Dominion Diamond Corporation

Jay Project Developer's Assessment Report

Hydrology

Overview

Overview of Assessment and Key Concepts

- General overview of presentation
  - Introduction
  - Jay Project DAR sections for the Hydrology Discipline
  - Assessment approach for the Hydrology discipline
  - Existing Environment
    - Methods
    - Results
  - Assessment
    - Methods
    - Results
  - Summary

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Introduction

Water Quality and Quantity Components found in the Jay Project DAR

Section/ Appendix Number	Section Title
Section 8	**Key Line of Inquiry: Water Quality and Quantity**
Appendix 8A	Hydrogeological Model for Pre-Mining, Mining, and Closure
Appendix 8B	Hydrogeological Model for Jay Pit - Post Closure
Appendix 8C	Hydrogeological Model for Misery Pit – Post Closure
Appendix 8D	**Regional Water Balance Model**
Appendix 8E	Site Discharge Water Quality Modelling
Appendix 8F	Hydrodynamic Models of Lac du Sauvage and Lac de Gras
Appendix 8G	Hydrodynamic Model of Jay and Misery Pits
Appendix 8H	Acute Toxicity Testing of Predicted Jay Effluent

Introduction

Water Quality and Quantity Components found in the Jay Project DAR - continued

Section/ Appendix Number	Section Title
Annex III	Geology Baseline
Annex VIII	Geochemistry Baseline
Annex IX	Hydrogeology Baseline
Annex X	**Hydrology Baseline**
Annex XI	Water and Sediment Quality Baseline

Assessment Approach

Valued Components, Assessment Endpoints and Measurement Indicators

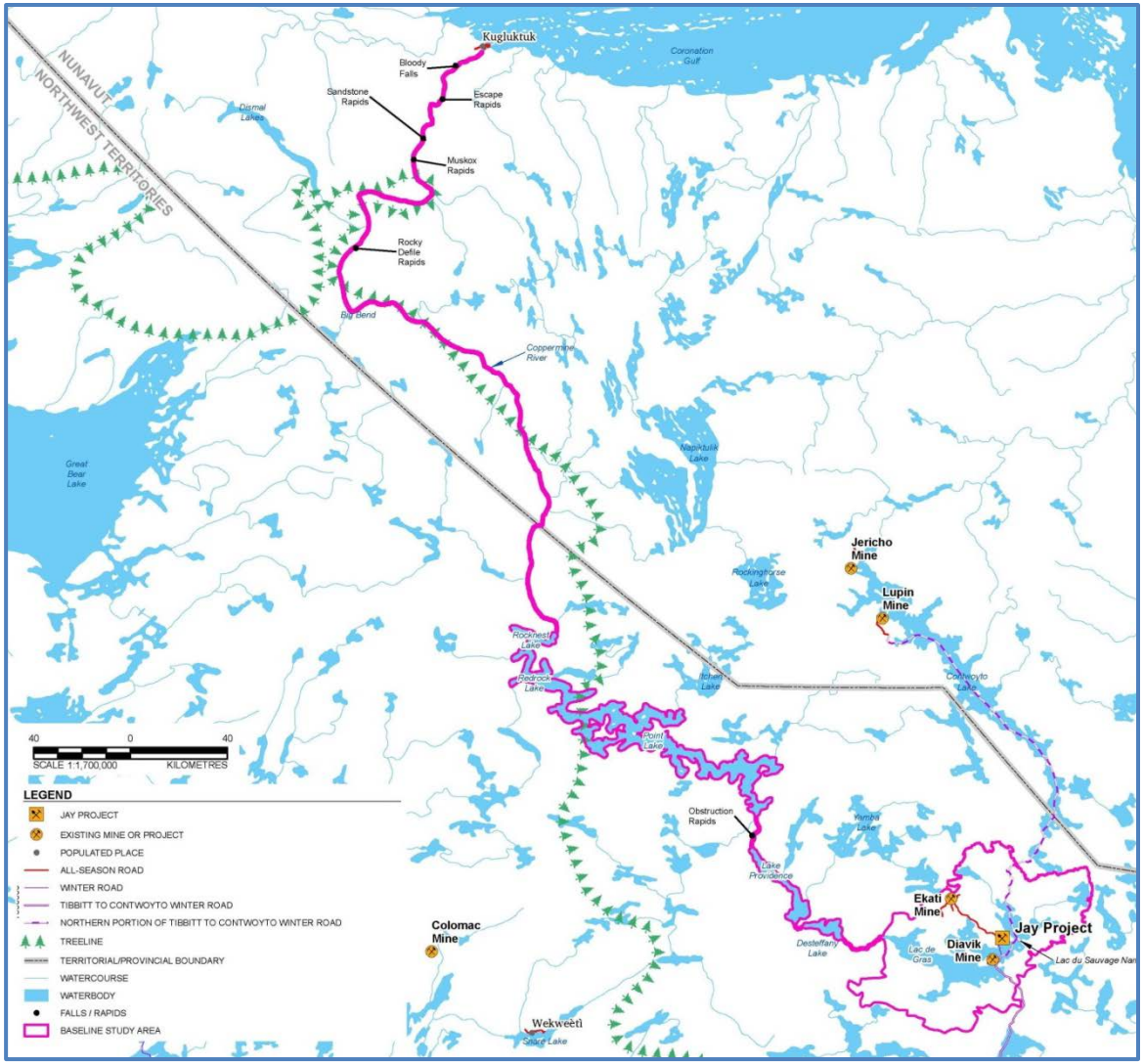
Valued Component	Assessment Endpoint	Measurement Indicator
Groundwater	• No specific assessment endpoint • Changes to groundwater are carried forward into the effects analysis for surface water quantity and quality	• Groundwater levels and flow rates • Spatial and temporal distribution of groundwater • Concentrations of physical analytes (e.g., pH, conductivity) • Concentrations of major ions and nutrients • Concentrations of total and dissolved metals
Surface Hydrology	• **No specific assessment endpoint** • **Changes to drainage paths, water levels, and discharges are carried forward into the effects analysis for surface water quality, fish and fish habitat, and traditional land use**	• **Lake water levels and outflow discharge rates** • **Stream channel parameters (e.g., channel depths, widths) and shoreline integrity** • **Basin water yields**

Water Quality	• Maintenance or suitability of surface water quality for healthy and sustainable aquatic and terrestrial ecosystems
	• Ecological function is maintained
	• Aquatic life is not impaired
		• Concentrations of water and sediment quality constituents:
		  • In situ physico-chemical water quality parameters (e.g., temperature, dissolved oxygen, pH, conductivity)
		  • Major ions, suspended solids, nutrients, and metals in water
		  • Distribution of particle size in surficial sediment
		  • Nutrients and metals in sediment

Assessment Approach

Baseline Study Area – Hydrology

- The Baseline Study Area included the entire Lac du Sauvage and Lac de Gras watersheds, as well as the Coppermine River downstream to its mouth
- Baseline studies focused on long-term data available for the Lac de Gras watershed and Coppermine River, with field studies focused mainly on the Lac du Sauvage watershed



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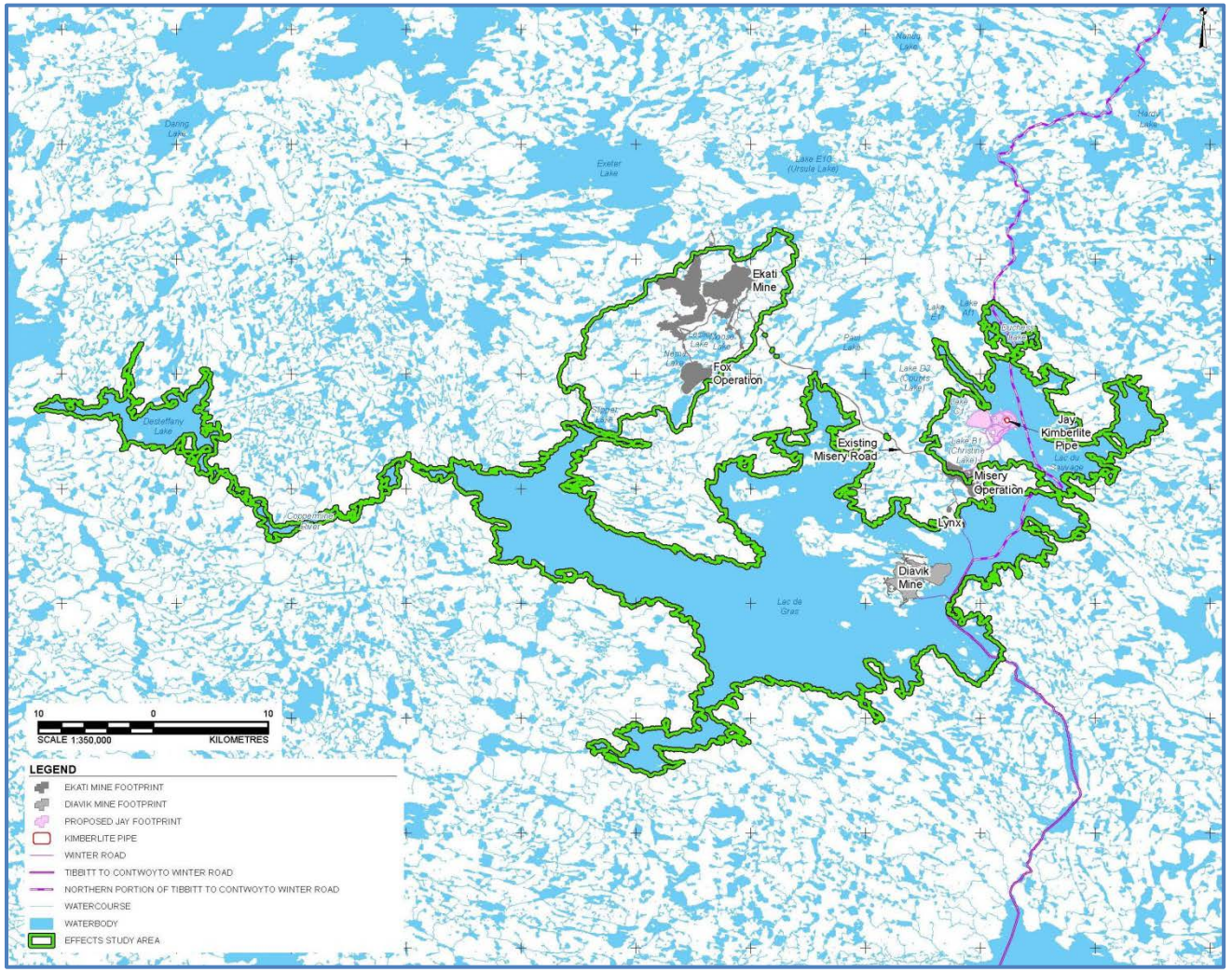
Assessment Approach

Effects Study Area – Hydrology

- The Effects Study Area includes waterbodies potentially directly affected by the Project
- These include Lac du Sauvage, Lac de Gras, affected tributaries, and Coppermine River to the Desteffany Lake outlet



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Assessment Approach

Assessment Cases

Base Case		Application Case	Reasonably Foreseeable Development Case
Reference Condition	2014 Baseline Conditions		
No or minimal human development	Conditions from all previous, existing, and approved developments before the Project	Base Case plus the Project	Application Case plus reasonably foreseeable developments

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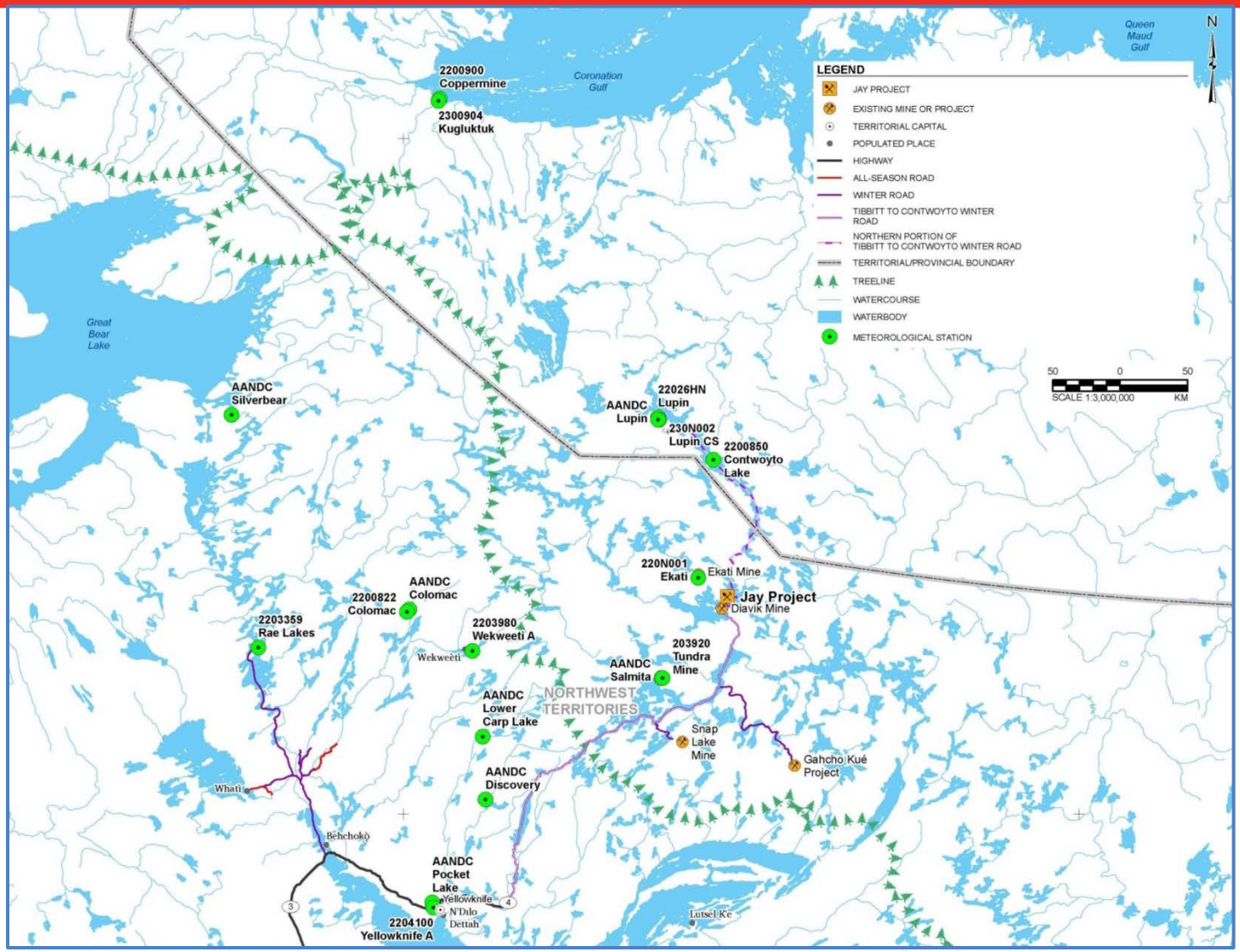
Existing Environment – Methods: Long-Term Climate Stations



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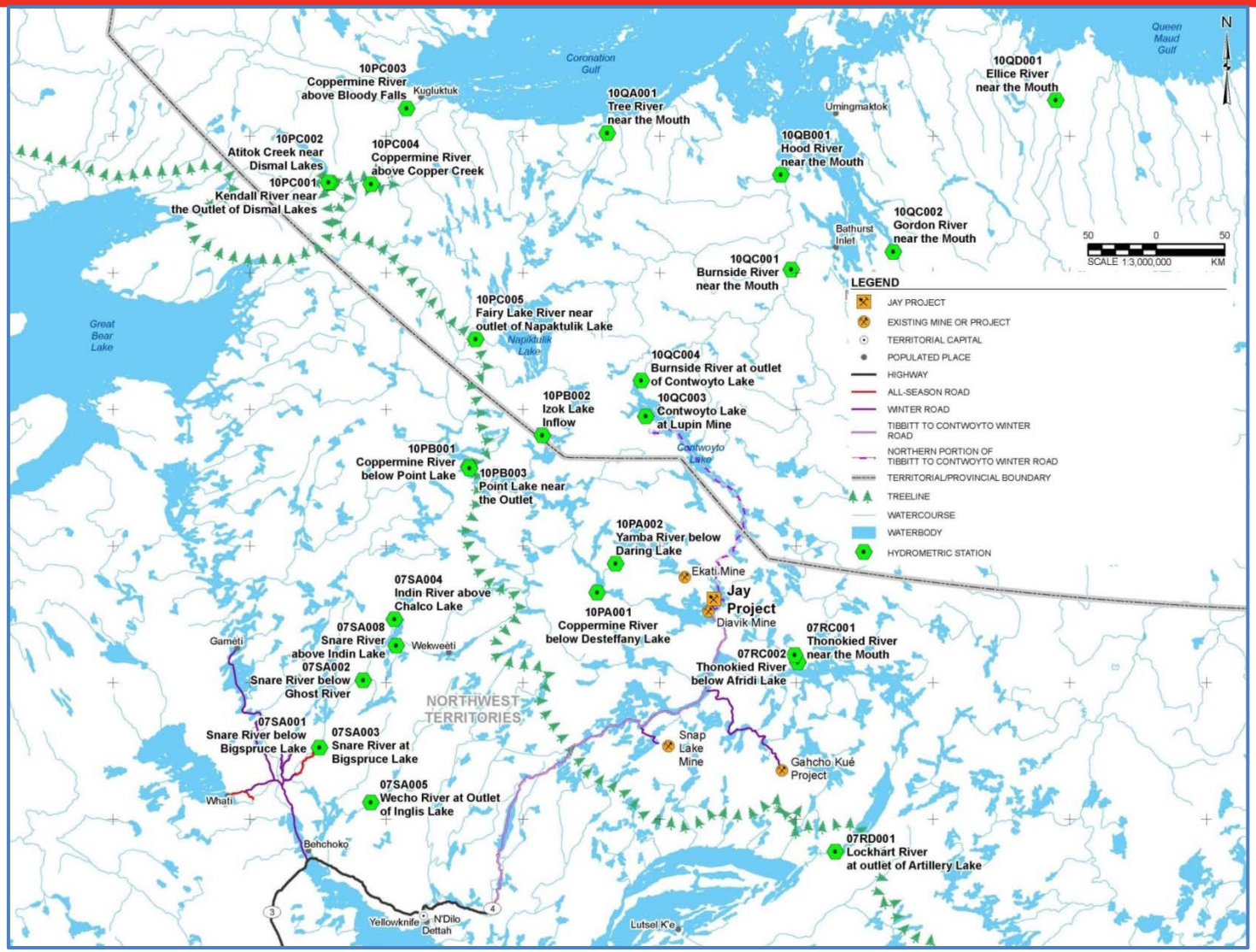
Existing Environment – Methods: Long-term Hydrometric Stations



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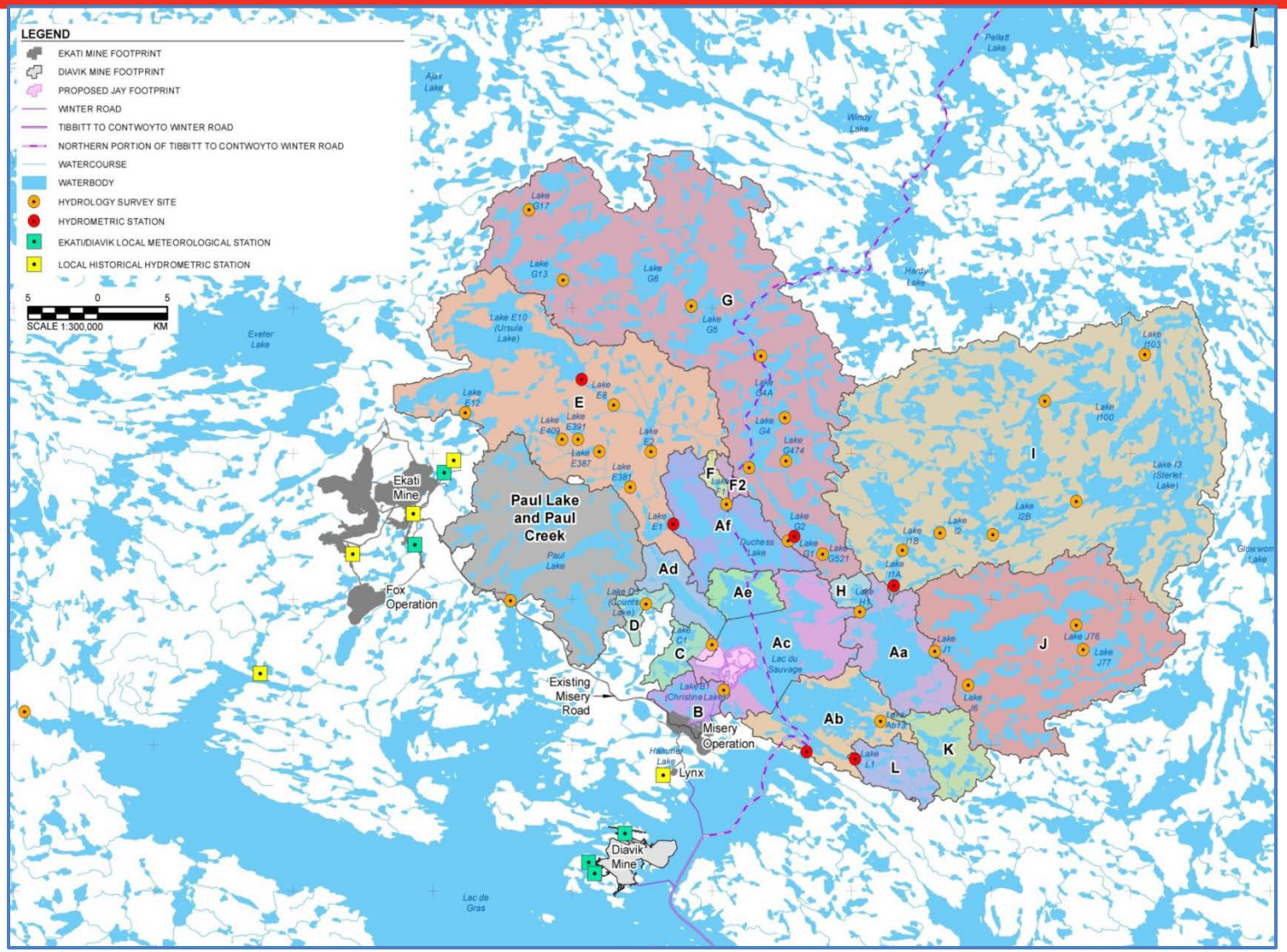
Existing Environment – Methods: Local Climate & Hydrometric Stations



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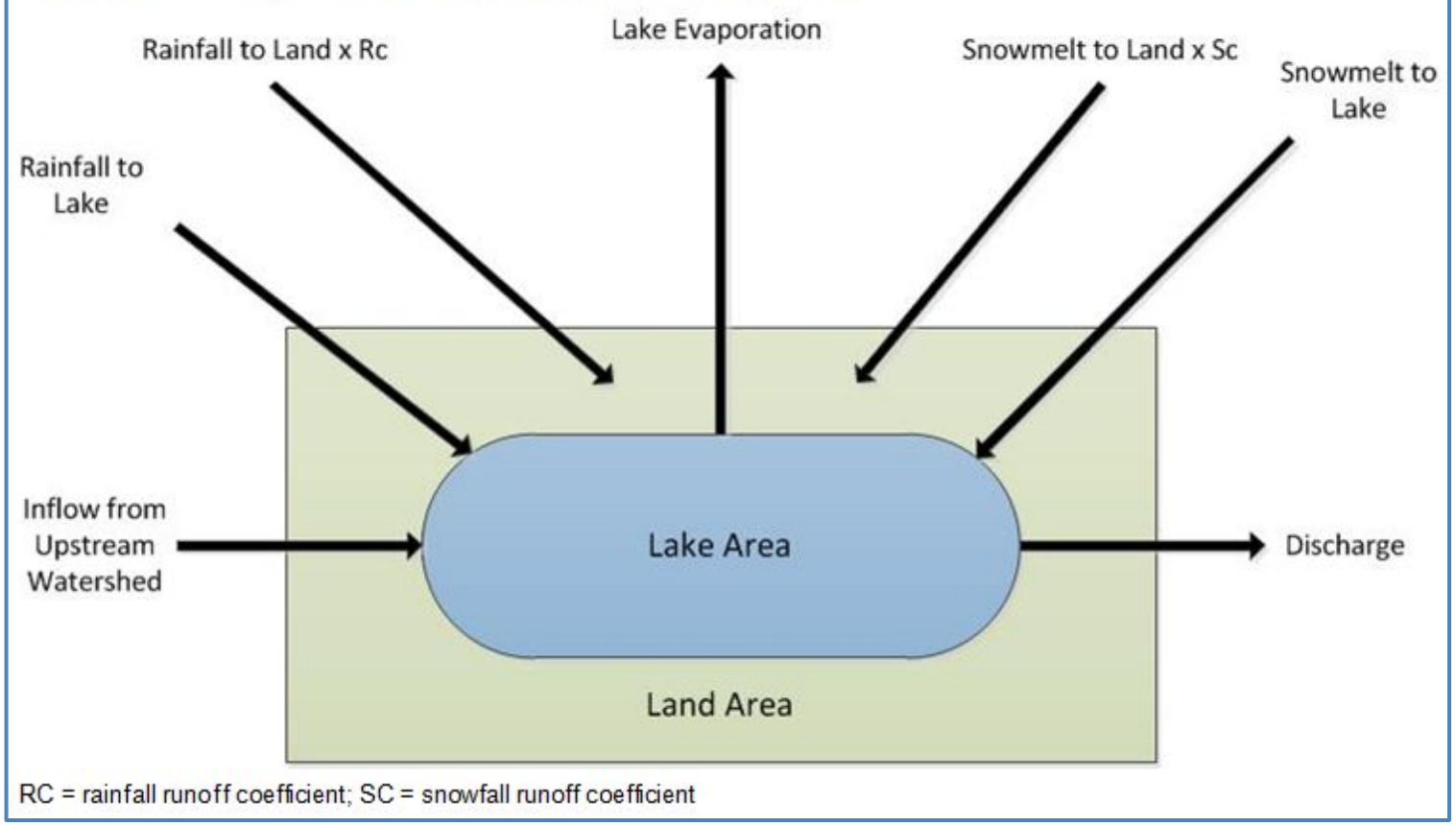
Existing Environment – Methods: Modeling

Lac du Sauvage Water Balance Model

Figure F3-1 Schematic of Typical Lake Reservoir Model



RC = rainfall runoff coefficient; SC = snowfall runoff coefficient

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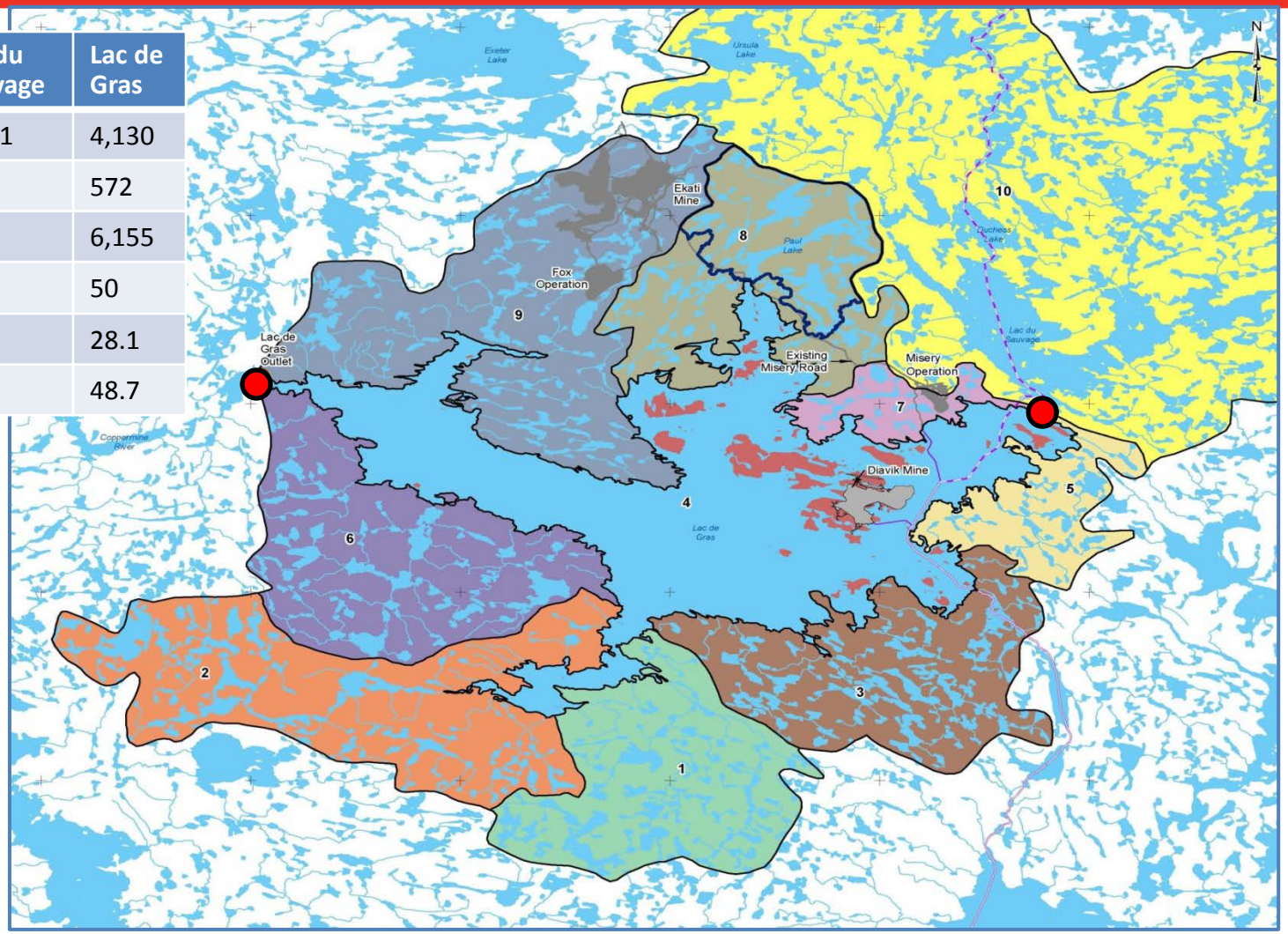
Existing Environment – Results: Lac du Sauvage and Lac de Gras

	Lac du Sauvage	Lac de Gras
Watershed Area (km^2)	1,461	4,130
Surface Area (km^2)	86	572
Volume (Mm^3)	631	6,155
Maximum Depth (m)	40	50
2-year Flood (m^3/s)	17.5	28.1
100-year Flood (m^3/s)	39.6	48.7



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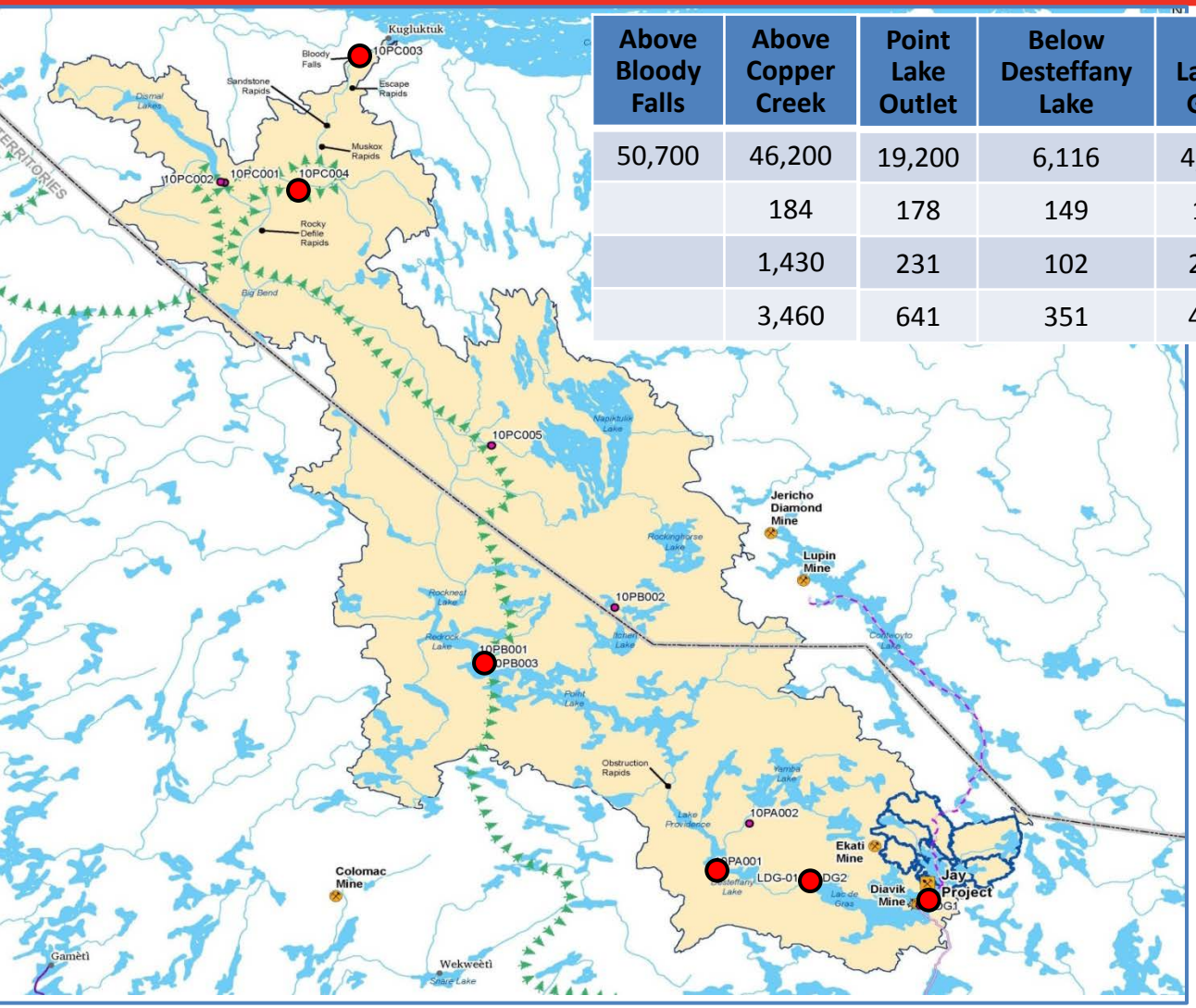
Existing Environment – Results: Lac du Sauvage and Lac de Gras

Lac du Sauvage Outlet, May 2014

Existing Environment – Results: Coppermine River



Above Bloody Falls	Above Copper Creek	Point Lake Outlet	Below Desteffany Lake	Lac de Gras	Lac du Sauvage	
50,700	46,200	19,200	6,116	4,130	1,461	**Watershed Area (km²)**
	184	178	149	149	149	**Mean Water Yield (mm)**
	1,430	231	102	28.1	17.5	**2-year Flood (m³/s)**
	3,460	641	351	48.7	39.6	**100-year Flood (m³/s)**

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Existing Environment - Results

Hydrology – Traditional Knowledge

- From the available TK information:
  - Local waters have traditionally been used for transportation, drinking, hunting, fishing, trapping, and cleaning and preparing hides and other materials. Open water allows transportation by canoes and other watercraft, and waterbodies provide landmarks for navigation and geographic boundaries.
  - The Lac du Sauvage Narrows has been identified as a particularly important location for camping, hunting, and fishing. The channel has been noted as deep enough to provide for winter movement of fish, and swift currents may keep waters open in the winter, facilitating fishing and easy access to fresh water.
  - Concerns about traditional land use include sensitivities to changes in water levels, which may affect traditional use and wildlife. A periodic lowering of the water levels in the Project area has also been reported, and suggested to potentially affect the direction of surface water flow from the area.
- Traditional Knowledge is generally consistent with the scientific knowledge.

Assessment – Project Activity Screening

Water Quantity (Hydrology)

- Identification of Project activities with a link to potential effects to water quantity

- Screening to identify the magnitude of the linkage: no linkage, secondary (negligible residual effect), primary (likely to result in change)
- Identification of potential overlapping effects between the Project and existing developments to water quantity
  - Cumulative effects

Assessment – Key Mitigations

Water Quantity (Hydrology)

- Roads and culverts will be constructed to limit disturbance and maintain natural drainage patterns
- Dike will be constructed to limit seepage from Lac du Sauvage into the diked area
- Diversion channels will be used to reduce runoff into the diked area
- A detailed dewatering plan will be used to manage discharges from the diked area during dewatering, to prevent harm to Lac du Sauvage, the Narrows, and downstream waterbodies
- A mine water management plan will minimize effects on natural waterbodies, by limiting water withdrawals and recycling process water
- Back-flooding of the Jay Pit and diked area will be managed to prevent harm to Lac du Sauvage, the Narrows, and downstream waterbodies
- Closure activities will reconnect the diked area and restore drainage in diverted basins

Assessment – Pathways Analysis of Water Quantity (Surface Hydrology)

The water quantity assessment focused on changes to water levels, flows and channel/bank stability, and considered Project effects on groundwater as required by the TOR

Pathways were identified and screened:

- 2 No Linkage pathways were identified
- 6 Secondary pathways were identified
- 8 Primary pathways were identified and assessed

- Altered site drainage and runoff from mine facilities
- Displacement of water in Lac du Sauvage due to placement of dike material
- Dewatering of the diked area in Lac du Sauvage
- Dewatering affecting groundwater and thereby affecting nearby lakes
- Groundwater seepage from Misery Pit affecting Lac de Gras
- Operational discharges from Misery Pit to Lac du Sauvage
- Pumping water from Lac du Sauvage to back-flood the Jay Pit and dewatered dike area
- Reconnection of the Lac du Sauvage diked area

Assessment Methods – Hydrology

Water Quantity (Hydrology)

- The baseline water balance model was modified to account for changes due to the Project, including:
  - Changes to runoff coefficients due to surface infrastructure and waste rock storage areas
  - Changes to drainage pathways due to surface infrastructure and drainage diversions
  - Changes to waterbody characteristics due to dike construction / breaching
  - Water transfers associated with dewatering, back-flooding, and other water management activities
- The water balance model was run to characterize changes in flows and water levels at key nodes for a range of metrics incorporating natural variability
- Where required (e.g., at the Lac du Sauvage Narrows), flow depths and top widths were also modelled
- Potential for effects on lake and channel bed and bank stability was evaluated qualitatively

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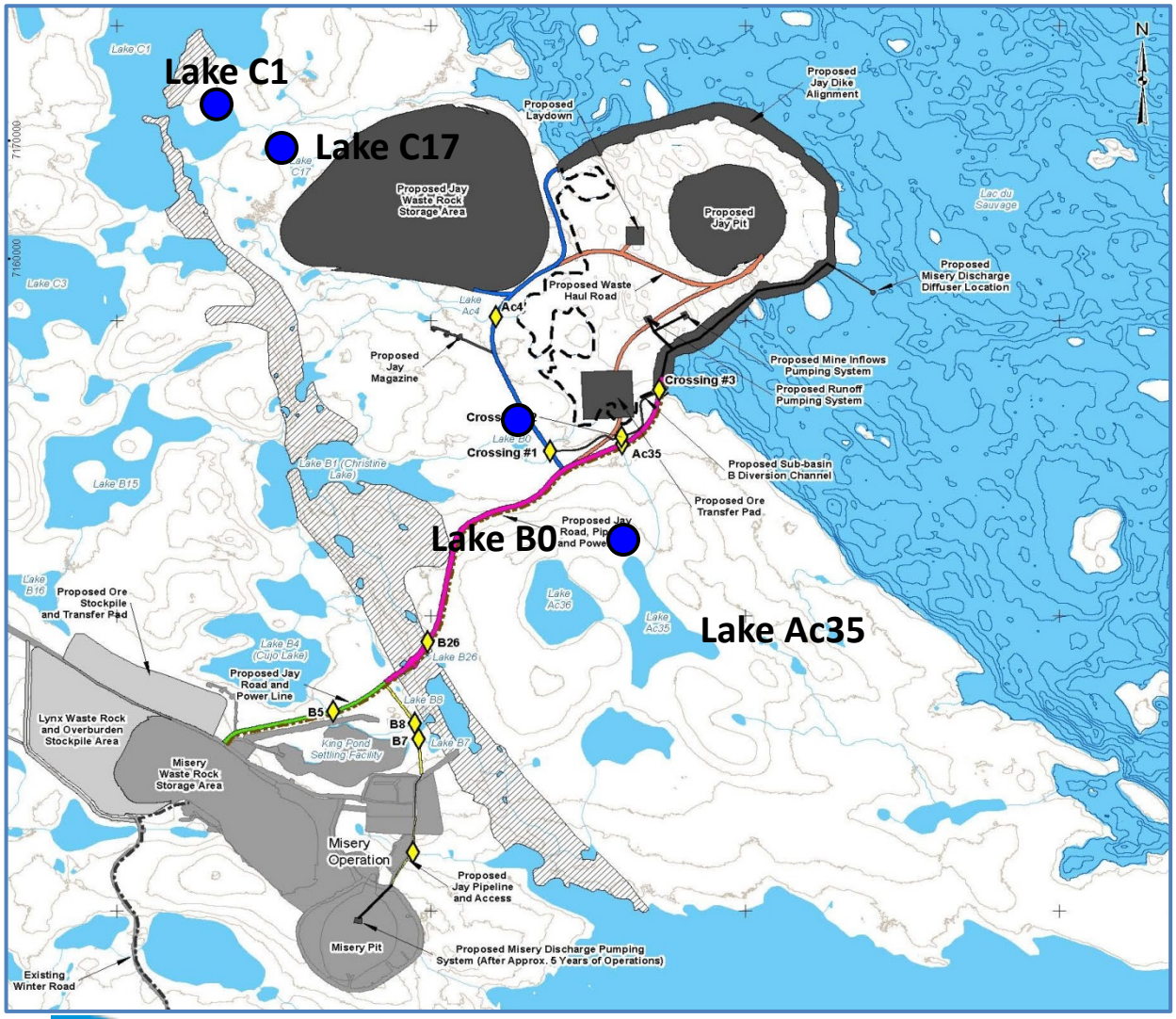
Assessment – Water Quantity Boundaries

Water Quantity - Temporal Assessment Boundaries

- Model snapshots, or temporal boundaries for the water balance model outputs:
  - Base Case
    - Existing Conditions (2010 to 2015)
  - Application Case
    - Construction Phase (2016 to 2019)
    - Early Operations Phase (2019 to 2024)
    - Late Operations Phase (2024 to 2029)
    - Closure Phase (2030 to 2033)
    - Post-closure Period (2034 to 2060)

- Spatial boundaries (assessment nodes) were selected based on locations of Project effects, and are shown with the assessment results

Assessment – Water Quantity Spatial Boundaries



Effects were assessed at nodes representing lake water levels and discharges

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Assessment – Effects to Lac du Sauvage Tributaries

Water Quantity (Hydrology) – Effects to Lac du Sauvage Tributaries

Lake	Effects Due To	Water level and discharge changes
Ac35	Project infrastructure, runoff diversion	Discharges increase up to 1% during construction; water levels unchanged
B0	Project infrastructure, WRSA, runoff diversion	Maximum discharge increase 10%; maximum water level increase 0.09 m
C1	WRSA, groundwater losses	Maximum discharge decrease 58%; maximum water level decrease 0.17 m
C17	WRSA	Maximum discharge decrease 80%; maximum water level decrease 0.72 m

- Effects on water levels and discharges at Lakes C1 and C17 were modelled conservatively by assuming WRSA runoff will be diverted
- Lake and channel bank and bed stability will not be affected
- Figures and tables showing Project effects are provided in DAR Section 8.5.3

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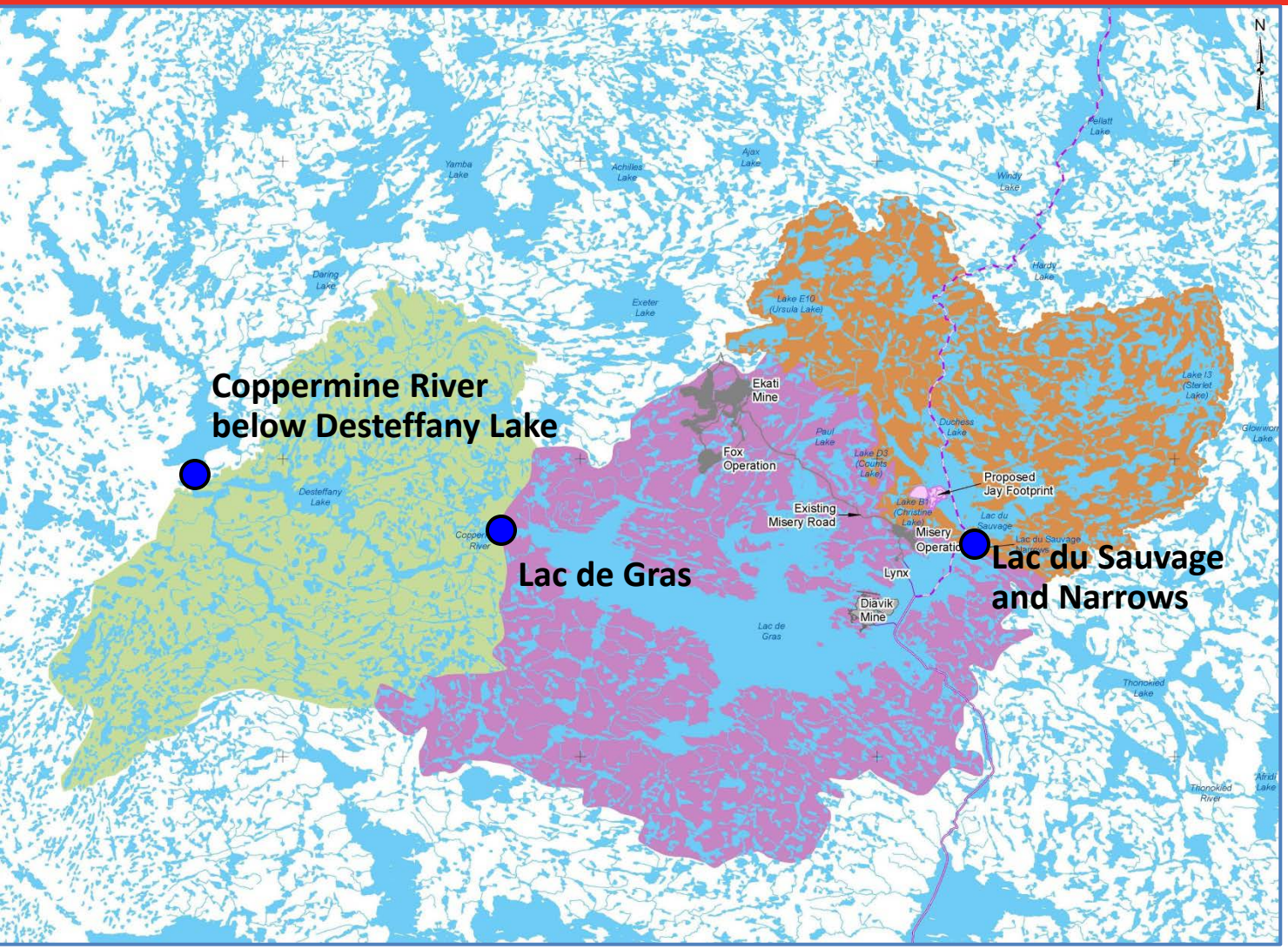
Assessment – Water Quantity Spatial Boundaries



Effects were assessed at nodes representing lake water levels and discharges

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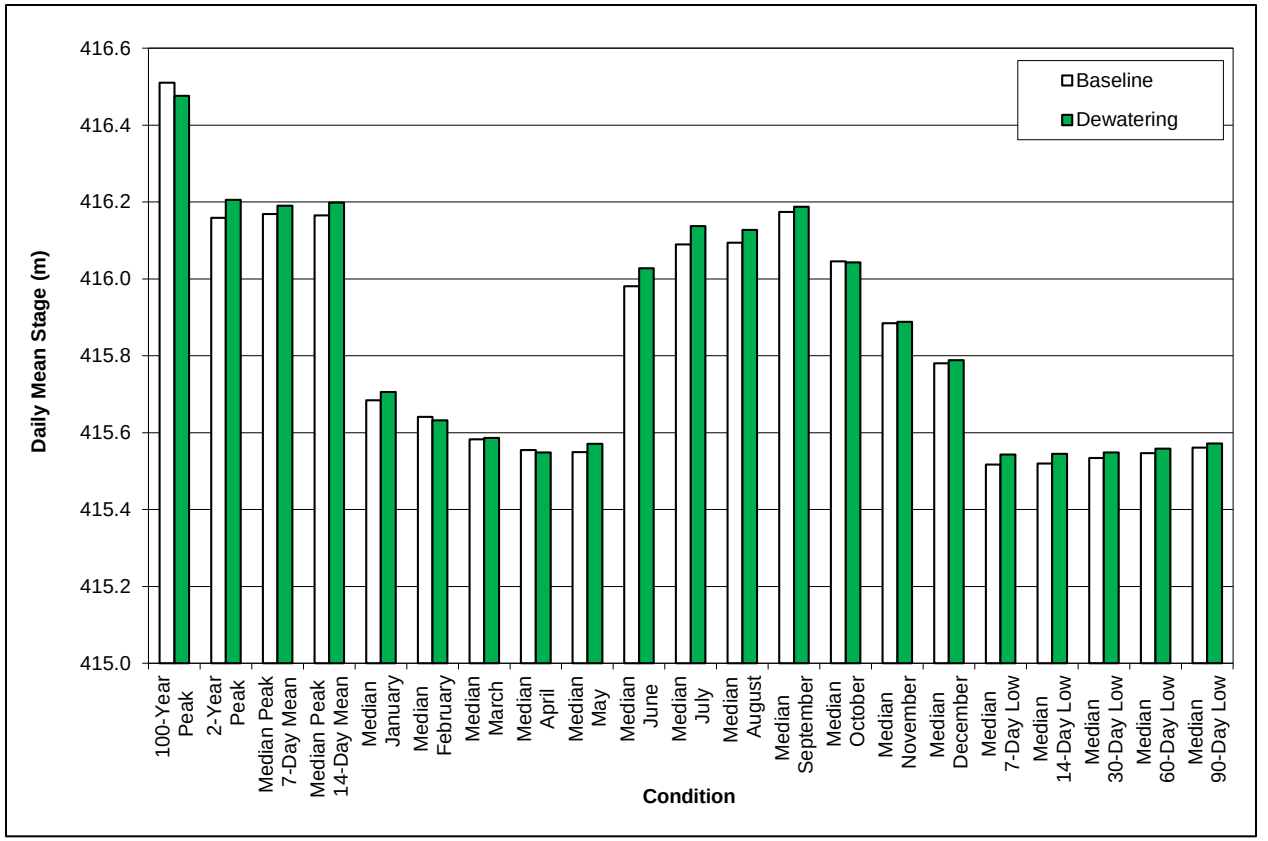
Assessment – Effects to Lac du Sauvage and Lac de Gras

- The greatest increases in Lac du Sauvage (LDS) and Lac de Gras (LDG) water levels are expected to occur during dewatering
- Increases in water levels are expected to be limited to 5 cm (LDS) and 6 cm (LDG)
- Increases in discharges are expected to range from 4% to 10% (LDS) and 4% to 6% (LDG)
- None of these changes are expected to affect lake or channel bank or bed stability



Above: Predicted water level changes at Lac du Sauvage during dewatering

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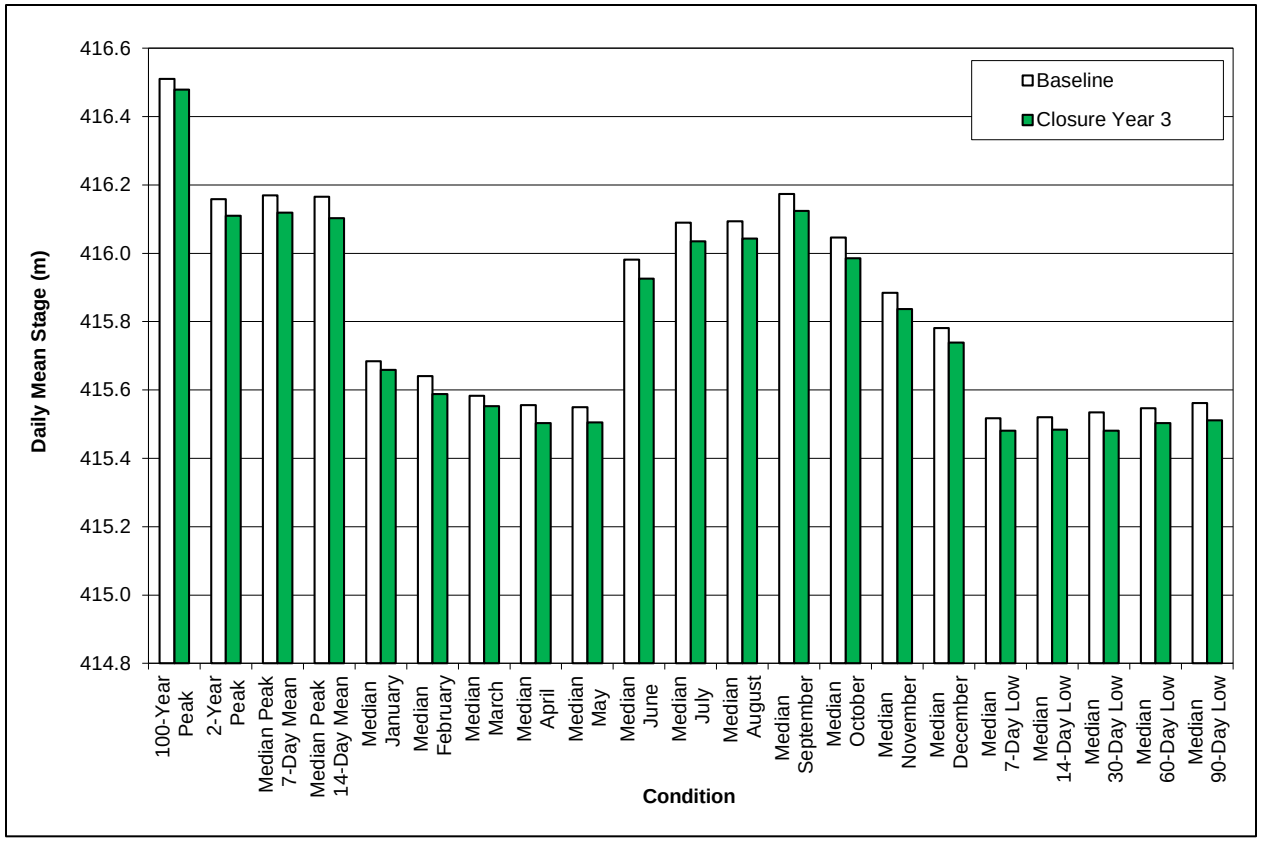
Assessment – Effects to Lac du Sauvage and Lac de Gras

- The greatest decreases in Lac du Sauvage (LDS) and Lac de Gras (LDG) water levels are expected to occur during back-flooding at closure
- Decreases in water levels are expected to be limited to 5 cm (LDS) and 8 cm (LDG)
- Decreases in discharges are expected to range from 5% to 22% (LDS) and 3% to 6% (LDG)
- None of these changes are expected to affect lake or channel bank or bed stability



Above: Predicted water level changes at Lac du Sauvage during back-flooding

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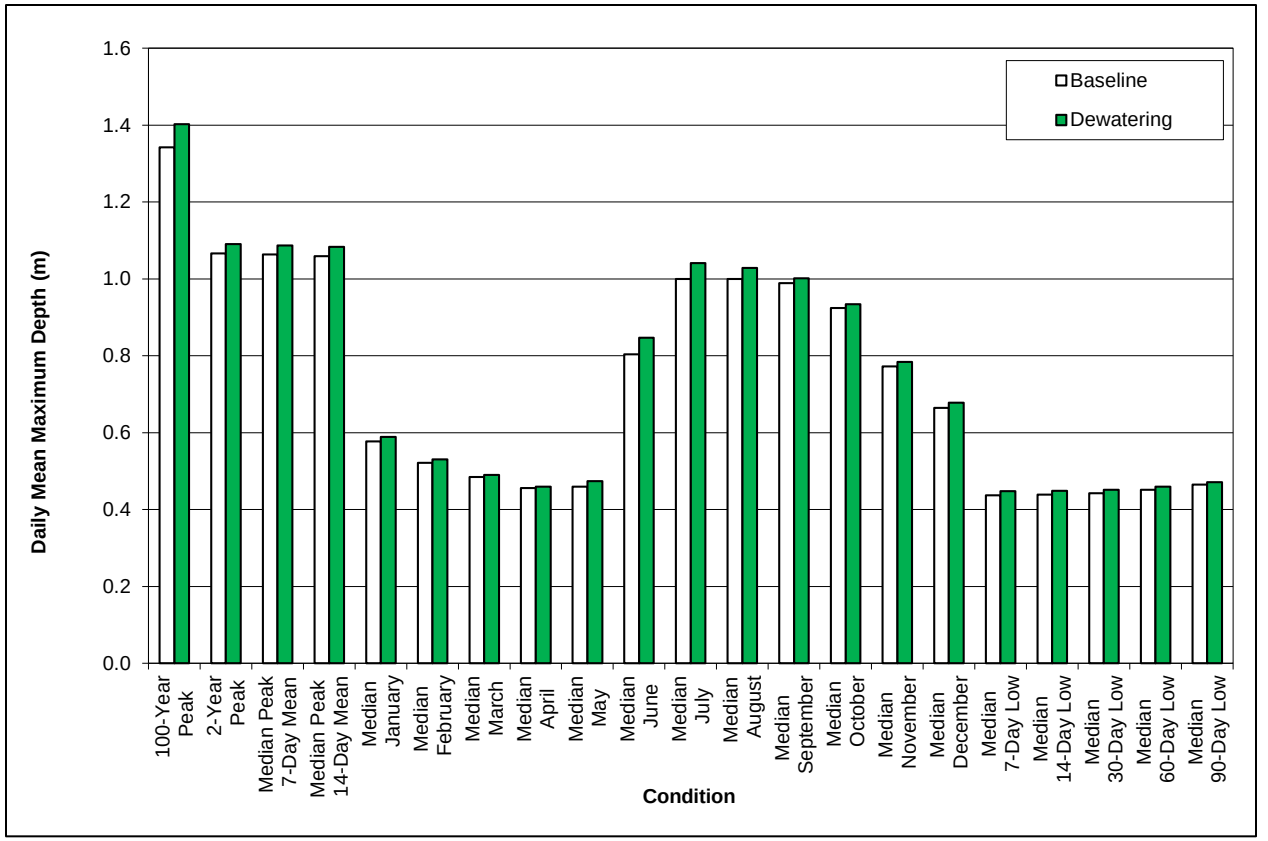
Assessment – Effects to Lac du Sauvage Narrows

- The greatest increases in Lac du Sauvage Narrows depths and top widths are expected to occur during dewatering
- Increases in water levels are expected to be limited to 4 cm
- Increases in top widths are expected be limited to less than 3 m
- None of these changes are expected to affect lake or channel bank or bed stability



Above: Predicted channel depth changes at Lac du Sauvage during dewatering

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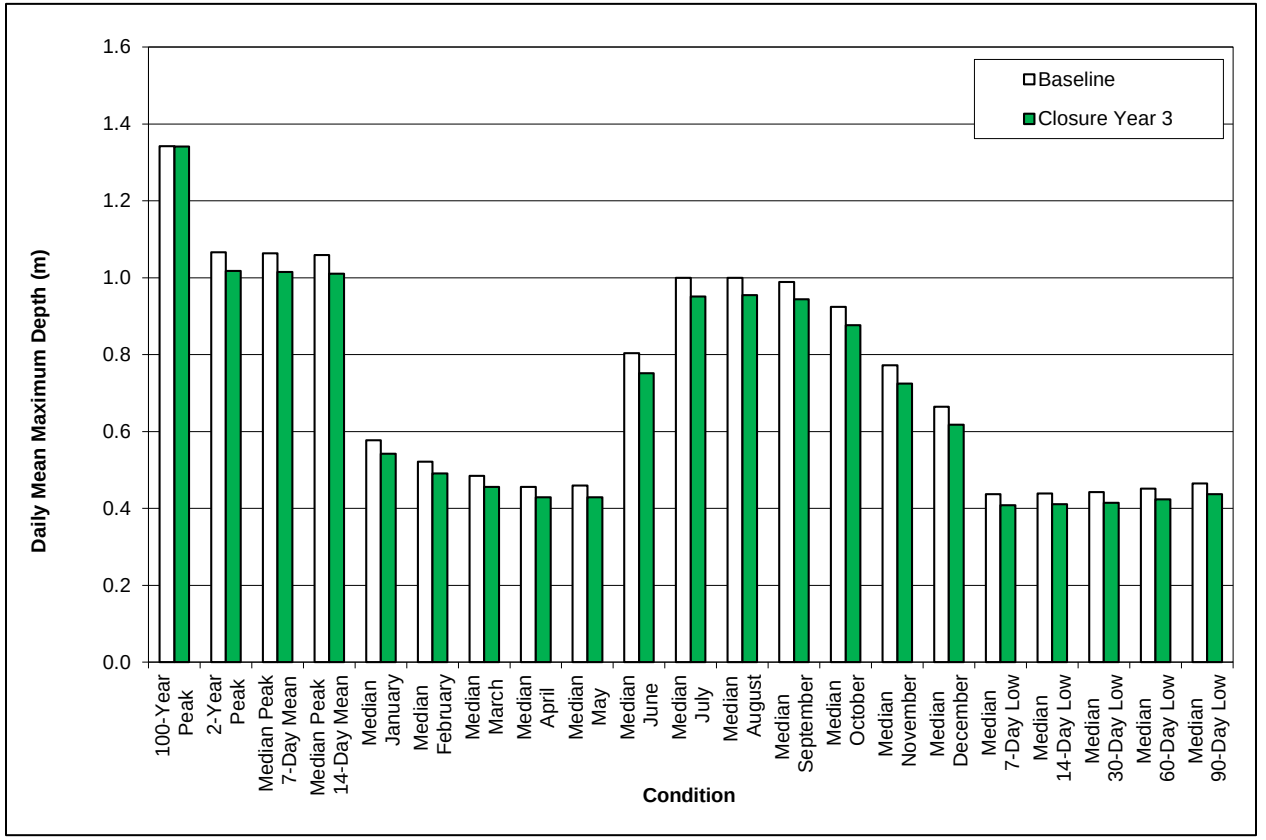
Assessment – Effects to Lac du Sauvage Narrows

- The greatest decreases in Lac du Sauvage Narrows depths and top widths are expected to occur during back-flooding
- Decreases in water levels are expected to be limited to 5 cm
- Decreases in top widths are expected be limited to less than 4 m
- None of these changes are expected to affect lake or channel bank or bed stability



Above: Predicted channel depth changes at Lac du Sauvage during back-flooding

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Assessment – Conclusion

Water Quantity (Hydrology) - Summary

- Changes to discharges and water levels at key nodes for each Project phase or period were predicted
- Changes to discharge and water levels are generally predicted to be small, except for a few situations at small Lac du Sauvage tributary lakes/streams
- No measureable long-term changes to discharges and water levels are predicted at Lac du Sauvage and Lac de Gras during the Post-Closure period
- Lake and channel bed and bank stability will not be affected by changes to discharges and water levels
- Changes were passed to the water quality, fish and fish habitat and traditional land use disciplines, as inputs to their assessments
- Additional hydrological monitoring in anticipate as an extension of the existing Ekati monitoring programs within the AEMP

Thank You

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