AMENDED EIS/EA REPORT
CHAPTER 6: EFFECTS ASSESSMENT
VERSION 3

CANADIAN MALARTIC CORPORATION

TABLES

Table 6-1: Location, Lithology, Acid Base Accounting and Net Acid Generation Test Results for 2009 Ore and Composite Samples

Parameter	Collar Location				From (m)	To (m)	Lithology ID[c]	Acid Base Accounting											Net Acid Generation Testing
	Zone	Section	Easting	Northing				Paste pH (s.u.)	NP[d] (t $CaCO_3$/1000 t)	AP[d] (t $CaCO_3$/1000 t)	NPR[d] (ratio)	CaNPR[d] (ratio)	Total Sulphur (%)	Sulphate (%)	Sulphide (%)	Total Carbon (%)	Carbonate (%)	Carbonate NP (%)	Final NAG-pH (s.u.)
Drill Hole Composites																			
BR-2	41	3470E	613783.11	5422056.3	145	191	11, 20, 50	9.31	73.2	5.43	**13.5**	**14.0**	0.16	<0.01	0.17	1.02	4.55	75.8	10.8
BR-13	41	3370E	613613.95	5422128.9	40.5	126	20, 32, 33, 34	9.23	70.4	6.59	**10.7**	**10.7**	0.33	0.12	0.21	0.98	4.23	70.5	10.1
BR-23	41	3270E	613543.79	5422052.9	63	139.5	20, 33, 40, 60	9.23	102	4.51	**22.6**	**24.2**	0.26	0.12	0.14	1.47	6.56	109.4	10.1
BR-28	A	1820E	612237.07	5421397.1	21.5	102.5	20, 33, 34, 40	9.15	51.2	4.41	**11.6**	**11.8**	0.26	0.11	0.14	0.72	3.11	51.8	10.1
BR-64	A	1670E	612220.71	5421160.8	91.5	292.5	11, 15, 20, 32, 40	9.29	59.8	6.42	**9.3**	**8.8**	0.35	0.14	0.21	0.84	3.40	56.7	10.6
BR-67	A	1670E	611838.62	5420825.7	NR	NR	NR	9.36	71.3	5.27	**13.5**	**13.1**	0.43	0.26	0.17	0.96	4.13	68.8	10.9
BR-68 [a]	A	1800E	612374.18	5421187.2	141	256.5	13, 15, 40	-	-	-	**-**	**-**	-	-	-	-	-	-	-
BR-87	A	1420E	611912.97	5421162.9	3.74	88.5	12, 15, 20	9.37	46.9	3.23	**14.5**	**13.8**	0.35	0.25	0.1	0.60	2.67	44.5	10.9
BR-88	A	1420E	611985.14	5421059.7	160.5	252	20	9.6	37.8	4.68	**8.1**	**7.6**	0.37	0.22	0.15	0.50	2.13	35.5	10.3
BR-102	A	1670E	612149.06	5421258	6.52	213	20, 33, 40	9.47	53	4.71	**11.3**	**10.9**	0.26	0.11	0.15	0.70	3.08	51.3	10.9
Zone Composites																			
A-Zone [b]	A	---	---	---	---	---	---	9.12	57.7	5.09	**11.3**	**11.3**	0.31	0.14	0.16	0.85	3.46	57.7	10.3
41-Zone [b]	41	---	---	---	---	---	---	9.39	85.2	3.54	**24.0**	**24.6**	0.39	0.28	0.11	1.17	5.22	87.0	9.8
Master Composite[b]	A and 41	---	---	---	---	---	---	9.32	66.3	7.8	**8.5**	**7.4**	0.31	0.1	0.3	0.93	3.5	57.8	10.6
Grade Composites																			
LG A-Zone [b]	A	---	---	---	---	---	---	9.05	55.9	2.83	**19.7**	**18.8**	0.19	0.1	0.09	0.75	3.19	53.2	10.5
HG A-Zone [b]	A	---	---	---	---	---	---	9.31	54.8	7.22	**7.6**	**7.0**	0.45	0.22	0.23	0.74	3.05	50.8	10.2
EHG[b]	41	---	---	---	---	---	---	9.07	71.2	13.00	**5.5**	**4.2**	0.80	0.38	0.42	1.02	3.26	54.3	9.3

Note:

0.1 = Non-Potentially Acid Generating (Non- PAG), according to MEND (2009) guidelines.

A dash "-" indicates that no data was reported. A triple dash "---" indicates that the data is presented in the Brett Resources Inc., 2009. An investigation of gold recovery from Hammond Reef Project samples, Project 11734-002 – Final Report. "NR" indicates that no information was recorded.

a) Acid base accounting (ABA) and net acid generation (NAG) testing were not conducted on the drill composite sample BR-68.

b) For further detail on sample composition of the composite samples see the Supplemental Information package provided as part of the Version 2 Geochemistry TSD.

c) Description of the lithology ID codes is as follows: 11- fine grained granite; 12- contaminated granite; 15 - chloritic granite porphyry; 20 - altered granitoid; 32- sheared granitoid; 33 - chlorite schist; 34 - tectonized-sheared vein zone/brecciated pegmatite; 40 - pegmatite; 50 - mafic dyke; 60 - intermediate dyke.

d) NP = neutralization potential; AP = acid potential; NPR = neutralization potential ratio; and CaNPR = carbonate neutralization potential ratio.

Table 6-2: Summary of Elemental Composition, ABA and NAG testing of Combined Tailing Composite Sample

Elemental Composition

Laboratory	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	Cr_2O_3 (%)	Ag (µg/g)	As (µg/g)	Cu (µg/g)	Mo (µg/g)	V (µg/g)	Cd (µg/g)	Zn (µg/g)
SGS Lakefield	67.8	13.3	3.61	0.01	0.22	2.5	30	3.6	35	0.33	46
Lakehead	67.4	13.4	3.65	0.01	<0.5	5.3	39	5.0	43	<0.5	64

ABA and NAG Results

Rock Type	Sulphur Species (wt%)			CO_3 (wt%)	Potentials (*t $CaCO_3$/1000t*)			NPR	CaNPR	NAG
	Total	Sulphate	Sulphide		NP	AP	CaNP			pH
SGS Lakefield	0.175	0.08	0.09	4.84	77	2.85	80	27	28	11
Lakehead	0.26	—	—	—	103.8	—	—	—	—	10.7/11.5

Table 6-3: Summary of Short Term Leach Test Results for Combined Tailings Composite Sample

Parameter	Unit	MISA	CWQG Aquatic Life	PWQO	SGS Lakefield		Lakehead
					SFE Leach	NAG Leach	NAG Leach
pH	units	6 - 9.5	6.5 - 9.0	6.5 - 8.5	**8.65**	**11.1**	**11.4**
SO_4	mg/L	—	—	—	55	19	—
Ag	mg/L	—	0.0001	0.0001	<0.00001	**0.00033**	<0.01
Al	mg/L	—	0.1[(a)]	0.075[(a)]	**0.14**	**1.6**	**2.31**
As	mg/L	1.0	0.005	0.005	0.001	0.0006	<0.025
B	mg/L	—	—	0.2	0.0038	**0.801**	—
Cd	mg/L	—	0.0001	0.000017	0.000005	<0.000003	<0.0005
Cr(total)	mg/L	—		0.009	<0.0005	**0.021**	**0.024**
Cr(VI)	mg/L	—	0.001	0.001	<0.00002	**0.02**	—
Cu	mg/L	0.6	0.002 - 0.004	0.001	**0.0013**	<0.0005	<0.005
Se	mg/L	—	0.001	0.1	<0.001	<0.001	<0.05
V	mg/L	—	—	0.006	0.00005	0.000003	—
Zn	mg/L	—	0.03	0.02	<0.001	<0.001	**0.048**

Note:
Bolded values do not meet one or more of the guidelines.
a) Criteria for aluminum based on observed pH values greater than 6.5.

Table 6-4: Aging Tests Results – Combined Tailing Composite Sample – Process Water

Parameter	Unit	MISA	CWQG Aquatic Life	PWQO	SGS Lakefield				Lakehead			
					Day 0	Day 7	Day 15	Day 30	Day 0	Day 7	Day 15	Day 30
pH	units	6 - 9.5	6.5 - 9.0	6.5 - 8.5	8.46	8.39	8.36	8.31	7.9	7.9	7.7	7.7
SO_4	mg/L	—	—	—	210	240	240	280	160	256	275	270
Total Concentrations												
Al	mg/L	—	0.1	0.075	**0.44**	0.04	0.01	0.04	**0.48**	**0.75**	**0.18**	**0.27**
Cd	mg/L	—	0.000017	0.0001	0.000012	0.000016	<0.000003	**0.00005**	<0.0002	0.0002	<0.0002	<0.0002
Co	mg/L	—	—	0.0009	**0.0028**	**0.0029**	**0.0028**	**0.003**	**0.0027**	**0.0025**	**0.0028**	**0.0029**
Cu	mg/L	0.3	0.002	0.001	**0.0047**	**0.015**	**0.0093**	**0.0045**	**0.019**	**0.057**	**0.16**	**0.16**
Mo	mg/L	—	—	0.04	**0.076**	**0.086**	**0.08**	**0.087**	**0.065**	**0.062**	**0.06**	**0.06**
Ni	mg/L	0.5	0.025	0.025	0.0077	0.0077	0.0067	0.0073	0.012	**0.029**	**0.039**	**0.034**
Pb	mg/L	0.2	0.001[1]	0.001	0.00089	**0.0032**	0.00024	0.00062	<0.0025	<0.0025	0.0026	<0.0025
U	mg/L	—	—	0.005	**0.0065**	**0.0062**	**0.0074**	**0.0094**	<0.05	<0.05	<0.05	<0.05
Zn	mg/L	0.5	0.03	0.02	<0.002	<0.002	<0.002	0.002	**0.032**	**0.031**	**0.043**	**0.051**
Dissolved Concentrations												
Al	mg/L	—	0.1	0.075	0.04	0.02	<0.01	0.04	0.017	—	—	—
Cd	mg/L	—	0.000017	0.0001	0.000009	**0.000026**	<0.000003	0.000028	<0.0002	—	—	—
Co	mg/L	—	—	0.0009	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	—	—	—
Cu	mg/L	0.3	0.002	0.001	**0.0027**	**0.016**	**0.0091**	**0.0044**	**0.012**	—	—	—
Mo	mg/L	—	—	0.04	**0.072**	**0.083**	**0.079**	**0.091**	**0.06**	—	—	—
Ni	mg/L	0.5	0.025	0.025	0.007	0.0078	0.0066	0.0079	0.011	—	—	—
Pb	mg/L	0.2	0.001[1]	0.001	0.00006	0.00008	0.00004	0.00044	<0.025	—	—	—
U	mg/L	—	—	0.005	**0.0063**	**0.0060**	**0.0072**	**0.0086**	<0.08	—	—	—
Zn	mg/L	0.5	0.03	0.02	<0.002	<0.002	<0.002	<0.002	0.002	—	—	—

Note:

Bolded values do not meet one or more of the criteria considered.

Table 6-5: Loss/Alterations to Soil Series in Local Study Area

Soil Map Unit	Baseline		Project Disturbance	
	Area (ha)	% LSA	Area (ha)	% LSA
Dystric Brunisol-fine	382	4	125	1
Dystric Brunisol-Gleysol –coarse	142	2	11	<1
Dystric Brunisol-Gleysol –fine	1,097	13	315	4
Dystric Brunisol-Regosol	205	2	75	1
Gleysol-Regosol	120	1	116	1
Gleysol-Terric Organic	125	1	15	<1
Terric Organic-Gleysol	693	8	281	3
Regosol-bedrock	4,816	57	64	1
Water	915	11	40	1
Total	**8,495**	**100**	**1,074**	**13**

Table 6-6: Loss/Alterations to Terrain Units in the Local Study Area

Terrain Unit	Baseline		Project Disturbance	
	Area (ha)	% LSA	Area (ha)	% LSA
Bedrock	5,633	66	632	7
Glaciolacustrine	1,277	15	371	4
Glaciofluvial ice contact deposits	187	2	36	<1
Fluvial	70	1	0	0
Water	902	4	36	<1
Total	**8,494**	**100**	**1,074**	**13**

Table 6-7: Activities and Compounds Released for the Mine Site

Project Component	Activity	Compounds Released												
		TSP	PM_{10}	$PM_{2.5}$	DPM	Metals	NO_X	CO	SO_2	HC	HCN	HCl	NH_3	NaOH
Open Pit Extraction	Blasting – fugitive dust and explosives	X	X	X	—	X	X	X	—	—	—	—	—	—
	Material Handling	X	X	X	—	X	—	—	—	—	—	—	—	—
	Bulldozing	X	X	X	—	X	—	—	—	—	—	—	—	—
	Grading	X	X	X	—	X	—	—	—	—	—	—	—	—
	Vehicles – Exhaust Emissions	X	X	X	X	—	X	X	X	X	—	—	—	—
	Vehicles – Unpaved Fugitive Road Dust	X	X	X	—	X	—	—	—	—	—	—	—	—
Low Grade Ore Stockpile	Material Handling	X	X	X	—	X	—	—	—	—	—	—	—	—
	Bulldozing	X	X	X	—	X	—	—	—	—	—	—	—	—
	Grading	X	X	X	—	X	—	—	—	—	—	—	—	—
Waste Rock Stockpile	Material Handling	X	X	X	—	—	—	—	—	—	—	—	—	—
	Bulldozing	X	X	X	—	—	—	—	—	—	—	—	—	—
	Grading	X	X	X	—	—	—	—	—	—	—	—	—	—
Surface Roads	Vehicles – Exhaust Emissions	X	X	X	X	—	X	X	X	X	—	—	—	—
	Vehicles – Unpaved Fugitive Road Dust	X	X	X	—	X	—	—	—	—	—	—	—	—
Ore Crushing and Screening	Material Handling	X	X	X	—	X	—	—	—	—	—	—	—	—
	Ore Crushing	X	X	X	—	X	—	—	—	—	—	—	—	—
	Ore Screening	X	X	X	—	X	—	—	—	—	—	—	—	—
Ore Processing and Refining	CIP Adsorption			—	—	—	—	—	—	—	—	—	X	X
	Acid Wash			—	—	—	—	—	—	—	—	X	—	—
	Carbon Regeneration	X	X	X	—	X	—	X	—	—	—	—	—	—
	Regeneration Furnace			—	—	—	X		X	—	—	—	—	—
	Cyanide Destruction			—	—	—	—	—	X	—	—	—	X	—
	Electrowinning			—	—	—	—	—	—	—	—	—	X	X
	Smelting Furnace	X	X	X	—	X	—	—	—	—	—	—	—	—
	Sodium Cyanide Use	—	—	—	—	—	—	—	—	—	X	—	—	—
Emergency Power Generators	Stationary Diesel Combustion	X	X	—	X	—	X	X	X	—	—	—	—	—
Comfort Heating	Propane Combustion	X	X	X	—	—	X	X	X	—	—	—	—	—

Note:
TSP = total suspended particulates; DPM = diesel particulate matter; — = Compound not released.

Table 6-8: Access Road (Hardtack/Sawbill) Fleet Traffic

Vehicle Type	Number of Trips per Day (1-way)
Pickup	3
Passenger Car	85
Passenger Van	1
Transport Truck	18

Table 6-9: Comparison of Mobile Emissions Sources in Construction and Operations Phases

Parameter	Construction Phase	Operations Phase
No. of trucks greater 2,000 HP	10	20
Total distance travelled (VKT/day) (indicator for dust emissions)	4,332	8,248
Diesel fuel consumption (L/yr.) mobile sources (indicator for exhaust gases emissions)	12,849,208	61,773,535
Diesel fuel consumption (L/yr.) stationary sources (indicator for electricity exhaust gases emissions)	7,078,080	Emergency testing only
Total diesel fuel consumption (L/yr.)	19,927,288	61,773,535

Table 6-10: Daily Emission Rates for the Mine Site

Project Component	Activity	Daily Emission Rates (g/s)												
		TSP	PM_{10}	$PM_{2.5}$	DPM	Metals	NO_X	CO	SO_2	HC	HCN	HCl	NH_3	NaOH
Open Pit Extraction	Blasting – fugitive dust and explosives	0.877	0.456	0.026	—	0.345	0.213	2.449	—	—	—	—	—	—
	Material Handling	9.549	3.819	1.528	—	3.762	—	—	—	—	—	—	—	—
	Bulldozing	5.072	1.089	0.533	—	1.998	—	—	—	—	—	—	—	—
	Grading	0.001	0.001	0.000	—	0.001	—	—	—	—	—	—	—	—
	Vehicles – Exhaust Emissions	0.702	0.702	0.681	0.702	—	19.504	12.165	0.003	2.827	—	—	—	—
	Vehicles – Unpaved Fugitive Road Dust	81.469	23.618	2.362	—	8.147	—	—	—	—	—	—	—	—
Low Grade Ore Stockpile	Material Handling	1.586	0.634	0.254	—	1.586	—	—	—	—	—	—	—	—
	Bulldozing	1.268	0.272	0.133	—	1.268	—	—	—	—	—	—	—	—
	Grading	0.000	0.000	0.000	—	0.000	—	—	—	—	—	—	—	—
Waste Rock Stockpile	Material Handling	5.787	2.315	0.926	—	—	—	—	—	—	—	—	—	—
	Bulldozing	1.268	0.272	0.133	—	—	—	—	—	—	—	—	—	—
	Grading	0.000	0.000	0.000	—	—	—	—	—	—	—	—	—	—
Surface Roads	Vehicles – Exhaust Emissions	0.801	0.801	0.777	0.801	—	22.249	13.878	0.003	3.225	—	—	—	—
	Vehicles – Unpaved Fugitive Road Dust	92.936	26.942	2.694	—	9.294	—	—	—	—	—	—	—	—
Ore Crushing and Screening	Material Handling	0.978	0.391	0.115	—	0.978	—	—	—	—	—	—	—	—
	Ore Crushing	0.527	0.196	0.362	—	0.527	—	—	—	—	—	—	—	—
	Ore Screening	0.047	0.016	0.002	—	0.047	—	—	—	—	—	—	—	—

Table 6-10: Daily Emission Rates for the Mine Site

Project Component	Activity	Daily Emission Rates (g/s)												
		TSP	PM_{10}	$PM_{2.5}$	DPM	Metals	NO_X	CO	SO_2	HC	HCN	HCl	NH_3	NaOH
Ore Processing and Refining	CIP Adsorption	—	—	—	—	—	—	—	—	—	—	—	0.469	0.268
	Acid Wash	—	—	—	—	—	—	—	—	—	—	1.973	—	—
	Carbon Regeneration	0.104	0.104	0.104	—	0.104	—	0.038	—	—	—	—	—	—
	Regeneration Furnace	—	—	—	—	—	0.024	—	0.000	—	—	—	—	—
	Cyanide Destruction	—	—	—	—	—	—	—	19.831	—	—	—	0.002	—
	Electrowinning	—	—	—	—	—	—	—	—	—	—	—	0.589	0.214
	Smelting Furnace	0.199	0.199	0.199	—	0.199	—	—	—	—	—	—	—	—
	Sodium Cyanide Use	—	—	—	—	—	—	—	—	—	0.462	—	—	—
Emergency Power Generators	Stationary Diesel Combustion	0.781	0.372	—	0.781	—	32.002	7.262	13.879	—	—	—	—	—
Comfort Heating	Propane Combustion	0.166	0.166	0.166	—	—	3.085	1.780	0.004	—	—	—	—	—

Note:
— = Compound not emitted from this source.

Table 6-11: Percentage Contributions for Daily Emission Rates

Project Component	Percentage Contributions for Daily Emission Rates (%)												
	TSP	PM_{10}	$PM_{2.5}$	DPM	Metals	NOx	CO	SO_2	HC	HCN	HCl	NH_3	NaOH
Open Pit Extraction	48%	48%	47%	31%	50%	26%	39%	<1%	47%	—	—	—	—
Low Grade Ore Stockpile	1%	1%	4%	—	10%	—	—	—	—	—	—	—	—
Waste Rock Stockpile	3%	4%	10%	—	—	—	—	—	—	—	—	—	—
Surface Roads	46%	44%	32%	35%	33%	29%	37%	<1%	53%	—	—	—	—
Ore Crushing and Screening	<1%	<1%	4%	—	5%	—	—	—	—	—	—	—	—
Ore Processing and Refining	<1%	<1%	3%	—	1%	<1%	<1%	59%	—	100%	100%	100%	100%
Emergency Power Generators	<1%	<1%	—	34%	—	42%	19%	41%	—	—	—	—	—
Comfort Heating	<1%	<1%	2%	—	—	4%	5%	<1%	—	—	—	—	—

Note:
— = Compound not emitted from this source.

Table 6-12: Daily Emission Rates for the Access Road (Hardtack/Sawbill)

Vehicle Type	Emission Rate (g/s)					
	TSP	PM_{10}	$PM_{2.5}$	NO_X	SO_2	CO
Pickup	0.79	0.34	0.03	0.003	0.00001	0.01
Passenger Car	22.42	9.62	0.96	0.026	0.00025	0.87
Passenger Van	0.26	0.11	0.01	0.001	0.00000	0.02
Transport Truck	4.75	2.04	0.20	0.052	0.00011	0.01

Table 6-13: Ontario Compliance Status of the Project

Compound	Averaging Period	POI Concentration (µg/m³)	Schedule 3 Standard/ Guideline	% of Standard/ Guideline
NO_X	24-hr	2.10	200	1%
NO_X	1-hr	103.30	400	26%
TSP	24-hr	76.97	120	64%
SO_2	24-hr	23.91	275	9%
SO_2	1-hr	221.90	690	32%
CO	1/2-hr	1,432.39	6,000	24%
HCl	24-hr	15.37	20	77%
Ammonia	24-hr	11.09	100	11%
HCN	24-hr	4.83	8	60%
NaOH	24-hr	5.04	10	50%
Silver	24-hr	1.00×10^{-4}	1	<1%
Arsenic	24-hr	4.58×10^{-4}	0.3	<1%
Beryllium	24-hr	1.97×10^{-4}	0.01	2%
Cadmium	24-hr	1.34×10^{-5}	0.025	<1%
Cobalt	24-hr	1.69×10^{-3}	0.1	2%
Chromium	24-hr	6.82×10^{-3}	0.5	1%
Copper	24-hr	3.87×10^{-3}	50	<1%
Manganese	24-hr	7.80×10^{-2}	0.4	19%
Nickel	24-hr	4.73×10^{-3}	2	<1%
Lead	24-hr	3.85×10^{-3}	0.5	1%
Antimony	24-hr	3.42×10^{-5}	25	<1%
Selenium	24-hr	2.53×10^{-4}	10	<1%
Tin	24-hr	2.24×10^{-4}	10	<1%
Tellurium	24-hr	7.85×10^{-5}	10	<1%
Vanadium	24-hr	7.29×10^{-3}	2	<1%

Table 6-14: Change in the Tributary Drainage Area to Lumby Creek

Watercourse Name	Existing Watershed Area (ha)	Change due to Runoff Diversion (ha)	Change due to Runoff Interception (ha)	New Watershed Area (ha)	Total Change as Percent of Existing Watershed Area (%)
Lumby Creek	6,272	+9.67	-439	5,842	-6.9%

Table 6-15: Changes to Monthly Mean Flows in Lumby Creek

Month	Maximum Change in Flow (%)	Minimum Change in Flow (%)
Jan	-3.3	-0.6
Feb	-2.2	0.0
Mar	-6.8	0.0
Apr	-7.7	-4.4
May	-7.6	-6.2
Jun	-7.5	-5.8
Jul	-7.4	-3.8
Aug	-7.1	-2.8
Sep	-6.7	-2.1
Oct	-6.8	-2.3
Nov	-6.1	-2.3
Dec	-5.5	-1.1
Overall	**-7.7**	**No change**

Table 6-16: Flows in Sawbill Creek

Flow Statistic	Magnitude (m^3/s)
Annual Mean	0.861
Fall Mean	0.638
Winter Mean	0.425
Spring Mean	1.393
Summer Mean	0.957
7Q20[(a)]	0.149

Note:

a) Annual minimum 7-day mean flow with a 20-year return period.

Table 6-17: Freshwater Supply to the Processing Plant

Month	Freshwater Supply (m^3/hr)								
	Average Year	Wet Year Return Period (yrs.)				Dry Year Return Period (yrs.)			
		10	25	50	100	10	25	50	100
Jan	301.5	301.5	301.5	301.5	301.5	490.9	858.0	861.6	864.8
Feb	301.5	301.5	301.5	301.5	301.5	898.0	898.0	898.0	898.0
Mar	301.5	301.5	301.5	301.5	301.5	808.2	819.1	826.2	832.4
Apr	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
May	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	349.9
Jun	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
Jul	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
Aug	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
Sep	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
Oct	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	397.3
Nov	301.5	301.5	301.5	301.5	301.5	301.5	301.5	477.6	684.3
Dec	301.5	301.5	301.5	301.5	301.5	301.5	558.1	791.4	800.2
Year	**301.5**	**301.5**	**301.5**	**301.5**	**301.5**	**406.4**	**460.2**	**495.4**	**526.2**

Table 6-18: Discharges of Treated Wastewater Effluent from the Mine Site

Month	Discharges of Treated Wastewater Effluent (m^3/hr)								
	Average Year	Wet Year Return Period (yrs.)				Dry Year Return Period (yrs.)			
		10	25	50	100	10	25	50	100
Jan	46.9	202.0	259.2	255.4	228.5	0.0	0.0	0.0	0.0
Feb	46.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	46.9	139.9	32.9	3.2	0.4	0.0	0.0	0.0	0.0
Apr	46.9	236.7	328.6	394.9	442.9	0.0	0.0	0.0	0.0
May	46.9	235.6	326.4	391.8	439.3	0.0	0.0	0.0	0.0
Jun	46.9	236.7	328.6	394.9	442.9	0.0	0.0	0.0	0.0
Jul	46.9	235.6	326.4	391.8	439.3	0.0	0.0	0.0	0.0
Aug	46.9	235.6	322.6	389.8	452.8	0.0	0.0	0.0	0.0
Sep	46.9	230.5	339.6	386.4	467.2	0.0	0.0	0.0	0.0
Oct	46.9	250.9	309.6	349.1	384.1	0.0	0.0	0.0	0.0
Nov	46.9	202.0	259.2	297.7	331.8	0.0	0.0	0.0	0.0
Dec	46.9	202.0	259.2	297.7	331.8	0.0	0.0	0.0	0.0
Year	**46.9**	**202.0**	**259.2**	**297.7**	**331.8**	**0.0**	**0.0**	**0.0**	**0.0**

Table 6-19: Changes in Annual Mean Inflows to Upper Marmion Reservoir

Project Activity	Changes to Annual Mean Inflows (m^3/s)		
	Average Year	100yr Dry	100yr Wet
Runoff Interception	0.115	0.035	0.218
Potable Water Supply to Camp Site	0.001	0.001	0.001
Process Water Supply to Mine Site	0.084	0.147	0.084
Treated Effluent Discharges from Camp and Mine Sites	-0.014	-0.001	-0.093
Mine Dewatering	0.006	0.006	0.006
Total Net Reduction	0.192	0.188	0.216

Table 6-20: Combined Project Influences on Upper Marmion Reservoir Inflows (Net Reduction)

Month	Net Reduction in Upper Marmion Inflows (m^3/s)								
	Average Year	Wet Year Return Period (yrs.)				Dry Year Return Period (yrs.)			
		10	25	50	100	10	25	50	100
Jan	0.137	0.114	0.108	0.109	0.126	0.192	0.284	0.275	0.276
Feb	0.127	0.150	0.160	0.160	0.170	0.295	0.285	0.285	0.275
Mar	0.127	0.111	0.151	0.149	0.170	0.261	0.264	0.266	0.257
Apr	0.177	0.194	0.189	0.180	0.177	0.180	0.160	0.150	0.130
May	0.307	0.514	0.549	0.571	0.588	0.230	0.210	0.180	0.183
Jun	0.307	0.364	0.369	0.380	0.397	0.200	0.170	0.160	0.140
Jul	0.257	0.244	0.239	0.251	0.248	0.180	0.160	0.140	0.130
Aug	0.187	0.174	0.180	0.172	0.174	0.140	0.140	0.120	0.120
Sep	0.187	0.156	0.135	0.132	0.120	0.130	0.120	0.110	0.110
Oct	0.177	0.150	0.144	0.143	0.143	0.160	0.150	0.130	0.156
Nov	0.167	0.154	0.158	0.157	0.158	0.140	0.140	0.169	0.226
Dec	0.147	0.134	0.138	0.127	0.128	0.130	0.201	0.256	0.248
Annual	**0.192**	**0.205**	**0.210**	**0.211**	**0.216**	**0.186**	**0.190**	**0.187**	**0.188**

Table 6-21: Predicted Changes in Upper Marmion Reservoir Outflows (Single-Year Lake Water Balances)

Month	Average Year	Wet Year Return Period (yrs.)				Dry Year Return Period (yrs.)			
		10	25	50	100	10	25	50	100
	Percentage Change in Outflows								
Jan	-0.34	-0.26	-0.22	-0.21	-0.22	-0.49	-0.80	-0.86	-1.40
Feb	-0.29	-0.33	-0.34	-0.32	-0.33	-0.77	-0.81	-0.86	-0.88
Mar	-0.40	-0.30	-0.38	-0.36	-0.40	-0.82	-0.92	-1.03	-1.06
Apr	-0.93	-0.66	-0.53	-0.49	-0.43	-1.16	-1.35	-1.50	-1.30
May	-3.10	-1.54	-1.02	-0.84	-0.72	-2.30	-2.10	-1.80	-1.80
Jun	-0.63	-0.38	-0.35	-0.33	-0.32	-2.00	-1.70	-1.60	-1.40
Jul	-0.43	-0.31	-0.28	-0.27	-0.26	-1.80	-1.60	-1.40	-1.30
Aug	-0.38	-0.30	-0.28	-0.24	-0.23	-0.77	-1.40	-1.20	-1.20
Sep	-0.55	-0.36	-0.28	-0.24	-0.21	-0.87	-1.20	-1.10	-1.10
Oct	-1.23	-0.65	-0.49	-0.44	-0.42	-1.60	-1.50	-1.30	-1.60
Nov	-0.50	-0.33	-0.32	-0.30	-0.27	-0.77	-1.40	-1.70	-2.30
Dec	-0.31	-0.26	-0.23	-0.22	-0.21	-0.35	-0.70	-1.90	-2.50

Table 6-22: Predicted Changes in Upper Marmion Reservoir Outflows (Continuous Lake Water Balances)

Month	Water Taking Scenario					
	Average Year		100 Year Wet		100 Year Dry	
	Maximum Percent Change	Minimum Percent Change	Maximum Percent Change	Minimum Percent Change	Maximum Percent Change	Minimum Percent Change
Jan	-1.30	-0.32	-0.70	-0.15	-2.90	-0.66
Feb	-0.74	-0.26	-0.88	-0.32	-1.96	-0.69
Mar	-0.44	-0.27	-0.51	-0.31	-1.07	-0.62
Apr	-1.40	-0.68	-0.49	0.00	-1.50	-0.71
May	-4.70	-1.06	-3.60	-0.30	-4.90	-1.11
Jun	-3.00	-0.41	-1.90	-0.20	-3.20	-0.42
Jul	-2.60	-0.36	-1.50	0.00	-2.70	-0.37
Aug	-2.40	-0.34	-1.30	0.20	-2.60	-0.35
Sep	-1.80	-0.36	-0.60	0.30	-1.90	-0.37
Oct	-2.40	-0.50	-1.50	0.00	-2.80	-0.55
Nov	-1.40	-0.39	-0.70	-0.10	-2.60	-0.53
Dec	-4.70	-0.33	-0.60	-0.09	-2.90	-0.57
Overall	**-4.70**	**-0.26**	**-3.60**	**0.30**	**-4.90**	**-0.35**

Table 6-23: Changes to Monthly Mean Water Levels in Unnamed Lake 5 (API #8)

Month	Maximum Change in Water Level (cm)	Minimum Change in Water Level (cm)
Jan	-0.6	-0.2
Feb	-0.3	-0.1
Mar	-1.0	-0.1
Apr	-1.7	-0.1
May	-2.1	-0.3
Jun	-1.6	-0.3
Jul	-1.5	-0.1
Aug	-1.7	0.0
Sep	-1.7	-0.1
Oct	-1.5	-0.2
Nov	-1.2	-0.3
Dec	-0.8	-0.2
Overall	**-2.1**	**No change**

Table 6-24: Changes in Monthly Mean Water Levels in Lizard Lake

Month	Maximum Change in Water Level (cm)	Minimum Change in Water Level (cm)
Jan	-0.3	0.0
Feb	-0.3	0.0
Mar	-1.0	0.0
Apr	-2.1	-0.2
May	-2.7	-0.5
Jun	-2.1	-0.5
Jul	-2.0	-0.2
Aug	-2.2	-0.3
Sep	-2.3	-0.1
Oct	-1.9	-0.2
Nov	-1.3	-0.2
Dec	-0.8	0.0
Overall	**-2.7**	**No change**

Table 6-25: Frequency of Below-Minimum Water Levels in Upper Marmion Reservoir

Year	Frequency	
	Baseline	Reservoir Outflows Unchanged
Average	1 (May)	1 (May)
10-year dry	2 (May – Jun)	3 (Apr – Jun)
25-year dry	5 (May – Sep)	6 (Apr – Sep)
50-year dry	6 (May – Oct)	7 (Apr – Oct)
100-year dry	8 (Apr – Nov)	8 (Apr – Nov)

Table 6-26: Changes in Upper Marmion Reservoir Water Levels (Single Year Lake Water Balances)

Month	Average Year	Wet Year Return Period (yrs.)				Dry Year Return Period (yrs.)			
		10	25	50	100	10	25	50	100
	Change in Water Levels (cm)								
Jan	-5.3	-4.9	-4.9	-4.9	-5.0	-4.5	-5.1	-5.2	-5.4
Feb	-5.8	-5.6	-5.6	-5.6	-5.7	-5.8	-6.3	-6.5	-6.6
Mar	-6.4	-6.1	-6.3	-6.3	-6.5	-7.0	-7.6	-7.7	-7.9
Apr	-7.3	-7.1	-7.2	-7.1	-7.4	-7.9	-8.3	-8.4	-8.5
May	-8.1	-8.5	-8.8	-8.8	-9.0	-8.5	-8.9	-9.0	-9.0
Jun	-0.8	-1.0	-1.0	-1.0	-1.1	-0.5	-0.5	-0.4	-0.4
Jul	-1.6	-1.7	-1.7	-1.7	-1.8	-1.1	-0.9	-0.8	-0.7
Aug	-2.1	-2.2	-2.2	-2.2	-2.3	-1.4	-1.3	-1.2	-1.1
Sep	-2.6	-2.6	-2.6	-2.6	-2.6	-1.8	-1.6	-1.5	-1.4
Oct	-3.1	-3.0	-3.0	-3.0	-3.0	-2.3	-2.1	-1.8	-1.8
Nov	-3.9	-3.7	-3.7	-3.7	-3.7	-2.9	-2.7	-2.6	-2.9
Dec	-4.6	-4.4	-4.4	-4.4	-4.4	-3.5	-3.7	-3.9	-4.1

Table 6-27: Changes in Upper Marmion Reservoir Water Levels (Continuous Lake Water Balances)

Month	Water Taking Scenario					
	Average Year		100 Year Wet		100 Year Dry	
	Maximum Change (cm)	Minimum Change (cm)	Maximum Change (cm)	Minimum Change (cm)	Maximum Change (cm)	Minimum Change (cm)
Jan	-4.3	0.0	-1.0	0.0	-6.8	0.0
Feb	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0
Apr	-0.6	0.0	-0.1	0.0	-0.7	0.0
May	-1.3	0.0	-1.0	0.0	-1.4	0.0
Jun	-1.8	0.0	-1.2	0.0	-1.9	0.0
Jul	-2.3	0.0	-1.0	0.0	-2.5	0.0
Aug	-2.8	0.0	-1.1	0.0	-3.1	0.0
Sep	-3.2	0.0	-1.2	0.0	-3.5	0.0
Oct	-3.7	0.0	-1.4	0.0	-4.1	0.0
Nov	-3.8	0.0	-1.1	0.0	-4.8	0.0
Dec	-4.4	0.0	-1.3	0.0	-6.1	0.0
Overall	**-4.4**	**0.0**	**-1.4**	**0.0**	**-6.8**	**0.0**

Table 6-28: Predicted Groundwater Inflow to Open Pit

Unit	Steady State Pit Inflow (m^3/d)	% of Inflow
0 to 30 mbgs	0	0
Shear Zones (30+ mbgs)	268	36%
Ore Zone (30+ mbgs)	370	50%
Host Rock Zone (30+ mbgs)	102	14%
Total	**740**	**100%**

Note:
mbgs = Metres below ground surface.

Table 6-29: Predicted Seepage Losses from Stockpiles and PPCP

Stockpile	Total Seepage (m^3/d)	Receptor	Receiving Discharge (m^3/d)
WRMF	241	east pit	133
		Marmion Reservoir (or water management system)	108
Low grade ore	32	west and east pits	32
Overburden	52	east pit	16
		Marmion Reservoir (or water management system)	36
PPCP	37	primarily west pit	36
		Marmion Reservoir (or water management system)	1

Table 6-30: Simulated Subwatershed Groundwater Discharge to Seeps, Wetlands and Streams

Subwatershed	Pre-Pit Discharge (m^3/d)	Ultimate Pit In-Place Discharge (m^3/d)	% Change
AB	32	0	-100%
AD	7	0	-100%
AF	17	25	+47%
AH	38	55	+45%
AI	1	0	-100%
G	8	8	0%
H	0	0	0%
I	41	25	-39%
J	13	1	-92%
K	42	0	-100%
L	21	0	-100%

Table 6-31: Summary of Basin Volumes and Residence Time

Basin	Common Name	Volume		Residence Time (days)
		(m^3)	% of Total	
1	Trap Bay	2,300,000	1.1%	0.78
2	Lynxhead Bay	19,900,000	9.1%	6.8
3	—	2,400,000	1.1%	1.0
4	—	1,500,000	0.7%	2.6
5	—	4,600,000	2.1%	2.3
6	—	9,100,000	4.2%	12
7a	Southern Sawbill Bay	16,600,000	7.6%	110
7b	Central Sawbill Bay	90,900,000	41.5%	730[a]
7c	Northern Sawbill Bay	43,500,000	19.9%	310[a]
7b and 7c	Central and Northern Sawbill Bay	134,400,000[b]	61.4%[b]	910[b]
8	—	10,500,000	4.8%	3.5
9	—	6,700,000	3.1%	2.2
10	—	3,100,000	1.4%	1,200
11	—	7,900,000	3.6%	2.6
Total	**Upper Marmion Reservoir**	**219,000,000**	—	**73**

Note:
a) Estimated residence time for Central and Northern Sawbill Bay does not include effect of wind driven exchange flows.
b) Estimated volume and residence time when model basins 7B and 7C are considered as one basin in the model.

Table 6-32: Summary of Basin Volumes and Retention Times

	Lizard Lake			
	Northern	Central	Southern	Total
Model Basin	1	2	3	
Approximate Volume (m^3)	1,970,000	2,310,000	6,100,000	10,390,000
Fraction of Total Volume	19%	22%	59%	100%
Average Inflow (m^3/s)	0.52	0.58	0.65	0.65
Retention Time (days)	44	46	108	184

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Table 6-33a: Estimated Monthly Mine Intake Flows for Return Period Conditions for Operations Phase

Return Period[a]		Estimated Mine Intake from Sawbill Bay (m^3/h)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry Return Period	100	864.8	898.0	832.4	301.5	349.9	301.5	301.5	301.5	301.5	397.3	684.3	800.2
	50	861.6	898.0	826.2	301.5	301.5	301.5	301.5	301.5	301.5	301.5	477.6	791.4
	25	858.0	898.0	819.1	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	558.1
	10	490.9	898.0	808.2	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
Average[b]		301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
Wet return period	10	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
	25	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
	50	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5
	100	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5	301.5

Note:
a) Return periods based on precipitation records at Atikokan.
b) Average conditions based on a 2-year return period.

Table 6-33b: Estimated Monthly Mine Discharge Flows for Return Period Conditions for Operations Phase

Return Period[a]		Estimated Mine Discharge into South End of Sawbill Bay (m^3/h)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry Return Period	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average[b]		56.3	0.0	0.0	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3
Wet return period	10	202.0	0.0	0.4	236.7	235.6	236.7	235.6	235.6	230.5	250.9	202.0	202.0
	25	259.2	0.0	3.2	328.6	326.4	328.6	326.4	322.6	339.6	309.6	259.2	259.2
	50	255.4	0.0	32.9	394.9	391.8	394.9	391.8	389.8	386.4	349.1	297.7	297.7
	100	228.5	0.0	139.9	442.9	439.3	442.9	439.3	452.8	467.2	384.1	331.8	331.8

Note:
a) Return periods based on precipitation records at Atikokan.
b) Average conditions based on a 2-year return period.

Table 6-34: Point of Discharge Comparison to Discharge Guidelines

Parameter	Units	Guidelines		Point of Discharge (Marmion Basin)[c]
		MMER[a]	MISA[b]	
Total Cyanide	mg/L	1	1	0.19
Arsenic	mg/L	0.5	0.5	0.000047
Copper	mg/L	0.3	0.3	0.11(e)
Lead	mg/L	0.2	0.2	0.00032
Nickel	mg/L	0.5	0.5	0.009
Zinc	mg/L	0.5	0.5	0.0093
TSS[d]	mg/L	15	15	<15
Ra 226[e]	Bq/L	0.37	—	—

Note:

a) Metal Mining Effluent Regulations. SOR/2002-222. Schedule 4, Column 2, Maximum Authorized Monthly Mean Concentration

b)Municipal/Industrial Strategy for Abatement (MISA). O. Reg. 560/94 Effluent Monitoring and Effluent Limits - Metal Mining Sector. Schedule 1, Monthly Average Concentration Limit

c) Average Maximum concentrations provided as indicated in Lake Water Quality TSD and Site Water Quality TSD for main discharge point at diffuser. Discharge from the sewage treatment plant will be actively treated to meet appropriate guidelines.

d) TSS will be maintained at <15 mg/L through active treatment if necessary

e) Ra 226 is not expected at this site based

— = no guideline or value not calculated as it is not expected.

Table 6-35: Results for Average Water Quality Predictions in Sawbill Bay, South End, During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir near Raft Lake Dam
		CCME CWQG	PWQO		Proportion (%)	
					0.00118	0.00087
Physical-Chemical						
pH	—	6.5-9	6.5-8.5	6.5	6.5 – 7.8	6.5 – 7.8
Acidity	mg/L	—	—	2.9	-	-
Alkalinity	mg($CaCO_3$)/L	—	-25%	19	19	19
Conductivity	µS/cm	—	—	49	-	-
Total Suspended Solids	mg/L	-20	—	4.5	-	-
Total Dissolved Solids	mg/L	—	—	53	-	-
Major Ions						
Calcium	mg/L	—	—	6.4	6.5	6.5
Chloride	mg/L	120	—	1.1	1.1	1.1
Fluoride	mg/L	—	—	0.031	-	-
Magnesium	mg/L	—	—	1.3	1.3	1.3
Potassium	mg/L	—	—	0.68	0.71	0.7
Sodium	mg/L	—	—	1.3	1.4	1.3
Sulphate	mg/L	—	—	1.6	1.8	1.8
Hardness	mg($CaCO_3$)/L	—	—	21	21	21
Cyanide (free)	mg/L	0.005	0.005	0.001	0.0012	0.0012
Cyanide (total)	mg/L	—	—	0.001	0.0012	0.0012

Table 6-35: Results for Average Water Quality Predictions in Sawbill Bay, South End, During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir near Raft Lake Dam
		CCME CWQG	PWQO		Proportion (%)	
					0.00118	0.00087
Nutrients						
Nitrate-N	mg/L	13	—	0.063	0.065	0.064
Ammonia-N	mg/L	—	—	0.023	0.041	0.036
Un-ionized ammonia	mg/L	0.019	0.02	0.000067	0.00027	0.00022
Phosphorus	mg/L	—	0.02	0.013	0.013	0.013
Dissolved Metals						
Aluminum [b]	mg/L	0.005-0.1	0.015-0.075	0.03	0.03	0.03
Antimony	mg/L	—	0.02	0.00078	0.00078	0.00078
Arsenic	mg/L	0.005	0.1	0.00049	0.00049	0.00049
Barium	mg/L	—	—	0.0071	0.0071	0.0071
Beryllium [d]	mg/L	—	0.011-1.1	0.00028	-	-
Bismuth	mg/L	—	—	0.00054	-	-
Boron	mg/L	1.5	0.2	0.014	0.014	0.014
Cadmium [c]	mg/L	see notes	0.0001-0.0005	0.000036	0.000036	0.000036
Chromium (total)	mg/L	0.009	0.009	0.00048	0.00048	0.00048
Cobalt	mg/L	—	0.0009	0.00017	0.00017	0.00017
Copper [d]	mg/L	0.002-0.004	0.001-0.005	0.0011	0.0012	0.0012
Iron (total)	mg/L	0.3	0.3	0.24	0.24	0.24
Lead [d]	mg/L	0.001-0.007	0.001-0.005	0.00029	0.00029	0.00029
Manganese	mg/L	—	—	0.024	0.024	0.024
Mercury	mg/L	0.000026	0.0002	0.000005	0.000005	0.000005
Molybdenum	mg/L	0.073	0.04	0.00036	0.00043	0.00041

Table 6-35: Results for Average Water Quality Predictions in Sawbill Bay, South End, During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir near Raft Lake Dam
		CCME CWQG	PWQO		Proportion (%)	
					0.00118	0.00087
Dissolved Metals (Continued)						
Nickel [d]	mg/L	0.025-0.15	0.025	0.00099	0.001	0.00099
Selenium	mg/L	0.001	0.1	0.0005	0.0005	0.0005
Silver	mg/L	0.0001	0.0001	0.000087	0.000087	0.000087
Strontium	mg/L	—	—	0.013	0.013	0.013
Thallium	mg/L	0.0008	0.0003	0.000084	0.000084	0.000084
Tin	mg/L	—	—	0.00071	0.00074	0.00073
Titanium	mg/L	—	—	0.0012	-	-
Tungsten	mg/L	—	0.03	0.0045	-	-
Uranium	mg/L	0.015	0.005	0.0022	0.0022	0.0022
Vanadium	mg/L	—	0.006	0.0005	0.0005	0.0005
Zinc	mg/L	0.03	0.02	0.0052	0.0052	0.0052
Zirconium	mg/L	—	0.004	0.0015	-	-

Note:
Underlined values exceed PWQO criteria. **Bold** values exceed CCME CWQGs.
- = Site water quality data was not modeled for this parameter.
— = Receiving water quality criteria do not exist for this parameter.
a) See Lake Water Quality TSD Appendix III for the list of all parameters, criteria and notes.
b) Aluminum PWQO and CWQG range is pH dependent. See Lake Water Quality TSD Appendix III for details.
c) Cadmium CWQG is calculated using a formula (See Lake Water Quality TSD Appendix III) that is hardness-dependent.
d) Beryllium, copper, lead and nickel criteria are hardness dependent. See Lake Water Quality TSD Appendix III for details.

Table 6-36: Upper Bound Water Quality Predictions in Sawbill Bay, South End, During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir near Raft Lake Dam
		CCME CWQG	PWQO		Proportion (%)	
					0.01518	0.00974
Physical-Chemical						
pH	—	6.5-9	6.5-8.5	6.5	6.5 – 8.3	6.5 – 8.3
Acidity	mg/L	—	—	2.9	-	-
Alkalinity	mg($CaCO_3$)/L	—	-25%	19	19	19
Conductivity	µS/cm	—	—	49	-	-
Total Suspended Solids	mg/L	-20	—	4.5	-	-
Total Dissolved Solids	mg/L	—	—	53	-	-
Major Ions						
Calcium	mg/L	—	—	6.4	6.7	6.6
Chloride	mg/L	120	—	1.1	1.8	1.5
Fluoride	mg/L	—	—	0.031	-	-
Magnesium	mg/L	—	—	1.3	1.4	1.4
Potassium	mg/L	—	—	0.68	1.2	1
Sodium	mg/L	—	—	1.3	2.7	2.2
Sulphate	mg/L	—	—	1.6	4.9	3.7
Hardness	mg($CaCO_3$)/L	—	—	21	22	22
Cyanide (free)	mg/L	0.005	0.005	0.001	0.0012	0.0012
Cyanide (total)	mg/L	—	—	0.001	0.0012	0.0012

Table 6-36: Upper Bound Water Quality Predictions in Sawbill Bay, South End, During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir near Raft Lake Dam
		CCME CWQG	PWQO		Proportion (%)	
					0.01518	0.00974
Nutrients						
Nitrate-N	mg/L	13	—	0.063	0.085	0.077
Ammonia-N	mg/L	—	—	0.023	0.251	0.17
Un-ionized ammonia	mg/L	0.019	0.02	0.000067	0.0096	0.0062
Phosphorus	mg/L	—	0.02	0.013	0.013	0.013
Dissolved Metals						
Aluminum [b]	mg/L	0.005-0.1	0.015-0.075	0.03	0.03	0.03
Antimony	mg/L	—	0.02	0.00078	0.0008	0.00079
Arsenic	mg/L	0.005	0.1	0.00049	0.00049	0.00049
Barium	mg/L	—	—	0.0071	0.0072	0.0071
Beryllium [d]	mg/L	—	0.011-1.1	0.00028	-	-
Bismuth	mg/L	—	—	0.00054	-	-
Boron	mg/L	1.5	0.2	0.014	0.014	0.014
Cadmium [c]	mg/L	see notes	0.0001-0.0005	0.000036	0.000039	0.000038
Chromium (total)	mg/L	0.009	0.009	0.00048	0.00048	0.00048
Cobalt	mg/L	—	0.0009	0.00017	0.0002	0.00019
Copper [d]	mg/L	0.002-0.004	0.001-0.005	0.0011	**0.0028**	**0.0022**
Iron (total)	mg/L	0.3	0.3	0.24	0.24	0.24
Lead [d]	mg/L	0.001-0.007	0.001-0.005	0.00029	0.00029	0.00029
Manganese	mg/L	—	—	0.024	0.025	0.025
Mercury	mg/L	0.000026	0.0002	0.000005	0.000005	0.000005

Table 6-36: Upper Bound Water Quality Predictions in Sawbill Bay, South End, During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir near Raft Lake Dam
		CCME CWQG	PWQO		Proportion (%)	
					0.01518	0.00974
Dissolved Metals (Continued)						
Molybdenum	mg/L	0.073	0.04	0.00036	0.0014	0.001
Nickel [d]	mg/L	0.025-0.15	0.025	0.00099	0.0011	0.0011
Selenium	mg/L	0.001	0.1	0.0005	0.0005	0.0005
Silver	mg/L	0.0001	0.0001	0.000087	0.000087	0.000087
Strontium	mg/L	—	—	0.013	0.018	0.016
Thallium	mg/L	0.0008	0.0003	0.000084	0.000085	0.000085
Tin	mg/L	—	—	0.00071	0.0011	0.00099
Titanium	mg/L	—	—	0.0012	-	-
Tungsten	mg/L	—	0.03	0.0045	-	-
Uranium	mg/L	0.015	0.005	0.0022	0.0023	0.0023
Vanadium	mg/L	—	0.006	0.0005	0.0005	0.0005
Zinc	mg/L	0.03	0.02	0.0052	0.0053	0.0052
Zirconium	mg/L	—	0.004	0.0015	-	-

Note:
Underlined values exceed PWQO criteria. **Bold** values exceed CCME CWQGs.
- = Site water quality data was not modeled for this parameter.
— = Receiving water quality criteria/guidelines do not exist for this parameter.
a) See Lake Water Quality TSD Appendix III for the list of all parameters, criteria and notes.
b) Aluminum PWQO and CWQG range is pH dependent. See Lake Water Quality TSD Appendix III for details.
c) Cadmium CWQG is calculated using a formula (See Lake Water Quality TSD Appendix III) that is hardness-dependent.
d) Beryllium, copper, lead and nickel guidelines are hardness dependent. See Lake Water Quality TSD Appendix III for details.

Table 6-37: Predicted Mixing and Predicted Total Nutrient Concentrations for Mixing In Sawbill Bay

Parameter	Units	Receiving WQ Guidelines[a]			Sawbill Bay		
		ODWS	*CCME CWQG*	PWQO	Predicted Mixing STP Discharge	PPCP Discharge	STP + PPCP
Nitrate	mg/L	10	13	—	0.23	0.086	0.32
Ammonia	mg/L	—	—	—	0.23	0.020	0.26
Unionized Ammonia[b]	mg/L	—	0.02	0.02	0.00016	0.00010	0.00026
Phosphorus	mg/L	—	—	0.02	0.23	0.009	0.24
cBOD	mg/L	—	—	—	0.35	—	0.35
TSS	mg/L	—	+5-25	—	0.35	2.24	2.59

Note:

a) See Appendix 2.IV for detailed notes for water quality guidelines.

b) Unionized ammonia calculated as f x [NH3 + NH4]: f = 1/(10pKa-pH +1), where f is the fraction of NH3; pKa = 0.09018 + 2729.92/T; T = ambient water temperature in Kelvin (K = °C + 273.16).

Table 6-38: Average TMF Seepage Water Quality Predictions for Lizard Lake During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Lizard Lake Baseline	Northern	Central	Southern
		CCME CWQG	PWQO		Proportion (%)		
					0.0028	0.0039	0.0041
Physical-Chemical							
pH	—	6.5-9	6.5-8.5	7	7.0 – 7.8	7.0 – 7.8	7.0 – 7.8
Acidity	mg/L	—	—	2.9	-	-	-
Alkalinity	mg($CaCO_3$)/L	—	-25%	27	-	-	-
Conductivity	µS/cm	—	—	63	-	-	-
Total Suspended Solids	mg/L	-20	—	2.1	-	-	-
Total Dissolved Solids	mg/L	—	—	55	-	-	-
Major Ions							
Calcium	mg/L	—	—	10	10	10	10
Chloride	mg/L	120	—	0.25	0.34	0.37	0.38
Fluoride	mg/L	—	—	0.03	-	-	-
Magnesium	mg/L	—	—	0.9	0.94	0.96	0.96
Potassium	mg/L	—	—	0.65	0.76	0.81	0.82
Sodium	mg/L	—	—	0.67	0.97	1.1	1.1
Sulphate	mg/L	—	—	1.9	2.6	2.8	2.9
Carbonate (CO_{32}-)	mg/L	—	—	5	-	-	-
Bicarbonate ($H(CO_3)$-)	mg/L	—	—	30	-	-	-
Hardness	mg($CaCO_3$)/L	—	—	30	31	31	31
Cyanide (free)	mg/L	0.005	0.005	0.001	0.0011	0.0011	0.0011
Cyanide (total)	mg/L	—	—	0.001	0.0011	0.0011	0.0011

Table 6-38: Average TMF Seepage Water Quality Predictions for Lizard Lake During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Lizard Lake Baseline	Northern	Central	Southern
		CCME CWQG	PWQO		Proportion (%)		
					0.0028	0.0039	0.0041
Nutrients							
Nitrate-N	mg/L	13	—	0.034	0.034	0.034	0.034
Ammonia-N	mg/L	—	—	0.022	0.078	0.1	0.1
Un-ionized ammonia	mg/L	0.019	0.02	0.000047	0.00075	0.001	0.0011
Phosphorus	mg/L	—	0.02	0.0082	0.0082	0.0082	0.0082
Dissolved Metals							
Aluminum [b]	mg/L	0.005-0.1	0.015-0.075	0.018	0.018	0.018	0.018
Antimony	mg/L	—	0.02	0.00097	0.00097	0.00097	0.00097
Arsenic	mg/L	0.005	0.1	0.00043	0.00043	0.00043	0.00043
Barium	mg/L	—	—	0.0069	-	-	-
Beryllium [d]	mg/L	—	0.011-1.1	0.00023	-	-	-
Bismuth	mg/L	—	—	0.00058	-	-	-
Boron	mg/L	1.5	0.2	0.011	0.011	0.011	0.011
Cadmium [c]	mg/L	see notes	0.0001-0.0005	0.00003	0.00003	0.00003	0.00003
Chromium (total)	mg/L	0.009	0.009	0.00049	0.00049	0.00049	0.00049
Cobalt	mg/L	—	0.0009	0.00012	0.00013	0.00013	0.00013
Copper [d]	mg/L	0.002-0.004	0.001-0.005	0.00087	0.0012	0.0013	0.0013
Iron (total)	mg/L	0.3	0.3	0.053	0.053	0.053	0.053
Lead [d]	mg/L	0.001-0.007	0.001-0.005	0.00024	0.00024	0.00024	0.00024
Manganese	mg/L	—	—	0.0094	-	-	-
Mercury	mg/L	0.000026	0.0002	0.000005	0.000005	0.000005	0.000005
Molybdenum	mg/L	0.073	0.04	0.00032	0.00054	0.00063	0.00065
Nickel [d]	mg/L	0.025-0.15	0.025	0.0008	0.00083	0.00084	0.00084
Selenium	mg/L	0.001	0.1	0.0005	0.0005	0.0005	0.0005

Table 6-38: Average TMF Seepage Water Quality Predictions for Lizard Lake During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Lizard Lake Baseline	Northern	Central	Southern
		CCME CWQG	PWQO		Proportion (%)		
					0.0028	0.0039	0.0041
Dissolved Metals (Continued)							
Silver	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Strontium	mg/L	—	—	0.015	-	-	-
Thallium	mg/L	0.0008	0.0003	0.000068	-	-	-
Tin	mg/L	—	—	0.00055	-	-	-
Titanium	mg/L	—	—	0.0013	-	-	-
Tungsten	mg/L	—	0.03	0.005	-	-	-
Uranium	mg/L	0.015	0.005	0.0025	0.0025	0.0025	0.0025
Vanadium	mg/L	—	0.006	0.00037	0.00037	0.00037	0.00037
Zinc	mg/L	0.03	0.02	0.0055	0.0055	0.0055	0.0055
Zirconium	mg/L	—	0.004	0.002	-	-	-

Note:
Underlined values exceed PWQO criteria. **Bold** values exceed CCME CWQGs.
- = Site water quality data was not modeled for this parameter.
— = Receiving water quality criteria/guidelines do not exist for this parameter.
a) See Lake Water Quality TSD Appendix III for the list of all parameters, criteria and notes.
b) Aluminum PWQO and CWQG range is pH dependent. See Lake Water Quality TSD Appendix III for details.
c) Cadmium CWQG is calculated using a formula (See Lake Water Quality TSD Appendix III) that is hardness-dependent.
d) Beryllium, copper, lead and nickel guidelines are hardness dependent. See Lake Water Quality TSD Appendix III for details.

Table 6-39: Upper Bound TMF Seepage Water Quality Predictions for Lizard Lake During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Lizard Lake Baseline	Northern	Central	Southern
		CCME CWQG	PWQO		Proportion (%)		
					0.0081	0.0095	0.0071
Physical-Chemical							
pH	—	6.5-9	6.5-8.5	7	7.0 – 7.7	7.0 – 7.7	7.0 – 7.7
DOC	% wt	—	—	8.2	-	-	-
TOC	% wt	—	—	8.5	-	-	-
Acidity	mg/L	—	—	2.9	-	-	-
Alkalinity	mg($CaCO_3$)/L	—	-25%	27	-	-	-
Conductivity	µS/cm	—	—	63	-	-	-
Total Suspended Solids	mg/L	-20	—	2.1	-	-	-
Total Dissolved Solids	mg/L	—	—	55	-	-	-
Major Ions							
Calcium	mg/L	—	—	10	11	11	10
Chloride	mg/L	120	—	0.25	0.81	0.91	0.74
Fluoride	mg/L	—	—	0.03	-	-	-
Magnesium	mg/L	—	—	0.9	1.1	1.1	1
Potassium	mg/L	—	—	0.65	1	1.1	1
Sodium	mg/L	—	—	0.67	1.7	1.9	1.6
Sulphate	mg/L	—	—	1.9	4.1	4.5	3.9
Hardness	mg($CaCO_3$)/L	—	—	30	32	32	31
Cyanide (free)	mg/L	0.005	0.005	0.001	0.0011	0.0011	0.0011
Cyanide (total)	mg/L	—	—	0.001	0.0011	0.0011	0.0011

Table 6-39: Upper Bound TMF Seepage Water Quality Predictions for Lizard Lake During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Lizard Lake Baseline	Northern	Central	Southern
		CCME CWQG	PWQO		Proportion (%)		
					0.0081	0.0095	0.0071
Nutrients							
Nitrate	mg/L	13	—	0.034	0.034	0.034	0.034
Ammonia	mg/L	—	—	0.022	0.18	0.21	0.16
Un-ionized ammonia	mg/L	0.019	0.02	0.000047	0.0017	0.0019	0.0015
Phosphorus	mg/L	—	0.02	0.0082	0.0084	0.0084	0.0083
Dissolved Metals							
Aluminum [b]	mg/L	0.005-0.1	0.015-0.075	0.018	0.018	0.018	0.018
Antimony	mg/L	—	0.02	0.00097	0.00098	0.00099	0.00098
Arsenic	mg/L	0.005	0.1	0.00043	0.00043	0.00043	0.00043
Barium	mg/L	—	—	0.0069	-	-	-
Beryllium [d]	mg/L	—	0.011-1.1	0.00023	-	-	-
Bismuth	mg/L	—	—	0.00058	-	-	-
Boron	mg/L	1.5	0.2	0.011	0.011	0.011	0.011
Cadmium [c]	mg/L	see notes	0.0001-0.0005	0.00003	0.00003	0.00003	0.00003
Chromium (total)	mg/L	0.009	0.009	0.00049	0.00049	0.00049	0.00049
Cobalt	mg/L	—	0.0009	0.00012	0.00014	0.00015	0.00014
Copper [d]	mg/L	0.002-0.004	0.001-0.005	0.00087	**0.0022**	**0.0024**	**0.002**
Iron (total)	mg/L	0.3	0.3	0.053	0.053	0.053	0.053
Lead [d]	mg/L	0.001-0.007	0.001-0.005	0.00024	0.00024	0.00024	0.00024
Manganese	mg/L	—	—	0.0094	-	-	-
Mercury	mg/L	0.000026	0.0002	0.000005	0.000005	0.000005	0.000005
Molybdenum	mg/L	0.073	0.04	0.00032	0.001	0.0012	0.00096
Nickel [d]	mg/L	0.025-0.15	0.025	0.0008	0.00087	0.00089	0.00087
Selenium	mg/L	0.001	0.1	0.0005	0.0005	0.0005	0.0005

Table 6-39: Upper Bound TMF Seepage Water Quality Predictions for Lizard Lake During Operations

Parameter	Unit	Receiving WQ Guidelines[a]		Lizard Lake Baseline	Northern	Central	Southern
		CCME CWQG	PWQO		Proportion (%)		
					0.0081	0.0095	0.0071
Dissolved Metals (Continued)							
Silver	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Strontium	mg/L	—	—	0.015	-	-	-
Thallium	mg/L	0.0008	0.0003	0.000068	-	-	-
Tin	mg/L	—	—	0.00055	-	-	-
Titanium	mg/L	—	—	0.0013	-	-	-
Tungsten	mg/L	—	0.03	0.005	-	-	-
Uranium	mg/L	0.015	0.005	0.0025	0.0026	0.0026	0.0026
Vanadium	mg/L	—	0.006	0.00037	0.00037	0.00037	0.00037
Zinc	mg/L	0.03	0.02	0.0055	0.0055	0.0055	0.0055
Zirconium	mg/L	—	0.004	0.002	-	-	-

Note:
Underlined values exceed PWQO criteria. Bold values exceed CCME CWQGs. .
- = Site water quality data was not modeled for this parameter.
— = Receiving water quality criteria do not exist for this parameter.
a) See Lake Water Quality TSD Appendix III for the list of all parameters, criteria and notes.
b) Aluminum PWQO and CWQG range is pH dependent. See Lake Water Quality TSD Appendix III for details.
c) Cadmium CWQG is calculated using a formula (See Lake Water Quality TSD Appendix III) that is hardness-dependent.
d) Beryllium, copper, lead and nickel guidelines are hardness dependent. See Lake Water Quality TSD Appendix III for details.

Table 6-40: Estimated Monthly Pit Lake Discharge Flows for Return Period Conditions for Post-closure Phase

Return Period[a]		Estimated Pit Lake Drainage into South End of Sawbill Bay (m^3/h)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry Return Period	100	6.0	1.0	11.0	22.0	0.0	0.0	0.0	0.0	14.0	36.0	32.0	15.0
	50	6.0	1.0	12.0	34.0	0.0	0.0	0.0	0.0	21.0	41.0	34.0	17.0
	25	7.0	1.0	13.0	48.0	0.0	0.0	0.0	0.0	29.0	47.0	37.0	18.0
	10	8.0	1.0	14.0	68.0	0.0	0.0	0.0	0.0	42.0	56.0	41.0	20.0
Average[b]		10.0	1.0	19.0	126.0	0.0	0.0	0.0	16.0	78.0	82.0	52.0	27.0
Wet return period	10	12.0	1.0	23.0	185.0	0.0	49.0	11.0	54.0	114.0	108.0	64.0	33.0
	25	13.0	1.0	25.0	207.0	0.0	64.0	25.0	68.0	128.0	118.0	68.0	35.0
	50	14.0	1.0	26.0	222.0	0.0	74.0	34.0	77.0	137.0	124.0	71.0	37.0
	100	14.0	1.0	27.0	235.0	6.0	83.0	42.0	85.0	145.0	130.0	74.0	38.0

Note:

a) Return periods based on precipitation records at Atikokan.

b) Average conditions based on a 2-year return period.

Table 6-41: Pit Lake Discharge Water Quality Predictions in Upper Marmion Reservoir under Average Conditions in Post-closure

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir (near Raft Lake Dam)
		CCME CWQG	PWQO		Proportion (%)	
					0.00062	0.00042
Physical-Chemical						
pH	—	6.5-9	6.5-8.5	6.5	6.5 – 7.1	6.5 – 7.1
DOC	% wt	—	—	8.8	-	-
TOC	% wt	—	—	9.3	-	-
Acidity	mg/L	—	—	2.9	-	-
Alkalinity	mg($CaCO_3$)/L	—	-25%	19	-	-
Conductivity	µS/cm	—	—	49	-	-
Total Suspended Solids	mg/L	-20	—	4.5	-	-
Total Dissolved Solids	mg/L	—	—	53	-	-
Major Ions						
Calcium	mg/L	—	—	6.4	6.4	6.4
Chloride	mg/L	120	—	1.1	1.05	1.05
Fluoride	mg/L	—	—	0.031	-	-
Magnesium	mg/L	—	—	1.3	1.3	1.3
Potassium	mg/L	—	—	0.68	0.68	0.68
Sodium	mg/L	—	—	1.3	1.3	1.3
Sulphate	mg/L	—	—	1.6	1.6	1.6
Hardness	mg($CaCO_3$)/L	—	—	21	21	21
Cyanide (free)	mg/L	0.005	0.005	0.005	-	-
Cyanide (total)	mg/L	—	—	0.002	-	-

Table 6-41: Pit Lake Discharge Water Quality Predictions in Upper Marmion Reservoir under Average Conditions in Post-closure

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir (near Raft Lake Dam)
		CCME CWQG	PWQO		Proportion (%)	
					0.00062	0.00042
Nutrients						
Nitrate-N	mg/L	13	—	0.063	0.063	0.063
Ammonia-N	mg/L	—	—	0.023	-	-
Un-ionized ammonia	mg/L	0.019	0.02	0.000067	0.00014	0.00012
Phosphorus	mg/L	—	0.02	0.013	0.013	0.013
Dissolved Metals						
Aluminum [b]	mg/L	0.005-0.1	0.015-0.075	0.03	0.03	0.03
Antimony	mg/L	—	0.02	0.00078	0.0008	0.0008
Arsenic	mg/L	0.005	0.1	0.00049	0.00049	0.00049
Barium	mg/L	—	—	0.0071	-	-
Beryllium [d]	mg/L	—	0.011-1.1	0.00028	-	-
Bismuth	mg/L	—	—	0.00054	-	-
Boron	mg/L	1.5	0.2	0.014	0.014	0.014
Cadmium [c]	mg/L	see notes	0.0001-0.0005	0.000036	0.000036	0.000036
Chromium (total)	mg/L	0.009	0.009	0.00048	0.00048	0.00048
Cobalt	mg/L	—	0.0009	0.00017	0.00017	0.00017
Copper [d]	mg/L	0.002-0.004	0.001-0.005	0.0011	0.0011	0.0011
Iron (total)	mg/L	0.3	0.3	0.24	0.24	0.24
Lead [d]	mg/L	0.001-0.007	0.001-0.005	0.00029	0.00029	0.00029
Manganese	mg/L	—	—	0.024	0.024	0.024
Mercury	mg/L	0.000026	0.0002	0.000005	0.000005	0.000005
Molybdenum	mg/L	0.073	0.04	0.00036	0.00036	0.00036
Nickel [d]	mg/L	0.025-0.15	0.025	0.00099	0.00099	0.00099
Selenium	mg/L	0.001	0.1	0.0005	0.0005	0.0005
Silver	mg/L	0.0001	0.0001	0.000087	0.000087	0.000087

Table 6-41: Pit Lake Discharge Water Quality Predictions in Upper Marmion Reservoir under Average Conditions in Post-closure

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir (near Raft Lake Dam)
		CCME CWQG	PWQO		Proportion (%)	
					0.00062	0.00042
Dissolved Metals (Continued)						
Strontium	mg/L	—	—	0.013	-	-
Thallium	mg/L	0.0008	0.0003	0.000084	-	-
Tin	mg/L	—	—	0.00071	-	-
Titanium	mg/L	—	—	0.0012	-	-
Tungsten	mg/L	—	0.03	0.0045	-	-
Uranium	mg/L	0.015	0.005	0.0022	0.0022	0.0022
Vanadium	mg/L	—	0.006	0.0005	-	-
Zinc	mg/L	0.03	0.02	0.0052	0.0052	0.0052
Zirconium	mg/L	—	0.004	0.0015	-	-

Note:
Underlined values exceed PWQO criteria. Bold values exceed CCME CWQGs.
- = Site water quality data was not modeled for this parameter.
— = Receiving water quality criteria do not exist for this parameter.
a) See Lake Water Quality TSD Appendix III for the list of all parameters, criteria and notes.
b) Aluminum PWQO and CWQG range is pH dependent. See Lake Water Quality TSD Appendix III for details.
c) Cadmium CWQG is calculated using a formula (See Lake Water Quality TSD Appendix III) that is hardness-dependent.
d) Beryllium, copper, lead and nickel guidelines are hardness-dependent. See Lake Water Quality TSD Appendix III for details.

Table 6-42: Results for Upper Bound Pit Lake Discharge Water Quality Predictions in Basin 5 of Upper Marmion Reservoir for Post-Closure Scenario

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir (near Raft Lake Dam)
		CCME CWQG	PWQO		Proportion (%)	
					0.0056	0.00337
Physical-Chemical						
pH	—	6.5-9	6.5-8.5	6.5	6.5 – 7.0	6.5 – 7.0
DOC	% wt	—	—	8.8	-	-
TOC	% wt	—	—	9.3	-	-
Acidity	mg/L	—	—	2.9	-	-
Alkalinity	mg($CaCO_3$)/L	—	-25%	19	-	-
Conductivity	µS/cm	—	—	49	-	-
Total Suspended Solids	mg/L	-20	—	4.5	-	-
Total Dissolved Solids	mg/L	—	—	53	-	-
Major Ions						
Calcium	mg/L	—	—	6.4	6.5	6.5
Chloride	mg/L	120	—	1.1	1.1	1.1
Fluoride	mg/L	—	—	0.031	-	-
Magnesium	mg/L	—	—	1.3	1.3	1.3
Potassium	mg/L	—	—	0.68	0.68	0.68
Sodium	mg/L	—	—	1.3	1.3	1.3
Sulphate	mg/L	—	—	1.6	1.6	1.6
Hardness	mg($CaCO_3$)/L	—	—	21	21	21
Cyanide (free)	mg/L	0.005	0.005	0.005	-	-
Cyanide (total)	mg/L	—	—	0.002	-	-

Table 6-42: Results for Upper Bound Pit Lake Discharge Water Quality Predictions in Basin 5 of Upper Marmion Reservoir for Post-Closure Scenario

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir (near Raft Lake Dam)
		CCME CWQG	PWQO		Proportion (%)	
					0.0056	0.00337
Nutrients						
Nitrate	mg/L	13	—	0.063	0.063	0.063
Ammonia	mg/L	—	—	0.023	-	-
Un-ionized ammonia	mg/L	0.019	0.02	0.000067	0.00102	0.00064
Phosphorus	mg/L	—	0.02	0.013	0.013	0.013
Dissolved Metals						
Aluminum [b]	mg/L	0.005-0.1	0.015-0.075	0.03	0.03	0.03
Antimony	mg/L	—	0.02	0.00078	0.00078	0.00078
Arsenic	mg/L	0.005	0.1	0.00049	0.00049	0.00049
Barium	mg/L	—	—	0.0071	-	-
Beryllium [d]	mg/L	—	0.011-1.1	0.00028	-	-
Bismuth	mg/L	—	—	0.00054	-	-
Boron	mg/L	1.5	0.2	0.014	0.014	0.014
Cadmium [c]	mg/L	see notes	0.0001-0.0005	0.000036	0.000036	0.000036
Chromium (total)	mg/L	0.009	0.009	0.00048	0.00049	0.00048
Cobalt	mg/L	—	0.0009	0.00017	0.00017	0.00017
Copper [d]	mg/L	0.002-0.004	0.001-0.005	0.0011	0.0011	0.0011
Iron (total)	mg/L	0.3	0.3	0.24	0.24	0.24
Lead [d]	mg/L	0.001-0.007	0.001-0.005	0.00029	0.00029	0.00029
Manganese	mg/L	—	—	0.024	0.024	0.024
Mercury	mg/L	0.000026	0.0002	0.000005	0.000005	0.000005
Molybdenum	mg/L	0.073	0.04	0.00036	0.00036	0.00036
Nickel [d]	mg/L	0.025-0.15	0.025	0.00099	0.00099	0.00099
Selenium	mg/L	0.001	0.1	0.0005	0.0005	0.0005
Silver	mg/L	0.0001	0.0001	0.000087	0.000087	0.000087

Table 6-42: Results for Upper Bound Pit Lake Discharge Water Quality Predictions in Basin 5 of Upper Marmion Reservoir for Post-Closure Scenario

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir (near Raft Lake Dam)
		CCME CWQG	PWQO		Proportion (%)	
					0.0056	0.00337
Dissolved Metals (Continued)						
Strontium	mg/L	—	—	0.013	-	-
Thallium	mg/L	0.0008	0.0003	0.000084	-	-
Tin	mg/L	—	—	0.00071	-	-
Titanium	mg/L	—	—	0.0012	-	-
Tungsten	mg/L	—	0.03	0.0045	-	-
Uranium	mg/L	0.015	0.005	0.0022	0.0022	0.0022
Vanadium	mg/L	—	0.006	0.0005	-	-
Zinc	mg/L	0.03	0.02	0.0052	0.0052	0.0052
Zirconium	mg/L	—	0.004	0.0015	-	-

Note:

Underlined values exceed PWQO criteria. Bold values exceed CCME CWQGs.

- = Site water quality data was not modeled for this parameter.

— = Receiving water quality criteria do not exist for this parameter.

a) See Lake Water Quality TSD Appendix III for the list of all parameters, criteria and notes.

b) Aluminum PWQO and CWQG range is pH dependent. See Lake Water Quality TSD Appendix III for details.

c) Cadmium CWQG is calculated using a formula (See Lake Water Quality TSD Appendix III) that is hardness-dependent.

d) Beryllium, copper, lead and nickel guidelines are hardness dependent. See Lake Water Quality TSD Appendix III for details.

Table 6-43: Estimated Monthly Total Project Site Runoff for Return Period Conditions for Post-closure Phase

Return Period[a]		Estimated Total Runoff from Facility (m^3/h)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dry Return Period	100	34	1	66	740	400	413	286	478	637	378	212	98
	50	37	1	72	821	438	453	320	519	681	403	228	107
	25	41	1	79	913	481	499	359	566	732	433	246	117
	10	46	1	90	1,054	546	569	419	638	810	477	274	132
Average[b]		62	1	120	1,451	730	765	588	842	1,029	603	352	175
Wet return period	10	78	1	151	1,856	918	966	760	1,049	1,253	732	432	219
	25	84	1	162	2,006	988	1,040	824	1,126	1,335	779	461	235
	50	88	1	170	2,106	1,034	1,090	867	1,177	1,391	811	481	246
	100	91	1	177	2,196	1,076	1,134	904	1,223	1,440	840	499	256

Note:

a) Return periods based on precipitation records at Atikokan.

b) Average conditions based on a 2-year return period.

Table 6-44: Assumed Partitioning of Facility Runoff to Upper Marmion Reservoir Model Basins

Facility	Estimated Runoff Percentage to Model Basin				
	Lizard Lake	Lynxhead Bay 2	South End of Sawbill Bay 6	Northern Sawbill Bay 7C	Trap Bay 1
Open Pit	0.0	0.0	5.1	0.0	0.0
Waste Rock Stockpile	0.0	1.3	8.3	0.0	12.8
TMF	5.8	0.0	0.0	55.7	0.0
Detonator Storage Area	0.0	0.0	0.0	0.0	0.0
Emulsion Plant	0.0	0.0	0.0	0.2	0.0
Process Plant	0.0	0.0	4.2	0.0	0.0
Overburden	0.0	1.4	0.0	0.0	1.4
Low Grade Ore Stockpile	0.0	1.8	0.1	0.0	0.0
ICP	0.0	0.0	1.7	0.0	0.0
Total	**5.8**	**4.6**	**19.5**	**55.9**	**14.2**
Rounded Values Used[1]	**0[2]**	**5**	**20**	**55**	**20[2]**

Note:

1) Percentages rounded to nearest 5%.

2) Runoff into Lizard Lake was assumed to drain to Trap Bay (Lizard Lake is included in Marmion Lake Model).

Table 6-45: Site Runoff Discharge Water Quality Predictions in Basin 7C of Upper Marmion Reservoir for Post-closure Scenario

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir (near Raft Lake Dam)
		CCME CWQG	PWQO		Proportion (%)	
					0.08952	0.02776
Physical-Chemical						
pH	—	6.5-9	6.5-8.5	6.5	6.5 – 6.8	6.5 – 6.8
DOC	% wt	—	—	8.8	-	-
TOC	% wt	—	—	9.3	-	-
Acidity	mg/L	—	—	2.9	-	-
Alkalinity	mg($CaCO_3$)/L	—	-25%	19	-	-
Conductivity	µS/cm	—	—	49	-	-
Total Suspended Solids	mg/L	-20	—	4.5	-	-
Total Dissolved Solids	mg/L	—	—	53	-	-
Major Ions						
Calcium	mg/L	—	—	6.4	7	6.6
Chloride	mg/L	120	—	1.1	1.1	1.1
Fluoride	mg/L	—	—	0.031	-	-
Magnesium	mg/L	—	—	1.3	1.3	1.3
Potassium	mg/L	—	—	0.68	0.68	0.68
Sodium	mg/L	—	—	1.3	1.3	1.3
Sulphate	mg/L	—	—	1.6	1.7	1.6
Hardness	mg($CaCO_3$)/L	—	—	21	23	22
Cyanide (free)	mg/L	0.005	0.005	0.005	-	-
Cyanide (total)	mg/L	—	—	0.002	-	-

Table 6-45: Site Runoff Discharge Water Quality Predictions in Basin 7C of Upper Marmion Reservoir for Post-closure Scenario

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir (near Raft Lake Dam)
		CCME CWQG	PWQO		Proportion (%)	
					0.08952	0.02776
Nutrients						
Nitrate	mg/L	13	—	0.063	0.063	0.063
Ammonia	mg/L	—	—	0.023	-	-
Un-ionized ammonia	mg/L	0.019	0.02	0.000067	0.000067	0.00007
Phosphorus	mg/L	—	0.02	0.013	0.014	0.013
Dissolved Metals						
Aluminum[b]	mg/L	0.005-0.1	0.015-0.075	0.03	0.05	0.036
Antimony	mg/L	—	0.02	0.00078	0.00089	0.00081
Arsenic	mg/L	0.005	0.1	0.00049	0.0005	0.00049
Barium	mg/L	—	—	0.0071	-	-
Beryllium[d]	mg/L	—	0.011-1.1	0.00028	-	-
Bismuth	mg/L	—	—	0.00054	-	-
Boron	mg/L	1.5	0.2	0.014	0.014	0.014
Cadmium[c]	mg/L	see notes	0.0001-0.0005	0.000036	0.000037	0.000036
Chromium (total)	mg/L	0.009	0.009	0.00048	0.00052	0.0005
Cobalt	mg/L	—	0.0009	0.00017	0.0002	0.00018
Copper[d]	mg/L	0.002-0.004	0.001-0.005	0.0011	0.0011	0.0011
Iron (total)	mg/L	0.3	0.3	0.24	**0.33**	0.27
Lead[d]	mg/L	0.001-0.007	0.001-0.005	0.00029	0.0003	0.0003
Manganese	mg/L	—	—	0.024	0.024	0.024
Mercury	mg/L	0.000026	0.0002	0.000005	0.000005	0.000005
Molybdenum	mg/L	0.073	0.04	0.00036	0.00038	0.00037

Table 6-45: Site Runoff Discharge Water Quality Predictions in Basin 7C of Upper Marmion Reservoir for Post-closure Scenario

Parameter	Unit	Receiving WQ Guidelines[a]		Upper Marmion Reservoir Baseline	Sawbill Bay south end (near discharge)	Upper Marmion Reservoir (near Raft Lake Dam)
		CCME CWQG	PWQO		Proportion (%)	
					0.08952	0.02776
Dissolved Metals (Continued)						
Nickel[d]	mg/L	0.025-0.15	0.025	0.00099	0.00099	0.00099
Selenium	mg/L	0.001	0.1	0.0005	0.0012	0.0012
Silver	mg/L	0.0001	0.0001	0.000087	0.000088	0.000088
Strontium	mg/L	—	—	0.013	-	-
Thallium	mg/L	0.0008	0.0003	0.000084	-	-
Tin	mg/L	—	—	0.00071	-	-
Titanium	mg/L	—	—	0.0012	-	-
Tungsten	mg/L	—	0.03	0.0045	-	-
Uranium	mg/L	0.015	0.005	0.0022	0.0022	0.0022
Vanadium	mg/L	—	0.006	0.0005	-	-
Zinc	mg/L	0.03	0.02	0.0052	0.0052	0.0052
Zirconium	mg/L	—	0.004	0.0015	-	-

Note:
Underlined values exceed PWQO criteria. Bold values exceed CCME CWQGs.
- = Site water quality data was not modeled for this parameter.
— = Receiving water quality criteria do not exist for this parameter.
a) See Lake Water Quality TSD Appendix III for the list of all parameters, criteria and notes.
b) Aluminum PWQO and CWQG range is pH dependent. See Lake Water Quality TSD Appendix III for details.
c) Cadmium CWQG is calculated using a formula (See Lake Water Quality TSD Appendix III) that is hardness-dependent.
d) Beryllium, copper, lead and nickel guidelines are hardness dependent. See Lake Water Quality TSD Appendix III for details.

Table 6-46: Average TMF Seepage Water Quality Predictions for Lizard Lake During Post-closure

Parameter	Unit	Receiving WQ Guidelines[a]		Lizard Lake Baseline	Northern	Central	Southern
		CCME CWQG	PWQO		Proportion (%)		
					0.0047	0.0055	0.0041
Physical-Chemical							
pH	—	6.5-9	6.5-8.5	7	7.0 – 7.3	7.0 – 7.3	7.0 – 7.3
Acidity	mg/L	—	—	2.9	-	-	-
Alkalinity	mg($CaCO_3$)/L	—	-25%	27	-	-	-
Conductivity	µS/cm	—	—	63	-	-	-
Total Suspended Solids	mg/L	-20	—	2.1	-	-	-
Total Dissolved Solids	mg/L	—	—	55	-	-	-
Major Ions							
Calcium	mg/L	—	—	10	10	10	10
Chloride	mg/L	120	—	0.25	0.3	0.3	0.3
Fluoride	mg/L	—	—	0.03	-	-	-
Magnesium	mg/L	—	—	0.9	0.9	0.9	0.9
Potassium	mg/L	—	—	0.65	0.7	0.7	0.7
Sodium	mg/L	—	—	0.67	0.7	0.7	0.7
Sulphate	mg/L	—	—	1.9	1.9	1.9	2
Hardness	mg($CaCO_3$)/L	—	—	30	30	30	30
Cyanide (free)	mg/L	0.005	0.005	0.005	-	-	-
Cyanide (total)	mg/L	—	—	0.002	-	-	-
Nutrients							
Nitrate-N	mg/L	13	—	0.034	0.034	0.034	0.034
Ammonia-N	mg/L	—	—	0.022	-	-	-
Un-ionized ammonia	mg/L	0.019	0.02	0.000047	4.65E-05	6.50E-04	6.50E-04
Phosphorus	mg/L	—	0.02	0.0082	0.0082	0.0082	0.0082

Table 6-46: Average TMF Seepage Water Quality Predictions for Lizard Lake During Post-closure

Parameter	Unit	Receiving WQ Guidelines[a]		Lizard Lake Baseline	Northern	Central	Southern
		CCME CWQG	PWQO		Proportion (%)		
					0.0047	0.0055	0.0041
Dissolved Metals							
Aluminum [b]	mg/L	0.005-0.1	0.015-0.075	0.018	0.018	0.018	0.018
Antimony	mg/L	—	0.02	0.00097	0.001	0.001	0.001
Arsenic	mg/L	0.005	0.1	0.00043	0.00043	0.00043	0.00043
Barium	mg/L	—	—	0.0069	-	-	-
Beryllium [d]	mg/L	—	0.011-1.1	0.00023	-	-	-
Bismuth	mg/L	—	—	0.00058	-	-	-
Boron	mg/L	1.5	0.2	0.011	0.011	0.011	0.011
Cadmium [c]	mg/L	see notes	0.0001-0.0005	0.00003	0.00003	0.00003	0.00003
Chromium (total)	mg/L	0.009	0.009	0.00049	0.00049	0.00049	0.00049
Cobalt	mg/L	—	0.0009	0.00012	0.00012	0.00012	0.00012
Copper [d]	mg/L	0.002-0.004	0.001-0.005	0.00087	0.0009	0.0009	0.0009
Iron (total)	mg/L	0.3	0.3	0.053	0.053	0.053	0.053
Lead [d]	mg/L	0.001-0.007	0.001-0.005	0.00024	0.00024	0.00024	0.00024
Manganese	mg/L	—	—	0.0094	0.009435	0.009435	0.009435
Mercury	mg/L	0.000026	0.0002	0.000005	0.000005	0.000005	0.000005
Molybdenum	mg/L	0.073	0.04	0.00032	0.0003	0.0003	0.0003
Nickel [d]	mg/L	0.025-0.15	0.025	0.0008	0.0008	0.0008	0.0008
Selenium	mg/L	0.001	0.1	0.0005	0.0005	0.0005	0.0005
Silver	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Strontium	mg/L	—	—	0.015	-	-	-
Thallium	mg/L	0.0008	0.0003	0.000068	-	-	-
Tin	mg/L	—	—	0.00055	-	-	-

Table 6-46: Average TMF Seepage Water Quality Predictions for Lizard Lake During Post-closure

Parameter	Unit	Receiving WQ Guidelines[a]		Lizard Lake Baseline	Northern	Central	Southern
		CCME CWQG	PWQO		Proportion (%)		
					0.0047	0.0055	0.0041
Dissolved Metals (Continued)							
Titanium	mg/L	—	—	0.0013	-	-	-
Tungsten	mg/L	—	0.03	0.005	-	-	-
Uranium	mg/L	0.015	0.005	0.0025	0.0025	0.0025	0.0025
Vanadium	mg/L	—	0.006	0.00037	-	-	-
Zinc	mg/L	0.03	0.02	0.0055	0.0055	0.0055	0.0055
Zirconium	mg/L	—	0.004	0.002	-	-	-

Note:
Underlined values exceed PWQO criteria. Bold values exceed CCME CWQG.
- = Site water quality data was not modeled for this parameter.
— = Receiving water quality criteria do not exist for this parameter.
a) See Lake Water Quality TSD Appendix III for the list of all parameters, criteria and notes.
b) Aluminum PWQO and CWQG range is pH dependent. See Lake Water Quality TSD Appendix III for details.
c) Cadmium CWQG is calculated using a formula (See Lake Water Quality TSD Appendix III) that is hardness-dependent.
d) Beryllium, copper, lead and nickel guidelines are hardness dependent. See Lake Water Quality TSD Appendix III for details

Table 6-47: Forest Losses in the Terrestrial Ecology RSA

Forest Ecosite/Type	Forest Cover Available in the RSA (ha)	Forest Cover Lost (ha)	% Lost in the RSA
Dense Coniferous Forest (ES-A, ES-B, ES-C, ES-D, ES-H)	74,297.4	430.43	0.58%
Dense Deciduous (ES-E)	72,974.4	191.22	0.26%
Dense Mixed Forest (ES-F, ES-G, ES-I)	220,707.9	150.50	0.07%
Total	**367,979.7**	**772.15**	**0.21%**

Table 6-48: Aquatic Habitats Directly Affected by Site Development

Infrastructure Feature	Aquatic API	Description	Description of Potential Effect
Open Pit	Mitta Lake (API #12) and its outlet stream	172,737 m^2 lake; approximately 449 m of stream; empties into Sawbill Bay; supports common white sucker (*Catostomus commersoni)*, ninespine stickleback (*Pungitius pungitius)*, brook stickleback (*Culaea inconstans*), fathead minnow (*Pimephales promelas)*, Iowa darter (*Etheostoma exile)*, mottled sculpin (*Cottus bairdi*)and finescale dace (*Chrosomus neogaeus)*.	Mitta Lake forms the active pit. The destruction of Mitta Lake results in the loss of 396 HU of useable littoral habitat and 7,311 HU of useable open water habitat.
	API #14	Upper portions of approximately 1,169 m stream; empties into Sawbill Bay; supports finescale dace, northern redbelly dace (*Chrosomus eos)*, fathead minnow; juvenile common white sucker captured in lower reach.	API #14 will be removed for the construction of the Support and Ancillary Structures near the open pit. Destruction of API #14 results in a loss of 45 HU of useable low gradient stream habitat and 119 HU of useable high gradient stream habitat.
	API #69	9,871 m^2 pond and 165 m of stream; pond supports common white sucker, pearl dace, Iowa darter, central mudminnow (*Umbra limi*), blacknose shiner, finescale dace and northern redbelly dace. No fish were found to exist within the outlet stream.	Headwater pond and upper reaches of API #69 will be destroyed through the construction of the open pit. Destruction of API #69 results in a loss of 224 HU of useable littoral habitat, 1,080 HU of useable open water habitat.
Mine Water Spill Emergency Pond	API #13	19,375 m^2 headwater pond; approximately 396 m of stream consisting of 476 m^2 of beaver impoundments; both pond and stream are fishless. Empties into Lynxhead Bay.	No useable habitat will be lost through the destruction of API #13 for purposes of Support and Ancillary Structure development.
Waste rock Stockpile	API #11	27,777 m^2 head water pond; approximately 787 m of stream including several 1,030 m^2 of beaver impoundments; empties into Lynxhead Bay; supports finescale dace, northern redbelly dace, fathead minnow.	API#11 will be destroyed through the construction of the Waste Rock Stockpile. 32 HU of useable low gradient stream, 13 m of useable high gradient stream, 58 HU of useable pond, 173 HU of useable littoral and 1,701 HU of useable open water habitat will be lost.

Table 6-48: Aquatic Habitats Directly Affected by Site Development

Infrastructure Feature	Aquatic API	Description	Description of Potential Effect
Tailings Management Facility	API #47	Approximately 762 m of stream including 29,944 m^2 of beaver impoundments; supports finescale dace, pearl dace (*Semotilus margarita),* and northern redbelly dace.	The streams and beaver impoundments of API #47 will be impacted by the proposed Tailings Management Facility. This will result in a loss of 11 HU of useable low gradient habitat, 34 HU of useable high gradient habitat and 1824 m^2 of useable pond habitat.
	API #48	Approximately 123 m of ephemeral/seasonal stream, 430 m of permanent stream and several beaver ponds (10,198 m^2 total); approximately 2,051 m^2 headwater pond; no hydraulic connection to downstream aquatic features. Finescale dace captured in one of the beaver ponds.	The outlet stream and associated beaver impoundments will be impacted by the proposed TMF. This will result in the loss of 239 HU of useable pond habitat.
	API #1	Approximately 894 m of stream, including 5,836 m^2 of beaver impoundments; empties into Sawbill Bay; upper sections support pearl dace, finescale dace and fathead minnows; juvenile and young-of-the-year (YOY) common white suckers captured in lower sections.	API #1 is entirely contained within the footprint of the TMF and thus we be destroyed. This will result in the loss of 266 HU of useable low gradient habitat, 21 m of useable high gradient habitat, and 2,722 HU of useable pond habitat.
	API #7	10,962 m^2 headwater pond; partially in-filled; fishless; connected to API #6 by a series of small beaver ponds (approximately 721 m^2).	Though API #7 will be destroyed by the proposed TMF, no useable habitat will be eliminated since the feature is fishless and isolated from API #6.
	API #6	5,385 m^2 pond, 437 m of stream, and 1,004 m of ephemeral stream; empties into Lizard Lake; pond and ephemeral stream are fishless; common white sucker and Iowa dater captured in lower segment of stream.	API #6 is contained within the footprint of the proposed TMF. This will result in the loss of 21 HU of useable low gradient stream habitat.
	API #2	124,351 m^2 lake and 2217 m of stream and 3,808 m^2 of beaver impoundments; supports pumpkinseed (*Lepomis gibbosus)*, northern pike, yellow perch (*Perca flavescens)*, Iowa darter (*Etheostoma exile),* common white sucker, blacknose shiner (*Notropis heterolepis)*.	The destruction of API #2 results in the loss of 632 HU of useable littoral habitat and 9,476 HU of useable open water habitat.

Table 6-49: Project Phase Activities and Direct Interactions with the Socio-community VECs

Project Activities	Population and Demographics	Labour Market	Government Finances	Public Services and Infrastructure	Housing and Accommodation	Transportation
Construction Phase						
Management Permitting and Employment	X	X	X	X	X	X
Linear Infrastructure	—	—	—	—	—	X
Support and Ancillary Infrastructure	—	—	—	X	—	X
Operations Phase						
Management, Permitting and Employment	X	X	X	X	X	X
Linear Infrastructure	—	—	—	—	—	X
Support and Ancillary Infrastructure	—	—	—	X	—	X
Closure Phase						
Management, Permitting and Employment	X	X	X	X	X	X
Support and Ancillary Infrastructure	—	—	—	X	—	X
Post-Closure Phase						
Management, Permitting and Employment	X	X	X	X	X	X
Support and Ancillary Infrastructure	—	—	—	X	—	X

Note:
X = Direct interaction.
— = No interaction identified.

Table 6-50: Project Phase Activities and Direct Interactions with the Land and Resource Use VECs

Project Activities	Outdoor Tourism and Recreation	Hunting	Trapping	Fishing	Water Use and Access	Mining	Forestry
Construction Phase							
Management, Permitting and Employment	X	X	X	—	—	—	X
Operations Phase							
Management, Permitting and Employment	X	X	X	—	—	—	X
Closure Phase							
Management, Permitting and Employment	X	X	X	—	—	—	X
Post-Closure Phase							
Management, Permitting and Employment	X	X	X	—	—	—	X

Note:
X = Direct interaction.
— = No interaction identified.

Table 6-51: Aboriginal Interests and Project Interactions in Construction Phase

Project Activity	Likely Effect on VSC		
	Aboriginal Community Characteristics	Aboriginal Heritage and Resources	Traditional Use of Land and Resources
Management, Permitting and Employment	Yes	No	No
Project physical activities (including all activities below)	No	Yes	Yes

Table 6-52: Aboriginal Interests and Project Interactions in Operations Phase

Project Activity	Likely Effect on VEC		
	Aboriginal Community Characteristics	Aboriginal Heritage and Resources	Traditional Use of Land and Resources
Management, Permitting and Employment	Yes	No	No
Project physical activities	No	Yes	Yes

Table 6-53: Aboriginal Interests and Project Interactions in Closure and Post-closure Phase

Project Activity	Likely Effect on VEC		
	Aboriginal Community Characteristics	Aboriginal Heritage and Resources	Traditional Use of Land and Resources
Management, Permitting and Employment	Yes	No	No
Project physical activities	No	No	No

Table 6-54: Valued Social Components Selected for Aboriginal Interests

Valued Social Component	Rationale for Selection	Indicators	Measures
Aboriginal community characteristics	■ The Project may affect the economic base and educational attainment of Aboriginal communities ■ Aboriginal right	■ Project Aboriginal employment ■ Project contracts awarded to Aboriginal businesses ■ Education and training of Aboriginal people	■ Project-related employment opportunities ■ Project-related expenditures ■ Project-related education and training
Aboriginal heritage resources	■ Aboriginal heritage resources such as archaeological sites may be affected by the development of Project lands ■ Specific cultural or spiritual sites may be affected by the development of Project lands ■ Aboriginal right	■ Identified archaeological sites and artefacts ■ Cultural or spiritual sites	■ Project-related disturbance of archaeological sites ■ Restricted access or disturbance of cultural or spiritual sites
Traditional use of land and resources	■ Aboriginal people have traditionally made use of lands and resources for their personal and community needs ■ The Project may affect plants, animals and fish that have been traditionally harvested and consumed by Aboriginal people ■ Treaty right	■ Adverse effects identified on the aquatic environment ■ Adverse effects identified on the terrestrial environment ■ Availability and quality of country foods	■ Loss of fishing opportunities ■ Loss of hunting, trapping and plant harvesting opportunities ■ Project-related changes to source and safety of country foods

Table 6-55: Environmental Impacts Assessment Matrix for Construction Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Site Preparation (clearing and grubbing, site levelling, etc.)	Air quality	Dust and emissions from equipment	Emissions controls are inherent in Project design. Receptors will be relocated	No predicted effects on human health or terrestrial life for most receptors Predicted risks to some human receptors close to site.	Can extend into Local Study Area	Confined to initial stages of construction phase	Continuous activity during construction	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no impacts predicted for human health or ecological receptors.
	Noise	Noise from equipment	Noise controls are inherent in Project design. Receptors will be relocated	No predicted effects on human health or terrestrial life for most receptors.	Can extend into Local Study Area	Confined to initial stages of construction phase	Continuous activity during construction	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations.	Low: no impacts predicted for human health or ecological receptors.
	Soils	Removal and stockpiling	Soil stockpiles will be protected against erosion.	Soils will be re-used at closure to promote revegetation.	Confined to Mine Study Area	Confined to initial stages of construction phase	Intermittent as sites are developed.	Partly reversible at closure	Low: Soils will be re-used	Low: localized impacts on terrestrial habit. Soils will be reused to restore habitat.
	Water Quality	Erosion and sedimentation	Construct ditching and sediment and erosion controls prior to commencing construction.	TSS will be managed through sediment and erosion controls that will be implemented prior to construction.	Can extend into Local Study Area	Confined to initial stages of construction phase	Could occur intermittently throughout construction	Immediately reversible upon cessation of activities	Low: TSS increase is not predicted in local watercourses and waterbodies	Low: no impacts predicted to surface water and aquatic life.
	Hydrology	Alteration of drainage	Habitat loss will be addressed through a fish compensation plan	Changes in drainage will affect aquatic life in some habitats.	Can extend into Local Study Area	Changes in drainage will be permanent.	Occurs once.	Changes to site drainage are not reversible	Low: Flow reductions and changes in lake levels are minor.	Low: small areas of aquatic habitat lost will be addressed through compensation.
	Groundwater	Change in recharge area	None required	Changes in groundwater contribution to surface waters will have a negligible effect on lake water levels and aquatic life.	Confined to Mine Study Area	Changes in drainage will be permanent	Occurs once	Change in infiltration areas will be permanent in most areas.	Low: Minor increases or decreases in groundwater levels are confined to small areas around infrastructure..	Low: no effects on terrestrial or aquatic life.
	Vegetation	Removal of vegetation	Merchantable timber will be harvested.	Insignificant loss of habitat within RSA. Extensive areas of similar habitat are available.	Confined to Mine Study Area	Vegetation removal will occur continuously during construction.	Continuous activity during construction.	Loss of vegetation will be reversible in most areas at closure.	Moderate: Overall loss from all development is 21% of wetland habitat and 15% of forest habitat in area of LSA	Low: loss of terrestrial habitat will displace some species.
	Terrestrial Biota	Loss of habitat	Clearing will avoid sensitive periods, such as nesting and denning. Compensation will be provided for lost bat habitat, if necessary.	Some species will be displaced but most will find alternate habitat in LSA and RSA. No effect in LSA or RSA.	Can extend into Local Study Area	Habitat loss will occur continuously during construction.	Loss of habitat will occur continuously as the site is developed.	Most habitat will be restored in closure.	Moderate: small mammals and nesting birds will be displaced	Low: loss of terrestrial habitat will displace some species. small areas of bat habitat lost in MSA will be addressed through compensation, if necessary.
	Aquatic Biota	Loss of habitat	Mitigation is not possible for most areas, and compensation will be provided for lost habitat.	Small waterbodies and watercourses will be affected in the MSA, some permanently. These comprise a small amount of the aquatic habitat within the LSA. No effects on fish populations within the LSA are expected	Can extend into Local Study Area	Loss of habitat in will occur continuously during construction.	Intermittent as sites are developed.	Some habitat will be restored in closure, but loss of habitat in other areas will be permanent.	Moderate: Some aquatic habitat in MSA will be lost permanently. Flow reductions may affect some habitats in adjacent areas of LSA.	Low: small areas of habitat lost in MSA will be addressed through compensation.

Table 6-55: Environmental Impacts Assessment Matrix for Construction Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
TMF Construction	Air Quality	Dust and emissions from equipment	Emissions controls are inherent in Project design. Receptors will be relocated.	No predicted effects on human health or terrestrial life for most receptors. Predicted risks to some human receptors close to site.	Can extend into Local Study Area	Will occur only during construction phase.	Continuous during construction of the TMF	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions.	Low: no impacts predicted for human health or ecological receptors.
	Noise	Noise from equipment	Noise controls are inherent in Project design. Receptors will be relocated	No predicted effects on human health or terrestrial life for most receptors.	Can extend into Local Study Area	Will occur only during construction phase.	Continuous during construction of the TMF	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates	Low: no impacts predicted for human health or ecological receptors.
	Soils	Removal and stockpiling	Stockpiles will be protected against erosion.	Removal is confined to the footprint of the containment berms.	Confined to Mine Study Area	Will occur only during construction phase.	Continuous during construction of the TMF	Reversible in closure as TMF is graded and soil amendment is added.	Low: Soils will be removed and stockpiled for re-use.	Low: localized impacts on terrestrial habit. Soils will be reused to restore habitat.
	Water Quality	Erosion and sedimentation	Mitigation measures will be implemented prior to commencing construction.	Ditching and erosion control measures will limit TSS in adjacent surface waters.	Can extend into Local Study Area	Will occur only during construction phase.	Intermittent during construction.	Immediately reversible upon cessation of activities	Low: TSS levels predicted to be low and within guidelines.	Low: no impacts predicted to surface water and aquatic life
	Hydrology	Alteration of drainage	Compensation plan will be developed for effects on fish and fish habitat.	Loss of drainage affects fish habitat in on-site waterbodies and in watercourses downstream. Loss of drainage has negligible effect on lake levels in Lizard Lake and Upper Marmion Reservoir.	Can extend into Local Study Area	Changes in drainage persist throughout all project phases	Continuous	Not reversible.	Low: Loss of drainage area has minimal effect on lake levels.	Low: small areas of aquatic habitat lost will be addressed through compensation.
	Groundwater	Loss of recharge area	None possible	Changes in groundwater contribution to surface waters will have a negligible effect on lake water levels and aquatic life.	Confined to Mine Study Area	Changes in infiltration persist throughout all project phases	Continuous	Not reversible.	Low: Geology and lack of soil cover limit infiltration capacity	Low: no effects on terrestrial or aquatic life are predicted.
	Vegetation	Removal of vegetation	Merchantable timber will be harvested.	Insignificant loss of habitat within RSA.	Confined to Mine Study Area	Throughout construction persisting through operations.	One time activity.	Some restoration is possible in closure.	Moderate: Overall loss from all development is 21% of wetland habitat and 15% of forest habitat in area of LSA	Low: loss of terrestrial habitat will displace some species.
	Terrestrial Biota	Loss of habitat	Clearing will avoid sensitive periods, such as nesting and denning.	Displaced species will find alternate habitat in LSA and RSA.	Can extend into Local Study Area	Throughout construction persisting through operations.	One time activity	Some restoration of habitat is possible in closure	Moderate: small mammals and nesting birds will be displaced	Low: loss of terrestrial habitat will displace some species.
	Aquatic Biota	Loss of habitat and effects on water quality and quantity	Effects of habitat loss cannot be mitigated. A compensation plan will be developed to address habitat loss.	■ Some aquatic features are lost entirely. Others will experience changes to natural hydrographs that can limit available habitat. ■ Negligible effect on lake water levels with no effect on lake dwelling aquatic species. No effects on fish populations within the LSA are expected ■ Sediment and erosion controls will minimize impacts of TSS on aquatic life in downstream habitats.	Loss of habitat confined to Mine Study Area. Water quality and quantity effects can extend into Local Study Area	Loss of habitat extends through all project phases. Water quality effects are confined to construction and operations phases.	One time activity for habitat loss. Intermittent for water quality depending on climatic conditions.	Habitat loss in some areas is not reversible. Water quality effects are reversible at closure	Moderate to High: Partial to complete loss of habitats in local waterbodies in MSA. Loss of drainage areas may affect some habitats in adjacent areas of LSA. No changes predicted in Upper Marmion Reservoir.	Low: compensation plan will address loss of small habitat areas affected. No effects on aquatic life due to water quality.

Table 6-55: Environmental Impacts Assessment Matrix for Construction Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Infrastructure Construction	Air Quality	Dust and emissions from equipment	Emissions controls are inherent in Project design. Receptors will be relocated.	No predicted effects on human health or terrestrial life for most receptors. Predicted risks to some human receptors close to site.	Can extend into Local Study Area	Will occur only during construction phase.	Continuous during construction.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no impacts predicted for human health or ecological receptors.
	Noise	Noise from equipment	Noise controls are inherent in Project design. Receptors will be relocated	No predicted effects on human health or terrestrial life for most receptors.	Can extend into Local Study Area	Will occur only during construction phase.	Continuous during construction.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no impacts predicted for human health or ecological receptors.
	Soils	Removal and stockpiling	Soils will be stockpiled for later re-use. Stockpiled will be protected against erosion.	Removal is confined to the footprint of the infrastructure.	Confined to Mine Study Area	Will occur only during construction phase.	Continuous during construction of the infrastructure	Reversible in closure in some areas as site is decommissioned.	Low: Soils will be removed and stockpiled for re-use.	Low: localized impacts on terrestrial habit. Soils will be reused to restore habitat.
	Water Quality	Erosion and sedimentation	Mitigation measures will be implemented prior to commencing construction.	Ditching and erosion control measures will limit TSS in adjacent surface waters.	Can extend into Local Study Area	Will occur only during construction phase.	Intermittent during construction.	Immediately reversible upon cessation of activities	Low: TSS levels predicted to be low.	Low: no impacts predicted to surface water and aquatic life
	Groundwater	Alteration of infiltration	None possible	Changes in groundwater contribution to surface waters will have a negligible effect on lake water levels and aquatic life.	Confined to Mine Study Area	Changes in infiltration persist throughout all project phases	Continuous	Not reversible in most areas. Decommissioning will restore natural infiltration in some areas.	Low: Geology and lack of soil cover limit infiltration capacity	Low: loss of infiltration will not affect terrestrial or aquatic life.
	Hydrology	Alteration of drainage	Effects cannot be mitigated to address habitat loss. A compensation plan will be developed	Some habitats are lost entirely. Others will experience water levels reductions that can limit available habitat.	Can extend into Local Study Area	Changes in drainage persist until closure.	Occurs once only.	Decommissioning in closure will restore natural drainage in most areas.	Low: Drainage changes have minor effect on lake levels.	Low: small areas of aquatic habitat lost will be addressed through compensation.
	Vegetation	Removal of vegetation	Merchantable timber will be harvested.	Insignificant loss of habitat within LSA and RSA.	Confined to Mine Study Area	Throughout construction persisting through operations.	One time activity.	Some restoration is possible in closure.	Moderate: Overall loss from all development is 21% of wetland habitat and 15% of forest habitat in area of LSA	Low: loss of vegetation will displace some species.
	Terrestrial Biota	Loss of habitat	■ Clearing will avoid sensitive periods, such as nesting and denning. ■ Temporary bat habitat replacement.	Displaced species will find alternate habitat in LSA and RSA.	Can extend into Local Study Area	Throughout construction persisting through operations.	One time activity	Some restoration of habitat is possible in closure	Moderate: small mammals and nesting birds will be displaced	Low: loss of habitat will displace some species. small areas of bat habitat lost in MSA will be addressed through compensation, if necessary.
	Aquatic Biota	■ Loss of habitat and effects on water quality and quantity. ■ Blast Vibration.	■ Effects of habitat loss cannot be mitigated. A compensation plan will be developed to address habitat loss. ■ Sediment and erosion controls are included in Project design.	■ Some aquatic features are lost entirely. Others will experience changes to natural hydrographs that can limit available habitat. ■ Negligible effect on lake water levels will not effect on lake dwelling aquatic species. No effects on fish populations within the LSA are expected ■ Sediment and erosion controls will minimize impacts of TSS on aquatic life in downstream habitats. Distance from shoreline will limit effects of blasting.	Can extend into Local Study Area	Loss of habitat extends through all project phases.	Throughout construction phase	Not reversible.	Moderate to High: Partial to complete loss of habitats in some MSA waterbodies. No predicted effects on aquatic habitats or aquatic life in LSA.	Low: compensation plan will address loss of small areas of habitat affected. No effects on aquatic life due to water quality. No predicted effects on habitat in the LSA.

Table 6-55: Environmental Impacts Assessment Matrix for Construction Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Site Access Roads	Air quality	Dust and emissions from equipment	Dust suppression as required	No predicted effects on human health or terrestrial life.	Can extend into Local Study Area	Will occur only during construction phase.	Continuous during construction.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no predicted effects on human health or ecological receptors
	Noise	Noise from equipment	None required	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Can extend into Local Study Area	Will occur only during construction phase.	Continuous during construction.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted effects on human health or ecological receptors.
	Soils	Removal and stockpiling	Soil stockpiles will be protected against erosion	Soils will be stockpiled for reclamation in closure. Stockpile will be protected against erosion to protect aquatic habitats.	Confined to Mine Study Area	Will occur only during construction phase.	Continuous during construction of roads.	Partly reversible in closure		Low: localized impacts on terrestrial habitat. Soils will be reused to restore habitat.
	Water Quality	Erosion and sedimentation	Road design will have ditching and sediment controls.	Sediment controls will be implemented to minimize TSS generated during construction. Short construction period minimizes potential impacts on aquatic life.	Can extend into Local Study Area	Will occur only during construction phase.	Continuous during construction of roads.	Immediately reversible upon cessation of activities	Low: short term increase in TSS as crossing is constructed	Low: no impacts predicted to surface water or aquatic life.
	Hydrology	Alteration of drainage	Flow will be maintained during construction	Road will not alter drainage system since channels will not be altered or blocked.	Can extend into Local Study Area	Throughout construction and operations phases.	Continuous	Fully reversible	Low: Minor restriction of flow during construction..	Low: temporary construction works will have minimal effect on aquatic life.
	Groundwater	Loss of recharge area	None required	Road surface will divert runoff to margins where infiltration can occur.	Confined to Mine Study Area	Throughout construction and operations phases.	Continuous	Partly reversible in closure	Low: small areas affected.	Low: changes in groundwater levels will not affect terrestrial or aquatic habitats.
	Vegetation	Removal of vegetation	Merchantable timber will be harvested.	Insignificant loss of habitat within RSA.	Confined to Mine Study Area	Throughout construction and operations phases.	Removal occurs once only as road is constructed.	Partly reversible in closure as some road are decommissioned	Moderate: Overall loss from all development is 21% of wetland habitat and 15% of forest habitat in area of LSA	Low: loss of habitat in small areas may displace some species
	Terrestrial Biota	Loss of habitat and disturbance of wildlife	Clearing will avoid sensitive periods, such as nesting and denning.	Displaced species will find alternate habitat in LSA and RSA.	Can extend into Local Study Area	Continuous through construction and operations.	Loss of habitat occurs once only. Disturbance of wildlife is continuous.	Partly reversible in closure	Moderate: small mammals and nesting birds will be displaced	Low: loss of habitat in small areas and disturbance will displace some species.
	Aquatic Biota	Disturbance during construction of stream crossings	Flows will be maintained during construction. Sedimentation will be minimized by constructing during low flow conditions.	Crossing construction will be timed to occur in low flow conditions and to avoid critical periods to minimize impacts on aquatic life.	Can extend into Local Study Area	Short term disturbance, limited to a few days at each crossing.	Once only at each crossing..	Immediately reversible upon completion of construction.	Low: small areas and short term disturbance.	Low: disturbance will be temporary and confined to non-critical periods for aquatic life.

Table 6-55: Environmental Impacts Assessment Matrix for Construction Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Main Access Road	Air Quality	Dust and emissions from equipment	Dust suppression as required	No predicted effects on human health or terrestrial life.	Confined to Linear Infrastructure Study Area	Will occur only during construction phase.	Continuous during construction.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no predicted effects on human health or ecological receptors.
	Noise	Noise from equipment	None required	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Confined to Linear Infrastructure Study Area	Will occur only during construction phase.	Continuous during construction.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted effects on human health or ecological receptors.
	Soils	Removal and stockpiling	Stockpiles will be protected against erosion.	Soils will be stockpiled for mine site reclamation in closure. Stockpile will be protected against erosion to protect aquatic habitats.	Confined to Linear Infrastructure Study Area	Will occur only in construction phase	Continuous during construction.	Partly reversible in closure	Low: soils will be re-used where practicable.	Low: localized impacts on terrestrial habit. Soils will be reused to restore habitat.
	Water Quality	Erosion and sedimentation	Design includes ditching and sediment traps that will minimize runoff to local streams.	Sediment controls will be implemented to minimize TSS generated during construction. Short construction period minimizes potential impacts on aquatic life.	Confined to Linear Infrastructure Study Area	Will occur only during construction phase.	Continuous during construction of roads.	Immediately reversible upon cessation of activities	Low: short term increase in TSS as crossing is constructed	Low: no impacts predicted to surface water or aquatic life.
	Hydrology	Alteration of drainage	Flow will be maintained during construction	Road will not alter drainage system since channels will not be altered or blocked.	Confined to Linear Infrastructure Study Area	Throughout construction and operations phases.	Continuous	Fully reversible	Low: Road will not alter drainage patterns.	Low: temporary construction works will have minimal effect on aquatic life.
	Groundwater	Loss of recharge area	None required	Road surface will divert runoff to margins where infiltration can occur.	Confined to Linear Infrastructure Study Area	Throughout construction and operations phases.	Continuous	Not reversible since road will not be decommissioned	Low: small areas affected.	Low: changes in groundwater level will not affect terrestrial or aquatic life.
	Vegetation	Removal of vegetation	Merchantable timber will be harvested.	Insignificant loss of habitat within RSA.	Confined to Linear Infrastructure Study Area	Throughout construction and operations phases.	Removal occurs once only as road is constructed.	Not reversible since road will not be decommissioned	Low: loss of habitat is restricted to margins of road	Low: loss of habitat in small areas will displace some species.
	Terrestrial Biota	Loss of habitat	Clearing will avoid sensitive periods, such as nesting and denning.	Displaced species will find alternate habitat in LSA and RSA. No predicted effects in LSA or RSA	Confined to Linear Infrastructure Study Area	Throughout construction and operations phases.	Removal occurs once only as road is constructed.	Not reversible since road will not be decommissioned	Moderate: small mammals and nesting birds will be displaced	Low: loss of habitat may displace some species.
	Aquatic Biota	Disturbance and sedimentation during construction of stream crossings	Flows will be maintained during construction. Sedimentation will be minimized by constructing during low flow conditions.	Crossing construction will be timed to occur in low flow conditions and to avoid critical periods to minimize impacts on aquatic life. Fish passage will be maintained.	Confined to Linear Infrastructure Study Area	Short term disturbance, limited to a few days at each crossing.	Once only at each crossing..	Immediately reversible upon completion of construction.	Low: small areas and short term disturbance.	Low: disturbance will be temporary and confined to non-critical periods for aquatic life.

Table 6-55: Environmental Impacts Assessment Matrix for Construction Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Drainage of Mitta Lake	Air Quality	Emissions from pumping and excavating equipment	None required	No predicted effects on human health or terrestrial life. Emissions are considered within bounding estimates.	Confined to Mine Study Area	Will occur only during construction phase.	Continuous during draining operation.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no effects on human health or terrestrial receptors.
	Noise	Noise from equipment	None required	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Confined to Mine Study Area	Will occur only during construction phase.	Continuous during draining operation.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no effects on human health or terrestrial receptors.
	Soils	No soils present								Not applicable
	Water Quality	Changes in water quality in Upper Marmion Reservoir	Water from final stages of pumping will need to be held on–site prior to release to allow for settling of entrained sediment.	No impact predicted on aquatic life since water quality is similar to Upper Marmion Lake.	Can extend into Local Study Area	Confined to pumping period	One time occurrence	Reversible upon cessation of pumping	Low: Water quality in Mitta Lake is similar to background levels in Upper Marmion Reservoir.	Low: no predicted effects on surface water and aquatic life.
	Groundwater	Alteration of groundwater flows	None possible	Alteration of groundwater flow to Upper Marmion Reservoir will have a negligible effect on aquatic habitats.	Can extend into Local Study Area	Extends throughout all project phases.	Occurs continuously once lake is pumped out	Not reversible	Low: groundwater flow to Mitta Lake is minor.	Low: no predicted effect on terrestrial or aquatic life.
	Hydrology	Alteration of drainage to Upper Marmion Reservoir	None possible	Mitta Lake contributes minor flow to Upper Marmion Reservoir. No effect predicted on aquatic habitats in Upper Marmion Lake.	Can extend into Local Study Area	Extends throughout all project phases.	One time occurrence	Not reversible	Low: Loss of outflow to Upper Marmion Reservoir has minor effect on lake levels.	Low: negligible effect on aquatic habitats in Upper Marion Reservoir.
	Vegetation	Loss of vegetation	Merchantable timber will be harvested.	Insignificant loss of habitat within RSA.	Confined to Mine Study Area	Extends throughout all project phases.	One time occurrence	Not reversible	Moderate: Overall loss from all development is 21% of wetland habitat and 15% of forest habitat in area of LSA	Low: loss of habitat will displace some species to LSA and RSA
	Terrestrial Biota	Loss of habitat in staging areas	Clearing will avoid sensitive periods, such as nesting and denning.	Displaced species will find alternate habitat in LSA and RSA. No predicted effects in LSA or RSA.	Confined to Mine Study Area	Confined to construction phase.	One time occurrence	Not reversible	Moderate: small mammals and nesting birds will be displaced	Low: loss of habitat will displace some species to LSA and RSA.
	Aquatic Biota	Loss of habitat	No mitigation possible. Loss will be compensated for in compensation plan.	Complete loss of lake habitat.	Confined to Mine Study Area	Extends throughout all project phases.	One time occurrence	Not reversible	High: All habitat will be removed.	Low: compensation will be provided for loss of habitat.

Table 6-56: Environmental Impacts Assessment Matrix for Operations Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Development of Open Pits	Air Quality	Dust and emissions from blasting and equipment	Emissions controls are inherent in Project design. Receptors will be relocated.	No predicted effects on human health or terrestrial life for most receptors. Predicted risks to some human receptors close to site.	Can extend into Local Study Area	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no impacts predicted for human health or ecological receptors.
	Noise	Noise from blasting and equipment	Noise controls are inherent in Project design. Receptors will be relocated	No predicted effects on human health or terrestrial life for most receptors.	Can extend into Local Study Area	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Effects are considered within bounding estimates and meet provincial regulations	Low: no impacts predicted for human health or ecological receptors.
	Soils	Soil removal and stockpiling	Soils will be stockpiled for later re-use. Stockpiled will be protected against erosion.	Removal is confined to the footprint of the pits.	Confined to Mine Study Area	Progressive soil removal will occur as pits are developed during operations phase.	Intermittent as pits are expanded	Not reversible.	Soils will be removed and stockpiled for re-use.	Low: loss of habitat will displace some species.
	Water Quality	Pumping of water from the pits.	Re-use of water and treatment of excess water prior to discharge will mitigate any adverse effects on aquatic life in receiving waterbodies.	Water will be re-used in processing plant or treated prior to discharge. No effects predicted on lake water quality or aquatic life.	Can extend into Local Study Area	Will occur throughout operations phase.	Continuous during operations	Reversible at end of mine operations.	Any water discharged to surface waters will meet guidelines or background levels.	Low: no predicted effects on surface water and aquatic life.
	Hydrology	Alteration of drainage to Upper Marmion Reservoir	None possible	Loss of drainage areas has minor impact on lake water levels and aquatic life.	Can extend into Local Study Area	Occurs progressively as pits are developed during operations phase.	Intermittent as pits are expanded.	Mainly not reversible, but some drainage will be restored in post-closure when pits overflow.	Water course in pit footprints contribute minor flows to adjacent waterbodies.	Low: no predicted effect on lake levels and aquatic life.
	Groundwater	Effect on local groundwater levels from seepage into pit	None possible	Inflow to pits is not predicted to affect water levels in adjacent waterbodies or aquatic life.	Can extend into Local Study Area	Throughout all project phases	Continuous	Some reduction in inflow to pits in post-closure as pits fill	Groundwater flow to pits is predicted to be low.	Low: no predicted effect on terrestrial or aquatic habitats.
	Vegetation	Removal of vegetation	Merchantable timber will be harvested.	Insignificant loss of habitat within LSA and RSA.	Confined to Mine Study Area.	Throughout operation and into post-closure	Progressively during closure as pits are expanded.	Not reversible	Overall loss from all development is 21% of wetland habitat and 15% of forest habitat in area of LSA	Low: loss of habitat in pit areas will displace some species.
	Terrestrial Biota	Loss of habitat	Clearing will avoid sensitive periods, such as nesting and denning.	Displaced species will find alternate habitat in LSA and RSA.	Confined to Mine Study Area.	Throughout operation and into post-closure	Progressively during closure as pits are expanded.	Not reversible	Small mammals and nesting birds will be displaced	Low: loss of habitat will displace some species.
	Aquatic Biota	Vibrations from blasting.	Blast intensities may need to be modified at locations close to sensitive habitats in Upper Marmion Reservoir, depending on transmissivity and habitat studies.	Blasting will be monitored during initial stages of pit development to understand vibration transmissivity on a site-specific basis. Habitat assessment will be undertaken to assess sensitive habitats and critical use periods.	Can extend to Local Study Area	In later stages of pit development	Intermittent	Immediately reversible	To be determined through testing during initial stages of pit development.	Residual impacts will be managed to result in low impacts.

Table 6-56: Environmental Impacts Assessment Matrix for Operations Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Operation of Processing Plant	Air Quality	Dust and emissions	Emissions controls are inherent in Project design. Receptors will be relocated.	No predicted effects on human health or terrestrial life for most receptors. Predicted risks to some human receptors close to site.	Can extend into Local Study Area	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no impacts predicted for human health or ecological receptors.
	Noise	Noise	Noise controls are inherent in Project design. Receptors will be relocated	No predicted effects on human health or terrestrial life for most receptors.	Can extend into Local Study Area	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no impacts predicted for human health or ecological receptors.
	Soils	No additional impacts to soils.								
	Water Quality	Effects on surface water quality	None required. Re-use of water and treatment prior to release are inherent in the project design.	Water will be treated as required prior to discharge. No effects predicted on aquatic life.	Can extend into Local Study Area	Throughout operations phase	Continuous during operations	Reversible at closure	Low: discharged water will meet guidelines and/or background water quality.	Low: no predicted effects on surface water or aquatic life.
	Hydrology	Effects on lake water levels from water taking	None required. Re-use of water is inherent in project design.	Water taking will be minimized by re-use of water. Lake levels predicted to change by less than 9 cm. No effects predicted on aquatic life.	Can extend into Local Study Area	Throughout operations phase	Continuous during operations	Reversible at closure	Low: minor effect on lake levels	Low: no predicted effects on aquatic habitats
	Groundwater	Changes in groundwater quantity and quality	None required	Groundwater quality and quantity are not predicted to change.	Can extend into Local Study Area	Throughout operations phase	Continuous during operations	Reversible at closure	Low: negligible change in groundwater levels predicted.	Low: no predicted effect.
	Vegetation	Effects of emissions on vegetation	None required	No incremental increase in soil concentrations due to emissions. No predicted increase in uptake in vegetation or effects on vegetation.	Confined to Mine Study Area.	Throughout operations phase	Continuous during operations	Reversible at closure	Low: predicted soil concentrations are below guidelines and background levels.	Low: no predicted risk to vegetation.
	Terrestrial Biota	Effects of emissions on wildlife	None required	On incremental increase in soil concentrations and no predicted increase in vegetation. No incremental increased risk to wildlife form soil or vegetation ingestion.	Confined to Mine Study Area.	Throughout operations phase	Continuous during operations	Reversible at closure	Low: predicted soil concentrations are below guidelines and background levels.	Low: no predicted risks to terrestrial biota.
	Aquatic Biota	Discharges to aquatic habitats	A treatment facility has been included in the project design.	No effects predicted on aquatic life form any discharges.	Can extend into Local Study Area	Throughout operations phase	Intermittent depending on need for re-use water	Reversible at closure	Low: discharge water will meet guidelines or background	Low: no predicted risks to aquatic life.

Table 6-56: Environmental Impacts Assessment Matrix for Operations Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Operation of TMF	Air Quality	No air emissions since tailings will be wet.								
	Noise	Noise	None required	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Confined to Mine Study Area.	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted risks to human health or ecological receptors.
	Soils	Loss of soils	None feasible	Soils in TMF footprint will be covered over permanently. Soils will not be salvaged under the TMF.	Confined to Mine Study Area	Progressive covering of soils throughout operations.	Continuous during operations	Not reversible. Soils will be covered over permanently.	Low: area of loss is relatively small within the RSA.	Low:
	Water Quality	Effects on surface water quality	Design includes seepage collection and reclaim pipeline from TMF to PPCP to eliminate direct release of TMF water to the environment..	Collection of seepage and re-use of tailings water will eliminate discharge of water from the TMF to receiving environments. No effects predicted on aquatic or terrestrial life.	Can extend into Local Study Area	Throughout operations phase	Continuous during operations	Reversible in post-closure	Low: water quality guidelines/background levels in receiving water will not be exceeded	Low: no effects predicted on surface water or aquatic life.
	Groundwater	Effects on groundwater quality	None require. Low ARD potential in tailings minimizes metals leaching and mobility.	Water quality in TMF seepage is not predicted to result in risks to aquatic life where groundwater expresses to surface waters	Confined to Mine Study Area	Throughout operations and into post-closure	Continuous	Not reversible	Low: water quality in TMF seepage not predicted to affect groundwater quality	Low: no predicted effects on terrestrial or aquatic life.
	Hydrology	No additional effects on drainage over construction phase								
	Vegetation	Loss of vegetation	Merchantable timber will be harvested.	Moderate loss within LSA but insignificant loss of habitat within RSA.	Confined to Mine Study Area	Progressive loss of vegetation in operations phase as TMF is filled	Continuous during operations phase.	Not reversible. Terrestrial habitat in footprint will be permanently lost.	Moderate: Overall loss from all development is 21% of wetland habitat and 15% of forest habitat in area of LSA	Low: habitat loss will displace some terrestrial wildlife species.
	Terrestrial Biota	Loss of habitat	Clearing will avoid sensitive periods, such as nesting and denning.	Displaced species will find alternate habitat in LSA and RSA. Low effect in RSA.	Can extend into Local Study Area	Progressive loss of habitat in operations phase as TMF is filled.	Continuous during operations phase.	Not reversible. Habitat loss in footprint of TMF is permanent.	Moderate: small mammals and nesting birds will be displaced	Low: habitat loss will displace some species.
	Aquatic Biota	Effects on surface water quality	Design includes seepage collection and reclaim pipeline from TMF to PPCP to eliminate direct release of TMF water to the environment..	Collection of seepage and re-use of tailings water will eliminate discharge of water from the TMF to receiving environments. No effects predicted on aquatic or terrestrial life.	Can extend into Local Study Area	Throughout operations phase	Continuous during operations.		Low: water quality guidelines/background levels will not be exceeded in receiving waters.	Low: no effects predicted on aquatic life.

Table 6-56: Environmental Impacts Assessment Matrix for Operations Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Waste Rock and Ore Stockpiles	Air Quality	Dust	Emissions controls are inherent in Project design. Receptors will be relocated.	No predicted effects on human health or terrestrial life.	Can extend into Local Study Area	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no impacts predicted for human health or ecological receptors.
	Noise	Noise	Noise controls are inherent in Project design. Receptors will be relocated	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Can extend into Local Study Area	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no impacts predicted for human health or ecological receptors.
	Soils	Loss of soils	None	Soils in waste rock stockpile will be covered over permanently. Soils will not be salvaged under either the waste rock or the ore stockpiles.	Confined to Mine Study Area.	Progressive covering of soils throughout operations.	Continuous during operations	Not reversible in waste rock disposal facility	Low: area of loss is relatively small within the RSA.	Low
	Water Quality	Effects on surface water quality	None required. Project design includes ditching and holding ponds for stormwater management. Water will be treated as required prior to discharge	Runoff and seepage will be collected by ditching and routed to the PPCP for re-use or treatment prior to discharge. No effects predicted on aquatic life.	Can extend into Local Study Area	Throughout operations phase	Continuous during operations	Reversible at closure	Low: water quality guidelines/background levels in receiving water will not be exceeded	Low: no predicted effects on aquatic life.
	Hydrology	Loss of drainage area	Drainage to Upper Marmion Reservoir will be restored in closure	The small drainage area affected will not affect water levels in adjacent waterbodies. No effects predicted on aquatic life.	Can extend into Local Study Area	Throughout operations and into closure.	Continuous during operations phase.	Not reversible	Low: small drainage area affected	Low: no predicted effects on aquatic life.
	Groundwater	Effects on recharge	None	Changes in infiltration are not predicted to result in changes in lake levels and effects on aquatic life. Water quality is not predicted to result in risks to aquatic life where groundwater expresses to surface waters	Confined to Mine Study Area.	Throughout operations and into post-closure	Continuous.	Not reversible	Low: permeability of subsurface is low.	Low: no predicted effects on aquatic life.
	Vegetation	Loss of vegetation	Merchantable timber will be harvested.	Insignificant loss of habitat within RSA.	Confined to Mine Study Area.	Progressive loss of vegetation throughout operations.	Continuous during operations.	Not reversible.	Moderate: Overall loss from all development is 21% of wetland habitat and 15% of forest habitat in area of LSA	Low: some species will be displaced.
	Terrestrial Biota	Loss of habitat	Clearing will avoid sensitive periods, such as nesting and denning.	Displaced species will find alternate habitat in LSA and RSA.	Can extend into Local Study Area	Progressive loss of habitat during operations.	Continuous during operations	Not reversible	Moderate: small mammals and nesting birds will be displaced	Low: some species will be displaced during operations.
	Aquatic Biota	Loss of habitat and water quality.	Mitigation for habitat loss is not possible. Loss will be addressed in compensation plan.	Small areas of aquatic habitat will be eliminated. Water will be directed to the PPCP and will be treated as required prior to discharge. No effects predicted on aquatic life.	Confined to Mine Study Area.	Progressive loss of habitat during operations.	Continuous during operations	Not reversible	Moderate: Some aquatic habitats will be eliminated.	Low: habitat loss will be compensated. No predicted effects from water quality.

Table 6-56: Environmental Impacts Assessment Matrix for Operations Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Operation of Site Water Management System	Air Quality	No predicted emissions from WTF								
	Noise		None required	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Confined to Mine Study Area.	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted effects on human health.
	Soils	No additional effects on soils								
	Water Quality	Effects on surface water quality	None required. Treatment of discharge is inherent in the Project design.	Discharge will not affect aquatic life. No risks to wildlife from exposure to water in TMF reclaim pond.	Can extend into Local Study Area	Throughout operations phase	Continuous during operations	Reversible in closure	Low: Discharges will meet guidelines and/or baseline conditions.	Low: no predicted effects on aquatic life.
	Hydrology	Water taking and discharge	None required. Project has been designed to minimize taking of freshwater from surface waters by re-use of water wherever possible.	Water taking will be modified by discharge. Net change will result in minor change in lake level. Change will not adversely affect aquatic life.	Can extend into Local Study Area	Throughout operations phase	Continuous during operations	Reversible in closure	Low: Minor decrease in lake levels	Low: no predicted effects on aquatic life.
	Groundwater	Effects on water quality	None required. Project design includes partial lining of the PPCP to limit infiltration and collect seepage from the TMF reclaim pond	Part of PPCP will be lined to minimize seepage to groundwater and migration to surface waters. No impacts predicted on aquatic life Water quality is not predicted to result in risks to aquatic life where groundwater expresses to surface waters	Mine Study Area	Throughout operation phase	Continuous during operations	Reversible at closure	Low: design minimizes seepage to groundwater	Low: no predicted effects on terrestrial or aquatic life.
	Vegetation	No additional effects on vegetation								
	Terrestrial Biota	Wildlife exposure to site water impoundments	None required. Measures may be required to keep wildlife away from PPCP if future monitoring shows wildlife are accessing the ponds.	Wildlife exposure to water in the TMF reclaim ponds do not result in predictions of risk. Wildlife exposure to water in the PPCP is not expected due to proximity to processing plant. Noise and activity will discourage wildlife in this area.	Mine Study Area	Throughout operations phase	Continuous	Reversible in closure	Low: concentrations in TMF reclaim pond are below effects levels.	Low: no predicted effects on terrestrial biota.
	Aquatic Biota	Effects on surface water quality and quantity	None required. Treatment of discharge is inherent in the Project design.	Small change in lake levels would not affect aquatic life. Discharge water will meet guidelines and/or baseline conditions in receiving waterbodies. No effects predicted on aquatic life. No increase in fish tissue residues predicted.	Can extend into Local Study Area	Throughout operations phase	Continuous during operations	Reversible in closure	Low: Minor change in lake levels. Discharges will meet guidelines and/or baseline.	Low: no predicted effects on aquatic life.

Table 6-56: Environmental Impacts Assessment Matrix for Operations Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Accommodations Camp	Air Quality	Emissions	None required	No predicted effects on human health or terrestrial life.	Confined to Mine Study Area.	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no predicted effect on human health or ecological receptors.
	Noise	Noise	None required	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Confined to Mine Study Area.	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted effect on human health or ecological receptors.
	Soils	No additional impacts on soils over those noted for construction phase.								
	Water Quality	Domestic wastewater	Treatment facility is inherent in the Project design	No effect on aquatic life is predicted	Can extend into Local Study Area	Throughout operations phase	Continuous	Reversible at closure	Low: discharges will meet regulations	Low: no predicted effects on surface water or aquatic life.
	Groundwater	No additional impacts on groundwater. Potable water will be sourced from surface water.								
	Hydrology	Water taking	None required	Minor change in lake levels not predicted to affect aquatic life	Can extend into Local Study Area	Throughout operations phase	Continuous	Reversible at closure	Low: effect on lake levels is included in bounding scenario.	Low: no predicted effects on aquatic life.
	Vegetation	No additional impacts on vegetation. Impacts on vegetation occurred during construction.								
	Terrestrial Biota	Disturbance and hunting pressure	Restrictions on hunting by camp personnel will be implemented	Hunting could affect local populations of some species, and affect Aboriginal use of these resources.	Regional Study Area	Throughout operations phase	Occasional	Fully reversible at closure	Moderate: could affect local populations of some species.	Low: effects on wildlife will be regulated.
	Aquatic Biota	Fishing pressure	Restrictions on fishing by camp personnel will be implemented.	Fishing in local waterbodies could deplete stocks of some species, with potential socio-economic impacts as well.	Local Study Area	Throughout operations phase	Occasional	Fully reversible at closure	Moderate to High: could affect local populations of some species.	Low: effects on fish population will be regulated.

Table 6-56: Environmental Impacts Assessment Matrix for Operations Phase

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Access Road (Hardtack-Sawbill)	Air Quality	Dust and emissions	Dust suppression as required	No predicted effects on human health or terrestrial life.	Confined to Linear Study Area.	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no predicted effects on human health or ecological receptors.
	Noise	Noise	None required	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Confined to Linear Study Area.	Will occur throughout operations phase.	Continuous during operations.	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted effects on human health or ecological receptors.
	Soils	No additional impacts on soils. Soils removal will occur in construction phase.								
	Water Quality	Road runoff	Regular maintenance of sediment control measures along road.	Road maintenance will include maintenance of sediment and erosion controls (e.g., sedimentation ponds). TSS concentrations are not expected to affect aquatic life.	Confined to Linear Study Area.	Throughout operations phase	Intermittent depending on precipitation events	Not reversible since road will remain after closure	Low: TSS concentrations are predicted to be low.	Low: no predicted effect on aquatic life.
	Groundwater	No additional impact above those noted for construction phase.								
	Hydrology	No flow alterations or obstruction will occur during operations								
	Vegetation	Brush clearing along ROW	Merchantable timber will be harvested.	Insignificant loss of habitat within RSA.	Confined to Linear Study Area.	Throughout operations phase	Intermittent: removal will be seasonal	Not reversible since road will remain after closure	Low: Habitat loss is confined to margins of road.	Low: some species may be displaced.
	Terrestrial Biota	Brush clearing along ROW. Wildlife-vehicle collisions	Clearing will avoid sensitive periods, such as nesting and denning.	Displaced species will find alternate habitat in LSA and RSA.	Confined to Linear Study Area.	Throughout operations phase	Intermittent: removal will be seasonal	Not reversible since road will remain after closure	Low: Habitat loss is confined to margins of road.	Low: some species may be displaced.
	Aquatic Biota	Road drainage effects on water quality	Regular maintenance of sediment control measures along road.	Road maintenance will include maintenance of sediment and erosion controls (e.g., sedimentation ponds). TSS concentrations are not expected to affect aquatic life.	Confined to Linear Study Area.	Throughout operations phase	Intermittent depending on precipitation events	Not reversible since road will remain after closure	Low: TSS concentrations are predicted to be low.	Low: no predicted effects on water quality or aquatic life.

Table 6-57: Environmental Impacts Assessment Matrix for Closure and Post-Closure Phases

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Site Decommissioning	Air Quality	Dust and emissions from equipment	None required	No predicted effects on human health or terrestrial life.	Can extend into Local Study Area	Confined to closure phase	Continuous during closure	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no predicted effects on human health or ecological receptors
	Noise	Noise from equipment.	None required	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Can extend into Local Study Area	Confined to closure phase	Continuous during closure	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted effects on human health or ecological receptors.
	Soils	Restoration of disturbed areas	None	Some disturbed areas can be restored.	Confined to Mine Study Area	Confined to closure phase	Intermittent as areas are decommissioned	Reversibility is not desirable.	Low positive: restoration of some disturbed areas.	Low: habitat restoration will permit return of some species.
	Water Quality	Erosion and sedimentation.	None	Erosion and sediment controls will be in place during closure. In post-closure revegetation of site will minimize TSS in runoff.	Can extend into Local Study Area	Confined to closure phase	Intermittent depending on precipitation events.	Reversible upon cessation of events.	Low: TSS increase is expected to be low and within guidelines.	Low: no predicted effect on water quality or aquatic life.
	Hydrology	Alteration of drainage	None	Natural drainage in some disturbed areas can be restored during closure. Minimizes lake level changes in post-closure due to the project, minimizing impacts on aquatic life.	Can extend into Local Study Area	Confined to closure phase	One time occurrence	Reversibility is not desirable	Low positive: natural drainage will be restored where feasible.	Low positive: minor changes in lake levels will be reversed as drainage is restored.
	Groundwater	Alteration of infiltration	None	Restoration of groundwater infiltration will assist in restoring some habitats such as wetlands. Water quality is not predicted to result in risks to aquatic life where groundwater expresses to surface waters	Confined to Mine Study Area	Confined to closure phase	One time occurrence	Not reversible	Low: groundwater infiltration will be restored in some areas.	Low positive: localized effects on habitats will be reversed in some areas.
	Vegetation	Effects of site restoration on vegetation	None	Restoration of small areas of habitat lost during construction an operations will promote return of wildlife.	Confined to Mine Study Area	Confined to closure phase	Intermittent as areas are decommissioned and restored	Reversibility is not desirable	Low positive: Moderate gain in vegetated areas lost.	Low positive: wildlife habitat will be progressively restored.
	Terrestrial Biota	Effects of site restoration on habitat	None	Restoration of small areas of habitat lost during construction and operations will promote return of wildlife.	Can extend into Local Study Area	Confined to closure phase	Intermittent as areas are decommissioned and restored	Reversibility is not desirable	Low positive: Moderate gain in habitat lost.	Low positive: wildlife habitat will be progressively restored.
	Aquatic Biota	Effects of site restoration on aquatic life	None	Sediment and erosion controls will be in place until end of closure. Re-vegetation will minimize sediment erosion in post-closure, minimizing effects on aquatic life.	Can extend into Local Study Area	Confined to closure phase	Intermittent depending on precipitation events.	Reversible at end of closure	Low: site runoff will be controlled to minimize TSS.	Low: no predicted effects on aquatic life.

Table 6-57: Environmental Impacts Assessment Matrix for Closure and Post-Closure Phases

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Closure of TMF	Air Quality	Dust and emissions from equipment	None	No predicted effects on human health or terrestrial life.	Can extend into Local Study Area	Confined to closure phase	Continuous during closure	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low;: no predicted effects on human health or ecological receptors
	Noise	Noise from equipment	None	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Can extend into Local Study Area	Confined to closure phase	Continuous during closure	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted effects on human health or ecological receptors.
	Soils	No additional impacts on soils								
	Water Quality	Effects on water quality	TMF will be sculpted to promote runoff and minimize infiltration. Soil amendment will promote vegetation growth minimizing TSS in runoff to local waterbodies. Excess water will be diverted to open pit until water quality is acceptable for aquatic life.	Seepage from TMF in post-closure is not predicted to affect aquatic life. Runoff will be released to local waterbodies when quality is acceptable for aquatic life.	Can extend into Local Study Area	Confined to closure phase	Continuous during closure	Reversible at end of closure	Low: Discharges will meet guidelines/background levels.	Low: no predicted effects on surface waters or terrestrial or aquatic life.
	Hydrology	Alteration of drainage	Drainage will be routed to Sawbill Bay when water quality is acceptable.	Drainage from the TMF will be routed to surface waters, reducing effects of construction and operation on lake levels.	Can extend into Local Study Area	Extends into post-closure	Continuous	Not reversible	Low: drainage from TMF in post-closure will be routed to surface waters.	Low: restoration of drainage will restore lake levels minimizing effects on aquatic life.
	Groundwater	Effects on groundwater quality and quantity	None	Sculpting of TMF will reduce infiltration, reducing groundwater levels under the TMF. Reducing seepage of TMF water to local aquifer will minimize effects of TMF seepage on groundwater quality. Water quality is not predicted to result in risks to aquatic life where groundwater expresses to surface waters	Confined to Mine Study Area	Throughout closure and post-closure	One time occurrence	Not reversible	Low: reduced infiltration due to sculpting of TMF	Low: no predicted effects on surface waters or ecological receptors.
	Vegetation	Effects on vegetation	None	Addition of soil amendment to TMF will promote vegetation growth on TMF in post-closure, restoring some habitat lost during construction and operations.	Confined to Mine Study Area	During closure phase	Throughout closure and post-closure	Reversibility is not desirable	Low positive: Moderate increase in vegetated area.	Low positive: some habitat will be restored permitting return of some species.
	Terrestrial Biota	Effects on habitat	None	Addition of soil amendment to TMF will promote vegetation growth on TMF in post-closure, restoring some habitat lost during construction and operations and facilitating return of some wildlife.	Can extend into Local Study Area	During closure phase	Throughout closure and post-closure	Reversibility is not desirable	Low positive: Moderate increase in vegetated area.	Low positive: some habitat will be restored permitting return of some species.
	Aquatic Biota	Effects on surface water quality and quantity	TMF will be sculpted to promote runoff and minimize infiltration. Soil amendment will promote vegetation growth minimizing TSS in runoff to local waterbodies. Excess water will be diverted to open pit until water quality is acceptable for aquatic life.	Seepage from TMF in post-closure is not predicted to affect aquatic life. Runoff will be released to local waterbodies when quality is acceptable for aquatic life.	Can extend into Local Study Area	During closure phase	Continuous during closure	Reversible at end of closure	Low: Discharges will meet guidelines and/or background levels.	Low: no predicted effects on aquatic life.

Table 6-57: Environmental Impacts Assessment Matrix for Closure and Post-Closure Phases

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Closure of Waste Rock Stockpile	Air Quality	Dust and emissions from equipment	None	No predicted effects on human health or terrestrial life.	Can extend into Local Study Area	Confined to closure phase. No emissions in post-closure	Continuous during closure	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no predicted effect on human health or ecological receptors.
	Noise	Noise from equipment	None	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Can extend into Local Study Area	Confined to closure phase. No sources of noise in post-closure	Continuous during closure	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted effect on human health or ecological receptors.
	Soils	No additional impacts								
	Water Quality	Effects on water quality	None	Water will be routed to open pits at closure until seepage water is of acceptable quality to discharge to local waterbodies. No predicted impact on aquatic life.	Can extend into Local Study Area	Closure phase into post-closure	Continuous during closure	Reversible in post-closure	Low: water discharged to local waterbodies will meet guidelines and/or background levels.	Low: no predicted effects on surface waters or aquatic life.
	Hydrology	Effects on drainage	None	Small reduction in drainage area until water is of acceptable quality to release to surface waters.	Can extend into Local Study Area	Closure phase potentially into post-closure	Continuous during closure	Reversible in post-closure	Low: drainage area contribution to lake levels is small.	Low: effects on lake levels and aquatic habitat will be progressively reversed.
	Groundwater	Effects on groundwater quality and quantity	None	Shallow groundwater will be intercepted by ditches minimizing impacts of seepage via groundwater to surface waters. Loss of groundwater contribution to surface waters will be restored in post-closure when drainage can be directed to surface waters. Water quality is not predicted to result in risks to aquatic life where groundwater expresses to surface waters	Confined to Mine Study Area	Closure phase potentially into post-closure	Continuous during closure	Reversible in post-closure.	Low: ditches will intercept shallow groundwater.	Low: effects on lake levels and aquatic habitat will be progressively reversed.
	Vegetation	Restoration of vegetation	None	The waste rock stockpile will be left to re-vegetate naturally. Vegetation may not revert fully to pre-development habitat.	Confined to Mine Study Area	Into post-closure	Continuous	Reversibility is not desirable	Low positive: Some species are expected to colonize the stockpile	Low positive: some habitat will be restored permitting return of some species.
	Terrestrial Biota	Restoration of habitat	None	Wildlife will gradually move in as the stockpile re-vegetates. Habitat may not revert fully to pre-development habitat.	Can extend into Local Study Area	Into post-closure	Continuous	Reversibility is not desirable	Low positive: some habitat lost in construction will be restored.	Low positive: some habitat will be restored permitting return of some species.
	Aquatic Biota	Effects on surface water quality and quantity	None	At closure seepage and runoff water will be directed to the open pits until water is of acceptable quality to discharge directly to local waterbodies. No effects are predicted on aquatic life.	Can extend into Local Study Area	Into post-closure	Continuous until water quality is acceptable	Not reversible	Low: Water quality will be acceptable for aquatic life upon release to surface waters	Low: no predicted effects on aquatic life.

Table 6-57: Environmental Impacts Assessment Matrix for Closure and Post-Closure Phases

Activity	VEC Affected	Potential Effect	Proposed Mitigation	Residual Environmental Effect	Predicted Degree of Impact after Mitigation					Significance of Residual Effect
					Extent	Duration	Frequency	Reversibility	Magnitude	
Open Pits	Air Quality	Dust and emissions from equipment	None	No predicted effects on human health or terrestrial life.	Confined to Mine Study Area	Throughout closure and post-closure	Continuous during closure	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates of emissions and meet provincial regulations.	Low: no predicted effect on human health or ecological receptors.
	Noise	Noise from equipment	None	No predicted effects on human health. Wildlife will avoid the area due to noise and activity.	Confined to Mine Study Area	Throughout closure and post-closure	Continuous during closure	Immediately reversible upon cessation of activities	Low: Effects are considered within bounding estimates and meet provincial regulations	Low: no predicted effect on human health or ecological receptors.
	Soils	No effect on soils predicted since no soils will be in the open pit								
	Water Quality	Effects on water quality	Water quality will be monitored during post-closure to verify that overflow will not affect aquatic life	Pits will overflow after approximately 218 years and drain to Upper Marmion Reservoir. Pit water quality at overflow is predicted to be acceptable for aquatic life.	Can extend into Local Study Area	Throughout closure and post-closure	Continuous	Not reversible	Low: Pit water quality at overflow will be acceptable for aquatic life	Low: no predicted effect on human health or ecological receptors.
	Hydrology	Effects on drainage	None	Pit overflow will restore some of the drainage to Upper Marmion Reservoir that was lost due to the project.	Can extend into Local Study Area	Throughout closure and post-closure	Continuous	Not reversible	Low positive: Some restoration of original drainage	Low: effects on lake levels and aquatic habitat will be progressively reversed.
	Groundwater	Effects on groundwater quality and quantity	None	Loss of groundwater contribution to adjacent surface waters is minor. Groundwater contribution to surface waterbodies will be restored when pits overflow. Groundwater quality is not predicted to be affected.	Confined to Mine Study Area	Throughout closure and post-closure	Continuous	Not reversible	Low: groundwater flow to Marmion Reservoir will be restored in post-closure. Quality is not predicted to be affected.	Low: effects on lake levels and aquatic habitat will be progressively reversed.
	Vegetation	No effects on vegetation predicted since pits will be aquatic habitat								
	Terrestrial Biota	Effects on habitat and wildlife	None	Pit water quality will be of acceptable quality for consumption by wildlife.	Confined to Mine Study Area	Throughout closure and post-closure	Continuous	Not reversible	Low: Water quality in pits will be acceptable quality for wildlife consumption	Low: no predicted effects on ecological receptors.
	Aquatic Biota	Effects on surface water quality and quantity	None	Water quality at overflow is predicted to meet background levels in Upper Marmion Reservoir and/or guidelines for protection of aquatic life. No impacts are predicted on aquatic life.	Can extend into Local Study Area	Throughout closure and post-closure	Continuous	Not reversible	Low: Overflow water quality will meet guidelines and/or background levels.	Low: no predicted effects on aquatic life.

Table 6-58: Summary of Overall Socio-economic Effects Assessment Results

Valued Ecosystem Component	Overall Residual Effect	Description
Population and Demographics	Positive	The population increase associated with the Project will first stem the decline and then augment the population of the Town. This will have an overall beneficial effect on the community.
Labour Market	Positive	The increase in employment and training and corresponding decrease in unemployment will bring additional income into the LSA, which will contribute to the overall economic wellbeing of the community.
Government Finance	Positive	Beyond additional revenue to the federal and provincial governments, new construction in the LSA will generate additional property assessment for the Town of Atikokan resulting in revenues that can be applied to the provision of services.
Public Services and Infrastructure	Neutral	There is sufficient capacity for existing infrastructure and service delivery to absorb the increases in demand associated with the Project.
Housing and Accommodation	Positive	The vacancy rate in the Town of Atikokan will be reduced by the influx of workers and their families, and new housing will be constructed. This will help stabilize the local housing market.
Transportation	Low-level adverse effect	The local transportation network currently operates well below capacity levels; hence the increase created by the Project can readily be absorbed.
Outdoor Tourism and Recreation	Low-level adverse effect	Upon the application of mitigation measures required for air quality and/or noise compliance, residual adverse effects on tourism and recreation are unlikely. The overall attractiveness of Atikokan and environs is not likely to be affected by the Project; however a low-level effect through loss of visual aesthetics is anticipated. Of note is that given the mining history in the vicinity of Atikokan, many people coming to Atikokan understand that mining activities take place in this area.
Hunting	Low-level adverse effect	No effect is anticipated on the number of hunting licences issued or on general hunting activity in the area. A relatively small amount of land will no longer be available for hunting, which will have a low-level effect on hunting in the LSA.
Trapping	Neutral	Upon the application of mitigation for the loss of some portions of tenured trapline areas, no residual adverse effect on trapping is anticipated.
Fishing	Neutral	Overall fishing activity in the study areas is not likely to be affected.
Mining	Positive	Beyond the positive effects of the Project described in this TSD, the Project would likely have net beneficial effects on local or regional exploration and development in this sector.
Forestry	Neutral	Upon the application of mitigation, no residual adverse effect on forestry is likely.
Water Use and Access	Neutral	Ongoing discussions with the downstream hydro-electric facilities to further understand the potential financial implications of the predicted changes to outflows from the Raft Lake Dam. Upon the application of mitigation, no residual adverse effect other commercial or industrial water users is likely.

Table 6-59: Human Health Residual Effects Evaluation by Assessment Criteria

Assessment Criteria	Noise Effects		Particulate Matter			
			DPM Effects		(PM_{10}) Effects	
	Level	Rationale	Level	Rationale	Level	Rationale
Geographic Extent (of effect)	High	Noise levels that may cause effects extend into RSA	Low	Cancer risks above target levels were only predicted at two trapper's cabins within the LSA	Low	PM_{10} concentrations above screening thresholds were not identified at receptors within the LSA
Frequency (of effect)	High	Noise is expected to be generated daily	Medium	Cancer risk is a result of long-term exposure	Low	Concentrations are below the screening threshold 95% of the time
Duration (of conditions causing effect)	High	Noise is expected during constructions, operations and closure	High	Diesel emissions may occur on a daily basis due to vehicle traffic within the MSA	High	Emissions of PM_{10} may occur on a daily basis due to activities within the MSA
Degree of Irreversibility (of effect)	Medium	Effects on sleep disturbance will not occur once the Project is finished	High	Cancer effects are irreversible	Medium	Cardiopulmonary effects may decrease once the Project is finished

Table 6-60: Magnitude Levels for Human Health Residual Effects

Noise Effects		DPM Effects		PM_{10} Effects	
Level	Rationale	Level	Rationale	Level	Rationale
Low	■ Predicted health measures are below Health Canada guidelines ■ Additional literature search identified potential noise effects at levels below guidelines ■ Assumed the receptors are subject to the predicted noise concentrations on a long-term basis	Low	■ The ILCR for both locations is 1.6×10^{-6} ■ DPM concentration based on maximum emissions during operation phase and assumed to apply for the entire constructions, operations and closure phases ■ The ILCR exceeded the target cancer risk level at one location only ■ Assumed that trapper is exposed to the maximum annual DPM concentration for 8 hours per day, 105 days per year for 15.5 years	Low	■ The maximum predicted 24-hour concentration was within 10 µg/m^3 of the screening threshold ■ The PM10 concentration was only above the screening threshold at one receptor location ■ 95% of the time the PM10 concentration would be below the screening threshold at that receptor location

Table 6-61: Summary of Average Projected Climate Trend Deviations from Observed Historic Values

Station/Period			Temperature [°C]	Precipitation [mm (equiv.)]
Sioux Lookout	2050s	Annual	+ 2.5 to 3.0	+ 30 to 40
		Spring	+ 2.0 to 2.5	+ 15 to 20
		Summer	+ 2.0 to 2.5	+ 5 to 10
		Fall	+ 2.5 to 3.0	+ 10 to 20
		Winter	+ 2.5 to 3.0	+ 15 to 20

Table 6-62: Climate Risk Matrix

Climate Factor	Trend	Justification
Frequency of Drought	Qualitative	
Freeze-Thaw Cycles	Increasing	Slight increase based increasing winter precipitation and average temperatures
High Humidity Periods	Increasing	Slight increase based on increasing precipitation from analysis of all models, and increase in temperatures.
Frequency of Extreme Temperatures	Unknown	Possible increase in extreme temperatures but strength of trend is unknown
Frequency of Rainfall	Unknown	Trend is unclear due to unknown distribution of rain events in future projections
Heavy Rain	Increasing	Slight increase based on higher rainfall volume in the summer season
Total Rainfall	Increasing	Increase of ~50 mm annually above historic baseline
Freezing Rain	Increasing	Slight increase in temperature will create a vertical profile that is conducive to freezing rain events
Rain on Snow Events	Increasing	Slight increase in temperature will create a vertical profile that is conducive to rain on snow events
Flash Freeze Event (Rain/Freeze-Thaw)	Qualitative	Further assessment of Trend is required due to unknown distribution of rain events in future projections
Snow Accumulation	Qualitative	Further assessment of Trend is required due to unknown distribution of precipitation events in future projections
Snowmelt	Qualitative	Further assessment of Trend is required due to unknown distribution of precipitation events in future projections
Sunny days	Qualitative	Further assessment of Trend is required due to lack of information on future dynamics (cloud cover)

Table 6-62: Climate Risk Matrix

Climate Factor	Trend	Justification
Extreme Heat	Increasing	Slight increase based on increase in average summer temperatures
Extreme Cold	Decreasing	Slight decrease based on increase in average winter temperatures
Cooling Degree Days	Increasing	Slight increase based on increase in average summer temperatures
Heating Degree Days	Decreasing	Slight decrease based on increase in average winter temperatures
Average Temperature	Increasing	Analysis of all models indicates and average increase of ~3°C above historic baseline

Table 6-63: Predicted Water Quality in Tailings Management Facility Reclaim Pond

Solution Description		100 Year Wet		50 Year Wet	
		Average/Steady State	Worst Case	Average/Steady State	Worst Case
Input Definition					
pH	s.u.	7.8	7.6	7.8	7.6
Alkalinity	mg/L as $CaCO_3$	104	119	105	119
Nitrate[(a)]	mg/L as N	0.000005	0.000006	0.000005	0.000006
Nitrate[(b)]	mg/L as N	3.7	4.7	3.8	4.7
Ammonia	mg/L as N	3.7	4.7	3.8	4.7
Aluminum	mg/L	0.01	0.01	0.01	0.01
Antimony	mg/L	0.002	0.002	0.002	0.002
Arsenic	mg/L	0.00002	0.00003	0.00002	0.00003
Boron	mg/L	0.001	0.002	0.001	0.002
Barium	mg/L	0.01	0.02	0.01	0.02
Calcium	mg/L	21	33	22	33
Cadmium	mg/L	0.00002	0.0003	0.00002	0.0003
Chloride	mg/L	21	48	21	49
Cobalt	mg/L	0.002	0.002	0.002	0.002
Chromium	mg/L	0.0002	0.0003	0.0002	0.0003
Copper	mg/L	0.08	0.11	0.08	0.11
Iron	mg/L	0.00007	0.00008	0.00007	0.00008
Mercury	mg/L	0.000009	0.000009	0.000009	0.000009
Potassium	mg/L	28	38	29	38
Magnesium	mg/L	12	18	12	18
Manganese	mg/L	0.04	0.07	0.04	0.07
Molybdenum	mg/L	0.06	0.07	0.06	0.07
Sodium	mg/L	73	93	74	94
Nickel	mg/L	0.008	0.009	0.008	0.009
Phosphorous	mg/L-P	0.02	0.03	0.02	0.03

Table 6-63: Predicted Water Quality in Tailings Management Facility Reclaim Pond

Solution Description		100 Year Wet		50 Year Wet	
		Average/Steady State	Worst Case	Average/Steady State	Worst Case
Input Definition					
Lead	mg/L	0.0001	0.0003	0.0001	0.0003
Selenium	mg/L	0.0006	0.00093	0.0006	0.00093
Silver	mg/L	0.00001	0.00001	0.00001	0.00001
Sulfate	mg/L	168	227	170	228
Strontium	mg/L	0.22	0.32	0.23	0.32
Tin	mg/L	0.02	0.03	0.02	0.03
Vanadium	mg/L	0.00002	0.00002	0.00002	0.00002
Thallium	mg/L	0.0001	0.0001	0.0001	0.0001
Uranium	mg/L	0.005	0.007	0.005	0.007
Zinc	mg/L	0.002	0.01	0.002	0.01
Cyanide	mg/L	0.19	0.19	0.19	0.19

Note:
a) Nitrate concentrations assuming no oxidation of ammonia.
b) Nitrate concentrations assuming complete oxidation of ammonia.

Table 6-64: Summary of Predicted Cumulative Environmental Effects

Project Component	Predicted Effect	Extent of Predicted Effect	Summary
Air Quality	Changes in air quality	Changes in air quality are confined to the Local Study Area	Changes in air quality beyond the local study area that could interact with other emissions sources are not predicted. There are no cumulative effects with respect to the atmospheric components of the Project and the four possible existing or reasonable future projects or activities that could potentially interact with the Project.
Noise	Increased noise levels due to project activities	Increases in noise levels are confined to the Local Study Area	Changes in noise levels beyond the local study area that could interact with other noise sources are not predicted.
Hydrology	Changes in water flows in mine area streams, and changes in lake levels in Lizard Lake and Upper Marmion Reservoir	Changes in stream flows are confined mainly to the MSA, with minor changes in some streams in the LSA. Lake level changes are less than 3 cm in Lizard Lake and less than 10 cm in Upper Marmion Reservoir.	Effects of the Project are confined to the mine area and immediately adjacent waterbodies. No downstream effects are predicted.

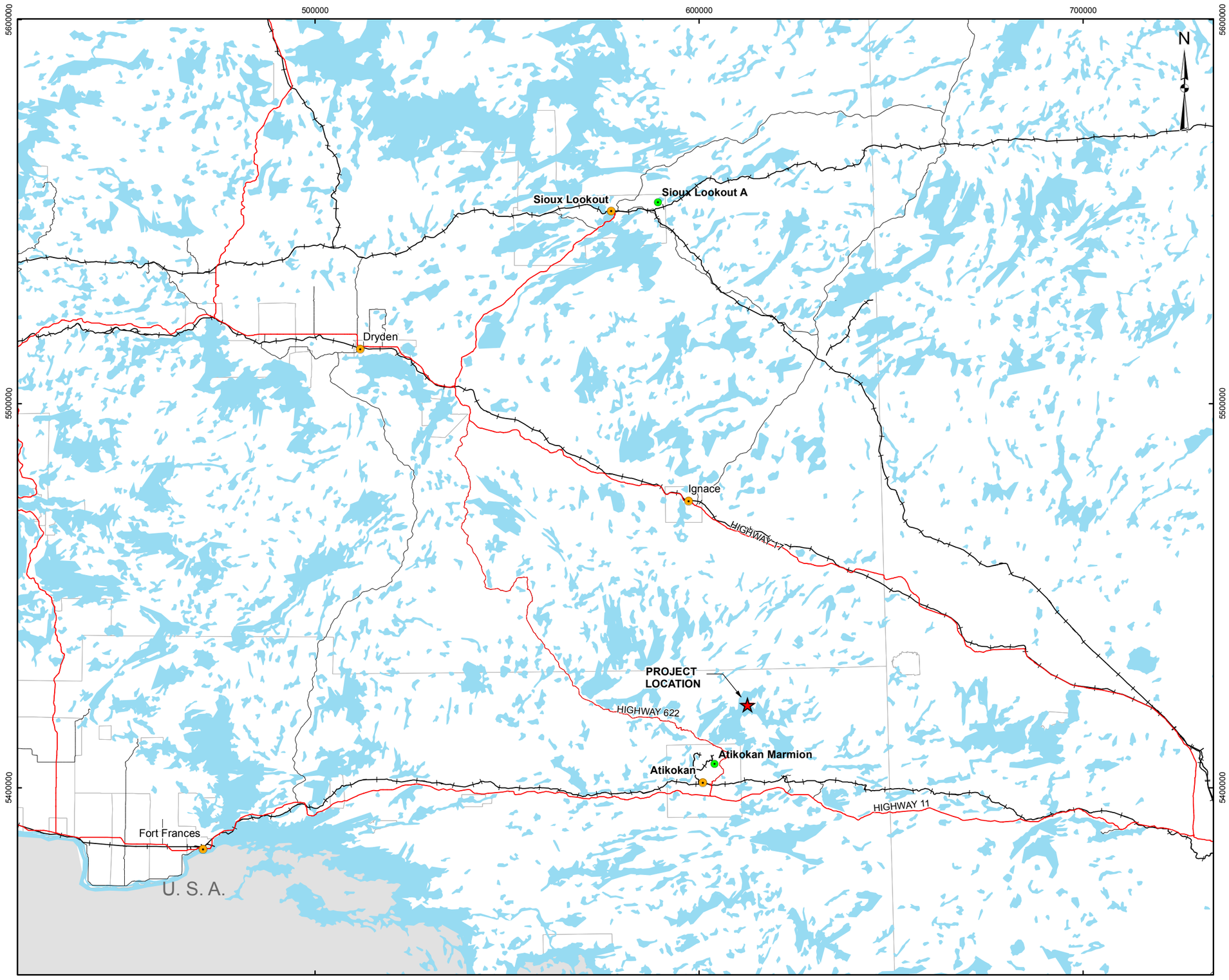
Table 6-64: Summary of Predicted Cumulative Environmental Effects

Project Component	Predicted Effect	Extent of Predicted Effect	Summary
Hydrogeology	Changes in groundwater quantity and quality within the footprint of the mine due to development of the open pits and construction of infrastructure.	Effects are confined to the LSA.	Effects of the Project on groundwater are not predicted to extend beyond the mine footprint and adjacent areas of the LSA.
Water Quality	Changes in water quality due to operation of the mine and post-closure flooding of the open pits.	Minor changes in some parameters are predicted in Upper Marmion Reservoir and Lizard Lake during operations and in post-closure. These are not predicted to adversely affect aquatic life or other water uses. Effects are confined to the LSA.	No changes in water quality are predicted to occur downstream of Upper Marmion Reservoir. Predicted changes are minor increases in some parameters that are not predicted to affect aquatic life.
Terrestrial Ecology	Removal of vegetation and construction of infrastructure will eliminate some habitat in the MSA, and displace some species into the LSA and RSA.	Effects are confined to the mine and access road footprints. No effects are predicted beyond the LSA.	Habitat loss will be confined mainly to the MSA with some effects on immediately adjacent areas of the LSA. Wildlife species within the MSA will be displaced to the LSA and RSA. Effects beyond the LSA are not predicted to occur.
Aquatic Ecology	Loss of small aquatic habitats within the MSA, and some flow reduction in small stream in the LSA. Minor changes in lake levels in Lizard Lake and Upper Marmion Reservoir	Loss of aquatic habitats is confined to the footprint of the mine. Flow reductions and changes in lake levels are confined to immediately adjacent water bodies in the LSA. No effects predicted into the RSA.	Effects are confined to water bodies immediately adjacent to the proposed mine. No downstream effects on aquatic life are predicted due to changes in flows, changes in lake levels, and water quality.

AMENDED EIS/EA REPORT
CHAPTER 6: EFFECTS ASSESSMENT
VERSION 3

CANADIAN MALARTIC CORPORATION

FIGURES



LEGEND

- Project Location
- Climate Station
- City/Town
- Provincial Highway
- Road
- Existing Railway
- Lake
- Municipal Boundary

REFERENCE

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd
Base Data - MNR NRVIS, obtained 2004
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N

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PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE
CLIMATE STATIONS

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008		
GIS	JO	2 Dec. 2013		
CHECK	NCH	2 Dec. 2013		
REVIEW	SC	2 Dec. 2013		

FIGURE: 6-1

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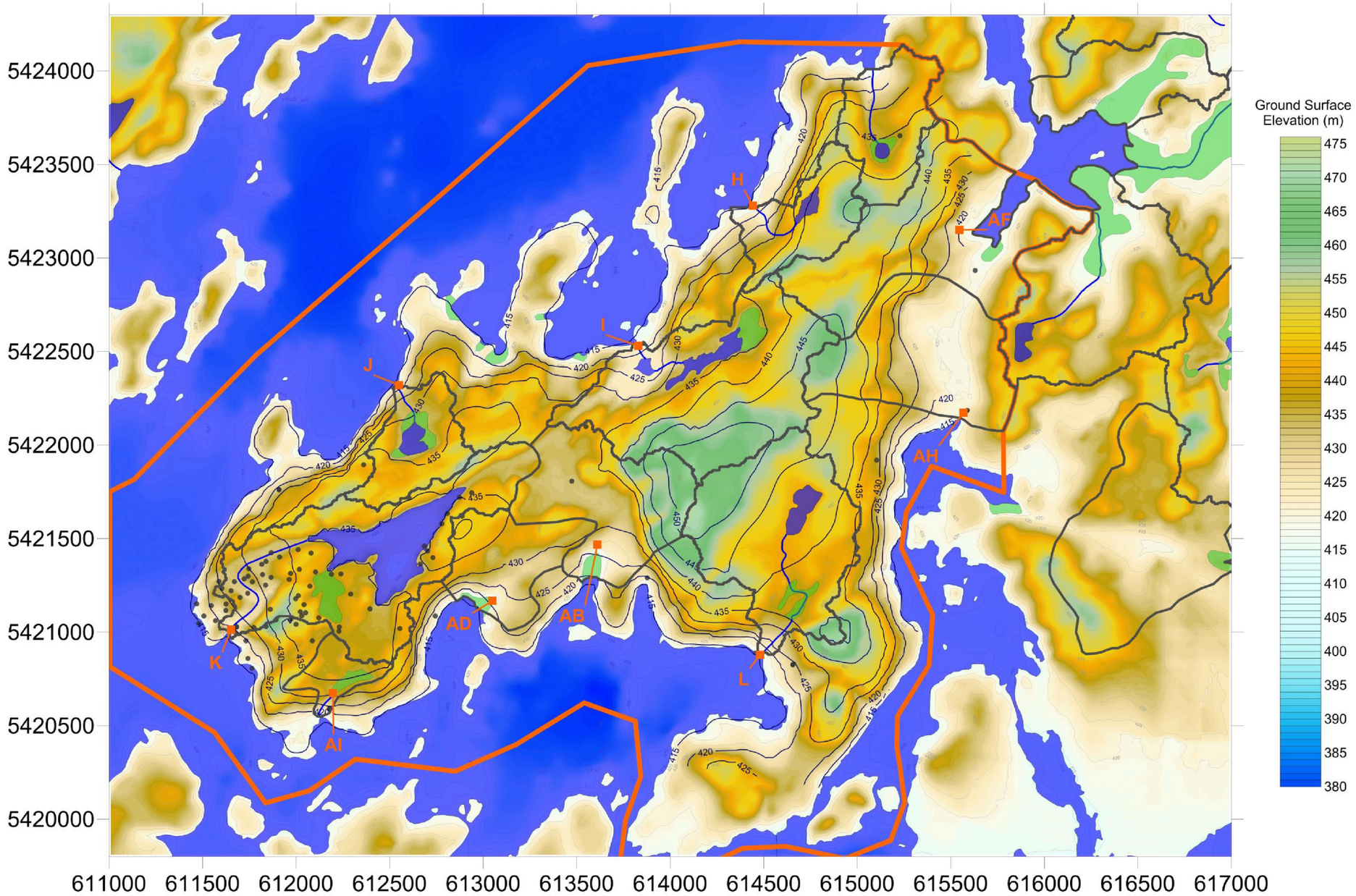

Notes

1. The current modelling work considers the pit shell provided by Osisko dated July 26, 2012.
2. The contour lines shown reflect the simulated water table elevations under Pre-Pit (current) conditions (5m contour interval).

Legend

- Model Extent
- Active Model Domain
- Simulated Water Table Elevation (m)
- Lakes
- Wetlands
- SW Flow Stations
- Streams/Rivers
- Surface Water Subwatersheds
- GW Head Calibration Point

PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE
SIMULATED REGIONAL GROUNDWATER ELEVATIONS – PRE-MINING

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008		
GIS	JO	2 Dec. 2013		
CHECK	SP	2 Dec. 2013		
REVIEW	SP	2 Dec. 2013		

FIGURE: 6-2

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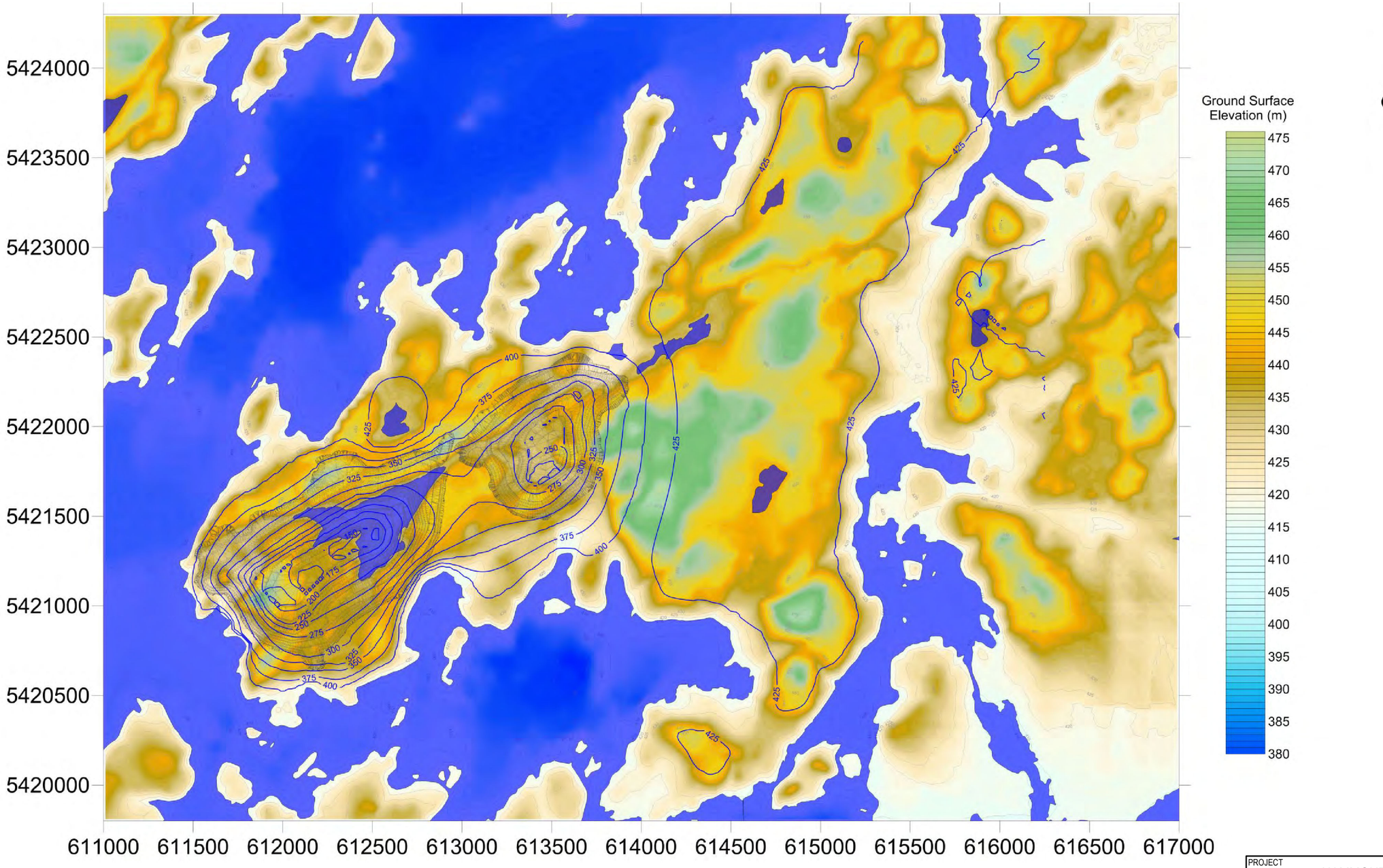


PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

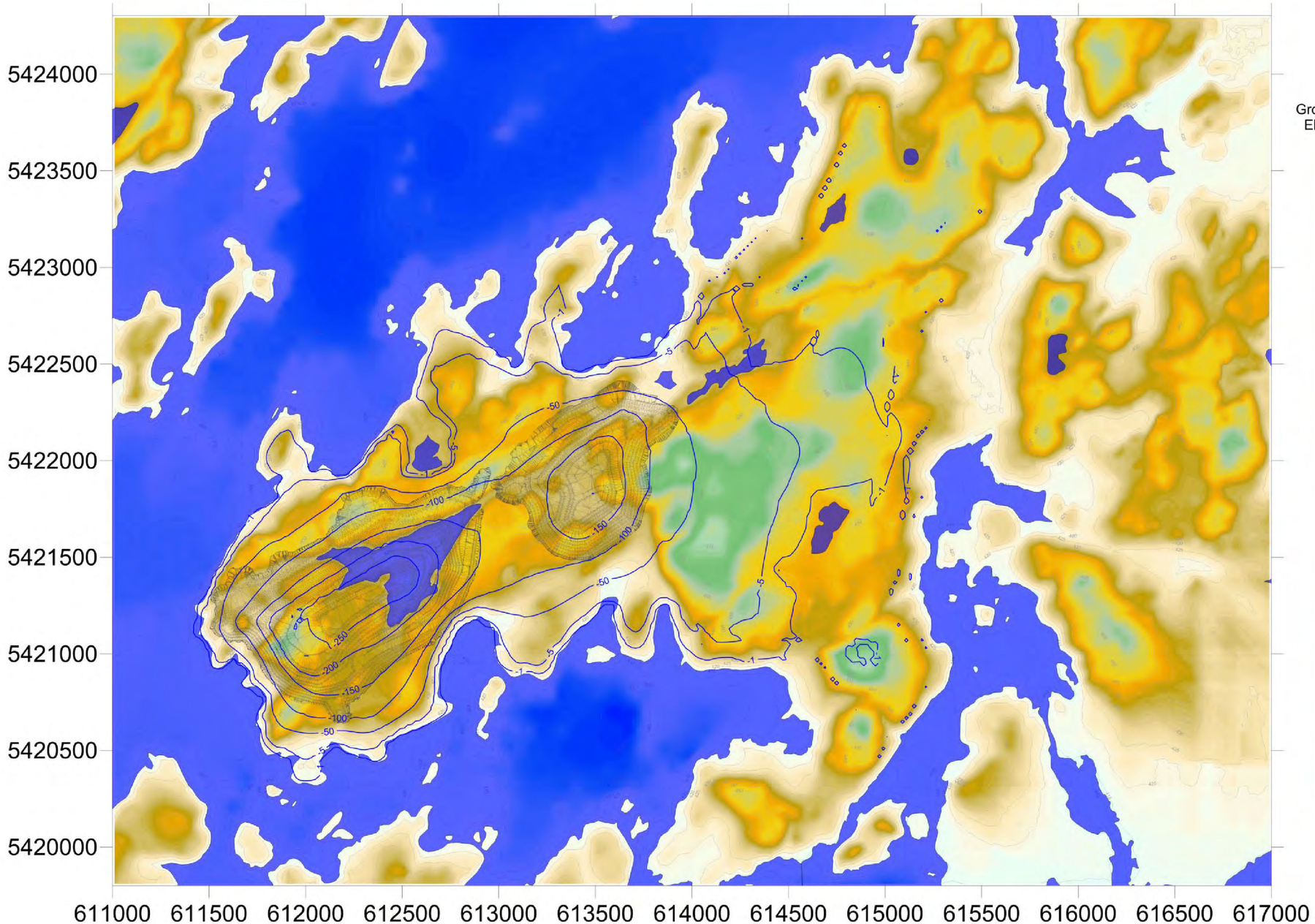
TITLE
SIMULATED REGIONAL GROUNDWATER ELEVATIONS - END OF MINING

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008		
GIS	JO	2 Dec. 2013		
CHECK	SP	2 Dec. 2013		
REVIEW	SP	2 Dec. 2013		

FIGURE: 6-3

G:\Projects\201313-1118-0010_Osisko_Hammond_Reef\GIS\MXDs\Reporting\EIS\Chapter 6\simulated_regional_groundwater_levels_end_mining.mxd



LEGEND

Simulated Groundwater Elevation

NOTES:

1.The contour lines shown reflect the change in simulated groundwater elevations from the calibrated Pre-Mining Model (Contour Interval -1. -5, -50, -100, -150, -200, -250, and -300m).

PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

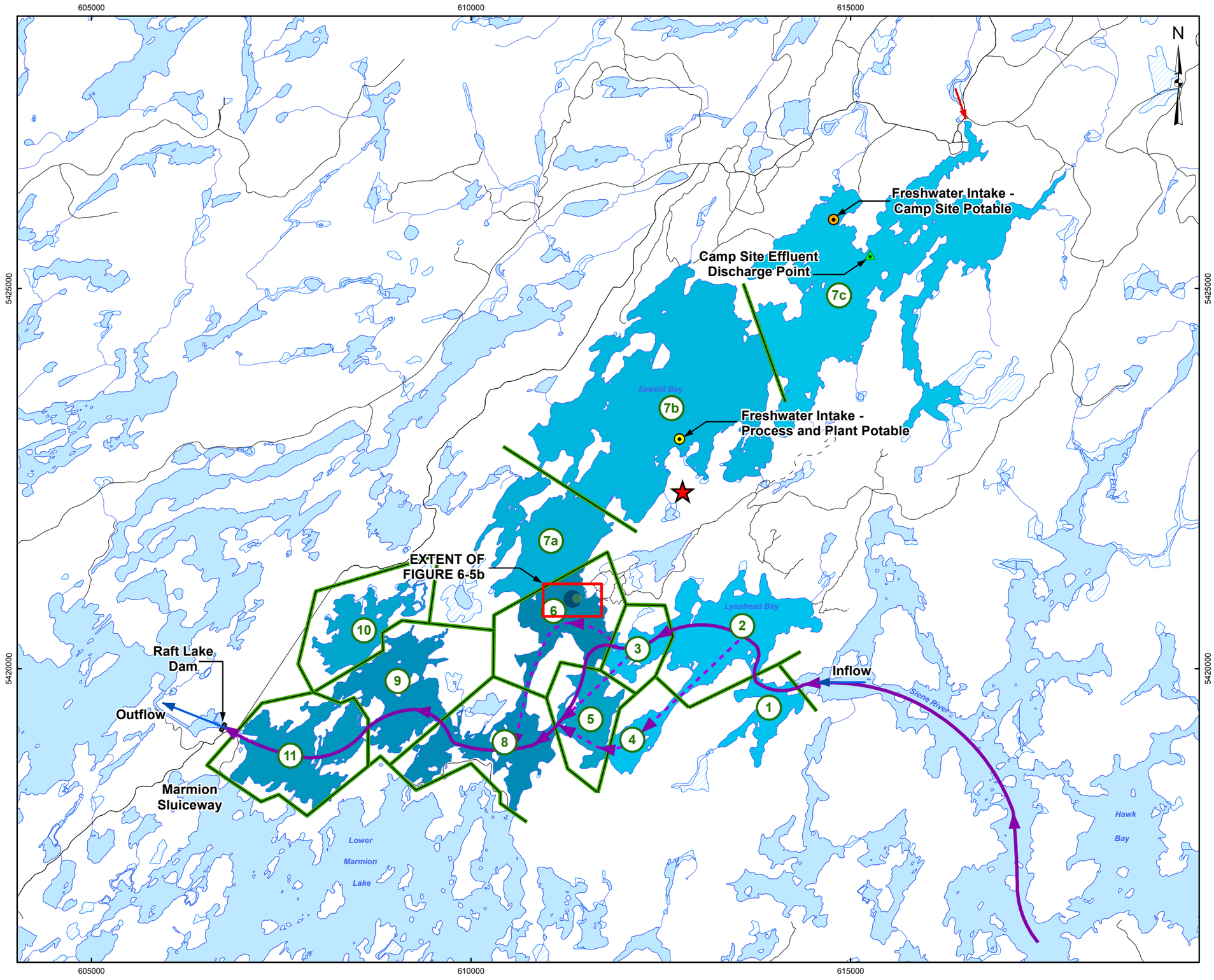
TITLE
SIMULATED GROUNDWATER DRAWDOWN - END OF MINING

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008		
GIS	JO	2 Dec. 2013		
CHECK	SP	2 Dec. 2013		
REVIEW	SP	2 Dec. 2013		

FIGURE: 6-4

G:\Projects\2013\13-1118-0010_Osisko_Hammond_Reef\GIS\MXDs\Reporting\EIS\Chapter 6\simulated_regional_drawdown_end_mining.mxd



LEGEND

- Proposed Location of Mine Processing Plant
- Effluent Discharge Point
- Freshwater Intake - Camp Site Potable
- Freshwater Intake - Process and Plant Potable
- Main River Flow
- Secondary Flow Path
- Major Tributaries
- Road
- River/Stream
- Lake
- Wetland
- Model Compartment

Average Mixing Proportion (%)		Worst Case Cu Concentration (µg/L)	Worst Case CN Concentration (µg/L)
	0	1.00	1.00
	0.011	1.01	1.02
	0.012	1.01	1.03
	0.045	1.05	1.10
	0.076	1.08	1.17
	0.085	1.09	1.19
	0.087	1.09	1.19
	0.089	1.10	1.20
	0.09	1.10	1.20
	0.118	1.13	1.26
	0.2	1.22	1.45
	1	2.09	3.24
	5	6.45	12.2
	10	11.9	23.4

NOTE:

Plume dilution shown for maximum design discharge (Q = 0.12m^3/s)

REFERENCE

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.
Base Data - MNR NRVIS, obtained 2004
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N

500 0 500 1,000 1,500 2,000
SCALE 1:50,000 METRES

PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

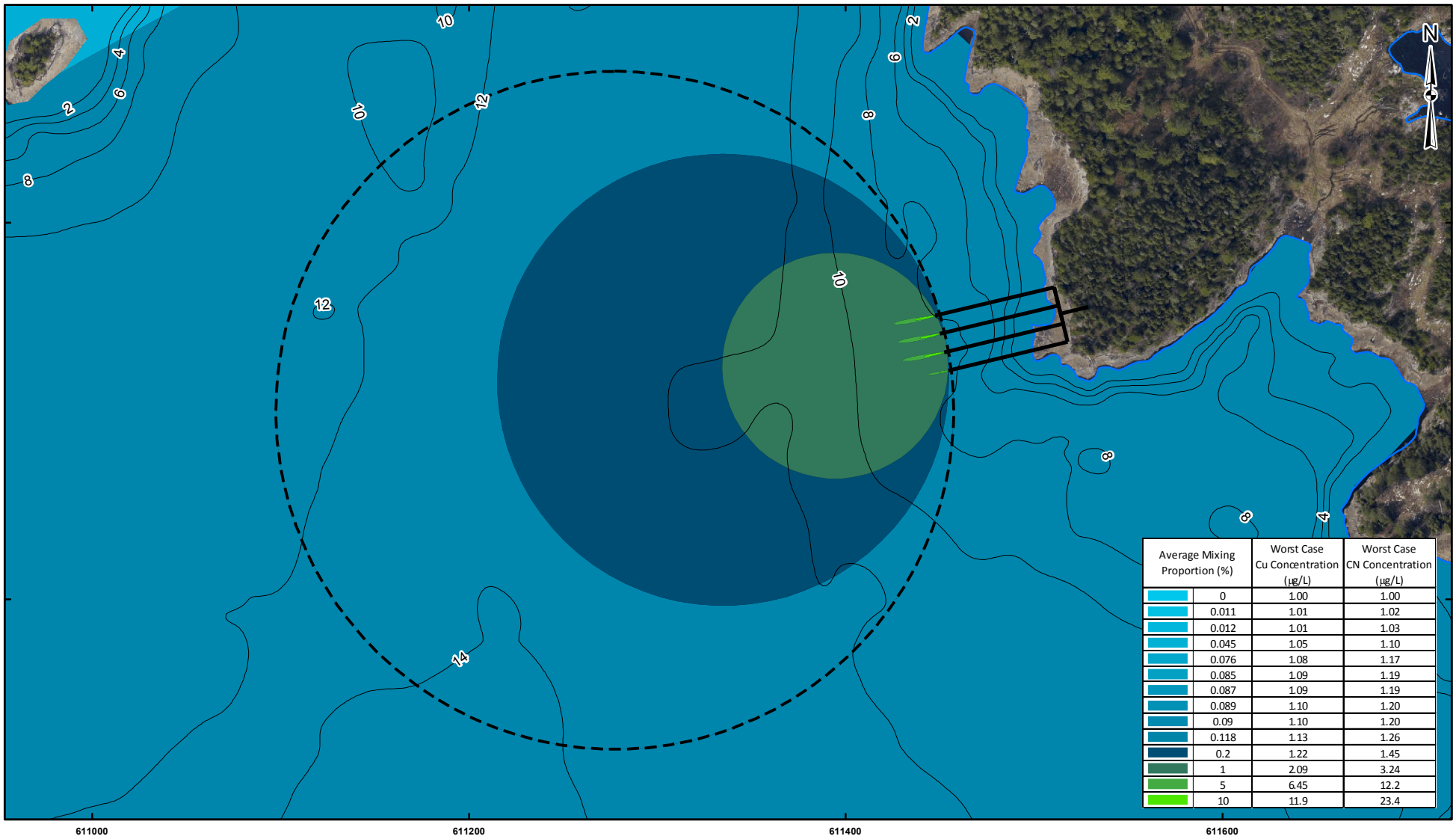
TITLE
LAKE WATER MIXING MODEL RESULTS - FAR FIELD IN UPPER MARMION RESERVOIR

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008		
GIS	JO	2 Dec. 2013		
CHECK	KDV	2 Dec. 2013		
REVIEW	KDV	2 Dec. 2013		

FIGURE: 6-5a

G:\Projects\2013\13-1118-0010_Osisko_Hammond_Reef\GIS\MXDs\Reporting\EIS\Chapter 6\PredictedLongTermAvgEffluentConcentrations.mxd



LEGEND

- Conceptual Effluent Pipeline
- Bathymetry Contour
- Shoreline

25 12.5 0 25 50 75 100
SCALE 1:3,000 Meters

REFERENCE

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd
Base Data - MNR NRVIS, obtained 2004
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N

NOTE:

Plume dilution shown for maximum design discharge (Q = 0.12m^3/s)

PROJECT

HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE

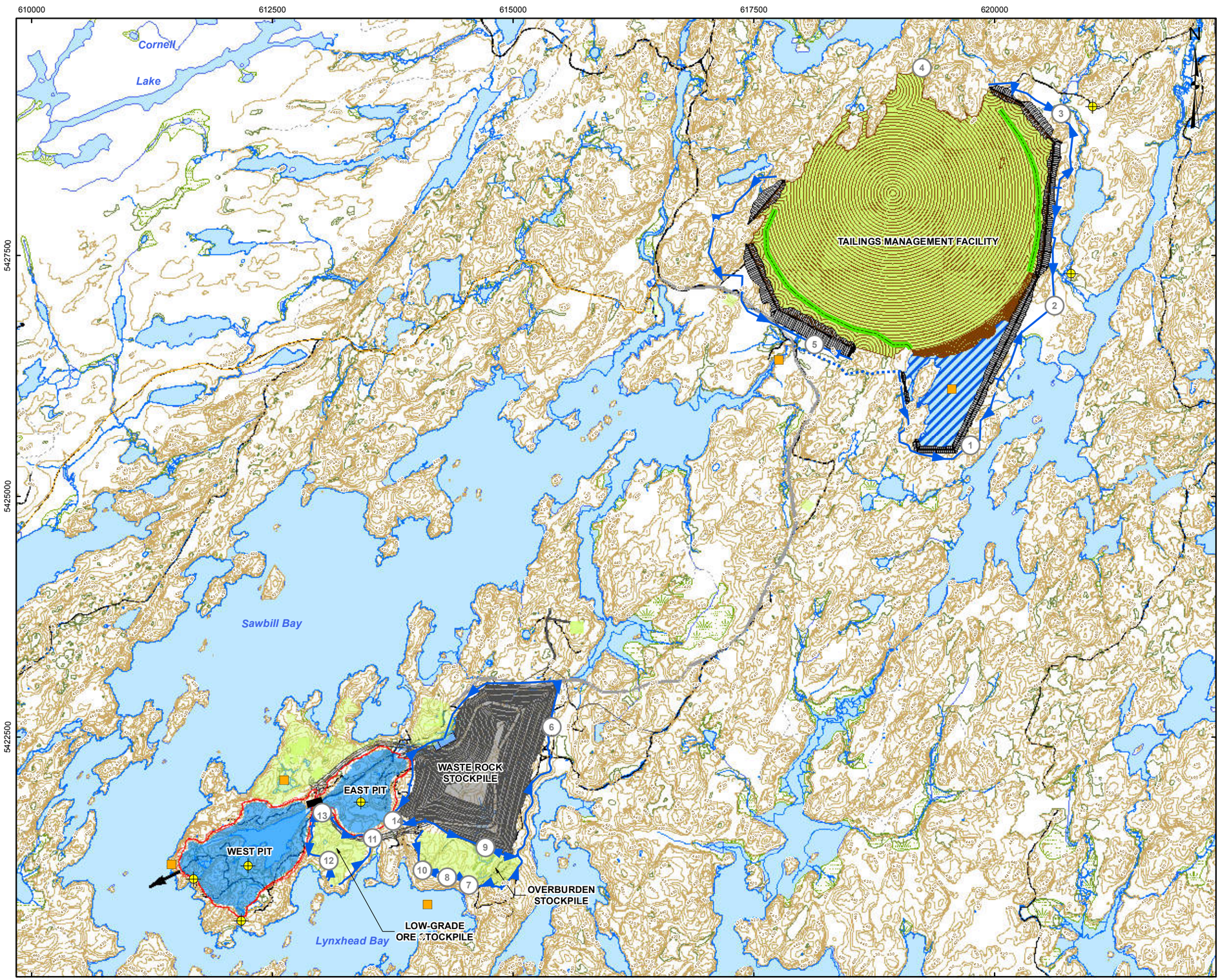
LAKE WATER MIXING MODEL RESULTS - NEAR FIELD AT DIFFUSER DISCHARGE

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	16 Mar. 2012		
GIS	JO	2 Dec. 2013		
CHECK	KDV	2 Dec. 2013		
REVIEW	KDV	2 Dec. 2013		

FIGURE: 6-5b

G:\Projects\2013\13-1118-0010_Osisko_Hammond_Reef\GIS\MXDs\Reporting\EIS\Chapter 6\Marmion_Reservoir_Average_Mixing_Proportions.mxd



LEGEND

- Index Contour (5m interval)
- Ditch
- Marsh/Swamp
- River/Stream
- Road
- Trail
- Lake
- Wetland
- Groundwater Monitoring Location
- Surface Water Monitoring Locaton
- (2) Decommissioned Pumping Station
- Proposed Ditch
- Pit Spillover Point
- Excavated Channel
- Tailings Drainage Channel Alignment
- Erosion Protected Channel
- Mine Site Road
- Access Road (Hardtack / Sawbill)
- Intermediate Collection Pond
- Revegetated Surface
- Open Pit Pond
- Waste Rock Stockpile
- Open Pit
- Tailings Management Facility Reclaim Pond

NOTES

1. Water in Tailings Management Facility Reclaim Pond will be redirected by ditch to Sawbill Bay once water quality is acceptable.

2. When the water quality in individual seepage collection ponds is acceptable for discharge, the ponds will be decommissioned.

REFERENCE

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.
Base Data - MNR NRVIS, obtained 2004
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N

500 0 500 1,000 1,500 2,000
SCALE 1:40,000 METERS

PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE
EXPECTED LONG-TERM POST-CLOSURE SITE CONDITIONS

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008		
GIS	JO	2 Dec. 2013		
CHECK	SP	2 Dec. 2013		
REVIEW	SP	2 Dec. 2013		

FIGURE: 6-6

G:\Projects\2013\13-1118-0010_Osisko_Hammond_Reef\GIS\MXDs\Reporting\EIS\Chapter 6\Expected_Longterm_ConditionsClosure.mxd

610000 620000 630000

5430000 5420000

N

Serpent Lake
Cornell Lake
Sawbill Bay
Mitta Lake
Lynxhead Bay
Marmion Reservoir
Light Lake
Upper Seine Bay
Hawk Bay

LEGEND

- Area of Potential Impact (API); Assessed 2010 - 2012
- Raft Lake Cut Location
- Trail
- Road
- River/Stream
- Lake
- Wetland
- Mine Site Road
- Access Road (Hardtack / Sawbill)
- Project Transmission Line
- Project Facilities

REFERENCE

Base Data - Provided by OSISKO Hammond Reef Gold Project Ltd.
Base Data - MNR NRVIS, obtained 2004
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N

1,000 0 1,000 2,000 3,000
METRES

PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE
AREAS OF POTENTIAL IMPACT

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008		
GIS	JO	2 Dec. 2013		
CHECK	BH	2 Dec. 2013		
REVIEW	GA	2 Dec. 2013		

FIGURE: 6-7

G:\Projects\2013\13-1118-0010_Osisko_Hammond_Reef\GIS\MXDs\Reporting\EIS\Chapter 6\fot_print_api.mxd

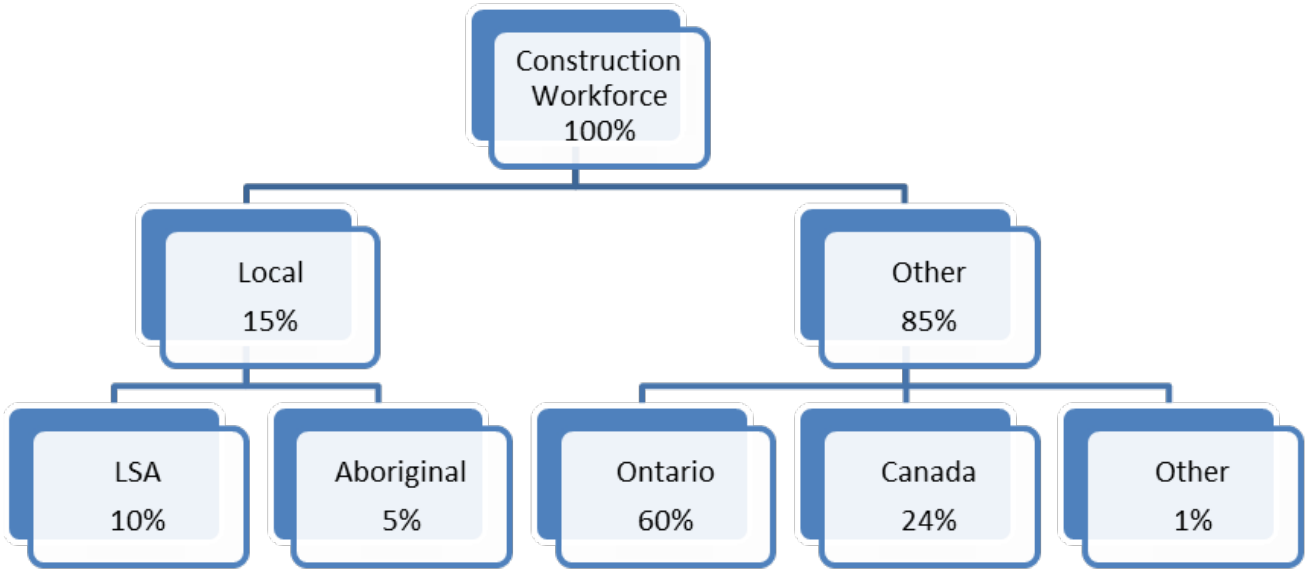


Figure 6-8: Assumed Place-of-Residence Distribution of Construction Workforce

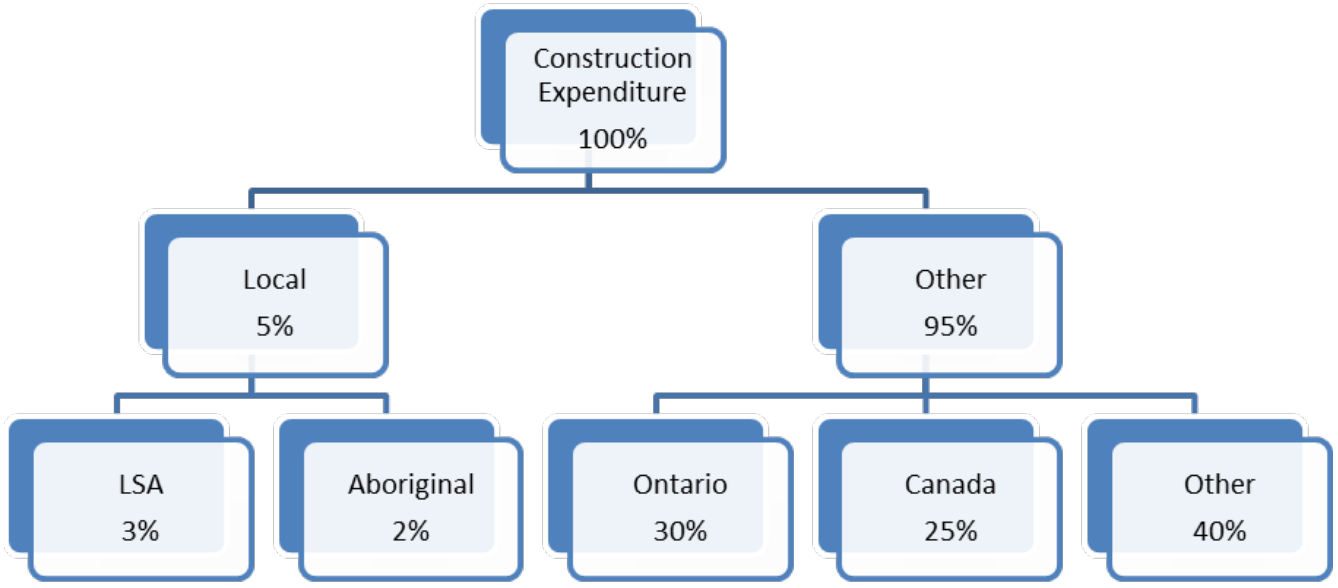


Figure 6-9: Assumed Distribution of Construction Expenditures

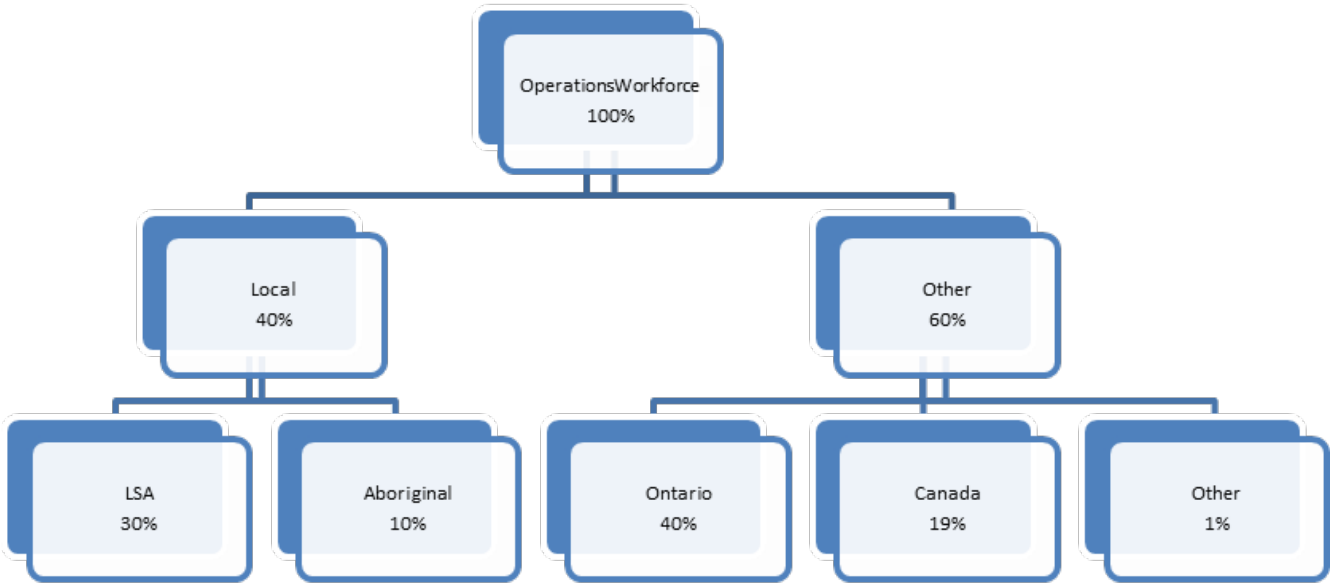
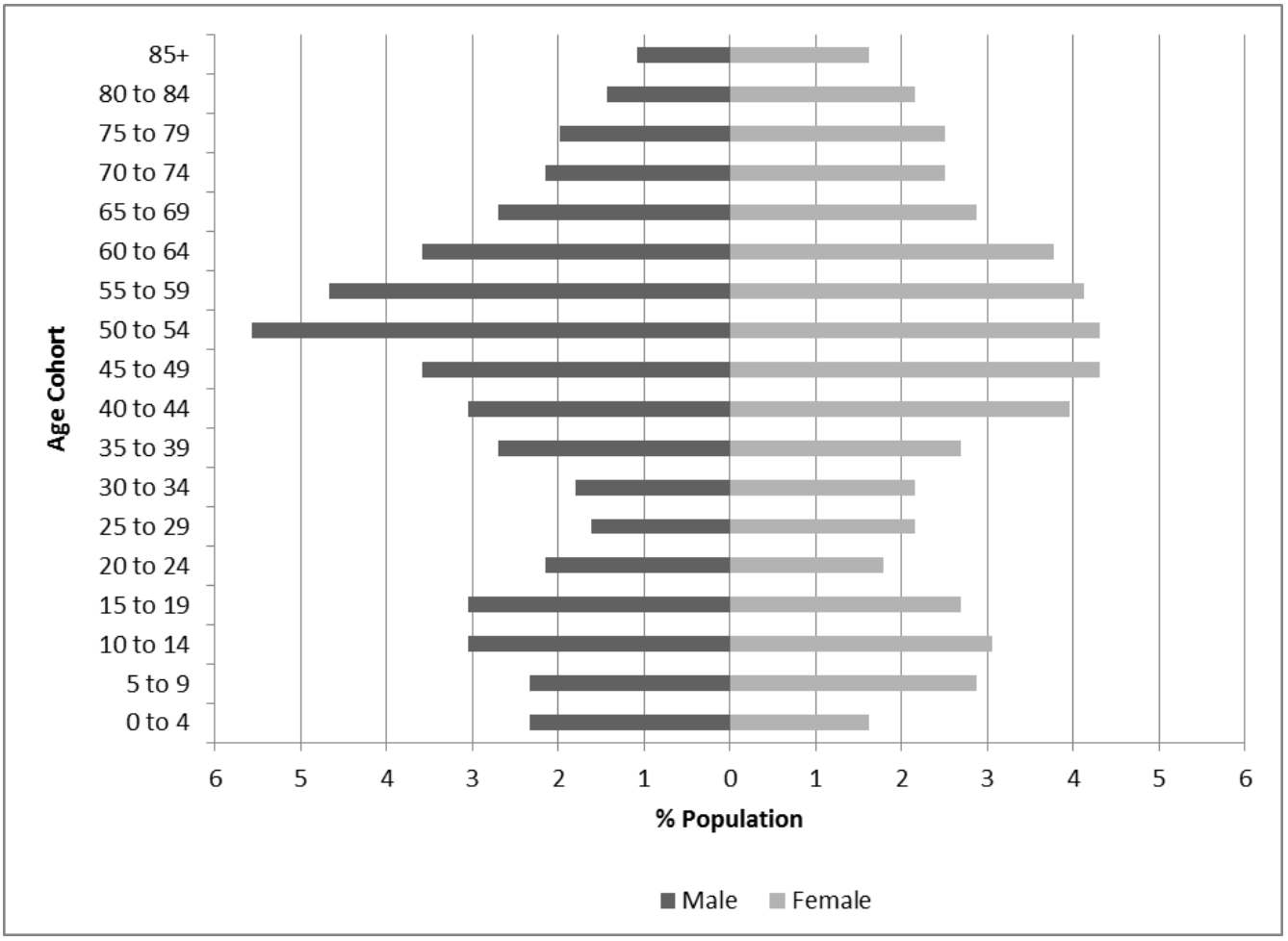


Figure 6-10: Assumed Place of Residence Distribution of Operations Workforce



Source: StatsCan 2012.

Figure 6-11: Age Profile for Atikokan (2011)

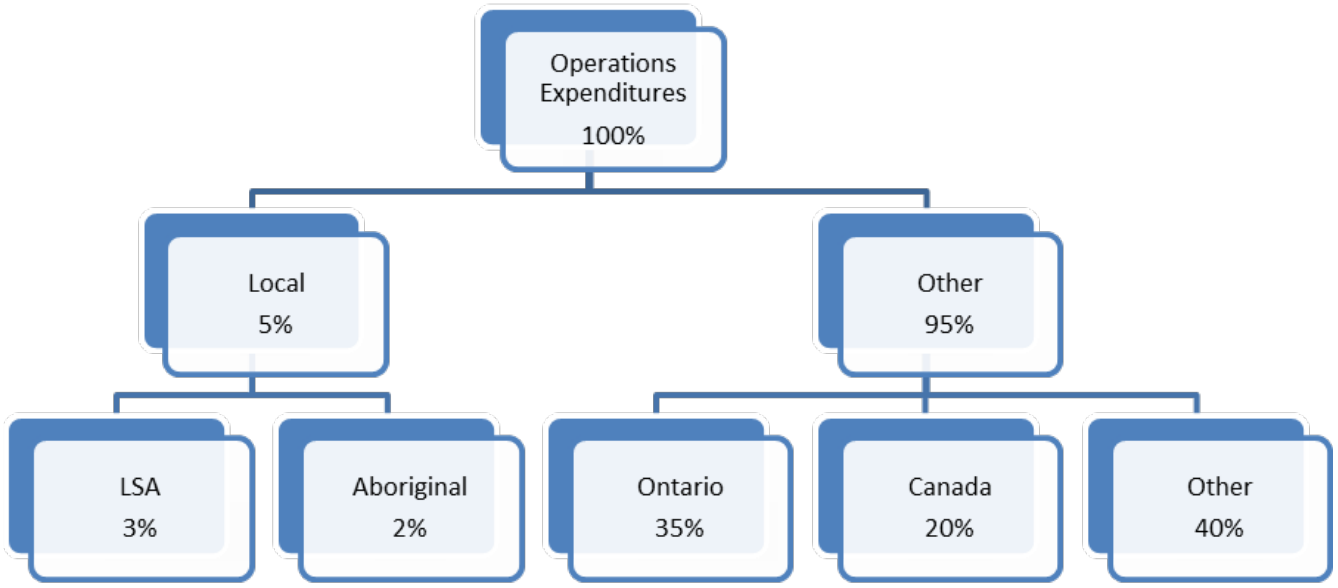


Figure 6-12: Distribution of Operations Expenditures

300000 400000 500000 600000 700000

5500000 5400000 5300000

MANITOBA
ONTARIO
MINNESOTA

Kenora
Dryden
Ignace
Upsala
Baudette
International Falls
Fort Frances
Mine Centre
Atikokan
Lac la Croix

GOLIATH PROJECT
JOSEPHINE CONE PROJECT
ATIKOKAN GENERATING STATION
STEEP ROCK MINE
RAINY RIVER GOLD PROJECT
VALERIE FALLS GENERATING STATION
HAMMOND REEF GOLD PROJECT
ATIKO-SAPAWE GOLD MINE
RESOLUTE FOREST PRODUCTS SAWMILL
RENTECH WOOD PELLET PRODUCTION FACILITY

Lake of the Woods
Rainy River
Rainy Lake
Turtle River
Marmion Reservoir
Seine River
Sturgeon Falls
Savanne River
Lac Des Mille Lacs
Namakan Lake
Lake Superior

N

LEGEND

- Hammond Reef Gold Project Location
- Past/Existing/Proposed Projects
- City/Town
- Provincial Border
- International Border
- River/Stream
- Lake
- Rainy River Watershed
- Seine River Watershed
- United States

REFERENCE

Base Data - Global Dataset, LAND INFO Worldwide Mapping, LLC
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
Drainage Basin and Sub-Basin digitized from Winnipeg River Drainage Basin, Lake of Woods Control Board (2000/12/01)
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 15N

20 0 20 40 60 80
SCALE 1:1,500,000 KILOMETERS

PROJECT
HAMMOND REEF GOLD PROJECT
ATIKOKAN, ONTARIO, CANADA

TITLE
PAST, EXISTING AND PROPOSED PROJECTS NEAR THE PROJECT STUDY AREA

Golder Associates
Mississauga, Ontario

PROJECT NO. 13-1118-0010			SCALE AS SHOWN	VERSION 2
DESIGN	CGE	14 Nov. 2008	FIGURE: 6-13	
GIS	SC	17 Jul. 2013		
CHECK	CC	17 Jul. 2013		
REVIEW	THW	17 Jul. 2013		

G:\Projects\2013\13-1118-0010_Ostisko_Hammond_Reef\GIS\MXD\sReporting\EIS\Chapter6\Existing_ProposedProjects.mxd

AMENDED EIS/EA REPORT
CHAPTER 6: EFFECTS ASSESSMENT
VERSION 3

CANADIAN MALARTIC CORPORATION

PHOTOS

Photo 6-1: Sawbill Bay – Large bay to the west of the Project Site, showing drawdown and exposure of littoral zone – April 2010.