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Memo

To:	John Roberts, PEng	**Client:**	TMAC Resources Inc.
From:	Sarah Portelance, PEng Kelly Sexsmith, PGeo	**Project No:**	1CT022.002
Reviewed By:	Maritz Rykaart, PhD, PEng	**Date:**	February 3, 2016
Subject:	Document P6-10b, Water and Load Balance Model – Results of Sensitivity Analysis for Discharges to the Marine Environment		

1 Introduction

A series of Technical Review comments requested additional scenarios to be evaluated through the water and load balance model. These included:

- ECCC 4, KIA 11A and KIA 11C: Requested inclusion of free cyanide, mercury and selenium from process water be included in the water quality predictions.
- KIA 11A: Requested a description of the site specific variable hydrology and requested that it be included into the load balance of the water quality predictions.
- KIA 5, KIA 11B and AANDC TC4: Requested that the water and load balance evaluate the 75th percentile input values for background water quality, pollution control and sediment control pond concentrations, ore and waste rock source terms and the tailings beach source term.

A memo documenting the results of the sensitivity analyses for the TIA pond and Doris Creek was provided to TMAC on January 28, 2016 (SRK, 2016)[1]. During technical sessions with the NWB and other parties on January 29, 2016, KIA also requested a summary of results from the sensitivity analyses for discharges to the marine environment prior to mixing and dispersion within Roberts Bay. The results for discharges from the TIA, groundwater, and mixed TIA/groundwater are presented herein.

SRK understands that ERM is completing hydrodynamic dispersion modelling to estimate concentrations within Roberts Bay after mixing. Results of those analyses will be provided at a later date.

[1] SRK Consulting (Canada) Inc. 2016. Document P6-10b, Water and Load Balance Model – results of Sensitivity Analysis for TIA and Doris Creek. Technical Memo prepared for TMAC Resources, Project Number 1CT022.002, January 28.

This memo was delivered to TMAC and has subsequently been submitted to the NIRB and NWB.

2 Results

The results for both the base case and sensitivity analyses for TIA discharges, groundwater concentrations and mixed concentrations are provided in Table 1. Discharge concentrations from the TIA are expected to vary over time, as shown in the figures provided in Attachment A of the January 28, 2016 memo (SRK 2016); therefore, maximum base case and sensitivity concentrations are shown in the summary table. Results for parameters with CCME water quality guidelines for the marine environment are highlighted, and include calculated dilution ratios required to meet the marine guidelines. The calculations indicate that the maximum dilution required to meet the guidelines is 6.4x. According to the preliminary results of near field 3D hydrodynamic modelling presented by ERM at the Cambridge Bay Technical Meeting between January 26 and 29, 2016, this can be achieved within 1.5 metres of the diffuser.

Table 1: Summary of Concentrations in TIA, Groundwater and Mixed Discharges to Roberts Bay

Parameter	Discharge Concentrations					Roberts Bay	Roberts Bay	CCME	Dilution Required				
	TIA Only		GW Only	TIA+GW					TIA		GW	TIA+GW	
	Base Case	Sensitivity	P95	Base Case	Sensitivity	median	P75	Guideline	Base Case	Sensitivity	P95	Base Case	Sensitivity
Total CN	0.096	0.12	0.0036	0.056	0.068	0.0012	0.0013						
WAD CN	0.051	0.062	0.0036	0.031	0.037								
Chloride	113	122	14780	6399	6404								
Ammonia N	3.3	3.9	3.4	3.3	3.7								
Nitrate	0.70	1.0	0.93	0.80	0.98	0.046	0.075	45	0.016	0.023	0.021	0.018	0.022
Nitrite	0.60	0.66	0.098	0.39	0.42								
Aluminum	0.25	0.33	0.035	0.16	0.20								
Arsenic	0.0072	0.016	0.0024	0.0051	0.010	0.0010	0.0014	0.0125	0.57	1.32	0.19	0.41	0.83
Barium	0.15	0.17	0.12	0.14	0.15	0.012	0.013						
Beryllium	0.00041	0.0017	0.00086	0.00060	0.0013	0.00050	0.050						
Boron	0.19	0.24	2.8	1.3	1.3	3.7	3.8						
Cadmium	0.00036	0.00040	0.00012	0.00026	0.00028	0.000056	0.000068	0.00012	3.0	3.4	1.0	2.2	2.3
Chromium	0.0083	0.0096	0.00086	0.0051	0.0058	0.0010	0.050	0.0015	5.5	6.4	0.6	3.4	3.9
Cobalt	0.0072	0.0091	0.0015	0.0048	0.0059	0.000050	0.000050						
Copper	0.058	0.064	0.0012	0.033	0.037	0.00041	0.00046						
Iron	3.5	3.9	4.7	4.0	4.2	0.011	0.031						
Lead	0.0020	0.0024	0.00029	0.0013	0.0015	0.000050	0.00022						
Manganese	0.16	0.23	1.7	0.82	0.86	0.0015	0.0019						
Mercury	0.000063	0.000081	0.000049	0.000057	0.000067	0.0000013	0.0000018	0.000016	3.9	5.0	3.1	4	4.2
Molybdenum	0.086	0.099	0.018	0.057	0.064								
Nickel	0.0103	0.0122	0.0018	0.0066	0.0077	0.00050	0.00058						
Selenium	0.0057	0.0063	0.0019	0.0041	0.0044	0.00050	0.00078						
Silver	0.010	0.011	0.000097	0.0059	0.0065	0.00020	0.0010	0.0075	1.38	1.52	0.013	0.79	0.87
Strontium	0.22	0.24	27	12	12	5.8	6.0						
Thallium	0.00034	0.00044	0.000086	0.00023	0.00029								
Uranium	0.00035	0.00045	0.000089	0.00024	0.00030	0.0023	0.0024						
Vanadium	0.0025	0.0031	0.00086	0.0018	0.0021	0.00077	0.10						
Zinc	0.037	0.045	0.15	0.086	0.090	0.00080	0.0018						