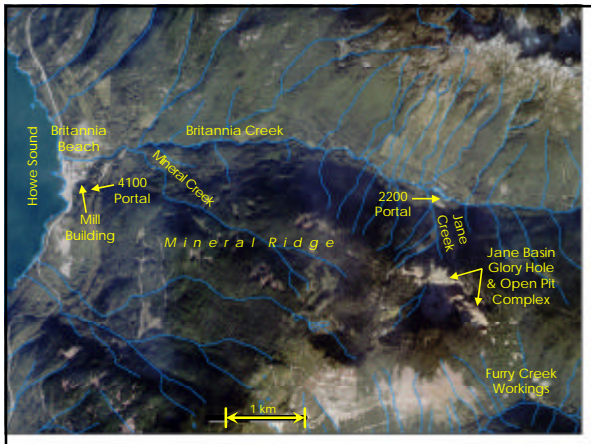
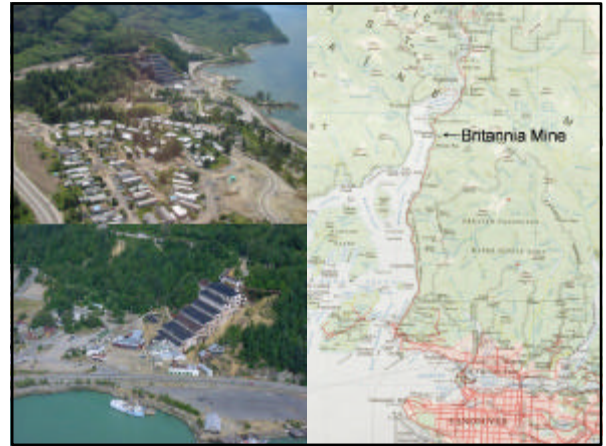
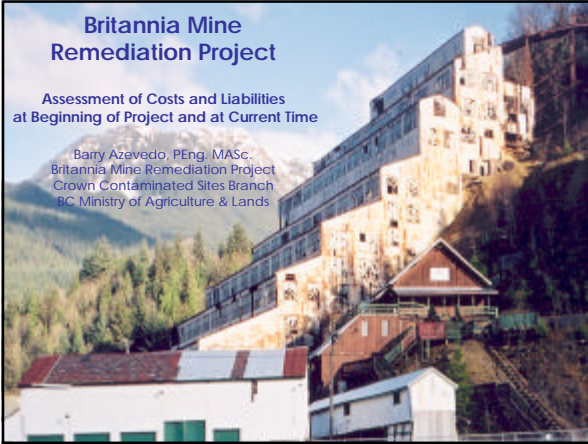


Britannia Mine Remediation Project

Assessment of Costs and Liabilities at Beginning of Project and at Current Time

Barry Azevedo, P.Eng, MASc,
 Britannia Mine Remediation Project
 Crown Contaminated Sites Branch
 BC Ministry of Agriculture & Lands

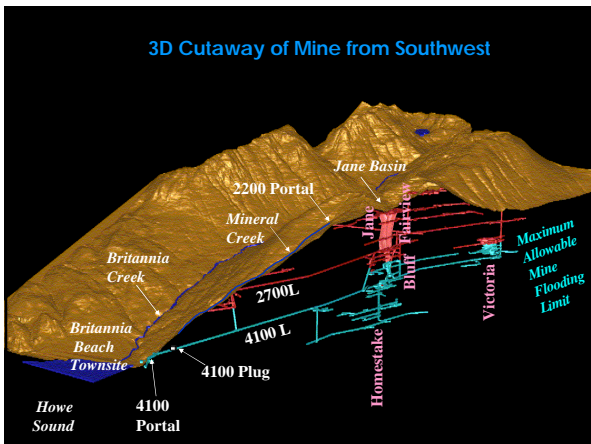


Brief History

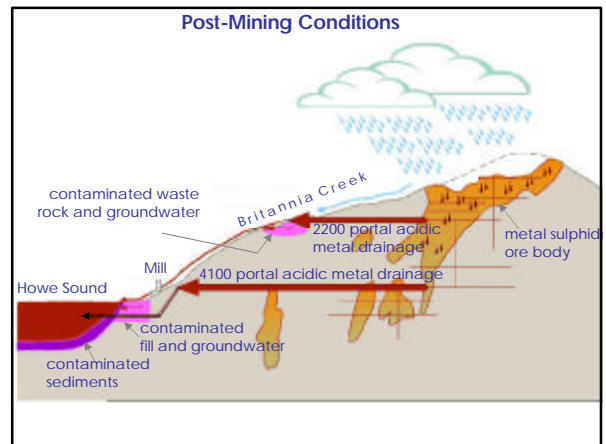
- 1905 – mine begins production
- 1920s – largest producing copper mine in Commonwealth; metal recovery from mine drainage
- 1970 – Pollution Control Act becomes effective
- 1973 – mine owners ordered to obtain permit (lime treatment)
- 1974 – mine closes; mine owner ordered to maintain metal recovery system
- 1979 – mine sold to real estate developer
- 1981 – works not being maintained; initiation of period of studies and monitoring to characterise impact and define liability (EC, DFO, BCMEM, BCMOE)
- 1997 – EC and BCMOE jointly fund pilot plant testing and conceptual design of HDS lime treatment of mine water
- 1997 – Contaminated Sites Regulation becomes effective
- 2001 – \$30M settlement with historical mine operators; initiation of remediation
- 2003 – Agreement with current land owner
- 2005 – Award of WTP contract



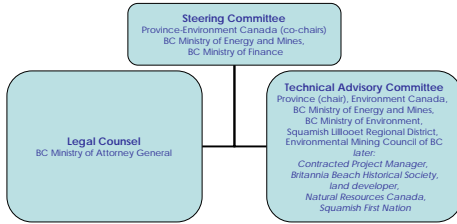
3D Cutaway of Mine from Southwest



Post-Mining Conditions



Project Management Structure (~1999)



Provincial Goals

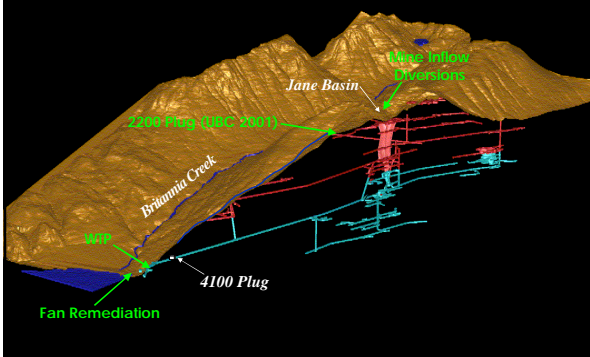
- Environmental goal
 - to reduce pollution from Mine into Howe Sound
- Financial goal
 - Minimize cost to taxpayers by maximizing opportunity for cost recovery through:
 - legal means
 - landowner contributions / development revenues
 - infrastructure grant
- Development goal
 - Optimize development capability of land (subject to costs)
- Operational goal
 - Long term operation of remedial works by party other than Province



mine safety?



3D Cutaway of Mine with Remedial Actions



Estimated Costs

	2001	
WTP Capital	\$ 11,569,964	
Fan Remediation	\$ 10,600,000	
JB Road Upgrade	\$ 1,375,000	Nominal Total Cost over 20 years = \$99.3M
Marine Remediation	\$ 15,000,000	
AA Remediation	\$ -	
Mine Inflow Diversions	\$ -	
Mine Safety	\$ -	
Project Management	\$ -	
Administration	\$ -	NPV Total Cost over 20 years = \$75.9M
Legal	\$ -	
Annual O&M - WTP	\$ 1,770,000	
Annual O&M - Fan	\$ 680,000	

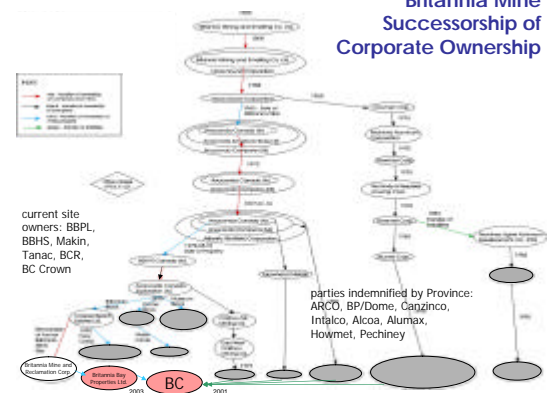


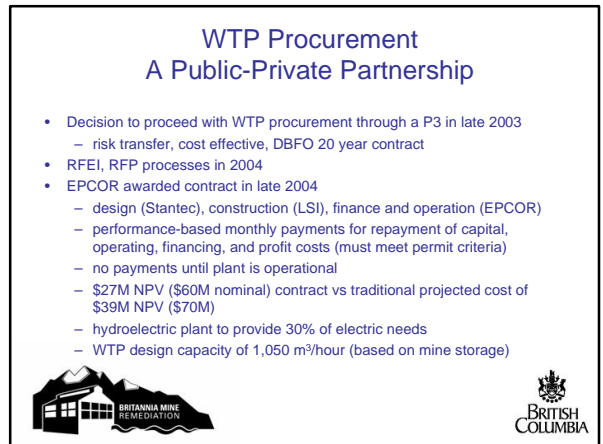
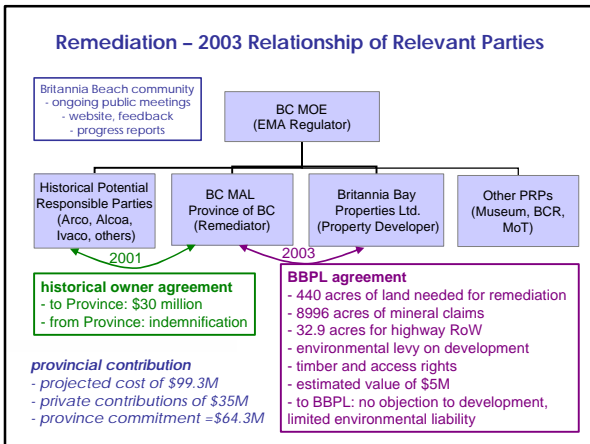
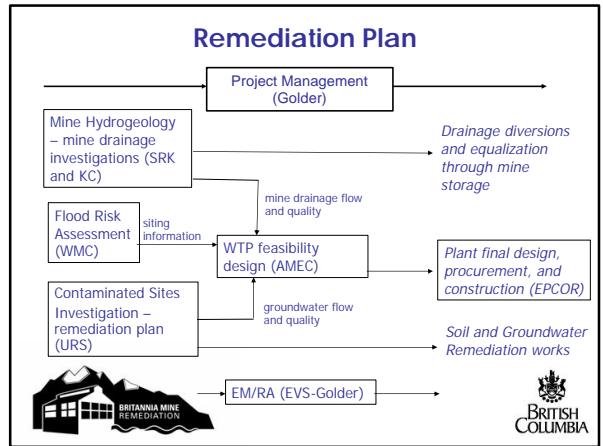
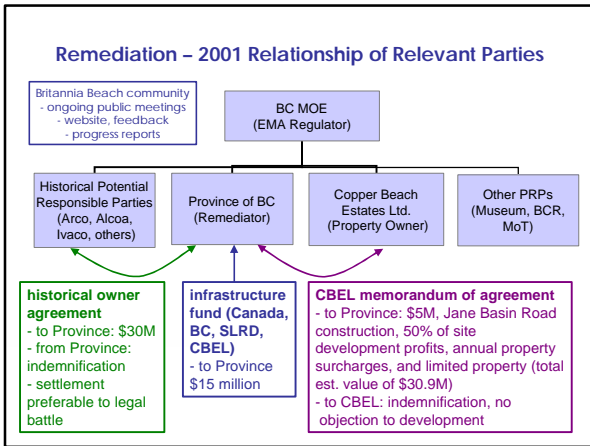
BC Environmental Protection Act (formerly Waste Management Act) and the Contaminated Sites Regulation (1997)

- Persons responsible for remediation of a contaminated site include: a current owner/operator, and a previous owner/operator.
- A responsible person is absolutely, retroactively, and joint & severally liable
- 1998 assessment of corporate history identified several existing companies that were successors to the historical mine owners and operators



Britannia Mine Successorship of Corporate Ownership



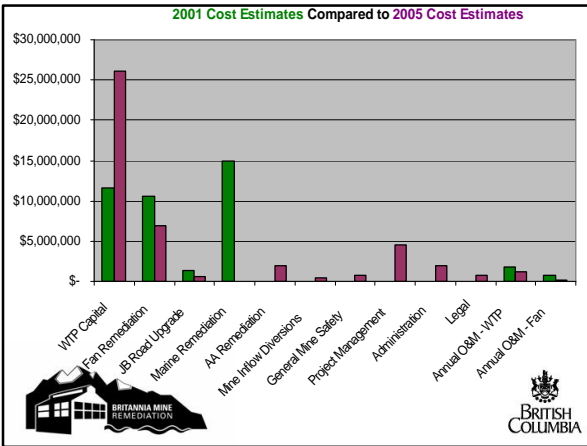


Comparison of Estimated Costs

	2001	2005
WTP Capital	\$ 11,569,964	\$ 26,031,000
Fan Remediation	\$ 10,600,000	\$ 6,966,366
JB Road Upgrade	\$ 1,375,000	\$ 541,909
Marine Remediation	\$ 15,000,000	\$ -
AA Remediation	\$ -	\$ 2,000,000
Mine Inflow Diversions	\$ -	\$ 423,620
Mine Safety	\$ -	\$ 800,000
Project Management	\$ -	\$ 4,506,514
Administration	\$ -	\$ 1,885,161
Legal	\$ -	\$ 701,105
Annual O&M - WTP	\$ 1,770,000	\$ 1,212,000
Annual O&M - Fan	\$ 680,000	\$ 200,000

BRITANNIA MINE REMEDIATION

BRITISH COLUMBIA



Unconsidered Costs in 2001 Budget

- WTP Capital: feasibility assessment, flood assessment, site demolition, residential development, access road, sludge filter plant, wtp site remediation, outfall location, building architecture, water supply, profit
- Fan Remediation: contaminated soil excavation and disposal
- AA Remediation: investigation and remediation
- Mine Inflow Diversions: East Bluff diversion
- Mine Safety: open raises, 4100 wye, ore bin, mine manager
- Project Management: project management, owner's engineer, construction management
- Administration: staff salaries and expenses
- Legal

Dismissed Costs in 2005 Budget

- WTP Capital: Jane Basin sludge disposal cell study and construction,
- Marine Remediation (\$15 million!!!)

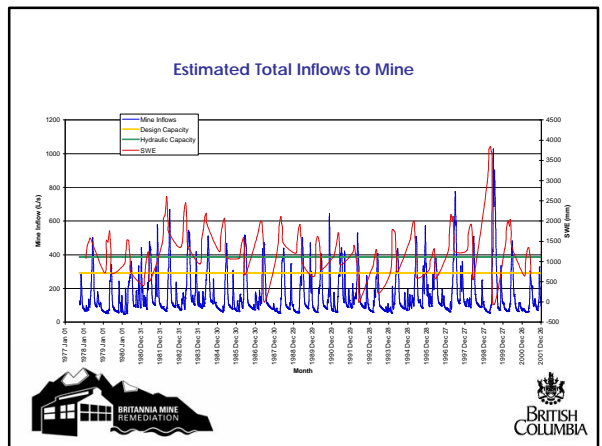
Outstanding Liabilities

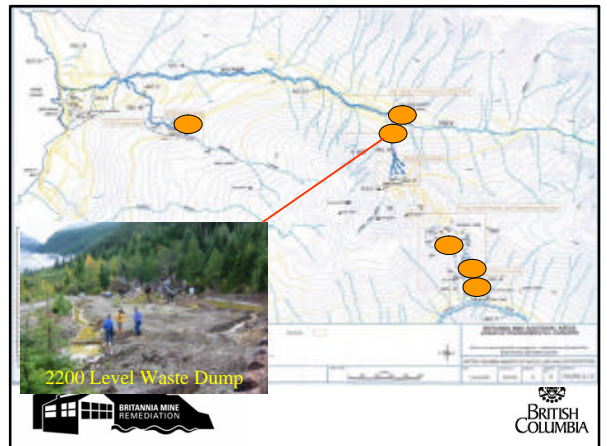
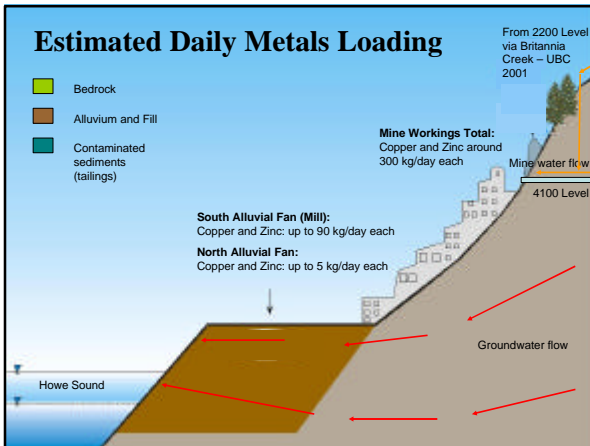
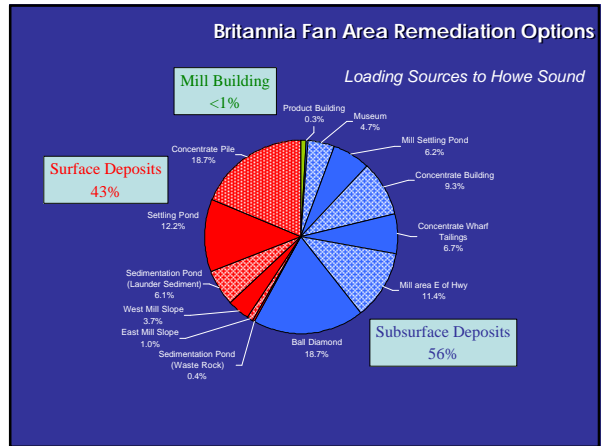
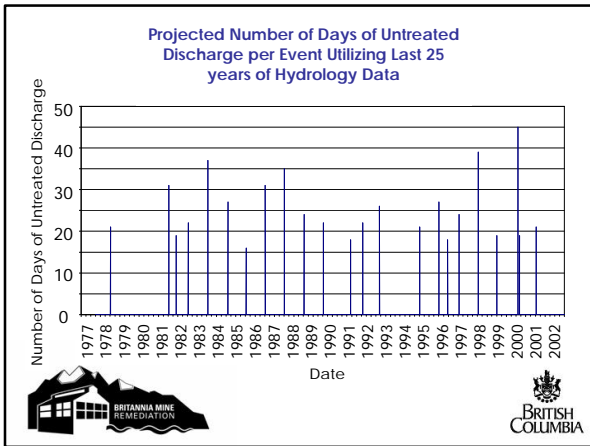
- Five large abandoned water reservoir dams on Britannia Creek
- Jane Basin Rock Block (20,000,000 m³)
- Loss of hydraulic continuity between mine ore body and 4100 portal (mine drainage exits at another location into Britannia Creek or Furry Creek)
- Excessive WTP bypasses despite mine storage (weather dependent)
- 3250 overflow into Mineral Creek despite mine storage (weather and mine working collapses)
- Open portals, raises, derelict structures, fall hazards
- Marine sediment contamination
- Upland waste rock dumps at mine portals – undefined remediation (RA)
- Outfall location instability
- Adjacent residential growth

Summary

- indemnification to historical mine operators has resulted in provincial taxpayer covering additional substantial remediation costs of \$64.3M (nominal)
- the project is on budget as set in 2001 (\$99.3M, nominal)
- the project is on budget due to some early conservative assumptions, and cost effective WTP procurement
- there are substantial outstanding liabilities which may impact budget
- the WTP is ahead of schedule, with no over-budget risk on contract items

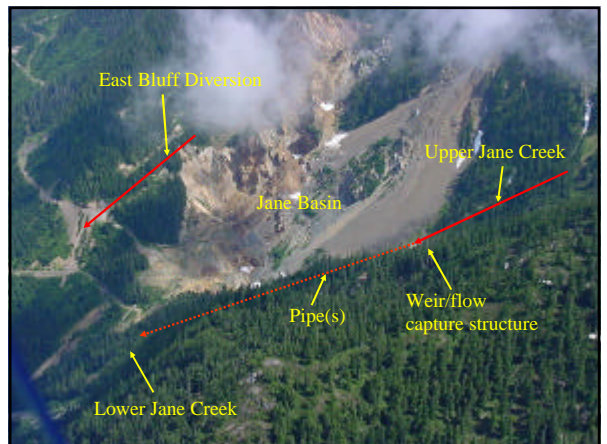
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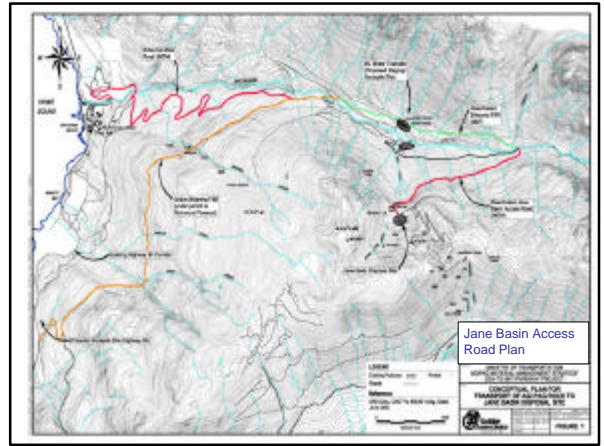


Permit Level Development Table

parameter	1999 permit		ambient	Mining	MMER	WTP	WTP	permit (diss)	permit (total)
	(diss)	(total)	criteria	PCO	(total)	design	design		
			(total)	(diss)	(total)	(diss)	(total)		
Cu (mg/L)	0.05	0.2	0.002-0.01	0.05-0.3	0.6	0.02	0.4	0.1	
Fe (mg/L)	0.01	0.5	0.05-0.3	0.3-1.0		0.01	0.3	0.1	
Zn (mg/L)	0.15	0.3	0.019-0.095	0.2-1.0	1	0.03	0.5	0.20	
Al (mg/L)	0.2	0.5	0.1	0.5-1.0		0.5	1	1	
Mn (mg/L)	0.2	1	0.1	0.1-1.0		0.2	0.4	0.4	
Cd (mg/L)	0.01	0.05	0.0001	0.01-0.10		0.001	0.002	0.01	
TSS (mg/L)		25		25-75	30		10		30
lower pH		6.5		6.5					
upper pH		9.5		8.5-10					
96HRLC50		100%		100%			100%		100%



Summary of Fan Area Remedial Work



WTP Location & Access Road

