

→ SULLIVAN

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testing was carried out on the Kivcet lead smelting process, as a possible alternative should it be necessary to replace the QSL technology. MIM's Isasmelt process is also being assessed.

The old lead smelter continued to operate at about 80 percent of its historical capacity during the year using a high proportion of zinc plant residues in order to recover metal values and reduce an environmental concern. Lead hygiene among plant workers continued to improve notably during the year. Approximately \$6.0 million was spent to replace a portion of the smelter's emission control system to ensure that environmental performance will be maintained.

In Zinc Operations, production for the year was approximately 90 percent of plant capacity, compared with approximately 66 percent in the previous year. The improvement came about as a result of the completion and successful start-up of several modernization projects in the zinc leaching plant. Minor modifications completed in the first quarter of 1992 will enhance process reliability.

Red Dog concentrate processing began in March 1991 and was quickly incorporated into the feedstock at close to forecast rates. Construction of an environmentally-advanced cadmium production plant was completed during the year; it will be fully commissioned in the first quarter of 1992.

Despite improved production levels, the significant decline in prices of all Cominco's metal products resulted in Trail Operations recording a loss of \$53.0 million for the year. In January 1992, the Company announced several initiatives designed to reduce annual costs and ensure continued operations at Trail. They include: a workplace restructuring program; efforts to reduce energy, transportation and other purchasing costs; and continued efforts to reduce the Water Licence Tax and Property Tax.

### Red Dog

The Red Dog zinc-lead mine is located in northwest Alaska, about 90 miles (145 km) north of Kotzebue. The orebody is owned by NANA Regional Corporation Inc. and leased to Cominco Alaska Incorporated, which owns and operates the mining and processing facilities. NANA is paid a royalty, which increases after the capital investment plus interest is recovered by Cominco.

Mining and milling are carried out year-round. Concentrates are trucked to the port site on the Chukchi Sea, 52 miles (84 km) from the mine site, and stored until the 10-week to 12-week summer shipping season when the sea is ice-free.

Some ore from the mine has proven difficult to treat and the operation experienced poor recoveries and lower than planned concentrate production. However a better understanding of ore types in the mine and the completion of modifications to the plant resulted in an improved performance toward year-end. During the 1991 shipping season, 522,000 tons (473,600) were sent to customers around the world, compared with 320,000 tons (290,300) in 1990. The financial performance of Red Dog was disappointing due to lower prices and sales of all products.

The ongoing commitment to training and local employment continued during the year. Fifty-five percent of the employees are NANA shareholders.

### Sullivan

The Sullivan mine and concentrator at Kimberley, B.C., operated throughout 1991 except for a three-week vacation shutdown in August. It was the first full year that the concentrator was operated on a five-day-a-week schedule with a reduced and consolidated workforce throughout Kimberley Operations.

Planned concentrate production was achieved and broken ore reserves were maintained at more than 1.0 million tons (907,000). Zinc concentrate production for the year totalled 209,300 tons (189,900), the highest level in the last 25

### PRODUCTION OF REFINED METALS

		1991	1990
<b>Zinc</b>	tons	266,700	203,200
	(tonnes)	(241,900)	(184,300)
<b>Lead</b>	tons	96,000	71,800
	(tonnes)	(87,100)	(65,100)
<b>Silver</b>	ounces	8,490,200	7,953,400
	(kg)	(264,000)	(247,400)
<b>Gold</b>	ounces	23,400	26,900
	(kg)	(728)	(840)
No. of employees at year-end		2,613	3,041

### RED DOG

		1991	1990
Ore milled	tons	1,599,276	996,695
	(tonnes)	(1,450,854)	(904,196)
<b>Zinc</b>	Average ore grade	22.5%	26.5%
	Concentrate tons	410,700	334,100
	(tonnes)	(372,600)	(303,100)
Average concentrate grade		57.1%	56.9%
<b>Lead</b>	Average ore grade	6.6%	8.5%
	Concentrate tons	76,600	55,800
	(tonnes)	(69,500)	(50,600)
Average concentrate grade		57.2%	55.1%
<b>Silver</b>	Average ore grade		
	oz./ton	2.8	3.6
	(g/tonne)	(87)	(112)
<b>Bulk</b>	Concentrate tons	34,100	52,100
	(tonnes)	(31,000)	(47,300)
Average concentrate grade			
Zinc		32.8%	31.7%
Lead		20.9%	22.9%
No. of employees at year-end		331	350

*Nick Henningson, Gen'l Mgr.*

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		1991	1990
Ore milled	tons	1,861,000	440,500
	(tonnes)	(1,688,300)	(399,600)
<b>Zinc</b>	Average ore grade	6.7%	5.9%
	Concentrate tons	209,300	42,200
	(tonnes)	(189,900)	(38,300)
Average concentrate grade		48.0%	48.2%
<b>Lead</b>	Average ore grade	5.3%	4.5%
	Concentrate tons	121,000	22,900
	(tonnes)	(109,800)	(20,800)
Average concentrate grade		59.1%	60.0%
<b>Silver</b>	Average ore grade		
	oz./ton	1.14	0.83
	(g/tonne)	(39)	(28)
No. of employees at year-end		660	655

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years. All concentrates were shipped to the Trail Operations except for 23,000 tons (20,900) of lead concentrate held in inventory at year-end.

Despite much improved productivities, Kimberley Operations were unprofitable in 1991 because of low prices for lead, silver and particularly zinc.

### Pine Point Mines

At the Pine Point operation at Pine Point, N.W.T., all buildings have been removed, although some reclamation work remains to be done. The final shipment of lead concentrate was made to Japan in October 1991.

### POLARIS

		1991	1990
Ore milled <sup>1</sup>	tons (tonnes)	1,178,700 (1,069,300)	1,121,300 (1,017,200)
<b>Zinc</b>			
Average ore grade		12.5%	14.4%
Concentrate	tons (tonnes)	180,400 (163,700)	194,100 (176,100)
Average concentrate grade		61.3%	62.7%
<b>Lead</b>			
Average ore grade		3.2%	4.0%
Concentrate	tons (tonnes)	34,600 (31,400)	41,200 (37,400)
Average concentrate grade		77.7%	78.2%
No. of employees at year-end		246	257

<sup>1</sup> Cominco owns 77.5 percent of the mine and Pine Point Mines Limited owns 22.5 percent. Ore milled is reported as 100 percent. Production data represent Cominco's 77.5 percent share.

### Polaris

The Polaris zinc-lead mine, concentrator and related exploration properties are owned 77.5 percent by Cominco and 22.5 percent by Pine Point Mines Limited. Cominco is the operator of the joint venture. The underground mining operation, which is located on Little Cornwallis Island, N.W.T., is celebrating its tenth full year of operations in 1992.

Polaris set a new record for tonnage milled in 1991. Ten shipments of lead and zinc concentrate were made to Europe between June 25, the earliest ever, and October 27, for a total of 277,800 tons (252,000).

Although Polaris continues to produce a large proportion of ore from pillar mining, operating costs have been contained and the mine has been profitable despite low metal prices.

Capital expenditures for 1991 included \$2.8 million for replacement of equipment and completion of the Garrow Lake discharge control structure. Exploration diamond drilling was carried out on nearby Truro Island. Results were sufficiently encouraging to justify further work in 1992.

### HIGHLAND VALLEY COPPER

		1991	1990
Ore milled <sup>1</sup>	tons (tonnes)	51,027,300 (46,292,000)	50,995,700 (46,263,000)
<b>Copper</b>			
Average ore grade		0.44%	0.43%
Contained in concentrate	tons (tonnes)	94,600 (85,800)	90,200 (81,800)
<b>Molybdenum</b>			
Average ore grade		0.008%	0.008%
Contained in concentrate	tons (tonnes)	1,000 (900)	1,100 (1,000)
<b>Silver</b>	ounces (kg)	1,055,000 (32,800)	983,500 (30,600)
<b>Gold</b>	ounces (kg)	7,000 (218)	6,500 (202)
No. of employees at year-end		1,194	1,227

<sup>1</sup> Ore milled is reported at 100 percent; the metal contained in production reported is Cominco's 50 percent share.

### SNIP

		1991
Ore milled <sup>1</sup>	tons (tonnes)	135,200 (122,600)
<b>Gold</b>		
Average ore grade	oz./ton (g/tonne)	0.89 (30.4)
Concentrate	tons (tonnes)	3,780 (3,431)
Average concentrate grade	oz./ton (g/tonne)	12.8 (440)
Bullion	ounces (kg)	16,950 (527)
No. of employees at year-end		126

<sup>1</sup> Ore milled is reported at 100 percent; the metal contained

### Highland Valley Copper

Highland Valley Copper is located near Logan Lake, B.C. The Highland Valley partnership comprises Cominco (50 percent), Rio Algom Limited (33.6 percent), Teck Corporation (13.9 percent, including 2.5 percent from Highmont) and Highmont Mining Company (2.5 percent, excluding Teck's 2.5 percent).

During the year, the mill processed 51,027,300 tons (46,292,000), achieving a record average daily throughput of 139,800 tons (126,800). Total production of payable copper contained in concentrate was a record 378.4 million pounds of which Cominco's share was 189.2 million pounds.

A detailed assessment of the potential mineralization within the area of interest surrounding the existing Highland Valley Copper operations was undertaken in 1991 with a view to identifying appropriate targets for regional exploration. Several promising targets are scheduled for investigation in 1992.

After protracted negotiations and a five-week work slowdown, a two-year collective agreement was reached with the United Steelworkers of America. The agreement, which provides for wage and benefit improvements, will remain in effect until September 30, 1993.

Cominco's share of Highland Valley Copper's earnings was \$50 million compared with \$75.0 million in 1990. The reduction was due to lower copper prices and a stronger Canadian dollar. Efforts continue to reduce operating costs.

### Snip

The Snip gold mine is a joint venture between Cominco (60 percent) and Prime Resources Group, Inc. (40 percent). The underground mine is located on the Iskut River about 60 miles (100 km) northwest of Stewart, B.C.

Ore treated from the start-up date of January 25 through year-end averaged 398 tons (361) per day, compared with the design capacity of 300 tons (272) per day, and at better than planned grade. Overall gold recovery averaged 91.1 percent, with the fourth quarter averaging 92.2 percent. The operation has exceeded

## Ore Reserves

### Operating Mines (Measured and Indicated Ore unless otherwise noted<sup>1</sup>)

	Cominco Ltd. Interest	1991				1990			
		Ore Tons x 1000	% Pb	% Zn	Ag oz./ton	Ore Tons x 1000	% Pb	% Zn	Ag oz./ton
Sullivan	100	20,300	4.7	7.6	0.8	22,800	4.5	7.3	0.8
Polaris	77.5	11,050	3.9	14.0		13,000	3.8	14.1	
Magmont	50	3,000	8.7	1.3	0.4% Cu	3,500	8.2	1.3	0.3% Cu
Troya	47.8	1,450	0.8	11.2		1,749	0.8	11.3	
Hellyer	46.3	14,100	6.0	12.0	4.1	15,700	6.4	12.4	4.37
Red Dog	100 <sup>2</sup>	65,800 <sup>2</sup>	5.5	18.4	2.7	67,000	5.4	18.5	2.7
		15,600 <sup>2</sup>	2.7	10.0	1.2	16,000 <sup>2</sup>	2.7	10.0	1.2
Glenbrook	82.3	650	1.25% Ni			940	1.3 Ni		
Highland Valley	50	763,000	0.41% Cu			839,300	0.41% Cu		
		39,000 <sup>2</sup>	0.45% Cu			38,000 <sup>2</sup>	0.44% Cu		
Warm Springs	100	6,800	30.0% P <sub>2</sub> O <sub>4</sub>			6,900	30.0% P <sub>2</sub> O <sub>4</sub>		
Vanscoy	100	124,900	25.0% K <sub>2</sub> O equiv.			125,000	25.0% K <sub>2</sub> O equiv.		
Owens Lake	100	33,000	Na <sub>2</sub> CO <sub>3</sub> equiv.			33,000	Na <sub>2</sub> CO <sub>3</sub> equiv.		
Snip	60	800	0.83 oz. Au/ton			870	0.85 oz. Au/ton		
		160 <sup>2</sup>	0.77 oz. Au/ton			170 <sup>2</sup>	0.75 oz. Au/ton		
Maria	31.7	360	12.8% Cu; 0.25% Mo		1.8	510	12.8% Cu; 0.25% Mo		1.8
		430 <sup>2</sup>	1.8% Cu; 0.67% Mo			430 <sup>2</sup>	1.8% Cu; 0.67% Mo		

### Advanced Projects (Measured and Indicated Ore unless otherwise noted<sup>1</sup>)

	Cominco Ltd. Interest	Ore Tons x 1000	1991		1990	
			Grade	Ore Tons x 1000	Grade	
Quebrada Blanca						
Enriched Zone	49.3	93,000	1.3% Cu	85,000	1.4% Cu	
Mariquita	64.6	23,000	0.53% Cu	23,000	0.53% Cu	
Alder Gulch	64.6	33,000	4.0% Garnet	30,000	4.0% Garnet	
San Martin	64.6	800	65% Wollastonite	800	65% Wollastonite	

<sup>1</sup> Mineral reserves of Cominco and associated companies are classified as Measured, Indicated and Inferred. The reserves are reviewed annually by the Company's engineering and geological staff and are based upon individual evaluations of operating results, drilling, other engineering data, and long-term metal price forecasts. The term "measured" is limited to those reserves at a mine which can be projected from one or more exposed faces on the basis of actual operating results. Reserves are classified as "Indicated" where there is sufficient information about the deposit or a portion of it to form the basis of a mine production forecast. Reserves computed on the basis of more limited information but adequate geological data to form the basis of a preliminary mine production plan are classified as "Inferred". Ore reserve figures are total reserves at the mines and are not limited to Cominco's interest.

<sup>2</sup> Inferred Ore.

<sup>3</sup> Subject to escalating royalty.

## Other Resources<sup>4</sup>

	Cominco Ltd. Interest	Ore Tons x 1000	1991		1990	
			Grade	Ore Tons x 1000	Grade	
Pebble Copper (Probable & Possible Resource)	100	500,000	0.35% Cu; 0.012 oz. Au/ton	200,000	0.4% Cu; 0.012 oz. Au/ton	
Quartz Hill (Probable Resource)	100	230,000	0.22% MoS <sub>2</sub>			
		1,200,000	0.12% MoS <sub>2</sub>			
Quebrada Blanca						
Protore (Possible Resource)	49.3	250,000	0.5% Cu	250,000	0.5% Cu	
Maria (Possible Resource)	31.7	400	1.4% Cu; 0.36% Mo	400	1.4% Cu; 0.36% Mo	
Lobo (Probable & Possible Resource)	32.3	70,000	0.047 oz. Au/ton	70,000	0.047 oz. Au/ton	
Sheep Creek (Possible Resource)	32.3	4,400	4.0% Cu	5,000	4.0% Cu	
Pinchi (Possible Resource)	100	1,200	6.4 lb. Hg/ton	1,200	6.4 lb. Hg/ton	

<sup>4</sup> The term "resource" is used for an estimate of mineralization of expected economic merit, but before complete geological, mine, metallurgical and cost data is available. The term "probable resource" is used when sufficient information is known about the geology, thickness, grade, continuity and extent of the deposit to permit defined grade and tonnage figures. "Possible resource" is a projection of mineralization computed on the basis of limited drilling but a reasonable understanding of the geology and the distribution and correlation of metal values.