

# **Optimization of the Annual Production Plan for the Mitis River System**

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# Presentation Outline

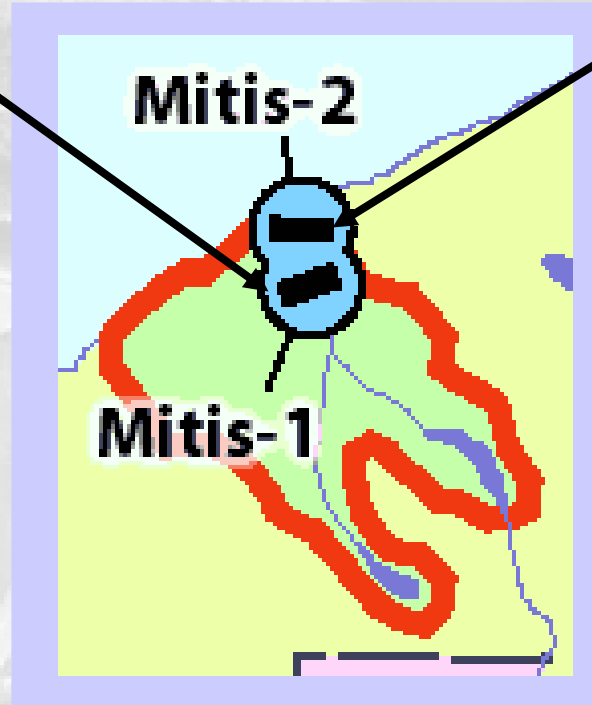
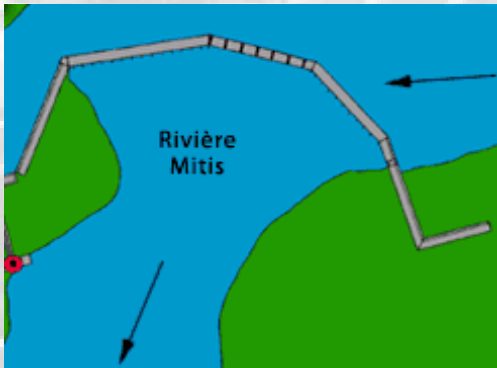
- Introduction
- Project Goals
- Model Formulation
- Sensitivity Analysis
- Model Comparison
- Conclusions



# Overview of the Mitis River System

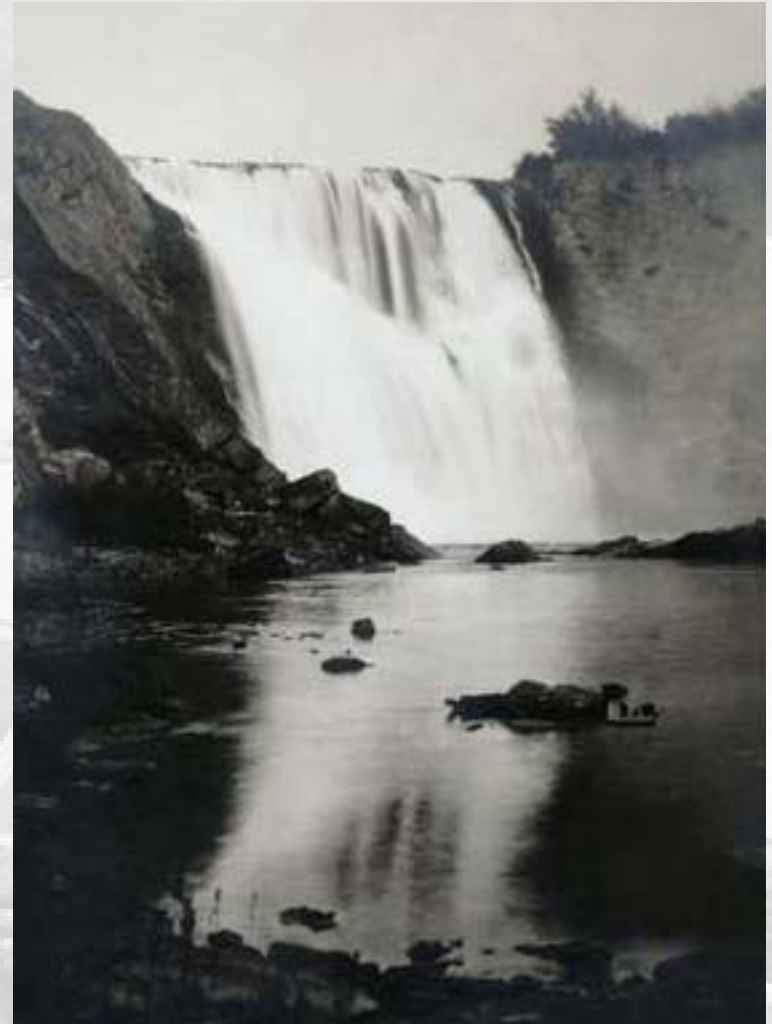
Mitis - 1

Mitis - 2

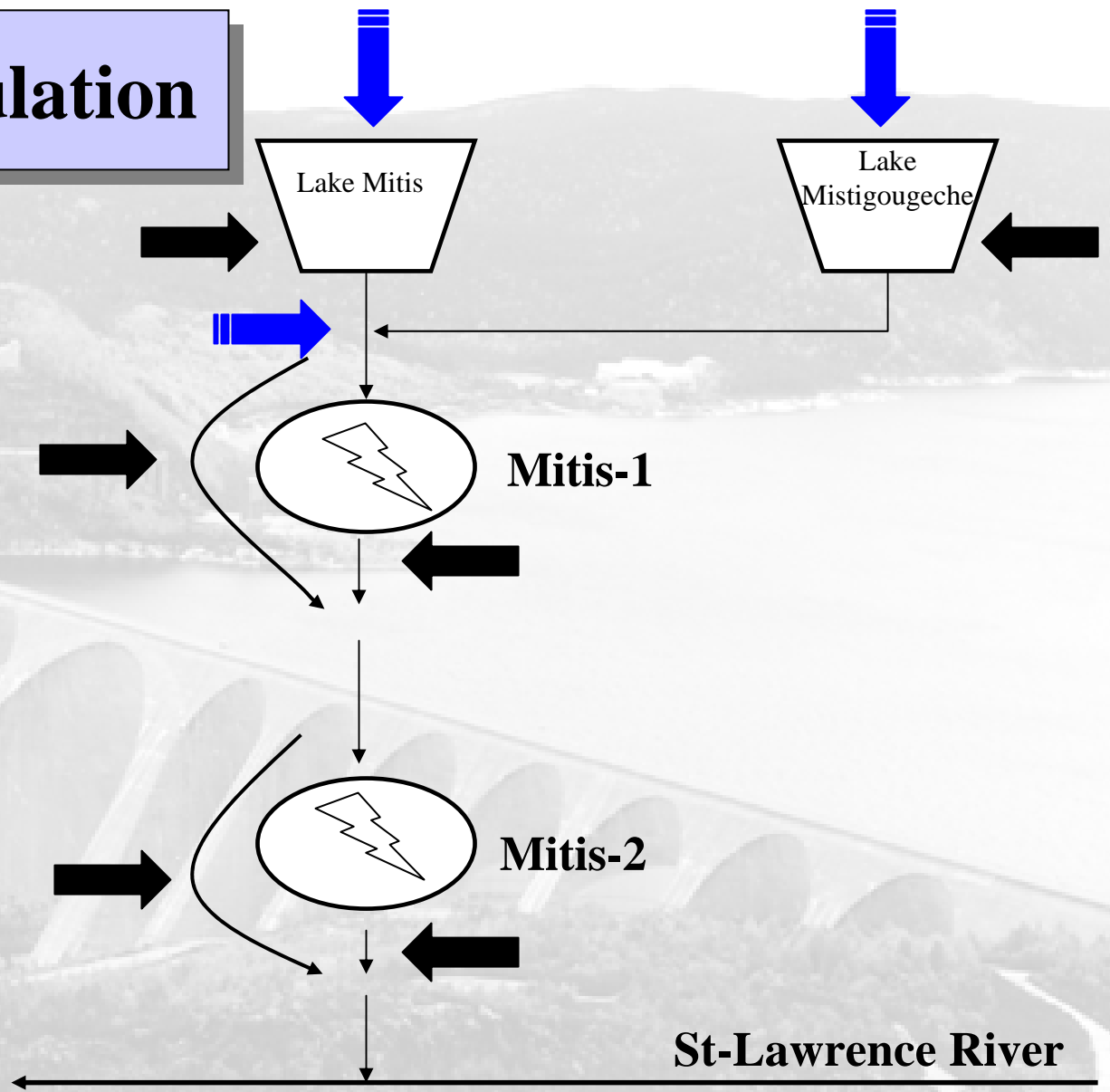


# Project Goals

- **Optimize the annual production plan**
- **Conduct sensitivity analysis**
  - ✦ **Modification of operational constraints**
  - ✦ **Production benefits from equipment upgrades**



# Model Formulation



St-Lawrence River

# Model Constraints

- **Balance of flow equations**

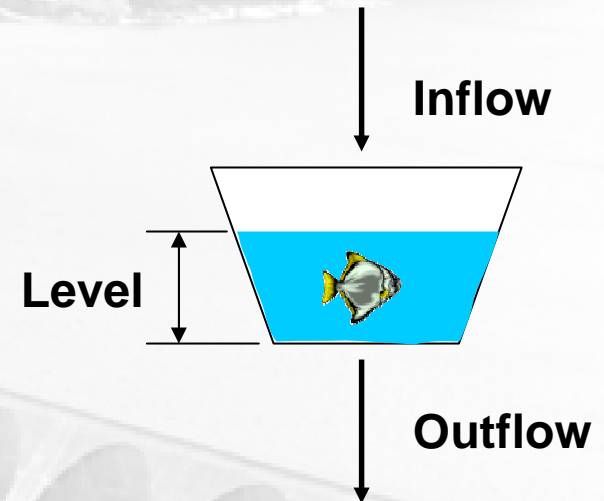
$$\text{Inflow} + \text{Level}_{\text{Beg}} - \text{Outflow} = \text{Level}_{\text{End}}$$

- **Evacuation capacities**

- **Downstream flows**

- **Production capacities**

- **Reservoir operational levels**



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# Sensitivity Analysis

- **Value of LP model**
  - LP vice Simulation
  - Real-time modeling
- **LP Optimization**
  - 9.1% improvement
  - Operate Mitis River Complex at 96.1%

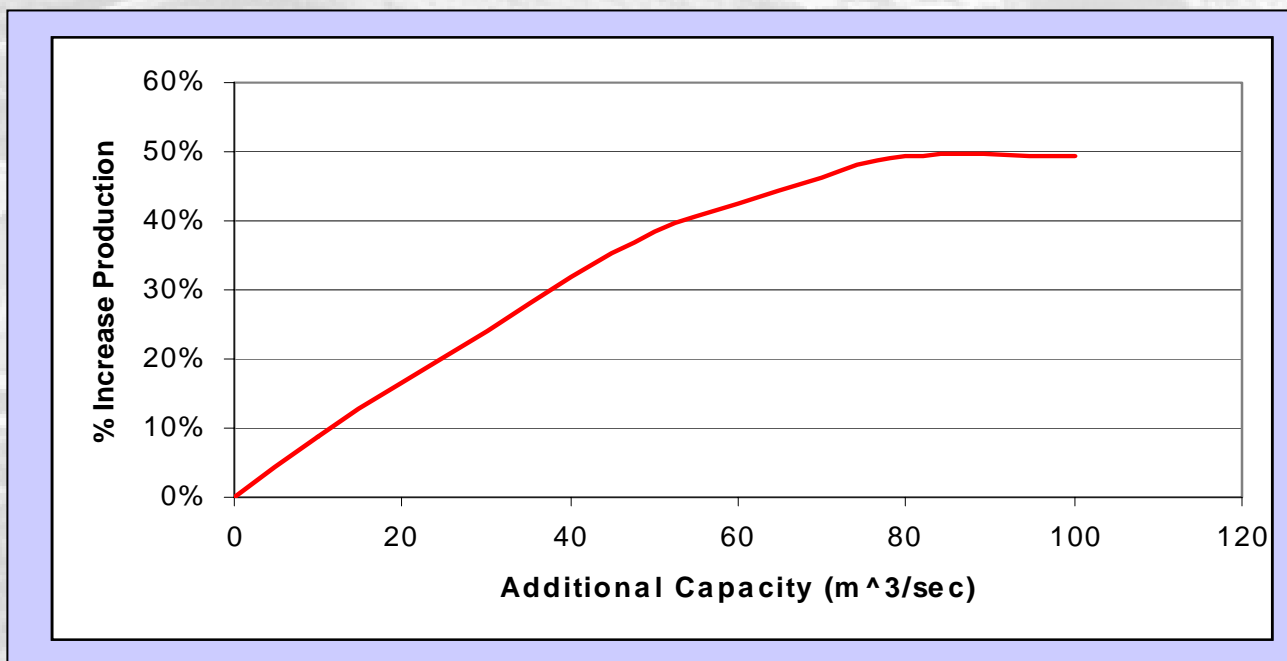


# Sensitivity Analysis

- **Deforestation of Lake Mistigougeche**
- **Downstream Flow Constraints**
  - **Ice Dams**
  - **Salmon**
- **Tributary Inflows**
  - **Accounts for 40% of inflow**
  - **Flood Control**

# Sensitivity Analysis

## *Upgrading Hydro-electric Generators*



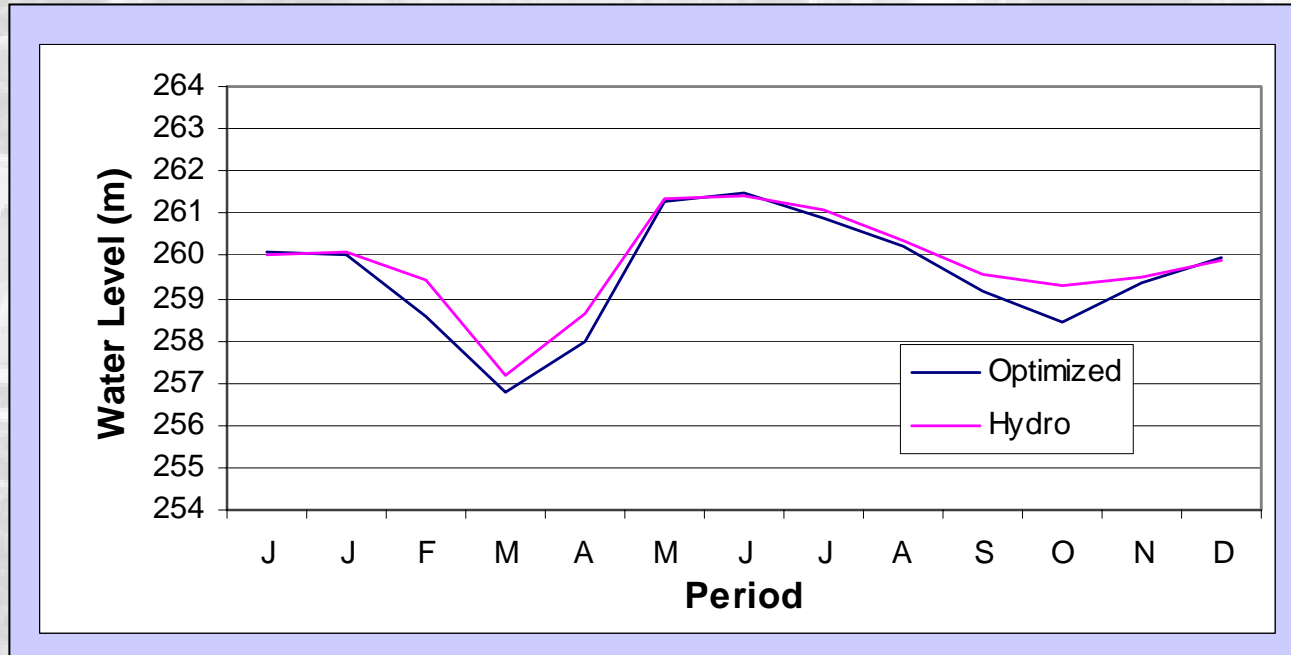
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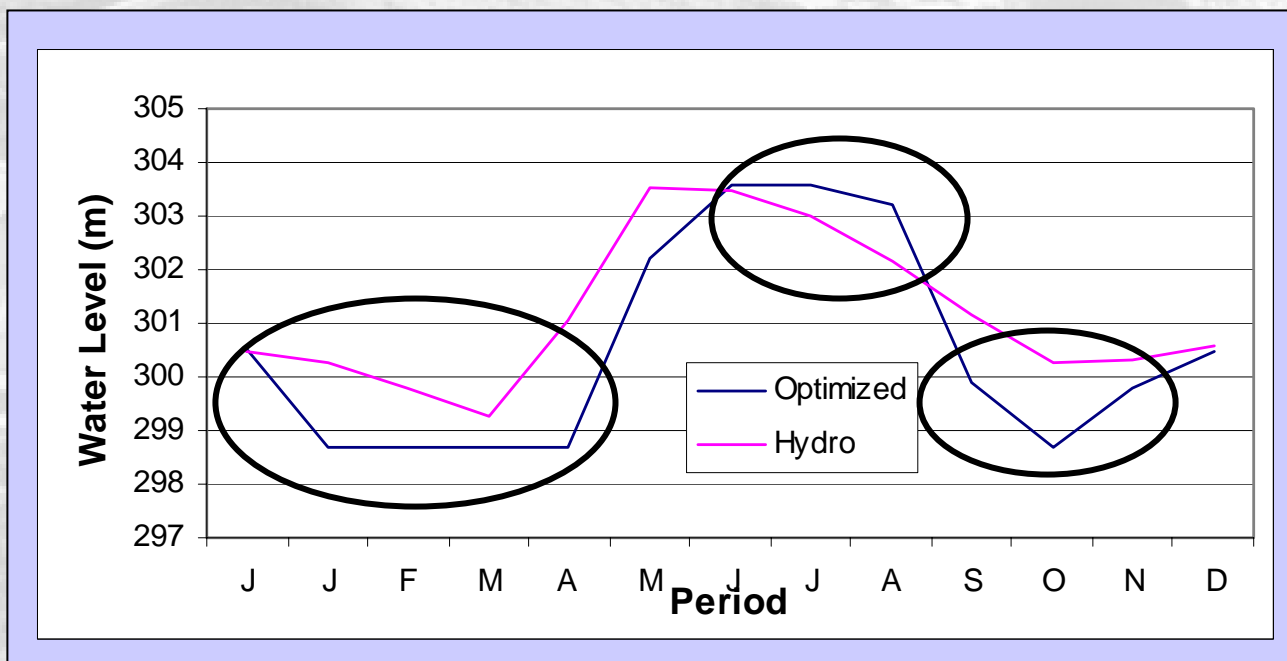
# Model Comparison

## *Reservoir Operation Lake Mitis ....*



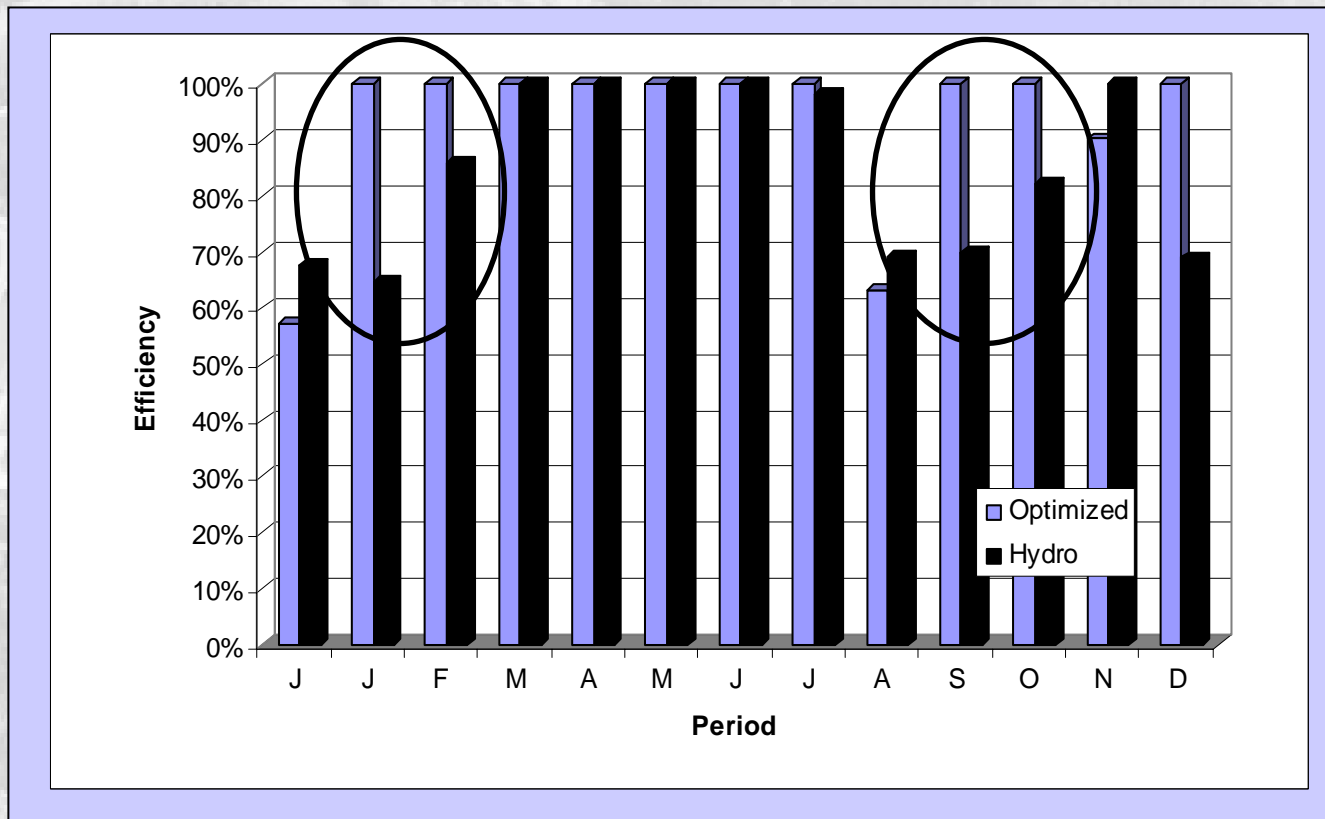
# Model Comparison

## *Reservoir Operation Lake Mistigougeche ....*



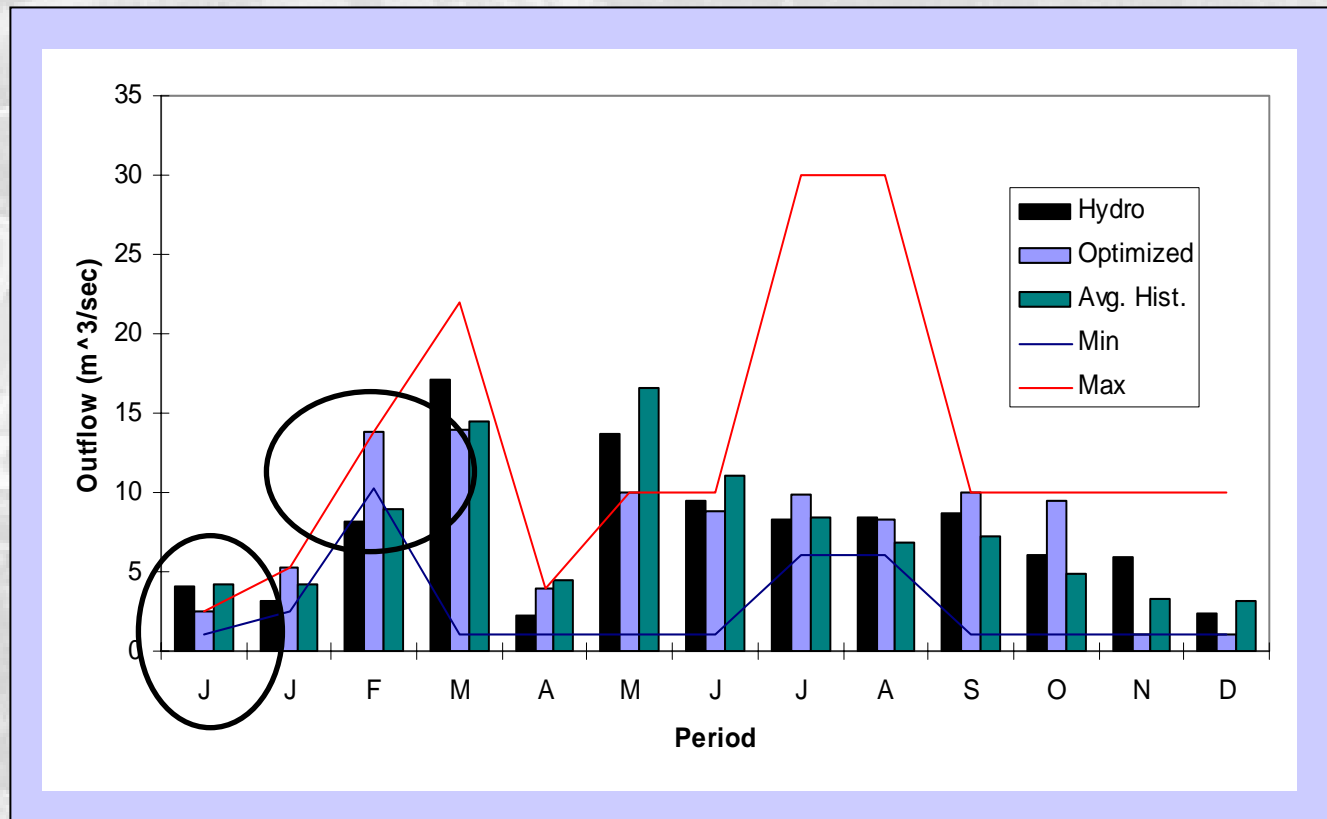
# Model Comparison

## *Production – Optimized vs. Hydro*



# Model Comparison

## *Downstream flows - Lake Mitis*



# Conclusions

- **9.1 % increase in annual production plan (9500 MWh)**
- **2.8 % additional increase from reservoir deforestation (2800 MWh)**
- **49 % additional increase from an equipment upgrade**
- **Simulation LP modeling**





# Questions ?



# Extra Material

# Project Collaborators

- **Luc Routhier, P. Eng.**  
Chief of Dam Safety  
Manicouagan Region
- **Louis-Marie Landry, P. Eng.**  
Dam Safety Engineer  
Manicouagan Region
- **Louise Tremblay, P. Eng.**  
Production Planning Engineer  
Manicouagan Region



Hydro-Quebec X

General | Lake Mitis Const. | Lake Mistigougeche Const.

Solve

Objective Function

Variables results

	Outflow L Mitis	Outflow L Misti	Prod Mitis-1	Spill Mitis-1	Prod Mitis-2	Spill Mitis-2
P1 - Jan 1-15	<input type="text" value="2.47"/>	<input type="text" value="1.67"/>	<input type="text" value="13.18"/>	<input type="text" value="0"/>	<input type="text" value="13.18"/>	<input type="text" value="0"/>
P2 - Jan 15-30	<input type="text" value="5.3"/>	<input type="text" value="9.46"/>	<input type="text" value="23"/>	<input type="text" value="0.8"/>	<input type="text" value="23.8"/>	<input type="text" value="0"/>
P3 - Feb	<input type="text" value="13.8"/>	<input type="text" value="1.11"/>	<input type="text" value="23"/>	<input type="text" value="0.8"/>	<input type="text" value="23.8"/>	<input type="text" value="0"/>
P4 - March	<input type="text" value="13.97"/>	<input type="text" value="2.08"/>	<input type="text" value="23"/>	<input type="text" value="7.38"/>	<input type="text" value="23.8"/>	<input type="text" value="6.58"/>
P5 - April	<input type="text" value="4"/>	<input type="text" value="7.2"/>	<input type="text" value="23"/>	<input type="text" value="48.39"/>	<input type="text" value="23.8"/>	<input type="text" value="47.59"/>
P6 - May	<input type="text" value="10"/>	<input type="text" value="2.27"/>	<input type="text" value="23"/>	<input type="text" value="78.88"/>	<input type="text" value="23.8"/>	<input type="text" value="78.08"/>
P7 - June	<input type="text" value="8.88"/>	<input type="text" value="4.22"/>	<input type="text" value="23"/>	<input type="text" value="4.72"/>	<input type="text" value="23.8"/>	<input type="text" value="3.92"/>
P8 - July	<input type="text" value="9.88"/>	<input type="text" value="2.9"/>	<input type="text" value="23"/>	<input type="text" value="0"/>	<input type="text" value="23"/>	<input type="text" value="0"/>
P9 - August	<input type="text" value="6.05"/>	<input type="text" value="2.8"/>	<input type="text" value="12.37"/>	<input type="text" value="0"/>	<input type="text" value="12.37"/>	<input type="text" value="0"/>
P10 - Sept.	<input type="text" value="9.42"/>	<input type="text" value="10.32"/>	<input type="text" value="23"/>	<input type="text" value="0"/>	<input type="text" value="23"/>	<input type="text" value="0"/>
P11 - Oct.	<input type="text" value="10"/>	<input type="text" value="4.54"/>	<input type="text" value="23"/>	<input type="text" value="0"/>	<input type="text" value="23"/>	<input type="text" value="0"/>
P12 - Nov.	<input type="text" value="3.26"/>	<input type="text" value="1.74"/>	<input type="text" value="23"/>	<input type="text" value="0"/>	<input type="text" value="23"/>	<input type="text" value="0"/>
P13 - Dec.	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="23"/>	<input type="text" value="0"/>	<input type="text" value="23.8"/>	<input type="text" value="0"/>