TECHNICAL MEMORANDUM

DATE June 2, 2014　　　　　　　　　**PROJECT No.** 13-1118-0010 (DOC0034_Rev 0)

TO Alexandra Drapack
Osisko Hammond Reef Gold Ltd.

FROM Ken DeVos; Mallory Drysdale; Kristina Skeries　　　**EMAIL** kdevos@golder.com

OSISKO HAMMOND REEF GOLD PROJECT – WATER QUALITY BACKGROUND INFORMATION

1.0　INTRODUCTION

This memorandum outlines the influencing factors, basic assumptions, rationale, and source term data used in prediction of water quality for the Hammond Reef Gold Project (Project) located in Northwestern Ontario, Canada. This memo is in response to comments received in information requests and at the meeting on April 28, 2014, specifically as they relate to water, and predictions of water quality. The intent of the memo is to further clarify the calculations and assumptions for the water quality predictions, and to facilitate additional discussion and conversation in the meeting planned for June 4, 2014.

2.0　REGULATORY ENVIRONMENT

Primary regulations with respect to comparison to water quality and water quality prediction can be considered in terms of receiving water quality (i.e. CCME; PWQO); or discharge water quality (e.g. MMER; O.Reg 560/94).

2.1　Receiving Water Quality Guideline Considerations

Receiving water quality guidelines are typically designed to protect all of the aquatic organisms at all times. These guidelines are put forth by the Canadian Council of Ministers of the Environment (CCME) and the Province of Ontario (Provincial Water Quality Objectives (PWQO)). Some key considerations with respect to these guidelines are:

■　The receiving water quality guidelines apply to receiving waters, not to source terms, or on-site waters; and

■　There are mechanisms within the guidelines to develop site specific objectives, if necessary, that take into consideration the receiving waters and associated habitat.

For the Project, CCME and PWQO guidelines apply in Marmion Basin and in Lizard Lake at the edge of defined mixing zones, where appropriate, and as defined in the EIS/EA Report (Osisko 2013a) and in responses to comments (Appendix A of the EIS/EA Report).

2.2　Discharge Water Quality Guidelines

Discharge water quality guidelines are typically applied at a property boundary or at a point of discharge and are often considered as a "do not exceed" threshold. There have been, and are exceptions to these values where it is demonstrated that the parameter is not relevant, background concentrations are already elevated, or there are

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no impacts expected. Recently approved mines (e.g., Detour Mine; Meadowbank Mine) and currently operating projects (e.g., Copper Cliff Complex; Xstrata Nickel Sudbury Smelter; Giant Mine; Con Mine) provide context for application of these guidelines.

Drainage and Seepage Control

For the Project, geochemical test work has been conducted which shows that the materials to be mined and processed will be non-acid generating (non-AG) overall. Mine rock segregation is not required at this site.

Overburden and ore will be stockpiled on site, mine rock will be placed in the Waste Rock Management Facility (WRMF) and tailings will be placed in the Tailings Management Facility (TMF). The Project plan is to ensure that the net drainage from these areas during construction, operations, closure, and following closure will not be acidic and will be protective of the receiving environment (i.e., waters from these areas will not constitute a deleterious substance within the context and application of criteria defined within the Metal Mine Effluent Regulations (MMER).

Modelling predictions have shown that any WRMF, overburden, and TMF seepage would be compliant with O.Reg 560/94 and MMER regulatory limits as shown in Table 1. Should operational results be different than predicted outcomes, then seepage control measures, or modifications to seepage control measures (i.e., additional ditching or collection pumping) would be installed on an as required basis to protect receiving waters.

Modelling predictions have shown that deleterious discharges are not expected at this site, however Osisko Hammond Reef Gold (OHRG) has agreed to construct a perimeter ditching and containment system as a precautionary measure as described in the EIS/EA Report. Predictive modelling has determined the system to be effective at a conceptual level (Golder, 2014).

Table 1: Applicable Federal and Provincial Regulatory Discharge Limits

		Federal Limits (MMER)[1]		Provincial Limits (O.Reg. 560/94)[2]	
		Daily Maximum	Monthly Average	Daily Maximum	Monthly Average
pH	—	6 - 9.5		6 - 9.5	
Arsenic	mg/L	1	0.5	1	0.5
Copper	mg/L	0.6	0.3	0.6	0.3
Total Cyanide	mg/L	2	1	2	1
Lead	mg/L	0.4	0.2	0.4	0.2
Nickel	mg/L	1	0.5	1	0.5
Zinc	mg/L	1	0.5	1	0.5
Total Suspended Solids	mg/L	30	15	30	15
Radium 226	Bq/L				
Toxicity - trout		<=50% mortality		<=50% mortality	
Toxicity - Daphnia Magna				<=50% mortality	

Notes: (1) MMER, 2002 (2) MOEE, 1994

2.3   Modelling Approach

The water quality results presented in the Final EIS/EA Report are based on a model that uses a mass balance approach which builds on geochemical data gathered throughout the baseline program(s) (Osisko 2013c) and feasibility studies for the Hammond Reef Gold Project (Ounpuu, 2011). The model considers the geochemical

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nature of the deposit and the Project Description as described in the Site Water Quality TSD. Several key assumptions and example calculations are discussed in Sections 3 and 4.

2.4   Precedents for Approach

Discussion of water quality modeling approaches for mine sites are provided in several documents including guideline documents from Price (1997); MEND (2005) and INAP (2012). An outline of the overall guidance document and key sections of these reports that relate to the prediction assumptions are as follows:

Price (1997): Draft Guidelines and Recommended Methods for Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia.

These guidelines outline the common questions relating to each phase of acid rock drainage (ARD) and metal leaching (ML) predictions, and discuss the materials and methods appropriate to each phase. Items addressed in the guidelines are: 1) basic understanding of mining, geology, weathering and environmental chemistry; 2) selection of test materials and methods; 3) interpretation of test results; and 4) understanding of the limitations and potential flaws in test procedures.

In Price (1997) Chapter 11 "*Geochemcial Models*" and Chapter 12 "*Prediction of Drainage Chemistry where Oxidation Rate is Limited*", discuss water quality prediction and provide some alternative methods. The EIS/EA Report uses an Equilibrium Based approach (Rate 2, Equation 12-3) since the material is expected to be non-AG with pH controlled by carbonate minerals. This approach has been used at other mine sites with similar non-AG granitic rock and was met with regulatory acceptance during public hearings. As stated in recent hearings of the Mackenzie Valley Land and Water Board by the Boards' geochemistry review consultant "*the approach you took to the source terms was one of using concentrations from humidity cell tests, which is one approach that's used in the industry…I do accept that concentration-based source terms are used and accepted in some cases*" (MVLWB, 2014).

Comparisons of laboratory and field test data from rock piles at Ekati Mine in Northwest Territories, Canada for the past 10 years show that direct analogue data from short term leach tests and humidity cells can be an effective and reasonable approach to developing mass loads when the material is non-AG and there is low potential for metal leaching (SRK 2013; Golder 2014), such as is the case at Hammond Reef.

MEND (2009): "Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials"

The manual provides good guidance including a "Recommended Flow Chart for the Prediction of Mine Site Drainage Chemistry" (page PA-3; Figure 1).

The objective of the manual is to provide guidance on how to characterize existing drainage chemistry and to predict future drainage chemistry with sufficient accuracy to prevent significant environmental impacts. The manual discusses procedures to follow and factors to consider in planning programs, collecting samples, selecting test materials, conducting static and kinetic testing, presenting data and interpreting results.
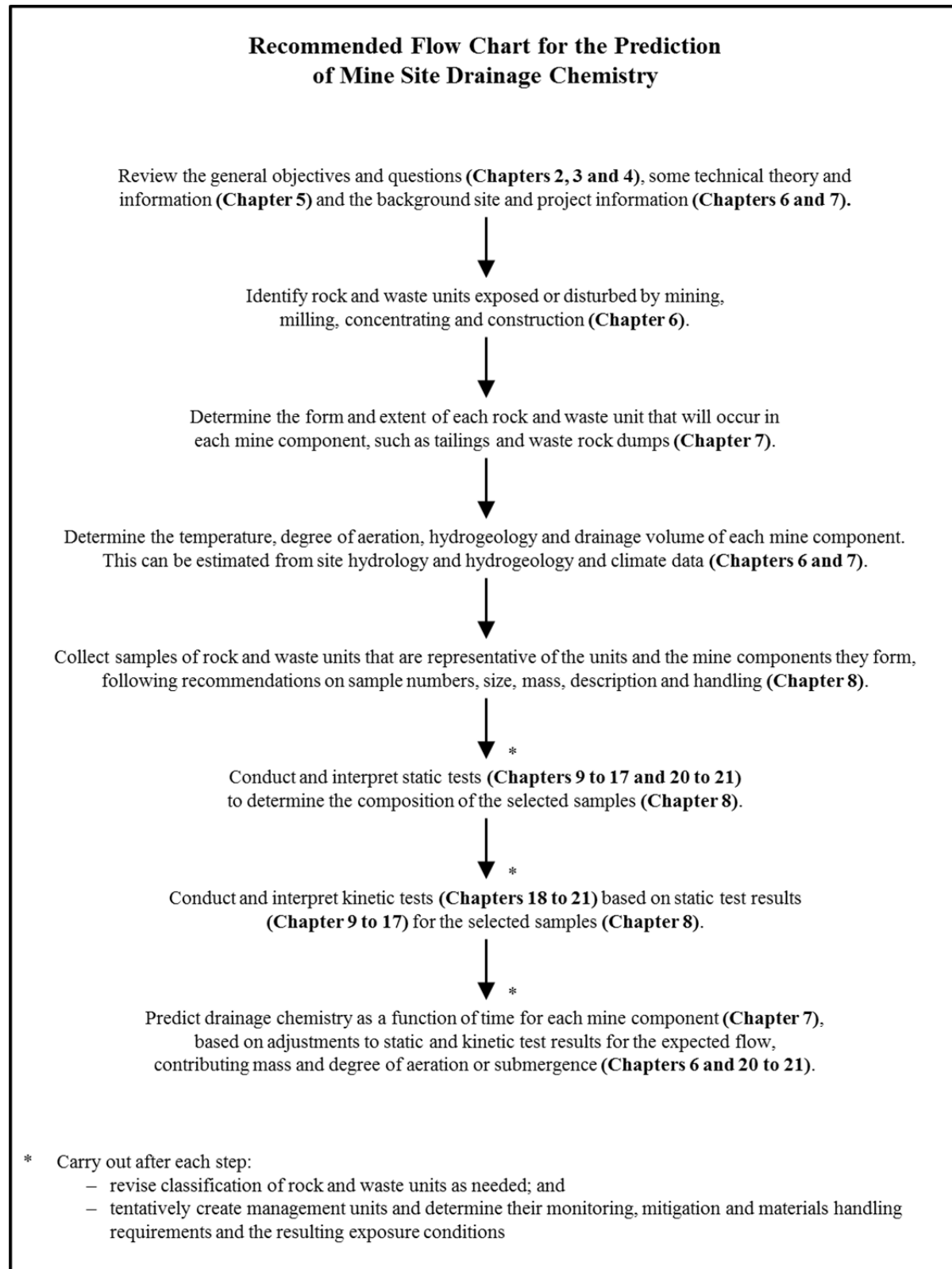
**Recommended Flow Chart for the Prediction
of Mine Site Drainage Chemistry**

Review the general objectives and questions **(Chapters 2, 3 and 4)**, some technical theory and information **(Chapter 5)** and the background site and project information **(Chapters 6 and 7).**

↓

Identify rock and waste units exposed or disturbed by mining, milling, concentrating and construction **(Chapter 6)**.

↓

Determine the form and extent of each rock and waste unit that will occur in each mine component, such as tailings and waste rock dumps **(Chapter 7)**.

↓

Determine the temperature, degree of aeration, hydrogeology and drainage volume of each mine component. This can be estimated from site hydrology and hydrogeology and climate data **(Chapters 6 and 7)**.

↓

Collect samples of rock and waste units that are representative of the units and the mine components they form, following recommendations on sample numbers, size, mass, description and handling **(Chapter 8)**.

↓ *

Conduct and interpret static tests **(Chapters 9 to 17 and 20 to 21)** to determine the composition of the selected samples **(Chapter 8)**.

↓ *

Conduct and interpret kinetic tests **(Chapters 18 to 21)** based on static test results **(Chapter 9 to 17)** for the selected samples **(Chapter 8)**.

↓ *

Predict drainage chemistry as a function of time for each mine component **(Chapter 7)**, based on adjustments to static and kinetic test results for the expected flow, contributing mass and degree of aeration or submergence **(Chapters 6 and 20 to 21)**.

*   Carry out after each step:
- revise classification of rock and waste units as needed; and
- tentatively create management units and determine their monitoring, mitigation and materials handling requirements and the resulting exposure conditions

Figure 1: Flow Diagram

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INAP 2012: Global Acid Rock Drainage (GARD) Guide

The Global Acid Rock Drainage (GARD) Guide deals with the prediction, prevention and management of drainage produced from sulphide mineral oxidation, often termed "acid rock drainage". It also addresses metal leaching caused by sulphide mineral oxidation. Chapter 4 of the GARD Guide provides guidance on characterization and Chapter 5 provides guidance on prediction. As stated in the introduction to Chapter 5:

All sites are unique for geological, geochemical, climate, commodity extraction, regulatory, and stakeholder reasons. Therefore, a prediction program needs to be tailored to the site in question. Also, the objectives of prediction programs are variable. For example, objectives can include definition of water treatment requirements, selection of mitigation methods, assessment of water quality impact, or determination of reclamation bond amounts.

Section 5.3 of the GARD Guide provides guidance on the prediction approach including common steps used in the prediction of water quality for mine sites (Section 5.3.3). Section 5.4 outlines the range of possible prediction tests, methods and tools that should be considered and possibly used to develop estimates of site chemistry and water quality, depending on the site specific conditions. Section 5.4.12 discusses the use of laboratory kinetic test data:

The results from kinetic testing are frequently used in combination with data from static test, mineralogical analyses and geochemical modeling to evaluate geochemical controls on leachate composition and conduct water quality prediction under a range of conditions. Similarly, kinetic testing results are often scaled up and used in combination with water balances for mine facilities to determine loadings and associated potential impacts to the receiving environment.

There are many ways in which the results from static tests and kinetic tests may be used, the methods of which differ depending on the potential rate of oxidation.

Depending on the end use of the kinetic test results, results may be expressed in terms of leachate quality (mass released/unit leachate volume), mass-based loadings (mass released/total mass/unit time), or surface-area-based loadings (mass released/total surface area/unit time).

For the Project, the materials to be mined, stockpiled and/or deposited in the TMF are expected to be non-AG with low potential for ML based on the mineralogy, acid base accounting (ABA) testing, net acid generation (NAG) testing, and short term leach test results, therefore results used for water quality prediction are expressed in terms of leachate quality (mass released / unit leachate volume) for the pile, and are considered to be equilibrium controlled.

Based on the guidance documents available, and the site specific conditions of the Project, assignment of leachate quality as mass released / unit leachate volume is considered to be the most appropriate approach for this site.

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3.0   MASS BALANCE EXAMPLE CALCULATION

To predict the results of water quality mixing, Excel was used to convert inputs and outputs from a water source into proportions based on the water balance.   Water quality inputs were applied to each flow component proportion to develop the mass of component which was subsequently mixed to develop the resulting concentrations using the following equations:

$$Mi = \ CiFi \qquad\qquad \textbf{Equation 1}$$

$$M = \ \left(\sum_{i=n}^{n} CiFi\right) \qquad\qquad \textbf{Equation 2}$$

$$C = \ \frac{M}{F} \ = \frac{\sum_{i=n}^{n} CiFi}{F} \qquad\qquad \textbf{Equation 3}$$

where:

M	=	Mass (milligrams) [mg/unit time]);
Mi	=	Mass in inflow 'i' (mg/unit time);
C	=	resulting concentration (milligrams per litre [mg/L]);
Ci	=	concentration in inflow 'i' (mg/L);
Fi	=	flow rate of inflow "i" (m^3/unit time);
n	=	number of inflows (unitless);
F	=	flow rate of outflow (m^3/unit time).

Mass is tracked independently of flow throughout the overall system, with discharge water quality being determined based on the total mass contained in the system per unit time and applied to the overall discharge from the site per unit time.   Where it is necessary to evaluate individual components, the maximum input concentration is typically used for the assessment of that particular facility.

Where flow input (F*i)* is based on climatic data, the net flow (total rainfall less 15% evaporation) is typically used, and all water incidents on the system are assigned a mass load per unit time.

Attachment C provides an overview of the calculations for key parameters that account for overall system interactions and discharge.

4.0   REVIEW OF KEY ASSUMPTIONS AND SOURCE TERM INPUTS

Assumptions regarding input parameters are provided in the Site Water Quality TSD (Osisko 2013f) and Lake Water Quality TSD (Osisko 2013e). A summary of key assumptions is provided below and in Attachment B.

4.1   Climate and flow

Total flow is based on hydrology assessment and surface area coverage by facilities. For the TMF, flow from processing and tailings deposition is also included. For the purposes of assigning mass load:

- Process flow does not change over time (as per design basis);

- Average Flow considered on an annual basis for typical climatic conditions;

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- Upper Bound (concentrations) uses 75th percentile process water concentrations and maximum values of short term and humidity cell test data as defined in Table 4-1 and in Sections 4.2.1 and 4.2.2 of the Site Water Quality TSD (Osisko 2103d). For upper bound concentrations in waste rock the maximum values for each parameter, for all rock types and all humidity cell results was selected.

- Upper Bound (proportional mixing in lake) uses 10 year wet flow conditions. This is about 18% more water discharging from site, with no change in lake volumes or discharges (average climatic conditions for the reservoir). Conservatively, the same concentration is applied **per unit water**, so more mass is applied under wet conditions (i.e., we do not dilute the concentration).

- Evaporation or water loss assumes 15% of water to be lost to the system – this water is assumed to be removed prior to interaction with waste materials, as such dilution and subsequent evaporative concentration in not considered. (note: if the evaporation rate were higher it would occur on the surface of the facility, therefore there would be less mass attributed to the system since less water would interact with the rock mass).

4.2 Tailings Management Facility Assumptions and Example Calculations (for Nickel)

Values used as source term inputs for the TMF are shown in Table 2.

Table 2: Tailings Management Facility Example Calculation for Upper Bound Nickel, Inputs and Mass Loads

Input	Nickel Concentration (mg/L)	Flow (m³/year)	Flow Proportion	Mass Load (mg/year)
Natural Runoff	0.001	614,835	4%	614,835
Direct Precipitation	0	482,707	3%	0
Waste Rock Runoff	0.0007	144,648	1%	101,254
Tailings Runoff	0.003	3,486,747	21%	10,460,241
Process Water	0.0124	11,792,308	71%	146,224,619

Notes:

1. $C = \dfrac{(614,835\ mg/year) + (0\ mg/year) + (101,254\ mg/year) + (10,460,241\ mg/year) + (146,224,619\ mg/year)}{16,521,245\ m^3/year}$

2. $C = \dfrac{157,400,949\ mg/year}{16,521,245\ m^3/year}$

3. $= 9\ mg/m^3 = 0.009\ mg/L.$

4. Tailings Runoff concentration based on maximum concentration observed throughout humidity cell testing of tailings

5. Process water concentrations based on maximum concentrations observed in tailings aging test (94.5% of volume) and cyanide destruction test (5.5% of volume)

6. Waste rock used in dams, concentration based on maximum concentrations observed throughout humidity cell testing of all waste rock samples

7. Direct precipitation to ponds

8. Natural runoff from areas not influenced by tailings placement but within catchment

Where applicable, geochemical controls were applied to the observed concentrations using PHREEQC. The application of geochemical controls is a tool used to account for thermodynamic constraints that could affect the composition of natural waters, including precipitation/dissolution of geochemically-credible mineral phases, and adsorption of metals onto ferrihydrite.

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4.3 Waste Rock Stockpile Assumptions and Example Calculations (for Nickel)

Values used as source term inputs for the Waste Rock Stockpile are shown in Table 3.

Table 3: Waste Rock Stockpile Example Calculation for Upper Bound Nickel, Inputs and Mass Loads

Input	Nickel Concentration (mg/L)	Flow (m³/year)	Flow Proportion	Mass Load (mg/year)
Natural Runoff	0.001	93,933	6%	93,933
Direct Precipitation	0	1,018	0%	0
Overburden Runoff	0.001	79,775	5%	79,775
Prepared Ground Runoff	0.001	98,507	7%	98,507
WRSF Runoff	0.0007	1,179,991	81%	825,994

Notes:

1. $C = \dfrac{(93,933\ mg/year) + (0\ mg/year) + (79,775\ mg/year) + (98,507\ mg/year) + (825,994\ mg/year)}{1,452,482\ m^3/year}$

2. $C = \dfrac{1,098,209\ mg/year}{1,452,482\ m^3/year}$

3. $C = 0.8\ mg/m^3 = 0.0008\ mg/L$.

4. WRSF Runoff concentration based on maximum concentrations observed throughout humidity cell testing of all waste rock samples

5. Overburden runoff concentration based on natural runoff concentrations

6. Prepared ground runoff based on natural runoff concentrations

7. Direct precipitation to ponds

8. Natural runoff from areas not influenced by tailings placement but within catchment

5.0 APPROPRIATENESS OF INPUT DATA

5.1 Preparation of Master Composite Tailings Sample

Preparation of the master composite tailings sample was conducted as part of the Project feasibility study (not yet published). Relevant aspects are discussed in response to information requests from the Draft EIS/EA Report as reported in Appendix A of the Final EIS/EA Report (Osisko 2013a). Key information was taken from Brett (2009) and is summarized below and in Attachment A:

■ In 2009, 10 individual drillhole composite samples (BR-2, BR-13, BR-23, BR-28, BR-64, BR-67, BR-68, BR-87, BR-88, and BR-102) were collected from various locations in the deposit. Table 4 shows the mass of each borehole composite sample.

■ The Master Composite sample was created from 78% East Pit (A-Zone) composite (115 kg) and 22% West Pit (41-Zone) composite (33 kg).

▪ The East Pit composite was created from six drillhole composites from the following drill holes: BR-28, BR-64, BR-68, BR-87, BR-88, and BR-102.

▪ The West Pit composite was created from three drillhole composites from the following drill holes: BR-02, BR-13, and BR-23.

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Table 4: Mass of Borehole Composite Tailings Samples

Composites	Zone	Mass Available (kg)
BR-2	41 (West Pit)	23
BR-13	41 (West Pit)	46
BR-23	41 (West Pit)	37
BR-28	A (East Pit)	38
BR-64	A (East Pit)	96
BR-68	A (East Pit)	56
BR-87	A (East Pit)	16
BR-88	A (East Pit)	44
BR-102	A (East Pit)	99

Table 5: Summary of Master Composite Tailings Sample Composition

	Number of Samples	Mass (kg)	Notes
East Pit (A-Zone)	484	230	115 kg to master composite
West Pit (41-Zone)	135	66	33 kg to master composite
East Pit and West Pit (Master Composite)	-	148	115 kg A-Zone + 33 kg 41-Zone

5.2   Comparison of Tailings and Waste Rock Variability

Throughout the Final EIS/EA Report, the geological logs units are differentiated based on visual properties; however, the geological logs units are essentially the same from a geochemical perspective. Tables 6 and 7 show the range of solid phase and leachate concentrations in the waste rock samples and the combined tailings sample for various parameters, including those parameters (As, Cu, Ni, Pb, Zn) considered in Schedule 4 of the Metal Mining Effluent Regulations (MMER 2002). In Table 7, results from the shake flask extraction tests, first week of the humidity cell tests, and first day of the aging tests (tailings only) were combined to calculate the statistics and range of concentrations.

The data set used to develop water quality estimates for the Project includes solid phase analyses, acid-generation potential, and ML.

Solid Phase Analyses

Analyses for solid phase trace element composition included:

■   14 zone and variability composite samples and 1 master composite tailings sample (Attachment B); and

■   123 waste rock samples.

With respect to the MMER parameters, the combined tailings sample and the waste rock samples have similar ranges in trace element concentrations of As, Cu, Ni, Pb, and Zn. Maximum concentrations in the waste rock samples for Cu and Ni are higher than the maximum concentrations in the combined tailings sample (Attachment A). However, an investigation of the average, median, and 75th percentile of the waste rock samples indicate that the majority (at least 75%) of the waste rock dataset is within the range of the concentrations of the combined tailings sample. Results for a larger suite of parameters are available in Version 2 of the Geochemistry, Geology and Soils TSD (Osisko 2013c).

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Table 6: Comparison of Solid Phase Concentrations for Key Parameters

Parameter	Unit	Tailings Samples			Waste Rock Samples[2]			
		Master[1]	Master from Geochem Report[2]	Range from Composite Samples[1]	Range	Average	Median	75th Percentile
S%	%	0.31	0.175	0.16 - 0.80	0.005 - 0.485	0.043	0.019	0.0455
SO_4%	%	0.06	0.08	< 0.01 - 0.28	< 0.01 - 0.18	0.02	0.02	0.03
S^-%	%	0.25	0.09	0.09 - 0.42	< 0.01 - 0.38	0.03	0.01	0.02
C %	%	0.93	1.05	0.50 - 1.47	0.03 - 4.02	0.70	0.54	0.77
CO_3 %	%	3.47	4.84	2.13 - 6.56	0.058 - 15.2	3.0	2.4	3.5
Semi-quantitative ICP Scan								
As	ppm	< 30	2.5	< 30	< 0.5 - 2.5	0.7	0.5	0.7
Cu	ppm	20	30	14 - 60	1.2 – 130	22	13	28
Ni	ppm	22	27	< 20 - 84	1.8 – 820	37	7.4	14
Pb	ppm	< 40	7.6	< 20 - 140	2.5 – 44	6.9	6.1	7.6
Zn	ppm	220	46	41 - 360	3.2 – 160	48	44	60

Note:

1) Data taken from SGS 2009.

2) Osisko 2013c.

Acid-Generation Potential

Analyses to determine acid generation potential included:

- Acid Base Accounting

  - 14 zone and variability composite samples and 1 master composite tailings sample

  - 123 waste rock samples

- Net Acid Generation Testing

The ABA results for the combined tailings sample and waste rock samples show similarities as well. Both the combined tailings sample and the waste rock samples have neutralization potential to acid potential (NP/AP) and carbonate neutralization potential to acid potential (CaNP/AP) ratios well above 2, indicating that neither set have the potential to be acid generating (a ratio less than 1 indicates potentially acid generating, and a ratio higher than 1 but less than 2 indicates that it is uncertain whether or not the material will be acid generating). Results of acid generation testing are provided in Version 2 of the Geochemistry, Geology and Soils TSD (Osisko 2013c).

Metal Leaching

Analyses conducted to determine potential for metal leaching included:

- Short term leach tests:

  - shake flask extraction tests

  - 1 master composite tailings sample

- 41 waste rock samples

- First week of the humidity cell tests

    - 1 combined tailings sample

    - 9 waste rock samples

- First day of the aging tests

    - 1 combined tailings sample

The combined tailings sample and the waste rock samples have similar ranges in leachate concentrations of As, Cu, Ni, Pb, and Zn. Maximum concentrations in the waste rock samples for As, Cu, and Pb are higher than the maximum concentrations in the combined tailings sample. However, an investigation of the averages, medians, and 75th percentiles of the combined tailings sample and the waste rock samples indicate that the majority (at least 75%) of the waste rock dataset is in fact within the range of the concentrations of the combined tailings sample. The averages, medians, and 75th percentile statistics of the waste rock samples are similar, if not lower than, the same statistics from the combined tailings sample. Results for a larger suite of parameters are available in Version 2 of the Geochemistry, Geology and Soils TSD (Osisko 2013c).

Table 7: Comparison of Leachate Concentrations for Key Parameters

Parameter	Unit	MMER[6]	Tailings Samples (n = 3[1])				Waste Rock Samples (n = 50[2])			
			Range	Average	Median	75th Percentile	Range	Average	Median	75th Percentile
Final pH	s.u.	6.0 – 9.5	7.90 - 8.65	8.21	8.46	8.54	7.51 - 10.12	8.93	9.83	9.93
Alkalinity	mg/L[3]	—	44 - 144	80	51	98	15 - 50	32	30	34
Conductivity	µS/cm	—	216 - 760	460	404	582	6 - 109	64	70	80
Cl	mg/L	—	1.1 - 16	6.7	2.9	9.5	0.4 - 7.2	1.4	1.0	2.0
SO_4	mg/L	—	55 - 210	138	150	180	< 0.2 - 2.5	0.6	0.3	0.5
Metals										
As	mg/L	0.5	0.0008 - 0.0015	0.0011	0.0010	0.0013	0.0002 - 0.019	0.0020	0.0009	0.0016
Cu	mg/L	0.3	0.0013 - 0.0027	0.0019	0.0018	0.0023	< 0.0005 - 0.0059	0.0010	0.0005	0.00058
Ni	mg/L	0.5	0.0005 - 0.007	0.0033	0.0025	0.0048	< 0.0001 - 0.0004	0.0002	0.0002	0.0003
Pb	mg/L	0.2	0.00006 - 0.00007	0.00007	0.00007	0.00007	< 0.00002 - 0.00032	0.00004	0.00002	0.00004
Zn	mg/L	0.5	< 0.001 - 0.002	0.002	0.002	0.002	< 0.001	< 0.001	< 0.001	< 0.001

Note:

1) Statistics calculated based on three tests of the same sample: one shake flask extraction test, and the initial results from both the humidity cell test and the aging test.

2) Statistics calculated based on 41 shake flask extraction samples, and initial results from 9 humidity cell tests.

3) mg/L $CaCO_3$.

4) All mercury concentrations measured in the laboratory were below the analytical detection limit of < 0.0001 mg/L, which is ten times greater than the typical existing monitoring mercury analytical detection limit. Given the observed existing data, it is considered reasonable, and more representative of the expected mercury conditions at the project site, to use an estimated values equivalent to the lower detection limit from the existing data (< 0.00001 mg/L) for the laboratory data mercury values for the purposes of modeling.

5) Statistics in this table calculated using values equal to half of the detection limit (0.0005 mg/L) for results that were below the detection limit (< 0.001).

6) MMER, 2002. Metal Mining Effluent Regulations, Column 2. Maximum Authorized Monthly Mean Concentration.

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The concentrations of As, Cu, Ni, Pb, and Zn in both the combined tailings sample and the waste rock samples are generally ten to a thousand times less than the MMER guideline, including the maximum values. Although the results being compared to the MMER guidelines are dissolved concentrations and the MMER guidelines govern total concentrations, the comparison to MMER guidelines remains relevant. As water on site is collected and redirected back to the PPCP and treated for total suspended solids (TSS) if necessary, total concentrations in the water being discharged will not exceed the guidelines.

6.0   RESULTS

Results of the water quality modelling assessment are presented in Version 2 of the Site Water Quality TSD (Osisko 2013f) and in Version 2 of the Lake Water Quality TSD (Osisko 2013e). A summary for key parameters associated with MMER is provided in Attachment C. Of note is that:

■   Leachate potential from all source term rock units, as well as tailings and predicted discharges from each facility is below MMER Schedule 4 Column 2 Maximum Authorized Monthly Mean Concentration.

■   Tailings are comprised of the same rock units as the waste rock and leachate potential from all tailings source terms and process water discharge to the TMF is below MMER Schedule 4 Column 2 Maximum Authorized Monthly Mean Concentration.

■   Leachate potential from all potential discharges from each facility is below MMER Schedule 4 Column 2 Maximum Authorized Monthly Mean Concentration.

Additional parameters and discussion is provided in the EIS/EA Report (Osisko 2013a) including the Site Water Quality TSD (Osisko 2013f); Lake Water Quality TSD (Osisko 2013e); Aquatic TSD (Osisko 2013b; and Human Health and Ecological Risk Assessment TSD (Osisko 2013d), which indicate that there is no potential for adverse impacts to aquatic or human health.

7.0   CLOSING REMARKS

The water quality modelling predictions have relied on sound methods and reasonable assumptions. The modelling required simplifying assumptions of the source terms and predictions. Source terms assignment is based on available information, which in some cases is, by necessity, limited to rock samples as collected during the exploration phase. Simplifying assumptions were reasonable and similar to those made for similar mining environments (i.e. non-acid generating with excess neutralizing potential). Reasonable conservativeness has been applied in assignment of water quality source terms, and upper bound conditions have been identified as described herein and in the EIS/EA Report (Osisko 2013a).

Based on the available information and assessment, it is considered that the assumptions and values used are reasonable and appropriate for the purposes of determination of potential water quality, aquatic, and human health impacts, and that the assessment as provided in the EIS/EA Report is appropriate for the purposes of decision making at an EIS/EA level.

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Ongoing water quality monitoring will be conducted throughout the life of mine and into post closure, and will be used to confirm and update predictions once additional detail design information is available. Although expected to be unnecessary, contingency plans and mitigation measures are available and adaptive management will be applied should it be required.

We trust this meets your requirements at this time.

GOLDER ASSOCIATES LTD.

<Original signed by>   <Original signed by>

V

Mallory Drysdale, P. Geo   Ken DeVos, P. Geo.
Geochemist   Principal, Geochemist

Attachments

Attachment A: Tailing Composition Range
Attachment B: Summary of Assumptions
Attachment C: Predicted Concentrations for Key Parameters

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ATTACHMENT A
Tailing Composition Range

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Preparation of tailings samples are described in SGS Report prepared for Brett Resouces Inc. (2009). An excerpt (Table 3) of this report shows the composition of the various composite samples.

Table A-1:   Head Analysis, Additional Chemical Analyses

Parameter	Unit	Master	Zone Composites		Grade Composites			Drill Hole Composites								
			A-Zone	41-Zone	LG A-Zone	HG A-Zone	EHG	BR-2	BR-13	BR-23	BR-28	BR-64	BR-67	BR-87	BR-88	BR-102
S	%	0.31	0.31	0.39	0.19	0.45	0.80	0.16	0.33	0.26	0.26	0.35	0.43	0.35	0.37	0.26
SO_4[1]	%	0.06	0.14	0.28	0.10	0.22	0.38	<0.01	0.12	0.12	0.11	0.14	0.26	0.25	0.22	0.11
$S=$[2]	%	0.25	0.16	0.11	0.09	0.23	0.42	0.17	0.21	0.14	0.14	0.21	0.17	0.10	0.15	0.15
C	%	0.93	0.85	1.17	0.75	0.74	1.02	1.02	0.98	1.47	0.72	0.84	0.96	0.60	0.50	0.70
CO_3	%	3.47	3.46	5.22	3.19	3.05	3.26	4.55	4.23	6.56	3.11	3.40	4.13	2.67	2.13	3.08
Semi-quantitative ICP Scan																
Ag	g/t	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Al	g/t	67,000	66,500	67,000	72,000	67,000	72,000	80,000	75,000	70,000	78,000	71,500	73,000	72,000	68,000	73,000
As	g/t	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Ba	g/t	450	440	420	480	410	470	410	490	430	550	435	460	500	450	490
Be	g/t	0.80	0.81	0.72	0.70	0.80	0.80	0.80	0.88	0.74	0.86	0.81	0.86	0.80	0.76	0.88
Bi	g/t	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Ca	g/t	20,000	19,000	24,000	18,000	18,000	23,000	25,000	21,000	28,000	17,000	22,500	24,000	18,000	14,000	19,000
Cd	g/t	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Co	g/t	<10	<10	28	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Cr	g/t	49	43	76	42	39	22	18	31	100	33	26.5	24	17	35	44
Cu	g/t	20	15.5	21	17	15	25	20	28	24	14	24	26	15	60	25
Fe	g/t	22,000	21,000	27,000	19,000	20,000	29,000	23,000	25,000	29,000	23,000	23,500	22,000	20,000	24,000	22,000
K	g/t	22,000	24,500	21,000	22,000	22,000	27,000	27,000	24,000	22,000	23,000	24,000	24,000	23,000	20,000	24,000
Li	g/t	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Mg	g/t	6,300	4,850	8,600	5,000	4,300	5,800	5,800	7,200	12,000	5,300	5,000	5,200	3,800	2,900	4,300
Mn	g/t	330	310	370	330	310	440	360	370	430	330	320	350	310	220	270
Mo	g/t	13	13	12	<10	15	18	11	<10	<10	26	11.5	<10	<10	<10	<10
Na	g/t	20,000	22,000	18,000	23,000	21,000	18,000	26,000	22,000	19,000	22,000	21,500	24,000	21,000	23,000	24,000
Ni	g/t	22	<20	39	<20	<20	<20	<20	<20	84	<20	<20	<20	<20	<20	<20
P	g/t	430	395	430	380	430	760	530	460	320	490	450	430	330	240	380
Pb	g/t	<40	<40	<40	<30	<30	<30	30	31	76	<20	<20	<20	25	140	25
Sb	g/t	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Se	g/t	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Sn	g/t	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Sr	g/t	120	110	120	110	110	110	130	120	120	100	120	120	120	100	110
Ti	g/t	1,800	1,650	2,000	1,700	1,800	2,800	1,900	2,300	2,300	2,000	2,050	2,000	1,800	1,400	1,600
Tl	g/t	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
U	g/t	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
V	g/t	35	32	43	33	31	46	34	51	45	39	36	35	29	22	30
Y	g/t	4.9	4.8	4.6	4.5	3.9	5.3	5.3	4.8	4.2	4.8	4.65	4.4	4.6	3.4	5.2
Zn	g/t	220	43	48	41	42	57	150	160	360	66	67.5	79	110	100	93

Source: SGS Minerals Ltd.; Table 3 excerpt from Brett (2009).
Note:
1) Sulphur as Sulphate (SO_4).
2) Sulphur as Sulphide ($S=$).

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Table A-2: Range of Concentrations from Waste Rock Samples by Rock Type

Parameter	Unit	Fine Grained Granite (n = 16)			Chloritic Granite (n = 31)			Tonalite (n = 30)			Altered Granitoid (n = 8)			Pegmatite (n = 11)			Mafic Dyke (n = 9)			Chloritic Granite Porphyry (n = 5)			Minor Units (n = 13)		
		Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
S%	%	0.005	0.11	0.031	0.005	0.20	0.037	0.005	0.38	0.044	0.017	0.068	0.038	0.005	0.10	0.038	0.005	0.28	0.058	0.014	0.097	0.049	0.005	0.49	0.059
$SO_4\%$	%	< 0.01	0.04	0.02	< 0.01	0.07	0.02	< 0.01	0.10	0.02	0.02	0.05	0.03	< 0.01	0.05	0.02	< 0.01	0.18	0.04	0.01	0.05	0.03	< 0.01	0.11	0.02
S⁻%	%	< 0.01	0.07	0.02	< 0.01	0.14	0.02	< 0.01	0.32	0.03	< 0.01	0.02	0.01	< 0.01	0.06	0.03	< 0.01	0.1	0.03	< 0.01	0.05	0.02	< 0.01	0.38	0.05
C %	%	0.23	4.0	1.0	0.24	1.7	0.66	0.052	1.2	0.35	0.12	1.0	0.58	0.030	1.6	0.50	0.25	2.1	1.3	0.80	1.8	1.2	0.069	2.5	0.74
CO_3 %	%	0.95	15	4.3	1.0	7.2	2.9	0.15	5.1	1.5	0.30	4.7	2.5	0.058	7.3	2.1	1.1	9.8	6.3	3.5	8.4	5.4	0.18	12	3.4
Semi-quantitative ICP Scan																									
Ag	ppm	0.20	1.6	0.50	0.20	1.2	0.45	0.13	63	2.5	0.21	4.7	0.95	0.05	4.5	0.78	0.12	3.4	0.81	0.19	0.58	0.37	0.22	0.83	0.48
Al	ppm	22,000	91,000	75,000	64,000	93,000	79,129	75,000	93,000	82,700	73,000	87,000	79,375	67,000	84,000	74,727	32,000	83,000	55,333	76,000	88,000	81,200	25,000	93,000	70,615
As	ppm	< 0.5	2.1	0.7	< 0.5	1.6	0.6	< 0.5	2.4	0.8	< 0.5	2.0	0.7	< 0.5	1.0	0.6	< 0.5	1.4	0.7	< 0.5	< 0.5	< 0.5	< 0.5	2.5	0.9
Ba	ppm	8.7	490	341	200	730	390	230	700	439	200	480	334	120	930	380	3.1	520	233	380	450	410	90	550	332
Be	ppm	0.40	0.89	0.74	0.43	0.98	0.75	0.50	0.91	0.73	0.61	0.91	0.77	0.39	0.93	0.63	0.23	0.85	0.55	0.77	0.86	0.81	0.2	0.86	0.61
Bi	ppm	< 0.09	0.13	0.10	< 0.09	0.72	0.11	< 0.09	0.19	0.10	< 0.09	0.11	0.09	< 0.09	1.2	0.19	< 0.09	0.17	0.10	< 0.09	0.17	0.12	< 0.09	0.25	0.11
Ca	ppm	15,000	49,000	25,313	11,000	42,000	21,226	14,000	34,000	22,933	2,800	26,000	15,813	6,700	26,000	14,718	15,000	69,000	43,667	21,000	35,000	28,200	5,600	49,000	24,123
Cd	ppm	0.11	0.47	0.25	0.04	0.33	0.22	0.10	0.36	0.21	0.07	0.26	0.17	0.02	0.29	0.14	0.09	0.45	0.22	0.14	0.25	0.21	0.03	0.37	0.21
Co	ppm	3.5	84	17	2.1	26	6.1	3.5	20	8.1	0.94	7.3	4.7	0.70	10	3.8	4.9	54	27	5.3	13	8.9	2.7	38	12
Cr	ppm	120	1,400	304	110	240	165	100	270	178	120	240	178	120	270	200	120	760	398	130	180	156	130	880	268
Cu	ppm	2.5	120	36	3.3	130	16	3.7	52	22	3.7	29	13	1.2	46	11	3.8	110	36	5.8	32	22	1.5	80	21
Fe	ppm	17,000	89,000	32,500	10,000	64,000	21,387	15,000	43,000	26,567	7,000	27,000	16,913	4,000	24,000	13,345	16,000	81,000	45,889	19,000	33,000	26,800	12,000	55,000	27,692
K	ppm	600	28,000	16,631	8,600	24,000	18,858	10,000	28,000	17,033	12,000	27,000	17,750	9,100	34,000	18,282	65	23,000	9,451	18,000	25,000	21,000	2,700	21,000	13,731
Li	ppm	3	25	11	< 2	26	7	5	34	10	< 2	14	5	< 2	7	4	5	71	31	< 2	16	10	< 2	57	13
Mg	ppm	3,100	81,000	15,775	1,600	19,000	5,058	3,000	24,000	7,050	700	5,500	3,800	500	11,000	3,473	3,900	52,000	24,144	5,400	13,000	8,800	1,200	45,000	11,254
Mn	ppm	200	1,300	468	130	940	301	250	570	359	80	360	255	77	420	195	240	1,300	732	290	600	428	91	930	380
Mo	ppm	0.2	2.0	0.6	0.3	3.8	0.8	0.2	3.9	0.7	0.4	16	2.7	0.2	3.6	1.1	0.1	0.6	0.3	0.3	0.8	0.5	0.1	3.5	1.8
Na	ppm	31	33,000	20,818	14,000	28,000	22,581	15,000	27,000	23,433	18,000	35,000	25,750	16,000	31,000	25,091	2,500	24,000	12,667	18,000	25,000	20,600	7,300	26,000	19,946
Ni	ppm	4.9	820	112	1.8	40	8.3	5.9	110	15	2.6	11	7.3	2.8	31	9.2	5.9	290	139	8.0	34	18	2.8	340	47
P	ppm	240	730	428	130	1,000	392	210	1,100	562	60	760	350	24	960	258	270	1,500	687	390	670	492	110	1,500	517
Pb	ppm	3.0	21	6.6	2.5	20	6.4	2.6	12	6.9	3.2	12	6.8	3.6	44	10	3.6	11	6.5	4.6	9.6	7.4	3.4	9.7	5.9
Sb	ppm	< 0.8	1.1	0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	0.9	0.8	< 0.8	1.1	0.9	< 0.8	< 0.8	< 0.8
Se	ppm	< 0.7	0.8	0.7	< 0.7	0.9	0.7	< 0.7	1.0	0.7	< 0.7	< 0.7	< 0.7	< 0.7	0.8	0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
Sn	ppm	0.9	2.0	1.5	0.5	15	2.7	0.9	4.5	1.8	1.0	3.8	2.1	0.9	7.7	2.4	1.0	2.4	1.3	1.5	16	4.7	0.5	4.4	1.6
Sr	ppm	110	320	174	110	440	155	84	370	201	52	170	126	120	180	149	98	350	200	130	180	150	45	260	164
Ti	ppm	1,100	3,100	1,819	490	5,700	1,433	1,000	3,600	2,110	170	2,800	1,139	100	2,100	776	800	7,000	2,778	1,200	2,900	1,900	400	5,200	1,883
Tl	ppm	0.03	0.32	0.21	0.06	0.36	0.24	0.10	0.36	0.22	0.13	0.30	0.20	0.06	0.29	0.19	0.02	0.37	0.14	0.19	0.32	0.27	< 0.02	0.30	0.18
U	ppm	0.14	1.7	0.99	0.36	1.7	1.0	0.48	2.1	1.2	0.83	2.4	1.2	0.65	2.1	1.2	0.062	3.0	1.0	0.81	2.2	1.4	0.58	1.2	0.91
V	ppm	17	160	50	5	170	29	14	75	39	< 1	35	21	< 1	33	14	20	240	97	27	66	45	10	120	45
Y	ppm	4.5	12	7.1	3.1	17	6.6	5.7	16	8.9	3.9	9.7	6.0	1.9	13	5.9	4.6	14	8.6	4.6	21	9.6	2.4	12	7.4
Zn	ppm	22	95	51	18	74	43	21	82	53	9.9	68	35	3.2	47	25	31	160	81	33	80	58	9.1	99	47

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ATTACHMENT B
Summary of Assumptions

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Flow and mass load key assumptions for the TMF are as follows:

Operations

Design

- The tailings will be thickened and deposited from a central location forming a shallow "cone"; perimeter embankments will be constructed where necessary

- Runoff from the tailings will be directed to a reclaim pond which will be pumped back to the mill during operations

- Downstream ditching and pumping stations will be constructed for use as a capture system to be used on an as-needed basis

- Water from the capture system would be returned to the TMF, if necessary

Geochemical Conditions

- Tailings are non-AG with excess buffering capacity in the form of carbonate minerals

  - Supporting information: (metallurgical zone composite and master composite samples show similar results for ABA and solid phase metal analyses: n = 15)

  - Zone composite and master composite samples range in size from 15 kg to 150 kg.

- Tailings are similar in composition to surrounding host rock and thus are expected to have similar leaching characteristics

- Pore water concentrations assigned to the tailings are based on:

  - Cyanide Destruction Tests:

    – Account for 5.5% of flow to the basin

    – Used treated results for recommended SO_2/air technology

    – Analysis for pH, Ni, Fe and Cu only

    – 5 ppm cyanide after cyanide destruction

  - Tailings Aging Tests:

    – Account for 94.5% of flow to the basin

- Nitrate and ammonia are added as a function of material use assuming a use rate of 0.27 kg/tonne and waste rate of 1.5%.

- Cyanide decays in the flow system based on the degradation rate (Simovic et al. 1985) and time in the system.

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Flow Logic

Operational Inputs

- Water contained in tailings discharge

- TMF runoff – all areas covered by tailings

  - Assigned as

    - TMF infiltration

    - Natural runoff (from within catchment not covered by tailings)

    - Precipitation

      - Direct precipitation

Operational Losses

- All water is directed to Marmion Basin (primary pathway is via. pump back to the PPCP for reuse or discharge at final effluent point)

- Evaporation

- Although not expected at this site, to manage deleterious substances, if any were to occur, OHRG has agreed to construct a perimeter ditching and containment system as is described in the EIS/EA Report.

- EIS/EA impact scenarios include assessment of additional (i.e., extra) flow to Lizard Lake, including both an average case and upper bound scenario

Mass Balance

Operational Inputs

- Input water mass is assigned based on the materials they are expected to encounter and amount of flow (process flow, or precipitation less evaporation) through material

Operational Losses

- All mass load is directed to Marmion Basin (primary pathway is via pump back to the PPCP for reuse or discharge at final effluent point)

- Evaporation (no mass lost)

Conservatism

- Use of "expected" (average) case and "upper bound" (maximum value) case

- Model scenarios include assessment of additional (i.e., extra) flow to Lizard Lake, including both an average case and upper bound scenario

- Model scenarios for Marmion Basin upper bound conditions assign additional flow and mass to the discharge from site relative to the climatic conditions used for the remainder of the basin

Golder Associates

REFERENCES

Simovic, L., Snodgrass, W., Murphy, K., and Schmidt, J. (1985). Development of a Model to Describe the Natural Degradation of Cyanide in Gold Mill Effluents. Cyanide and the Environment, Vol. II, Colorado State University, Fort Collins, CO, pp. 413-432.

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Alexandra Drapack
Osisko Hammond Reef Gold Ltd.

Submitted as part of the Version 3 HRGP Amended EIS/EA Documentation
January 2018 – 1656263
13-1118-0010 (DOC0034_Rev 0)
June 2, 2014

ATTACHMENT C
Predicted Concentrations for Key Parameters

Alexandra Drapack
Osisko Hammond Reef Gold Ltd.

13-1118-0010 (DOC0034_Rev 0)
June 2, 2014

Table C-1:   Predicted Concentrations for Key Parameters

Input Name		Description	Statistic	Number of Samples[2]	Source	Flow[3] (m³/yr)	Flow Proportion	pH[6] (s.u.)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cyanide (mg/L)
								MMER[1]	6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
AVERAGE CASE[4]														
Overburden Stockpile														
IN	Natural Runoff	Surface runoff from catchment area	Average	42	Average non-freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	6,996	4%	6.9	0.0006	0.0007	0.001	0.0004	0.003	
	Direct Precipitation	Direct precipitation onto pond	Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	848	1%	5	0	0	0	0	0	
	Overburden Runoff	Surface runoff from exposed overburden	Average	42	Average non-freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	155,950	95%	6.9	0.0006	0.0007	0.001	0.0004	0.003	
OUT	Overburden Stockpile (Pumping Station 10)	Water pumped from Overburden Stockpile to Low Grade Ore Stockpile	Calculated	N/A	Calculated	163,052	N/A	6.9	0.0000090	0.00022	0.0010	0.0000084	0.0026	

Note:

1) MMER, 2002. Metal Mining Effluent Regulations, Column 2. Maximum Authorized Monthly Mean Concentration.

2) In the case of surface and groundwater sampling locations: total number of samples collected including all locations. In the case of humidity cell testing or aging testing: number of samples submitted for analysis.

3) Flows are calculated in the water balance based on estimated climate conditions.

4) Average Case water quality predictions are based on "Scenario 1" site water quality inputs (average statistics) and average climatic conditions.

5) Upper Bound Case water quality predictions are based on "Scenario 4" site water quality inputs (maximum process water, tailings runoff, waste rock runoff, pit wall runoff and low-grade ore runoff statistics) and 10-year wet climatic conditions.

6) pH values are based on average values for each input calculation.

Concentrations are all dissolved.

When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

Geochemical controls were applied when calculating output concentrations at each point.

Natural runoff concentrations were applied to overburden, treated sewage and prepared ground runoff.

☐ = Mine waste contact water (mine waste runoff, pit wall runoff, process water).

☐ = Non-mine waste contact water (direct precipitation, natural runoff, prepared surface runoff, groundwater inflow, treated sewage).

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Osisko Hammond Reef Gold Ltd.

Table C-1:   Predicted Concentrations for Key Parameters

Input Name		Description	Statistic	Number of Samples[2]	Source	Flow[3] (m³/yr)	Flow Proportion	pH[6] (s.u.)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cyanide (mg/L)
					MMER[1]			6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
AVERAGE CASE[4] (Continued)														
Low Grade Ore Stockpile														
IN	Natural Runoff	Surface runoff from catchment area	Average	42	Average non-freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	24,855	7%	6.9	0.0006	0.0007	0.001	0.0004	0.003	
	Direct Precipitation	Direct precipitation onto pond	Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	1,130	0%	5	0	0	0	0	0	
	Low Grade Ore Runoff	Surface runoff from exposed low grade ore	Average	1	Average of steady state concentrations (final five weeks of testing) of the humidity cell reporting the highest average gold grade (0.198 g/t) [2010-HR-027 - tonalite]	132,968	36%	7.1	0.0002	0.0005	0.0001	0.00002	0.001	
	Waste Rock Runoff	Surface runoff from exposed waste rock at Pumping Station 15	Average	8	Average of steady state concentrations (final five weeks of testing) of eight waste rock humidity cells mixed at proportions of units observed in cross sections	48,475	13%	7.2	0.00056	0.0005	0.0001	0.00002	0.001	
	Overburden Stockpile (Pumping Station 10)	Surface runoff from exposed overburden	Calculated	N/A	Calculated	163,052	44%	6.9	0.0000090	0.00022	0.0010	0.0000084	0.0026	
OUT	Low Grade Ore Stockpile (Pumping Station 14)	Water pumped from Low Grade Ore Stockpile to the Process Control Pond	Calculated	N/A	Calculated	369,491	N/A	6.9	0.00007	0.0003	0.00057	0.00003	0.0018	

Note:

1) MMER, 2002. Metal Mining Effluent Regulations, Column 2. Maximum Authorized Monthly Mean Concentration.

2) In the case of surface and groundwater sampling locations: total number of samples collected including all locations. In the case of humidity cell testing or aging testing: number of samples submitted for analysis.

3) Flows are calculated in the water balance based on estimated climate conditions.

4) Average Case water quality predictions are based on "Scenario 1" site water quality inputs (average statistics) and average climatic conditions.

5) Upper Bound Case water quality predictions are based on "Scenario 4" site water quality inputs (maximum process water, tailings runoff, waste rock runoff, pit wall runoff and low-grade ore runoff statistics) and 10-year wet climatic conditions.

6) pH values are based on average values for each input calculation.

Concentrations are all dissolved.

When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

Geochemical controls were applied when calculating output concentrations at each point.

Natural runoff concentrations were applied to overburden, treated sewage and prepared ground runoff.

    = Mine waste contact water (mine waste runoff, pit wall runoff, process water).

    = Non-mine waste contact water (direct precipitation, natural runoff, prepared surface runoff, groundwater inflow, treated sewage).

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Table C-1: Predicted Concentrations for Key Parameters

Input Name		Description	Statistic	Number of Samples[2]	Source	Flow[3] (m³/yr)	Flow Proportion	pH[6] (s.u.)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cyanide (mg/L)
					MMER[1]			6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
AVERAGE CASE[4] ***(Continued)***														
Waste Rock Stockpile														
IN	Natural Runoff	Surface runoff from catchment area	Average	42	Average non-freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	77,695	6%	6.9	0.0006	0.0007	0.001	0.0004	0.003	
	Direct Precipitation	Direct precipitation onto pond	Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	848	0%	5	0	0	0	0	0	
	Overburden Runoff	Surface runoff from exposed overburden at Pumping Stations 6 and 9	Average	42	Average non-freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	66,440	5%	6.9	0.0006	0.0007	0.001	0.0004	0.003	
	Prepared Ground Runoff	Runoff from site facilities	Average	42	Average non-freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	81,959	7%	6.9	0.0006	0.0007	0.001	0.0004	0.003	
	Waste Rock Runoff	Surface runoff from exposed waste rock	Average	8	Average of steady state concentrations (final five weeks of testing) of eight waste rock humidity cells mixed at proportions of units observed in cross sections	983,026	81%	7.2	0.00056	0.0005	0.0001	0.00002	0.001	
OUT	Intermediate Collection Pond	Water pumped from Waste Rock Stockpile to Process Control Pond	Calculated	N/A	Calculated	1,209,226	N/A	7.0	0.00025	0.0004	0.0003	0.000055	0.0015	

Note:

1) MMER, 2002. Metal Mining Effluent Regulations, Column 2. Maximum Authorized Monthly Mean Concentration.

2) In the case of surface and groundwater sampling locations: total number of samples collected including all locations. In the case of humidity cell testing or aging testing: number of samples submitted for analysis.

3) Flows are calculated in the water balance based on estimated climate conditions.

4) Average Case water quality predictions are based on "Scenario 1" site water quality inputs (average statistics) and average climatic conditions.

5) Upper Bound Case water quality predictions are based on "Scenario 4" site water quality inputs (maximum process water, tailings runoff, waste rock runoff, pit wall runoff and low-grade ore runoff statistics) and 10-year wet climatic conditions.

6) pH values are based on average values for each input calculation.

Concentrations are all dissolved.

When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

Geochemical controls were applied when calculating output concentrations at each point.

Natural runoff concentrations were applied to overburden, treated sewage and prepared ground runoff.

⬜ = Mine waste contact water (mine waste runoff, pit wall runoff, process water).

⬜ = Non-mine waste contact water (direct precipitation, natural runoff, prepared surface runoff, groundwater inflow, treated sewage).

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June 2, 2014

Table C-1:   Predicted Concentrations for Key Parameters

Input Name		Description	Statistic	Number of Samples[2]	Source	Flow[3] (m³/yr)	Flow Proportion	pH[6] (s.u.)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cyanide (mg/L)
					MMER[1]		6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
AVERAGE CASE[4] (Continued)														
Open Pits														
IN	Groundwater Inflow	Groundwater inflow to the Open Pits	Average	12	Average composition of the pumping test samples collected in 2011 and 2012 from two monitoring wells (BR0220 and BR0231) located within the bounds of the proposed open pits	273,750	23%	7.6	0.001	0.001	0.002	0.001	0.004	
	Pit Wall Runoff	Runoff from exposed pit walls into the Open Pits	Average	8	Average of steady state concentrations (final five weeks of testing) of eight waste rock humidity cells mixed at proportions of units observed in cross sections	941,105	77%	7.2	0.00056	0.0005	0.0001	0.00002	0.001	
OUT	Open Pit	Water pumped from the Open Pits to the Process Control Pond	Calculated	N/A	Calculated	1,214,855	N/A	7.0	0.00023	0.0003	0.0003	0.00003	0.0014	
Tailings Management Facility														
IN	Natural Runoff	Surface runoff from catchment area	Average	42	Average non-freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	508,548	3%	6.9	0.0006	0.0007	0.001	0.0004	0.003	
	Direct Precipitation	Direct precipitation onto pond	Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	402,132	3%	5	0	0	0	0	0	
	Waste Rock Runoff	Runoff from waste rock in the containment dykes	Average	8	Average of steady state concentrations (final five weeks of testing) of eight waste rock humidity cells mixed at proportions of units observed in cross sections	120,241	1%	7.2	0.00056	0.0005	0.0001	0.00002	0.001	
	Tailings Runoff	Runoff from exposed unsaturated tailings	Average	1	Average of steady state concentrations (final five weeks of testing) of one tailings humidity cell	2,902,538	18%	7.3	0.0002	0.0007	0.0003	0.00003	0.002	
	Process Water	Process water within tailings slurry	Average	1	Average of concentrations observed during aging testing of process water	11,792,308	75%	7.8	0.00013	0.1098	0.0111	0.000155	0.002	0.3
OUT	TMF Reclaim Pond	Water pumped from the TMF to the Reclaim Tank	Calculated	N/A	Calculated	7,752,815		7.8	0.00003	0.0825	0.0084	0.00013	0.0020	0.206150

Note:

1) MMER, 2002. Metal Mining Effluent Regulations, Column 2. Maximum Authorized Monthly Mean Concentration.

2) In the case of surface and groundwater sampling locations: total number of samples collected including all locations. In the case of humidity cell testing or aging testing: number of samples submitted for analysis.

3) Flows are calculated in the water balance based on estimated climate conditions.

4) Average Case water quality predictions are based on "Scenario 1" site water quality inputs (average statistics) and average climatic conditions.

5) Upper Bound Case water quality predictions are based on "Scenario 4" site water quality inputs (maximum process water, tailings runoff, waste rock runoff, pit wall runoff and low-grade ore runoff statistics) and 10-year wet climatic conditions.

6) pH values are based on average values for each input calculation.

Concentrations are all dissolved.

When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

Geochemical controls were applied when calculating output concentrations at each point.

Natural runoff concentrations were applied to overburden, treated sewage and prepared ground runoff.

= Mine waste contact water (mine waste runoff, pit wall runoff, process water).

= Non-mine waste contact water (direct precipitation, natural runoff, prepared surface runoff, groundwater inflow, treated sewage).

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Table C-1: Predicted Concentrations for Key Parameters

Input Name		Description	Statistic	Number of Samples[2]	Source	Flow[3] (m³/yr)	Flow Proportion	pH[6] (s.u.)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cyanide (mg/L)
					MMER[1]			6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
AVERAGE CASE[4] (Continued)														
Process Control Pond														
IN	Direct Precipitation	Direct precipitation onto pond	Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	33,517	1%	5	0	0	0	0	0	
	Prepared Ground Runoff	Runoff from site facilities	Average	42	Average non-freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	241,526	8%	6.9	0.0006	0.0007	0.001	0.0004	0.003	
	Treated Sewage	Treated sewage from site facilities	Average	42	Average non-freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	12,775	0%	6.9	0.0006	0.0007	0.001	0.0004	0.003	
	Low Grade Ore Stockpile (Pumping Station 14)	Water pumped from Low Grade Ore Stockpile to the Process Control Pond	Calculated	N/A	Calculated	369,491	12%	6.9	0.00007	0.0003	0.00057	0.00003	0.0018	
	Open Pit	Water pumped from the Open Pits to the Process Control Pond	Calculated	N/A	Calculated	1,214,855	39%	7.0	0.00023	0.0003	0.0003	0.00003	0.0014	
	Intermediate Collection Pond	Water pumped from Waste Rock Stockpile to Process Control Pond	Calculated	N/A	Calculated	1,209,226	39%	7.0	0.00025	0.0004	0.0003	0.000055	0.0015	
OUT	Process Control Pond	Water pumped from the Process Control Pond to the Reclaim Tank	Calculated	N/A	Calculated	2,339,010	N/A	7.0	0.0002	0.0003	0.0004	0.00004	0.0015	
Final														
OUT	*WATER TREAMENT FEED - RECLAIM TANK*	*Final Discharge Point*	*Calculated*	*N/A*	*Calculated*	*410,856*	*N/A*	7.8	0.00004	0.0754	0.0077	0.00012	0.0019	0.188450

Note:

1) MMER, 2002. Metal Mining Effluent Regulations, Column 2. Maximum Authorized Monthly Mean Concentration.

2) In the case of surface and groundwater sampling locations: total number of samples collected including all locations. In the case of humidity cell testing or aging testing: number of samples submitted for analysis.

3) Flows are calculated in the water balance based on estimated climate conditions.

4) Average Case water quality predictions are based on "Scenario 1" site water quality inputs (average statistics) and average climatic conditions.

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6) pH values are based on average values for each input calculation.

Concentrations are all dissolved.

When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

Geochemical controls were applied when calculating output concentrations at each point.

Natural runoff concentrations were applied to overburden, treated sewage and prepared ground runoff.

☐ = Mine waste contact water (mine waste runoff, pit wall runoff, process water).

☐ = Non-mine waste contact water (direct precipitation, natural runoff, prepared surface runoff, groundwater inflow, treated sewage).

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Table C-1: **Predicted Concentrations for Key Parameters**

Input Name		Description	Statistic	Number of Samples[2]	Source	Flow[3] (m³/yr)	Flow Proportion	pH[6] (s.u.)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cyanide (mg/L)
								MMER[1]	6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
UPPER BOUND CASE[5]														
Overburden Stockpile														
IN	Natural Runoff		Average	42	Average freshet (July to March) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ 14, HRWQ-21 and HRWQ 25)	8,458	4%	6.8	0.0004	0.001	0.001	0.0003	0.003	
	Direct Precipitation		Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	1,018	1%	5	0	0	0	0	0	
	Overburden Runoff		Average	42	Average freshet (April and June) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	187,175	95%	6.8	0.0004	0.001	0.001	0.0003	0.003	
OUT	Overburden Stockpile (Pumping Station 10)		Calculated	N/A	Calculated	195,909	N/A	6.8	0.0000030	0.000080	0.0012	0.00000054	0.0027	

Note:

1) MMER, 2002. Metal Mining Effluent Regulations, Column 2. Maximum Authorized Monthly Mean Concentration.

2) In the case of surface and groundwater sampling locations: total number of samples collected including all locations. In the case of humidity cell testing or aging testing: number of samples submitted for analysis.

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6) pH values are based on average values for each input calculation.

Concentrations are all dissolved.

When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

Geochemical controls were applied when calculating output concentrations at each point.

Natural runoff concentrations were applied to overburden, treated sewage and prepared ground runoff.

[orange] = Mine waste contact water (mine waste runoff, pit wall runoff, process water).

[green] = Non-mine waste contact water (direct precipitation, natural runoff, prepared surface runoff, groundwater inflow, treated sewage).

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Input Name		Description	Statistic	Number of Samples[2]	Source	Flow[3] (m³/yr)	Flow Proportion	pH[6] (s.u.)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cyanide (mg/L)
								MMER[1]	6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
UPPER BOUND CASE[5] (Continued)														
Low Grade Ore Stockpile														
IN	Natural Runoff		Average	42	Average freshet (April and June) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	30,050	7%	6.8	0.0004	0.001	0.001	0.0003	0.003	
	Direct Precipitation		Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	1,357	0%	5	0	0	0	0	0	
	Low Grade Ore Runoff		Maximum	9	Maximum concentration observed throughout humidity cell testing of nine waste rock and ore samples	159,610	36%	6.9	0.03	0.009	0.0007	0.0002	0.007	
	Waste Rock Runoff		Maximum	9	Maximum concentration observed throughout humidity cell testing of nine waste rock and ore samples	58,191	13%	6.9	0.0300	0.009	0.0007	0.0002	0.007	
	Overburden Stockpile (Pumping Station 10)		Calculated	N/A	Calculated	195,909	44%	6.8	0.0000030	0.000080	0.0012	0.00000054	0.0027	
OUT	Low Grade Ore Stockpile (Pumping Station 14)		Calculated	N/A	Calculated	444,128	N/A	6.8	0.015	0.0029	0.00094	0.00005	0.0048	

Note:

1) MMER, 2002. Metal Mining Effluent Regulations, Column 2. Maximum Authorized Monthly Mean Concentration.

2) In the case of surface and groundwater sampling locations: total number of samples collected including all locations. In the case of humidity cell testing or aging testing: number of samples submitted for analysis.

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6) pH values are based on average values for each input calculation.

Concentrations are all dissolved.

When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

Geochemical controls were applied when calculating output concentrations at each point.

Natural runoff concentrations were applied to overburden, treated sewage and prepared ground runoff.

= Mine waste contact water (mine waste runoff, pit wall runoff, process water).

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Input Name		Description	Statistic	Number of Samples[2]	Source	Flow[3] (m³/yr)	Flow Proportion	pH[6] (s.u.)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cyanide (mg/L)
					MMER[1]		6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
UPPER BOUND CASE[5] (Continued)														
Waste Rock Stockpile														
IN	Natural Runoff		Average	42	Average freshet (April and June) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	93,933	6%	6.8	0.0004	0.001	0.001	0.0003	0.003	
	Direct Precipitation		Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	1,018	0%	5	0	0	0	0	0	
	Overburden Runoff		Average	42	Average freshet (April and June) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	79,775	5%	6.8	0.0004	0.001	0.001	0.0003	0.003	
	Prepared Ground Runoff		Average	42	Average freshet (April and June) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	98,507	7%	6.8	0.0004	0.001	0.001	0.0003	0.003	
	Waste Rock Runoff		Maximum	9	Maximum concentration observed throughout humidity cell testing of nine waste rock and ore samples	1,179,991	81%	6.9	0.0300	0.009	0.0007	0.0002	0.007	
OUT	Intermediate Collection Pond		Calculated	N/A	Calculated	1,452,483	N/A	6.9	0.024	0.0041	0.00080	0.00010	0.0064	

Note:

1) MMER, 2002. Metal Mining Effluent Regulations, Column 2. Maximum Authorized Monthly Mean Concentration.

2) In the case of surface and groundwater sampling locations: total number of samples collected including all locations. In the case of humidity cell testing or aging testing: number of samples submitted for analysis.

3) Flows are calculated in the water balance based on estimated climate conditions.

4) Average Case water quality predictions are based on "Scenario 1" site water quality inputs (average statistics) and average climatic conditions.

5) Upper Bound Case water quality predictions are based on "Scenario 4" site water quality inputs (maximum process water, tailings runoff, waste rock runoff, pit wall runoff and low-grade ore runoff statistics) and 10-year wet climatic conditions.

6) pH values are based on average values for each input calculation.

Concentrations are all dissolved.

When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

Geochemical controls were applied when calculating output concentrations at each point.

Natural runoff concentrations were applied to overburden, treated sewage and prepared ground runoff.

☐ = Mine waste contact water (mine waste runoff, pit wall runoff, process water).

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Table C-1: Predicted Concentrations for Key Parameters

Input Name		Description	Statistic	Number of Samples[2]	Source	Flow[3] (m³/yr)	Flow Proportion	pH[6] (s.u.)	Arsenic (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cyanide (mg/L)
					MMER[1]			6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
UPPER BOUND CASE[5] (Continued)														
Open Pits														
IN	Groundwater Inflow		Average	12	Average composition of the pumping test samples collected in 2011 and 2012 from two monitoring wells (BR0220 and BR0231) located within the bounds of the proposed open pits	273,750	19%	7.6	0.001	0.001	0.002	0.001	0.004	
	Pit Wall Runoff		Average	8	Average of steady state concentrations (final five weeks of testing) of eight waste rock humidity cells mixed at proportions of units observed in cross sections	1,130,867	81%	6.9	0.0300	0.009	0.0007	0.0002	0.007	
OUT	Open Pit		Calculated	N/A	Calculated	1,404,617	N/A	6.9	0.02237	0.003	0.0008	0.00004	0.0062	
Tailings Management Facility														
IN	Natural Runoff		Average	42	Average freshet (April and June) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	614,835	4%	6.8	0.0004	0.001	0.001	0.0003	0.003	
	Direct Precipitation		Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	482,707	3%	5	0	0	0	0	0	
	Waste Rock Runoff		Maximum	9	Maximum concentration observed throughout humidity cell testing of nine waste rock and ore samples	144,648	1%	6.9	0.0300	0.009	0.0007	0.0002	0.007	
	Tailings Runoff		Maximum	1	Maximum concentration observed throughout humidity cell testing of one tailings sample	3,486,747	21%	7.3	0.0008	0.002	0.003	0.00007	0.04	
	Process Water		Maximum	1	Maximum concentrations observed during aging testing of process water	11,792,308	71%	7.7	0.00003	0.1598	0.0124	0.00044	0.002	0.3
OUT	TMF Reclaim Pond		Calculated	N/A	Calculated	8,548,293		7.6	0.00003	0.1145	0.0094	0.00033	0.0107	0.196075

Note:

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Concentrations are all dissolved.

When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

Geochemical controls were applied when calculating output concentrations at each point.

Natural runoff concentrations were applied to overburden, treated sewage and prepared ground runoff.

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								MMER[1]	6 to 9.5	0.5	0.3	0.5	0.2	0.5	1.0
UPPER BOUND CASE[5] (Continued)														
Process Control Pond														
IN	Direct Precipitation		Average	137	Average composition of samples in the Environment Canada CapMon Pickle Lake precipitation monitoring station dataset (CapMon 2012) for available chemical parameters	40,233	1%	5	0	0	0	0	0	
	Prepared Ground Runoff		Average	42	Average freshet (April and June) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	290,291	8%	6.8	0.0004	0.001	0.001	0.0003	0.003	
	Treated Sewage		Average	42	Average freshet (April and June) concentrations from water quality sampling locations within the Project watershed, draining away from the site and TMF (locations HRWQ-2, HRWQ-3, HRWQ-4, HRWQ-6, HRWQ-8, HRWQ-14, HRWQ-21 and HRWQ 25)	12,775	0%	6.8	0.0004	0.001	0.001	0.0003	0.003	
	Low Grade Ore Stockpile (Pumping Station 14)		Calculated	N/A	Calculated	444,128	12%	6.8	0.015	0.0029	0.00094	0.00005	0.0048	
	Open Pit		Calculated	N/A	Calculated	1,404,617	39%	6.9	0.02237	0.003	0.0008	0.00004	0.0062	
	Intermediate Collection Pond		Calculated	N/A	Calculated	1,452,483	40%	6.9	0.024	0.0041	0.00080	0.00010	0.0064	
OUT	Process Control Pond		Calculated	N/A	Calculated	2,902,146	N/A	6.9	0.02011	0.0032	0.0008	0.00006	0.0057	
Final														
OUT	*WATER TREAMENT FEED – RECLAIM TANK*		*Calculated*	*N/A*	*Calculated*	*1,769,470*	*N/A*	8.3	0.000	0.1002	0.0083	0.0003	0.010	0.170850

Note:

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6) pH values are based on average values for each input calculation.

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When calculating input values, concentrations below the analytical detection limit are assumed to be equal to the detection limit.

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