

GOVERNMENT FUNDED RECLAMATION  
PROGRAM ON PRE-LEGISLATION TAILINGS PONDS

Paper presented  
by:

A.L. O'Bryan  
B.C. Ministry of Energy, Mines and Petroleum Resources

GOVERNMENT FUNDED RECLAMATION PROGRAM  
ON PRE-LEGISLATION TAILINGS PONDS

INTRODUCTION

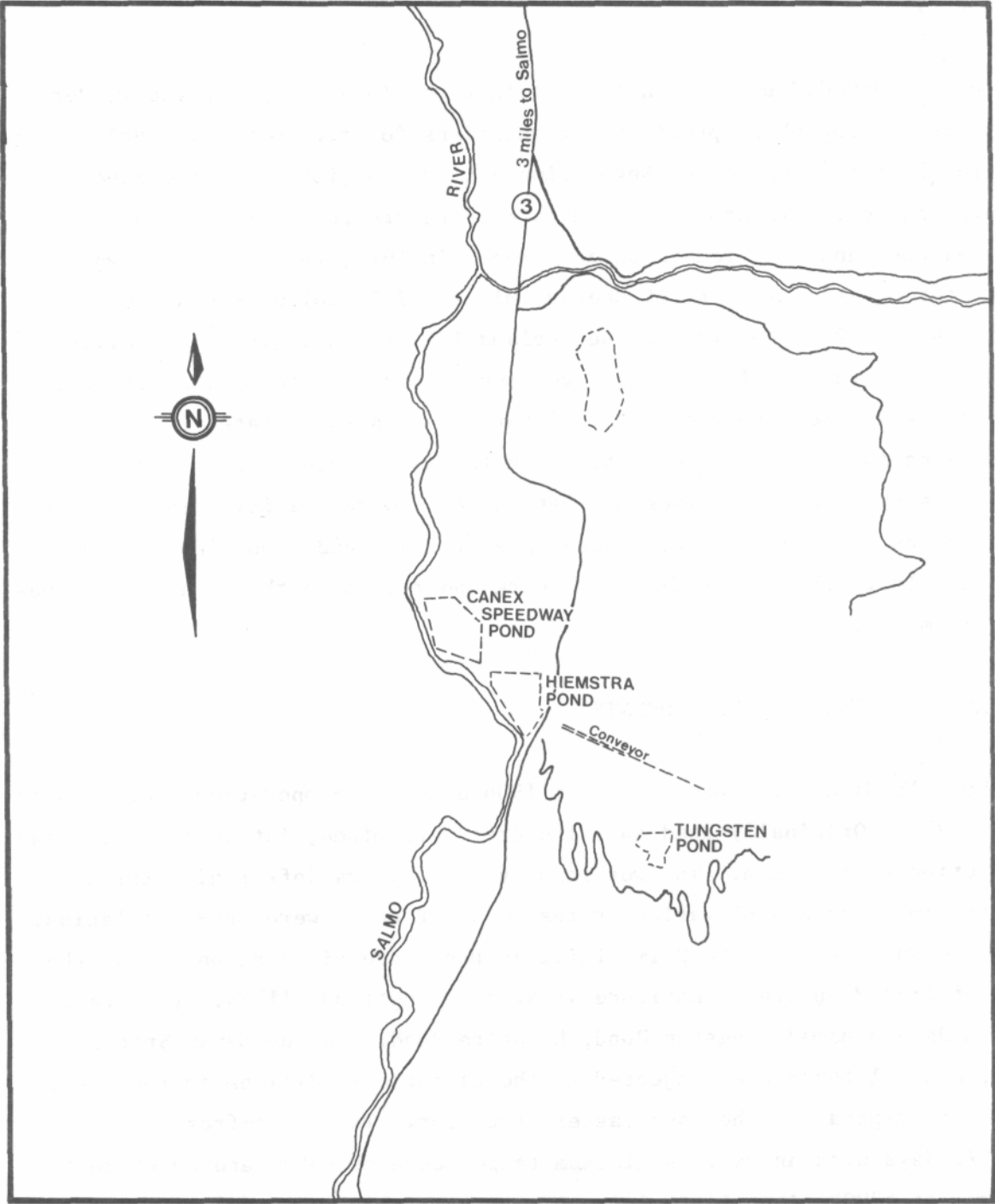
Not until 1969 did public reaction against possible damage of the wilderness areas bring about provincial regulations for reclamation, specifically Section 8 of the Coal Mines Regulation Act and Section 11 of the Mines Regulation Act. Disturbances in existence before this date were not covered and generally remain unreclaimed. In 1978, the provincial government, through the Ministry of Energy, Mines and Petroleum Resources, established a fund to finance the reclamation of pre-legislation tailings ponds. The overall aim of this Government program is to provide financial assistance in order to return the disturbed areas to a state of use and appearance that will be compatible with the surrounding areas. In 1978, the Ministry of Energy, Mines and Petroleum Resources initiated programs on tailings ponds at Princeton (see paper by Lane and McDonald), Phoenix and at Salmo. This paper discusses work undertaken on three tailings ponds near Salmo, B.C.

EMERALD MINE TAILING IMPOUNDMENTS

The Emerald Mine began production in 1906 and was in operation sporadically until 1972. Originally lead and zinc ores were mined, but in 1942 it began production of tungsten. The workings over the years left behind three tailing impoundments of various sizes, most of which were pre-legislation. These ponds, known as the Salmo Tailings ponds are situated on and at the foot of Iron Mountain at Latitude 49°N. and Longitude 117°W. (Figure 1). The ponds are named Tungsten Pond, Hiemstra Pond, and the Canax Speedway Pond, and all three are subjected to the climatic conditions in the area, which are typical of the Southeastern Interior. The frost-free period is only 71 days with an extreme minimum temperature of -35°C and an extreme maximum of 42°C. Annual precipitation averages 25 inches (63 centimetres) with approximately one-third falling as snow.

**FIGURE 1**

**LOCATION OF TAILING PONDS IN THE SALMO AREA**



### Soil Analysis

From the soil analysis report undertaken during the initial reclamation survey, it was determined that the average pH of the three pond areas was 7.5 and that the material was extremely deficient in nitrogen, phosphorus and potassium, with phosphorus as the main limiting mineral nutrient in all samples examined. The tailings material is easily eroded by wind and water, but was found to have fair to good moisture retention. It was also felt that once vegetation is established on the tailings, the moisture retention will increase, permitting the plants to survive on natural precipitation.

### Previous Reclamation Program, 1973

Two of the three tailings ponds were seeded and fertilized in 1973. The Tungsten Pond was broadcast seeded and harrowed and the Hiemstra Pond was seeded and fertilized by aerial means. No reclamation work was done on the Canax Speedway Pond. A local farmer has built a house and has planted a large lawn and garden on the Hiemstra Pond. Mr. Hiemstra claims that he built the soil up by mulching and working the ground as only a farmer can do, and that commercial fertilizer was used. During the initial aerial seeding of the Hiemstra tailing pond, much of the seed was lost due to a combination of hard ground surface and surface wind. However, some seed remained and germinated which resulted in approximately 30% of the pond being covered with excellent vegetation. This is the area in which we will use the "green manure" approach, to build up humus and nutrients in the tailings.

### RECLAMATION PLANNING AND METHODS

After a visit to the sites in the summer of 1978 with Mr. Lloyd Gavelin, of Craigmont Mines and Mr. George Efanoff, long time Placer employee, it was decided to carry out a general clean up of the three ponds.

The first step involved the removal of all old lumber and trestles as well as the standing dead trees. This rubbish was then piled and burned.

Step number two was the grading and shaping of the pond surfaces in order to make the land usable for all types of equipment in the future. This was a problem when our first try, which employed a grader, ended in failure. The grader was unable to operate on the loose tailings and in the moist areas in the centre of the ponds. Next we tried a 450 John Deere Crawler Tractor with a hydraulic blade and were more successful. It was fast and we had little difficulty in smoothing out the irregularities.

Step number three was to mark out the area in one-acre plots and apply fertilizer with a hand-operated cyclone spreader. The fertilizer, 13-16-10, was applied at a rate of 300 pounds per acre. A six-acre area was fertilized using 70 pounds of nitrogen, 200 pounds of phosphorus and 30 pounds of potassium per acre. The fertilizer was then worked down into the tailings to a depth of 8 to 10 inches, or in some areas as deep as possible. For this we used a two-way agricultural disc, pulled by the John Deere 450. This worked very well except for the area that had the excellent vegetation cover. On this area we had hoped to use the "green manure" approach, in order to, build up humus and nutrients in the tailings to a point where vegetation would be self sustaining. This area should have been deep plowed, but when a plow was not available, we disced the fertilizer and vegetation into the ground by going over the area as many as four times.

The ponds were then harrowed with a light spike-tooth harrow, pulled by a small rubber-tired tractor. The harrowing left the ground in a fairly smooth condition which made it easy to walk on when seeding, but the most important part was that little trenches about 1 - 1-1/2 inches deep were formed. Seed was applied by the use of hand-operated Cyclone Seeders. The rate of application was 40 pounds per acre and was a customer-specified mix, with all legumes inoculated.

Crested Wheatgrass	-	15%
Creeping Red Fescue	-	15%
Orchardgrass	-	15%

Smooth Bromegrass	-	15%
Alfalfa	-	15%
Sainfoin	-	15%
Alsike	-	10%

The entire area was then floated using the harrows in the inverted position. This left the seed with approximately 1 to 1-1/2 inches of cover.

#### 1979 PROGRAM

In the spring, as soon as work is possible on the tailings ponds, 100 pounds per acre of 21-0-0 fertilizer will be applied to the entire 70 acres. It is anticipated that adequate self-sustaining growth will be established in 4 - 5 years.

During the previous programs, no reclamation was undertaken on the tailings dam benches; however, if funds are available, reforestation of these areas could be undertaken successfully considering the excellent natural revegetation of Poplar and Cottonwood on the surrounding area.

#### COSTS OF THE RECLAMATION PROGRAM

Total costs for the site general clean up, conditioning of the tailings, seed, fertilizer and equipment rental can be broken down as follows:

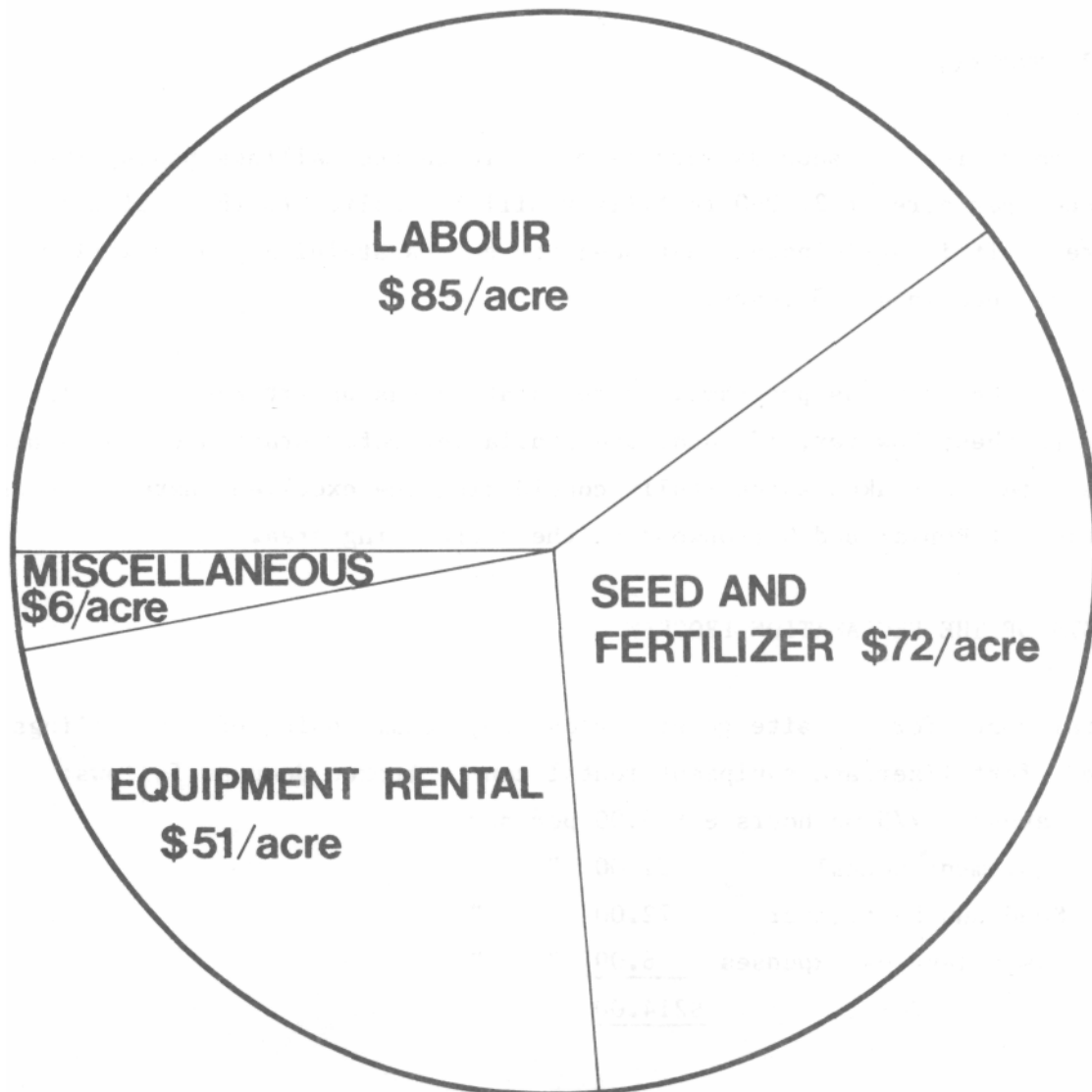
Labour - 775 manhours @ \$85.00 per acre.			
Equipment Rental	51.00	"	"
Seed and Fertilizer	72.00	"	"
Miscellaneous Expenses	<u>6.00</u>	"	"
Total	<u>\$214.00</u>		

Total cost for 63 acres of level ground and 7 acres of sloped ground including some recontouring, amounted to 214 dollars per acre and Figure 2 shows the proportions of expenditure in relation to total costs, and Table 1 provides a more detailed analysis of costs on an acre and hectare basis.

## FIGURE 2

### COST BREAKDOWN OF B.C. M.E.M.P.R. REVEGETATION

#### PROGRAM ON THE SALMO TAILINGS POND



**TOTAL COST- \$214/acre**

TABLE 1

DETAILED BREAKDOWN OF COSTS ON 70 ACRES OF THE  
SALMO TAILINGS POND RECLAMATION PROGRAM

LABOUR

773.5 manhours at 8.16 dollars (average) per hour =  
85.27 dollars per acre (35.53 dollars per hectare)

EQUIPMENT RENTAL

Half-ton pick up	2 weeks
J.D. 450 tractor (Cat)	141.5 hours
Massey Harris tractor	94.0 hours
Harrows	70.0 hours
Disc (two-way)	<u>70.0 hours</u>
Total rental:	3,572.37 dollars = 51.03 dollars per acre (21.26 dollars per hectare)

SEED AND FERTILIZER

Seed	2,744.00 dollars
Fertilizer	<u>2,308.07 dollars</u>
Total	5,152.07 dollars
	= 72.17 dollars per acre (30.07 dollars per hectare)

MISCELLANEOUS EXPENSES

Freight charges	308.20 dollars
Supplies and material	<u>123.98 dollars</u>
Total	<u>432.18 dollars</u>
	= 6.17 dollars per acre (2.57 dollars per hectare)



## CONCLUSIONS

The 1979 follow-up work will include fertilization in the spring, and a program to evaluate vegetation growth with respect to plant species will be started.

It has been my experience that the first attempt at a project is most difficult, if one has no significant previous experience but wishes to do a good job. Reclamation, however, is a long-term proposition and time is the essential element in determining our success or failure.

DISCUSSION RELATED TO ART O'BRYAN'S PAPER

Stan Weston, Wesagp. Mr. Chairman, I would like to correct a few things. In 1969 I seeded the Tungsten pond. Nothing further was done there, but tailings were dumped on top of this area when the mine started up again, don't know what happened after the three years that I had worked there. The No. 1 pond was seeded and fertilized at that time and was not covered up. We tried to use hand seeders but they did not work. We used aircraft, and the seed did not blow away. It seems that you are inventing the wheel, because you are going backwards and ending up with the bucket method. My concern from the industry point of view is that your techniques are somewhat expensive. I am sure that the results that you get will not improve over what we did at the start. The problems you have had are well known, so I don't know if the intent was just to spend money. If you are spending money and putting it "down the drain", you should be accountable for it, and I don't think you are under this program.

ANS. Well, I hope that we would be Stan. We are all learning and part of the problem that has developed is that some of the previous work that has been done wasn't correctly documented. The area had had some work done on it before and we were just continuing along those lines. Allan Lamb, I believe, did some work for Placer on the Tungsten Pond after you. I wasn't aware that you had done any work in 1969, Stan, but then as you stated nothing had been done on the Number 2 Pond, which I now call the Canex Speedway Pond. That's originally where we started, and we just expanded to the other two ponds to try and enhance them. We hope to keep the 30% vegetative cover on the No. 1 pond going. After talking to the farmer who had been doing a lot of little farming methods there such as going out in the fall to spread the seed and trying to keep growth going, we just hope that in the end this money wasn't wasted.

Jake McDonald, Ministry of Energy, Mines and Petroleum Resources. This is not a question, Mr. Chairman, but I would like to make an overview of this program. The money was spent on these tailing ponds which are pre-legislation. At that time, some of the ponds had no vegetation. It was our

mandate as the Ministry of Mines to go in and try to revegetate these ponds for a useful purpose. The method which we chose is a relatively cheap one and it creates employment. We, as a Ministry, are not saying this is the total answer but we have done this and we hope to get some answers to many of the problems. I think that it's a step in the right direction and, that in the next couple of years, we are going to derive a lot of answers and we hope that this will continue and benefit the mining industry.

ANS. Thank you Jake. Just one other point, we did use more modern methods on the 45-acre Tremblay pond near Grand Forks at the Phoenix mine. We used more up-to-date methods because the equipment was available. But during the Emeralds Mine project the equipment was not available and we wanted to create some employment as well as get some results.

Stan Weston, Wesago. Well, Mr. Chairman, let me make one point in regards to the remarks made by Jake (McDonald), who talked about the program being cheap. Now, I don't know what is being paid to the help that is used, but to the mining companies, (I think this is true and the people here can verify it) the cost of a labourer in the field is going to be something like 100 dollars a day, and that is a fairly recent figure. Now that gets to be quite expensive. In addition, as soon as you put a piece of equipment—ground rig equipment—onto this type of land your costs of reclamation are going to go up from maybe a few hundred dollars to a few thousand dollars. That's about what's happening today, what the costs will be a little further down the line should make interesting comparison. So I am concerned with what I have heard on the tailings pond here and at the tailings pond near Princeton. We have worked on the tailings pond and we feel we have the answers, furthermore, the Department has actually inspected it and yet there is no reference to the work that has been done. I thought that these reports were filed in Victoria and were available. I am rather surprised that they were not available to you and that I would have been asked about it, because if we could have been helpful we certainly would have been glad to have been so.

ANS. Thank you. Any further questions.

John Dick, Ministry of the Environment. I have looked at quite a few projects around the province where techniques varying from broadcast seeding to seeding with harrowing, and aircraft seeding have been used; and I say my experience is that in good conditions, broadcast seeding gives equally good results as seeding with harrowing. When the conditions become more adverse, for a given level of results, you have got to go to the more expensive methods. You may have to broadcast three or four times to get a given level of ground cover and you may only have to seed once to the same level of ground cover by seeding with harrowing. As long as we talk only about the techniques, the cost of techniques without relating those to a given level of results, our discussions are meaningless.