Proceedings of the 10th Annual British Columbia Mine Reclamation Symposium in Vernon, BC, 1986.
The Technical and Research Committee on Reclamation

MATERIALS HANDLING AND RECLAMATION OF YUKON PLACER MINES

AN OVERVIEW BY:

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INTRODUCTION

This presentation reports on some preliminary results of a study conducted by Wright Engineers Limited, Norecol Environmental Consultants Ltd. and Focus Minerals for the Northern Affairs Program of the Department of Indian Affairs and Northern Development. Funding was from the Canada/Yukon Economic Development Agreement. The study objective was to investigate the best practical technology for all phases of materials handling in placer mining operations with respect to both the most cost effective mining methods and the integration of mining practices with reclamation. This presentation gives an overview of how materials handling affects revegetation and suggests how alternative methods such as pumping and conveying could improve revegetation.

The geographic scope of the study included the entire Yukon Territoy, a total area of 482,681 km², but this presentation focuses on the Klondike, an area of about 21,000 km² or 4.3 % of the Yukon.

The Klondike Plateau (Bostock 1965) is a low relief plateau averaging about 1,000 metres above sea level in elevation. Bedrock in the region is mainly metamorphic rocks (quartzites, schists and gneiss) with inclusions of sandstone, shale, granodiorite, andesite, basalt and other rocks. The region was glaciated during Wisconsin times only by some valley glaciers from the Olgive Mountains to the north. Most of the lower elevations

are capped with deposits of loess overlying deep gravels.

The Klondike is within the zone of discontinuous permafrost. Brunisols, Greysols and Regosols are the common soil orders in the Canadian System of Soil Classification; Luvisols may occur in some upland areas (Oswald and Senyk 1977).

Natural vegetation is mostly moderately dense to open forests dominated by black spruce (Picea mariana (Mill.) B.S.P.), white spruce (P. glavca (Moench.) Voss) and white birch (Betula papyrifera Marsh.). Trembling aspen (Populus tremuloides Michx.) and balsam poplar (P. balsamifera L.) are common on slopes lacking permafrost or in burned over areas. Willows, Ericaceous shrubs and shrub birch (Betula glandulosa Michx.) are dominant understory species.

HISTORICAL BACKGROUND AND MINING METHODS

Placer mining has been operating in the Klondike for about 90 years. The Klondike has more than half (120) of the 226 active placer mines in the Yukon (1983/1984 data).

Many different mining methods (see Tables 1 through 4) are used but most operations use diesel equipment for stripping and mining (see Table 2). Natural revegetation of mined areas does occur but, to date, little treatment of disturbed areas has been done.

End land use values are often relatively low; re-mining may be the highest end land use in many cases. The small size and transient nature of many operations also restricts capital expenditures and creates logistic difficulties for carrying out reclamation. Therefore, current emphasis is on natural revegetation and on leaving sites in a condition hospitable to vegetation.

Placer mine operations were classed according to one of four deposit types: Gulch deposits, Narrow Valley deposits, Wide Valley deposits, and High Bench deposits.

The scale of the mining operations generally increases from gulch to narrow valley to wide valley deposits. Mining operations of a range of scales are present at high bench deposits. The characteristics of typical mining operations at each class of deposit are summarized in Table 5.

The four types of deposits are discussed in detail in the report (Wright Engineers Limited 1986).

TABLE 1

STRIPPING METHODS AT YUKON PLACER MINING OPERATIONS

METHOD	1983 - 1984		
	< 3 m (10 feet)	> 3 m (10 feet)	TOTAL
	(%)	(%)	(%)
Mechanical	32	47	79
Hydraulicking	0	3	3
Mechnical plus Hydraulicking	0	19	19
Mechanical plus Ground sluicing	1	0	1

TABLE 2

EQUIPMENT UTILIZED AT YUKON PLACER MINING OPERATIONS

EQUIPMENT	1983 - 1984
	(%)
Bulldozers, loaders and hoes	87
Draglines alone	1
Draglines with other equipment	2
Scrapers with other equipment	5
Dredges	1
Hand	4
Hydraulic alone	1

TABLE 3

GOLD RECOVERY SYSTEMS AT YUKON PLACER MINING OPERATIONS

	1983 - 1984 Preclassification		
Concentrator	Not Used	Grizzly	Trommel, Screen, etc.
	(%)	(%)	(%)
Single run sluice	35	14	13
Multi-run sluice	18	3	16
TOTAL - SLUICES	53	17	29
Jigs			< 1
Barrels			< 1

TABLE 4

TREATMENT OF EFFLUENT AT YUKON PLACER MINING OPERATIONS

METHOD	1983 - 1984
	(%)
No treatment	11
Filtration in tailings	11
Settling ponds	56
Settling ponds with recirculation	22

TABLE 5

CHARACTERISTICS OF TYPICAL MINING OPERATIONS

Deposit Class	No. Employees	Pieces Equipment	Pit Shape	Size Classification	Sluice Boxes	Mining Rate (cu.yd/hour)
Gulch	1 - 3	1 - 3	Narrow	Most Operations	Single	30 - 120
Narrow Valley	3 - 5	2 - 4	Rectangular	Some Operations	Single or Multiple	50 - 150
Broad Valley	5 - 6	3 - 5	Square	Some Operations	Single or Multiple	100 - 200
High Bench - Small	1 - 2	0 - 1	Rectangular	None	Single	10 - 75
High Bench - Large	4 - 6	3 - 4	Square	All Operations	Multiple	75 - 100

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OVERVIEW OF THE RECLAMATION PROBLEM

The materials handling practices used involve segregation of materials into size classes as suggested in Figure 1 and leave large areas covered with coarse materials that are in poor configurations (such as ramps, mounds, or ridges) particularly from the point of view of excessive drainage. Field reconnaissance and literature (Brady 1984; Durst 1981; Holmes 1980; Rutherford and Meyer 1981) indicate the importance of substrate and site characteristics related to availability of water: for example, % fines, % macropores, drainage, etc. The general relationship is illustrated in Figure 2. (It is recognized but not documented that other related factors such as temperature and nutrient absorption are also important.)

FIGURE 1

OVERVIEW OF MATERIALS HANDLING PROCESS

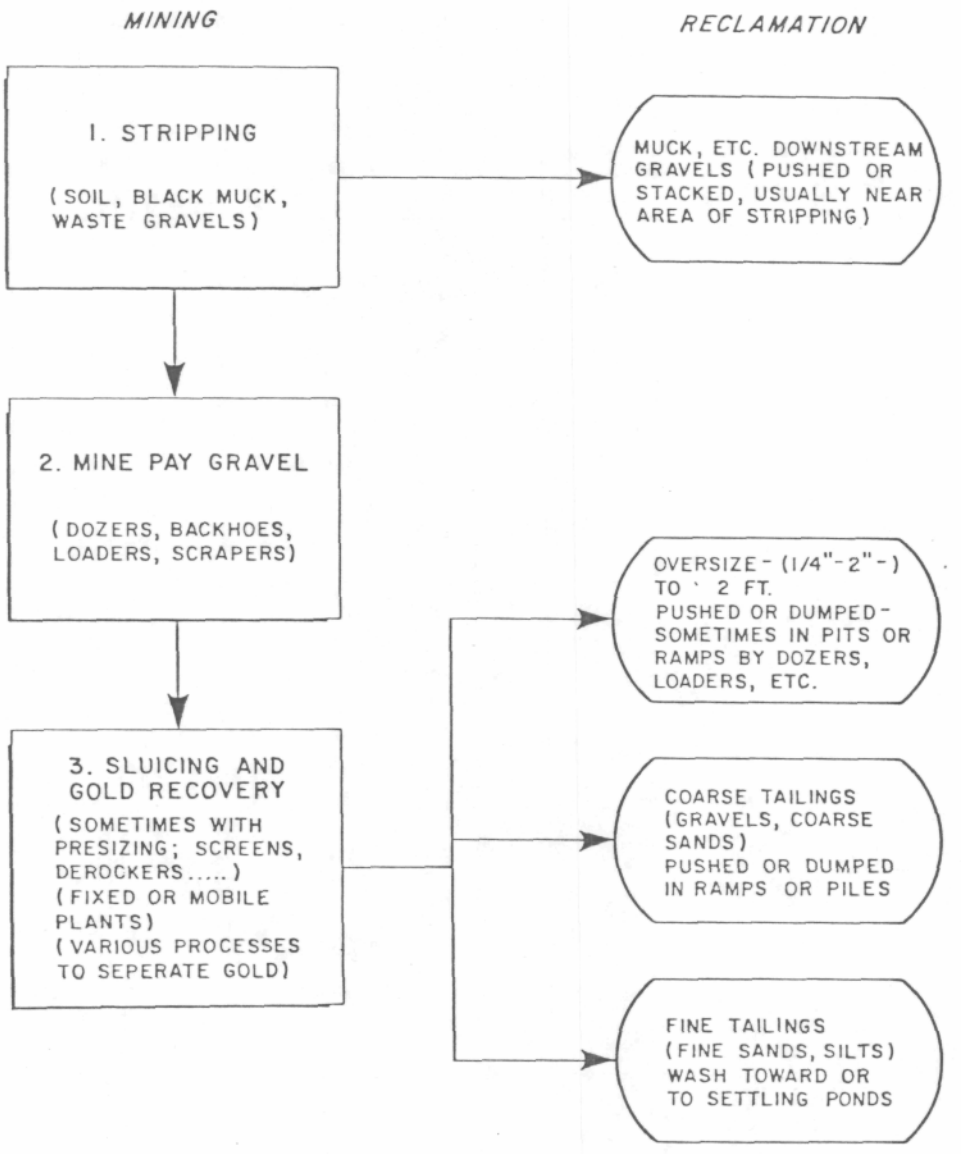
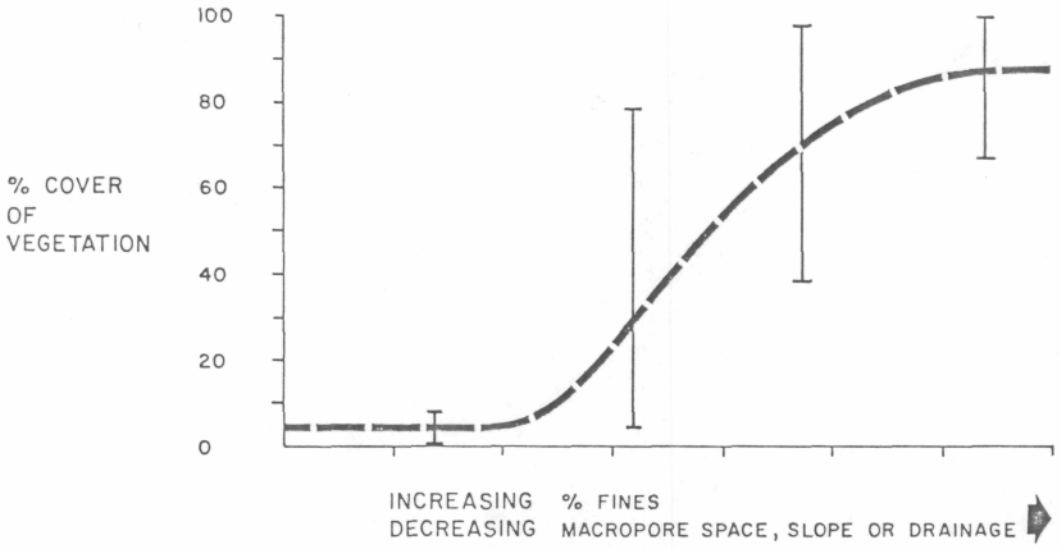


FIGURE 2

TREND OF INCREASING VEGETATION COVER WITH CHANGES IN SOME SUBSTRATE VARIABLES



RANGE OF OBSERVATIONS:

% FINES	0 - 100 %
DRAINAGE	VERY RAPIDLY DRAINED TO POORLY
MACROPORE SPACE	30 - 0 %
SLOPE	60 - 0

CONCLUSIONS

The development of alternative materials handling methods has potential to improve the cost effectiveness of mining and also to aid revegetation because fine tailings, "black muck" and other materials suitable for plant growth may be more easily transported and materials can be placed in more favourable configurations. There is also the opportunity to integrate materials handling practices and costs with reclamation objectives.

The potential is encouraging but more work is needed to test the practicality of materials handling systems in various situations. Surveys of materials variablity and of vegetation as well as field trials using pumping and conveying are proposed.

LITERATURE CITED

Brady, M. A. 1984. Natural revegetation of mining disturbances in the Klondike area, Yukon Territory. M.Sc. thesis. Faculty of Forestry, University of B.C., Vancouver. 122 pp. and appendices.

Durst, J. D. 1981. Vegetation responses to gold dredging at Nyac, Alaska, with wildlife implications: a progress report. Bureau of Land Management. Anchorage District Office, Anchorage, Alaska.

Holmes, K. W. 1980. Natural revegetation of dredge tailing at Fox, Alaska. 2nd Annual Conference on Alaska Placer Mining. Univ. of Alaska. MIRL Report #46.

Oswald, E. T. and J. P. Senyk. 1977. Ecoregions of the Yukon Territory. Canadian Forestry Service, Pacific Forest Research Centre, Victoria, B.C. Info. Report BC-X-164. 97 pp., appendices and map.

R & M Consultants, Inc. 1982. Placer mining wastewater settling pond demonstrations project. State of Alaska, Department of Environmental Conservation.

Rutherford, C. and K. Meyer. 1981. Revegetation on gold dredge tailings, Nyac, Alaska. Bureau of Land Management, Anchorage District Office, Anchorage, Alaska.

Wright Engineers Limited. 1986. Materials handling technology. Draft report on Yukon placer mines for Northern Affairs Program of the Dept. of Indian Northern Development. Project No. 1401-140. March 1986.