RECLAMATION OPERATIONS AT CARDINAL RIVER COALS, LTD.

G. Acott

Introduction

Cardinal River Coals, Ltd. is a joint coal mining venture owned 50% by Luscar, Ltd. and 50% by Consolidation Coal, Co. of Canada. The mine-site is located approximately 40 kilometres south of Hinton. Mining is conducted between 1,650 and 1,860 m in an area predominated by Engelmann Spruce/Alpine Fir on north and east facing slopes, and Lodgepole Pine on south and west exposures. Summers are characteristically short and wet; an average of 800 mm of precipitation (water equivalent) is received annually with about 80% falling as rain between May and September. High winds and frequent chinooks may be expected in fall and winter respectively.

CRC, Ltd. employs an open pit truck/shovel operation to remove 14 million BCY of overburden and 1.7 million CST of medium volatile bituminous metallurgical coal annually. Current production rates are about 60% of the 1982 levels and the economic forecast for metallurgical coal use is not encouraging.

Land Use Objective

In the planning of a development involving substantial surface disturbance, the selection of a final land use objective is likely one of the most important decisions to be made. It lays the groundwork for the reclamation plan and ultimately determines the cash outlay required to achieve a certifiable reclamation product. To be acceptable, it must be consistent with or amenable to the pre-development land use, and it must be cost effective.

The forested lands at CRC, Ltd. were largely unmerchantable as a result of elevation and subsequent short growing season. Rather than replace unproductive forest, the mine chose to extend and improve upon the wildlife habitat of the surrounding site; predominantly that of the Rocky Mountain Bighorn Sheep which were native to the area. Specifically, reclamation would achieve:

i) a final landscape of 40% cover/60% open grazing area. Under the assumption that wildlife would utilize the edge of the natural forest, the amount of cover required could be correspondingly reduced.

ii) a forage crop would be established in the open grazing areas which would be easily available, self-sustaining and nutrious to the grazing wildlife sector.

iii) reforestation on cover areas would provide concealment, thermal protection and sightline interruption in addition to providing nutrious browse.

iv) travel corridors would be developed to encourage wildlife utilization of the entire reclaimed area.

Site Preparation Prior to Development

The majority of the minesite is covered with non-merchantable forest. In pit areas, the timber is felled and bucked to 3 m lengths to prevent damage to mining equipment. Overburden is discarded directly over trees in an external dump area. Merchantable timber stands have been encountered in certain locations; trees are then felled, limbed, skidded and hauled to Champion Forest Products (Alberta), Ltd.

Two types of soil materials are selectively salvaged for use in the reclamation process. Regolith is a relatively poor quality, till type material with a high coarse fragment content which is salvaged during mining operations. Topsoil material (rated as good or fair in a pedological survey) is generally from one of two sources. Highly organic material, often of low pH, is encountered in low lying areas, whereas a shallow sandy brunisolic or luvisolic soil is normally found on the lower hillsides and slope bottoms. Wherever possible, these two types of topsoil are mixed to improve textural and nutrient qualities of both.

Reclamation - Materials Handling

The initial step in the reclamation program is to reduce the final angle of dumps and highwalls to 27 degrees or less as prescribed by our

Development and Reclamation Approval. To allow recontouring of highwalls, overburden will either be dumped over the face or the crest will be drilled and blasted to provide the required broken material such that the wall takes on the configuration of a dump slope. Dozers are then employed to cut at the crest and place at the toe.

Collectively, these operations will consume approximately about 50% of the life-of-mine reclamation budget. Thus, it is very important that these operations be controlled to maximize cost efficiency. Cardinal River Coals, Ltd. has done a number of sloping and blasting trials the results of which are beyond the scope of this presentation.

Regolith material is then spread over the entire recontoured surface to a depth of 15 cm. Wherever possible, regolith is taken directly from an active face to eliminate the need for special stockpiling locations or the rehandle costs associated with stockpiling. The receiving area is divided into sections (using stakes or rangepoles), and the volume required in each section is determined from the measured area. Loads are appropriately spaced to reduce dozer spreading costs. D8L dozers equipped with wide pads conduct spreading operations working the material downslope in a windrow perpendicular to the gradient. In situations where the regolith is wet and backing up is difficult, the dozers work side by side making passes from the crest to the toe then backing up an adjacent rock area where traction is better for the next cycle.

Reforestation efforts at Cardinal River Coals, Ltd. on the tops of external dumps, which have been left flat and exposed, have met with limited success. Attempts have been made to dump the final lift in "fingers" allowing the creation of depressions and protected areas which should provide a more moist, sheltered microsite for reforestation establishment. This will also develop a rolling topography aiding in sightline relief and thermal protection for wildlife.

Topsoil material is placed to a depth of 30 cm over the regolith only in selected locations. The topsoil "island" locations are chosen based on the suitability of the site for establishment of woody vegetation (such as north facing slopes and the depressions referred to earlier), and the need for travel corridors and browse for areas utilized by deer and moose.

These topsoil areas will be entirely reforested and will constitute approximately 15% of the total disturbed area; that percentage will be much higher in areas designated for deer/moose habitat and much less in areas frequented by bighorn sheep.

Reclamation - Vegetation Establishment

The areas between the topsoil islands are seeded to a grass/legume crop. The seed mix is composed of the following species:

Grasses		Legumes	
6.9%	Durar Hard Fescue	12.0%	Rambler Alfalfa
7.4%	Arctared Creeping Fescue	4.0%	Aurora Alsike Clover
1.4%	Ruebens Canada Bluegrass	12.0%	Sainfoin
1.8%	Kentucky Bluegrass	9.9%	Oxley Cicer Milkvetch
16.2%	Streambank Wheatgrass	4.2%	Sweet Clover
4.2%	Orchardgrass		
20.0%	Smooth Bromegrass		

The percentage by weight of each species is determined by the average number of seeds per kilogram as documented by Agriculture Canada and an average spread of 2,690 live seeds per meter^2(250 live seeds per foot^2). Generally, each species within the mix will have a similar number of seeds per unit area; due to the large seed size of sainfoin and milkvetch, they are the exception to this rule. The mixture is bagged in 19.06 kg (42 lb.) sacks such that a bag of seed will cover 0.40 ha (1.0 acre).

Seed application is done by one of three methods. On long steep slopes, helicopter seeding has proven to be very fast and cost effective. It is, however, very weather dependent; to achieve an even spread, it often has

to be completed early in the morning when winds are not a factor. The use of the helicopter has proven very effective for subsequent refertilization as the heavier fertilizer prills are less subject to wind drift. On shorter steep slopes which are accessible from top and bottom, a hydro-seeder is used for seed application. This also enables the use of mulch and tackifiers on areas where vegetation establishment may be somewhat difficult. A small dozer with a rear mounted electric cyclone seeder pulling a set of harrows is the favoured seeding method and is employed wherever the slope angle permits. The harrows break the crust which normally forms on the high silt/clay soils in the area and incorporates the seed into the substrate. This has proven to speed the rate of germination and increase the consistency of the vegetation cover. Costs of the latter two seeding methods are comparable; although helicopter seeding can be done for approximately half the cost of hydro or dozer seeding, the chance of having to re-seed or "fill in the gaps" is fairly high.

As mentioned previously, reforestation is done on the topsoiled locations only. The following species are the most commonly utilized:

Coniferous	Deciduous
Engelmann Spruce	Green Alder
Lodgepole Pine	Swamp Birch
	Balsam Poplar (hybrid)
	Willow
	Canadian Buffaloberry
	Silverberry
	Wood Rose
	Black Elderberry

All these varieties (with exception of hybrid poplar) are native to the area. Seed is collected on site and forwarded to nurseries for containerized propogation. The seedlings are generally covered in snow and overwintered in a holding facility and outplanted the following spring. The areas to be reforested are seeded prior to planting with a light application of sweetclover to act as a nitrogen fixing nurse crop.

Rocky Mountain Bighorn Sheep

An intensive study was initiated in 1985 at Cardinal River Coals, Ltd. on the resident herd of bighorn sheep to provide an on-going feedback on reclamation success. The major objectives of the survey included:

- seasonal population counts by age and gender.
- determination of on-site travel corridors and mineral lick locations.
- identification of preferred escape terrain and feed areas.
- evaluation of the general vigour of the herd.
- assessment of reproductive success (the importance of the reclaimed areas for rutting and lambing).
- determination of preferred forage species and general grazing stress on the reclaimed areas.

The study would also make recommendations as to the design of a subsequent program which would have a reduced monitoring intensity but continue to provide useful information with regard to the above objectives.

Although the study is still ongoing, certain highwalls and dump slopes have been identified which the sheep use on a regular basis as travel routes and escape terrain. These areas will be left in their current unrecontoured state; helicopter seeding has been conducted on a trial basis at some of these sites to offer a limited amount of forage to the sheep on escape terrain.

Lake Creation

Open pit mining is often conducted as a series of pits along the geological strike of the resource. In most cases, an external dump is utilized for the placement of overburden from the initial pit, then a progressive backfilling sequence is established for the remaining pits. The final excavation must either be backfilled as a separate rehandle from a dump or through the use of drilling and blasting techniques to reduce the angle of the highwall.

An alternative to this very costly procedure is to create a lake in the final pit such as that currently being completed at Cardinal River Coals, Ltd. in the 50-B-6 Pit. The lake will fit well with the wildlife habitat

land use and will expand on the recreational and sport fishing importance of the Coal Branch Area.

The development of a lake requires a great deal of preplanning. Some of the more important considerations include:

- will there be adequate inflow to provide a realistic filling and flushing rate?
- will the chemical and physical water quality support a thriving biological community?
- can adequate primary production and spawning areas be provided to fulfill the needs of a self-sustaining sportfish population?

In the 50-B-6 Pit situation, development design included the permanent diversion of a neighbouring watershed to provide additional flow to the original creek which flowed through the pit area. Temporary diversion around the active area (within a 1.2 m culvert) permitted the construction of a suitable lake inflow and also provided public access to the outflow end of the lake after the pit was allowed to fill. Water quality in other pits allowed to partially fill during a dormant mining period had always been excellent with a high level of oxygenation in the epilimnion. Drilling, blasting and resloping of a wide safety bench was undertaken to increase the area of littoral zone near the outflow end. Organic topsoil was then spread in these shallow areas prior to lake filling. As the water surface reaches this level, a macrophyte innoculation program will be conducted to bring in native underwater species from a natural lake nearby. Large tires will be placed along submerged safety benches on the north side of the lake to provide additional fisheries enhancement.

A study initiated in 1985 will monitor physical and chemical water quality during filling. Stratification of temperature and dissolved oxygen will be recorded bi-annually and chemical analysis will be conducted to assess the need for nutrient supplementation. Biological investigations will determine the rate of increase of phytoplankton, zooplankton and macrophytes and ultimitely identify when initial fish stocking may be undertaken. A further program to enhance downstream fisheries habitat may be conducted

at a future date to encourage lake colonization by natural fisheries populations.

Conclusion

Reclamation activities at Cardinal River Coals, Ltd. have been very successful to date. Recontouring and vegetation establishment have been undertaken since 1971 and 144.5 ha (356.9 ac) have been certified by the Provincial Government. The direction of future reclamation operations is well defined and field scale research will continue to be conducted to find the most efficient and cost effective methodology to attain the final objective. Alternate land uses will continue to be considered as opportunities arise which will serve to diversify the primary land use goals.

PROCEEDINGS

ALBERTA RECLAMATION CONFERENCES

1985
Planning and Certification
of Land Reclamation
April 16-17, 1985
Edmonton Inn, Edmonton

1986
Reclamation in the
Eastern Slopes of Alberta
September 25-26, 1986
Overlander Lodge, Hinton

C.B. Powter
R.J. Fessenden
D.G. Walker
Compilers

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P R O C E E D I N G S

1985 AND 1986
ALBERTA RECLAMATION CONFERENCES
ALBERTA CHAPTER, CANADIAN LAND RECLAMATION ASSOCIATION

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For more information on the Alberta Chapter of the Canadian Land Reclamation Association please write to CLRA, Box 682, Guelph, Ontario, Canada N1H 6L3.

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