ASHCROFT ROOFING GRANULE QUARRY PROJECT
PLANNING AND RECLAMATION FOR A NEW MINE EV AN AREA OF MULTIPLE USE

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ABSTRACT

The Ashcroft Quarry Project, located approximately 65 km west of Kamloops in arid sagebrush-bunchgrass rangeland, entails the extraction and processing of crushed basaltic tuff for the manufacture of roofing granules. The Mining Lease is on Crown land, within the Agricultural Land Reserve (ALR. The quarry and processing plant are expected to operate at least 50 years and will alienate about 45 ha of high quality rangeland grazed by both cattle and wildlife.

Intensive reclamation of the areas of short-term disturbance will minimize the loss of range in the near-term. Final reclamation of the quarry and dump areas will involve the use of both native and agronomic grasses (bunchgrass and annuals), as well as native shrubs and trees. A weed control program, involving the identification and eradication of weed species through mechanical and chemical controls, was initiated in the first year of major site development.
This paper provides a brief description of the development and major planning issues, as well as a review of the reclamation objectives and specific practices employed at the site in the first two years of development.

INTRODUCTION

The Ashcroft Quarry Project is located 3 km east of Ashcroft, B.C., on the south side of the Thompson River (Figure 1). The operator, I.G. Machine and Fibers Ltd., is affiliated with IKO Industries Ltd., a private Canadian company involved in the manufacturing and sale of asphalt roofing materials.

The project entails the construction and operation of a 249,000 tonne per year basalt quarry and a crushing and colouring plant. Associated site works include access roads, a waste dump, a service utility corridor, and a runoff diversion ditch. These site works will ultimately result in the direct disturbance of about 45 ha of rangeland.

The quarry and plantsite are located on Crown land, within the Agricultural Land Reserve (ALR). The bunchgrass rangelands of the site, part of an historic ranch, are under a long-term Grazing Licence. In addition to the Mines Act Permit, the project required approval of the BC Agricultural Land Commission, rezoning of the plant site by the Thompson Nicola Regional District, and extensive consultation with the Range Management Branch of the Ministry of Forests, and various branches of the B.C. Ministry of Environment, Lands and Parks.

The quarry, waste dump and processing plant are expected to operate at least 50 years and will alienate about 45 ha of rangeland grazed by both cattle and wildlife, over the life of the project. The loss of grazing land will be off-set by the reclamation of disturbed lands and through a leaseback arrangement of an adjacent, irrigated field that the project owner has purchased to compensate the Range Licence holder. Additional range mitigation measures include fencing, new stock watering facilities, and an underpass of the site access road.

The primary objective of this paper is to describe the reclamation plan and the practical solutions utilized in the first two years of site development.
SITE DESCRIPTION

**Landform and Soils**

In the vicinity of the quarry and plant site, the soils have been mapped as strongly sloping to moderately rolling (9-15%), rapidly to well drained, Orthic Dark Brown Chernozems, developed on medium to moderately fine textured moraine (Talisman, March 16, 1999). The soils range from slightly to moderately stony and are associated with bedrock outcrops. A very steeply sloping (30~60%), eroded unit of this soil type occurs along the Barnes Creek gully.

Soils classified as Degraded Dystric Brunisols have developed on steeply sloping (30~60%), rapidly drained, stony, gravely, coarse textured colluvial and colluvial fan deposits, occurring between the upland morainal deposits and the glacifluvial deposits along the Thompson River.

**Vegetation**

The development site lies within the Very Dry Hot Bunchgrass (BGxh) Subzone [Thompson Very Dry Hot Bunchgrass (BGxh2) variant] of the Bunchgrass Biogeoclimatic Zone. The primary vegetation association is the Sagebrush (*Artemesia tridentata*) — Bunchgrass (*Agropyron spicatum*) community type (Cascade Environmental Resource Group & Polster Environmental Services, January 29, 1999). Extensive areas within the Mining Lease were reseeded during the 1980s to crested wheatgrass (*Agropyron cristatum*) and alfalfa (*Medicago sativa*).

**Wildlife**

The wildlife survey identified 27 bird, 6 mammalian and 2 herptile species within the Mining Lease (SDF Environmental Contracting, July 26, 1999). Of these, three species (Long-billed Curlew [*Numenius americanus*], Lewis’ Woodpecker [*Melanerpes lewis*] and Great Basin Gopher Snake [*Pituophis melanoleucus deserticola*]) are currently blue-listed (vulnerable), while five are considered sensitive or regionally important.

Regionally important or sensitive species also observed within the Mining Lease include Mule Deer (*Odocoileus hemionus hemionus*) Black Bear (*Ursus americanus*), Chukar (*Alectoris chukar*), Bald Eagle
(Haliaeetus leucocephalus), Blue Grouse (Dendragapus obscurus), and Northern Harrier (Circus cyaneus).

A spring and summer search for western rattlesnake (Crotalus viridis) and hibernacula over the Mining Lease showed no evidence of either snake presence or potential hibernacula.

Archaeology

Eleven archaeological sites have been identified within the Mining Lease. Two sites of "low to moderate" significance were located within the proposed footprint of the project works. One site, along the lower terraces of the South Thompson River, is rated as having particular scientific and ethnic significance, while the remaining sites are rated as having "low" significance.

Land Use

In addition to its high ecological values, the site is primarily used for cattle grazing in the early spring or late fall. The adjacent Barnes Lake recreation area is intensively used year round for camping, boating and fishing. Recreational use of the site, including hiking and hunting, has been curtailed by range fencing, signage and gating of road access.

Grazing

The development area occupies or crosses parts of four, separately fenced, critical spring/fall open rangeland pastures. The range is used on a rotational basis with 3 out of the four pastures being used in any given year for spring/fall use.

The range pastures are either fenced or bounded by natural barriers such as gullies or rock outcrops that deter cattle movement. In the 1980's, significant areas of the site were cleared of sagebrush and reseeded to crested wheatgrass with a minor inclusion of alfalfa, using a rangeland drill. Water is a limiting factor in efficient use of this spring/fall range. A cattle watering trough fed by piped spring water is located along the east central boundary of the range unit and cattle also use Barnes Creek, which is difficult to access because it is in a deeply incised, steep sided gully.
PROJECT DESCRIPTION

Project Works

The major project works comprise the quarry, the plant site, the waste dump, the main site access road, a runoff water diversion channel, and a utility corridor. A plan view of the general layout of the 25 year quarry, waste dump and plant site shows a relatively confined area of disturbance; 1 km by 0.8 km, with a total area of disturbance of about 45 ha (Figure 2).

Quarry

The basalt rock is a combination of mafic tuff and mafic lapilli tuff/breccia, as well as other mafic volcanic rock, with proven reserves of about 7 million tonnes and inferred reserves of about 30 million tonnes (Clifton Associates Ltd., 1999). At the proposed annual production rate of 250,000 tonnes, this is equivalent to 15 years (proven) to nearly 50 years (inferred) of extraction.

The maximum extraction depth is approximately 50 m for the 25 year plan and 80 m for the 50 year plan. The area disturbed by the quarry (25 year) is estimated to be approximately 15 ha.

For each tonne of rock extracted from the quarry, 0.55 tonnes of product will be recovered and 0.45 tonnes of fine crusher waste material (medium sand to silt size material) will be produced.

Waste Dump

The waste dump, located in a remnant glacial gully adjacent to the quarry, is designed to accommodate at least 50 years of waste material. The area occupied by the 25 year waste dump, haul road and dam is estimated to be approximately 14 ha.

At DCO's Ontario plant, which is very similar to the Ashcroft operation, some of the waste reject is screened and sold for use as road maintenance sand, and some of the fine reject is used as filler in the production of shingles. The growth of the waste dump will be governed both by the rate of waste production, related to the quarry production rate, and the local consumption of the waste for other purposes.
FIGURE 2
PROJECT WORKS

Waste Dump (50 Year)

Utility Corridor

Diversion Ditch

Plantsite

Water Line

Topsoil Stockpile

Overburden Stockpile

Quarry (50 Year)

Dam

Cattle Underpass

Access Road

Barnes Lake Road

0 200 400 600 800 1000 (metres)

N S E W

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Plant Site

The plant site lies immediately east of the quarry. The site will contain the secondary and tertiary crushing plant, the colouring plant, offices, storage silos, and an employee parking lot. The plant site occupies 4 ha.

Site Access Road

The plant and quarry are accessed off of Barnes Lake Road, which was upgraded in 1999 to allow year-round trucking of materials and product. The site access road, also constructed in 1999, is about 1 km in length, covering about 3 ha.

Utility Corridor

The utility corridor, which will contain buried water and gas lines as well as the overhead electric transmission line, extends from the benches of the Ashcroft industrial area along the South Thompson River to the quarry/plant site, a distance of 3 km. An 8 to 10 m wide section of the utility corridor was cleared and grubbed in the fall of 1999, and the transmission line was installed. The utility corridor width will be increased to 15 m this year, and the gas and water lines installed. The water system will likely draw from the South Thompson River, although groundwater investigations are currently being carried out to look at the potential of well water.

Diversion Channel

A runoff diversion channel and containment facilities have been constructed to protect Barnes Creek and the waste dump by intercepting high run-off volumes up-hill of the site works and diverting flows into a natural drainage gully north of the waste dump.

Construction Schedule

Construction activities carried out prior to and during 1999 included:

1. an intense pattern of 45 exploratory diamond drill holes in the quarry area, (roughly 50 m spacing);
2. a series of 9 geotechnical holes to assess quarry and waste dump stability;
3. construction of exploration trails and a main tote road (about 3.6 ha total, temporary disturbance);
4. initial soil stripping and some bedrock blasting for rough leveling in the plant site (5 ha);
5. overburden removal in the initial quarry extraction area (5 ha) and topsoil removal from the quarry staging area (5 ha);
6. construction of a 1 km long, site access road (3 ha);
7. creation of overburden and topsoil storage piles (1.4 ha additional disturbance);
8. clearing and grubbing of an 8 m wide utility corridor and installation of a 3 km electrical transmission line (3 ha);
9. construction of two small dams and 500 m long diversion ditch (2 ha).

The total area of site disturbance to the end of 1999 was about 27 ha (Figure 3).

Construction activities planned for this year include:

1. completion of plant site excavation, backfilling, compacting, and grading;
2. construction of plant foundation and building;
3. construction of water intake and pumping station on the South Thompson River;
4. widening of utility corridor to 15 m and installation of gas and water lines;
5. construction of a water reservoir for plant use and fire fighting requirements;
6. installation of weigh scale and truck turn-around.

The plant will be competed in the spring of 2001 and is expected to be operational that summer.

PROJECT PLANNING

Environmental and Resource Use Issues

The major environmental and resource use issues identified in the project planning and permitting phase included the following:

- erosion control and water quality protection;
- protection of the sensitive grassland ecosystem and associated wildlife;
- maintenance of historic rangeland use;
- minimizing aesthetic, noise, and air quality impacts on local residents and Barnes Lake recreation area users; and
protection of archaeological sites.

As the Mining Lease is in the ALR and under Grazing Licence tenure, a considerable effort was expended in pursuing Agricultural Land Commission approval, in consultation with the Ministry of Forests Range Division, and the ranching community. The following primarily addresses the soil salvage and initial revegetation programs that are being carried out in the first two years of project construction.

**Impact Avoidance and Mitigation Planning**

Potential impacts on agricultural (grazing) use, wildlife habitat, known archaeological sites, and Barnes Lake recreation users, were avoided or reduced through specific project planning and design measures, including:

- avoidance of high value archaeological sites;
- the quarry was designed to include a west backwall separating the quarry and potential runoff from Barnes Creek;
- strategic location of the plant site in a depressional area and reduction of building height to reduce its visibility from Barnes Lake;
- strategic location of the waste dump to minimize potential dust generation and to enhance rangeland capability following dump reclamation;
- strategic location of the site access road and the utility corridor to avoid fractionation of high capability range pastures to the extent possible;
- installation of range fencing, cattle watering facilities, and a cattle underpass;
- purchase of deeded hay land and a lease back to the Range Licence holder to compensate for range impacts.
- development of a detailed reclamation plan to address erosion control and revegetation requirements for replacing both wildlife and cattle grazing values; and
- implementation of a weed control program.

The major components of the reclamation plan are described in the following.
Reclamation Plan

The Initial Environmental Assessment and Reclamation Plan (Cascade Environmental Resource Group & Polster Environmental Services, January 1999) provides the following (slightly abridged) reclamation objectives:

1. to protect the land from wind and water erosion and protect aquatic resources (Barnes Creek) from sedimentation;
2. to provide a vegetation cover that is compatible with the surrounding vegetation and has a productive capacity, for both cattle and wildlife, equal to or greater than currently exists;
3. to be self-sustaining and to encourage the establishment of later successional species, where desired.

The detailed reclamation strategies address the six major disturbance areas, notably the:

1. quarry (total removal of soil and overburden, resulting in a terraced bedrock landscape);
2. waste dump (landscape burial and creation of new landform through sand/silt waste placement);
3. plant site (soil salvage and leveled surface);
4. utility corridor (temporary disturbance including soil salvage and replacement);
5. temporary roads and disturbed sites (loss of vegetative cover, soil disturbance, potential for weed growth); and
6. site access road (soil salvage, significant cut and fill).

The reclaimed quarry will have no practical grazing value because of the difficult access created by the steep bench faces. Reclamation in this area and the steepest face of the waste dump will target maximising wildlife values, especially for bird and small mammal use. The remaining areas will be reclaimed to crested wheatgrass or bunchgrass rangeland, depending on their pre-development use. Of these areas, the most extensive area of natural bunchgrass is associated with the utility corridor.

The use of agronomic species will continue in areas previously seeded to crested wheatgrass, however it is the intent of the proponent to utilize native species, including bluebunch wheatgrass, along the utility corridor, an area of extensive native range. Final reclamation in the quarry and dump areas will involve the use of both native and agronomic grasses and native shrubs.
Plan Implementation

Construction during the first year (1999) resulted in a number of disturbances covering approximately 27 ha, which required a combination of short, medium and long-term reclamation works. The principal reclamation activities included detailed soil suitability mapping, topsoil and overburden salvage, and extensive hydro-seeding of disturbed areas. A brief description of the site-specific reclamation activities follows. Figure 3 delineates the disturbed areas that were reclaimed in 1999.

Plant Site and Main Access Road

Prior to disturbance in the plant site and access road areas, a detailed (approximately 2 inspection sites per ha) soil survey and mapping program was undertaken to determine soil suitability and depth. Using published soil quality criteria (Alberta Agriculture, 1987) it was determined that the common thickness of suitable topsoil ranged from 25 to 40 cm. Limitations primarily included excess coarse fragments (particles greater than 2 mm diameter), and to a lesser extent salinity/sodicity in seepage collection areas, as well as rockiness (exposure and shallow depth of bedrock) in ridged areas. The deeper subsoil generally displayed firm consistence and a high lime (CaCO₃) content.

Soil salvage was conducted using a bulldozer to pile the topsoil and a loader to load dump trucks used to haul topsoil to the long-term stockpile (Photos 1 & 2, Appendix 1). The topsoil stockpile, covering about 1.4 ha, is located in a well drained area, out of the way of future project disturbances. The steepest face of the topsoil pile was regraded to less 35% gradient and tracked to create micro-sites for moisture retention and seed capture. The topsoil is composed primarily of high suitability, silty, non-gravelly material.

Quarry

The detailed soil survey indicated that it was not feasible to salvage highly suitable topsoil separately from subsoil in the bedrock controlled, ridged portion of the quarry. In this area, bulk soil (mixed topsoil and heterogeneous, till-like overburden) was salvaged using an excavator, while topsoil was separated from the subsoil in the more gently sloping, glacial till dominated southeastern corner, by dozer.
The bulk overburden stripped from the quarry area was stockpiled separately from the topsoil in a low, berm along the south side of the quarry. The berm provides a visual and sound barrier to the south of the plant site. As for the topsoil stockpile, the berm was regraded and tracked for ease of revegetation. The heterogeneous, overburden material may be used for bulk fill or deep root zone material in future site reclamation activities.

**Diversion Channel**

Shallow topsoil and cobbly subsoil on steeply inclined portions of the alignment made soil salvage impractical. Topsoil was not separated from subsoil along the steep segment of the ditch alignment. Only in the gently sloping area of crested wheat-grass, at the north end of the alignment, was topsoil salvaged (windrowed separately) and replaced over the recontoured ditch surface. Mixed soil (topsoil and subsoil) fill was recontoured to form the outer shoulder of the channel. The fill surface and adjacent shallow gradient ditch bottom were tracked to improve seed micro-site conditions. Subsequently the area was hydroseeded (crested wheatgrass dominated mix) along with a hydromulch, tackifier and fertilizer.

This is the final treatment for this area. Some on-going vegetation maintenance may be required along the steep cutbank of the ditch as well as along the traveled portion of this trail, as it is the primary access for diversion dam maintenance.

**Utility Corridor**

Initial work in the corridor was related to the installation of the 3 km long, wood pole electrical transmission line. A narrow trail was required for construction access.

Soils along the corridor vary widely in their character, including a silty aeolian capping on cobbly till, loose, medium sand to gravelly fluvio-glacial deposits, and minor areas of shallow colluvium and bedrock. The topsoil was windrowed by bulldozer to one side of the alignment, and then the other side was rough leveled to permit equipment access. The salvage thickness of the organically enriched, non-calcereous topsoil layer was generally 0.3 m. On the very steep sections of the corridor, it was not possible to separate topsoil from subsoil, hence the windrowed material was mixed.

The topsoil was generally placed along the lower side of corridor, for temporary storage, to permit construction access for the power pole and pipeline (water and natural gas) installations. The existing
construction corridor will have to be widened this year, from about 8 m to 15 m, to allow pipeline installation. Prior to pipeline installation, additional topsoil will be salvaged and stockpiled to one side of the corridor. Because of the ridged topography and extremely steep slopes, an excavator hoe will have to be used.

For over-winter protection, a series of temporary cross berms or water bars were installed on the steepest sections of the utility corridor. The entire alignment received an application of wood fibre mulch with tackifier and was seeded to annual rye for early spring germination.

Access Road

Reclamation activities along the 1 km long access road included topsoil salvage over the footprint of the disturbance, with long-term storage in the stockpile at the plant site, and direct reseeding of the steep (1.5:1) cut and fill slopes (Photo 3). These very steep, often credible, droughty slopes were hydroseeded with a bonded-fibre matrix (BFM) which was applied in a couple of thin layers and included fertilizer and seed mix components. The seed mix included fast germinating annual rye grass, as well as crested wheatgrass and a legume (alfalfa).

Where space allowed in the road side ditches, check dams were installed to reduce the potential flow velocities and to retain coarse sediments that could be periodically cleaned out (Photo 4).

Other disturbances

A number of other disturbances were associated with the development including a temporary tote road for site access, a pump trail to access Barnes Creek for water, and the trails to drill holes and the old bulk sample track. Soil was not salvaged along these temporary disturbances.

Considerable surface and shallow subsurface compaction occurred on the heavily used tote road. Upon abandonment, its surface was deep ripped, using a 2 tyne equipped dozer, and tracked to create a suitable seedbed. Dozer tracking was a common treatment on most disturbed surfaces. These areas were hydroseeded with a standard mulch, tackifier, fertilizer- and crested wheatgrass dominated seed mix.
The pump trail had two very steep sections where water bars were installed at frequent spacing to prevent excessively long runoff channels from forming. The bulk sample track was ripped and tracked to alleviate compaction and till weeds prior to reseeding with agronomic range species.

**Longer-term Issues**

A few issues that will be assessed further as the reclamation program progresses include:

- effectiveness of erosion control methods;
- productivity assessment of reclaimed range (set up of monitoring sites);
- source and viability of agronomic and native plant materials (grasses and shrubs);
- topsoil replacement trials: topsoil replacement through the use of organically amended 'sterile' waste materials (angular sands and silts), where amendments may include various organic materials such as animal manure; and
- effectiveness of weed control methods.

**ACKNOWLEDGEMENTS**

We wish to acknowledge our clients, owners of the Ashcroft Rock Quarry, IG Machine & Fibers Ltd., for their cooperation in allowing us to present this paper. Throughout this project, we have maintained close liaison with personnel from the Ministry of Energy and Mines, the B.C. Agricultural Land Commission and the B.C. Ministry of Forests, who have been very supportive and pro-active in project planning and implementation. The project team continues to work closely with Bruce Rendell, of IG Machine & Fibers Ltd., the current Project Manager. We would also like to pay special tribute to Lome Warner, the former Project Manager, who tragically passed away during the first year of project construction.

Project Team:
- Clifton Associates Ltd. (geology and engineering);
- Areas Consulting Archeologists Ltd. (site archaeology impact assessment);
- Cascade Environmental Resource Group & Polster Environmental Services (initial environmental assessment & reclamation plan);
- Shaun Freeman, (wildlife inventories);
- Talisman Land Resource Consultants Inc. (agricultural assessment and detailed reclamation program).


Province of BC. Soil Conservation Act — Section 3
Province of BC. Agricultural Land Commission Act — Sect 22 non-farm use
APPENDIX 1
SITE PHOTOS
Photo 1: Topsoil salvage in the plant site area was undertaken using a D9 bulldozer.

Photo 2: Facing east over the stripped plant site to the recontoured and hydroteeded topsoil stockpile. Prior to hydroteeding, the slopes were reduced to 2:1 and tracked vertically by cat to reduce erosion and assist germination in the spring.
**Photo 3:** Facing north along the west side of the site access road. Note the check dams in the ditch and the hydroseeding of the cut slopes. The Bonded Fibre Matrix has been applied to the steep cut banks (tan colored area) and the standard hydroseeding mix to the more gentle slopes (light green areas).

**Photo 4:** Contractor applying a layer of bonded fibre matrix along a steep cutbank in the weathered rock and glacial till. The photo is taken looking north near the north end of the access road.
APPENDIX 2

REVEGETATION PROGRAM FOR YEAR 1

The revegetation program was implemented to stabilize the soil surface from wind and water erosion, retard the invasion of weeds and re-establish range species in temporarily damaged grazing areas.

The following describes the hydroseeding program carried out at the end of the 1999 construction season (Oct 29- Nov 7).

Project disturbances primarily within areas of crested wheatgrass range were hydroseeded to the following mixture:

- Crested wheatgrass 32 kg/ha
- Annual ryegrass 30 kg/ha
- Alfalfa (Beaver) 2 kg/ha
- Fertilizer (18-18-18 & S) 300 kg/ha
- Mulch (EcoFibre) 2,200 kg/ha
- Tackifier 66 kg/ha

Areas reseeded to this mixture covered 9.5 ha, including:

- the topsoil/overburden stockpiles;
- the diversion dam and ditch disturbance;
- the Quarry bulk sample access road and the perimeter of the Quarry (except its south side);
- the tote road and miscellaneous disturbances resulting from vehicular traffic and exploration equipment;
- perimeter of the plant site and eastern topsoil salvage area.

Cut and fill slopes along the site access road that were 1.5:1 or greater in gradient, totaling 1.7 ha, were seeded to the same seed and fertilizer mixture, though the standard mulch was replaced with 4000 kg/ha of Bonded Fibre Matrix (EcoAegis).
Areas along the utility corridor, totaling 2.7 ha, primarily within natural bunchgrass rangeland (i.e., not previously planted to crested wheatgrass), were hydroseeded, for temporary protection, to a modified mixture which included:

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall rye</td>
<td>40 kg/ha</td>
</tr>
<tr>
<td>annual rye</td>
<td>15 kg/ha</td>
</tr>
<tr>
<td>mulch (Ecofibre)</td>
<td>2200 kg/ha</td>
</tr>
<tr>
<td>tackifier</td>
<td>66 kg/ha</td>
</tr>
</tbody>
</table>

**Note:** The utility corridor hydroseeding was carried out to prevent erosion over the winter 1999/early spring 2000 period. As the corridor will be widened from approximately 8 m to 15 m during the 2000 construction period, and the hydroseeded area will be completely disturbed again, no bunchgrass or fertilizer was included in the mixture.