

# Britannia Mine Water Treatment Plant: Environmental Compliance and Risk Transfer in a Collaborative Partnership

**Presented at the MEND Manitoba Workshop**  
Winnipeg, Manitoba  
June 4, 2008



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# Whistler



# Britannia Beach



# Vancouver



## Britannia Mine Remediation Project – 1905 to 2005

- 1905 – mine begins production
- 1920s-1930s – largest producing copper mine in Commonwealth; metal recovery from mine drainage initiated
- 1970 – Pollution Control Act becomes effective at Britannia
- 1973 – mine owners ordered to obtain permit (lime treatment)
- 1974 – mine closes;
- 1981 to 1997 – studies to characterize impact, liability, and develop solutions
- 1997 – [Contaminated Sites Regulation becomes effective](#)
- 2001 – \$30M settlement with historical mine owners. Initiation of remediation project.
- September 2003 – Acquisition of land for remedial actions.
- January 2004 - RFEOI posted on BC Bid.
- March 2004 - Six EOIs received.
- May 2004 - Three RFPs issued to short-listed Proponents.
- November 2004 - Province announces that EPCOR has been selected to design, build, finance and operate WTP
- October 2005 – EPCOR starts WTP 3 months ahead of schedule



# Aerial View of Britannia Mine Site

Howe Sound

Britannia  
Beach

Britannia Creek

Water Treatment Plant

4100  
Portal  
Mill  
Building

2200  
Portal

Jane  
Creek

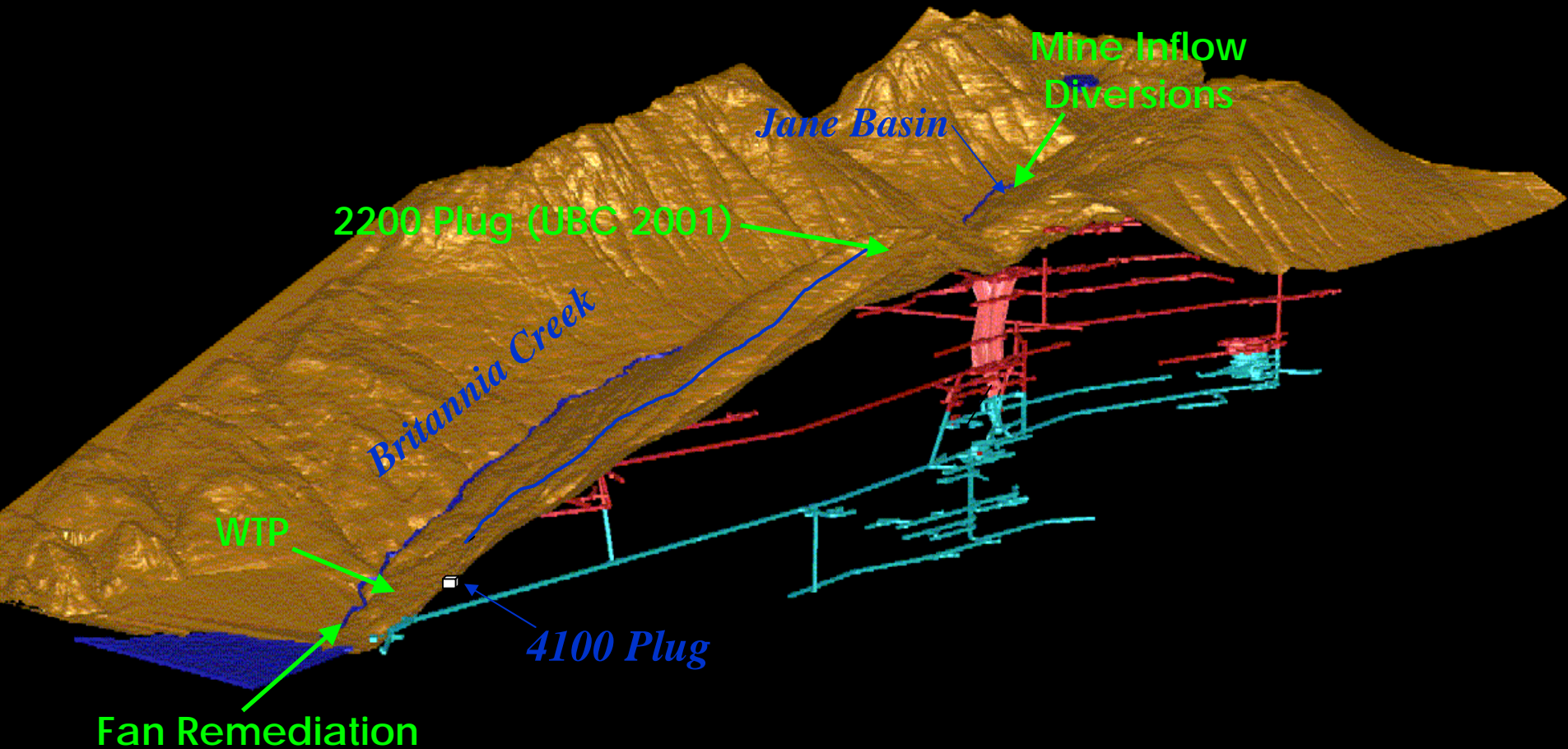
*Mineral Ridge*

Jane Basin  
Glory Hole  
& Open Pit  
Complex

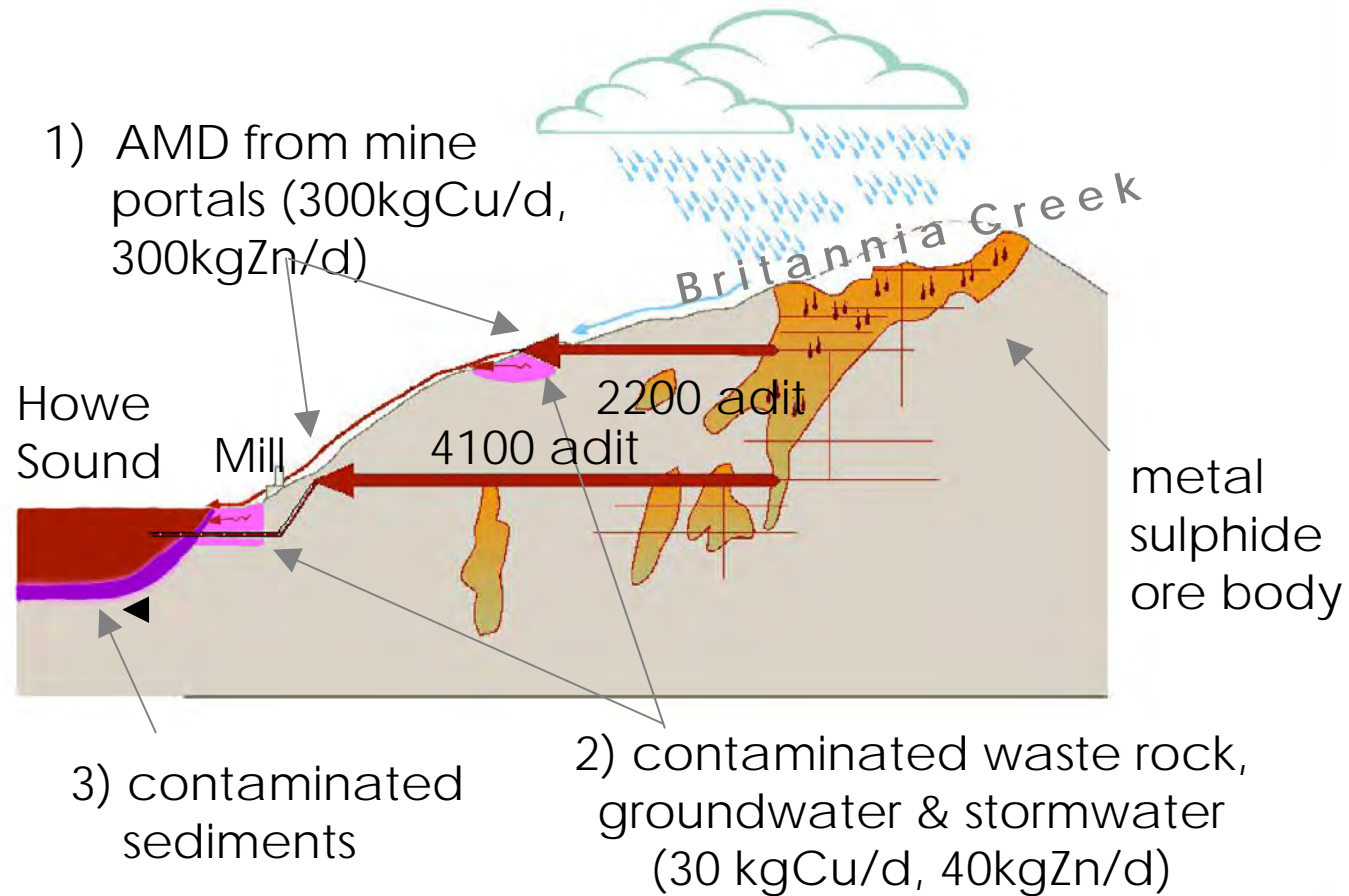
Furry Creek  
Workings



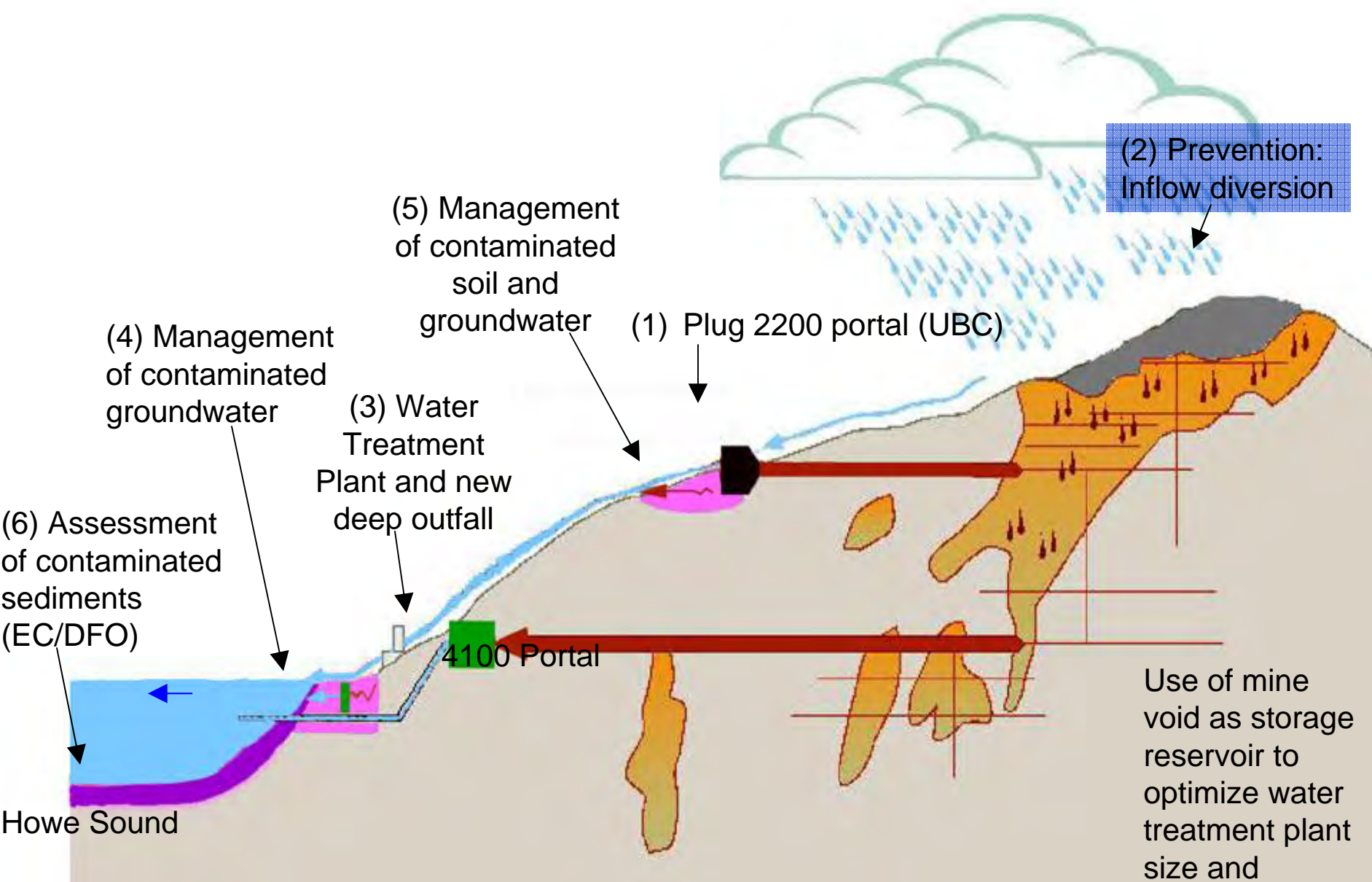
## 3D Cutaway of Mine with Remedial Actions



## Post-Mining Conditions



# Province's Conceptual Remediation Plan



# Britannia Mine Successorship

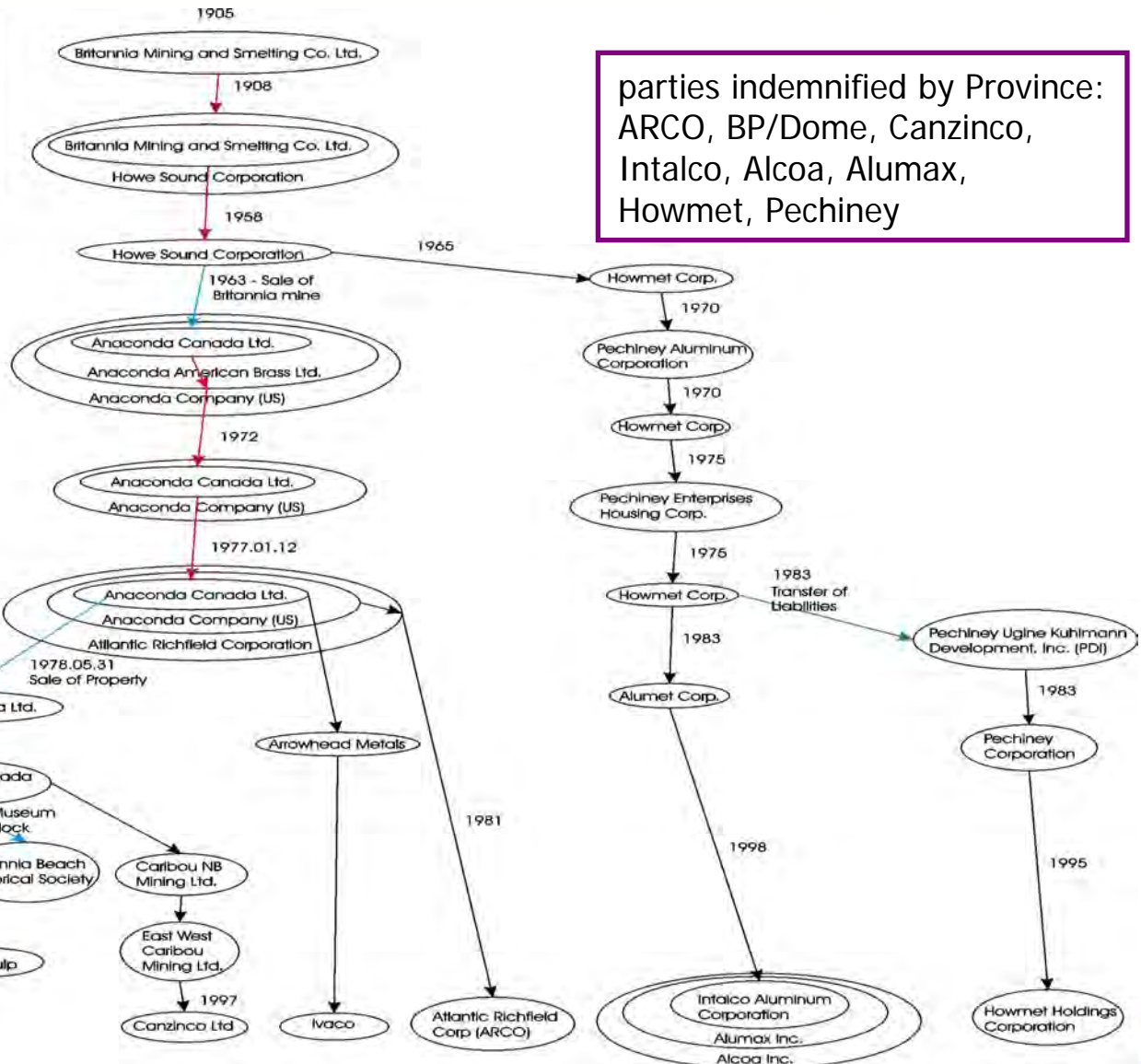
**BRITANNIA MINE OWNERSHIP OF MINE AND SUCCESSORSHIP OF OWNERSHIP**

produced October 19, 2000  
revised November 22, 2000  
by BCMELP-LMR-P2  
based on legal submissions from various companies

**INDEX**

- red - transfer of ownership of company and mine
- black - transfer of ownership of company
- blue - transfer of ownership of mine property
- green - transfer of liabilities

parties indemnified by Province:  
ARCO, BP/Dome, Canzinc, Intalco, Alcoa, Alumax, Howmet, Pechiney



Mine closes  
1974.11.01

current site owners: BBPL, BBHS, Makin, Tanac, BCR, BC Crown

Remainder of former Britannia Mine Site



## Project Background



- Mine water treatment plant integral part of Ministry of Agriculture & Lands (MAL) environmental remediation plan for entire Britannia area site
- Left untreated, contaminated mine water would deposit 600 kg/day of heavy metals into Howe Sound (7 million pennies annually)
- New plant will treat up to 500 million litres of contaminated water annually
- Project first of its kind in BC (P3 DBFO)
- MOE issued permit to MAL which formed performance requirements for RFP (quality and schedule)

## Risk Analysis and Procurement Method

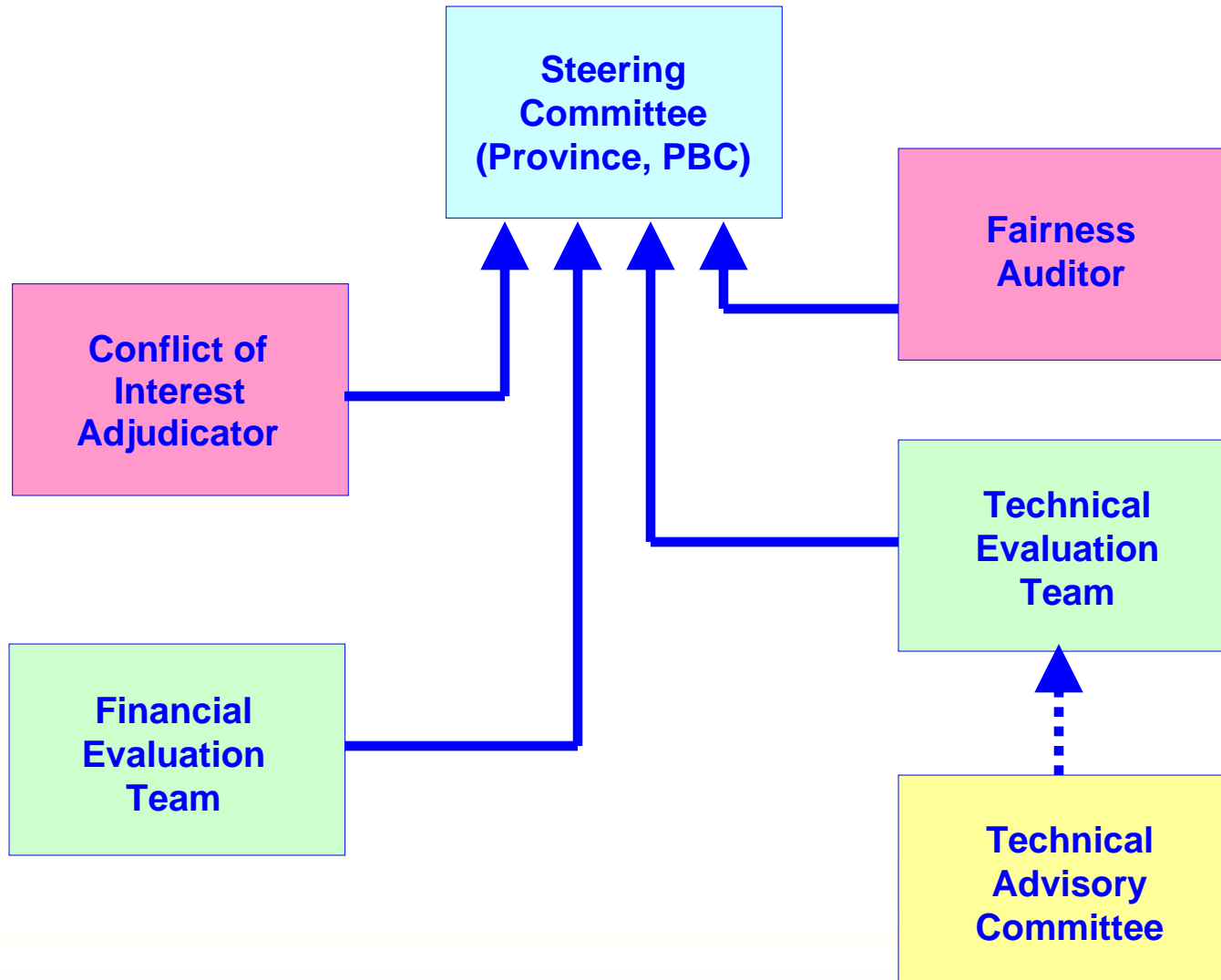
- Risk Analysis Matrix
  - Procurement Risks
  - Design Risks
  - Construction Risks
  - Financial Risks
  - Operational Risks

Will anyone bid?  
Will regulators be satisfied with design capacity?  
Construction cost inflation?  
What if operator goes bankrupt?  
What if mine water chemistry changes?

- Risk varies with procurement method
- 2003 – Government selects DBFO procurement for WTP based on value for money with strong consideration to risk transfer
- Concern regarding lack of contractor interest in necessary large investment in P3 proposal, leads to procurement undertaken in two steps (RFEOI & RFP)



# BMWTP Province Procurement Organization



# Procurement Steps



- RFEOI – **Ability of Proponent Team** to do the job: experience of team, financial capacity, and demonstrable technology
- RFP – **Cost in terms of 20 year NPV cost** based on: specified treatment capacity, influent water quality range, required discharge quality, and preferred discharge quality.

# From Key Objectives to Evaluation Criteria

## Key Objectives

Provide suitable treatment for mine water and suitable disposal of sludge

Conform to all regulatory requirements

Design, build & operate to provide best value to Province

Provide flexible process to allow future upgrading

## RFEOI Evaluation Criteria

Use of Demonstrated Technology (P/F)

Financial Capacity (P/F)

Proponent Organization

Technical Expertise

Project Understanding

## RFP Evaluation Criteria

Risk Adjusted NPV 20 Year Cost (60 pts)

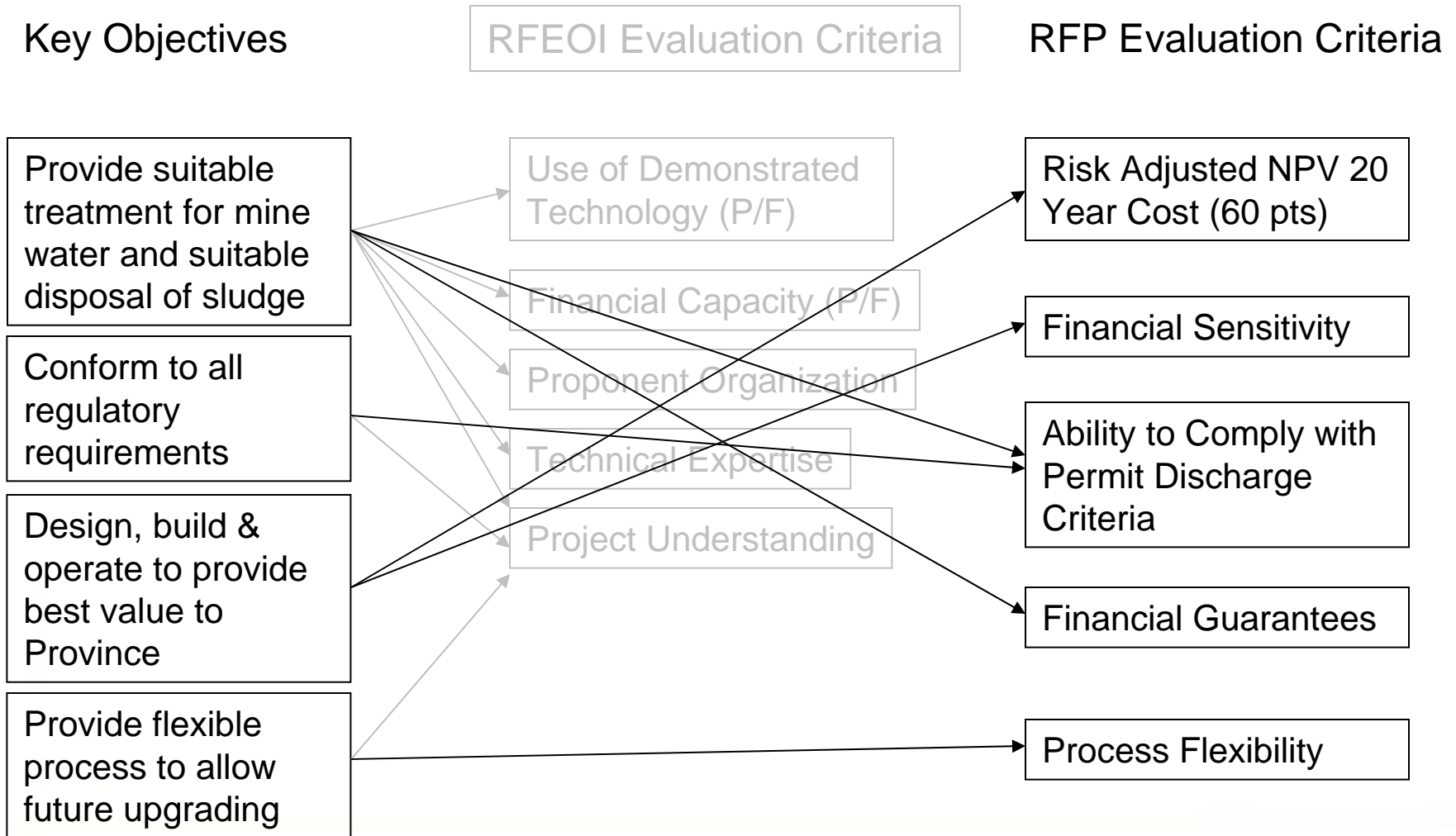
Financial Sensitivity

Ability to Comply with Permit Discharge Criteria

Financial Guarantees

Process Flexibility

## From Key Objectives to Evaluation Criteria



# Assignment of Risk



Risk Description	EPCOR	Province
Operations, maintenance and repair costs	X	
Construction costs/inflation and schedules	X	
Water treatment plant discharge compliance	X	
Water treatment plant efficiency	X	
Project financing	X	
Catastrophic events		X
Internal mine working collapse		X
Volume of water treated		X
Liability of disposed sludge		X
Operating cost inflation	X	X
Influent water chemistry within 10/90 percentile	X	
Influent water chemistry beyond 10/90 percentile		X
Plant site geotechnical risk	X	
Marine outfall geotechnical risk		X

# The Monthly Periodic Payment Equation

(Base Payment + Variable Payment)

**Province Risk**

volume of  
water  
treated



consumer  
price index

labour  
inflation  
index

chemical  
unit costs

utility unit  
costs

sludge  
disposal  
unit costs

Capital Repayment + Replacement + Labour + Chemicals + Utilities + Sludge Disposal

R/R  
overruns

operating  
labour  
overruns

chemical  
use  
efficiency

energy  
use/generation  
efficiency

sludge  
generation  
efficiency

**EPCOR Risk**

WTP  
startup  
date

construction  
cost  
overruns



## Operational Performance Requirements Non-Compliance Penalties and Quality Bonuses

**Operational Performance Requirements** are:

- stated in the Contract
- specify indicators
- specify Contractor rectification
- specify consequences (9 major, 5 minor, and 1 bonus)
- include compliance with discharge quality criteria, maximizing treatment of water, monitoring, and reporting

**Major Event Consequence** – is a deduction in Monthly Payment of 1/30<sup>th</sup> of Monthly Payment for each day that a Major Event occurred.

**Minor Event Consequence** – is a deduction in Monthly Payment of 1/3000<sup>th</sup> of Monthly Payment for each day that a Minor Event occurred.

**Quality Event Bonus** – is a bonus awarded at end of each year if the annual average preferred discharge levels are achieved. Bonus equals 1/250<sup>th</sup> of average monthly payment for the year.

## The Primary Operational Performance Requirement – OPR2

Parameter	Discharge Criteria/Permit	Provincial Guidelines
dissolved copper	$\leq 0.1$ mg/L	$\leq 0.02$ mg/L
dissolved iron	$\leq 0.1$ mg/L	$\leq 0.01$ mg/L
dissolved zinc	$\leq 0.2$ mg/L	$\leq 0.03$ mg/L
dissolved aluminum	$\leq 1$ mg/L	$\leq 0.5$ mg/L
dissolved manganese	$\leq 0.4$ mg/L	$\leq 0.2$ mg/L
dissolved cadmium	$\leq 0.01$ mg/L	$\leq 0.001$ mg/L
total suspended solids (TSS)	$\leq 30$ mg/L	$\leq 10$ mg/L
pH range	6.5 to 9.5	6.5 to 9.5
96HRLC50 fish bioassay	$\geq 100\%$ survival (non-acutely toxic)	$\geq 100\%$

## Objectives of the Britannia Mine WTP



- Provide suitable treatment for mine water, and environmentally-acceptable disposal of sludge or treatment of by-products
- Conform to all applicable requirements of authorities having jurisdiction with respect to design, construction, operations, maintenance and oversight
- Minimize Provincial liability (risk transfer)
- Design, built, financed and operated in a manner that provides the best overall value to the Province
- Sufficiently flexible to be able to allow upgrading in response to changes in environmental regulation.

## Project Sensitivities

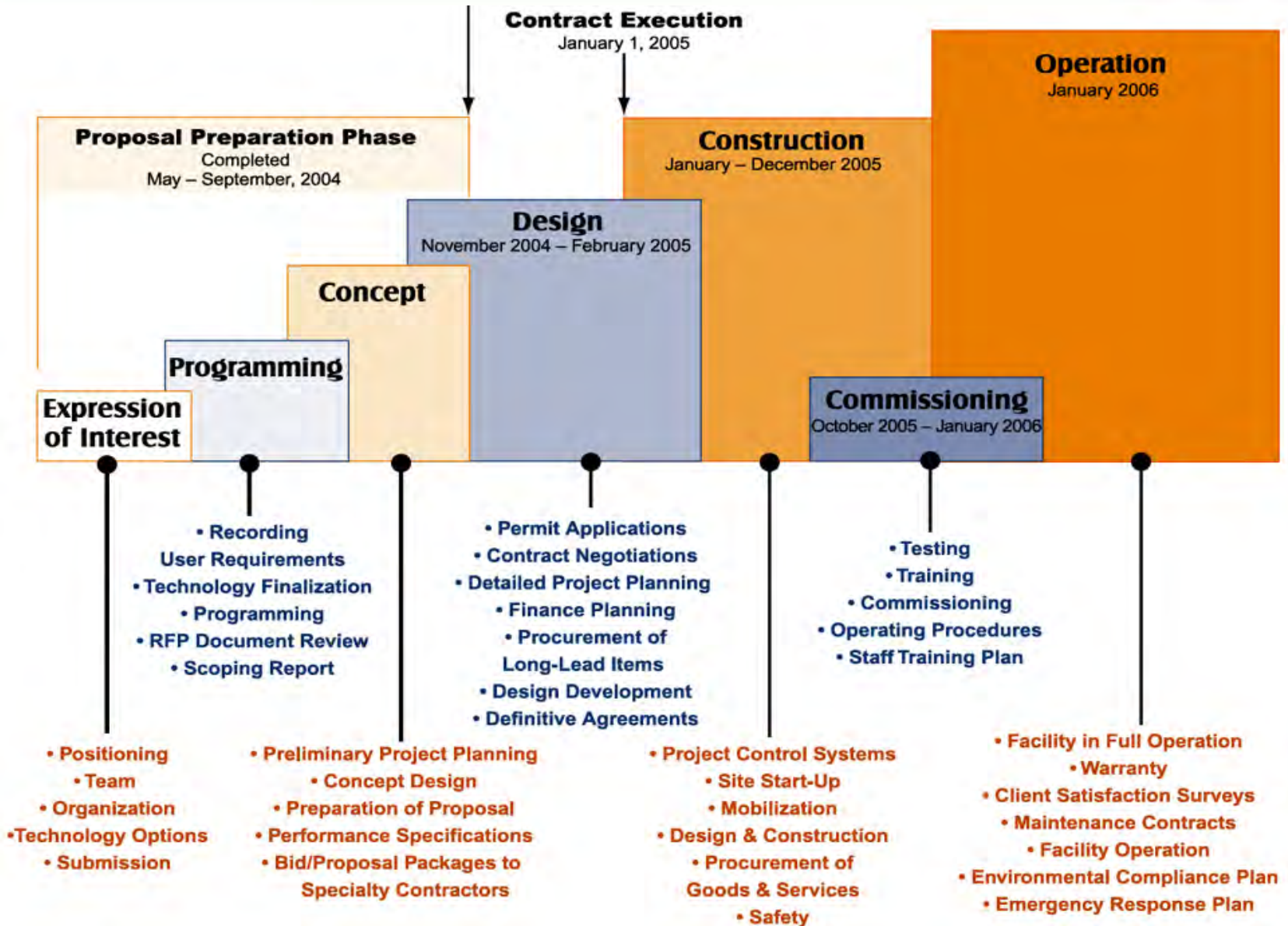
- High profile project
- Treatment plant integral part of the overall mine rehabilitation
- Large and diverse group of stakeholders with different visions and value sets
- Alternate Project delivery method could be sensitive
- Project constructed in and around a residential neighborhood



## Terms of Agreement



- EPCOR to build plant within 1 year and operate for 20 years
- EPCOR will finance, design, construct, operate and maintain treatment plant
- MAL to provide performance-based payments to EPCOR
- Performance payments begin once plant in operation
- Must meet 12 Operational Performance Requirements (OPR's)
- EPCOR to assume risk for plant construction & operation



## Performance – Schedule

- **Award Contract – Dec 2004**
- Design Dec 2004 – Mar 2005
- Site Grading – Feb 2005
- Foundation – Mar 2005
- Outfall – May/June 2005
- **Groundwater Pumpstation Complete – May 31, 2005**
- Building Erection – Jun 2005
- Controls/Lime System Installation – Aug 2005
- Clarifier Mechanism Installation – Sep 2005
- **Start up – October 21, 2005**



## Performance – Value for Money



	Capital Cost	Operating Cost	Total
<b>EPCOR</b>	\$15.5 million	\$11.6 million	<b>\$27.2 million</b>
<b>Traditional Delivery</b>	\$18.2 million	\$21.5 million	<b>\$39.7 million</b>

Partnerships BC – Britannia Mine Water Treatment Plant Value for Money Report

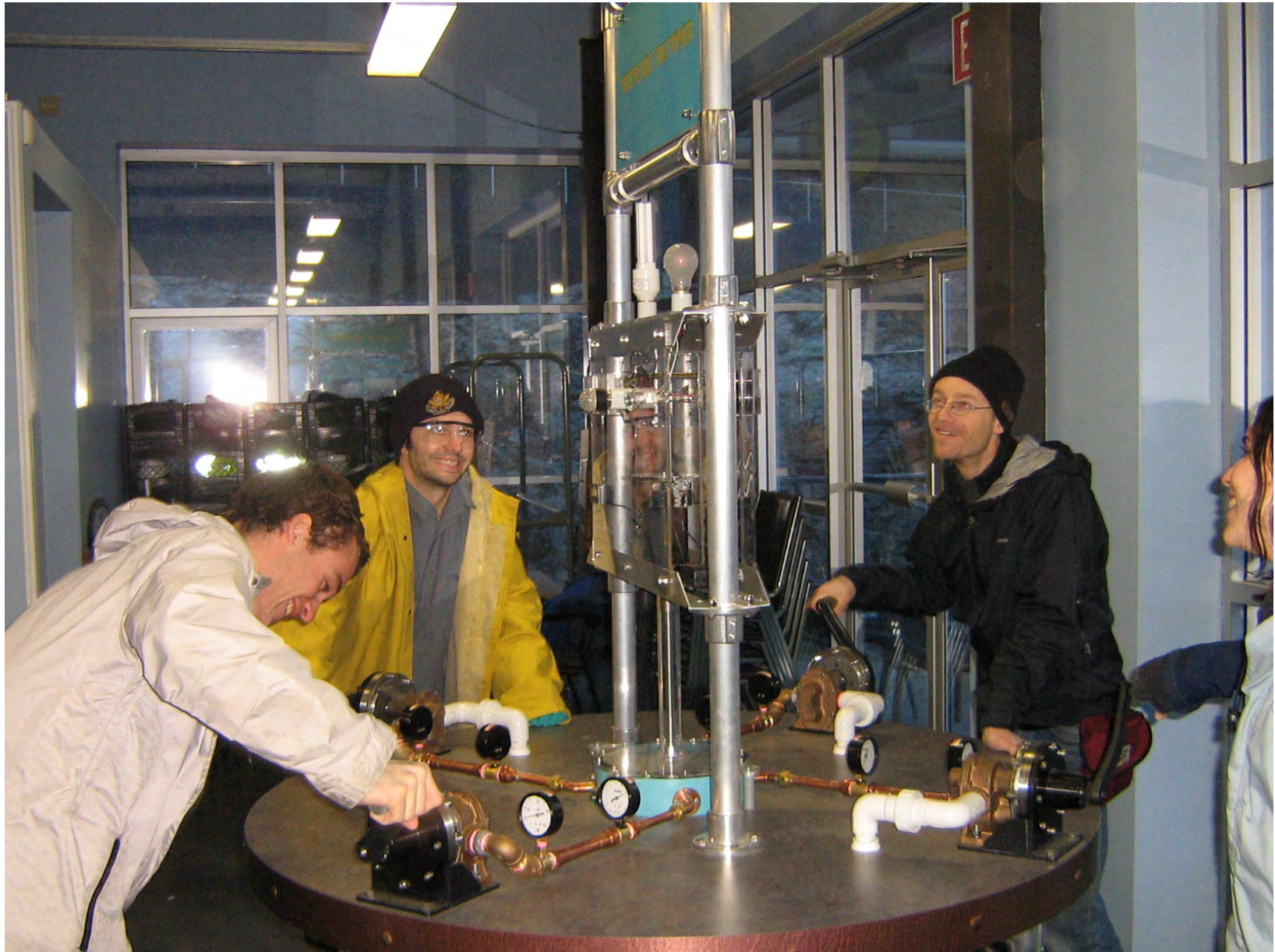


## Performance – Environmental



- Algae growing in sensitive inter-tidal zone
- Micro-turbine producing 40% of plant power needs
- Water re-use for process systems (<1 m<sup>3</sup> per day of fresh water for domestic use)
- Completed pilot project for metal recovery and sludge re-use
- Discovery Centre Completed (environmental education)







## Performance – Water Quality



Parameter	Permit	Guideline	Value	Comment
Copper	≤ 0.1	≤ 0.02	0.007	Meets Permit and Guideline
Iron	≤ 0.1	≤ 0.01	≤0.005	Meets Permit and Guideline
Zinc	≤ 0.2	≤ 0.03	0.023	Meets Permit and Guideline
Aluminum	≤ 1.0	≤ 0.5	0.44	Meets Permit and Guideline
Manganese	≤ 0.4	≤ 0.2	0.14	Meets Permit and Guideline
Cadmium	≤ 0.01	≤ 0.001	≤ 0.002	Meets Permit and Guideline
pH	6.5-9.5	≤ 6.5-9.5	8.0	Meets Permit and Guideline
TSS	≤ 30	≤ 10	6	Meets Permit and Guideline
96hrLC50	≥100%	≥ 100%	≥ 100%	Meets Permit and Guideline

# Performance – Successful Risk Transfer



- OPR's and Payment Mechanism
  - Non-compliance events (mostly manganese, several TSS) have totalled seventeen resulting in a deduction total of \$132,606. There has been no non-compliance events since December 2006.
- Schedule and Construction Risk
  - Construction inflation during period 1-2% per month
- Environmental Compliance
- Sludge Storage Facility and Management
  - Added sludge storage cover
- Site Security
  - Additional security measures added

## Performance – Why It Worked



- Well Defined Scope of Work
- Linked Payment Mechanism and Key Performance Indicators
- Solid, Experienced Teams
- Shared Values – Everyone “Owned” and was Committed to the Project

## Next Steps



- Ongoing testing and optimization of the plant to maximize throughput and metal reduction
- Review pilot results and determine approach (Objective – nothing leaves the site save treated water and useable products)
- Assess new smaller turbine to increase number of days power can be generated
- Stormwater system installation
- Groundwater system optimization (with Golder)