TECHNICAL MEMORANDUM

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TO Richard Bargery
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JAY PROJECT – PIT LAKE HYDRODYNAMIC MODELLING – LOWER BOUND SCENARIO

1.0 INTRODUCTION

Dominion Diamond Ekati Corporation (Dominion Diamond) submitted a Developer's Assessment Report (DAR) for the Jay Project (the Project) (Dominion Diamond 2014) to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) in November 2014. A key component of the Project water management strategy is to pump minewater stored in the upper 50 metres (m) of the Misery Pit to the bottom of Jay Pit at closure. The Misery Pit will be back-flooded with water pumped from Lac du Sauvage and the Jay Pit will be back-flooded with freshwater pumped from Lac du Sauvage, catchment runoff, and groundwater inflows. This water management strategy is intended to produce meromictic conditions in the Jay and Misery Pits, permanently isolating minewater stored in the bottom layer of the Jay and Misery Pits (monimolimnion) from mixing with the overlying freshwater (mixolimnion).

Hydrodynamic modelling (Golder 2015) indicates that meromictic conditions in both the Jay and Misery pits will develop at closure. The modelling completed to date was based on the conservative DAR (also referred to as the EA Conservative Scenario) and reasonable estimate conditions for groundwater inflows to the Jay Pit during operations. During the Project technical sessions (April 20 to 24, 2015), MVEIRB, as well as the Government of the Northwest Territories (GNWT), raised concerns that meromixis might not occur in the Jay Pit at closure should the groundwater quantity and quality to the Jay Pit during mining operations be less than predicted. To address this concern, Dominion Diamond retained Golder Associates Ltd. (Golder) to update the Project water quality model for a Lower Bound Scenario. This memorandum provides the details of the model updates as well as the Jay and Misery Pit hydrodynamic model results.

2.0 MODEL UPDATES

Previous water quality modelling indicates the Project discharge water quality model, including the pit lake hydrodynamic models, are most sensitive to changes in groundwater inflow quantity and quality. Therefore, the Lower Bound Scenario was defined by reducing the thickness of the assumed enhanced permeability zone (EPZ) to 20 metres (m), reducing the hydraulic conductivity of the EPZ to 1 x 10^{-6} metres per second (m/s), and reducing the porosity to 0.005. These changes to the EPZ properties correspond to a reduction in fault transmissivity that is approximately 30 times less than assumed in the reasonable estimate scenario and 50 times less than assumed in the DAR scenario.

The updated groundwater quality predictions were subsequently carried forward into the site water quality model (Appendix 8E of the DAR) to track changes to water quality in the Misery Pit during operations and back-flooding of the Jay and Misery pits at closure. The projected concentrations in the pit lakes were then used to define the initial conditions in the Jay and Misery pit lakes for the post-closure groundwater (Appendix 8B and 8C of the DAR) and hydrodynamic models. The likelihood of the pits to remain stratified during post-closure was evaluated using CE-QUAL-W2, consistent with the pit lake hydrodynamic models included in the DAR.

All other model inputs remained unchanged. The reader is referred to Golder (2015) and Appendices 8A, 8B, 8C, 8E, and 8G of the DAR for additional details related to the model development.

3.0 RESULTS

3.1 Jay Pit Groundwater Quantity and Quality

The modelled groundwater quantity and quality representative of the Lower Bound Scenario for the Jay Pit during operations are provided in Table 1. For discussion purposes, comparison of projected groundwater inflows, and total dissolved solids concentrations (TDS) for the Lower Bound Scenario with those predicted for the reasonable estimate and DAR scenarios are provided in Figure 1.

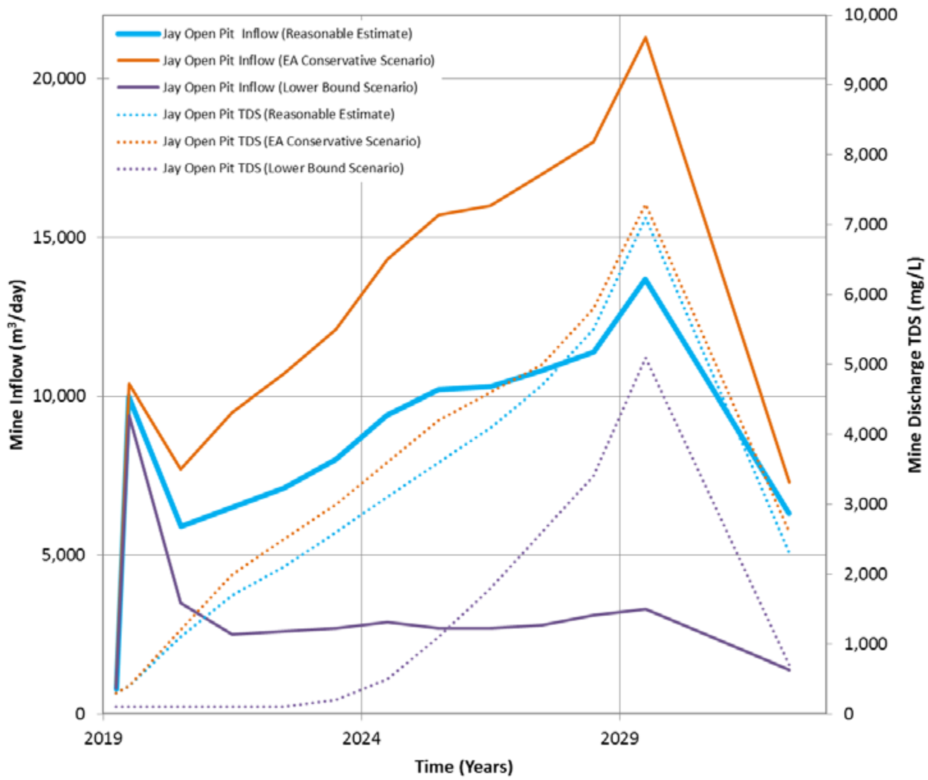
Predicted groundwater flows for the Lower Bound Scenario are much less than predicted in the other assessment scenarios with only 3,300 cubic metres per day (m^3/d) predicted to report to the Jay Pit in the final year of mining in comparison with 13,700 m^3/d for the same period in the reasonable estimate scenario and 21,300 m^3/day in the DAR scenario. Predicted groundwater quality is also lower with TDS reaching only 5,100 milligrams per litre (mg/L) in the final year of mining comparison with 7,100 mg/L for the same period in the reasonable estimate scenario and 7,300 mg/L in the DAR scenario.

Table 1 Predicted Groundwater Inflow Quantity, TDS Concentration, and Lakewater Contribution for the Lower Bound Scenario

Period	Phase	Duration (Days)	Groundwater Inflow (m^3/d)		Groundwater Quality (mg/L)	Lakewater Proportion in Total Inflow
			Jay Pit	Diked Area around Jay Pit	Jay Pit	
1	Dewatering	180	800	3,300	100	0%
2	Stripping	90	9,400	1,800	100	0%
3	OP Mining	365	3,500	0	100	0%
4	OP Mining	365	2,500	0	100	4%
5	OP Mining	365	2,600	0	100	8%
6	OP Mining	365	2,700	0	200	15%
7	OP Mining	365	2,900	0	500	21%
8	OP Mining	365	2,700	0	1,100	26%
9	OP Mining	365	2,700	0	1,800	33%
10	OP Mining	365	2,800	0	2,600	36%
11	OP Mining	365	3,100	0	3,400	41%
12	OP Mining	365	3,300	0	5,100	47%
13	Closure (OP Flooding)	1018	1,400	0	700	76%
14	Closure (Sump Flooding)	332	-500	-11,000	NA	N/A

m^3/d = cubic metres per day; mg/L = milligrams per day; % = percent; OP= open pit.

Figure 1 Comparison of Projected Groundwater Inflows, and Total Dissolved Solids Concentrations (TDS) for the Lower Bound, Reasonable Estimate, and DAR Scenarios



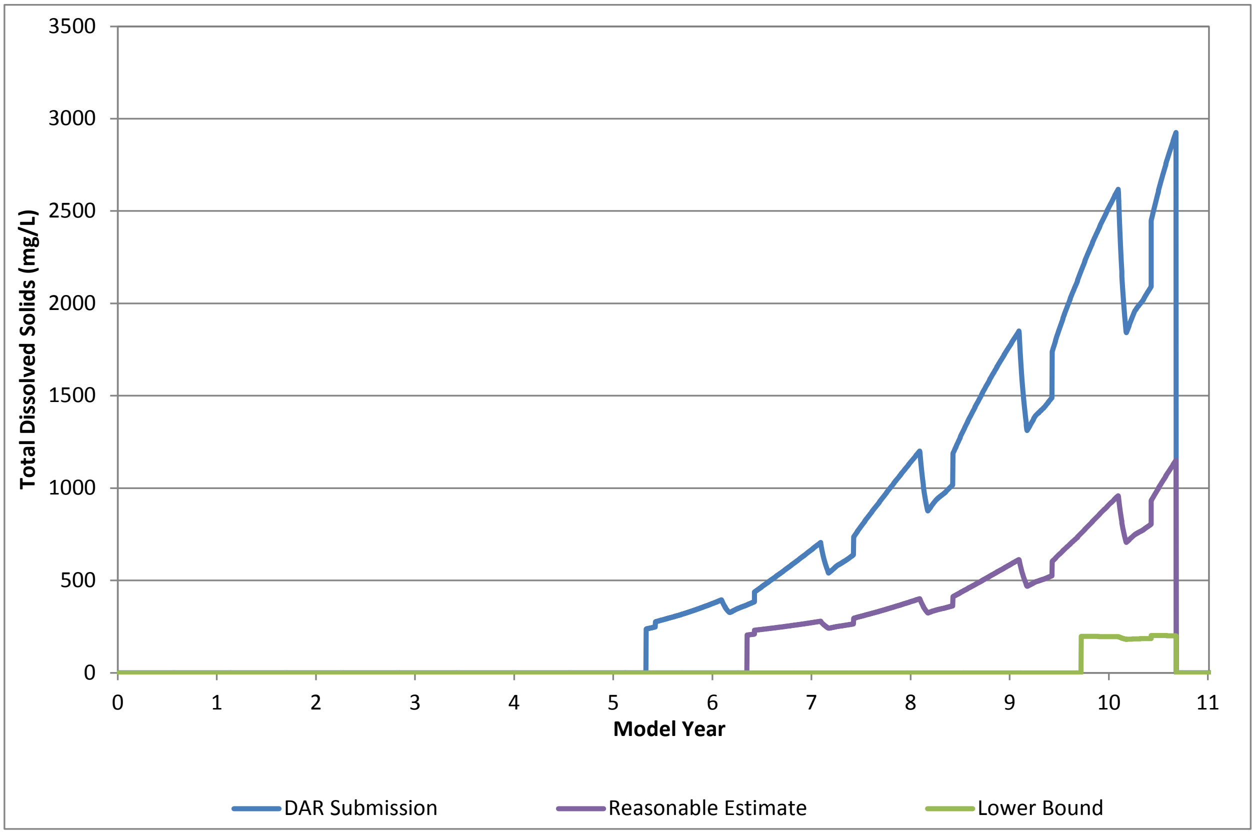
m^3/day = cubic metres per day; mg/L = milligrams per litre

3.2 Site Water Quality Predictions

As presented in Section 8E2.2 of the Appendix 8E of the DAR, each flow that could influence site discharge water quality for the Project was itemized and assigned a source term chemical profile based on geochemical testing of waste rock materials, observed mine site facility drainage at the Ekati Mine operations, and baseline surface and groundwater quality monitoring data. The chemical inputs used to represent site facility drainage during operations were not changed as part of the reasonable estimate scenario water quality model and the reader is referred to Section 8E3 of Appendix 8E of the DAR for a detailed discussion of the chemical profiles selected to represent the quality of the drainage.

The Lower Bound Scenario groundwater inflows were carried forward into the site water quality to track changes in Misery Pit total dissolved solids (TDS) concentrations during operations. Figure 2 provides the updated water quality Misery Pit discharge concentrations. For discussion purposes, the DAR and Reasonable Estimate scenarios are also presented.

Figure 2 Misery Pit – Operational Discharge TDS Concentrations



mg/L = milligrams per day

The following are the key findings of the lower bound Misery Pit discharge water quality predictions:

- TDS concentrations are much lower than the reasonable estimate and DAR scenarios (Figure 2), with a maximum peak concentration of 202 mg/L; and,
- Due to a reduction of the groundwater inflows, discharge from the Misery Pit is not required until the last year of operations.

Since previous water quality modelling (Golder 2015) for more conservative scenarios (i.e., DAR and reasonable estimate) indicated there were no adverse impacts to surface water quality in Lac du Sauvage, projected Misery Pit discharge concentrations were not carried forward into the lake hydrodynamic models. The key purpose of the site water quality model update was, therefore, to define the initial TDS concentrations of the mixolimnion and monimolimnions of the Misery and Jay pits following back-flooding of the pits to enable an evaluation of the stability of long-term meromixis under the Lower Bound groundwater scenario.

As described in the Section 8E2.2.2 of Appendix 8E of the DAR, the upper 50 m of water stored in the upper layer of the Misery Pit will be pumped to the bottom of the Jay Pit at closure. This Misery Pit will then be back-flooded with water pumped from Lac du Sauvage to create a 60 m deep (including the 10 m operational freeboard) freshwater cap with a total capacity of 16.8 million cubic metres (m^3). The Jay Pit will be back-flooded with groundwater inflows, catchment runoff, and freshwater pumped from Lac du Sauvage. The initial TDS concentrations and volumes of the mixolimnion and the monimolimnion of the Jay and Misery pits following back-flooding are provided in Table 2. For comparative purposes, the initial conditions for the reasonable estimate and DAR scenarios are also provided.

Table 2 Misery and Jay Pit – Initial Conditions

Layer	Misery Pit			Jay Pit		
	TDS (mg/L)	Elevation (m)	Capacity (Mm^3)	TDS (mg/L)	Elevation (m)	Capacity (Mm^3)
DAR Scenario						
Mixolimnion (upper layer)	50	>380	17	29	>292	82
Monomolimnion (bottom layer)	5,471	<380	24	2,732	<258	27
Reasonable Estimate Scenario						
Mixolimnion (upper layer)	18	>380	17	16	>292	82
Monomolimnion (bottom layer)	4,282	<380	24	1,297	<258	27
Lower Bound Scenario						
Mixolimnion (upper layer)	8	>380	17	12	>216	104
Monomolimnion (bottom layer)	756	<380	24	278	<216	16

TDS = total dissolved solids; m = metre; Mm^3 = million cubic metres; < = less than; > = greater than

As can be seen in Table 2, the lower groundwater inflows to the Jay Pit during operations also influence post-closure concentrations in the back-flooded Misery and Jay pits. TDS concentrations in the monimolimnions of the Misery and Jay pits are much lower in comparison to the initial conditions in the reasonable estimate and DAR scenarios (Table 2).

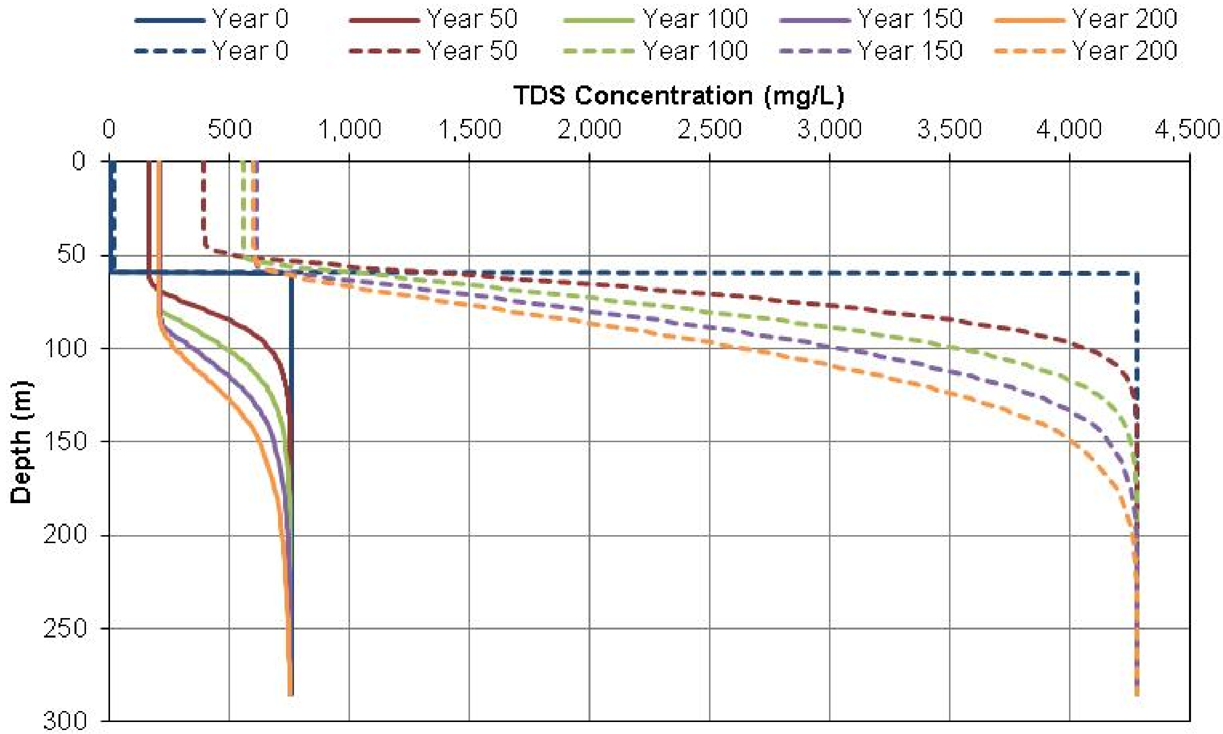
3.3 Hydrodynamic Model Updates

The initial conditions projected in the site water quality model were carried forward into the Jay and Misery Pit hydrodynamic model to evaluate if the Misery and Jay pits would develop meromictic conditions and remain stratified in the Lower Bound Scenario. Consistent with the DAR, pit lake hydrodynamic models were developed for Jay and Misery pits using CE-QUAL-W2. The purpose of the hydrodynamic modelling was to evaluate the vertical stratification potential within the pits during the first 200 years of the post-closure period (i.e., when the mined-out pits are entirely filled with water).

The hydrodynamic model results for the Misery and Jay Pits are provided in Figures 3 and 4, respectively. For discussion purposes, the results of the reasonable estimate scenario are also presented. Both the Misery and Jay pits are predicted to remain stratified within the 200 year simulation period. Predicted TDS profile concentrations for the Lower Bound Scenario were lower compared to the reasonable estimate scenario as a result of lower initial concentrations (Table 2).

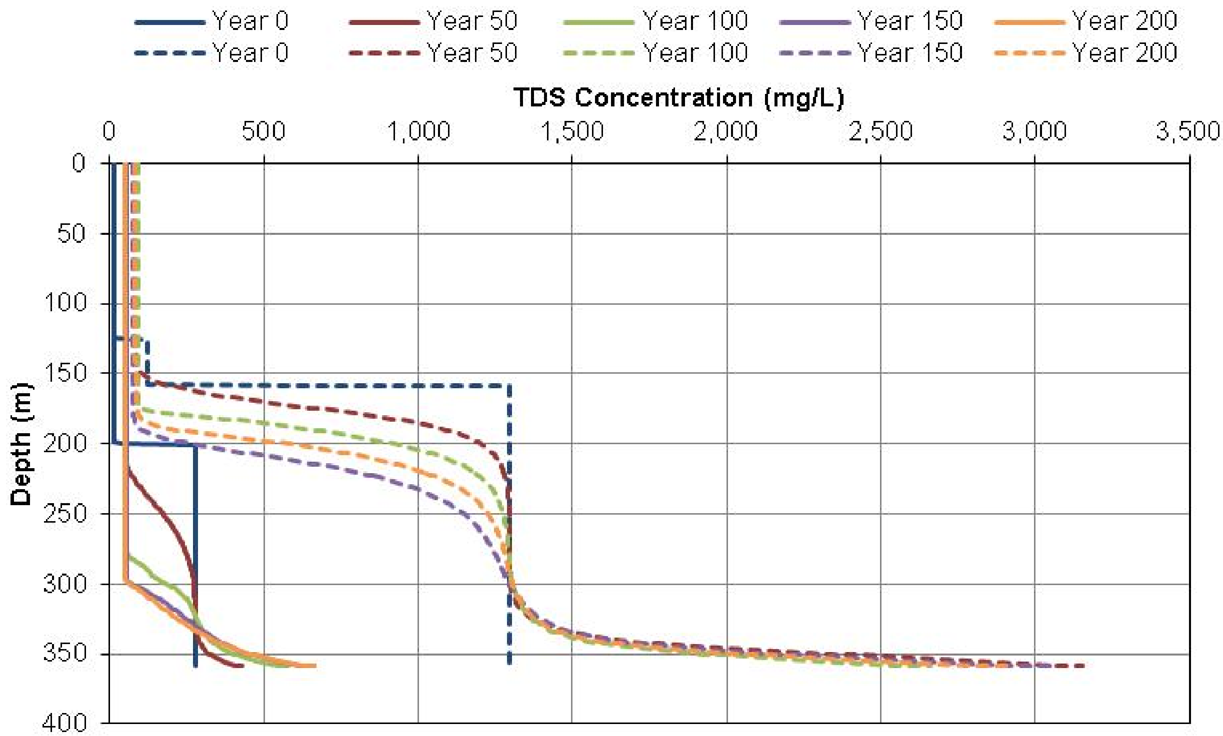
The hydrodynamic model results indicate that the depth of the freshwater cap will increase to approximately 100 m in the Misery Pit and the transition layer above the monimolimnion will increase (Figure 3) as a result of water in the mixolimnion mixing with the monimolimnion. Concentrations below approximately 200 m are not expected to change. In the Jay Pit, the freshwater cap is predicted to increase to 300 m and concentrations in the underlying transition layer and monimolimnions will increase from groundwater inflows (Figure 4).

Figure 3: Misery Pit Hydrodynamic Model Results



Note: Solid Lines - Lower Bound Scenario, Dotted Lines - Reasonable Estimate Scenario.
TDS = total dissolved solids; m = metre

Figure 4: Jay Pit Hydrodynamic Model Results



Note: Solid Lines - Lower Bound Scenario, Dotted Lines - Reasonable Estimate Scenario.
TDS = total dissolved solids; m = metre

4.0 SUMMARY

During the Project technical sessions (April 20 to 24, 2015), MVEIRB, as well as the GNWT, raised concerns that meromixis might not occur should the groundwater quantity and quality to the Jay Pit during operations be less than predicted. To address this concern, Dominion Diamond retained Golder to update the Project water quality model for a Lower Bound Scenario.

Previous water quality modelling (Golder 2015) indicated groundwater inflows to the Jay Pit were the main control on site discharge water quality. Therefore, the Lower Bound Scenario was defined as a reduction in the Jay Pit EPZ, bedrock hydraulic conductivity, and porosity. The following were the key findings of the Lower Bound Scenario:

- Jay Pit groundwater inflows and TDS concentrations were lower in comparison to the reasonable estimate and DAR scenarios;
- The reduced groundwater inflows delay the timing of discharge from Misery Pit to Lac du Sauvage until the last year of operations;
- The reduced groundwater inflow TDS concentrations to the Jay Pit result in a decrease in the Misery Pit discharge TDS concentrations to Lac du Sauvage and mixolimnion and monimolimnion concentrations in the Misery and Jay Pits; and,

- Although the Jay and Misery Pits have much lower mixolimnion and monimolimnion TDS concentrations in comparison to the reasonable estimate scenario, hydrodynamic modelling indicates the pits will stratify and remain stratified during the 200 year model timeframe.

5.0 CLOSURE

We trust this memorandum satisfies your current requirements. Should you have any questions or require any additional information, please do not hesitate to contact the undersigned.

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6.0 REFERENCES

Dominion Diamond (Dominion Diamond Ekati Corporation). 2014. Developer's Assessment Report for the Jay Project. Prepared by Golder Associates Ltd., October 2014. Yellowknife, NWT, Canada.

Golder (Golder Associates Ltd.). 2015. Jay Project - Compendium of Supplemental Water Quality Modelling. Submitted to Mackenzie Valley Environmental Impact Review Board. April 2015.