RECLAMATION STANDARDS IN THE NATIONAL PARKS OF WESTERN CANADA

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INTRODUCTION

On February 24, 1982, the Federal Minister of the Environment requested the Executive Chairman of the Federal Environmental Assessment Review Office (FEARO) to form an Environmental Assessment Panel to review the environmental and social impacts of the Rogers Pass Development Project that would add a second main railroad through Glacier National Park. The project proposed by CP Rail included a surface route, two tunnels, and an elevated trestle. Extensive cuts and fills were proposed for a 13 km stretch between the north entrance of the Park and a location west of Stoney Creek where the railroad would enter a 1.8 km tunnel under the TransCanada Highway and then would enter a 14.5 km tunnel under Mount MacDonald— the longest in North America.

The Environmental Assessment Panel held public hearings in 1982 and 1983 at which environmental and social issues were aired. Parks Canada expressed doubts as to the likely success of CP Rail's reclamation plan based upon experience with past efforts along the existing CP Rail line at Mountain Creek Bridge in Glacier National Park and at Lake Louise in Banff National Park (Paradine 1983). Parks Canada stressed that effective revegetation was crucial in ensuring both minimal visual impacts and minimal surface erosion.

The Environmental Assessment Panel concluded, among other things, that "There will be significant visual and terrain impacts along the surface route for at least a decade following construction" and that "Stringent revegetation standards should be applied to reclamation of disturbed areas along the surface route" (Paradine 1983). Reclamation standards proposed at the public hearings (Walker 1983) were accepted by the Panel, Parks Canada, and CP Rail and presently are part of a legal agreement between Parks Canada and CP Rail.

The Rogers Pass Development Project has almost been completed. This paper describes the reclamation standards and also provides a background for the standards. Technical information is provided to support the basis for the standards. Suggestions are made for assessing the standards in the field.

ENVIRONMENTAL SETTING

Glacier National Park is located in the Columbia Mountain system in the southeastern interior of British Columbia. The Columbia Moutains are composed of hard, crystalline rocks which resist erosion thus presenting a striking topography of deep, narrow valleys and steep, massive mountain peaks. Because the Columbias are the first large range of mountains east of the Coastal Ranges of British Columbia, precipitation levels are high. Mid-elevations receive about 50 cm of rain per annum and 970 cm of snow. Temperatures are more moderate in the Columbia Mountains than at equivalent elevations in the Rocky Mountains to the east. The moderate temperatures and heavy rainfall allow many plants normally limited to the Pacific Coast to flourish; the valley east of Rogers Pass is occupied by a dense, rain forest of western hemlock, western cedar, and devil's club. Glaciers and avalanche tracts are prominent features of the area. The CP Rail Rogers Pass Development follows an alignment along the west side of the Beaver River valley on slopes that range up to 37° (1.3:1, 70%) in steepness.

RECLAMATION STANDARDS

This section describes standards for reclamation that were adopted by CP Rail and Parks Canada in the form of an agreement for the Rogers Pass Development. The rationale for the adoption of reclamation standards by the principals involved was to provide a concise understanding of expected results to ensure a harmonious working relationship over the course of the construction period and beyond.

Revegetation of drastically disturbed lands is a relatively recent development and a history of experience is lacking that could reduce differences of professional opinion. The adoption of standards allowed CP Rail the freedom to select preferred revegetation methods while protecting the interests of Parks Canada by clearly defining the expected results. The reclamation standards are comprised of four criteria: (1) herbaceous vegetation, (2) self-sustaining vegetation, (3) woody vegetation, and (4) erosion control.

HERBACEOUS VEGETATION

Herbaceous vegetation composed of agronomic grasses and legumes performs several important functions— erosion control, visual impact mitigation, wildlife habitat mitigation, and restoration of soil productivity by the development of a self-sustaining vegetative cover. Two standards are proposed for herbaceous vegetation.

PLANT DENSITY STANDARD

minimum10 plants/m^2
in any area 10 X 10 m
90% minimum frequency

A minimum initial plant density of 108 plants/m^2 (10 plants/ft^2) was suggested by CP Rail as a criteria for remedial seeding (Fox 1983:57). The optimum plant density for maximum forage production in an arid region of western Canada is approximatley 20 plants/m^2 (Leyshon et al. 1981). A density of 20-40 plants/m^2 is recommended for maximum seed production of creeping red fescue (Najda 1986). The value of 10 plants/m^2 was chosen as a minimum plant density because personal experience has demonstrated that such a density will develop a satisfactory stand without excluding the invasion of native species. Invading native plants should be included in the assessment, the area of canopy cover of transplanted woody species should be excluded, and areas of bedrock, blasted rock, and shallow soil over bedrock should be excluded. While the density value is low, the frequency value is high. The standard requires that 90% of the square meters in any area measuring 10 by 10 m should contain at least ten plants. This means that 10 m^2 could be devoid of vegetation and still pass the standard. High densities of agronomic species are undesirable in a National Park setting where the final reclamation objective is a return to the pre-existing vegetation.

GROUND COVER STANDARD

minimum 80% ground cover
in any area 10 X 10 m
including plant litter

Vegetation was selected by CP Rail as the primary method of erosion control (Polster 1983). As such, the vegetative ground cover criteria is very importance in providing an adequate level of erosion control. An extensive amount of research on the effects of associated mulch and vegetative canopy cover indicates that a combined mulch (plant litter) and live plant cover of over 90% can be 99% effective in controlling erosion but that erosion control drops quickly when ground cover is below 70% (Wischmeier and Smith 1978, Warrington 1981). Figure 1 illustrates the relationship between percent cover of vegetation, percent cover of mulch and soil loss ratio. The value of 80% ground cover was chosen as a reasonable compromise that would provide an adequate level of erosion control and yet not exclude the invasion of native species onto the site. Another reason for adopting a ground cover value that is only just sufficient for erosion control is the effect of high ground cover values on the quality of wildlife habitat. Research has demonstrated that wildlife use of reclaimed sites declines as the cover of dense vegetation increases (Mindell 1978, Forren 1981, Kimmel 1982, Whitmore 1980, Wray et al. 1982). Ground cover may be assessed by a number of well established techniques including the point-quadrat method, line-intercept method, 35 mm slide technique, and the ocular estimate method (see Chambers and Brown 1983).

The density and cover standards are compatible with each other. A plant cover of 80% is possible for most grass and legume species at a minimum plant density of 10 plants/m^2. Figure 2 illustrates the number of plants of 17 species of grasses and legumes that are required to provide a canopy coverage of 80%. Plants were space planted at 2 m and coverage was measured after two growing seasons in the Edmonton area. Annual growth is expected to be less under climatic conditions more limiting to plant growth than experienced in Edmonton but there is considerable latitude in the number of plants required to produce the required cover. Sheep fescue was the only species that would require a density higher than 10 plants/m^2 to provide a minimum 80% canopy cover. In addition, accumulated litter is expected to contribute substantially to ground cover after the first 2-3 years. The rationale for the low density is that a small number of large, healthy plants will provide a better vegetative cover for erosion control and adverse climatic conditions than a stagnant stand of crowded plants.

SELF-SUSTAINING VEGETATION

Vegetation must be capable of maintaining cover and density without the aid of applied fertilizers beyond the time when residual effects have ceased.

SELF-SUSTAINING VEGETATION STANDARD

A minimum of 3 growing seasons should elapse after the last inputs of seed and fertilizer before measuring herbaceous vegetation

Residual growth effects from high rates of nitrogen fertilizer can last 4 years (Smith et al. 1968) and even 9 years (Power 1981). A value of 3 growing seasons without fertilizer input was chosen as a compromise that would provide release from reclamation responsibility in a reasonable time period yet provide a assurance that the site is self-sustaining.

WOODY VEGETATION

The primary purpose of woody vegetation was to provide a visual screen to hide the rail right-of-way from the TransCanada Highway located on the opposite valley wall.

STOCKING DENSITY STANDARD

minimum 3000 plants/ha (30/100 m2)
minimum growth rate 20% of native species

The CP Rail reclamation plan called for transplanting densities of 6000 (for trees) to 11,250 (for shrubs) stems/ha (Polster 1983). Typical stocking rates for trees in British Columbia range from 600-700 stems/ha for saw logs to 1200-1600 stems/ha for a mixture of saw logs and pulp logs (Watts 1983). The value of 3000 stems/ha was chosen as a compromise between the higher rates proposed by CP Rail and the lower recommended rates for reforestation. This

value will allow for some transplant mortality without sacrificing the requirement for an adequate visual screen. The question of growth rate may become an issue in areas where woody transplants suffer heavy competition from herbaceous species. Several years may elapse before woody transplants are tall enough to be "released" from competition and a normal growth rate is achieved. When there is a question of whether woody transplant growth is not satisfactory, a minimum growth rate standard is recommended. This rate is 20% of the rate of the same species growing off-site. Growth rate should be measured by incremental annual production (twig or leader length). Where adjacent species of equivalent age are unavailable, comparison should be made to an indicator specimen. Indicator specimens are plants of the same species growing on-site under similar conditions except that competing vegetation has been controlled with herbicides, hand-weeding, or plastic mulches. Assessment of stocking density of woody species should include invading native species. The standard applies to all areas originally transplanted.

EROSION CONTROL

Soil loss by erosion must be controlled to an acceptable level to restore soil productivity and avoid sedimentation of surface water.

EROSION CONTROL STANDARD

maximum soil loss 100 tonnes/hectare/year

Acceptable levels of soil loss tolerance are dependent on several factors. Some soil erosion off-site into native vegetation during the construction period is an unavoidable environmental risk. Plants on the forest floor will be buried and low-lying areas may experience sediment accumulations. Sedimentation of aquatic habitats is best monitored by water sampling and is beyond the scope of these standards. Soil loss tolerance for a reclaimed area depends on balancing erosion losses with soil formation by weathering and accumulations of organic matter. Current soil conservation practice accepts soil loss tolerances in the range of 2-10 tonnes/hectare/yr. depending on the rate of weathering and climatic conditions (Kirby and Morgan 1980). The objective of a self-sustaining vegetative cover requires that organic matter accumulates as rapidly as possible. A soil loss of 100 tonnes/ha represents a loss of less than 1 cm for a typical forest soil. Assessment of the erosion control standard will probably be unnecessary if the preceding reclamation standards are met. However, if serious rill or gulley erosion develops an erosion loss standard may be required to protect the environment. Erosion losses may be determined by a number of methods including erosion pins, sediment collectors, rill meters, and sediment yield in water (see de Ploey and Gabriels).

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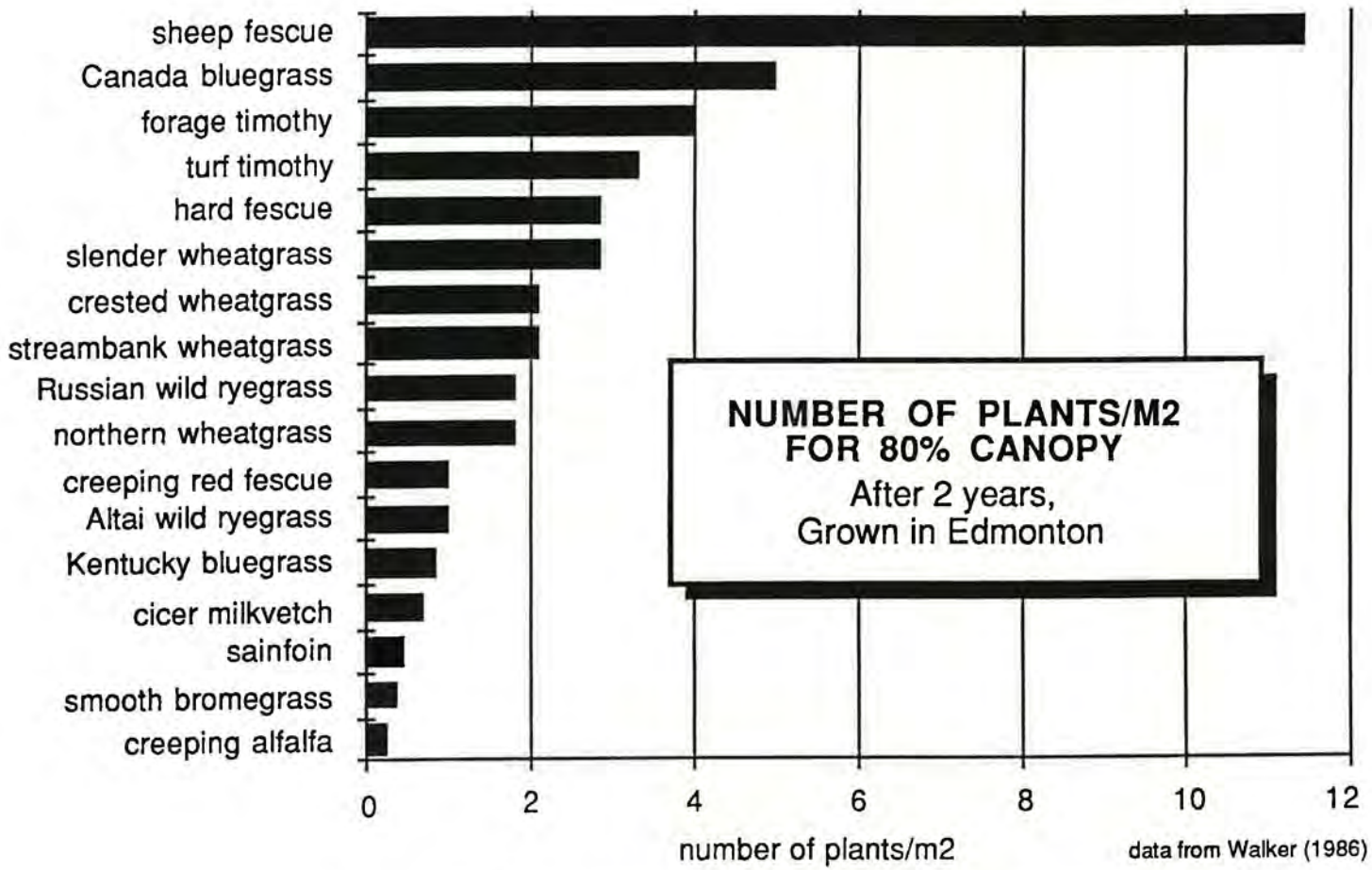

Figure 1. Relationship between plant density and canopy cover.

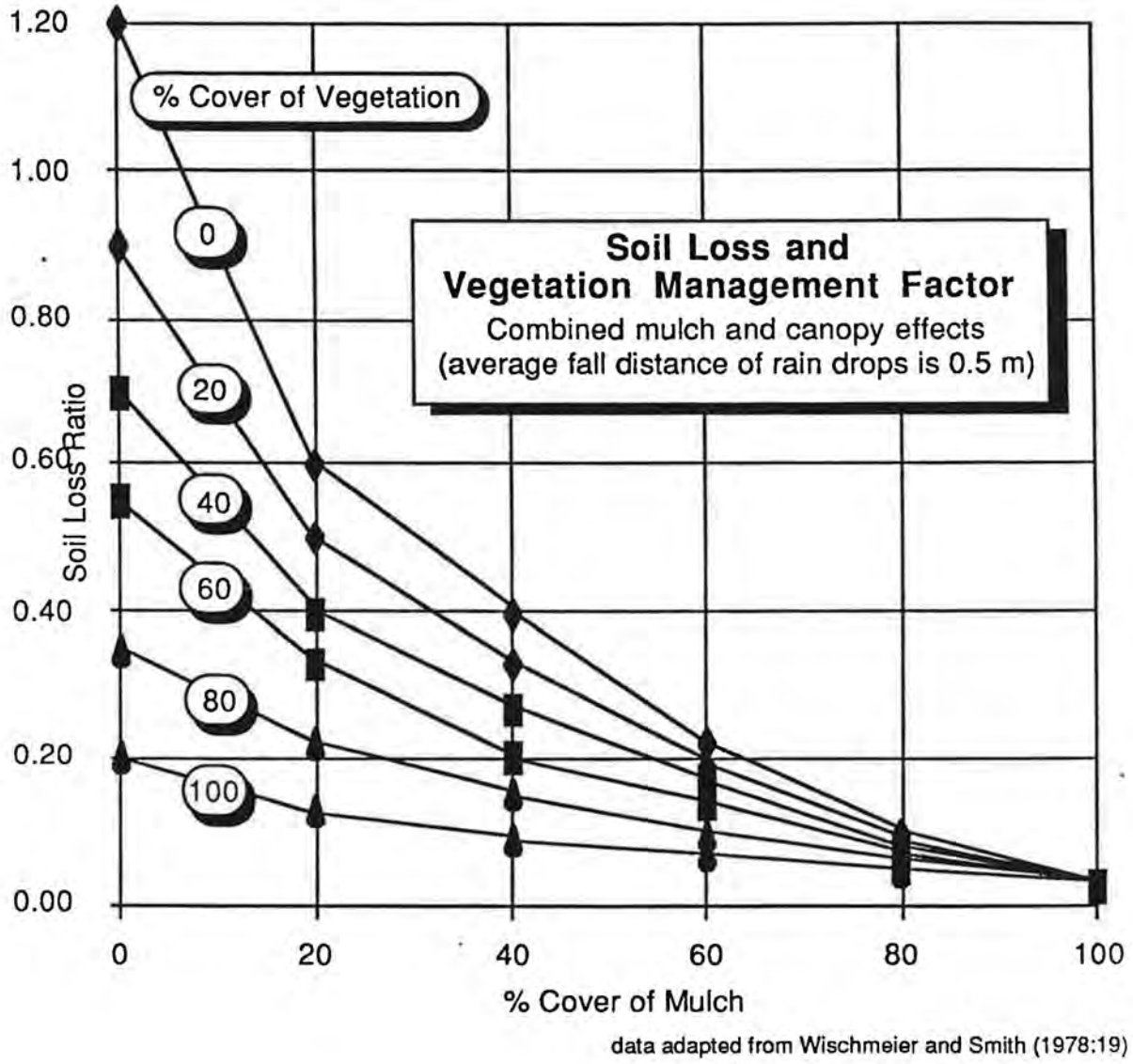

Figure 2. Relationship between ground cover and soil loss.

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
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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, Alberta

Powter, C.B., R.J. Fessenden and D.G. Walker, compilers.

ACKNOWLEDGEMENTS

The Chapter gratefully acknowledges the time and effort put into organizing the 1985 conference by Paul King, Dave Walker, Bob Fessenden, and Chris Powter and the 1986 conference by Chris Powter, Dave Walker, and Bob Fessenden. The Chapter also thanks Debra Scott, Glen Singleton, and Doug Mead for assistance during the conferences.

Much appreciation is also due to the Research Management Division, Alberta Environment, the Reclamation and Reforestation Branch, Alberta Forest Service, and the Terrain Sciences Department, Alberta Research Council for providing manpower, supplies and mailing facilities for the conference pamphlets. Special thanks to Meliza Canafranca and Susan Parker, Research Management Division for typing (patiently) the programs and other material and to Dave Walker and his Mac for the cover art.

Most of the work, however, was done by the speakers who prepared the papers and delivered the talks to us and we offer them a strong vote of thanks.

Last, but not least, thanks to the two hotels for excellent accomodations and facilities.

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

The papers contained in this proceedings are the original, unedited manuscripts provided by the authors.

This report may be cited as:

Powter, C.B., R.J. Fessenden and D.G. Walker. 1987. Proceedings of the 1985 and 1986 Alberta Reclamation Conferences. Alberta Chapter, Canadian Land Reclamation Association. AC/CLRA Report #87-1. 272 pp.

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