RECLAMATION OF MINED LANDS, GREAT CANADIAN OIL SANDS LTD. LEASE SITE, TAR ISLAND, ALBERTA

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Introduction

In the open pit method of mining oil sands at the Great Canadian Oil Sands (G.C.O.S.) lease site, two operations are performed, creating a land disturbance and other environmental impacts. Overburden is placed in waste dumps in areas uneconomical to mine. The oil extraction process produces large quantities of tailings sand used in dyke building for impoundment of liquid tailings. The tailings sand dyke and overburden waste dump are illustrated in Figures 1 and 2, respectively.

Tailings sand is a fine-textured, high pH (8.0-8.5), low nutrient and poor water holding material. Overburden spoil, generally, is saline, above neutral in pH, high in clay content, low in organic matter, low in fertility, and may contain a small percentage of oil sands. The overburden component muskeg, usually a sedge or moss peat, is the principal amendment used to improve the adverse characteristics of tailings sand and overburden spoil.

Our reclamation program is designed around the primary short-term objective of erosion control and secondary objectives of establishing a self-supporting vegetative cover, improving aesthetics and providing a habitat for wildlife.

Description of Program

1. Revegetation Progress from 1969 to 1975

Growth room experiments were initiated in co-operation with the Alberta Department of Agriculture in 1969, followed by field verification in 1970. Applying the recommendations of the laboratory and field work, operational revegetation commenced on our tailings dyke in 1971. To date 140 acres are under vegetation.

In 1974, laboratory experiments by the Alberta Environment and field testing by the Alberta Forest Service set the basis for revegetation of 40 acres of an overburden waste dump in 1975.

To date, 35,000 trees and shrubs have been planted on the tailings dyke and overburden waste dumps in various experimental combinations. The afforestation program, in co-operation with the Alberta Forest Service, serves a twofold purpose at this stage - the actual afforestation of these areas and field experimentation.

2. Methods

A four(4) inch cover of muskeg is incorporated with fertilizer into the tailings sand slope at a volumetric ratio of one-to-one by using a rotovator. Seeding was initially accomplished by hydroseeder; however, better results were obtained with a Brillion Grass Seeder (see Figure 3 for seeding and fertilizer rates and mixtures).

The overburden waste dump was handled differently, using a disc and/or harrows to mix fertilizer and muskeg into the slope surface. Seeding and fertilizing was accomplished by a Cyclone Broadcaster mounted on the rear of a Bombardier. Seed and fertilizer was harrowed into the seedbed.

Maintenance fertilizer was initially applied manually, then by broadcaster on Bombardier,and by helicopter once the areas were large enough to be economical.

Trees and shrubs are generally planted at a density of 430 per acre. The ratio of coniferous to deciduous species has been about 2 to 1. As suitable nursery stock becomes available this ratio will be changed to 1 .to 4. Native stock propagated from locally collected cuttings and seed, now introduced as propagative technology, is being developed. Trees and shrubs are generally planted in established grass and legume cover with scarification at each seedling planting site. All seedlings, container and bare-root, are hand planted and watered if required at time of planting.

3. Results

By the end of the second growing season the grass and legume cover is dense and uniform enough to control water and wind erosion on the tailings sand slopes. Generally, the proportion of grasses in the plant cover,in the second season, is 50%. After the second growing season the legumes are phased out with Creeping Red Fescue becoming the dominating species. There is evidence of invasion by native species as well as volunteer growth, probably propagating from vegetative material in the muskeg.

The tree and shrub survivals have been increasing as methods improve, more adaptable species are available and nursery stock of good quality becomes available. Figure 4 represents survival rates of various species planted over the past four years. To date, lack of moisture (in 1972 and 1973) and mouse damage have been the major contributing factors to mortality.

Other factors affecting survival and growth which are being studied are species suitability, time of planting, type of herbaceous cover, uncontrolled water erosion, quality of nursery stock and nutrient status.

4. Government Involvement

Government activity has been at a high level recently with most of the ongoing projects now being directed through the Alberta Oil Sands Environmental Research Program. This program is a joint agreement established last year between the federal and provincial governments to undertake the task of researching environmental problems associated with oil sands development.

Major ongoing projects are summarized as follows:

- Alberta Forest Service: testing of native and introduced tree and shrub species.
- Alberta Agriculture: testing of native and introduced grass and legume species.
- University of Alberta Soil Science Department: fertility studies, soil properties, nutrient movement.
- Canadian Wildlife Service: small mammals study to control mouse problem on vegetated dyke slopes.

Other agencies involved,in the past,were the Alberta Agriculture Soils Division, Alberta Environment Earth Licensing Division and Environment Canada Forestry Service.

Future Considerations

1. The major cost of reclaiming oil sands mined land is the handling of muskeg. More needs to be known of storage effects and investigation into handling methods.

2. We will have to intensify research into the testing of native vegetation, technology of seed production and handling and establishment of a source of supply in hopes of achieving a self-supporting plant cover.

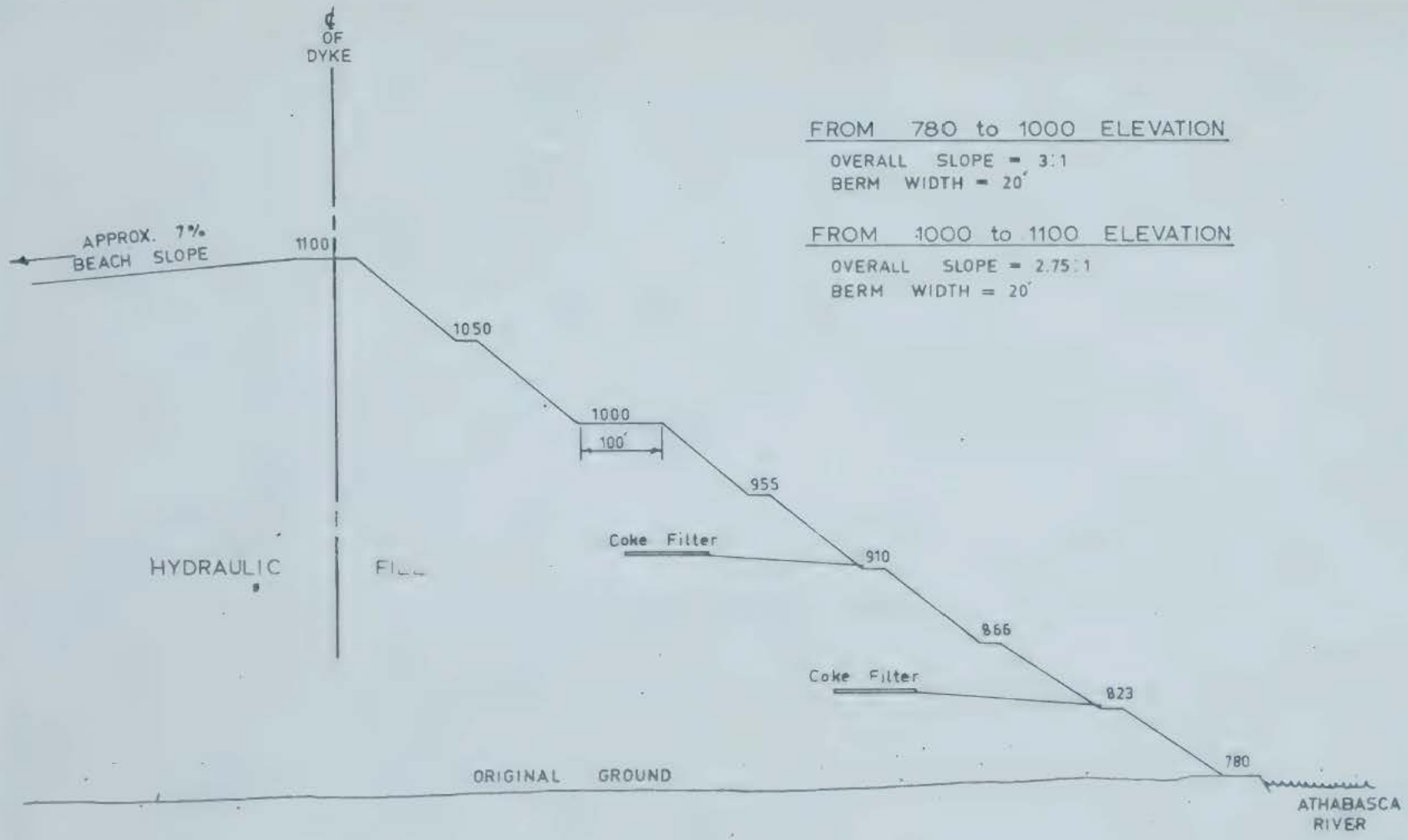
3. More attention must be devoted to the control of surface water runoff on tailings sand slopes. This problem overlaps into engineering aspects of dyke design and construction. We are planning the installation of a comprehensive surface drainage system in 1976.

Future Considerations (continued)

4. A word or two should be said on our long-range plans. In preparation for a long-range reclamation plan, muskeg and/or topsoil material will be inventoried and sampled this winter. The reclamation of 200 acres of tailings dykes and overburden waste dumps and the planting of 100,000 trees and shrubs would not be an unrealistic projection for the next five years. Larger areas will be reclaimed as mining advances and the mine pit is backfilled with tailings sand.

Conclusion

This report presents the G.C.O.S. Reclamation Program in a nutshell. As is evident from the problems described herein, more research is required. However, we are optimistic that a total effort by government, industry and others concerned could reclaim mined oil sands land to an ecologically acceptable condition.



TYPICAL SECTION OF SAND DYKE

SCALE: HORZ.- 1"= 200'
VERT.- 1"=100'

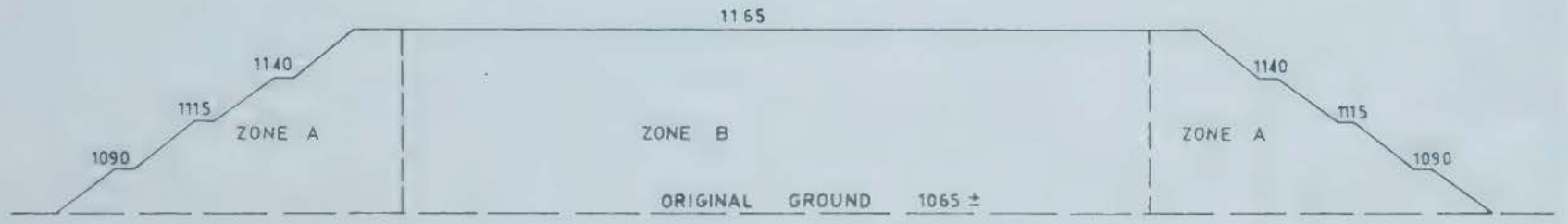
FIGURE I

MATERIAL PLACEMENT

ZONE A – GOOD FILL MATERIAL

ZONE B – MUSKEG & SILT

NOTE OVERALL SLOPE = 3:1
BERM WIDTH = 20'



TYPICAL SECTION of OVERBURDEN WASTE DUMP

SCALE: HORZ. – 1" = 200'
VERT – 1" = 100'

FIGURE II

FIGURE 3 (a) SEEDING MIXTURES & RATES

SPECIES	TAILINGS DYKE - 1974		WASTE DUMP - 1975	
	% BY WEIGHT IN MIXTURE	RATE IN LB/AC	% BY WEIGHT IN MIXTURES	RATE IN LB/AC
Grasses	-	15	-	18
Bromegrass	34	-	20	-
Crested Wheat-				
grass	27	-	17	-
Creeping Red				
Fescue	15	-	6	-
Slender Wheat-				
grass	-	-	17	-
Legume	-	5	-	12
Sweet Clover	7	-	17	-
Alsike Clover	7	-	13	-
Alfalfa	10	-	10	-

FIGURE 3 (b) FERTILIZER COMPOSITION & RATE

SPECIES	TAILINGS SAND			OVERBURDEN		
	LBS/AC			LBS/AC		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
1st Growing						
Season						
Starter	12	48	48	23	23	0 *
Mid-Summer	40	-	-	23	23	0
Maintenance	40	30	20	60	50	50

* No potassium was applied because soil tests showed sufficient available potassium.

TAR ISLAND TAILINS DYKE
TREE AND SHRUBS

FIGURE 4(a) PLANTED IN 1972

SPECIES	% SURVIVAL			
	1972	1973	1974	1975
Caragana arborescens	56.6	45.0	45.0	45.0
Poplar-Populus griffithi	62.0	17.0	17.0	17.0
Aspen-Populus tremuloides	24.0	2.0	0.0	0.0
Birch-Betula papyifera	52.0	16.0	15.0	15.0
Elm, Manchurian-Ulimus pumila	99.0	80.0	79.0	60.0
Pincherry-Prunus pensylvanica	74.0	33.0	25.0	17.0
Choke Cherry-Prunus virginiana	36.0	28.0	25.0	7.0
Buffalo Berry-Shepherdia argentea	15.0	0	0	0
Wolf Willow-Elaeagnus commutata	28.0	2.0	2.0	2.0
Willow-Salix spp	28.0	28.0	25.0	7.0
Jackpine-Pinus banksiana	15.0	15.0	15.0	15.0
White spruce-Picea glauca	9.0	9.0	9.0	9.0

FIGURE 4(b) PLANTED IN 1973

SPECIES	% SURVIVAL		
	1973	1974	1975
Poplar-Russian	36.0	13.0	8.0
Willow-Salix spp	60.0	28.0	17.0

FIGURE 4(c) PLANTED IN 1974

SPECIES	% SURVIVAL	
	1974	1975
Aspen-Populus tremuloides	50.0	32
Poplar-Balsam-populus balsamifera	4.0	2
Birch-Betula papyrifera	24.0	19
Willow-Salix spp	4.0	2
Spruce-Picea glauca	92.0	88
J.Pine-Pinus banksiana	72.0	66
Lodgepole Pine-Pinus contorta	44.6	43
Pine-Hybrid	48.0	45
Balsam Fir-Abies balsamea	30.0	4

FIGURE 4(d) PLANTED IN 1975

SPECIES	% SURVIVAL
	1975
Pinus banksiana-Bare Root	61
Pinus banksiana-Containers	49
Pinus contorta - Containers	51
Picea glauca	51
Picea mariana	36
Alder - Native	24
Willow - Salix spp	88
Maple - Acer negundo L.	77

OVERBURDEN WASTE DUMP No 7
SEEDLINGS

FIGURE 4(e) PLANTED IN 1974

SPECIES	% SURVIVAL	
	1974	1975
Spruce - Picea glauca	96	94
J. Pine - Pinus banksiana	72	55

FIGURE 4(f) PLANTED IN 1975

SPECIES	% SURVIVAL
	1975
Lodgepole Pine - Pinuscontorta	2
J. Pine - Pinus banksiana	35
Spruce - Picea glauca	74
- Picea mariana	73

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FORMERLY
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