> percentile threshold (240.12 L/min).</li> <li>Throughout April, the average weekly Seepage Pond pumping rates (128.43 to 195.17 L/min) were below the 5<sup>th</sup> percentile threshold (156 L/min) for two consecutive weeks (March 28 – April 3 = 136.71 L/min and April 4 – April 10 = 128.43 L/min).</li> <li>Statistically significant decreasing trend in the Seepage Pond pumping rate.</li> </ul> |
| Seepage Pond water level                | n/a                | <ul style="list-style-type: none"> <li>This assessment is only performed during the open-water season.</li> </ul>  |
| Seepage Pond water level rate of change | n/a                | <ul style="list-style-type: none"> <li>This assessment is only performed during the open-water season.</li> </ul>  |

### 4.3 Follow-up Action Required

The Seepage Pond pumping rate trigger was activated in April by a statistically significantly decreasing trend in the Seepage Pond pumping rate. Confirmation of an annual calibration of the flow meter should be conducted.

## 5.0 AMP EVENT 4 – DEGRADED WATER QUALITY IN DOME CREEK DOWNSTREAM OF MINE FACILITIES

### 5.1 Description

Dome Creek, downstream of the tailing impoundment area, receives inputs from the mine site via direct discharge from the Seepage Pond, inflows from the mill area, and seepage and groundwater inflows from mine site facilities. The water quality in Dome Creek below the mine site facilities is measured at stations WQ-DC-U and WQ-DC-R. Station WQ-DC-U is located downstream of the confluence of Dome Creek and the Seepage Pond discharge and station WQ-DC-R is located in Dome Creek at the mine access road crossing. Water quality samples are collected monthly, with the exception of spring. At this time, an additional sample is collected during freshet. For the assessment of triggers during this period, the bi-weekly concentrations were averaged for the month. The average monthly value was carried forward and assessed as per the AMP Protocol. Water quality samples are analyzed for a full suite of parameters including total suspended solids, cyanide species, nitrogen species, sulphate, hardness, total and dissolved metals.

The water quality in Dome Creek, below the mine site facilities, shows a clear mine-related influence with elevated concentrations of key contaminants of concern including sulphate, arsenic, iron, manganese, cadmium, and zinc. Total and WAD cyanide is also present in Dome Creek below the mine facilities, although at concentrations typically well below the CCME guidelines.

A summary of the AMP thresholds for Event 4 is provided in Table 7.

**Table 7: Summary of AMP Event 4 Thresholds**

| Indicators  | Locations                 | Thresholds   | Frequency |
|---|---------------------------|--|-----------|
| Sulphate<br>Total and Dissolved Arsenic<br>Total Cadmium<br>Total Zinc<br>Total and Dissolved Iron<br>Total and Dissolved Manganese | WQ-DC-U<br>and<br>WQ-DC-R | <ul style="list-style-type: none"> <li>Three consecutive monitoring results at WQ-DC-U or WQ-DC-R greater than the upper 95<sup>th</sup> percentile of the reference period (2008 to 2013); or,</li> <li>A statistically significant (0.05) increasing trend in the monitoring results from WQ-DC-U or WQ-DC-R which, when extrapolated forward one year, would result in values greater than the 95<sup>th</sup> percentile. For the purposes of AMP trend line development, data from 2008 and on is used for the trend analysis.</li> </ul> | Monthly   |

### 5.2 AMP Event 4 – Data Review

Assessment under the AMP of the relevant water quality data from WQ-DC-U and WQ-DC-R was carried out using the April 2016 water quality data. The results of the assessment are summarized in Tables 8 and 9.



**Table 8: Summary of AMP Event 4 Assessment – WQ-DC-U**

| Indicators          | Trigger Activation | Results  |
|---------------------|--------------------|--|
| Sulphate            | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (311.0 mg/L) was below the 95<sup>th</sup> percentile threshold (785.1 mg/L).</li> <li>Statistically significant increasing trend in sulphate concentrations but not estimated to reach 95<sup>th</sup> percentile threshold value for another 4 years.</li> </ul>      |
| Total Arsenic       | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.012 mg/L) was below the 95<sup>th</sup> percentile threshold (0.052 mg/L).</li> <li>Statistically significant increasing trend in total arsenic concentrations but not estimated to reach 95<sup>th</sup> percentile threshold value for another 8 years.</li> </ul> |
| Dissolved Arsenic   | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.012 mg/L) was below the 95<sup>th</sup> percentile threshold (0.031 mg/L).</li> <li>Statistically significant increasing trend in dissolved arsenic concentrations but not estimated to reach threshold value for another 2 years.</li> </ul>                        |
| Total Cadmium       | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.00014 mg/L) was below 95<sup>th</sup> percentile threshold (0.00066 mg/L).</li> <li>Decreasing trend, but not statistically significant.</li> </ul>  |
| Total Iron          | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (2.3 mg/L) was below the 95<sup>th</sup> percentile threshold (10.5 mg/L).</li> <li>Increasing trend, but not statistically significant.</li> </ul>   |
| Dissolved Iron      | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (1.30 mg/L) was below the 95<sup>th</sup> percentile threshold (5.35 mg/L).</li> <li>Statistically significant increasing trend in dissolved iron concentrations but not estimated to reach threshold value for another 7 years.</li> </ul>                             |
| Total Manganese     | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (1.11 mg/L) was below the 95<sup>th</sup> percentile threshold value of 5.94 mg/L.</li> <li>Statistically significant increasing trend in total manganese concentrations but not estimated to reach threshold value for another 9 years.</li> </ul>                     |
| Dissolved Manganese | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (1.14 mg/L) was below the 95<sup>th</sup> percentile threshold value of 5.68 mg/L.</li> <li>Statistically significant increasing trend in dissolved manganese concentrations but not estimated to reach threshold value for another 8 years.</li> </ul>                 |
| Total Zinc          | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.030 mg/L) was below the 95<sup>th</sup> percentile threshold (0.090 mg/L).</li> <li>Decreasing trend, though not significantly significant.</li> </ul>   |

**Table 9: Summary of AMP Event 4 Assessment – WQ-DC-R**

| Indicators          | Trigger Activation | Results   |
|---------------------|--------------------|---|
| Sulphate            | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (271.5 mg/L) was below the 95<sup>th</sup> percentile threshold (490.8 mg/L).</li> <li>Statistically significant increasing trend in sulphate concentrations but not estimated to reach 95<sup>th</sup> percentile threshold value for another 4 years.</li> </ul> |
| Total Arsenic       | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.014 mg/L) was below the 95<sup>th</sup> percentile threshold (0.055 mg/L).</li> <li>Statistically significant decreasing trend.</li> </ul>  |
| Dissolved Arsenic   | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.011 mg/L) was below the 95<sup>th</sup> percentile threshold (0.018 mg/L)</li> <li>Statistically significant increasing trend in dissolved arsenic concentrations but not estimated to reach threshold value for another 12 years.</li> </ul>                   |
| Total Cadmium       | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.00011 mg/L) was below 95<sup>th</sup> percentile threshold (0.00044 mg/L).</li> <li>Decreasing trend, but not statistically significant.</li> </ul>   |
| Total Iron          | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (1.39 mg/L) was below the 95<sup>th</sup> percentile threshold (6.09 mg/L).</li> <li>Decreasing trend, but not statistically significant.</li> </ul>   |
| Dissolved Iron      | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (1.14 mg/L) was below the 95<sup>th</sup> percentile threshold (1.58 mg/L).</li> <li>Statistically significant increasing trend in dissolved iron concentrations but not estimated to reach threshold value for another 2 years.</li> </ul>                        |
| Total Manganese     | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (1.09 mg/L) was below the 95<sup>th</sup> percentile threshold value of 2.96 mg/L.</li> <li>Increasing trend, but not statistically significant.</li> </ul>  |
| Dissolved Manganese | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (1.07 mg/L) was below the 95<sup>th</sup> percentile threshold value of 2.56 mg/L.</li> <li>Increasing trend, but not statistically significant.</li> </ul>  |
| Total Zinc          | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.034 mg/L) was below the 95<sup>th</sup> percentile threshold (0.068 mg/L).</li> <li>Decreasing trend, though not significantly significant.</li> </ul>  |

### 5.3 Follow-up Action Required

No AMP triggers were activated at WQ-DC-U or WQ-DC-R under AMP Event 4 during the April 2016 assessment. Therefore no follow up is required at this time.

## 6.0 AMP EVENT 5 – DEGRADED WATER QUALITY IN VICTORIA CREEK AT MINE ACCESS ROAD

### 6.1 Description

Victoria Creek, downstream of the mine site area, receives inputs from the mine site from surface water inflows and from groundwater inflows from mine site facilities. The receiving environment for the site is represented by sampling location WQ-VC-R. This location is downstream of inputs from both Dome and Back Creek, and includes all potential mine related inputs to the receiving environment. In contrast to Dome Creek, Victoria Creek is known to support fish and fish habitat. The water quality in Victoria Creek at WQ-VC-R is collected monthly, with the exception of spring. At this time, an additional sample is collected during freshet. For the assessment of triggers during this period, the bi-weekly concentrations were averaged for the month. The average monthly value was carried forward and assessed as per the AMP Protocol. During winter, water quality in this area is sampled 150 m downstream at WQ-VC-R+150. Water quality samples are analyzed for a full suite of parameters including total suspended solids, cyanide species, nitrogen species, sulphate, hardness, total and dissolved metals.

The water quality in Victoria Creek, below the mine site facilities, shows a clear mine-related influence with elevated concentrations of key contaminants of concern, compared to background, including sulphate, dissolved arsenic, dissolved iron, dissolved manganese, dissolved cadmium, and dissolved zinc. The water quality at WQ-VC-R is also significantly influenced by elevated levels of suspended solids from both natural and anthropogenic sources (including placer mining in the Back Creek and Pony Creek watersheds). Due to this influence of upstream sediment inputs, the development of the AMP Event for Victoria Creek is based on dissolved metals. Taking this approach enables the isolation of site-related influences and eliminates the interfering effects of elevated suspended solids contributed from upstream, in the Victoria Creek catchment.

A summary of the AMP thresholds for Event 5 is provided in Table 10.

**Table 10: Summary of AMP Event 5 Thresholds**

| Indicators  | Locations                    | Thresholds   | Frequency |
|---|------------------------------|--|-----------|
| Sulphate<br>Dissolved Arsenic<br>Dissolved Cadmium<br>Dissolved Zinc<br>Dissolved Iron<br>Dissolved Manganese | WQ-VC-R<br>or<br>WQ-VC-R+150 | <ul style="list-style-type: none"> <li>• Three consecutive monitoring results at WQ-VC-R or WQ-VC-R+150 greater than the upper 95<sup>th</sup> percentile of the reference period (2008 to 2013); or</li> <li>• A statistically significant (0.05) increasing trend in the monitoring results from WQ-VC-R or WQ-VC-R+150 which, when extrapolated forward one year, would result in values greater than the 95<sup>th</sup> percentile. For the purposes of AMP trend line development, data from 2008 and on will be used for the trend analysis.</li> </ul> | Monthly   |

### 6.2 AMP Event 5 – Data Review

Assessment under the AMP of the relevant water quality data from WQ-VC-R + 150 was carried out using the April 2016 water quality data. The results of the assessment are summarized in Table 11.

**Table 11: Summary of AMP Event 5 Assessment**

| Indicators          | Trigger Activation | Results  |
|---------------------|--------------------|--|
| Sulphate            | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (23.0 mg/L) was below the 95<sup>th</sup> percentile threshold (45.9 mg/L).</li> <li>Statistically significant increasing trend in sulphate concentrations but not estimated to reach threshold value for another 5 years.</li> </ul> |
| Dissolved Arsenic   | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.002 mg/L) was at the 95<sup>th</sup> percentile threshold (0.002 mg/L), but was not included with three consecutive exceedances of the threshold.</li> <li>Decreasing trend, but not statistically significant.</li> </ul>         |
| Dissolved Cadmium   | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.00004 mg/L) was below the 95<sup>th</sup> percentile threshold (0.00009 mg/L).</li> <li>Decreasing trend, but not statistically significant.</li> </ul>  |
| Dissolved Iron      | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.258 mg/L) was below the 95<sup>th</sup> percentile threshold (0.270 mg/L).</li> <li>Increasing trend, but not statistically significant.</li> </ul>  |
| Dissolved Manganese | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.047 mg/L) was below the 95<sup>th</sup> percentile threshold (0.120 mg/L).</li> <li>Increasing trend, but not statistically significant.</li> </ul>  |
| Dissolved Zinc      | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.0064 mg/L) was below the 95<sup>th</sup> percentile threshold (0.0082 mg/L).</li> <li>Decreasing trend, but not statistically significant.</li> </ul>  |

### 6.3 Follow-up Action Required

No AMP triggers were activated at WQ-VC-R+150 under AMP Event 5 during the April 2016 assessment. Therefore no follow up is required at this time.

## 7.0 AMP EVENT 6 – DEGRADED WATER QUALITY IN PONY CREEK DOWNSTREAM OF MINE AREA

### 7.1 DESCRIPTION

The water quality in Pony Creek downgradient of the mine area (below the Brown-McDade Pit) is currently affected by the historic practice of depositing waste rock within the stream channel. The water quality in Pony Creek in this area is measured monthly, when flowing, at WQ-PC-D with the exception of spring. At this time, an additional sample is collected during freshet. For the assessment of triggers during this period, the bi-weekly concentrations were averaged for the month. The average monthly value was carried forward and assessed as per the AMP Protocol. The collected water quality samples are analyzed for a full suite of parameters including total suspended solids, cyanide species, nitrogen species, sulphate, total and dissolved metals.

The environmental consequence of degraded water quality in Pony Creek is the potential exposure of aquatic and terrestrial resources, and human users to increased levels of

contaminants. Water quality in Pony Creek in this area shows a clear site-related influence with elevated levels of total cadmium, copper and zinc in comparison to background water quality.

A summary of the AMP thresholds for Event 6 is provided in Table 12.

**Table 12: Summary of AMP Event 6 Thresholds**

| Indicators    | Locations | Thresholds   | Frequency |
|---------------|-----------|--|-----------|
| Total Cadmium | WQ-PC-D   | <ul style="list-style-type: none"> <li>Three consecutive monitoring results at WQ-PC-D greater than the upper 95<sup>th</sup> percentile of the reference period (2008 to 2013); or</li> <li>A statistically significant increasing trend in the monitoring results from WQ-PC-D when extrapolated forward one year, would result in values greater than the 95<sup>th</sup> percentile. This trend assessment will be carried out using the trend analysis technique outlined in Section 2.4 of the AMP Protocol. For the purposes of AMP trend line development, data for WQ-PC-D from 2008 and on will be used for the trend analysis.</li> </ul> | Monthly   |
| Total Copper  |           |  |           |
| Total Zinc    |           |  |           |

### 7.2 AMP Event 6 – Data Review

Assessment under the AMP of the relevant water quality data from WQ-PC-D was carried out using the April 2016 water quality data.

**Table 13: Summary of AMP Event 6 Assessment**

| Indicators    | Trigger Activation | Results   |
|---------------|--------------------|---|
| Total Cadmium | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.0028 mg/L) was below the 95<sup>th</sup> percentile threshold (0.0044 mg/L).</li> <li>Increasing trend, but not statistically significant.</li> </ul> |
| Total Copper  | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.017 mg/L) was below the 95<sup>th</sup> percentile threshold (0.040 mg/L).</li> <li>Decreasing trend, but not statistically significant.</li> </ul>   |
| Total Zinc    | No                 | <ul style="list-style-type: none"> <li>April (average) concentration (0.25 mg/L) was below the 95<sup>th</sup> percentile threshold (0.42 mg/L).</li> <li>Increasing trend, but not statistically significant.</li> </ul>     |

### 7.3 Follow-up Action Required

No AMP triggers were activated at WQ-PC-D under AMP Event 6 during the April 2016 assessment. Therefore no follow up is required at this time.