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YOS → BRENDA  
(Property)

April 24, 1992

File: 200-20/BPSU

## AGENDA

### BRENDA MINE PUBLIC SURVEILLANCE COMMITTEE

Time: May 6, 1992 - 7:00 p.m.

Place: Peachland Municipal Hall

#### A. Introduction - Ed Beswick - Ministry of Mines

1. Previous Minutes
2. Contaminated Soil - Motorways Site Kelowna

#### B. Thompson Okanagan Manufacturers Authority - Randy Black

1. Project Report
2. Crown Lands Application

#### C. Brenda Mines - Ron Brown

1. Project update
2. Water Management Plan
  - a) SRK/Rescan
    - Options
    - Environmental Impact Evaluation
    - Water quality impacts
    - 1992 program

#### D. Next Meeting ?

J. E. Beswick, P.Eng.  
Chairman, Brenda Public Surveillance Committee

JEB/lm

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**BRENDA MINE CLOSURE — PUBLIC SURVEILLANCE COMMITTEE**

In June 1990, after over 20 years of operation and production of approximately 278,000 tonnes copper, 66,000 tonnes molybdenum, 125 tonnes silver and two tonnes of gold, the Brenda Mine located near Peachland on Okanagan Lake ceased operation.

Prior to the closure, the Chief Inspector of Mines formed a Public Surveillance Committee composed of provincial and local governments, Brenda personnel, as well as interested individuals and groups. The committee, chaired by the Ministry of Energy, Mines and Petroleum Resources, is monitoring and providing input to the progress of decommissioning and reclamation at the mine. The Ministry, through this committee, is ensuring that the public is well-informed of the Brenda mine closure.

Public meetings are held at the Municipal Hall in Peachland, where representatives of the committee and the public are given the opportunity to discuss issues surrounding the closure. The important issue of alkaline mine drainage is of utmost concern to the committee and Brenda continues to research and to conduct field scale trials in hopes of reducing as much as possible the molybdenum concentrations in runoff waters.

Further information may be obtained by contacting Ed Beswick, Engineering and Inspection Branch, 200-2985 Airport Drive, Kamloops, British Columbia, V2B 7W8, phone: (604) 828-4566.

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**BRENDA MINES LTD.**

**1991**

**ANNUAL RECLAMATION REPORT**

Prepared for:

**Brenda Mines Ltd.**  
2281 Hunter Road  
Kelowna, British Columbia  
V8W 1H9

Prepared by:

**C.E. Jones & Associates Ltd.**  
Suite 204, 26 Bastion Square  
Victoria, British Columbia  
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March 1992



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**1.0 INTRODUCTION**

Brenda Mines Ltd., an open pit copper and molybdenum mine located 23 km northwest of Peachland, British Columbia, ceased mining operations in June 1990. The mine operated for 20 years and produced approximately 200,000,000 t of ore.

The primary pre-mine land use at Brenda Mines was wildlife habitat. The mine area was forested with seral lodgepole pine and some mature spruce, and no logging had occurred within the area at the time of mine development. Some trapping and limited recreation in the form of fishing and hunting occurred in the vicinity of the mine development.

Reclamation research and work have been conducted by Brenda Mines Ltd. since 1971. Inactive areas have been seeded and trials established to determine species suitability and efficient reclamation techniques. In 1985, a reclamation research program was initiated to determine optimal post-mine land uses. Land use objectives were developed for the reclaimed sites based on the surrounding land uses and physical and chemical limitations of the various site types. Research trials were initiated to determine the most cost-effective methods of achieving the land use objectives.

Operational reclamation was completed on large portions of the mine area in 1991. A significant portion of the tailings pond was seeded, as were some smaller areas on waste rock piles and along roads. A large portion of the tailings dam was planted with native shrub species. Maintenance fertilizer was applied to large areas of waste rock piles, the tailings pond and tailings dam. A program to create a wetland in the tailings pond for water treatment was also initiated. Organic matter was deposited in the pond, and 10 t of fertilizer was added to the pond to promote algal growth. The program also included planting submergent aquatic plants (see Figure 1-1).





Figure 1-1. Planting submergent aquatic plants in Brenda Mines tailings impoundment, 1991.

## 2.0 MINING PROGRAM

### 2.1 Description of Deposit

The Brenda ore body was located within the Brenda Stock, a quartz diorite of Jurassic age which intrudes the stratified tuffs, tuff breccias, argillites and limestones of the Nicola Group. Mineralization of economic grade occurred in a strongly fractured area 800 m long and 400 m wide near the west margin of the Brenda Stock, approximately 250 to 300 m from the contact with the Nicola Group. Ore grade mineralization extended to depths exceeding 300 m. The ore minerals, chalcopyrite and molybdenite, along with minor pyrite and occasional magnetite, occurred as fillings within fractures (Brenda Mines, 1980).

### 2.2 Waste Disposal

#### 2.2.1 Tailings

Waste discharged from the concentrator as tailings was deposited in a dam-reservoir complex located 3 km downstream of the mill. The main tailings dam, built primarily from the coarse fraction of the tailings, provided storage space for the total enclosure of the fine fraction of

fraction of the tailings, provided storage space for the total enclosure of the fine fraction of tailings, recycled mill water and local surface runoff (Brenda Mines, 1980). The total area of the tailings complex is 381 ha. Vegetation has been established on 116 ha of tailings for one or more years.

### **2.2.2 Waste Rock Piles**

Waste rock and low grade ore piles were constructed on the north, east and south boundaries of the pit. In 1991, 11.0 ha of waste rock piles were resloped or harrowed in preparation for revegetation. The total area occupied by the waste rock piles is 168 ha, approximately half of which (81.6 ha) has had vegetation established for one or more years.

### **2.2.3 Overburden Stockpiles**

The mining program resulted in the removal of scattered pockets of glacial overburden material early in the development of the pit. Stockpile development placed this material at the bottom of the current waste rock piles. Some till was available when the North rock pile became inactive, and was used to amend the upper level surface of this pile. No large stockpile of overburden was established. Till deposits located at the tailings reservoir site were utilized in the reclamation of the crest of the main tailings dam.

## **2.3 Surface Development**

### **2.3.1 Surface Development to Date**

Surface developments at Brenda Mines are as follows:

- open pit for ore recovery;
- waste rock piles flanking the pit on three sides;
- tailings impoundment;
- plant site occupied by the mill, shops, and administrative buildings;
- water diversion works, including perimeter ditching;
- McDonald Creek Diversion, and the Peachland Lake complex; and
- pipelines, powerline and roadway corridors connecting the various areas.



The total area developed is approximately 881 ha, of which about 346 ha have been revegetated. A summary of areas disturbed and reclaimed to December 31, 1991 is provided in Table 2.3.1-1. Reclaimed areas are also shown on Map 1 (Map Pocket).

### 2.3.2 Surface Development in 1991

No mining activity has occurred subsequent to mine closure in June 1990.

### 2.3.3 Projected Reclamation Activities

Table 2.3.3-1 summarizes anticipated reclamation activities during the next five years. The current projections are that the last recontouring and seeding will occur in 1994, with maintenance fertilizer applied as necessary. Total areas which have or will be reclaimed for each mine facility are summarized as follows.

- All remaining road and plant site areas not previously revegetated will be seeded/planted in 1994.
- The pit area will be established as a lake for water treatment and storage.
- Most waste rock piles not previously revegetated will be seeded/planted by the end of 1993. Approximately 35 ha will be seeded in 1992 and 4.4 ha will be seeded in 1993.
- The last major tailings seedings are scheduled for 1992. This will include revegetation of the remaining 7 ha on the main tailings dam, and 90 ha of beached tailings in the pond area which had not been revegetated previously. It is anticipated at this time that approximately 100 ha within the tailings impoundment will remain ponded indefinitely. Current plans are to develop a wetland within this ponded area, one of the functions of which will be to provide water treatment.
- The stream diversion structures will be left in place in perpetuity. The banks of the diversion structures will be revegetated prior to mine closure.
- All water reservoirs and power line rights-of-way have been revegetated.
- The Peachland Lake gravel pit (9 ha) will be revegetated in 1992. All remaining disturbances in the 'other' category (including the refuse pit, equipment laydown area, explosive storage and access road, and cyclone building site) will be seeded by 1995 at the latest.





TABLE 2.3.1-1

Summary of Areas Disturbed and Reclaimed at Brenda Mines to December 31, 1991

Disturbance	Area Disturbed (ha)		Area Recontoured (ha)		Area Seeded (ha)		Area Maintenance Fertilized (ha)		Area Where Vegetation Has Been Established for One or More Years (ha)
	1991	Total <sup>1</sup>	1991	Total <sup>2</sup>	1991	Total <sup>2</sup>	1991	Total <sup>2</sup>	
Roads	0.0	31.0	0.0	0.0	5.5	20.5	0.0	15.0	15.0
Plant Site	0.0	30.0	0.0	0.0	0.0	9.0	0.0	9.0	9.0
Pit Area	0.0	170.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste Rock Piles	0.0	168.0	11.0	99.5	22.0	103.6	80.0	119.3	81.6
Tailings Pond	0.0	291.0	0.0	0.0	41.0	90.0	49.0	99.0	45.0
Tailings Dam	0.0	90.0	0.0	0.0	0.0	83.0	58.5	158.5	71.0
Stream Diversion	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Reservoirs	0.0	21.0	0.0	0.0	0.0	21.0	0.0	21.0	21.0
Power Lines	0.0	19.0	0.0	0.0	0.0	19.0	0.0	19.0	19.0
Other	0.0	53.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.0	881.0	11.0	107.5	68.5	346.1	187.5	440.8	261.6

<sup>1</sup> Total area disturbed through December 31, 1991. (Last disturbance occurred in 1959.)

<sup>2</sup> Total completed to December 31, 1991.

TABLE 2.3.3-1

Five Year Projection of Anticipated Reclamation at Brenda Mines

Disturbance	Area Disturbed (ha)	Area Recontoured (ha)						Area Seeded/Planted (ha)						Area Maintenance Fertilized (ha)					
		1992	1993	1994	1995	1996	Total <sup>1</sup>	1992	1993	1994	1995	1996	Total <sup>1</sup>	1992	1993	1994	1995	1996	Total <sup>2</sup>
Roads	31			10.5			10.5			10.5			31	5.5	5.5	5.5	10.5	10.5	53
Plant Site	30			21			29			21			30				21	21	51
Pit Area	170						0						0						0
Waste Rock Piles	168	19	3				122	35	4.4				143	106	143	67	39	4.4	480.7
Tailings Pond	291						0	90 <sup>3</sup>					180	90	180	131	90		590
Tailings Dam	90						0	7					90	56.5	66.5	7	7		286.5
Stream Diversion	8			8			8				8		8			8	8	8	24
Water Reservoirs	21						0						21						21
Power Lines	19						0						19						19
Other	53 <sup>4</sup>	4					4	12			41		53		12	20	53	41	26
TOTAL <sup>5</sup>	881	23	3	40	0	0	174	144	4.4	32	49	0	575	262	406	238	229	85	1,562

<sup>1</sup> Total completed to December 31, 1996, (including areas completed prior to 1992).

<sup>2</sup> Cumulative total maintenance fertilized over to December 31, 1996 (i.e. includes areas maintenance fertilized more than once).

<sup>3</sup> Area to be reclaimed is dependent upon the ultimate water level in the pond.

<sup>4</sup> Area now suspected to be over-estimated.

<sup>5</sup> Column totals.

**3.0 RECLAMATION PROGRAM**

**3.1 Reclamation Land Use Objectives**

Land use objectives for the various disturbed areas on the mine site are described in the final reclamation plan (C.E. Jones and Associates, 1990). The 1991 research program focused on metal and nutrient levels in reclamation area revegetation, to ensure that the proposed end land uses for the various revegetated areas are appropriate.

**3.2 Reclamation Facilities and Staff**

Reclamation at Brenda Mines is the responsibility of Mr. R. Brown, Project Manager. C.E. Jones and Associates Ltd. has been retained by Brenda Mines to coordinate a reclamation program for the mine site. Mine equipment used in reclamation includes D-9 and D-5 Caterpillar tractors, a seed drill, harrows and a spray-emulsion applicator. In addition, fixed-wing aerial seeding equipment was rented as required.

**3.3 Operational Reclamation**

An extensive reclamation program was completed in 1991. Approximately 11 ha of waste rock piles were recontoured and harrowed in preparation for revegetation. This area and an additional 11 ha of piles which had been prepared in 1990 were seeded in June.

Figure 3.3-1 shows regrading of the lower portion of a waste rock pile at Brenda Mines. During the regrading process, larger rocks left on the surface are first pushed to the base of the slope. A second push is then completed to bury these rocks with suitable materials from higher up on the slope.

A legume re-seeding was also done on 9.8, 37.4, and 20.2 ha of the North, Northeast, and South waste rock piles, respectively. A view of the Northeast rock pile in August 1991 is provided in Figure 3.3-2. A portion of the Northeast rock pile (20 ha) had been scheduled for planting with native trees and shrubs in September 1991, however the planting was delayed until the spring of 1992 due to exceptionally dry weather in September and early October.



Maintenance fertilizer was applied to 80 ha of previously revegetated waste rock dumps in 1991. Seed mixtures used on the waste rock dumps in 1991 are provided in Tables 3.3-1 and 3.3-2. A fertilizer of 11:43:3 (N:P:K) was applied at 400 kg/ha on newly seeded sites and at 200 kg/ha on previously revegetated areas.

An area of 41 ha of beached tailings in the tailings pond was seeded, fertilized and sprayed with an asphalt-emulsion to minimize wind erosion. An additional 58.5 ha on the tailings dam and 49 ha on the tailings beach received an application of maintenance fertilizer. The seed mix used in the revegetation of the tailings is provided in Table 3.3-3. Native trees and shrubs (Table 3.3-4) were planted on 24 ha of the tailings dam in September, 1991. Figure 3.3-3 shows the tailings dam in August, 1991.

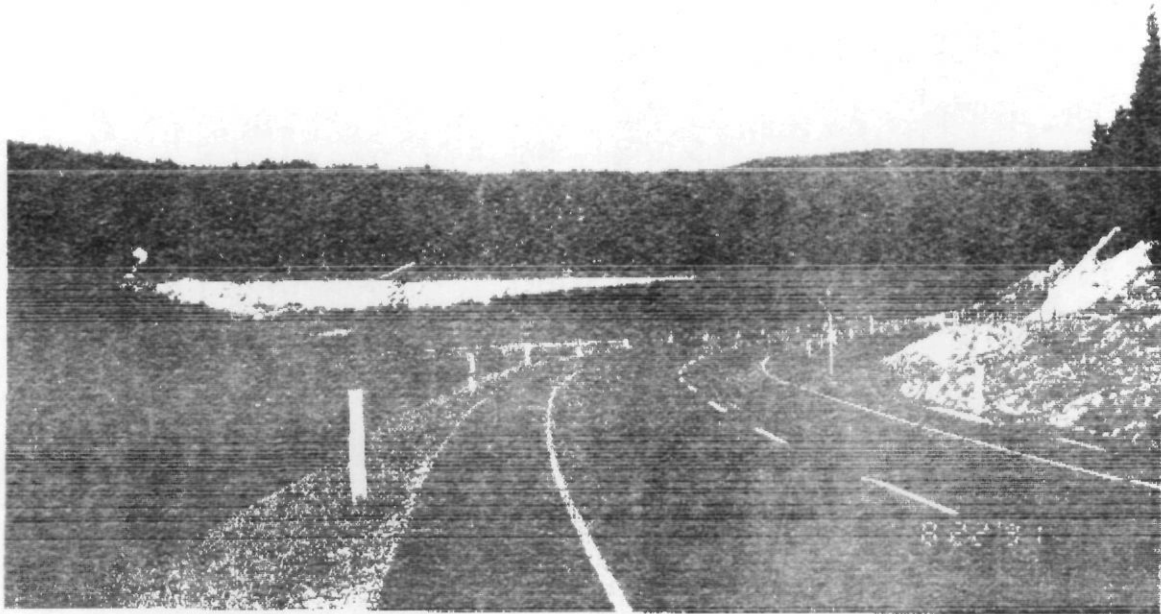


Figure 3.3-3. Brenda Mines Tailings Dam, August 1991.

### **3.4 Reclamation Research**

#### **3.4.1 Waste Rock Pile Study**

The 1991 waste rock pile research program focused on metal and nutrient levels in agronomic grasses and legumes established on the various waste rock piles. As discussed in the 1990 Annual Reclamation Report (C.E. Jones & Associates, 1991), the metals of concern at Brenda Mines are copper and molybdenum.

Grass and legume tissues were collected from the North, Northeast, East and South waste rock piles. The samples were analyzed for macro- and micronutrients (Table 3.4.1-1), with separate analyses for copper, molybdenum and sulfur (Table 3.4.1-2). All nutrient data were compared to general recommended levels for mature plant tissue health (Table 3.4.1-3). Copper and molybdenum data were compared to general recommended levels for beef cattle health (Table 3.4.1-4). Results of these comparisons are shown in Tables 3.4.1-5 and 3.4.1-6. Sulfate levels were typically higher in legumes than in grasses, but did not show any direct relationship to molybdenum concentration.

Based on the assessment of plant tissue nutrient levels relative to plant health requirements, nutrient levels appear to be generally acceptable for most parameters. The primary exceptions are low nitrogen, phosphorus and calcium levels in grasses. Nitrogen levels in legumes also tend to be low.

Based on a comparison of the copper and molybdenum data from the waste rock pile vegetation with criteria for beef cattle nutrition, copper levels appear to be generally acceptable, but molybdenum levels exceed maximum criteria in all cases. An evaluation of nutrient and metal levels on a site specific basis is presented as follows.

#### **North Rock Pile (till) (seeded 1980)**

Nitrogen, phosphorus and calcium levels are below plant health criteria in grasses, but acceptable to slightly below acceptable levels in legumes. Potassium and magnesium levels are generally acceptable.



### 3.5 Proposed Reclamation, 1992

Proposed reclamation activities for 1992 are as follows:

- An additional 19 ha of waste rock piles and 4 ha of the Peachland Lake gravel pit will be recontoured and prepared for seeding.
- The remainder of the beached tailings within the impoundment (90 ha) and small areas on the saddle and main tailings dams (7 ha) will be seeded, fertilized and sprayed with an asphalt emulsion.
- An additional 35 ha of waste rock piles and 9 ha of the Peachland Lake gravel pit will be seeded and fertilized.
- Maintenance fertilizer will be applied to 262 ha of reclaimed areas, including 5.5 ha of roads, 108 ha of waste rock piles, 90 ha within the tailings impoundment, and 58.5 ha on the tailings dam.

In addition, work initiated in 1991 to create a wetland in the tailings pond for water treatment will be continued in 1992. This will involve further plantings of submergent aquatic vegetation and addition of floating peat. Wetland work at other sites will also continue, with addition of duckweed to the sewage lagoon, fertilizer application to the pit pond, and creation of peat islands in the pit pond.

