# CP RAIL'S ROGERS PASS PROJECT RECLAMATION PROGRAM

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June 2, 1988

*Proceedings of the 12th Annual British Columbia Mine Reclamation Symposium* in Vernon, BC, 1988.
The Technical and Research Committee on Reclamation

## INTRODUCTION

The Rogers Pass Project, currently being built by CP Rail, is the largest single project undertaken by the railroad since the completion of the transcontinental rail line in 1885. The finished project will reduce the west bound grade from the current average of 2.2 percent to 1 percent, compensated for curvature and in the tunnels. The project consists of 17.18 km of new surface grade and two tunnels, one which is 1.83 km long and the other which, at 14.63 km, will be the longest mainline rail tunnel in North America.

Most of the project is being undertaken in Glacier National Park, between Golden and Revelstoke, British Columbia. Concern for the park environment has lead to the establishment of detailed environmental protection and reclamation standards. This paper presents an overview of the reclamation program which has been developed in conjunction with the project. The following sections provide information on the development of the reclamation program and its implementation. The program which has been developed has been termed "successional reclamation" on the basis of the integrated approach to reclamation which has been taken. Special reclamation measures have been developed to deal with the steep slopes encountered along the new grade. Details of these measures are presented.

## RECLAMATION PLANNING

The reclamation program for the Rogers Pass Project was developed in 1982 and 1983, prior to the initiation of major construction on the project. The program was developed in concert with the development of detailed engineering plans, allowing the integration of the engineering design with the reclamation design. Objectives for the reclamation program were formulated early in the planning process. Four major reclamation objectives were established as follows:

- Reclamation of disturbances created in conjunction with the Rogers Pass Project will seek to revegetate exposed erodible materials to minimize erosion and subsequent water quality degradation.

- Reclamation will aid in the amelioration of the visual impacts of cuts and fills through the use of vegetation.

- Reclamation will seek to develop a self-sustaining vegetation cover which is compatible with the naturally occurring vegetation in the area.

- Native species which occur in Glacier National Park will be used where this does not compromise the other objectives of the program.

Reclamation concepts were developed early in the planning process. The development of a suitable rooting medium for plant growth was seen as critical for the establishment of self-sustaining ecosystems on the reclaimed lands. Revegetation of the project disturbances would be based on the natural processes of succession so that these natural process could be used to enhance the reclamation process. Reclamation would be undertaken as sites were completed and the development of the revegetation efforts would be closely monitored to ensure success.

The formulation of reclamation objectives and concepts provided a basis for the development of detailed reclamation plans. However, little was known about the potential for various revegetation species to perform the tasks required to achieve these objectives. Reclamation trials were initiated in the spring of 1982 to test the performance of selected species and species mixes in the field. The trials were developed as operational trials in that they would perform some useful reclamation function should they be successful. In addition, evaluations of the soil materials along the proposed new surface grade in terms of their ability to support plant growth were undertaken. Information on the natural vegetation and successional processes along the new grade was also collected.

Detailed reclamation plans were developed for areas which would be disturbed by the project. The plans provide information on the need for soil salvage, the species composition and any special reclamation measures which should be employed along the new grade, at the tunnel portals and at other project sites. These plans have become working drawings for the conduct of the reclamation work on the project and have become part of every major contract for the project. The reclamation plans were developed with input from the design engineers and the visual impact assessment personnel.

Engineering design for the new surface grade called for the development of cuts and fills at 1.5 : 1 slopes (33.7 degrees) with rock cuts at 0.8 : 1 (51.3 degrees). These slopes were developed to minimize the amount of materials to be moved and to limit the amount of surface area disturbed. However, concern was expressed by Parks Canada that these slopes would be difficult if not impossible to satisfactorily reclaim. The reclamation plans for the project were developed to account for these slopes with the inclusion of a variety of bioengineering techniques for dealing with steep slopes. Some of the soil slopes on the Viaduct section of the surface grade were built at grades of up to 1 : 1 (45 degrees). The following section provides details of the reclamation of these slopes.

The reclamation plans for the Rogers Pass Project are based on the re-establishment of the natural successional

processes which operate in the area, hence the term successional reclamation". Substrates which would support plant growth were selected for use as top dressing. These not need to be top soil, but rather characteristics such the amount of fine textured soil particles were emphasized. The material was required to have a minimum of 18 percent passing a 200 mesh screen to be considered suitable as top dressing. In most cases, top soil was actually used as this material was not suitable for construction of grade and had to be disposed of in some way. it was found that the most efficient manner of disposing of this material in the National Park where wasting *of* material was not allowed was to spread it on the slopes as top dressing. In many cases, the soils which were used to construct the new grade were suitable for reclamation purposes.

Successional considerations were taken into account in the development of the substrate materials. Plant species which pioneer on sites of mineral soil, or pioneering primary successional species, have developed characteristics which aid in the enhancement of the soil for future plant growth. The ability to fix nitrogen and the ability to incorporate large amounts of organic matter in the soil aid in the amelioration of soils which have not previously been vegetated.

Revegetation of disturbed sites was planned to mimic natural succession on disturbed sites. Natural succession occurs in four distinct, although overlapping, phases. The initial phase is the colonization of the site by pioneering species. These are primarily herbaceous. This phase is followed quickly by the establishment of pioneering shrubs. These prepare the site for invasion by pioneering conifers which are in turn replaced by climax conifer species.

In the case of the Rogers Pass Project, plans for revegetation call for a seeded cover of grasses and legumes to be established as the first phase of revegetation. Table 1 shows the species mixes which were developed for the project. Woody shrubs such as willows, alder, red osier dogwood, thimbleberry, elderberry and juniper would planted on the sites to mimic the second phase in the natural successional process. Alder was selected to be the dominant species in the revegetation program for several reasons. Alder has the ability to fix nitrogen, and can thus grow on relatively nutrient poor sites. Large amounts of biomass are produced by this species and can further ameliorate adverse soil conditions. In addition, plantings along the tracks, alder is a shrub, and will therefore not interfere with the operation of trains, can be cut repeatedly and still maintain a healthy root system and it is resistant to damage by heavy snow Loads.

TABLE 1
Grass and Legume Seed Mixes
Rogers Pass Project

| Variety | Species | Percent by Species Composition | Percent by Weight |
|---|---|---|---|
| Dry Sites Mix | | | |
| | Boreal Creeping Red Fescue | 15 | 10.32 |
| | Durar Hard Fescue | 10 | 7.27 |
| | Troy Kentucky Bluegrass | 5 | 1.14 |
| | Sodar Streambank Wheatgrass | 10 | 27.20 |
| | Fairway Crested Wheatgrass | 10 | 20.55 |
| | Chinook Orchardgrass | 10 | 8.54 |
| | Climax Timothy | 15 | 4.93 |
| | Aurora Alsike Clover | 20 | 11.28 |
| | Rambler Alfalfa | 5 | 8.77 |
| Moist Sites Mix | | | |
| | Boreal Creeping Red Fescue | 15 | 11.41 |
| | Troy Kentucky Bluegrass | 5 | 1.26 |
| | Chinook Orchardgrass | 10 | 9.44 |
| | Climax Timothy | 15 | 5.45 |
| | Redtop | 10 | 0.96 |
| | Revenue Slender Wheatgrass | 10 | 29.95 |
| | Aurora Alsike Clover | 20 | 12.45 |
| | Rambler Alfalfa | 15 | 29.08 |

The third and fourth phases of natural succession are represented by the planting of pioneering conifer species such as Douglas fir and lodgepole pine with climax species such as hemlock, red cedar, and spruce. The desire to accelerate the successional process has lead to planning for all of the woody species to be planted in one pass, often in the same year that the site is seeded. This is also a more efficient way to handle the tree planting operations.

The final aspect of the planned reclamation program is a commitment for the maintenance of the sites until they reach a state where they are self-sustaining and where the desired stocking rate has been achieved. As with the rest of the reclamation program, the reclamation maintenance program has been ongoing since the completion of the first reclamation on the project in 1984. In addition to these aspects *of* the reclamation maintenance program, the need to monitor the sites during the first few years for potential soil stability problems was noted. Fresh cuts and fills are prone to settling and readjustment during the first few years. Slumps, seepages and other such problems were

anticipated during the planning process. These are corrected on a site specific basis using a variety of techniques.

Special reclamation measures, designed to treat problem sites were developed with the reclamation plans. Modification of European bioengineering techniques have been made to accommodate the particular conditions of the Rogers Pass Project. Successional considerations have been incorporated in the design of these measures so that, for instance, species which would naturally colonize a moist seepage zone, such as willows and cottonwood, are used for the treatment of such sites as they occur in project areas.

The following section presents details of the operational reclamation program. Details of the reclamation materials and methods are presented as are discussions of their effectiveness.

## OPERATIONAL RECLAMATION PROGRAM

Operational reclamation was initiated on project disturbances in 1984. One of the first major tasks was the landscaping of the construction camp areas. Three camps were constructed to house project workers. Reclamation design for the camp areas was developed to make the camps pleasing places to live. The Rogers camp, which was in operation for the first two years of the project during the summer periods only was seeded with a grass and legume mixture. At the Beaver and Flat Creek camps, year round operation with attendant *snow* removal requirements resulted in a decision to pave the roadways. Lawns were developed with sod. Gravel drip strips were provided around the buildings and covered walkways were built. Large trees were transplanted from areas to be disturbed along the surface grade to the camps. By the end of the 1984 season, the camp landscaping was well established.

Major construction work on the surface grade was initiated in 1984. The first task of the operational reclamation program on the surface grade was the establishment of top dressing salvage zones. These areas had been defined during the reclamation planning process through careful soils assessments. Signs were erected to clearly mark those areas where top dressing could be obtained from., Stripping of top soils was conducted prior to the construction of the new grade. Stockpiles of this material were established. In many cases, soil was stripped from one area and placed on a completed portion of the *grade* in one operation. A surplus of top dressing material developed as the organic soils were stripped in advance of grade construction. Rather than haul this material out of the park, applications of top dressing were made to cuts and fills in addition to those for which top dressing was specified. This resulted in a savings

terms of reduced movement of this material. During construction of the new grade it was found that there was an excess of top dressing materials available in certain sections of the grade. This material was built into toe berms at some of the fills where it would be available for later use if shortages occurred.

Major revegetation work on the project was initiated in the fall of 1984 on sites which had been completed over the summer. A total of 26 acres (10.5 ha) were hydroseeded on project sites and 14.3 acres (5.8 ha) were broadcast seeded. Seed is applied at a rate of 75 pounds per acre (84 kg/ha) while fertilizer (19-19-19) is applied at a rate of from 200 to 300 pounds per acre (224 to 336 kg/ha). In some cases, where the potential for erosion is minimal, no fertilizer is applied. This limits the growth of the seeded grasses and legumes and reduces the food and cover for rodents which tend to be a problem on some sites. Wood fiber mulch is applied with the seed and fertilizer on sites being hydroseeded. The mulch is applied at a rate of between 200 to 400 pounds per acre (224 to 448 kg/ha) depending on the site and the time of seeding.

A total of 20,882 shrubs were planted in the fall of 1984 on completed portions of the new surface grade. Nursery grown stock is shipped to the site in refrigerated trucks and planted immediately. Stock is planted by hand using conventional forestry techniques. A fertilizer tablet is placed in the hole for each plant except alder. Fertilization of alder is thought to reduce the ability of this species to fix nitrogen. In addition to the planting of nursery grown stock, a total of 49 large trees were transplanted from along the new grade to the cut at Mountain Creek which is particularly visible from the Trans Canada Highway.

Reclamation work continued in 1985 with the seeding of an additional 115.6 acres (46.8 ha). Both hydroseeding and broadcast seeding methods were used. A total of 222,016 trees and shrubs were planted during the 1985 season.

Special reclamation measures were developed to treat sites where the normal reclamation methods were insufficient to adequately reclaim the site. Soil binding spray was used in the establishment of a grass and legume cover on some particularly steep rock cuts. Slopes on these cuts were 0.8 to 1, or 51.3 degrees. The soil binding spray, DECI 162, acts to glue the seed to the slope and to hold the fine textured materials in place until the seeded cover can become established. This material was also used on the steep sandy slopes of the ventilation shaft access road which would have otherwise been severely eroded before the vegetation could become established. Bioengineering techniques were used for the first time on the Rogers Pass Project in 1985. Live pole drains, where a bundle of living

willow and poplar cuttings is placed in a shallow trench to drain excess soil moisture, were established at a number of locations. Freshly cut slopes can develop soil moisture problems when groundwater flow patterns are interrupted by the cut. A total of 60 linear feet (18.3 m) of live pole drains were established in the spring on the Mountain Creek cut where shallow soils over bedrock had become saturated and started to slide. An additional 510 linear feet (155.4 m) of live pole drains were installed along the newly constructed surface grade in the fall of 1985.

Living cutting of willow and poplar were used to hold the sod which had resulted from the seeding using the soil binding spray in place on the ventilation shaft access road. These cutting act in two ways to reclaim the slope. The physical presence of the cuttings acts to hold the blanket of sod in place during the first few years of growth. Many of the cuttings take root and grow, adding additional stability to the slope. It is unlikely this slope will cause additional problems as the cuttings have taken root and are now well established.

A total of 222,016 trees and shrubs were planted on the completed portions of the grade during the 1985 planting season. Planting of woody stock was conducted in May, August and October. A dry period during the August planting resulted in the need to water the freshly planted stock.

Construction of the surface grade from Rogers to Stoney Creek was completed by the end of the 1986 season. A total of 210.8 acres (85.3 ha) were seeded, although a tractor was used for 10 acres (4.5 ha) and 5 acres (2 ha) were seeded with hand held broadcasters. A total of 162,931 trees and shrubs were planted during the 1986 season. A variety of bioengineering techniques were employed on difficult sites during the 1986 season. A total of 1,158 linear feet (353 m) of live pole drains were installed on seepages sites along the newly constructed grade. In addition, wattle fences, which are short retaining walls built across the slope using living willow and poplar cuttings, were used for the first time. The fences were constructed on a slope adjacent to the existing mainline track where a steep soil slope was continually ravelling down onto the tracks. The site has an average slope of 53 degrees, although it is flatter near the base and steeper near the top. There is a small bedrock cliff at the base of the slope, with the tracks right below. Wattle fences were built across the slope from about the middle of the slope to the top. The area was then seeded with a grass and legume seed mix and a soil binding spray was applied. Most of the willow and poplar cuttings used in the fences are now growing and the seeded cover forms a dense sod between the fences. No further failures of this slope are anticipated. This form of slope stabilization is significantly less expensive than traditional methods for stabilizing slopes.

The 1987 construction season saw the completion of the surface grade and the laying of track from Rogers to the east portal of the Mount Shaughnessy tunnel. The section *of* grade from Stoney Creek to the tunnel is built on a very steep sidehill. Much of this section was built as a viaduct, or bridge, to carry the track across the worst portion of the sidehill. Reclamation of this area entailed the resloping of the access roads which had been built to construct the viaduct. This was done using backhoes with articulating buckets. Once the area was resloped, the completed portion was seeded. Seeding was conducted throughout the growing season so that there would be as much growth as possible by the end of the season. Trees and shrubs were planted on this area in the fall, and bioengineering works were constructed on the steepest sites.

A total of 73.5 acres (29.7 ha) were seeded in 1987, with most of the seeding being done with a hydroseeder. Trees and shrubs were planted in the early spring and late fall, with a total of 312,293 plants planted. A total of 1,910 feet (582 m) of wattle fences were built, and 806 feet (246 m) of live pole drains were installed. Table 2 provides a summary of the revegetation work completed to the end of the 1987 season.

TABLE 2
REVEGETATION SUMMARY TO NOVEMBER, 1987
ROGERS PASS PROJECT

| | 1984 | 1985 | 1986 | 1987 | TOTAL |
|---|---|---|---|---|---|
| Seeding (in acres) | | | | | |
| Hydroseeding | 26.0 | 101.3 | 195.8 | 66.0 | 389.2 |
| Broadcast seeding | 14.3 | 14.3 | 5.0 | 7.5 | 41.1 |
| Tractor seeding | | | 10.0 | | 10.0 |
| Total Seeding | 40.3 | 115.5 | 210.8 | 73.5 | 440.3 |
| Woody Species | | | | | |
| Alder | 14,393 | 101,383 | 64,493 | 111,069 | 291,338 |
| Cottonwood | | 6,681 | 6,978 | 6,000 | 19,659 |
| Red-osier Dogwood | 2,386 | 17,515 | 18,059 | 18,760 | 63,886 |
| Thimbleberry | 1,991 | 12,448 | 9,925 | 12,200 | 44,733 |
| Willow | 2,112 | 10,085 | 8,350 | | 20,547 |
| Juniper | | 5,490 | 700 | 885 | 7,075 |
| Elderberry | | 4,896 | 965 | 1,680 | 7,541 |
| Paper Birch | | | 640 | | 640 |
| Douglas Fir | | 10,715 | 2,996 | 20,670 | 34,381 |
| Lodgepole Pine | | 4,898 | 1,090 | 12,900 | 18,888 |
| Western Red Cedar | | 5,495 | 6,060 | 7,675 | 19,230 |
| Subalpine Fir | | 1,395 | | 75 | 1,470 |
| Spruce | | 26,835 | 19,275 | 73,284 | 119,394 |
| Western Hemlock | | 14,180 | 23,400 | 31,760 | 69,340 |
| Total Woody Species | 20,882 | 222,016 | 162,931 | 312,293 | 718,122 |

Reclamation work on project disturbances continues this year, with about 50,000 trees and shrubs having been planted this spring, and some touch-up seeding being conducted. Slumping during the spring thaw has resulted in the need for some slope repairs. The project is slated to be completed by the end of this year. Project facilities such as the camps and the contractors yards will be removed and the sites reclaimed. Major revegetation programs are planned for the fall of 1988 and the spring of 1989. It is expected that most of the reclamation work will be completed by the spring, in time for the grand opening of the new line in May, 1989.