02

Decommissioning Details and Lessons Learned and Implemented

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Decommissioning (Some) Lessons Learned

- All issues need resolutions (no more “wait and see”)
- Start with a detailed risk assessment to target key issues
  - Quantify Risk
  - Identify natural variation
  - Identify long term trends, are they acceptable?
- Assess the potential of natural wetlands and sediments
- Challenges with the return of site to a natural state
  - e.g. difficult access, wildlife damage
- Rightsholders and the public will identify their own issues which are not necessarily easy to anticipate

Claude Mining Area

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Claude Mining Area

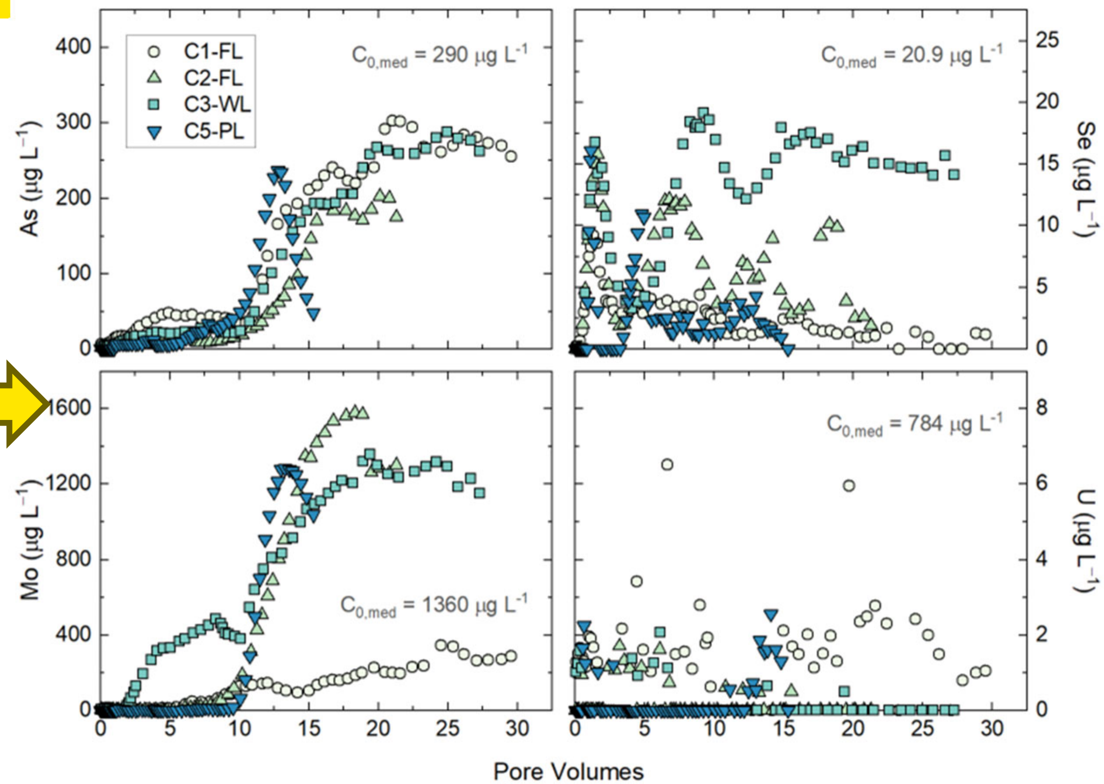
- **Pit was backfilled with waste rock and demolition debris, covered, planted with trees**
- **Waste rock pile was shaped, compacted, covered with a ‘moisture store-and-release’ till layer, and seeded**
- **Vegetation is self-sustaining, pile is stable, and successfully minimizing net percolation rates**
- **Achieving surface water quality in Claude Lake now and in the long-term**

Claude Lake Sediments: A Natural Sink

- **Understanding Natural Sediment Attenuation Capacity**
- **Where contaminants are expected to enter the sediments (understand detailed contaminant transport and focus on the local environment)**
- **How thick/ uniform are the impacted sediments?**
- **What is the organic content of the sediments/ their current contaminant loading?**

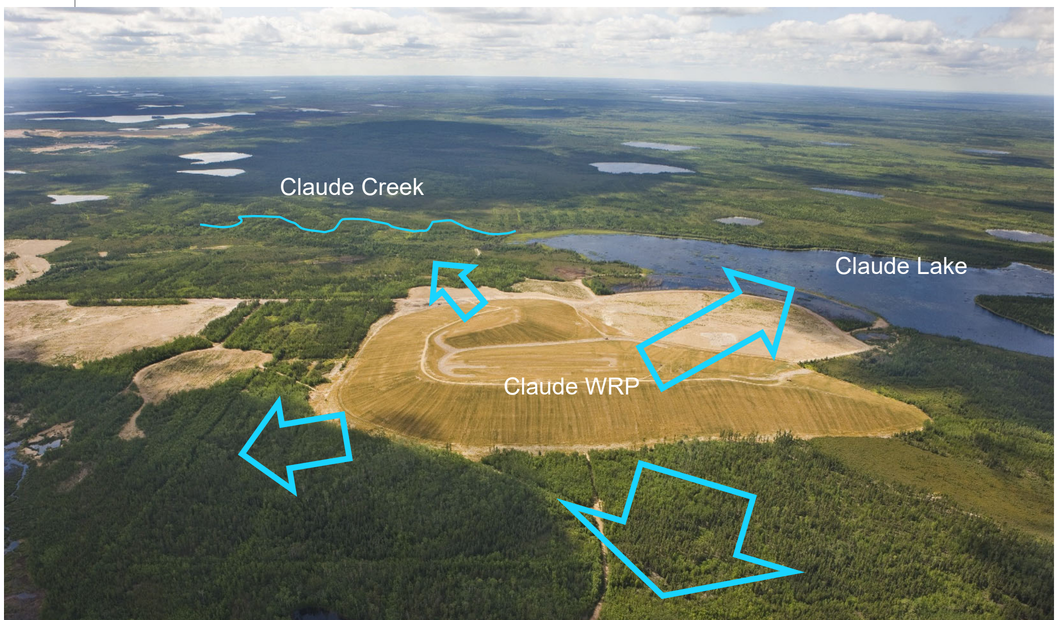
Clade Lake Sediments are ideal for sequestering contaminants. The lake is shallow with deep, high organic content sediments and is moving towards becoming a wetland

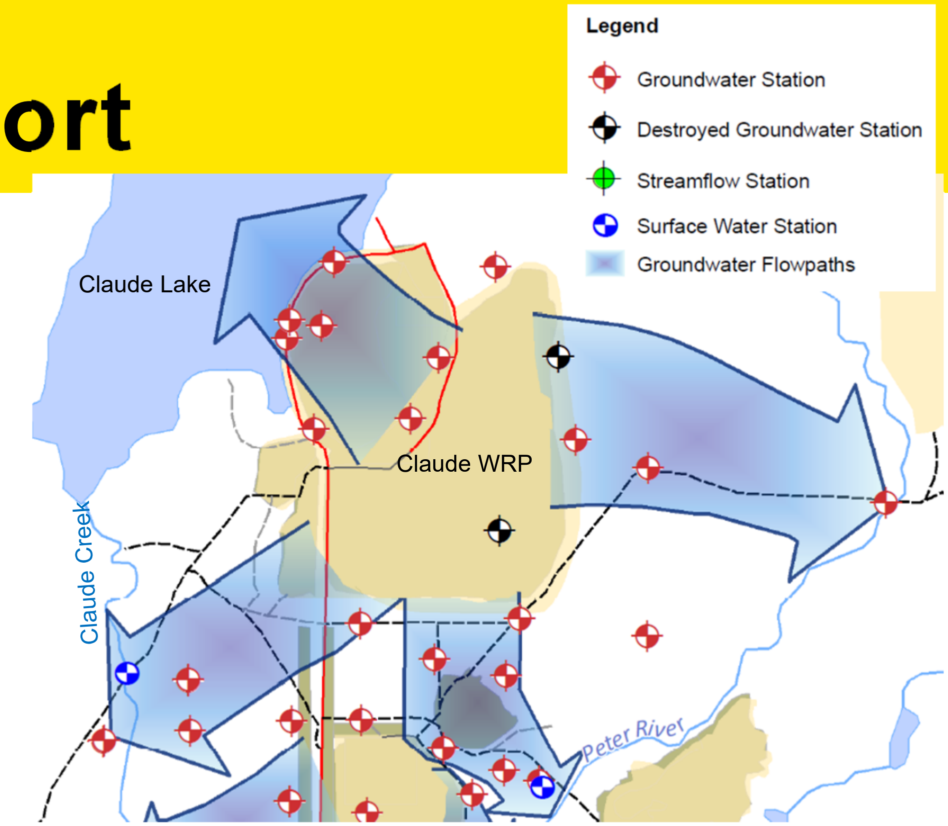
McClean Lake Sediment Studies



Sediment Column Studies were completed at the Lindsay Lab at the UofS investigating the sediment attenuation capacity in downstream of the McClean Lake Tailings Management Facility

A detailed understanding of
Contaminant Transport

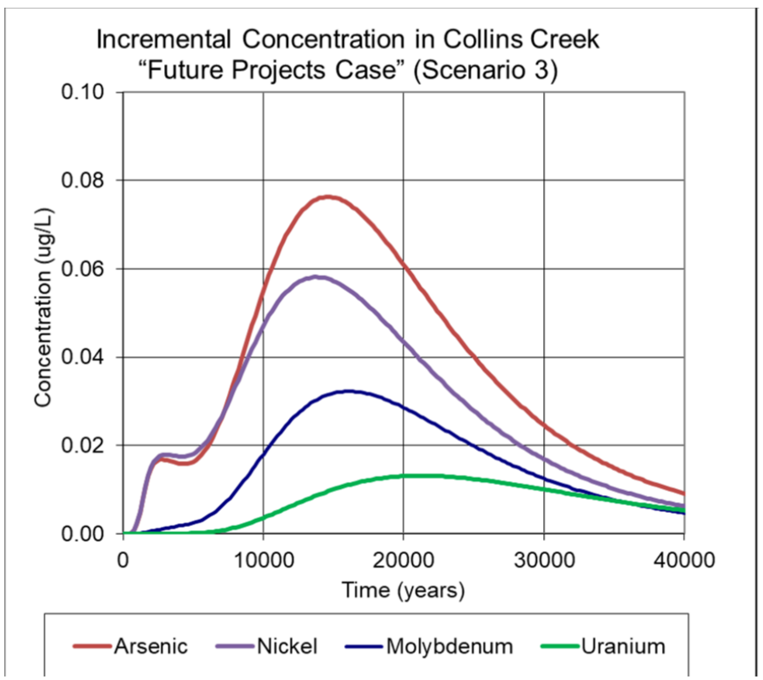


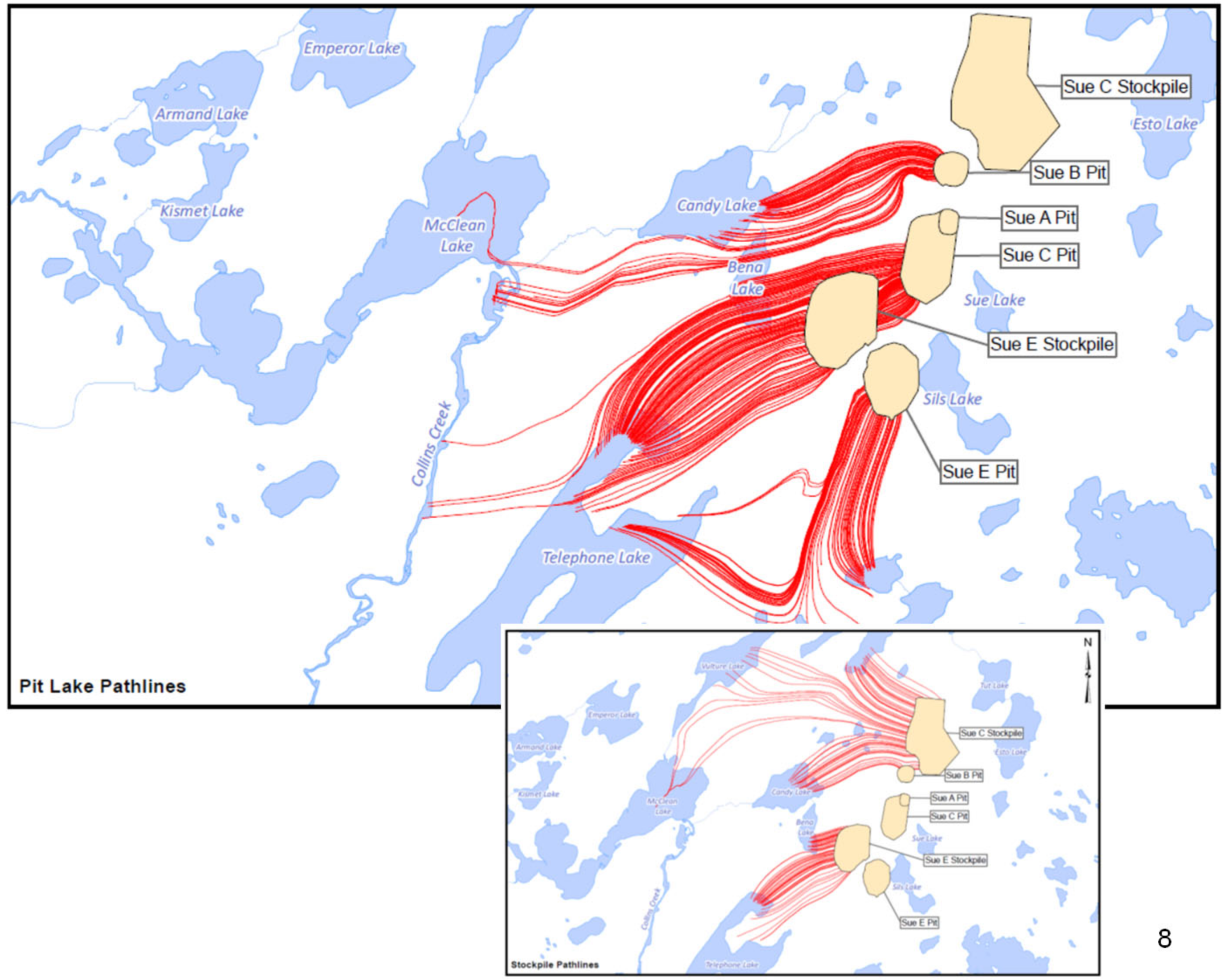


- Contaminant transport was modelled every 5 years incorporating new data
- The results feed into environmental risk assessments
- Understanding change over time gave a good understanding of site stability and key areas of risk

Lessons Applied in Contaminant Transport

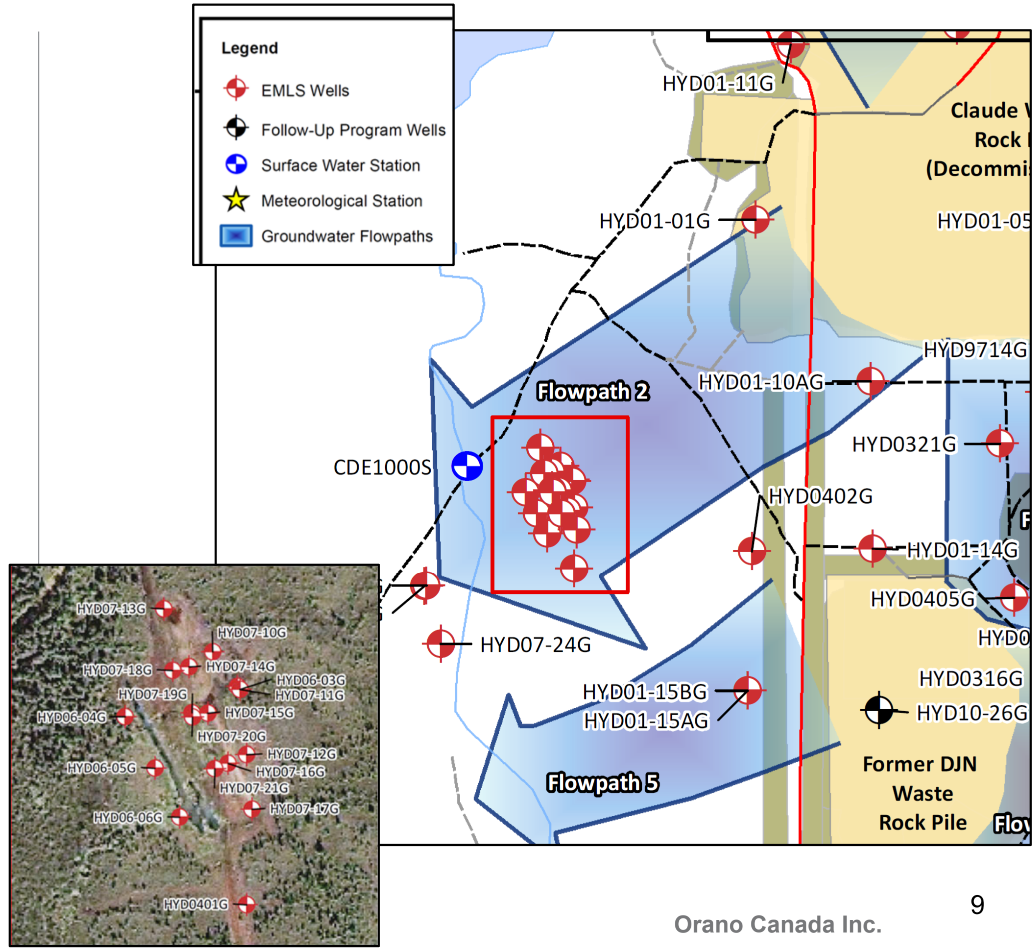
The McClean Lake Management Technical Information Document Models contaminant transport before it occurs and predicts effects to inform decommissioning programs





Understanding Risk:
The Peat Trenches Case Study

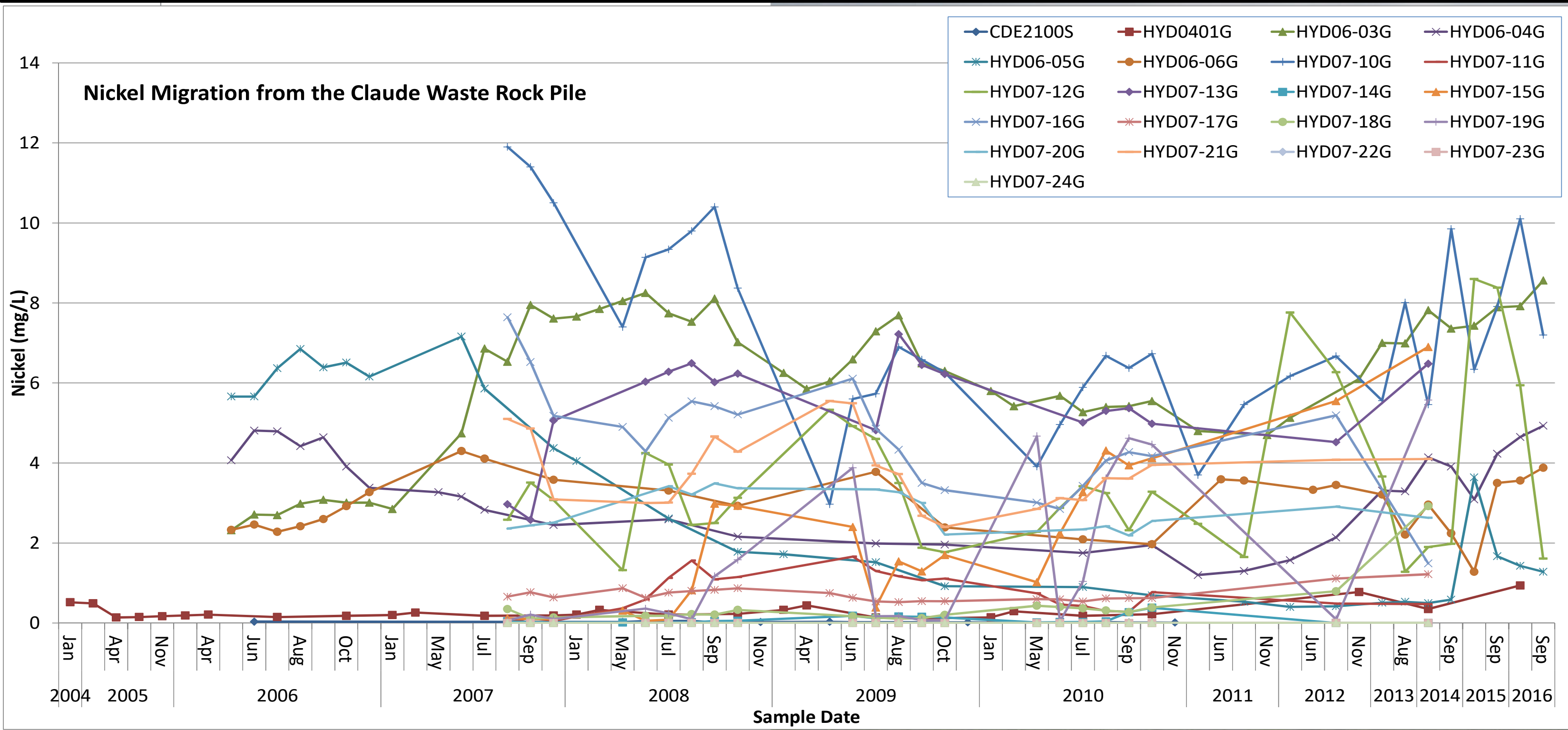
- **A groundwater pathway was identified from the Claude Waste Rock Pile to the SW**
  - Two peat trenches installed (2005 &2006) to attenuate nickel from the Claude Pile
  - Three sets of groundwater wells (20 total) monitor the area and the effect of the peat trenches
  - A component of the Follow-Up Program until 2015
  - Monitored under the Environmental Monitoring Schedule until 2018



Peat Trenches: What Information did we need?

Key Questions for Long Term Monitoring:

Are the peat trenches effective? Is there any unreasonable risk to humans or the environment?



Claude Area Re-Vegetation: Public Perception

D Mining Area

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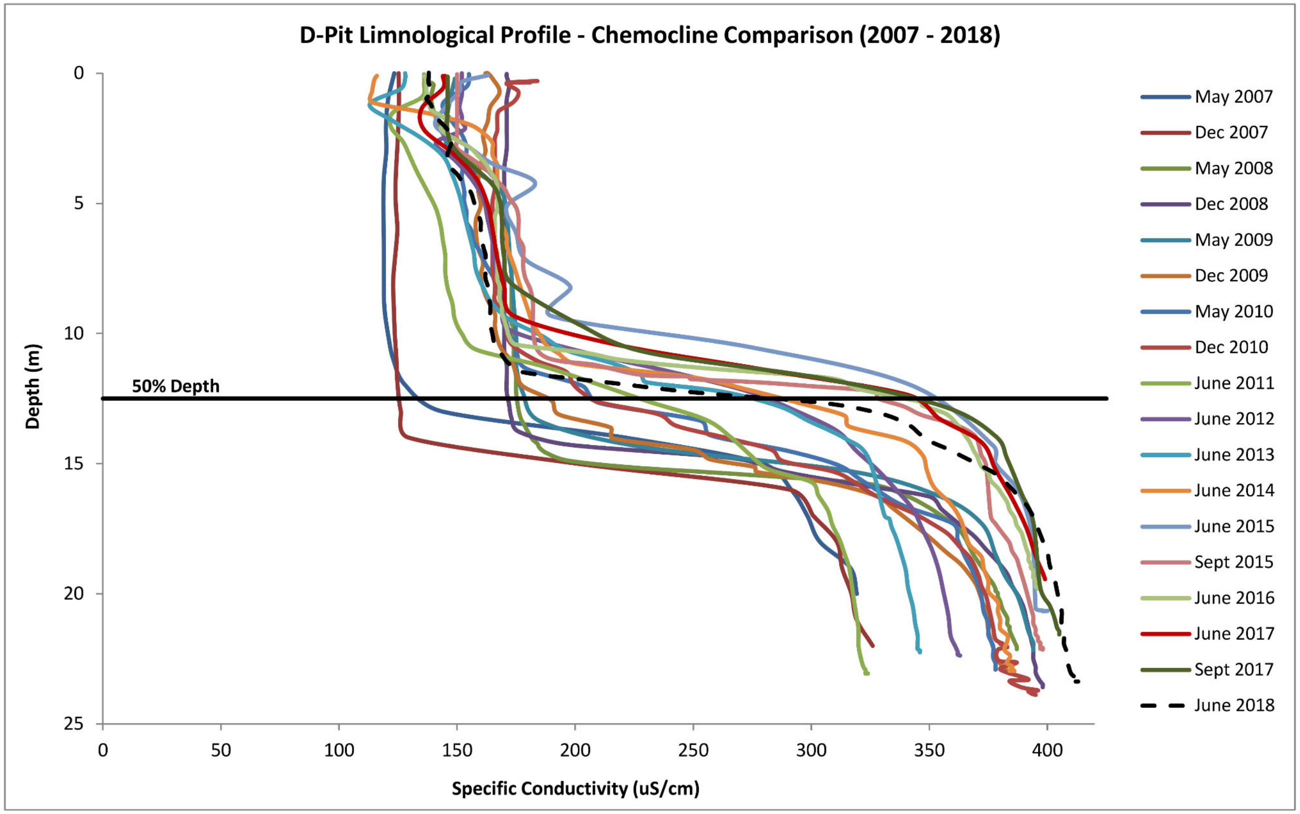
D Mining Area

- **First deposit mined**
- **Decommissioned as pit lake, flooded in 1983**
- **Stable chemocline, surface water quality objectives achieved in the long-term**

Establishment of Stable Chemoclines



D-Pit limnological profiles demonstrate a stable chemocline over 14 years

Water with higher concentrations of contaminants is sequestered at the bottom of the pit, never interacting with the surface water

Progressive Reclamation - Sue Pit Water Management

- ***Project Need:*** water in Sue pits is not of acceptable quality for decommissioning
- ***Current Plan:*** at closure; pump and treat and either allow to reflood and/or fully or partially backfilled with waste rock
- ***Project Objective:*** develop a geochemical method for in-situ remediation of the Sue pit lakes to achieve long-term decommissioning plan of pit water that achieves stable acceptable water quality
  - Validate the addition of ferric iron to remove COPCs (arsenic primarily); followed by adjustment of pH with slaked lime to remove nickel

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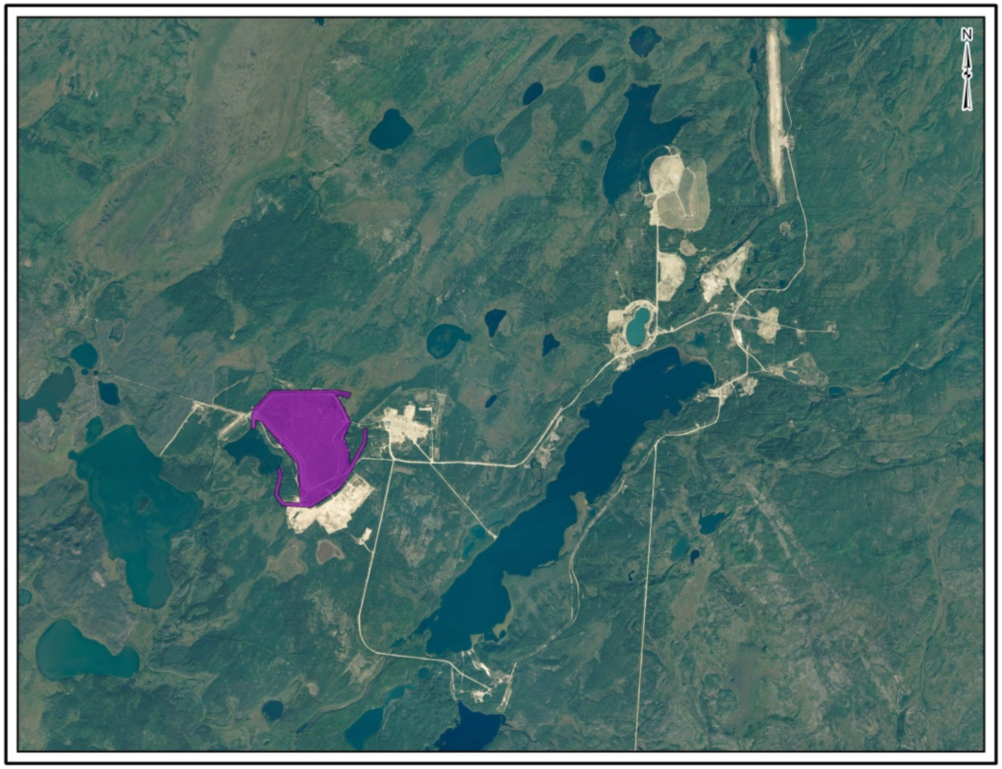
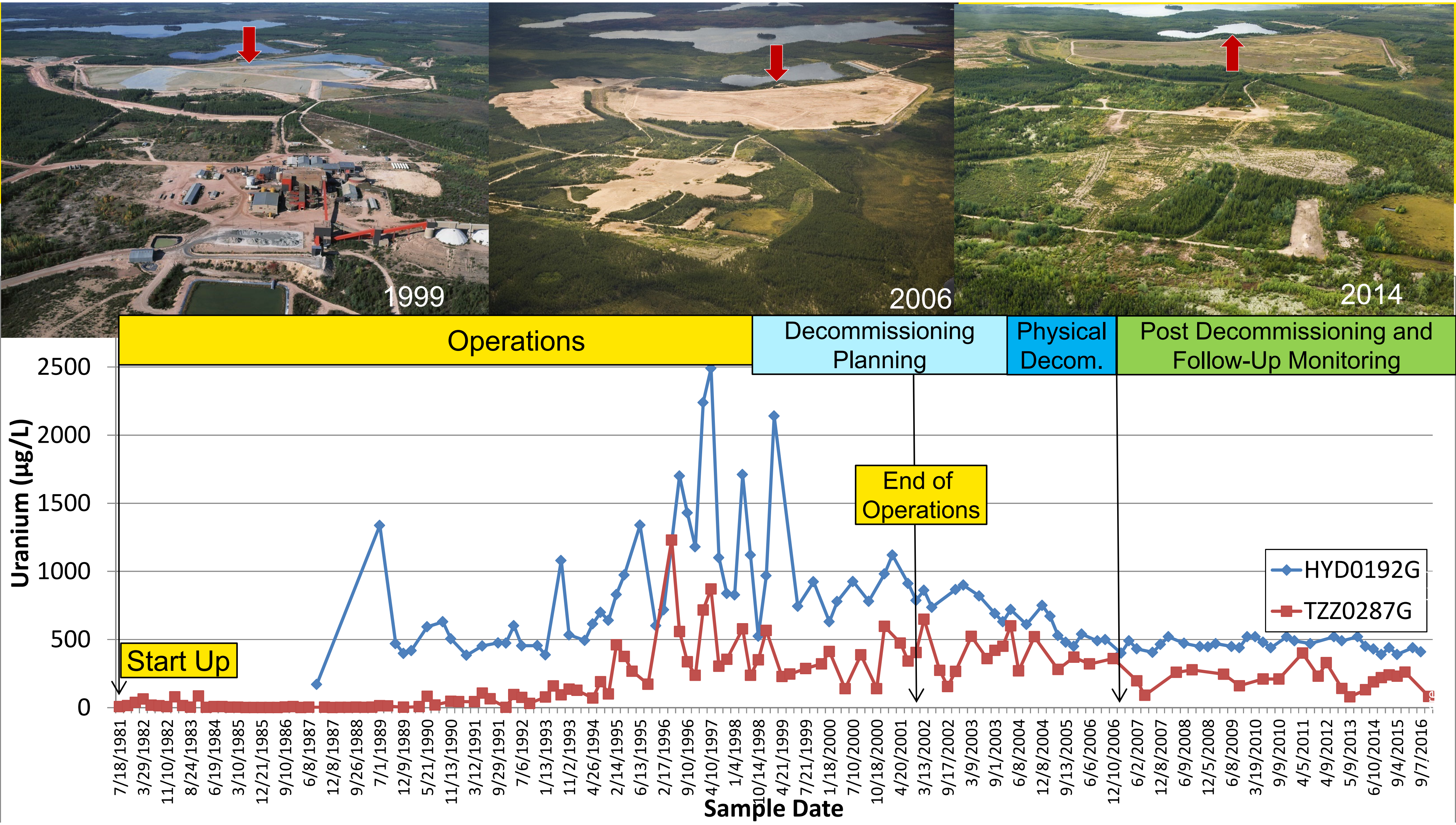
Tailings Management Area



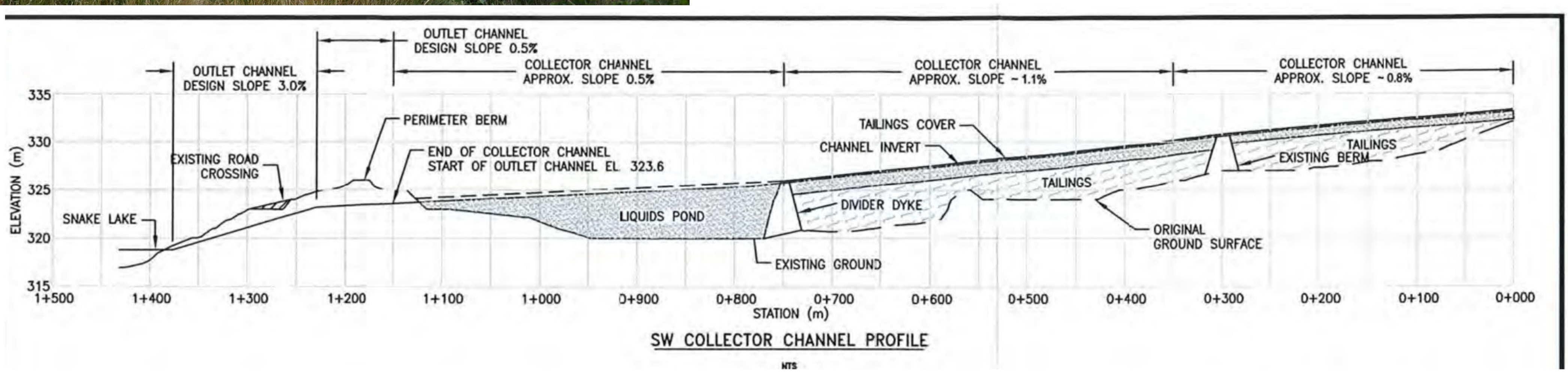
Tailings Management Area: Recognition of Operational Effects

- **Low permeability tailings consolidated to remove pore water**
- **Till ‘moisture store-and-release’ cover placed, graded, and seeded**
- **Storm water management: north and south diversion ditches, collector channel, surface grading; designed to route Probable Maximum Flood**
- **Vegetation is self-sustaining, storm water management achieved under passive care, design successfully minimizing net percolation rates**
- **Achieving surface water quality in Snake Lake now and in the long-term**

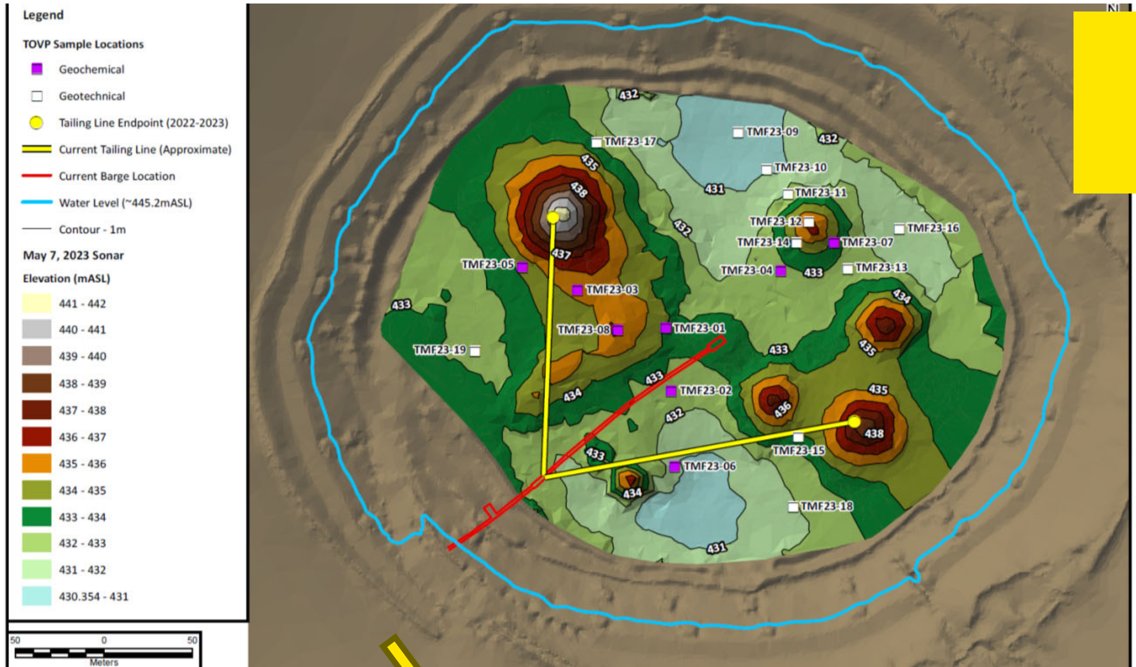

1999
2006
2014
Operations
Decommissioning Planning
Physical Decom.
Post Decommissioning and Follow-Up Monitoring
Start Up
End of Operations
Uranium (µg/L)
Sample Date
HYD0192G
TZZ0287G

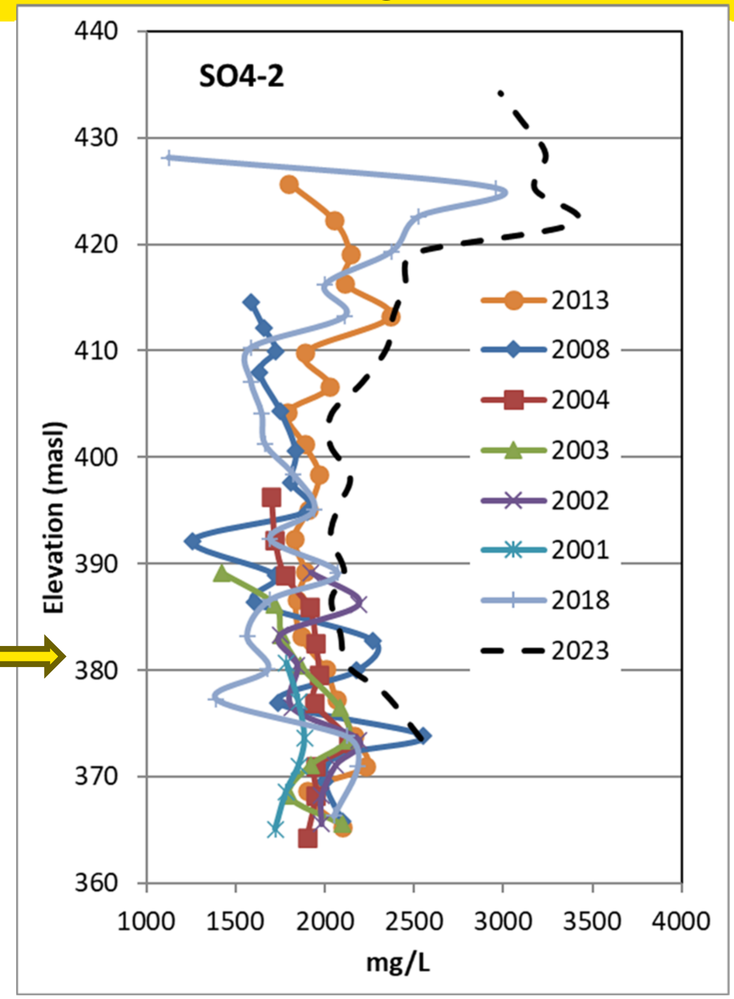
TMA Stability

- A key concern of rightsholders and the public
- Many questions about cover design and monitoring including interactions with wildlife
- Additional risk assessments were conducted based on consultation which found no risk to the public or the environment



Lessons Applied:
The Tailings Optimization and Validation Program





We now have over 25 years of solids and pore water data for the McClean lake tailings

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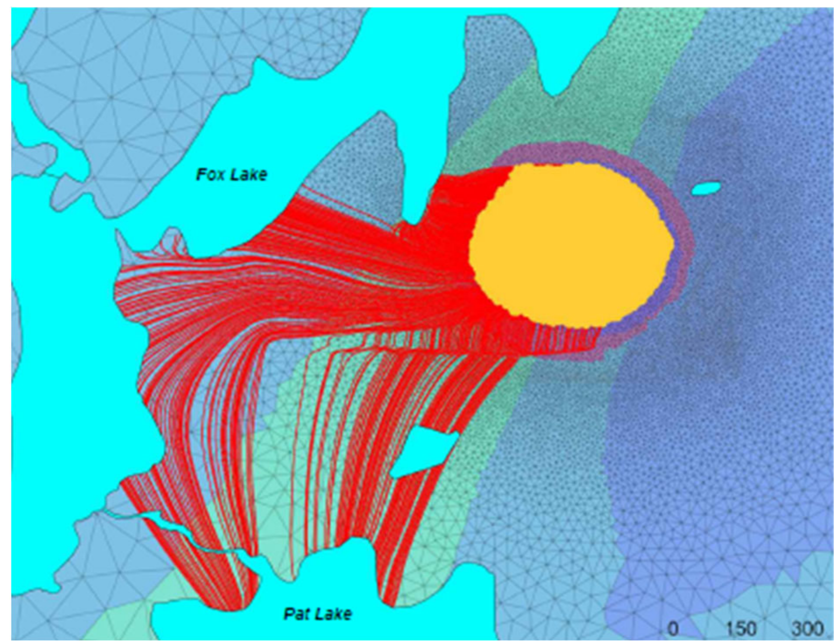
Post-Decommissioning Control of Solute Release to the Receiving Environment

The TOVP sampling is used to validate Two Passive Techniques for the control of contaminant transport from the TMF

- **geotechnical** – natural surround design: physical control of groundwater flow path around a consolidated tailings mass.
- **geochemical** – engineered tailings geochemistry: minimize and stabilize COC pore water concentrations in tailings solids as stable long-term mineral phases



TOVP & JEB TMF Groundwater and Contaminant Transport Modelling

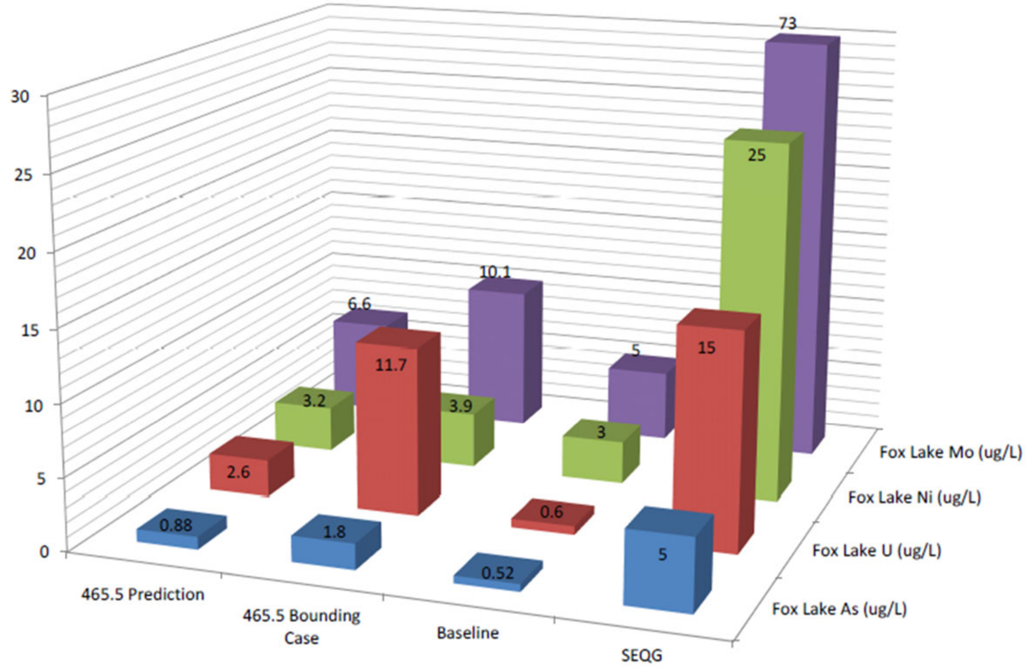
Outputs:

- Long-term expected water quality in Fox/Pat Lakes
- Sensitivity cases to address uncertainty
- Back calculation of maximum arsenic source term (7mg/L) to achieve surface water quality guidelines (5µg/L)

Historical Target COPCs:
As, Ni, U, Mo

COPCs targeted for further research based on 2020 tailings TID data:
Cu, Pb, Se

2020 Tailings TID Contaminant Transport Results, Predicted Concentrations in Pat Lake



	465.5 Prediction	465.5 Bounding Case	Baseline	SEQG
Fox Lake As (ug/L)	0.88	1.8	0.52	5
Fox Lake U (ug/L)	2.6	11.7	0.6	15
Fox Lake Ni (ug/L)	3.2	3.9	3	25
Fox Lake Mo (ug/L)	6.6	10.1	5	73

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