Britannia Mine Remediation Project
Assessment of Costs and Liabilities at Beginning of Project and at Current Time

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Britannia Mine Remediation Project
Crown Contaminated Sites Branch
BC Ministry of Agriculture & Lands

Howe Sound
Britannia Creek
Mill
Building
Britannia Beach
Townsite

• 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

Brief History

• 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

Post-Mining Conditions

3D Cutaway of Mine from Southwest
Project Management Structure (~1999)

Steering Committee
- Province-Environment Canada (co-chairs)
- BC Ministry of Energy and Mines
- BC Ministry of Finance
- BC Ministry of Attorney General

Legal Counsel
- BC Ministry of Attorney General

Technical Advisory Committee
- Contracted Project Manager, Britannia Beach Historical Society, land developer, Natural Resources Canada, Squamish First Nation

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

Estimated Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTP Capital</td>
<td>$11,569,964</td>
</tr>
<tr>
<td>Fan Remediation</td>
<td>$10,600,000</td>
</tr>
<tr>
<td>JB Road Upgrade</td>
<td>$1,375,000</td>
</tr>
<tr>
<td>Marine Remediation</td>
<td>$15,000,000</td>
</tr>
<tr>
<td>AA Remediation</td>
<td>$-</td>
</tr>
<tr>
<td>Mine Inflow Diversions</td>
<td>$-</td>
</tr>
<tr>
<td>Mine Safety</td>
<td>$-</td>
</tr>
<tr>
<td>Project Management</td>
<td>$-</td>
</tr>
<tr>
<td>Administration</td>
<td>$-</td>
</tr>
<tr>
<td>Legal</td>
<td>$-</td>
</tr>
<tr>
<td>Annual O&amp;M - WTP</td>
<td>$1,770,000</td>
</tr>
<tr>
<td>Annual O&amp;M - Fan</td>
<td>$680,000</td>
</tr>
</tbody>
</table>

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

Britannia Bay Properties Ltd.

20012003

Britannia Mine

Successorship of
Corporate Ownership

Remediation - 2001 Relationship of Relevant Parties

Historical Potential Responsible Parties: Arco, Alcoa, Ivaco, others

- Province of BC (Remediator)
- Britannia Beach Estates Ltd. (Property Owner)
- White Space (MBE Regulator)
- Other PRPs: Museum, BCR, MoT

Infrastructure fund (Canada, BC, SLRD, CBEL) - to Province $15 million

CBEL memorandum of agreement - to Province: $30M, Jane Basin Road construction, 50% of site development profits, annual property surcharges, and limited property (total est. value of $30.9M)
- to CBEL: indemnification, no objection to development

Historical owner agreement - to Province: $30M from Province: indemnification
-settlement preferable to legal battle

Remediation - 2003 Relationship of Relevant Parties

Historical Potential Responsible Parties: Arco, Alcoa, Ivaco, others

- BBPL agreement
- 440 acres of land needed for remediation
- 8996 acres of mineral claims
- 32.9 acres for highway RoW
- environmental levy on development
- timber and access rights
- estimated value of $5M
- to BBPL: no objection to development, limited environmental liability

BBPL agreement
- project cost of $99.3M from Province: indemnification
- private contributions of $33M
- province commitment = $64.3M

Other PRPs (Museum, BCR, MoT)

BC ME (EMA Regulator)

2001

2003

Remediation Plan

- Project Management (Golder)
- Plant final design, procurement, and construction (EPCOR)
- Drainage diversions and equalization through mine storage
- Soil and groundwater remediation works
- WTP feasibility design (AMEC)
- Contaminated Sites Investigation - remediation plan (URS)
- Flood Risk Assessment (WMC)
- WTP Procurement - A Public-Private Partnership

WTP Procurement - A Public-Private Partnership

- Decision to proceed with WTP procurement through a P3 in late 2003
- RFP, RFP processes in 2004
- EPCOR awarded contract in late 2004
- design (Stantec), construction (LSI), finance and operation (EPCOR)
- performance-based monthly payments for repayment of capital, operating, financing, and profit costs (must meet permit criteria)
- no payments until plant is operational
- $27M NPV ($80M nominal) contract vs traditional projected cost of $79M NPV ($70M)
- hydroelectric plant to provide 30% of electric needs
- WTP design capacity of 1,050 m^3/hour (based on mine storage)

Comparison of Estimated Costs

<table>
<thead>
<tr>
<th>2001</th>
<th>2005</th>
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WTP Under Construction - Commissioning October 21, 2005
Full operation in early November
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
### Permit Level Development Table

<table>
<thead>
<tr>
<th>parameter</th>
<th>1999 permit</th>
<th>ambient</th>
<th>mining</th>
<th>WTP</th>
<th>WTP</th>
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<tr>
<td></td>
<td>(total)</td>
<td>(total)</td>
<td>design</td>
<td>design</td>
<td>strategy</td>
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<tr>
<td>Cu (mg/L)</td>
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<td>0.000-0.01</td>
<td>0.000-0.5</td>
<td>0.0</td>
<td>0.01</td>
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<tr>
<td>Fe (mg/L)</td>
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<td>0.1</td>
<td>0.000-0.3</td>
<td>0.3-1.0</td>
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<tr>
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<td>0.000-0.0035</td>
<td>0.2-1.0</td>
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<tr>
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<td>0.1</td>
<td>0.000-0.1</td>
<td>0.1-1.0</td>
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<tr>
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<tr>
<td>pH</td>
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<td>6.5-7.5</td>
<td>6.5-7.5</td>
<td>6.5-7.5</td>
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<td>25</td>
<td>25</td>
<td>25</td>
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<tr>
<td>upper pH</td>
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<td>6.5-7.5</td>
<td>6.5-7.5</td>
<td>6.5-7.5</td>
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<tr>
<td>lower pH</td>
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<td>6.5-7.5</td>
<td>6.5-7.5</td>
<td>6.5-7.5</td>
<td>6.5-7.5</td>
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<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

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### Estimated Daily Metals Loading
- **Bedrock**: 56%
- **Allochthonous sediments**: 43%
- **Subsurface deposits**: 56%
- **Surface deposits**: 43%

**Mine workings total**: Copper and Zinc around 200 kg/day each.

**South alluvial fan (WBF)**:
- Copper and Zinc: up to 90 kg/day each.

**North alluvial fan**:
- Copper and Zinc: up to 5 kg/day each.

**Estimated daily metals loading**
- **Mine workings total**: Copper and Zinc around 200 kg/day each.

**Groundwater flow**
- From 2200 Level via Britannia Creek – UBC 2001

**Mine water flow**
- From 2200 Level via Britannia Creek – UBC 2001

**From 2200 Level Waste Dump**: Copper and Zinc up to 5 kg/day each.

**Howe Sound**
- Estimated metals loading:
  - **Concentrate Pile**: 18.7%
  - **Sedimentation Pond (Waste Rock)**: 0.4%
  - **West Mill Slope**: 3.7%
  - **Sedimentation Pond (Launder Sediment)**: 6.1%
  - **Settling Pond**: 12.2%
  - **Concentrate Wharf**: 6.7%
  - **Concentrate Building**: 9.3%
  - **Subsurface Deposits**: 56%

**Mining area E of Hwy 11**:
- 11.4%

**Product Building**: 0.3%

**Concentrate Wharf (Tailings)**: 6.7%

**Concentrate Pile**: 18.7%

**Museum**: 4.7%

**Mill Settling Pond**: 6.2%

**Mill area E of Hwy 11**:
- 11.4%

**Product Building**: 0.3%

**Concentrate Wharf (Tailings)**: 6.7%

**Concentrate Building**: 9.3%

**Subsurface Deposits**: 56%

**Permit Level Development Table**

- **Convert all units to mg/L**

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### Britannia Fan Area Remediation Options

- **Mill Building**: 43%
- **Surface Deposits**: 43%
- **Subsurface Deposits**: 56%

**Loading sources to Howe Sound**

- **2200 Level Waste Dump**

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**Upper Jane Creek**

**East Bluff Diversion**

**Lower Jane Creek**

**Pipe(s)**

**Weir/flow capture structure**
Summary of Fan Area Remedial Work

- Settling Pond and Northeast Fan Piles
- Sedimentation Pond
- Concentrator Pile
- East Mill Slope
- Contaminated Stormwater Collection System
- Groundwater Pumping System
- Existing Deep Outfall

WTP Location & Access Road

- Jane Basin Access Road
- Upper Bridge
- Lower Bridge
- Highway 99 Access
- New Road Section

Jane Basin Access Road Plan

WTP Location & Access Road Map

INSERT JB ROAD MAP