



Section F

Conservation and Reclamation Plan

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F. CONSERVATION AND RECLAMATION PLAN

F.1 INTRODUCTION

The following document presents the objectives and methods that will be used to develop and reclaim the lands disturbed by Benga Mining Company's (Benga) Grassy Mountain Coal Project (Project).

This Conservation and Reclamation (C&R) Plan for the Project has been prepared to:

- provide information about the planning process for the ongoing reclamation and the ultimate closure of the Project; and
- provide the goals and endpoints for the development and reclamation of the Project.

The closure plan provides an overview of the development and reclamation plan, while the conservation and reclamation plan focuses on the 27-year mining and reclamation plan.

This document forms the basis for the application for approval of the Project under the *Alberta Environmental Protection and Enhancement Act* (EPEA). It contains information required as per Section 3.2.8 of the Terms of Reference (ToR) for the Project issued by the Alberta Energy Regulator (AER) (Appendix 1), which states:

3.2.8 Conservation and Reclamation

[A] *Provide a conceptual conservation and reclamation plan for the Project. Describe and map as applicable:*

- a) *any existing Conservation and Reclamation Plan;*
- b) *current land use and capability and proposed post-development land use and capability;*
- c) *anticipated timeframes for completion of reclamation stages and release of lands back to the Crown including an outline of the key milestone dates for reclamation and how progress to achieve these targets will be measured;*
- d) *constraints to reclamation such as timing of activities, availability of reclamation materials and influence of natural processes and cycles including natural disturbance regimes;*
- e) *post-development land capability with respect to:*
 - i. *self-sustaining topography, drainage and surface watercourses representative of the surrounding area,*

- ii. *existing traditional use with consideration for traditional vegetation and wildlife species in the reclaimed landscape,*
 - iii. *end pit lakes,*
 - iv. *wetlands,*
 - v. *self-sustaining vegetation communities representative of the surrounding area capable of ecological succession, and*
 - vi. *reforestation and forest productivity;*
- f) *a revegetation plan for the disturbed terrestrial, riparian and wetland areas;*
 - g) *water supply capability of post-mine landscape;*
 - h) *reclamation material salvage, storage areas and handling procedures;*
 - i) *reclamation material replacement indicating depth, volume and type;*
 - j) *existing and final reclaimed site drainage plans;*
 - k) *integrating surface and near-surface drainage within the Project Area; and*
 - l) *promotion of biodiversity.*
- [B] *Provide a map of the predicted Ecological Land Classification for the post reclamation landscape considering potential land uses, including traditional uses and how the landscape and soils have been designed to accommodate future land use.*
- [C] *Provide a conceptual plan to monitor reclamation performance and success (including soils, vegetation, wildlife and aquatic resources).*
- [D] *Describe how the use of progressive reclamation was considered in the project design and reclamation planning.*
- [E] *Discuss uncertainties related to the conceptual reclamation plan.*

Additional legislation and direction regarding the reclamation of coal mines includes:

- *C&R Regulations of EPEA (Province of Alberta, amended to 2014);*
- *C&R Guidelines for Alberta (Alberta Environmental Protection[AEP], 1997);*

- "A Guide to the Preparation of Applications and Reports for Coal and Oil Sands Operations" (Land Conservation and Reclamation Center [LCRC], 1991); and
- *Guide to Content for Industrial Approval Applications: New, Renewal and Amendment*, April 2012 Draft.

F.1.1 The Company

Benga Mining Limited (Benga), a wholly owned subsidiary of Riversdale Resources Limited (Riversdale), acquired the Grassy Mountain, Bellevue, Adanac, and Lynx properties from Devon Canada and CONSOL of Canada (50/50 Joint Venture) in 2013 (Figure A.3.1-1). Post-acquisition, Benga have focussed their interest on the Grassy Mountain property, which comprises approximately 2,800 ha of the total Crowsnest Pass acquisition. Development efforts to date have included the pre-feasibility study work, a re-evaluation of the historical coal quality data, and the development of a detailed engineering feasibility study. Further details regarding Benga are provided in Section A.3, with rationale for the Project Need in Section A.2.

F.1.2 Project Components

Benga has the opportunity to develop a world class steelmaking coal mine supplying global seaborne markets and further enhance Canada's reputation as a supplier of high quality metallurgical coal to the world's largest steel makers who continue to be key players in global growth and industrialization. The Project components are shown on Figure F.1.2-1. Table F.1.2-1 provides the estimated areas of disturbance associated with the Project components for the Project.

Project Component	Component Area (ha)	Percentage of Development (%)
Coal Handling Processing Plant and Infrastructure	94.1	6.2
Coal Load-Out and Railway Loop	33.1	2.2
Construction Camp	1.9	0.1
Haul Road	0.3	<0.1
Powerline, Access and Conveyor RoW	15.2	1.0
Reclamation Material Storage	37.9	2.5
Surface Water Management Ponds and Ditches	74.6	4.9
Ultimate Rock Disposal Extent	589.9	38.8
Ultimate Pit Extent	632.4	41.6

Table F.1.2-1 Summary of Spatial Extent of the Primary Project Components		
Project Component	Component Area (ha)	Percentage of Development (%)
Proposed Water Pipeline/Service Road Right of Way	1.5	0.1
Proposed Golf Course Development ¹	38.1	2.5
Proposed Helipad Access ¹	1.6	0.1
Total Mining Activities Reclamation Area	1,481.0	97.4
Total Non-Mining (Incidental) Area ¹	39.7	2.6
TOTALS²	1,520.7	100

¹ Benga Reclamation Responsibility include “incidental physical activities” identified by CEAA

² Due to rounding of values, totals may not equal the sum of the individual values presented in the table.

The development and reclamation of the mine project will be phased over time and will allow for implementation of a progressive reclamation program. Figures of the annual mining and reclamation progressions are provided in [Section C.1 \(Figures C.1.3-1 to C.1.3-25\)](#).

F.1.3 Project Location

The Project is located in southwest Alberta near the Crowsnest Pass, approximately 7 km north of the community of Blairmore ([Figure F.1.2-1](#)). The Project involves a surface metallurgical (steel making) coal mine, a coal handling and preparation plant (CHPP), and associated infrastructure including a coal conveyor system, a rail load-out facility, an access corridor, maintenance shops, and other pertinent facilities. The rail load out facility will displace a portion of the Crowsnest Pass Golf and Country Clubs golf course ([Figure F.1.3-1](#)). The proposed golf course development is included to ensure potential impacts are considered and mitigated.

The Project is located within the Rocky Mountain Natural Region, which is comprised of mountains, high foothills, and deep glacial valleys. Within the Rocky Mountain Natural Region, the majority of the Project is located within the Subalpine Natural Subregion with the remaining portion being located within the Montane Natural Subregion (Natural Regions Committee [NRC] 2006).

Soils in the Subalpine Natural Subregion develop on unstable parent materials over steeply sloping bedrock and contribute to the development of Brunisols (Eutric and Dystric) as well as Regosols and non-soils (*i.e.*, colluvium, exposed bedrock) (NRC, 2006). In areas of less pronounced terrain and finer textured soils, Orthic and Brunisolic Gray Luvisols have developed (NRC, 2006). Wetland soils are usually Gleysols but Organic soils also do occur (NRC, 2006). In the Subalpine Natural Subregion, a

broad range of vegetation species are characteristic of mesic sites due to significant variations in elevation. Vegetation communities at lower elevations are characterized by closed canopy forests of lodgepole pine, Engelmann spruce, and subalpine fir. Whitebark pine is found at higher elevations where the forest canopy is generally more open (Archibald *et al.* 1996).

The soils found within the Montane Natural Subregion consist of Chernozems, Brunisols, Regosols, Luvisols, Gleysols, and Organics (NRC, 2006). Orthic Black Chernozems are typical under grasslands and Orthic Dark Gray Chernozems are dominant in wooded areas (NRC, 2006). In the valleys, Eutric Brunisols are dominant on fluvial and glaciofluvial deposits. Regosols are typical of both fluvial terraces adjacent to rivers and side slopes where there have been recent occurrences of erosion or slope movement (NRC, 2006). On valley side-slopes that are stable enough for soil development, Luvisols and Dystric Brunisols can occur (NRC, 2006). Gleysols and Organic soils are typically associated with fens (NRC, 2006). Vegetation in the Montane Natural Subregion is characterized by a pattern of open forests and grasslands, with modal sites having forested stands of Douglas fir, lodgepole pine, white spruce, aspen or mixtures of all. The subregion occurs at lower elevations than the Subalpine Natural Subregion and has warmer climatic conditions as a result. Limber pine may be present, but is commonly restricted to dry, exposed ridge tops. Abrupt changes in vegetation can occur over very short distances due to high variability in microclimates from differing aspects, slope positions and wind exposure (NRC, 2006).

The southern portion of the Project is located within a Mountain Goat and Bighorn Sheep Range and the northern portion within a Grizzly Bear Zone. A small portion on the southwest edge of the proposed Mine Permit Boundary is located within a Key Wildlife and Biodiversity Zone (CR #10, Figure 4.2-5).

The Project currently has a number of important land uses including historic mining, oil and gas, recreation, grazing, timber harvesting, trapping and traditional uses located on both crown and freehold land. Section E.15 – Land Use Impact Assessment and Consultant Report (CR) #10 – Land Use, provides a comprehensive assessment of current land use and potential impacts of the Project. A portion of the freehold land is owned by Benga, with access to the remaining freehold land under discussion with landowners. The area within the Mine Permit Boundary contains seven properties that have existing dwellings in the form of cabins. The Historic Town of Lille and two additional dwellings are located just east of the Mine Permit Boundary (CR #10, Figure 4.1-1).

Traditional Land Use, as identified by Aboriginal Groups is provided in detail in Section H – Aboriginal Consultation and in the available TEK consultant reports provided by Aboriginal groups (Appendix 7c). The summary also includes the collection of traditional plants, hunting, trapping and spiritual connection with the lands. Aboriginal consultation will be ongoing through the life of the

mine. Input from the Aboriginal consultation has been considered for species selection for revegetation plans and for terrain and vegetation planning to support vegetation and wildlife of importance to Aboriginal groups.

The proposed golf course development area has been identified by the Canadian Environmental Assessment Agency (CEAA) as “incidental physical activities” associated with the development of the mine. These areas are included as part of the Project assessment. The Crowsnest Pass Golf and Country Club will develop the replacement facilities, will own them and be responsible for the construction, operation and closure of them (Figure F.1.3-1). The golf course development will be zoned recreational and developed accordingly. The Department of Agriculture and Forestry is responsible for the helipad access that will be used as a Forestry resource. As shown in Table F.1.3-1, most of these lands are privately owned (34.7 ha), with a minor component (4.8 ha) being crown lands with 0.5 ha existing roadway. Final reclamation and closure of these areas are not included in this assessment as the responsibility to each component is intended to extend beyond the operational and closure plan life of the Project’s mining activities.

Incidental Physical Activity	Freehold		Crown	Other	Total ¹
	Benga	Other			
Proposed Golf Course Development - East Area	8.2	0.1	-	-	8.3
Proposed Golf Course Development - West Area	25.7	-	4.1	-	29.8
Proposed Helipad Access	1.0	0.1	0.2	0.4	1.6
Totals ¹	34.8	0.2	4.3	0.4	39.7
	35.0				

¹ Due to rounding of values, totals may not equal the sum of the individual values presented in the table.

F.1.4 Land Capability

Land capability is defined as:

“the ability of the land to support a given land use, based on an evaluation of the physical, chemical and biological characteristics of the land, including topography, drainage, hydrology, soils and vegetation”. For the purposes of the definitions of land

capability and equivalent land capability, land is defined as “terrestrial, semi-aquatic, and aquatic landscapes” (Province of Alberta 2016).

The goal of reclamation in Alberta is to achieve a land capability that is equivalent to what existed prior to disturbance. Specific reclamation targets are determined by regulatory requirements to return lands to an equivalent land capability that will support stated end land use objectives. However, the return of equivalent land capability does not mean that the reclaimed landscape will be identical to pre-disturbance conditions; rather, it will provide flexibility to potential equivalent land uses. For example, land capability may be improved following reclamation. Typically, vegetation and soils are used to evaluate biophysical site factors that will return biologically achievable end land uses.

F.1.5 Reclamation Goals and Principles

The reclaimed lands will feature regionally compatible landforms and vegetation patterns that are ecologically functional and successional. The goal of the reclamation plan is to develop lands that are maintenance-free and self-sustaining. The landscape will evolve through seral states of initial revegetation to self-sustaining ecosystems, consisting of mature vegetation communities typical of the Subalpine or Montane Sub Regions of the Rocky Mountain Natural Region (Natural Regions Committee 2006).

The following goals and principles have been incorporated in the C&R and Closure Plans:

- progressive reclamation will be undertaken within the requirements of the mine plan;
- topsoil/reclamation material will be salvaged during site construction and preserved for reclamation activities;
- where possible, Project construction and operations will minimize impact to established communities;
- direct placement of reclamation material will be undertaken, whenever practical, to maximize the potential viability of native seed banks and propagules;
- landforms will be geo-technically stable and will be integrated into the surrounding natural landforms;
- a variety of landforms (slopes and aspects) will be in the reclamation landscape;
- surface water drainage systems will be designed to minimize erosion rates and sediment loading;
- reclaimed areas will be developed into self-sustaining ecosystems with an acceptable degree of biodiversity (relative number of native species and structural layers as early stage target community);

- forest capability, including commercial forestry potential, will be equivalent to pre-development conditions;
- natural encroachment of native vegetation will be encouraged in ecologically receptive areas;
- local native seed sources will be used wherever practical to maintain genetic integrity of re-established plant communities;
- creation of habitat features that will benefit or help re-establish wildlife species known or reported to occur in the area;
- creation of features to help support SARA listed species (both vegetation and wildlife) known or reported to occur in the area;
- creation of features to promote Traditional Use or promote the establishment of valued components for Traditional Use;
- on-site public health and safety will be protected;
- the end pit lake will be ecologically sustainable; and
- reclamation certification will be achieved to allow transfer of the lands back to landowners and to the Crown.

During the on-going reclamation and closure process Benga will ensure that:

- end land use objectives are developed in consultation with Aboriginal Groups, the public, and regulatory stakeholders, building on the existing consultation process;
- site wide environmental monitoring will be conducted throughout the life of the Project and throughout reclamation to ensure landforms, soil conditions and vegetative communities maintain the appropriate trajectory towards the desired end land uses; and
- adaptive management of the C&R and Closure Plans will be pursued through the incorporation of the results of the site wide environmental monitoring programs.

Land capability objectives, reclamation goals and principles, pre-disturbance vegetation inventories and post-mining monitoring programs, will be used to evaluate reclamation success and identify areas for improvement. Benga has also developed the C&R and Closure Plan in consideration of the environmental impact assessment as well as input from extensive public and Aboriginal engagement.

F.1.6 End Land Use

The end land use goals for the Project include:

- reclamation of the landscape to an equivalent land capability, optimizing the value of watershed, timber, grazing, wildlife habitat, fish habitat, recreation or other resources, taking into account threatened species, public input, and Aboriginal Group VCs;
- return of forest productivity to equivalent pre-development levels;
- return of aesthetic qualities of the landscape;
- provision for traditional land use (*e.g.*, gathering, hunting and trapping) as identified through consultation with Aboriginal Groups; and
- maintain equivalent recreational land use specific to the proposed golf course development.

Reclamation will be conducted to construct landscape patterns, provide mine soil substrates, establish surface hydrology, and establish plants to initiate development of a functioning ecosystem. End land use will vary spatially and temporally across the reclaimed Project area and will be focused on forestry, grazing, watershed protection, riparian, wetland and wildlife objectives.

The following assumptions were made for end land uses and final certification:

- the target ecosystems and vegetation communities identified in the C&R and Closure Plans will allow multiple uses. For example, areas reclaimed to commercial forest use will also provide for wildlife, recreation and traditional land uses;
- end land use options available will be constrained by the type of landforms to be constructed; and
- final end land use decisions will, in part, depend on government, local stakeholder, and Aboriginal Group input.

Regional land use was considered in the determination of end land uses. End land use objectives of the Project's reclamation program include watershed protection, ecological values, forestry, fisheries, wildlife habitat, traditional use and recreational use.

F.1.6.1 Integrated Resource Planning

The local study area (LSA) and regional study area (RSA) fall under two Integrated Resource Plans (IRPs) prepared by the Government of Alberta; the Livingstone-Porcupine Hills Sub Regional IRP and the Crowsnest Corridor Local Sub Regional IRP (Alberta Forestry, Lands & Wildlife [AFLW], 1990). Each IRP is put in place to assist proponents in land use planning and assessment. The applicability of each plan to the Project are summarized below:

Livingstone-Porcupine Hills Sub Regional IRP

The primary intent of the Livingstone-Porcupine Hills Sub Regional IRP is:

“To achieve social and economic benefits by providing for the optimal use of all available resources, while maintaining the overall integrity of the natural environment for which the area is known (pp. 9)” IRP (AFLW 1987).

Within the Livingstone-Porcupine Hills Sub Regional IRP, the seven land use zones identified in the Eastern Slopes Policy (Energy and Natural Resources 1984) were refined based on more specific objectives. Of these seven zones, two are located within the LSA and RSA including:

- Special Use Zone where coal development is allowed but may require special conditions and controls; and
- Multiple Use Zone where coal development is considered compatible under normal guidelines and compatible land use regulations.

Within the IRP, the Project area is also distinguished by seven Resource Management Areas (RMAs). The Project area is located within the West Livingstone and Crowsnest Watershed RMAs. As stated in the IRP, the primary intent of the West Livingstone RMA is to *provide a full range of multiple use activities managed to prevent adverse environmental impacts on watershed, fisheries, wildlife and recreation values in the area (AFLW, 1987, pp. 37)* and the intent of the Crowsnest Watershed RMA is to *provide a full range of multiple use activities managed to maintain high watershed quality, and to recognize the social and economic needs of Crowsnest Pass (AFLW, 1987).*

Crowsnest Corridor Local Sub Regional IRP

The primary intent of the Crowsnest Corridor Local Sub Regional IRP is:

“To identify a comprehensive, coordinated approach to the management of public land and public resources that optimizes resource decisions in the public interest and provides social and economic benefits to Albertans, especially residents of the Municipality of Crowsnest Pass, while at the same time protecting the natural environment” (AFLW, 1991).

Within the IRP, the land use zones identified in the Eastern Slopes Policy (Energy and Natural Resources 1984) were modified. Four land use zones are located within the LSA and RSA including:

- Prime Protection Zone where coal development and exploration is not permitted;

- Critical Wildlife Zone where coal development is allowed but may require special conditions and controls;
- Multiple Use Zone where coal development is considered compatible under normal guidelines and compatible land use regulations; and
- Facility Zone where coal development and exploration is not permitted.

Benga recognizes the values contained within these documents and has incorporated them into conservation and reclamation planning. Based on specific IRP objectives for the Livingstone and Crowsnest Watershed RMAs, nine resource uses have been identified for the reclaimed Project landscapes. These uses are ecologically and economically sustainable, socially acceptable and are compatible with government planning objectives and regulatory requirements. One or more of these resource uses will be designated on the unit’s reclaimed landscape, depending on site characteristics.

Table F.1.6-1 outlines the nine resource objectives from the West Livingstone and Crowsnest Watershed RMAs that pertain to the development and reclamation of the Project:

Table F.1.6-1 Project Resource Objectives (from AFLW, 1990)	
Resource	Objectives Associated with Project Area
Recreation and Tourism	<p>Objectives: (Livingstone p. 57, Crowsnest p. 131)</p> <ol style="list-style-type: none"> 1. To maintain and upgrade existing recreation facilities as required. (Livingstone) 2. To provide opportunities for dispersed recreational activities with provision for motorized recreation where this use is compatible with other land uses and environmental constraints. (Livingstone, Crowsnest) 3. To manage 19 White Area quarter sections of public lands for extensive recreation values. (Crowsnest) 4. To recognize the Forestry Trunk Road as an important auto touring route. (Livingstone, Crowsnest) 5. To recognize the focus of the area as extensive recreation and its potential for development of recreational staging areas. (Livingstone) 6. To provide opportunities for the private sector to meet the needs of the area’s recreational users where appropriate, while recognizing that the Municipality of Crowsnest Pass contains tourism services and facilities. (Crowsnest)
Wildlife	<p>Objectives: (Livingstone p. 62, Crowsnest p. 128)</p> <ol style="list-style-type: none"> 1. To increase the number and distribution of elk, sheep, moose and goats using the resource management area on a year round basis. (Livingstone, Crowsnest) 2. To promote elk and sheep winter use of former underutilized or current underutilized wintering areas. (Livingstone, Crowsnest)

Table F.1.6-1 Project Resource Objectives (from AFLW, 1990)	
Resource	Objectives Associated with Project Area
	<ol style="list-style-type: none"> 3. To encourage the increase or re-establishment of goat populations on vacant or underutilized ranges. (Livingstone, Crowsnest) 4. To promote forest management practices to enhance moose habitat. (Livingstone, Crowsnest) 5. To maintain recreational hunting and commercial trapping opportunity and non-consumptive uses of wildlife. (Livingstone, Crowsnest) 6. To develop a land management strategy for parts of the RMA to promote wildland qualities for recreational hunting. (Livingstone) 7. To minimize wildlife depredation on private lands adjacent to the RMA in the Municipality of Crowsnest. (Crowsnest) 8. To reduce the negative impacts of landuse activities on wildlife and wildlife habitat. (Livingstone, Crowsnest) 9. To maintain current levels of abundance and distribution of other wildlife species by maintaining diverse habitat types. (Livingstone, Crowsnest) 10. To maintain a forage base capable of sustaining the following wildlife populations: 15/30 sheep (winter/summer); 35 goats; 100/265 elk (winter/summer); 50/450 mule deer (winter/summer); 100 white-tailed deer, and 75 moose. (Livingstone) 11. To maintain a forage base capable of sustaining the following wildlife populations: 80/65 sheep (winter/summer); 25 goats; 100/200 elk (winter/summer); 100/400 mule deer (winter/summer); 100 white-tailed deer, and 50 moose. (Crowsnest)
Fisheries	<p>Objectives: (Livingstone p. 64, Crowsnest p. 129)</p> <ol style="list-style-type: none"> 1. To maintain a high quality water supply of sufficient quantity for sport fish production. (Livingstone, Crowsnest) 2. To protect the integrity of aquatic and riparian habitats critical for continued sport fish production, primarily spawning, rearing and overwintering areas on the Oldman River, Dutch Creek, Racehorse Creek and its tributaries. (Livingstone) 3. To protect the integrity of aquatic and riparian habitats critical for continued sport fish production, primarily spawning, rearing and overwintering areas on tributaries to the Crowsnest River. (Crowsnest) 4. To maintain current population levels and high productivity in sport fishing populations. (Livingstone, Crowsnest) 5. To maintain current angler days of recreational fishing. To increase, where possible, recreational fishing opportunities. (Livingstone, Crowsnest) 6. To recognize and protect the provincial Class 1 stream status of the Oldman River. (Livingstone) 7. To recognize and protect the integrity of the Allison Creek drainage and Chinook Lake drainage for trout blood rearing purposes. (Crowsnest)

Table F.1.6-1 Project Resource Objectives (from AFLW, 1990)	
Resource	Objectives Associated with Project Area
Historic	<p>Objectives: (Livingstone p. 67, Crowsnest p. 134))</p> <ol style="list-style-type: none"> 1. The broad resource management objective applies within the RMA. (Livingstone) 2. To protect historical resources from potential or actual impact related to future resource development; and to conserve these resources for future generations. (Crowsnest) 3. To protect the Lille Townsite area from physical or visual impact and to preserve this resource for future generations. (Crowsnest)
Timber	<p>Objectives: (Livingstone p. 68, Crowsnest p. 136)</p> <ol style="list-style-type: none"> 1. To maintain a sustained yield land base capable of satisfying commercial demands for forest products. (Livingstone, Crowsnest) 2. To manage the 19 White Area quarter sections of public land that are contiguous with the Rocky Mountain Forest Reserve and have value for timber production, as part of the sustained yield land base. (Crowsnest)
Range	<p>Objectives: (Livingstone p. 68, Crowsnest p. 137)</p> <ol style="list-style-type: none"> 1. To provide a forage base capable of supporting 2 184 animal unit months (AUMs). (Livingstone) 2. To provide a forage base capable of supporting 1 039 AUMs in the Rocky mountain Forest Reserve portion of the RMA. (Crowsnest) 3. To maintain current levels of AUMs of domestic grazing on existing grazing dispositions in the White Area north of the Municipality of Crowsnest Pass. (Crowsnest)
Minerals	<p>Objective: (p. 69)</p> <ol style="list-style-type: none"> 1. To provide opportunities for renewed exploration and development of coal reserves particularly where major deposits have been identified. (Livingstone, Crowsnest) 2. To provide opportunities for industry to define the limits of and recover the reserves within the productive geologic structures of the Coleman gas field particularly since there is an existing commitment to its development under A Policy for Resource Management of the Eastern Slopes, Revised 1984. (Livingstone, Crowsnest) 3. To provide opportunities for the orderly exploration and development of hydrocarbons. (Livingstone, Crowsnest) 4. To maintain opportunities for the recovery of limestone in order to support the continued operation of the lime plant in the Crowsnest Pass. (Crowsnest) 5. To provide opportunities for the private sector to explore and develop quarriable and metallic mineral resources. (Livingstone)
Access	<p>Objectives: (Livingstone p. 70, Crowsnest p. 140)</p> <ol style="list-style-type: none"> 1. The broad access management objectives apply. (Livingstone, Crowsnest)

Table F.1.6-1 Project Resource Objectives (from AFLW, 1990)	
Resource	Objectives Associated with Project Area
Ecological	Objectives : (Crowsnest p. 133) 1. To protect the natural values of the Ptolemy Valley and the Ptolemy Caves. (Crowsnest)

F.1.6.2 South Saskatchewan Regional Plan

The Project falls within the southwest limits of the South Saskatchewan Regional Plan (SSRP) (Government of Alberta 2014). The SSRP was established in accordance with Alberta’s Land Use Framework (LUF) and came into effect on September 1, 2014. The SSRP identifies strategic directions for the region over the next 10 years and sets the stage for robust growth, vibrant communities and a healthy environment within the region for the next 50 years (Government of Alberta 2014). The previously developed IRPs remain in effect and will continue to provide operational guidance until they are reviewed and incorporated into the SSRP implementation strategy.

Based on the regional vision for the South Saskatchewan region the following regional outcomes have been established as part of the SSRP and are relevant to C&R and Closure planning:

- biodiversity and ecosystem function are sustained through shared stewardship;
- watersheds are managed to support healthy ecosystems and human needs through shared stewardship;
- land is used efficiently to reduce the amount of area that is taken up by permanent or long-term developments associated with the built environment; and
- Aboriginal peoples are included in land-use planning.

Additional details are available in the Land Use Report available in Consultant Report #10 (CR #10).

F.1.7 Gold Creek Stewardship Program

Considerable degradation has occurred within and along Gold Creek because of legacy mining activities and other historical land uses that include ATV and four-wheel drive use in the creek and along the riparian areas. In the absence of any substantive long-term remediation plan to address historical mining activities, which largely terminated in the early 1960s, Benga plans to establish and be a catalyst for a Gold Creek Stewardship Program. The program will address some of the current issues that relate to the water quality and fisheries in Gold Creek. While the aquatic environment is the first priority of this program, the terrestrial and social components may also be captured. Benga will spearhead this program and foresees involvement from a wide range of stakeholders, environmental groups, aboriginal communities, academia, researchers and regulators. A function of

the program would be active engagement in local research and monitoring that would tie directly in to the westslope cutthroat trout Recovery Plan.

F.1.8 Public Engagement and Aboriginal Group Values and Issues Related to Closure, Conservation and Reclamation Planning

Benga received considerable input on existing land values and expectations for reclaimed lands through extensive public engagement and aboriginal consultation. Information gained during the environmental assessment process has been used to identify issues relating to development and reclamation of the Project. Through the examination of the existing mining operations in the SSRP (Government of Alberta, 2014), input from public engagement and aboriginal consultation and consideration of the Terms of Reference (AER, 2015), an issue screening process has been completed. Examples of identified issues include:

- native plant species are important;
- commercial forest productivity needs to be re-established;
- forest communities need to be established such that all of their functions are returned;
- water quality and quantity is very important;
- fisheries habitat is important to protect and to re-establish;
- landform types and integration with adjacent undeveloped areas;
- reclamation performance in terms of ecological development and sustainability;
- end land uses – balancing the wants and needs of the various stakeholders (*e.g.*, golf course);
- wildlife habitat, health and population levels need to be protected and re-established;
- wildlife density on reclaimed lands needs to be planned and managed so as not to become higher than the natural carrying capacity.

A more comprehensive list of issues relating to the development of the Project is included in [Section G](#) (Public Engagement). Issues and concerns identified by Aboriginal groups are responded to individually for each group throughout [Section H](#) (Aboriginal Consultation). Consultation with Aboriginal groups on the C&R Plan will be ongoing throughout the environmental assessment process.

F.1.9 Traditional Ecological Knowledge and Land Use

Traditional Ecological Knowledge (TEK) and Traditional Land Use reports were completed as part of the Project by Aboriginal groups identified as potentially affected by the Project and are provided in [Appendix 7\(c\)](#) and summarized in [Table F.1.9-1](#). Several Aboriginal groups identified as less affected by the Project provided TEK for use in the assessment of potential effects. TEK was provided by

Métis Nation of British Columbia, Métis Nation of Alberta, and Samson Cree First Nation.

Traditional Use reports that were screened by Aboriginal groups for public record are provided in [Appendix 7\(c\)](#):

- [Appendix 7\(c\)\(i\)](#) - Kainai Nation;
- [Appendix 7\(c\)\(ii\)](#) - Piikani Nation;
- [Appendix 7\(c\)\(iii\)](#) - Siksika Nation;
- [Appendix 7\(c\)\(iv\)](#) - Stoney Nakoda Nation; and
- [Appendix 7\(c\)\(v\)](#) - Tsuut'ina Nation.

Elders and technicians provided input on the key issues, themes, observations, wisdom, insights, traditional knowledge and land use through a series of site visits, workshops, meetings, and other communication events. Recommendations and ideas expressed to date by Aboriginal Groups that are relevant to conservation and reclamation planning include:

- protect and harvest lodgepole pines and other plants of interest on a regular and ongoing basis;
- make efforts to relocate trees from areas of development for use on the reserves;
- protect and monitor water;
- impose no-go buffers around sacred sites of 100 m;
- maintain habitat for wildlife, including eagles nests;
- ensure that effective reclamation involves reforestation of evergreen species to outcompete weeds;
- ensure efforts for research focus specifically in areas that have not been disturbed;
- provide adequate funding for ongoing project involvement and costs associated with indigenous traditional environmental monitoring and harvesting vegetation throughout the Project;
- annual project review with Benga for the life of the Project;
- have an emergency preparedness plan in the event of leaks, spills or other disasters to address concerns regarding water quality and species dependent on clean water resources;
- ensure new areas of development encompass previously disturbed areas; and
- consider socio-economic effects of the proposed Project.

Various traditional land uses objectives were also identified in the reports. Some of the TEK principles that Benga will incorporate into the C&R and Closure Plans include:

- where possible, impact to significant vegetative communities will be managed or mitigated;
- on Benga private land lodgepole pine and other significant plants will be harvested and, will be made available to Aboriginal groups potentially affected by the Project;
- wildlife habitat for traditionally important wildlife species will be re-established in areas of disturbance;
- reclamation, revegetation and reforestation efforts will be implemented to ensure weed species are outcompeted;
- water management plans will be implemented to manage surface and groundwater across the Project so that potential impacts to downstream users is mitigated;
- weed control efforts will be implemented throughout the life of the mine and during reclamation;
- where feasible, encourage biodiversity in the reclaimed landscape and re-establishment of native vegetation through direct placement of salvaged soil;
- local seed sources will be utilized for reforestation of native species and for the reestablishment of traditionally important plant species;
- wetlands, water bodies and grassy areas around waterbodies will be established; and
- previous disturbances across the Project area will be incorporated into the C&R plan for the mine resulting in improved biodiversity.

Benga is respectful of the spiritual aspects of TEK. Local stakeholders have identified the importance of harvesting lodgepole pine as well as other significant plants. Benga will engage with Aboriginal groups prior to and during mine construction to offer opportunities for these species to be harvested, re-located or otherwise utilized.

Vegetation species identified during the Aboriginal Consultation process including TEK species (vascular and non-vascular) observed in the vegetation LSA during vegetation field surveys are provided in [Table F.1.9-1](#). Additional species identified by Aboriginal groups outside of the systematic vegetation field surveys, are also provided in [Table F.3.6-3](#). The TEK reports in [Appendix 7\(c\)\(i to v\)](#) provide additional details on traditionally important plants. The types of vegetation identified as VC's for TEK and the vegetation assessment were also focussed on during the C&R Planning to ensure the reclamation program establishes suitable habitat for various wildlife species. The various wildlife VC's identified as representative species for the Project wildlife assessment is located in [CR#9 Section 3.2.3](#) and [Table 3.2-2](#). The full list of identified Treaty 7 First Nations wildlife VC's is provided in [CR#9 Section 2.2](#) and [Table 2.2-1](#)). Reclamation planning for wildlife species important to Treaty 7 First Nations is further described in [F.2.6](#).

Table F.1.9-1 Traditional Ecological Knowledge Vegetation Valued Component Species Identified in the Local Study Area

Life Form	Name			Number of occurrences in LSA ¹	First Nations Identified VCs				
	Provided TEK	Scientific	Common		Piikani Nation ²	Kainai Nation ³	Siksika Nation ⁴	Tsuut'ina Nation ⁵	Stoney Nakoda FN ⁶
Tree	Sweet pine	<i>Abies lasiocarpa</i>	Subalpine fir	44	x	x		x	x
Tree	Lodgepole pine	<i>Pinus contorta</i>	Lodgepole pine	93	x	x		x	x
Tree	Poplar	<i>Populus balsamifera</i>	Balsam poplar	12	x			x	
Tree	Cottonwood or poplar	<i>Populus tremuloides</i>	Aspen	28	x	x			
Shrub	Saskatoon berry	<i>Amelanchier alnifolia</i>	Saskatoon	34	x	x		x	
Shrub	Bearberry	<i>Arctostaphylos uva-ursi</i>	Common bearberry	30	x	x		x	
Shrub	Mountain sage	<i>Artemisia</i> sp.	Sage	2	x			x	x
Shrub	Dogberry	<i>Cornus stolonifera</i>	Red-osier dogwood	4				x	
Shrub	Juniper	<i>Juniperus communis</i>	Ground juniper	59	x	x		x	
Shrub	Juniper	<i>Juniperus scopulorum</i>	Rocky mountain juniper	1	x	x		x	
Shrub	Rose hip	<i>Rosa acicularis</i>	Prickly rose	41		x			
Shrub	Rose hip	<i>Rosa woodsii</i>	Common wild rose	10		x			
Shrub	Raspberry	<i>Rubus idaeus</i>	Wild red raspberry	8		x		x	
Shrub	Thimbleberry	<i>Rubus parviflorus</i>	Thimbleberry	19		x		x	
Shrub	Willow	<i>Salix bebbiana</i>	Beaked	4	x	x		x	

Table F.1.9-1 Traditional Ecological Knowledge Vegetation Valued Component Species Identified in the Local Study Area

Life Form	Name			Number of occurrences in LSA ¹	First Nations Identified VCs				
	Provided TEK	Scientific	Common		Piikani Nation ²	Kainai Nation ³	Siksika Nation ⁴	Tsuut'ina Nation ⁵	Stoney Nakoda FN ⁶
			willow						
Shrub	Willow	<i>Salix scouleriana</i>	Scouler's willow	11	x	x		x	
Shrub	Black elderberry	<i>Sambucus racemosa</i>	Red elderberry	1				x	
Shrub	Low-bush cranberry	<i>Viburnum edule</i>	Low-bush cranberry	2				x	
Forb	Prince's pine	<i>Chimaphila umbellata</i>	Prince's-pine	25				x	
Forb	Ferns	<i>Cystopteris fragilis</i>	Fragile bladder fern	2					x
Forb	Fireweed	<i>Epilobium angustifolium</i>	Common fireweed	54				x	
Forb	Horsetail	<i>Equisetum arvense</i>	Common horsetail	10		x		x	
Forb	Horsetail	<i>Equisetum fluviatile</i>	Swamp horsetail	1		x		x	
Forb	Scouring-rush	<i>Equisetum scirpoides</i>	Dwarf scouring-rush	7		x		x	
Forb	Strawberry	<i>Fragaria virginiana</i>	Wild strawberry	56					x
Forb	Three-flowered avens	<i>Geum triflorum</i>	Three-flowered avens	7					x
Forb	Cream-coloured vetchling	<i>Lathyrus ochroleucus</i>	Cream-coloured vetchling	31					x
Forb	Lupine	<i>Lupinus arbustus</i>	Longspur lupine	2					x

Table F.1.9-1 Traditional Ecological Knowledge Vegetation Valued Component Species Identified in the Local Study Area

Life Form	Name			Number of occurrences in LSA ¹	First Nations Identified VCs				
	Provided TEK	Scientific	Common		Piikani Nation ²	Kainai Nation ³	Siksika Nation ⁴	Tsuut'ina Nation ⁵	Stoney Nakoda FN ⁶
Forb	Lupine	<i>Lupinus arcticus</i>	Arctic lupine	8					x
Forb	Lupine	<i>Lupinus argenteus</i>	Silvery perennial lupine	12					x
Forb	Lupine	<i>Lupinus sericeus</i>	Silky perennial lupine	21					x
Forb	Lupine	<i>Lupinus sulphureus</i>	Sulphur lupine	8					x
Forb		<i>Phacelia hastata</i>	Silver-leaved scorpionweed	4					x
Forb	Silky scorpionweed	<i>Phacelia sericea</i>	Silky scorpionweed	3					x
Forb	Lance-leaved stonecrop	<i>Sedum lanceolatum</i>	Lance-leaved stonecrop	22					x
Forb	Clasping-leaved twisted-stalk	<i>Streptopus amplexifolius</i>	Clasping-leaved twisted-stalk	3				x	
Herb	Yarrow	<i>Achillea millefolium</i>	Common yarrow	35	x	x			x
Herb	Tall everlasting	<i>Antennaria anaphaloides</i>	Tall everlasting	4					x
Herb	Heart-leaved arnica	<i>Arnica cordifolia</i>	Heart-leaved arnica	42					x
Herb	Balsamroot	<i>Balsamorhiza sagittata</i>	Balsamroot	4					x
Herb	Thistle	<i>Cirsium edule</i>	Edible thistle	1				x	
Herb	Bear root or Indian potato	<i>Heracleum lanatum</i>	Cow parsnip	18				x	

Table F.1.9-1 Traditional Ecological Knowledge Vegetation Valued Component Species Identified in the Local Study Area

Life Form	Name			Number of occurrences in LSA ¹	First Nations Identified VCs					
	Provided TEK	Scientific	Common		Piikani Nation ²	Kainai Nation ³	Siksika Nation ⁴	Tsuut'ina Nation ⁵	Stoney Nakoda FN ⁶	
Herb	Dandelion	<i>Taraxacum officinale</i>	Common dandelion	14		x			x	
Grass	Common sweetgrass	<i>Hierochloe hirta</i>	Sweet grass	6				x		
Lichen - ground	Buffalo horn lichen	<i>Cladonia</i> spp. (n=20 species)	Cladonia	156				x		
Lichen	Tree lichen	<i>Letharia vulpina</i>	Wolf lichen	47	x	x		x		
Lichen - epiphyte	Tree lichen	<i>Usnea</i> and <i>Bryoria</i> spp. (n=8 species)	Old man's beard	55	x	x		x		
Additional Species Noted in First Nation TEK Reports^{2, 3, 4, 5}										
Tree	Birch	<i>Betula</i> sp.	Birch		x	x				
Tree	Choke cherry	<i>Prunus virginiana</i>	Choke cherry			x				
Shrub	Poison ivy	<i>Rhus radicans</i>	Poison ivy			x				
Shrub	Lingonberry	<i>Vaccinium vitis-idaea</i>	Lingonberry, northern mountain cranberry					x		
Shrub	Muskeg tea	<i>Ledum groenlandicum</i>	Labrador tea					x		
Forb	Alpine fern	<i>Woodsia alpina</i>	Alpine fern		x					
Forb	Wild licorice	<i>Glycyrrhiza lepidota</i>	Wild licorice			x				
Forb	Mountain holly fern	Note: this common name is not known to occur in Alberta, identification not confirmed			x					
Bryophyte	Moss				x			x		

Table F.1.9-1 Traditional Ecological Knowledge Vegetation Valued Component Species Identified in the Local Study Area

Life Form	Name			Number of occurrences in LSA ¹	First Nations Identified VCs				
	Provided TEK	Scientific	Common		Piikani Nation ²	Kainai Nation ³	Siksika Nation ⁴	Tsuut'ina Nation ⁵	Stoney Nakoda FN ⁶
Bryophyte	Dry tree moss					x			
Bryophyte	Moist ground moss					x			
Fungus	Mushrooms					x			
Fungus	Tree fungus							x	

¹ Number of observations during the vegetation surveys of the LSA.

² Source: Consultation information and Piikani Nation (2015).

³ Source: Consultation information and Kanai Nation (2015).

⁴ Source: No species were identified. SCO (2015) indicated site visit in October 2014 was not sufficient for providing a list of TEK in the Project area and further visits would be required.

⁵ Source: Consultation information and Tsuut'ina Nation (2015).

⁶ Source: Consultation information.

F.2 Reclamation Planning

F.2.1 Environmental Assessment

Throughout the proposed Mine Permit and the surrounding region, there is evidence of disturbance from historical underground and surface mining activities (Figure A.1.0-6). These legacy mine disturbances shown in Figure F.2.1-1 and Figure F.2.1-2 were created in the early 1900's to the mid-1960's, where little to no environmental mitigations or reclamation measures were taken or implemented. The potential impacts from these legacy activities have been substantial in the form of erosion and sedimentation and continue to this day. Recent short-term mitigation measures have been implemented by Benga that include surface water management and erosion and sediment control mitigations. Based on this historical disturbance, it is Benga's intention during mining operations and at closure, to include all the legacy Grassy Mountain mining areas in the mitigation measures planned for the entire Project. This will result in an overall net positive improvement in the current conditions on Grassy Mountain and its associated watersheds.

To support the development of the C&R Plan, a baseline assessment was conducted for the Project and an inventory of baseline conditions was prepared. In addition to the baseline conditions,

anticipated Project related impacts were assessed and mitigation proposed. Supporting information for this C&R Plan was sourced from the corresponding consultant reports (CR):

- Hydrogeology (CR #3);
- Hydrology (CR #4);
- Surface Water Quality (CR #5);
- Fisheries (CR #6);
- Terrain and Soils (CR #7);
- Vegetation and Wetlands (CR #8);
- Wildlife (CR #9);
- Land and Resource Use (CR #10); and
- TEK and Land Use (Appendix 7(c)).

F.2.1.1 Hydrogeology

The baseline study was completed based on a literature review and field investigations. A field program was completed with the installation of 19 monitoring wells at five locations (which have been sampled monthly for water chemistry and depths), and installation of nested vibrating wire piezometers on seven geotechnical boreholes, testing of artesian wells, sampling of springs and groundwater discharge points, completion of a water well survey and supplemental sampling of surface waterbodies.

Benga has a geological database that contains over 450 drill holes that were used to develop a groundwater model for the Project. This information has provided a valuable understanding of the groundwater resource and contributions to the local watershed.

F.2.1.2 Hydrology

The Project is located within the Blairmore Creek and Gold Creek watersheds, east of the Rocky mountain range. Blairmore Creek and Gold Creek collect runoff from an upstream area of 50 km² and 60 km² respectively and both discharge into Crowsnest River. The Crowsnest River connects to the Oldman River watershed, which flows into the Saskatchewan River, and ultimately discharging into Lake Winnipeg.

Six hydrometric stations were established in the Blairmore Creek drainage. Three stations were established in the Gold Creek drainage and another was set up on the Crowsnest River. These were established to measure the local flows for the Project. In addition to the local hydrometric stations

being established, 18 regional meteorological stations and 8 regional hydrological stations were used to refine site specific hydrology parameters for the Project.

The legacy mining activities that are present in the Project area currently have a negative impact on the local hydrology and receiving waters during spring freshet and during intense rainfall events. Incorporation of these into the proposed development will improve current conditions by capturing and managing this previously uncontrolled runoff.

All surface water that enters the active mining area and all groundwater that reports to the pit will be captured, collected and managed. It will be removed from the active mining areas using a series of drainage ditches, sumps and pumps to transport it to one of the five sediment ponds for treatment and release to the environment. Water will be collected, treated and discharged throughout the year which will provide flow to the main stems of Blairmore and Gold Creeks. Additional details on the Water Management strategy that facilitates both the management and use of water from the Project are available in [Section C.5](#).

F.2.1.3 Surface Water Quality

With the Project being located within three important local drainages (Gold Creek, Blairmore Creek, Crowsnest River), particular attention was given to developing a robust surface water management program. Baseline surface water sampling was completed in each of these three drainage basins with some additional sampling completed in their tributaries.

The legacy mining activities currently have a negative impact on the local water quality during spring freshet and during intense rainfall events. Incorporation of these into the proposed development will improve current conditions by capturing and managing this previously uncontrolled runoff which has not been monitored or measured since the closure of mining activities in the early 1960's.

Surface runoff and rainfall that percolates into the external rock disposal areas are expected to contain selenium concentrations that will require further management prior to release to the environment. Water from these areas will be collected in surge ponds that will not be released immediately to the environment. A selenium management plan has been developed to address this potential water quality/aquatic issue. The selenium management design is further discussed in [Section F.4.4](#) and in [Sections C.5 and C.8](#).

F.2.1.4 Fisheries

Considerable effort in the design of the Project was completed to ensure the pit, external rock disposal areas and infrastructure did not directly impact Blairmore Creek, Gold Creek, or the Crowsnest River. No direct disturbance or impact will occur to any of these watercourses, which are all fish bearing.

Benga has completed and continue to collect fisheries (fish and fish habitat) data on Blairmore Creek and Gold Creek, which includes, but not limited to detailed mapping habitat, benthic invertebrate sampling, sediment quality analysis, and a comprehensive fish population assessment. Both Blairmore Creek and Gold Creek are fish bearing and contain populations of brook trout, cutthroat trout, and westslope cutthroat trout, which is a *Species at Risk Act (SARA)* (Government of Canada 2015) Schedule 1 listed fish species.

There have been observations indicating that the legacy mining activities continue to provide a source of coal fines (from historical coal slack piles) into Gold Creek (and potentially Blairmore Creek) during times of intense rainfall (*i.e.*, during spring freshet and/or during intense rainfall events). These historical coal slack piles occur at high elevations on Grassy Mountain's east facing slopes, and in some areas along the Gold Creek streambank (*e.g.*, one such pile exists near the historic town of Lille). For the areas of potential deposition into Gold Creek at higher elevations, Benga has implemented sediment and erosion control measures to prevent further deposition. To mitigate this potential coal fine source, reclamation of the legacy mining activities has been incorporated into this C&R Plan. In addition to this C&R Plan, Benga are committed to help initiate and fund a collaborative grassroots stewardship program for the Gold Creek watershed aimed at improving critical habitat for westslope cutthroat trout from present state to help support species recovery.

F.2.1.5 Terrain and Soils

The Project is located primarily within Soil Correlation Area (SCA) 16. Mineral landscapes are largely comprised of till and colluvium, often occurring over shallow bedrock (Pedocan, 1993). Surficial deposits within the soil LSA and RSA are composed mainly of colluvial or leached Cordilleran till and alluvial deposits. Landform type and spatial distribution are closely linked to the physiography of the region.

Upland areas are dominated by Brunisols and Regosols with Luvisols in lower elevations, sporadic occurrence of Chernozems, and Organics common in poorly drained areas. A soil survey covering the entire Project has been completed based on soil and terrain information obtained during the 2014 field season. A considerable area (185.2 ha) within the proposed pit development was previously mined or disturbed by legacy mining activities as shown in [Figure F.2.1-1](#). There are no soil resources present within these previously mined areas as represented in photos shown in [Section F.2.1](#).

All soils present with the Project area have been mapped for soil location, type, thickness and quality. Soil suitability for reclamation was rated as part of the assessment. Details on the reclamation suitability of the reclamation materials are provided in the soil assessment ([CR#7, Section 4.2](#)). The following summary is provided:

- A horizons ranged from fair (F) to unsuitable (U) as reclamation growth media;
- B horizons ranged from good (G) to unsuitable (U) as reclamation media; and
- BC and C horizons ranged from good (G) to unsuitable (U) as reclamation media.

All soil will be salvaged as reclamation material ([Figure F.2.1-3](#)), as per the Terms of Reference (ToR) and stored for reclamation purposes.

Upland surface soil is a stratum salvaged from an upland soil that includes the forest floor, A horizon and in some cases part or all of the B horizon (AEW, 2012), and is referred to as reclamation material in the ToR (Section 3.2.8[A]h). Salvage of upland surface soil is not constrained by soil chemistry, however handling concerns (*e.g.* extremely steep slopes) do exist. The salvaged reclamation material will be replaced across the final reclaimed Project landscape.

Majority of landscapes within the Project footprint are colluvium/bedrock controlled. Soils developed in this environment are usually juvenile with little or no profile development. The upland areas have thin leaf litter and A horizons. Salvage of part or all B horizon is recommended to meet the reclamation materials balance requirements. The risk of degrading the quality of the reclamation material by salvaging the deeper substrates is minimal, largely due to it being of very similar quality.

The soil material has been rated for their reclamation suitability as shown in [Figure F.2.1-4](#). The methodology outlined in the Baseline Soil Survey and Impact Assessment report (CR #7, Section 4.2 and [Appendix C](#)) was also used to estimate the suitability of blended upland surface soil material as a growing media. Assumptions were used to estimate the post disturbance soil physical and chemical regimes which include:

- Salvaged soil will consist of a mixture of mineral A and B horizons and overlying litter material, referred to as “upland surface soil”.
- Chemical and physical characteristics of the mineral A and B horizons were blended in interpretative calculations to simulate reclamation material salvage and placement activities during construction.

[Table F.2.1-1](#) shows reclamation suitability of A and B horizons separately as well as blended together.

Table F.2.1-1 Reclamation Suitability Ratings for Soil Models for A Horizons, B Horizons and blended A and B Horizons (possible reclaimed soils)

Soil Model (SM)	Reclamation Suitability Ratings		
	A horizon	B Horizon	A+B Horizons (blended) ³
CON5	P	P	P
DNL1	-	-	-
FVCP16	P	G-F	G-P
FVCP4	P	G-F	G-P
FVHE4	P	F	F-P
FVNK16	P	F	P
FVRD5	P	F	P
FVX4	P	F	P
FVXfi11	P	F	P
HDFR18	-	U	U
HDTB18	U	-	U
MTF20	-	-	-
NKRD1	P	-	P
NS	-	-	-
SPgrWL1	F	G-P	F
SPLT4	G-F	F	G-F
SPR1	F	F	F
SPRgr1	F	P	F
TUCD1	G-U	G	G-P
ZDL	-	-	-
ZWA	-	-	-

All soils have similar reclamation suitability ratings for A horizons and blended A and B horizons.

Approximately 3.3 million m³ of reclamation material is available to be salvaged which will facilitate an average reclamation material replacement depth of 20 cm on reclaimed lands. All legacy mining disturbance located within the project development will be reclaimed, will have reclamation material replaced and will be revegetated. Reclaiming the legacy mining disturbances will result in an improvement over pre-disturbance conditions.

Land capability for the disturbance area has been catalogued by rating the Soil Map Units (SMUs) according to *Forest Land Capability Classification for the East Slopes Area, Alberta* (Duffy and Nemeth, 1969). This classification system was used to evaluate the soils based on soil and landscape features such as climate, relief, soil conditions and erosion. Rating is adjusted by “limiting factors” as determined in the classification system. Applicable limiting factors include restriction of rooting zone by bedrock, exposure, excess soil moisture, stoniness and elevation. The capability classes are based on mean annual increment and range from Class 3 (the best conditions possible) to Class 7 (marginal for forest production). The detailed methodology, land capability classes definition and assumptions made for post reclamation ratings calculation are described in [CR #7, Appendix F](#).

Baseline land capability classification has been provided in [Figure F.2.1-5](#) and reclaimed ratings are presented in [Figure F.2.1-6](#). Comparison of the baseline and reclaimed land capability ratings for the Project footprint are provided in [Table F.2.1-2](#). Post reclamation land capability will be similar or better than ratings determined for the pre-disturbance soil map units.

Table F.2.1-2 Comparison of the Pre-Disturbance and Reclaimed Land Capability Ratings for the Project Footprint					
Capability Class	Pre-disturbance Capabilities		Reclaimed Capabilities		Difference (%)
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)	
4	33.6	2.3	57.3	3.9	1.6
4-5	123.2	8.3	426.6	28.8	20.5
4-6	27.1	1.8	877.4	59.2	57.4
5	1.7	0.1	1.7	0.1	0.0
5-6	325.0	21.9	63.8	4.3	-17.6
5-7	679.5	45.9	-	-	-45.9
6	3.5	0.2	-	-	-0.2
7	287.5	19.4	35.8	2.4	-17.0
NA ¹	0.1	<0.1	18.4	1.2	1.2
TOTAL^{2,3}	1,481.0	100	1,481.0	100	-

Dash (-) there are no occurrences of a particular land capability class

¹ Open Water, Post-closure lake

² Due to rounding, total values may not equal the sum of the individual values

³ Area of Proposed Golf Course Development and Helipad Access Areas totalling 39.7 ha is not included

F.2.1.6 Vegetation and Wetlands

A detailed vegetation and wetlands assessment was completed on the project disturbance area in 2014 which was supplemented in the spring of 2016 to provide more information on the abundance and distribution of foothills rough fescue, whitebark pine and limber pine within the Project Footprint.

The assessments included:

- vegetation communities;
- rare plants and rare plant communities;
- rangeland resources;
- forest resources;
- old growth forests;
- TEK vegetation resources;
- wetlands;
- biodiversity and fragmentation;
- noxious and invasive species; and
- potential acid input and nitrogen deposition.

A total of 480 plant species were observed and documented within the Vegetation Local Study Area (LSA) during field sampling surveys in 2014. These included 298 vascular plants, 77 mosses and liverworts, and 105 lichen species.

The Montane and the Subalpine Natural Subregions occupy 518.8 ha and 523.9 ha of the Project Footprint, respectively. The proposed golf course development and helipad access areas are considered “*incidental physical activities*” (CEAA 2016) and will be owned and operated by the Crowsnest Pass Golf and Country Club and the Department of Agriculture and Forestry, respectively, who will have the construction and reclamation responsibility for these lands. These lands make up 39.7 ha of the Project Footprint, of which 35.0 ha is private land, exclusively within the Montane Natural Subregion.

Within the Project Footprint, 16 ecosite phases were mapped in the Montane and 8 in the Subalpine. The dominant ecosite phases mapped in the Montane Subregion are d2 – creeping mahonia-white meadowsweet Pl (187.7 ha, 12.3% of Project Footprint), e1 – thimbleberry/pine grass Pl (160.6 ha, 7.0%), and c4 – Canada buffaloberry/hairy wild rye Aw-Sw-Pl-Fd (55.0 ha, 3.6%). In the Subalpine Subregion, the dominant ecosite phases are e1 – false azalea-grouseberry Pl (353.4 ha, 23.2%), , f1 – thimbleberry Pl (32.0 ha, 2.1%), and B1 – bearberry/hairy wild rye Pl (48.1 ha, 3.2%).

The Project footprint occupies 1,520.7 ha, which removes 1,039.5 ha of upland ecosite phases, 3.2 ha of lowland ecosite phases, 163.2 ha of grassland open forest area, less than 1 ha of open water, 28.0 ha of barren land, and 274.2 ha of anthropogenic disturbance which includes 185.2 ha of legacy mining disturbance. The legacy mining is currently largely disturbed without vegetation.

Whitebark pine (*Pinus albicaulis*) has been identified within the Project Footprint and is designated as an endangered species in the *Alberta Wild Species General Status Listing - 2010* (AESRD 2010a) and is a SARA listed Schedule 1 species in the provinces of Alberta and British Columbia. The objectives and strategies of the Alberta whitebark pine recovery plan (WBP Recovery Plan), established by the Alberta Whitebark and Limber Pine Recovery Team (2014a), will be implemented as further detailed in [Section F.3.2.3](#).

Foothills rough fescue (*Festuca campestris*) has also been identified within rangelands located within the Project Footprint and is protected under a provincial Protective Notation due to its known sensitivities to disturbance (Desserud 2006). A mitigation plan that outlines revegetation strategies designed to promote the re-establishment of foothills rough fescue is provided in [Section F.3.2.4](#).

Project development will remove approximately 1,042.8 ha (28.5% decrease from baseline) of ecosite phases that support TEK vegetation potential. Traditional use plants have a high potential to occur within Montane c1, c4, g1, and Subalpine d1 ecosite phases. These include approximately 102.4 ha (27% decrease from baseline) of high TEK potential in the Montane Natural Subregion and 0.8 ha (100% decrease from baseline) of land with very high TEK potential in the Subalpine Natural Subregion. Species with very high or high TEK potential that will be impacted include lodgepole pine, prickly rose, ground juniper, willow, aspen, balsam poplar, Saskatoon, thimbleberry, bearberry and dwarf birch. These species are incorporated into the revegetation planning for the Project.

Timber productivity rating and timber volumes for the Project footprint were provided as part of the vegetation assessment ([CR #8, Section 4.4](#)) and are discussed in [Section F.3.3](#) in the Timber Management Plan. The estimated merchantable timber volume to be removed during Project development includes 122,463 m³ coniferous timber and 10,692 m³ deciduous timber volume for a total of 133,155 m³. The project will result in a 72,153 m³ drain against the timber dispositions held on public lands which is approximately 34% of the AAC for the C5 forest management unit. There is an additional 60,741 m³ on private lands. The majority of timber volume within the Project footprint is lodgepole pine. All whitebark pine will be salvaged as well and are part of the total volume. Mitigation for potential Project impacts on forest resources are the salvage of merchantable timber where practicable and implementation of recommended best practice methods described for soil handling and placement, tree species selection, tree planting and periodic monitoring.

Wetlands were found on 16.9 ha of the vegetation LSA. Shrubby open fens (FONS) (11.2 ha) were the most dominant wetland type, followed by treed swamps (STNN) (4.8 ha), open water less than 2 m deep (0.5 ha), and open graminoid marshes (MONG) (0.4 ha). Project development will result in the removal of 9.7 ha of wetlands including 9.6 ha of FONS, and less than 0.1 ha each of MONG and WONN. None of these wetland types will be completely removed from the LSA.

Potential effects to vegetation and wetlands as a result of the Project will be mitigated through revegetation activities, including all the previously disturbed legacy mining areas. Wetlands will be targeted in the remnants of the sediment and surge ponds. The revegetation activities will be aimed at the long term establishment of vegetation communities and wetland types characteristic to the Montane and Subalpine Natural Subregions.

F.2.1.7 Wildlife

One of the goals of the land reclamation program is the return of wildlife habitat and maintaining or increasing wildlife populations, with emphasis on providing suitable habitat for wildlife considered to be valued components to the public and Aboriginal Groups. Wildlife surveys for the Project commenced in 2013 and were completed in 2016. The surveys were completed to determine the status of the wildlife assemblages present in the area and to inventory the types and extent of wildlife habitat. The legacy mining disturbances were included in the baseline assessment and contributed little to the effective habitat.

The impact assessment completed as part of the wildlife assessments provided recommendations for mitigation for Project impacts to the wildlife assemblages and wildlife habitats in the Project development area. This included reclamation of the legacy mining disturbance, which results in an improvement of habitat conditions.

Potential Project effects to wildlife and wildlife habitat will be mitigated by the establishment of suitable wildlife habitats in the reclaimed landscape. Refer to [Section F.2.6](#) for a summary of wildlife and wildlife habitat mitigations that have been included in the reclamation planning.

F.2.1.8 Land and Resource Use

The land and resource uses that occur in the proposed development area were assessed to identify how development of the proposed mine may impact those uses and to recommend mitigation measures to reduce impacts to either existing or potential land and resource uses. Details of the assessment are available in [CR #10 Land Use](#).

In order to minimize the potential direct impacts of the proposed Project development on other land and resource users in the area, Benga will undertake the following:

- progressive reclamation, and reclaim the area to a landscape that includes provisions for a variety of land uses, including forestry, wildlife habitat, grazing, recreational use, *etc.*; and
- monitor changes in land use policies and initiatives and, through adaptive management, incorporate new requirements into the ongoing reclamation plans.

F.2.1.9 Traditional Ecological Knowledge and Land Use

Consultation and discussions with Aboriginal Groups resulted in a number of recommendations for the Project. Key recommendations include:

- allow annual access to the site and surrounding lands for traditional harvesters;
- provide access to lodgepole pine salvaged ahead of mine development;
- provide one year notice when pine stands may be cleared and where possible lodgepole pine should be harvested in the spring when they have more sap and are easier to peel;
- restore habitat so that moose, elk, deer, and other wildlife may return to the land, without grass there is nothing for moose and elk to eat;
- monitor to see what wildlife is present and use that to assess the health of the land;
- remediate the damage done by previous mine owners;
- protect the streams and water during development;
- harvest and greenhouse important plants to return them to the land with reclamation; and
- include the local communities in developing the final reclamation plans.

F.2.2 Reclamation Schedule

Reclamation will begin as soon as practical after mining activities are completed in areas where no additional mining, dumping or stockpiling is required. Progressive reclamation will be optimized through the mine planning process to take advantage of all opportunities for progressive reclamation.

Reclamation will be undertaken in sequential steps as mining operations are completed. These steps and general timing are illustrated in [Table F.2.2-1](#).

Table F.2.2-1 Reclamation Schedule Upon Completion of Mining Activities	
Reclamation Activity	Timing
Terrestrial Reclamation:	
Resloping/ Reclamation material placement	Year 0
Initial revegetation	Year 1

Table F.2.2-1 Reclamation Schedule Upon Completion of Mining Activities	
Reclamation Activity	Timing
Fertilizing	Years 1 – 3
Woody species planting	Years 2 – 4
Biophysical monitoring	Years 1 – 12
Reclamation certification	Year 15 – 20
Release back to Crown	Site-dependent
Lake Reclamation:	
Resloping & channel construction	Year 0
Final water line reached	Site-dependent
Revegetation:	
	Year 1 – 4

The final reclaimed landscape will consist of 1,462.6 ha of reclaimed lands (Table F.2.2-2); 18.4 ha will remain as the end pit lake (as discussed in Section F.3.6.4), and 39.7 ha will convert to recreational land use. The land use change is due to the proposed golf course development area and alternate helipad access road being identified as “*incidental physical activities*” associated with the development of the Project. It is assumed that the Crowsnest Pass Golf and Country Club will be responsible for construction, operation and reclamation of these components. They will follow industry best practices for preservation of reclamation materials and will target an equivalent land capability which will be a conversion of end land use to recreational land use.

The detailed site development, disturbed areas and reclamation areas are shown yearly on the annual mine status maps (Figures C.1.3-1 to C.1.3-25) and are summarized in Table F.2.2-2. The maximum Project spatial disturbance will occur in Year 14 (2032) with no additional spatial disturbance to follow (Figure C.1.3-14), and the reclamation closure scenario where the majority of the reclamation is completed will occur in Year 27 (2045) (Figure C.1.3-25). At full closure the water management surge ponds (to manage selenium) will be decommissioned and removed from the plan. This will occur when the selenium levels in these ponds are below the release criteria as discussed in Section C.5 and C.8.

Upon completion of mining and backfilling, reclamation activities can commence. This process begins with resloping/recontouring slopes (to a maximum slope angle of 23°), replacement of reclamation material, revegetation and finally reforestation. Reclamation material will be replaced through direct placement techniques when available, or will be hauled from reclamation material

stockpile areas. Areas will be revegetated depending on the slope class of the reclaimed area and the desired ecological unit ([Section F.3.6](#)).

The 2.1 ha Construction Camp will be reclaimed by Year 1 (2019) and the first mine area that will be ready to reclaim is in Year 2 (2020), located within the South Rock Disposal Area (SRDA) ([Figure F.3.6.1](#)). This area will be eligible to have reclamation material directly placed from the active mining area on the north edge of the mine and will be revegetated. Additional areas of the SRDA will be reclaimed on an annual basis until final reclamation of this area is complete in Year 13 (2031).

In Year 5, reclamation will commence on the Central Rock Disposal Area (CRDA) and in an area immediately north of the processing plant as shown on [Figure F.3.6-1](#). These areas contribute to the 64.2 ha of land reclaimed by the end of Year 5. These reclamation areas progress towards each other before resulting in a total reclamation area of 155.2 ha in Year 7 ([Figure F.3.6-2](#)) that encompasses the southernmost tip of the pit and portions of the CRDA and SRDA adjacent to the powerline right of way and along the east Project Footprint boundary.

Reclamation commences along the northwest edge of the North Rock Disposal Area (NRDA) in Year 11 ([Figure F.3.6-3](#)) and contributes to the 292.0 ha of reclaimed land across the mine within the rock disposal areas and the southern portion of the pit by Year 11 ([Figure F.3.6-3](#)). The total reclaimed area of the mine progresses annually from each of these reclaimed areas with the reclamation of the CRDA being completed in Year 20 (2038), the NRDA in Year 22 (2040), and the remaining pit area the year following mine closure in Year 24 (2042) ([Figures F.3.6-5 and F.3.6-6](#)).

The available mine area to be reclaimed will increase annually through mine closure to Year 24 (2042) ([Figure F.3.6-6](#)) at which point 1,090.4 ha of Benga's 1,462.6 ha reclamation responsibility will be reclaimed. In Year 25 (2043), 206.8 ha of reclamation will be conducted in the areas of the end pit lake and the processing plant. Reclamation will continue beyond mine closure to Year 27 at which point all but 32.2 ha associated with the Selenium Management System will have been reclaimed. The remaining areas will have final surface reclamation completed once the surge ponds have measured selenium levels that are within allowable discharge limits and can be released to the environment without further treatment. Once no longer needed, the surge ponds will be removed and reclaimed. At final closure (end of reclamation), all 1,462.6 ha of Benga's reclamation responsibility will be reclaimed, 18.4 ha will remain as end pit lake, 38.1 ha will remain as the proposed golf course development and 1.6 ha will remain as the proposed helipad access.

The reclamation program will result in the formation of a mosaic of reclaimed areas with multiple end land uses across the mine site. This process allows for the earliest reclamation possible, thereby reducing erosion and increasing the opportunities for direct placement of reclamation material and storing less in stockpiles.

Reclamation certification will be requested when a block of land has achieved the required vegetation cover, landform stability and overall performance criteria. There will be several years between the time that initial reclamation work is completed and the time that tree survival and growth have met the standards set in the evaluation criteria. All reclaimed lands will achieve equivalent capability and lands owned by the crown will be returned to the crown once they have been certified and are no longer required for the Project. Additional details of the mining, reclamation schedule and reclamation material handling are shown in [Table F.2.2-2](#) and provided in [Sections F.3](#) and [F.4](#).

Table F.2.2-2 Annual Reclamation Material Balance of Mining Areas

Year	Period	Disturbance Area ¹ (ha)	Cumulative Disturbance Area (ha)	Soil Stripping Area (ha)	Salvaged Deep Organics Volume (m ³)	Salvaged Upland Surface Soil Volume (m ³)	Total Salvaged Reclamation Material (m ³)	Reclamation Area ^{1,2} (ha)	Cumulative Reclamation Area (ha)	Reclamation Material Replacement Volume ³ (m ³)
2018	Y00	625.1	625.1	537.2	155,088	1,458,562	1,613,649	0	0	0
2019	Y01	93.0	718.2	74.1	-	238,528	238,528	1.9	1.9	3,846
2020	Y02	101.2	819.4	81.1	10,822	189,173	199,995	17.4	19.4	34,890
2021	Y03	124.6	944.0	83.2	164,138	208,596	372,734	19.6	39.0	39,197
2022	Y04	62.0	1,006.0	21.6	-	75,560	75,560	10.0	49.0	20,006
2023	Y05	223.9	1,229.8	156.5	-	440,697	440,697	15.3	64.2	30,550
2024	Y06	61.6	1,291.5	32.0	-	97,599	97,599	19.2	83.4	38,349
2025	Y07	56.6	1,348.1	32.8	-	67,678	67,678	71.8	155.2	143,515
2026	Y08	51.6	1,399.7	26.2	-	78,419	78,419	61.4	216.6	122,804
2027	Y09	0	1,399.7	0	-	-	-	21.1	237.7	42,148
2028	Y10	0	1,399.7	0.0	-	-	-	24.1	261.7	48,124
2029	Y11	25.6	1,425.3	19.2	-	64,916	64,916	30.3	292.0	60,574
2030	Y12	0	1,425.3	0	-	-	-	35.7	327.7	71,436
2031	Y13	0	1,425.3	0	-	-	-	112.3	440.0	224,653
2032	Y14	55.8	1,481.0	38.2	-	99,933	99,933	23.4	463.4	46,731
2033	Y15	0	1,481.0	0	-	-	-	27.2	490.7	54,499
2035	Y17	0	1,481.0	0	-	-	-	13.2	503.9	26,492

Table F.2.2-2 Annual Reclamation Material Balance of Mining Areas

Year	Period	Disturbance Area ¹ (ha)	Cumulative Disturbance Area (ha)	Soil Stripping Area (ha)	Salvaged Deep Organics Volume (m ³)	Salvaged Upland Surface Soil Volume (m ³)	Total Salvaged Reclamation Material (m ³)	Reclamation Area ^{1,2} (ha)	Cumulative Reclamation Area (ha)	Reclamation Material Replacement Volume ³ (m ³)
2036	Y18	0	1,481.0	0	-	-	-	11.5	515.4	23,035
2037	Y19	0	1,481.0	0	-	-	-	111.2	626.7	222,499
2038	Y20	0	1,481.0	0	-	-	-	104.3	730.9	208,512
2039	Y21	0	1,481.0	0	-	-	-	140.7	871.6	281,403
2040	Y22	0	1,481.0	0	-	-	-	40.9	912.5	81,716
2041	Y23	0	1,481.0	0	-	-	-	17.6	930.1	35,204
2042	Y24	0	1,481.0	0	-	-	-	160.3	1,090.4	320,580
2043	Y25	0	1,481.0	0	-	-	-	206.8	1,297.1	413,516
2044	Y26	0	1,481.0	0	-	-	-	0	1,297.1	0
2045	Y27	0	1,481.0	0	-	-	-	133.3	1,430.5	266,654
2045+	EOR	0	1,481.0	0	-	-	-	32.2	1,462.6	64,324
Grand Total			1,481.0	1,102.0⁴	330,047	3,019,660	3,349,707	1,462.6	1,462.6	2,925,256

¹ – Area of Proposed Golf Course Development and Helipad Access areas totalling of 39.7 ha is not included in material balance calculation

² – Proposed area of post-closure lake totaling approximately 18.4 ha is not included into reclamation area

³ – Reclamation Material replacement depth of 20 cm used for all areas. Surplus material will be used to enhance reclamation of the land disturbed for the Project.

⁴ – Soil stripping area differs from cumulative disturbance area due to previous disturbances, open water, and steep slopes.

F.2.3 Adaptive Management for Reclamation

Benga's adaptive management approach will involve establishing end land use objectives according to pre-development land use capability, site-specific conditions, improved practices based on research and monitoring results, and input from the public engagement and aboriginal consultation programs. As reclamation proceeds, monitoring of reclamation and revegetation performance will allow land use objectives to be reviewed and, if necessary, modifications can be made to site expectations according to natural revegetation processes.

Adaptive management is intended to respond to changes and advances in technology, such as reclamation material replacement and revegetation, to meet specific objectives. Benga will incorporate adaptive management techniques as routine components in all of its environmental management activities. These techniques provide the opportunity to develop and fine-tune the reclamation program using data collected on-site and from other regional operators.

Adaptive management may be used at any point throughout the project life cycle, but will have the greatest benefit in the early planning stages when the location and compositions of landforms are still to be decided. When landforms are designed or constructed, their intended end use will facilitate the decision-making process on surface contouring measures and corrective initiatives that could improve surface drainage, decrease erosion or enhance vegetation performance.

Benga will use the experience gained during the development of the Project, and other successes by the regional coal operators over the next 24 years, to manage and implement an effective reclamation program.

Benga will work with other operators of coalmines, AEP, AER and local stakeholders, to further develop criteria and monitoring programs that clearly demonstrate progress toward reclaiming environmentally sound sustainable ecosystems.

F.2.4 Conservation and Reclamation (C&R) Assumptions

The C&R Plan was developed using several key assumptions regarding closure planning, detailed reclamation planning, end land uses and final certification and release of certain lands back to the Crown, including the following:

- changes to the mine plan will require modification of the reclamation and closure plans;
- the probability of design changes to the mine and closure plans increases over time and changes are therefore expected;

- the design of the closure landscape will be integrated with the surrounding undisturbed terrain;
- the design of the closure landscape will be stable with self-sustainable drainage patterns;
- uncertainties in the closure planning process include the long-term performance of vegetation communities and capability to return landscape biodiversity;
- uncertainties in landscape performance and technology will be resolved through use of the principles of adaptive management, and knowledge gaps are to be resolved through research programs;
- the C&R Plan provided is conceptual in nature due to the evolutionary nature of mine technology development, mine planning and reclamation planning;
- reclamation practices used by other regional coal mine operators and information gained from the EIA are used as the foundation of the Project's reclamation planning;
- current soil handling practices provide the basis for soil reconstruction and revegetation practices;
- reconstructed soil performance will mimic natural soils over time;
- the revegetation program will be guided by information gained by the EIA, and by input from public engagement and aboriginal consultation; and
- target vegetation communities identified in the C&R Plan are conceptual in nature and it is recognized that it is not currently possible to accurately predict ecosystem succession over time.

F.2.5 Reclamation Planning for Biodiversity

The construction and operation stages of the Project will result in the removal of vegetation, and a temporary reduction of native species diversity in the Project Footprint. The ecosite phases impacted by Project development have mostly moderate to high biodiversity potential. After mine closure and reclamation, native species richness is expected to be lower than the intact naturally developed vegetation, with the exception of the 185.2 ha of previously disturbed land on the Project Footprint, which will result in an improvement over pre-development conditions. Over time, species and community diversity will improve across the reclaimed Project Footprint and landscape.

The re-establishment of species and landscape level biodiversity on reclaimed areas will depend on several factors such as terrain design, soil handling procedures, revegetation plans and the establishment of the drainage system. The reclaimed landscape will increasingly resemble pre-development conditions as the landscape matures and evolves.

The reclamation program designed by Benga will focus on the re-establishment of key species and communities that will promote additional species diversity, community structure, and ecological function in the reclaimed areas of the Project. These communities will emulate the landscape diversity of natural analogues in the area.

There are numerous mechanisms that can be used to enhance the biodiversity of the reclaimed landscape. These include:

- direct placement of salvaged soil (with propagules) from new mining areas as much as is practicable;
- establishing self-sustaining drainage patterns;
- re-establishing native species by planting native trees (including whitebark and limber pine), native shrub species, and native graminoids to provide structural diversity, wildlife habitat and wildlife browse;
- an adaptive revegetation strategy to take advantage of opportunities for establishment of a variety of target vegetation communities and wetlands (closed conifer forests, moderate mixed forests, native herbaceous grasslands and treed wetlands); or other vegetation communities that may become more appropriate with knowledge gained from adaptive management;
- creating a micro-hummocky surface that enhances moisture by using rough soil replacement techniques to unevenly spread soil on the recontoured surfaces; and
- managing for introduced or invasive species.

Monitoring for biodiversity will be conducted as part of the vegetation monitoring to identify species, overall health, and to measure progress towards reclamation targets. [Section F.3.7](#) identifies the specific reclamation targets and [Section F.3.9](#) provides additional details on monitoring intent.

A detailed management system for monitoring biodiversity will be developed and implemented. Input from regional management plans will be incorporated.

F.2.6 Reclamation Planning for Wildlife

As stated in [Section F.2.1.7](#), one of the primary goals for the reclamation program is the return of wildlife habitat. The mitigations proposed in the impact assessment completed for the wildlife assessment were considered in the reclamation planning for the Project.

Reclamation ecological communities established to provide habitat for TLU wildlife species utilization are presented in [Table F.2.6-1](#).

Table F.2.6-1 Wildlife Identified by Aboriginal Groups									
Wildlife Species	Piikani Nation¹	Kainai Nation	Siksika Nation³	Tsuut'ina Nation⁴	Stoney Nakoda FN⁵	Reclaimed Ecological Unit	Samson Cree Nation	Metis Nation of Alberta	Metis Nation of BC
Birds									
Owl	x	---	---	---	---	Closed Conifer Forest, Mixed Forest			
Woodpecker	---	x	---	-	---	Closed Conifer Forest, Mixed Forest			
Wild turkey	---	x	---	---	---	Grassland Open Forest		x	
Crow	---	x	---	---	---	Grassland Open Forest, Mixed Forest, Closed Conifer Forest			
Golden eagle	x	x	x	x	---	Barren land, open water			
Sprague's pipit (out of range)						n/a	x		
Prairie chicken (out of range, extirpated)						n/a			
Marten					x	Closed Conifer Forest			

Table F.2.6-1 Wildlife Identified by Aboriginal Groups									
Wildlife Species	Piikani Nation¹	Kainai Nation	Siksika Nation³	Tsuut'ina Nation⁴	Stoney Nakoda FN⁵	Reclaimed Ecological Unit	Samson Cree Nation	Metis Nation of Alberta	Metis Nation of BC
Grouse	x					Mixed Forest	x	x	x
Furbearers									
Bear	x	x	---	-	x	Closed Conifer Forest, Grassland Open Forest, Mixed Forest	x	x	x
Cougar	---	x	---	-	---	Grassland Open Forest	x		
Lynx	---	---	---	-	x	Closed Conifer Forest, Mixed Forest	x		
Wolf	x	x	---	-	---	Closed Conifer Forest, Mixed Forest	x		
Wolverine						Closed Conifer Forest, Mixed Forest, Barren Land	x		

Table F.2.6-1 Wildlife Identified by Aboriginal Groups									
Wildlife Species	Piikani Nation ¹	Kainai Nation	Siksika Nation ³	Tsuut'ina Nation ⁴	Stoney Nakoda FN ⁵	Reclaimed Ecological Unit	Samson Cree Nation	Metis Nation of Alberta	Metis Nation of BC
Coyote					x	Closed Conifer Forest, Grassland Open Forest, Mixed Forest, Barren Land			
Porcupine	x					Closed Conifer Forest, Mixed Forest			
Beaver	x		x		x	Open Water, Mixed Forest			
Otter (extirpated)	x	---	---	---	---	n/a			
Gopher	x	---	---	---	---	Grassland Open Forest			
Badger	x	---	---	---	---	Grassland Open Forest			
Mink					x	Treed Wetland, Open Water			
Rabbit	x	x	x	-	---	Closed Conifer Forest, Mixed Forest			x

Table F.2.6-1 Wildlife Identified by Aboriginal Groups									
Wildlife Species	Piikani Nation¹	Kainai Nation	Siksika Nation³	Tsuut'ina Nation⁴	Stoney Nakoda FN⁵	Reclaimed Ecological Unit	Samson Cree Nation	Metis Nation of Alberta	Metis Nation of BC
Squirrel	x	x	---	-	x	Closed Conifer Forest, Mixed Forest			
Skunk						Closed Conifer Forest, Mixed Forest, Grassland Open Forest	x		
Mice/Small rodents	---	---	x	-	x	Closed Conifer Forest, Mixed Forest, Grassland Open Forest, Treed Wetland, Anthropogenic			
Ungulates									
Buffalo (extirpated)	x	x	x	x	---				
Moose	x	x	x	x	x	Closed Conifer Forest, Mixed Forest, Open Water, Treed Wetland	x		x

Table F.2.6-1 Wildlife Identified by Aboriginal Groups									
Wildlife Species	Piikani Nation¹	Kainai Nation	Siksika Nation³	Tsuut'ina Nation⁴	Stoney Nakoda FN⁵	Reclaimed Ecological Unit	Samson Cree Nation	Metis Nation of Alberta	Metis Nation of BC
Bighorn sheep	x	x	x	x	---	Grassland Open Forest, Barren Land	x		
Mountain goat	x					Barren Land			
Deer	x	x	x	x	x	Mixed Forest, Closed Conifer Forest, Grassland Open Forest	x	x	x
Elk	x	x	x	x	x	Grassland Open Forest, Mixed Forest	x	x	x

¹ Source: Consultation information and Piikani Nation (2015).

² Source: Consultation information and Kanai Nation (2015).

³ Source: Consultation information and SCO (2015).

⁴ Source: Consultation information and Tsuut'ina Nation (2015).

⁵ Source: Consultation information.

The Wildlife Assessment report ([CR #10](#)) provides further detail on wildlife species selected as VCs and [Appendix C](#) of that report provides a detailed summary of the habitat requirements of each VC.

F.2.6.1 Ungulates

Ungulates are often used as umbrella species for reclamation to wildlife habitat because they have large home ranges, require a variety of landform features and vegetation types to fulfill their annual life requirements, and are important prey for carnivores. The provision of the habitat requirements for ungulates fulfills the habitat requirements for an assemblage of other wildlife species.

Elk and moose were identified as VCs for the Project. Both species are secure provincially, not at risk federally, known common residents of the study area, important harvest and recreation hunting species, culturally important to Aboriginal groups, and prey base for large predators. Elk are known to colonize reclaimed coalmines and are indicators of grassland habitat. Moose are indicators of riparian zones, shrubland and moist forests.

Incorporating diverse wildlife habitat components is a key wildlife mitigation measure associated with the Project. The mitigation recommendations for wildlife and wildlife habitat reclamation include:

- minimize the overall disturbance footprint through the mine planning process;
- establish a variety of vegetation communities consisting of upland grasslands, shrublands, wetlands, mixed wood forest and coniferous forest;
- encourage understory complexity in the reclaimed forests by planting native shrubs such as alder and willow;
- establish a variety of vegetation communities suitable for moose, consisting of mixed wood forest and wetlands and to encourage structural complexity to the forest;
- establish willow species as they are of particular importance to moose;
- ensure that core security areas are provided for wildlife;
- maximize the direct placement of salvaged soil to enhance native plant development;
- retain slash and large woody debris in the salvaged soil to provide microsites for native plant and hide cover for wildlife;
- preserve remnant forest patches within the development areas where feasible to provide habitat, habitat connectivity and hide cover for wildlife species; and
- limit sight lines by maintaining mature forest stands as buffers between roads and reclamation areas.

Where feasible these mitigations have been incorporated in the conceptual reclamation planning for the Project.

F.2.6.2 Carnivores

Carnivores are very important indicators of the status of ecosystem development. The following carnivore VCs were identified for the Project:

- grizzly bear;
- American marten; and
- Canada lynx.

Grizzly bear, lynx, and marten, all known residents of the area, are culturally important to Aboriginal groups and are affected by anthropogenic disturbances. Grizzly bears are at risk both provincially and federally and are rated as “Special Concern” by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) but are not on *Species at Risk Act* (SARA) Schedule at this time. Populations in the Castle-Livingstone region are potentially declining. Lynx are listed as “sensitive” in Alberta, are economically important for fur harvest and are an indicator of early successional forest and mine reclamation. Marten are important for fur harvest and are indicators of late successional conifer forests.

Project specific mitigations provided by the impact assessments have been incorporated into the reclamation planning. Carnivore-targeted mitigations will include:

- minimize the overall disturbance footprint through the mine planning process;
- retain slash and large woody debris in the replaced soil landscape;
- establish mixed wood forest stands;
- establish high density coniferous tree stands;
- provide understory complexity in the reclaimed forests by planting native shrubs such as alder and willow to provide security cover for the carnivores and their prey;
- plant native shrubs early in the reclamation process to initiate hiding cover;
- preserve remnant forest patches in the development areas to provide habitat, habitat connectivity and hide cover for wildlife species;
- maximize the amount of ungulate habitat;
- prior to final reclamation, disrupt linear disturbances and sight lines by mounding surface soils, piling brush; and

- limit sight lines by maintaining mature forest stands or by planting high density coniferous stands to act as buffers between roads, project disturbance boundaries and the reclaimed mine areas.

Mitigation that is specifically targeted to grizzly bears and grizzly bear habitat but also provides additional support to carnivore habitat include:

- maintaining a 100 m undisturbed forested buffer around Blairmore Creek and other riparian corridors;
- leaving patches of residual forest within and adjacent to the mine footprint; and
- commence reclamation early on in mine operations by seeding reclaimable areas with plant species favourable to grizzly bear forage and plant shrub and tree species that provide suitable cover (*e.g.*, willow, alder, coniferous trees)."

These have been incorporated in the conceptual reclamation planning for the Project.

F.2.6.3 Amphibians

The western toad and Columbian spotted frog were identified as VCs. Both species are known residents of the study area and are listed as "Sensitive" in Alberta, and are vulnerable to human disturbance. The western toad is listed as "Special Concern" by COSEWIC¹, and is an indicator of wetland and aquatic habitat. The Columbian spotted frog is an indicator of aquatic/riparian habitat, and relies on breeding ponds in the wildlife study area, which are of limited availability and distribution in the pre-disturbance landscape.

Overall mortality risk to amphibians from anthropogenic disturbances is low but the primary anthropogenic cause of mortality is likely to be a direct result of off-road ATV and vehicle traffic.

The mitigation measures relevant to the reclamation planning are:

- conduct monitoring to identify other habitable ponds and identify habitat requirements and constraints;
- construct trial breeding ponds;
- reclaim upland habitat adjacent to reconstructed breeding ponds; and
- avoid habitat destruction and alteration.

¹ Western toad was originally listed as Special Concern by COSEWIC in 2002, and then put on SARA's Schedule 1 in 2005. In November 2012, the species was split into two populations, both of which were listed as Special Concern by COSEWIC. Neither population has been reassessed by SARA or placed on a SARA schedule at the time of report submission.

Benga intends to maintain sediment ponds through to reclamation before partially dewatering them to become treed wetlands. These waterbodies and wetlands will be evaluated for habitat suitability and may be developed as amphibian habitat.

F.2.6.4 Birds

Two bird species were identified as VCs for the Project: olive-sided flycatcher and great grey owl.

Olive-sided flycatcher, a confirmed resident of the study area, is a species at risk both provincially and federally and is a SARA Schedule 1 species for which a federal draft recovery strategy exists. Olive-sided flycatchers are an indicator of mature coniferous and riparian forests, burned woodland, and edge habitat. They and their nest sites are protected under the *Migratory Bird Convention Act*.

Great grey owls are uncommon residents of the study area and the species is listed as sensitive in Alberta. It is an indicator of mature and old growth forests and is vulnerable to habitat loss from forestry practices. Great grey owls and their nests are protected under the *Alberta Wildlife Act*. This species is of significant cultural importance to Aboriginal groups.

The mitigation measures for birds relevant to the reclamation planning are:

- where possible, vegetation clearing will be planned to avoid the April 15 to August 31 breeding bird season. If clearing is required during this period, nest surveys will be completed prior to the clearing operations to determine specific requirements to protect the wildlife resource;
- retain slash and large woody debris in the salvaged soil to provide microsites for native plants and hide cover and perches for wildlife; and
- ensure reclaimed areas promote the re-establishment of woody species and are on a trajectory for reforestation.

Disturbed areas of the mine will proceed directly to reclamation upon completion of operations for that specific area. Targeted establishment of tree species *via* tree planting or natural regeneration will promote reforestation of the Project area and the restoration of disturbed bird habitat.

F.2.6.5 Bats

In Alberta, little brown myotis are common and are likely the most abundant bat species. This species was selected as a VC for the Project. They are a known resident of the study area, are endangered federally, and are on SARA's Schedule 1. They are an indicator of mature and old growth forests and have been known to colonize old mines.

The mitigation measures for bats relevant to the reclamation planning are:

- ensure reclaimed areas promote the re-establishment of woody species and wetland vegetation and are on a trajectory for forest and wetland establishment; and
- preserving remnant forest patches within the development areas where feasible to provide habitat, habitat connectivity and roost sites for bat species.

Disturbed areas of the mine will proceed directly to reclamation upon completion of operations for that specific area. Targeted establishment of tree species *via* tree planting or natural regeneration will ensure reforestation of the Project area and the restoration of disturbed bat habitat.

F.2.7 Reclamation Planning for Vegetation

Benga intends to establish self-sustaining plant communities that are equivalent in capability to the native plant communities that occur in the area.

Since soil nutrient, moisture regime, slope, aspect, and slope position of specific points within the mine footprint will not be the same as baseline conditions, nearby natural analogues will be used to guide the establishment of suitable plant communities across the reclaimed areas rather than the restoration of what existed at baseline conditions.

To achieve equivalent land capability Benga will implement:

- a re-vegetation program that aims to establish diverse native vegetation communities (closed conifer forests, moderate mixed forests, natural upland herbaceous grasslands, and treed wetlands) with equivalent pre-disturbance capability;
- a plan that aims to establish communities that are locally and regionally limited in distribution where conditions allow;
- preservation of adjacent vegetation communities by minimizing the area required for construction and operation of the Project;
- provision of appropriate soil substrate where vegetation communities can establish;
- a seed collection program in advance of construction and operations to collect seed from local sources for use in reclamation;
- seeding of stockpiled reclamation material with suitable vegetation species mix to ensure long term stability of the soil piles, which reduces erosion and the potential for weed establishment;
- use of coarse woody debris and direct soil placement techniques to augment mycorrhizal and microbial inoculums;

- use direct placement of soil for provision of propagules to enhance opportunity for re-establishment of native species composition and enhanced species richness; and
- planting of multiple layers of native vegetation (*e.g.*, trees, shrubs and graminoids) to provide initial structure for wildlife habitat and to enhance biodiversity.

Given that various wetland classes are rare in the Project Footprint and in the region, added mitigation measures for wetland impacts should include the following:

- use of best practices to maintain the hydrologic regime of mineral soil wetlands;
- creation of transition areas between re-vegetated communities as outlined in the reclamation plan to the treed swamps, where it is possible and/or appropriate to do so; and
- placement of culverts within wetlands that will be divided by roads to ensure that water flow between wetlands will not be affected.

Vegetation species that have current or historical uses and importance to Aboriginal groups are considered TEK resources. Supplementary mitigation measures for TEK vegetation impacts include the following:

- consult with and involve Aboriginal groups in designing mitigation measures for sustainable management of TEK vegetation;
- implement a re-vegetation program that aims to re-establish vegetation communities, such as those previously mentioned (closed conifer forests, mature mixed forests, native upland herbaceous grasslands and treed swamps) that are common to the pre-disturbed landscape and that will support TEK vegetation for gathering and hunting purposes; and
- where practicable, utilize locally collected seed to preserve the legacy of species and of place.

Vegetation species to be targeted for establishment *via* planting and natural recovery are presented in [Table F.3.6-2](#) and [Table F.3.6-4](#). TEK vegetation species to be established that correspond with targeted reclamation species include:

Species to be Established - Planting and Natural Recovery:

- Lodgepole pine;
- Prickly Rose;
- Ground Juniper;
- Willow;
- Aspen; and
- Balsam Poplar.

Naturally-occurring plant species to be encouraged:

- Saskatoon;
- Thimbleberry;
- Bearberry; and
- Dwarf Birch.

Native Woody Plant Species for Reclamation (tree plantings from locally collected seed or cuttings):

- Subalpine fir; and
- Dogwood.

The establishment of reclaimed ecological communities will support natural recovery of TEK vegetation species that are not being established through direct planting.

F.3 Conservation and Reclamation Plan

The C&R Plan for the Project provides details on the reclamation activities throughout the life of the Project and at mine closure. The C&R Plan provides the specific reclamation procedures that will be employed while the Closure Plan outlines the goals and processes of the reclamation planning.

The mine reclamation plan identifies efforts needed to maintain the development area's biodiversity, to sustain ecological conditions, and to achieve equivalent land capability. Following mine closure, the Project Footprint will maintain comparable distribution of upland forests, grasslands, and wetlands. A slight reduction in overall slope of the site is expected at closure, which will facilitate a rapid revegetation of the Project Footprint. This plan will identify how and when these end points are expected to be achieved.

The reclamation plan was developed for the mine by integrating information assessed in the project EIA, applying standard and innovative reclamation practices and techniques, and with consideration to stakeholder preferences.

The documents used in the preparation of this plan are referenced in the applicable sections.

Prior to the commencement of mining operations, the conservation of timber and soil resources will be completed. Prior to soil disturbance, the construction of the surface water management systems will be completed. It is estimated that full development of the Project will disturb 1,520.7 ha. The progression of clearing for the first 15 years of mine development is described in detail in [Section F.3.6](#) (Mine Reclamation) and shown in associated figures, [Figure F.3.6-1](#) (Years 1 to 5), [Figure F.3.6-2](#) (Years 6 to 10) and [Figure F.3.6-3](#) (Years 11 to 15).

F.3.1 Vegetation Clearing

Development of the mine will require clearing existing vegetation from the Project Footprint. The Project Footprint has been developed recognizing Benga's commitment to minimizing the amount of disturbance that is required for Project development. There may be opportunities to reduce the mine disturbance area through an adaptive management program.

All merchantable timber will be salvaged as per the Timber Salvage Plan discussed in [Section F.3.3](#). The disposition of timber removed from crown land will be made available to the local timber rights holders. The timber from private land will be made available to Aboriginal groups, to local timber rights holders, or disposed by some other process.

Non-merchantable timber and slash materials will be disposed of, incorporated with soil, or will be stored for use during reclamation. The placement of coarse woody debris on reclaimed landscapes will provide value for the establishment of native plant species as well as providing wildlife habitat values such as perching and hiding cover.

In areas where there will be minimal soil disturbance, such as powerline rights of way, the remaining vegetation may be mulched after the merchantable timber has been removed. Mulching will be completed to the requirements of *ASRD Directive 2009-1* that requires a maximum mulch depth of 5 cm to promote micro topography, moisture storage during dry periods and erosion control. Managing the volumes and depths of mulch as per this directive will ensure volumes do not degrade soil quality or become a pathway for wild fire. Mulching will only be conducted on areas within the project footprint intended for disturbance. (Alberta Sustainable Resources and Development [ARSD] 2009)

F.3.2 Rare Plant Mitigation

Rare plant species rankings in Alberta are largely determined by the number of observations of the species that are reported in the province. Based on this system, low profile, difficult to locate, and hard to identify species are more likely to be listed as rare (Alberta Biodiversity Monitoring Institute [ABMI] 2007). It is difficult to determine if some species are rare due to location at the edge of their natural range. Taxonomic uncertainty and misidentification may also result in the rare status of certain species. Avoidance of rare plant species provincially ranked between S1 and S3 is the most preferred mitigation option. Where avoidance is not an option, site-specific and species-specific mitigation planning may be possible. Based on a review of the species descriptions and habitat requirements of the rare plant species located in the Project Footprint, Benga has developed a rare plant species mitigation program.

The Project's rare plant species mitigation program took the following factors into account during the plans development:

- transplanting rare plants from one location to another is a potential mitigation strategy, but is not widely accepted (Canadian Botanical Association 1991, Fahselt 1998). Transplanting has been shown to have a low rate of success for rare vegetation (Allen 1994, Howald 1996);
- collecting seed and propagating it for additional seed, or for propagules for transplantation (e.g., container stock) from rare plant species is more successful than direct transplantation, but can also have a low success rate unless proper planning is involved (Munshower 1994, Sinton Gerling *et al.* 1996);
- locating and identifying rare vascular plant species, especially annual plant species, on a yearly basis is difficult;
- transplanting rare vascular plants to an undisturbed location with equivalent habitat (which is often sensitive in nature) often causes considerable disruption to the undisturbed habitat (e.g., damage to plants in the undisturbed area, introducing a plant species not indigenous to the undisturbed habitat, opening additional habitat for weed and invasive species) (Canadian Botanical Association 1991, Fahselt 2013); and
- transplanting is even more difficult for non-vascular lichen and bryophyte species, as they often have specific microclimate requirements and/or symbiotic relationships that must remain intact for survival, which makes transplanting an unviable option (Canadian Botanical Association 1991, Allen 1994, Howald 1996).

Based on these factors, the Project's rare plant species mitigation plan was developed to accommodate the following four strategies:

- Rare Plant Propagule or Relocation Mitigation Plan – for perennial vascular plants (with the exception of whitebark pine and foothills rough fescue grasslands [[Sections F.3.2.3](#) and [F.3.2.4](#), respectively]);
- Rare Plant General Mitigation Plan – for all other rare plant species (except whitebark pine and rough fescue grasslands);
- Whitebark Pine and Limber Pine Mitigation Plans; and
- Fescue Grassland Community Mitigation Plan.

The details of each sub-plan are discussed in the following sections.

F.3.2.1 Rare Plant Propagule or Relocation Mitigation Plan

A review of the rare plant species located in the Project Footprint, their specific growth traits and habitat requirements, and the factors outlined above, has identified the following seven vascular plant species as potential candidates for propagule collection and or relocation:

- *Angelica dawsonii* – yellow angelica (observed at three sites in the Subalpine e1 ecosite phase);
- *Berberis (Mahonia) repens* – creeping mahonia (one site in Montane c4);
- *Carex petasata* – pasture sedge (two sites in Subalpine a1, one site along Overland Conveyor in Montane c4);
- *Crepis atriebarta* – slender hawk’s-beard (observed once in a disturbed site along the Overland Conveyor within the Montane Subregion);
- *Eucephalus engelmannii* – elegant aster (one site in Subalpine e1);
- *Phacelia hastata* – silver-leaved scorpionweed (five sites Subalpine a1, e1, and previously mined area); and
- *Streptopus roseus* – rose mandarin (one site in each of Montane c1 and g2 and Subalpine e1).

Separate mitigation plans are developed for whitebark pine and limber pine, and rough fescue containing grasslands, which are included in [Sections F.3.2.3](#) and [F.3.2.4](#), respectively.

F.3.2.1.1 Rare Plant Propagule Collection

The collection of seed and reseeded rare plant species (including producing additional seeds from the collected seeds), or the potential propagation of individual plants from collected seed for transplantation, into the reclaimed landscape is a more successful revegetation strategy when compared to direct transplantation, but still has limitations (Munshower 1994, Sinton Gerling *et al.* 1996). Prior to any collection, the seven species listed in [Section F.3.2.1](#) will be reviewed by a seed collection and propagation specialist, with experience in seed collection, storage and propagation. The feasibility to collect seeds for any of these seven species, when the seed should be collected, and if the collected seeds should be stored for use in reseeded, propagated for additional seed, or propagated for use in a transplantation propagation will be determined by this expert. This will depend on the inherent characteristics of each species.

Once the species suitable for seed collection have been selected, accessible locations of these plants will be visited (as plotted on [Figure F.3.2-1](#)) for approximately the first 22 years after Project operations start (*i.e.*, from start of Project operations to maximum Project disturbance, or when no seed collection areas remain). This will be completed at varying intervals during the summer and fall prior to area disturbance, to determine if seeds are available for collection (*i.e.*, at the time of flowering and before dispersal) as not all species go to seed, or seed at the same time, every year. If disturbance

of the rare plant species location will not occur for three to four years in the future (or more), no more than 50% of the seed will be collected at each visit from no more than 10% of the plants, with 2 years between each collection (Alberta Native Plant Council 2007, Native Plant Working Group 2000). If the disturbance is going to occur immediately, 100% of the seeds will be collected. The seeds will be collected, identified, transported, registered, stored, cleaned and tested according to the *Alberta Native Plant Council Plant Collection Guidelines for Horticultural Use of Native Plants* (Alberta Native Plant Council 2007) and *Alberta Native Plants and Seeds: Wild Harvest, Registration and Deployment. A Guide for Technicians and Practitioners* (Smreciu 2011) documents. Given the variable nature of plant species in terms of regeneration, and responses to biotic and abiotic variables, some or all of these rare plant species may not be located or provide enough seed to be used.

Based on the input of the seed collection and propagation specialist, the inherent characteristics of the particular rare plant species, and the volume of the seeds collected, they will remain in storage for future seeding, be propagated for more seeds, or propagated for transplantation in accordance with the Smreciu (2011) document. The type and areas for seeding and transplantation propagation (*e.g.*, bare rootstock, container type, container size, *etc.*) will be determined in consultation with the seed collection and propagation specialist. This work will be coordinated with the reclamation schedule for the Project so that appropriate amount and type of material for revegetation will be available for placement (*i.e.*, seeding and/or transplantation) into a habitat that correlates as close as possible with the requirements of each particular species. The species will be placed (*i.e.*, seeded and transplanted) within one of the four following reclamation ecological units: closed conifer forests, moderate mixed forests, natural upland herbaceous grasslands, and treed wetlands (Figure F.3.6-7 and Figure F.3.6-8).

F.3.2.1.2 Rare Plant Relocation

If consultation with the seed collection and propagation specialist determines that any of the seven species outlined above are not candidates for seed collection or enough seed cannot be collected, direct transplantation is the only remaining mitigation plan. For direct placement, if any of the species' known locations are included in the upcoming years' Project planned disturbance; these locations would be visited as early as possible in that spring (*i.e.*, so that the species have remained hardened-off) to attempt to transplant the species as soon as possible. Direct transplant of hardened-off, or plants remaining as hardened-off as possible, increases the likelihood of revegetation success (Munshower 1994).

Unlike seed or propagated transplants, direct transplantation candidates, cannot be stored or developed as needed. As a result, rare species that may be disturbed in the first two years of Project operations will not be transplanted. However, as reclaimed areas will be available two years after Project operations start, rare plants in areas to be disturbed after this time will be available for transplantation. This process will be completed each spring until the maximum extent of disturbance

is reached and no areas are left for transplantation; approximately 22 years after operations commence.

Given the variable nature of plant species in terms of regeneration, and responses to biotic and abiotic variables, candidate rare plant species may not be located for direct transplantation. If the target rare plant species is located, the plant species population will be noted in terms of area occupied by the population, the patches (if applicable) of the species within the population area, and the number of individual plants within the various patches and population area. For transplantation, 100% of the located individuals within the population will be moved, if possible, as all of them are slated for disturbance. Guidance on the type of transplantation method most applicable to each species (*e.g.*, cuttings, whole plant transplantation, sod transplantation, *etc.*) will be provided by a qualified specialist and also as found in the *Establishing Native Plant Communities* (Smreciu *et al.* 2003) document.

As noted above, rare plant species will not be directly transplanted into undisturbed areas due to the considerable disruption that would occur to the undisturbed habitat. Suitable relocation sites will be identified within areas of the mine undergoing reclamation or recently reclaimed.

F.3.2.1.3 Rare Plant Monitoring & Management Program

The seeding or transplantation of grown propagules, especially the direct transplantation of rare plant species is often challenging; therefore, comprehensive monitoring and management of areas seeded or transplanted with rare species will be required to ensure it is successful. The following is an outline of the monitoring for the Rare Plant Propagule or Relocation Mitigation Plan:

- annual assessment of seeded areas to determine germination success and survival; and
- annual assessment of propagule transplantation and/or direct transplantation areas to determine transplant survival and health.

The following is the management that may be required to ensure success of the mitigation plan:

- continuous reseeded of areas that may have an initial low germination rate (less than 5-15 plants/m²) (Alberta Environment 2003);
- additional transplantation (of propagated materials) due to low survival (less than 2 plants/m²) of initial transplanting activities (Alberta Environment 2003a);
- managing weed and invasive species in seeded areas and transplant areas to limit competition; and
- watering (by Benga Operations and Reclamation staff) of transplanted areas to assist with long-term transplant survival.

The Best management Practices for determining revegetation success, as provided in *Sites Reclaimed Using Natural Recovery Methods Guidance on Site Assessment* (Alberta Environment 2003b) will be adhered to.

F.3.2.2 Rare Plant Species General Mitigation Plan

With the exception of whitebark pine and limber pine, all rare species identified are considered globally secure and do not have provincial or federal recovery plans in place. For the Project whitebark pine and limber pine have species specific recovery plans, and fescue are protected under provincial protective notations, the other 18 rare plant species located in the Project Footprint are globally secure and are not suitable for Rare Plant Propagule collection or Relocation Mitigation Plan for the following reasons:

- they are annual vascular plants and the likelihood of locating them is low;
- they do not produce propagules that can be stored or propagated (*e.g.*, the spores of lichens, mosses and liverworts); or
- they have specific microclimate requirements and/or symbiotic relationships that must remain intact for survival, which makes transplanting an unviable option (*e.g.*, obligate mycorrhizae associated with orchid species).

Based on these factors the following mitigation measures will be implemented for rare plants (with the exception of whitebark pine, limber pine and native fescue grassland):

- a re-vegetation program which aims to establish diverse native vegetation communities (closed conifer forests, grassland open forests, mixed forests, and treed wetlands) with equivalent pre-disturbance capability;
- establishing communities that are locally and regionally limited in distribution where conditions allow;
- preservation of adjacent vegetation communities by minimizing the area required for construction and operation of the Project;
- provision of appropriate soil substrate where re-vegetated areas can establish;
- seeding of stockpiled reclamation material with suitable vegetation species mix to ensure long term stability of the soil piles, which reduces erosion and the potential for weed establishment;
- use of coarse woody debris and direct soil placement techniques to augment mycorrhizal and microbial inoculums;
- use direct placement of soil for provision of propagules to enhance opportunity for re-establishment of native species composition and enhanced species richness; and

- planting of multiple layers of native vegetation (*e.g.*, trees, shrubs and graminoids) to provide initial structure for wildlife habitat and to enhance biodiversity.

Also, the following monitoring measures will be implemented:

- periodic assessment of the composition, structure, ecological succession and biodiversity of reclaimed vegetation; and
- survival, growth and health assessments of re-vegetated areas to monitor the effectiveness of reclamation efforts relative to re-vegetation targets (including noxious and invasive species and effectiveness of control methods).

These mitigative measures are also applicable to the species included in the Rare Plant Propagule or Relocation Mitigation Plan ([Sections F.3.2.1](#)) and the Foothills Rough Fescue Mitigation Plan ([Section F.3.2.4](#)).

F.3.2.3 Whitebark Pine and Limber Pine Mitigation Plan

Whitebark pine (*Pinus albicaulis*) is listed as “Endangered” in Alberta and British Columbia under SARA Schedule 1 in 2012 (Government of Canada 2015), and limber pine (*Pinus flexilis*) was designated as “Endangered” throughout its range in Alberta and British Columbia by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in November 2014. Limber pine is listed as globally secure (G4 or G5) while whitebark pine is not (G3/G4).

The distribution of whitebark pine and limber pine species have been confirmed *via* aerial assessment and plotted on [Figure F.3.2-1](#). Assessment methodologies are discussed in [CR#8, Sections 2.3.2.2](#) and [2.3.2.4](#). Pre-development counts estimated 20,692 whitebark and limber pine with less than 1,000 limber pine stems estimated across the entire Project Footprint. Since limber pine are difficult to distinguish from whitebark pine without cones and before the pollen season, at the time of assessment they were included in the whitebark pine counts. In the Project Footprint, whitebark pine individuals, sparse clusters, and mixed species stands were found on both east and west aspects along crest and upper slope positions ([Figure F.3.2-1](#)).

The reclamation plan will follow guidance provided in the Alberta Whitebark Pine Recovery Plan and Limber Pine Recovery Plan, established by the Alberta Whitebark and Limber Pine Recovery Team (2014a). In addition to recommending a reduction of direct mortality of the species, which has been considered throughout the development of the Project Footprint, Benga will develop and introduce white pine blister rust-resistant strains; conserve genetic diversity; and manage habitat and natural regeneration.

The criteria identified in the provincial recovery plan will be followed to identify disease resistant trees. To preserve genetic diversity, clusters of whitebark pine will be investigated for suitability for cone/seed collection prior to disturbance, and seed collection would include selection of trees showing evidence of white pine blister rust resistance. Seeds will be provided to greenhouses for seed extraction and storage until needed for reclamation and or to support provincial recovery plans.

Whitebark pine, due to its greater vulnerability and more limited range, will be preferred over limber pine for reclamation. No specific recommendations for planting of limber pine are available at this time; trials are underway. Recommendations specific to planting of whitebark pine will be used when planting limber pine until specific guidance is available.

Whitebark Pine will be planted in pure stands or patches in areas with high light and low competition. Microsites will be established from rocks, stumps, or coarse woody debris and will avoid swales or frost pockets. Spacing recommendations identified in the Recovery Plan will be followed to avoid interspecies competition. Combined, the number of seedlings planted will be three times the pre-disturbance number (Table F.3.2-1), to account for planting and natural mortality, reclamation of historical mine areas, and future losses. Planting will occur primarily in the fall to avoid hot dry summer conditions and seedlings will be strategically placed to promote seedling growth and establishment within targeted ecological units and landscapes. Planting locations will target exposed hilltop areas within developed grasslands, areas with a lack of reclamation material, and other areas where limited competition exists including the high wall. Areas where whitebark and limber pine will be planted are identified in Figures F.3.6-4, F.3.6-7, and F.3.6-8.

Tree Species	Pre-disturbance landscape			Reclaimed landscape		
	Area (ha)	% Area	Count	Area (ha)	% Area	Count
Whitebark Pine	47.4	3.1	15,203	310	20	63,000
Whitebark Pine (sparse distribution)	197.3	13.0	5,489			
Total Whitebark Pine	244.7	16.1	20,692	310	20	63,000

¹ Due to rounding of values, totals may not equal the sum of the individual values presented in the table.

F.3.2.4 Foothills Rough Fescue Mitigation Plan

The preferred primary mitigation strategy for native foothills rough fescue grasslands is avoidance. Vegetative disturbance within the project footprint is unavoidable, and therefore mitigation strategies

will be implemented to improve the likelihood of re-establishing rangeland communities across the project throughout the life of the mine. The targeted distribution of grasslands in the reclaimed landscape is demonstrated in [Table F.3.2-2](#) and is shown in comparison to pre-disturbance landscapes.

Benga acknowledges that restoration of foothills rough fescue inhabited lands is relatively unproven but will rely on industry best practices and will utilize key findings from successful efforts made on other industrial disturbances in similar fescue grassland areas. A search of available literature, such as Lancaster *et al.* (2016), demonstrates several successes on similar landscapes, which will be incorporated into the reclamation plan as further defined below.

Vegetation assessments conducted across the mine have identified multiple fescue community types across the Project footprint. Foothills rough fescue dominant communities occupy 3.4 ha of pre-disturbance landscape, grassland communities where foothills rough fescue is a sub-dominant component occupy approximately 18.2 ha, and open forest grassland ecological units which have foothills rough fescue as a component of the ecological unit contain 36.3 ha, as identified in [Table F.3.2-2](#) and as shown in [Figure F.3.2-1](#). The pre-disturbance foothills rough fescue communities exist in open valley bottoms, on south facing slopes, on ridges, and in patches in the Montane and Sub-Alpine Natural Subregions. The targeted distribution of reclaimed grassland ecological units is shown in [Figures F.3.6-4, F.3.6-7, and F.3.6-8](#).

[Table F.3.2-2](#) demonstrates the distribution of foothills rough fescue dominant grasslands and grasslands with a foothills rough fescue component in the pre-disturbance landscape and the target distribution for the final reclaimed landscape. The foothills rough fescue dominant grasslands are expected to be disturbed early in the mine development from Year 1 through to Year 5. Foothills rough fescue seed will be collected prior to disturbance and annually through the five years as further discussed below. Avoidance measures will be exercised annually to allow seed collection from undisturbed portions of the foothills rough fescue dominated lands through to Year 5 when the lands surrounding the fescue-dominated areas are completely disturbed.

Foothills Rough Fescue Community	Pre-disturbance landscape		Reclaimed landscape	
	Area	% Area	Area	% Area
Foothills rough fescue dominant	3.4	0.2	4.0	0.3
Grasslands	18.2	1.2	276.7	18.2
Open forest grasslands	36.3	2.4		
Total foothills rough fescue distribution	57.9	3.8	280.7	18.5

¹ Due to rounding of values, totals may not equal the sum of the individual values presented in the table.

Mitigation specific to the re-establishment of foothills rough fescue are further documented in [CR#8, Section 4.3.4](#) and will include:

- direct reclamation material placement from grassland areas, when opportunities exist;
- collection of native foothills rough fescue seed from across the site;
- seeding of wild harvested certified weed-free native seed as a monocultures and as part of a certified, weed-free native seed mix;
- seeding and growing of foothills rough fescue plugs in a greenhouse for transplanting onto reclaimed areas of the site;
- occurrences of natural regeneration of native fescue; and
- promote the seeding of foothills rough fescue on the rough areas of the proposed golf course development to increase overall distribution of fescue grasslands.

The application of each of these methods is dependent on:

- the timing of the disturbance versus the availability of land ready to be reclaimed;
- availability and viability of certified weed free seed sources; and
- accessibility of ranges across the mine.

Direct placement of salvaged reclamation material will be prioritized, when opportunities exist, to promote foothills rough fescue and native grassland establishment. Specific opportunities to align the

disturbance of the foothills rough fescue dominated communities with the availability of areas scheduled to be reclaimed will be pursued and considered before all other mitigation. Areas where direct placement is targeted will be further supported by other seeding and maintenance techniques to ensure soil stability and vegetation establishment of the desired communities is achieved.

As the growth of native foothills rough fescue grasslands may require a long period of time, the majority of early stage reclamation will use a certified, weed-free native seed mix that is representative of the range type communities identified in [CR#8, Table 4.3-1](#), for the reclamation of natural upland herbaceous grasslands. Specifically, the *C5 Forest Management Plan 2006-2026* (Government of Alberta 2010b) recommends that for reclamation work to adhere to the *Native Plant Revegetation Guidelines for Alberta – February 2001* (Native Plant Working Group 2000). These guidelines state that seed mixes, and the accompanying seed certificates of analysis, be submitted to appropriate AEP staff for approval prior to seed application. Benga has discussed the conceptual mixes with AEP and has been directed to confirm specific seed mixes prior to seeding.

Seeding of wild harvest collected native fescue seed is the preferred method for all reclaimed grassland ecological units. If the availability and collection of native fescue seed becomes limiting to re-vegetative efforts, seed sources will be supported with locally certified, weed-free native seed mixes.

As the mine reaches maximum disturbance in Year 15, approximately 4.0 ha of reclaimed landscape will be selected to seed monocultures of foothills rough fescue as recommended by Sherritt (2012) in Lancaster, *et al.* (2016) as shown in [Figure F.3.6-4](#). Once seeded, monitoring programs will be implemented that will assess the success of foothills rough fescue establishment so that corrective actions can be recommended. The early development of rangeland communities will benefit from the remaining years of reclamation schedule and will utilize the adaptive management program to ensure that healthy rangeland communities are established. Following Year 15, additional landscape areas will be selected based on the results of the previously targeted foothills rough fescue dominated areas.

A portion of wild harvest collected fescue seed will be utilized to grow fescue plugs in local greenhouses. Tannas (2011) has documented that developing seedlings in an environmentally protected location, such as a greenhouse and transplanting to site, protects the seedlings from competition and environmental effects during their most vulnerable growth periods. Transplanting of plugs will target seeded areas of the reclaimed landscape where foothills rough fescue establishment has been limited, and these efforts will be coordinated with local recovery strategies. They are expected to be limited by the availability of local seed and local plugs, but will be utilized throughout the life of the mine ensure fescue communities establish and are maintained.

Reclaimed areas are also expected to benefit from a certain amount of natural regeneration of foothills rough fescue. These areas will be identified as part of the ongoing monitoring program for the mine. Areas where natural regeneration is identified will provide study opportunities to better understand the success parameters that can then feed into future efforts across the mine, elsewhere throughout the province, and throughout industry. Areas identified during monitoring where foothills rough fescue establishment is limited will be supplemented with a combination of overseeding, amending with hay cuttings/mulch harvested from the foothills rough fescue being collected, and transplanting of plugs as required.

Well-designed monitoring programs are very important during the first five years following construction and reclamation, and long term monitoring programs are recommended for disturbance and reclamation of rough fescue grasslands (AESRD 2011). In addition to monitoring of the establishment in the first few years of reclamation, range health assessment of natural upland herbaceous grasslands would be conducted at Year 5 and Year 10 once each reclamation phase has been completed. Additional annual range health assessments would be conducted after Year 10 should the results of the range health assessments indicate that the range health functions of the community are not being restored.

F.3.3 Timber Management Plan

The Project Footprint is located on both private and public land and will require timber removal from areas intended to be developed. [Figure F.3.3-1](#) demonstrates the proposed and potential timber harvest areas by owner across the mine. Timber salvage will commence in Year 1 of mine development and will progress annually until full disturbance of the mine area is achieved in Year 14 (2032).

On public land, timber rights fall under the C5 Forest Management Unit (FMU). FMU C5 has five quota holders in the project area which will be given first right of refusal for the timber salvage generated by the development of the mine. As per the approval conditions for the FMU, *“Timber salvage produced in the FMU shall be accounted and reported as drain against each timber operator’s disposition based on the disposition holders allocated percentage of the AAC”* (Government of Alberta, 2010). The current approved Coniferous Allocations and Annual Allowable Cut (AAC) (Government of Alberta, 2014) are shown in [Table F.3.3-1](#).

Table F.3.3-1 Approved FMU C5 Annual Allowable Cut (AAC)			
Company Name	Disposition Number	C5 FMU	
		Primary Disposition Allocation (%)	Total Approved AAC (m3)
793128 Alberta Ltd.: Private	CTQC050002	1.65	3,455
770538 Alberta Ltd.: Forest Resource Improvement Association of Alberta	CTQC050005	4.38	9,172
Spray Lakes Sawmills (1980) Ltd.	CTQC050008	29.07	60,877
Crowsnest Forest Products Ltd.	CTQC050009	58.69	122,905
Community Timber Permit Program (CTPP)	CTPP	6.21	13,005
FMU C5 TOTAL		100.00	209,414

The estimated merchantable timber volumes available for distribution to quota holder (public land) and to be distributed by the titled landowner (private land) are summarized in [Table F.3.3-2](#).

Table F.3.3-2 Estimated Merchantable Timber Volumes			
Landowner	Coniferous Timber Volume (m ³)	Deciduous Timber Volume (m ³)	Total Timber Volume (m ³)
Crown	71,480	673	72,153
Freehold Benga (100% ownership)	50,494	10,019	60,513
Freehold Benga (50% ownership)	228	0	228
Freehold – Crowsnest Pass Golf & Country Club	261	0	261
TOTAL	122,463	10,692	133,155

The project will result in a 72,153 m³ drain against the timber dispositions held on public lands which is approximately 34% of the AAC for the C5 forest management unit. There is an additional 60,513m³

on private lands for a total of 133,155 m³. Coniferous timber volumes consist of approximately 68 to 83% pine, 6 to 12% spruce and 5 to 20% other coniferous species. Deciduous timber volumes consist of 98 to 100% aspen.

As per AEP guidance (Juhlin, 2016 pers. com.), timber volumes from Crown land will be offered to the two main quota holders, Spray Lakes Sawmills (1980) Ltd. and Crowsnest Forest Products. Should these quota holders decline, the volumes will be made available to other interested parties.

Private land within the Project Footprint falls within the CO2 FMU in which generic provincial regulations apply. Each individual landowner is responsible for determining the use of the timber resources. Aboriginal groups have expressed interest in small volumes of timber for poles and rails, and Benga will engage interested Aboriginal groups in advance of clearing to identify opportunities to provide timber for this purpose. Consultation in advance of clearing will identify potential plants and trees that are of cultural importance to Aboriginal groups either for relocating or for salvage and use. Remaining merchantable timber will be offered to quota holders of the adjacent public lands or to other interested parties as per the public lands process.

All cleared timber will be placed in log decks located strategically around the mine and removed by quota holders and/or Aboriginal groups. Non-merchantable timber will be salvaged with the reclamation material. If the volumes of non-merchantable timber are excessive and cannot be incorporated into the soil, it will need to be disposed of, most likely by burning. Some of the excess material may be stored as coarse woody debris for select reclamation areas.

F.3.4 Soil Conservation Program

A foundational component of achieving equivalent land capability is ensuring sufficient volume and quality of reclamation material are maintained; and this soil management plan achieves that. The goal of the soil conservation program is to ensure there will be sufficient volumes of suitable reclamation material to support the self-sustaining vegetation communities required to achieve the planned end land uses. These help satisfy the ToR, specifically Section 3.2.8 [A], as provided in [Section F.1](#), which includes: *h) reclamation material salvage, storage areas and handling procedures and i) reclamation material replacement indicating depth, volume and type.*

Soil surveys were conducted in 2014-2015 with soil inspection data obtained at an intensity level as defined in the AER ToRs for the Project. Surface soil characteristics were identified and rated for reclamation suitability as Good, Fair, Poor or Unsuitable. Details of the soil survey and soil suitability maps are included in [CR #7, Figures 3.1-1 to 3.1-3 and 4.1-2 to 4.1-3](#) (Soil and Terrain).

Reclamation material salvage operations will ensure the salvage of all available upland surface soil. The soil balances and annual volumes are provided in [Table F.2.2-2](#). Terrain features indicate that

1,102 ha of land has salvageable upland surface soil and salvageable organic soil present. Some of the project area has lands without soil material present or the topography is too steep to allow soil to be salvaged safely (Figure F.2.1-2). Soil salvage guidance by experienced professionals and pre-disturbance soil survey information will result in minimal soil losses due to conventional salvage and handling methods and minimize impacts to soil quality.

All available reclamation material will be salvaged to meet the requirements of the reclamation plan with some additional volume for contingency. There are limitations to the volumes of soils that can be salvaged. Salvageability of wet soils and soils located on slopes steeper than 23° may be limited due to access and safety restrictions.

The soil salvage practices planned by Benga will provide a suitable quality reclamation material with sufficient volume for the soil replacement requirements of the reclamation plan while providing a suitable seed bed for the revegetation program.

F.3.5 Overburden

The in situ overburden has been analyzed for reclamation suitability and most of the samples have been rated as suitable for reclamation. A few samples had high pH or sodium adsorption ratio (SAR) values that exceeded the guidelines, but these occurred in small isolated zones and should not be of concern. All overburden material will be sampled prior to reclamation material placement to determine the suitability of the material and unsuitable material will be covered by at least 1 m of suitable material prior to replacement.

An overburden sampling program will be conducted prior to reclamation material placement to determine the soil replacement requirements at reclamation. An overburden assessment program coupled with proper reclamation material salvage and prescriptive replacement plan will allow for suitable reclaimed soil profiles to be replaced after mining.

F.3.6 Mine Reclamation

Annual progression maps provided in Section C.1 (Figures C.1.3-1 to C.1.3-25) highlight the mining and reclamation progress on an annual basis throughout the life of the mine to reclamation closure. It should be noted that the Grassy Mountain area has had considerable surface and underground mining activities in the past. The legacy operations will mostly be captured by this mine plan and will be disturbed again. It is critical to note that the entire legacy disturbance (185.2 ha) will then be reclaimed to the current standards and that despite no available reclamation material available on this area, the final reclamation of the mine will ensure adequate reclamation material is available to incorporate these areas into the final reclamation plan.

The first reclamation to be completed is planned for Year 2 ([Figure F.3.6-1](#)). The planned reclamation for the Project has been shown in five-year intervals on the following figures:

- Years 1 to 5 – [Figure F.3.6-1](#);
- Years 6 to 10 – [Figure F.3.6-2](#);
- Years 11 to 15 – [Figure F.3.6-3](#);
- Years 16 to 20 – [Figure F.3.6-5](#); and
- Years 21 to End of Reclamation (EOR) – [Figure F.3.6-6](#).

At Year 27, all reclamation activities will be completed, with the exception of three surge ponds that will be retained as part of the selenium control and management program. These will be required until the selenium levels in the water are within the allowable release limits to the environment. Once the water is below the release limits, the earthworks will be removed and small wetlands will remain, with all water flowing directly to Blairmore or Gold Creeks.

The mine reclamation program will include the following major activities:

- final grading and recontouring;
- reclamation material replacement;
- revegetation; and
- reforestation.

As mining operations on certain areas of the mine are finalized, the mining areas will be graded and contoured in preparation for reclamation material placement as part of final reclamation. Reclamation material will be sourced from active mining areas if direct placement opportunities exist or will be hauled from stockpile locations on the mine. Replaced reclamation material will be revegetated through a combination of seeding, planting and natural regeneration, depending on the type and extent of the reclamation area, to ensure soils are stabilized and that the species selection promotes the intended final ecological end point.

F.3.6.1 Final Grading and Recontouring

Recontouring operations will be undertaken progressively as each mining phase is completed. Two external rock disposal areas will be created and the majority of the pit will be backfilled with rock as well. As the backfilled areas are completed they can be leveled off and reclamation can begin. Dozers will be used to recontour all disturbed areas. The dozers push material from the crest to the toe (top to bottom); this process achieves the necessary slope reduction and, at the same time, breaks down the coarse rock overburden into finer material.

All areas will be recontoured to a maximum slope angle of 23° (2.5:1) with the exception of the standing highwall located on the north end of the pit.

The final topography will form the final reclamation landforms and will include ridges, benches, valleys, and steep slope inclines that will be integrated with surrounding undisturbed landscape as further discussed in [Section F.4.1](#). The final reclamation landforms will consist of micro and macro scale topographies that will support re-vegetation and provide valuable wildlife habitat components. Activities such as design dumping will be completed on the tops of the reclaim areas to provide an undulating surface. Mineral wetlands will be constructed in depressional areas that are capable of holding water for parts of the year. The sediment ponds will be contoured to develop into small waterbodies and constructed wetlands. Final closure landscapes are further discussed in [Section F.4](#).

F.3.6.2 Reclamation Material Replacement Plan

Upon completion of recontouring and final grading, an assessment of the overburden material will be completed as per [Section F.3.5](#), and previously salvaged and stockpiled reclamation material will be replaced on reclaimed lands. The surge ponds, sediment ponds and the end pit lake that will remain as part of the final reclamation landscape will have mineral soil replaced around the perimeter and across the littoral zones. The surge and sediment ponds will be developed into treed wetlands. Undisturbed areas of the mine site that have the original soil profile intact will not require additional soil placement.

Reclamation material will be replaced over the overburden and will be left in a rough or mounded state. The advantages of a rough soil surface are well documented (Knapik *et al*, 1995) as a rough soil surface will provide a variety of values for revegetation and wildlife reclamation planning. Benga will replace reclamation material across the Project Footprint at a targeted average depth of 20 cm, over suitable overburden. Reclamation material will be replaced on the reclaimed areas and spread roughly at depths expected to vary between 10 and 30 cm. Areas of the reclaimed mine that have been compacted will be ripped to promote microsites that support tree planting and or natural regeneration.

The following preliminary reclamation material replacement prescriptions are provided for the replacement plan for areas with suitable overburden/subsoil:

- upland soils: 20 cm average replacement depth of reclamation material;
- wetland soils: 20 cm average replacement depth of reclamation material:
 - areas will be reclaimed as wetlands; and
 - lake littoral zones will have mineral soils replaced.
- no soil replacement required:

- open water sections of surge ponds and sediment ponds;
- end pit lake;
- standing highwall area; and
- areas with no disturbance to the soil profile.

For areas that may have overburden/subsoil that is classed as unsuitable, one metre of suitable material will be placed over the unsuitable material before the reclamation material will be replaced.

As part of the progressive reclamation program, direct placement of salvaged reclamation material will be prioritized for recontoured areas of the completed mining area as they become available for reclamation and as areas of new development have reclamation material salvage operations conducted. The geology of the coal bearing strata and the required mine plan for the development of the Project make the scheduling of direct placement of reclamation material difficult to achieve, however potential for direct placement opportunities are expected to be available during reclamation material salvage of the foothills rough fescue areas scheduled for Year 2. Stockpiled reclamation material will be used to reclaim areas on the majority of the disturbance area.

As areas of the mine are backfilled and recontoured, reclamation material will be directly placed from active areas of the mine or imported from the reclamation material stockpile locations. The reclamation material will be excavated from the source location using an excavator, and loaded on trucks for transport to the reclamation areas. Once reclamation material has been replaced at the reclamation areas, dozers will spread the soil at the prescribed depths.

The preferred method of reclamation material placement is to place it with minimal levelling or bulldozing to create a rough soil surface with enhanced micro-relief. To ensure efficient use of the available reclamation material, and to prevent potential shortages, some levelling and spreading will be necessary. The average depth of the replaced reclamation material will be 20 cm but is expected to vary from 10 cm to about 30 cm. Woody slash, stumps, seeds, and roots, provide significant surface cover, roughness, and source of native plant propagules. Knapik *et al.* (1995) reported that this method has several advantages over conventional "dump & level" methods:

- The soil is not as dense, and so is allowed to settle. This produces a suitable soil bulk density for rooting, with water infiltration and reduced run-off/erosion.
- The varied relief provides more effective shelter from wind, collects and holds snow during chinook wind events, and utilizes more snow melt moisture than levelled soil.
- The slash and debris stay on top to provide cover.
- This technique produces numerous microsites for planting tree seedlings and encourages natural invasion, which produces diversity and opportunity for native species establishment.

- The median thickness provides sufficient water holding capacity on those sites where soil depth may be a limiting factor.
- Surface temperatures are lower on hot summer days due to roughness and debris cover.

This soil spreading practice can be achieved on various surfaces ranging from level to steep areas, or on concave land surfaces.

F.3.6.3 Revegetation Plan

Benga has identified six ecological units occurring over the minesite, based on ecosite phases present in the Montane and Subalpine Natural Subregions ([Table F.3.6-1](#)). Many of the ecological units can be further broken down, based primarily on moisture (dry versus moist). Archibald’s *et al.* (1996) ecosites do not conform exactly to the ecological units, for example, ecosite “c” can be broken into open coniferous, deciduous, and mixedwood ecological units. The ecological units do conform to ecosite phases. Additional ecosite phases for grassland and shrubland have come from Willoughby (2007).

Archibald *et al.* (1996) do not provide ecosite phases for non-vegetated ecological units; the codes provided in [Table F.3.6-1](#) for these ecological units come from the Alberta Vegetation Inventory (AVI) (ASRD 2005). The AVI wetland types have been provided in [Table F.3.6-1](#) for the treed wetland ecological unit.

Table F.3.6-1 Correlation of Pre-Mining Ecosite Phases to Reclaimed Ecological Units	
Pre-Mine Ecosite Phase	Reclaimed Ecological Unit
Montane: b1, c1, c2, d2, d3, e1, e3	Closed Conifer Forest
Subalpine: a1, b1, e1, e2, e3, e4, f1, f2, h1	
HG, SO ¹ , SC ¹	Grassland Open Forest
Montane: a1 ¹	
Subalpine: d1	
Montane: b2, b3, c3, c4, d1, e2, f1, g1, g2	Mixed Forest
FONG/MONG ¹ , FONS ¹ , FTNN ¹ & STNN ¹	Treed Wetland
Subalpine: g1 ¹ , h2 ¹	
NWF, NWL, NWR (WONN) ¹	Open Water
NMR	Barren Land

Table F.3.6-1 Correlation of Pre-Mining Ecosite Phases to Reclaimed Ecological Units	
Pre-Mine Ecosite Phase	Reclaimed Ecological Unit
AIH, AII ¹ , AIM, ASC, CC, CIP, CIW, CL, CO, CP	Anthropogenic

¹ Ecosite Phase or AVI Unit mapped outside of the Project Footprint but within the terrestrial LSA

Table F.3.6-2 indicates the plant species that can be used for revegetation of each of the vegetated ecological units. The topography, aspect and ecosite that the reclaimed ecological unit is expected to represent in the medium to long-term is provided. It is anticipated that the reclamation program will provide the conditions that will guide each reclaimed ecological unit on the desired trajectory.

The reclaimed ecological units that incorporate slope, aspect, and the plants/plant materials should be similar to the ecosites provided in Table F.3.6-2. Figure F.3.6-4 depicts the conceptual plan for reclaimed ecological units across the reclaimed mine site at Year 15, and Figure F.3.6-7 illustrates the reclaimed ecological units at Year 27.

Table F.3.6-2 Target Species of Reclaimed Ecological Communities					
Reclaimed Ecological Unit	Climactic Zone		Ecosite Expected (Montane)	Trajectory Setting	
	Topographic Position	Aspect		Naturally Occurring Plant Species to be Encouraged	Species to be Established – planting and natural recovery
CONIFEROUS, CLOSED FOREST					
dry	level, crest, upper to mid-slope	level, north, east, south	d	<u>Shrubs:</u> snowberry, creeping mahonia, white meadowsweet	<u>Trees:</u> lodgepole pine, white spruce <u>Shrubs:</u> green alder, prickly rose <u>Forbs and Grasses:</u> seed mix 1, 2
moist	midslope	all aspects	e	<u>Shrubs:</u> snowberry, Saskatoon, thimbleberry <u>Forbs and Grasses:</u> hairy wild rye, pine grass	<u>Trees:</u> lodgepole pine, white spruce <u>Shrubs:</u> prickly rose <u>Forbs and Grasses:</u> seed mix 3

Table F.3.6-2 Target Species of Reclaimed Ecological Communities					
Reclaimed Ecological Unit	Climactic Zone		Ecosite Expected (Montane)	Trajectory Setting	
	Topographic Position	Aspect		Naturally Occurring Plant Species to be Encouraged	Species to be Established – planting and natural recovery
GRASSLAND, OPEN FOREST					
dry	midslope	level and south	b	<u>Shrubs:</u> Canada buffalo-berry, bearberry <u>Forbs and Grasses:</u> hairy wild rye	<u>Trees:</u> lodgepole pine <u>Shrubs:</u> prickly rose, ground juniper <u>Forbs and Grasses:</u> seed mix 1, 2
moist	midslope	west	c	<u>Shrubs:</u> Canada buffalo-berry <u>Forbs and Grasses:</u> hairy wild rye, rough fescue	<u>Trees:</u> white spruce, lodgepole pine <u>Shrubs:</u> willow, prickly rose <u>Forbs and Grasses:</u> seed mix 3
MIXEDWOOD FOREST					
moist	mid- to lower-slope	south, east north	e + c	<u>Shrubs:</u> Canada buffalo berry, snowberry, Saskatoon, thimbleberry <u>Forbs and Grasses:</u> hairy wild rye, pine grass	<u>Trees:</u> aspen, balsam poplar, white spruce, lodgepole pine <u>Shrubs:</u> willow, prickly rose <u>Forbs and Grasses:</u> seed mix 3
TREED WETLAND					
moist	depression to level	level	h (Subalpine)	<u>Trees:</u> Engelmann spruce, dwarf birch	<u>Trees:</u> white spruce <u>Shrubs:</u> prickly rose <u>Forbs and grasses:</u> seed mix 4

F.3.6.3.1 Traditional Use Species

Consultation with Aboriginal Groups identified a desire to preserve and utilize existing vegetative resources from the mine site. Areas intended for development can benefit Aboriginal groups by providing the harvested lodgepole pine and the opportunity to collect and relocate other key species used for medicinal, ceremonial, food, or aesthetic purposes in the Project area.

Project development will remove approximately 1,042.8 ha (or 28.5% of the vegetation LSA at baseline) of ecosite phases that support TEK vegetation potential (Table F.3.6-3). These include 2.4 ha (27.3% decrease from Baseline) of very high or high TEK potential areas in the Montane and 0.8 ha (100%) Subalpine Natural Subregions.

Table F.3.6-3 Effects on TEK Plant Potential in the Local Study Area					
TEK Plant Potential	Ecosite Phase / Land Class Description ¹	Area (ha) ²		Change from Baseline (Without Mitigation)	
		Baseline	Application Case	Area (ha) ²	Percent Change (%)
Montane					
High	c1, c4, g1	374.3	271.9	-102.4	-27.3
Moderate	b1, b2, b3, c2, c3, d1, d2, d3, e1, e2, e3, f1	1,600.8	1,187.9	-412.9	-25.8
Low	a1, g2	88.0	84.4	-3.6	-4.1
Total Montane	-	2,063.0	1,544.2	-518.8	-25.1
Subalpine					
Very high	d1	0.8	0.0	-0.8	-100.0
Moderate	a1, b1, e3, e4, f2, h1	489.7	391.0	-98.7	-20.1
Low / Very low	e1, e2, f1	1,109.1	684.7	-424.5	-38.3
Total Subalpine	-	1,599.6	1,075.7	-523.9	-32.8
Total LSA	-	3,662.7	2,619.9	-1,042.8	28.5

¹ Ecosite phases are from Archibald *et al.* 1996.

² Baseline and application case areas and TEK potential for each ecosite / land class are provided in Table 4.1-1 of CR#8 (Vegetation). Due to rounding of numbers, total values may not equal the sum of the individual values.

- not applicable.

Note: For individual species or groups of species identified during the consultation process many are common and occur within a range of ecosites. For example pine, poplar, rose, raspberry, fireweed are common species with wide distributions. Other TEK species or groups of species identified, such as tree lichens and fungus, are common but occur primarily in late succession within mature and old forests. For these species, removal by the project will have an extended effect similar to that described for the assessment of the old growth forest VC (Section 4.5 of CR#8 (Vegetation)).

Ecosite phases with high and moderate TEK plant potential are presented in CR #8, Table 4.6-1 (Vegetation and Wetlands) and equate to reclamation ecological communities closed coniferous (Montane b1, c1, c2, d2, d3, e3 and subalpine a1, b1, e3, e4, f2), grassland open forest (Subalpine a1, b1), mixed forest (Montane b2,c3, c4, d1, e2, g1) and treed wetland (Subalpine h1).

Aboriginal groups have expressed that Benga should take steps to ensure existing resources are salvaged and native plant species are included in reclamation plans.

Benga will undertake further consultation with the Aboriginal groups to initiate research and development to determine the potential efficacy of the use of the identified native plant species in the reclamation program. Revegetation targets will aim to include native vegetation species and establish communities that support TEK vegetation.

F.3.6.3.2 Revegetation Techniques

The primary criteria for the selection of revegetation techniques are that they:

- meet reclamation goals;
- are manageable to implement over the spatial scale to which they will be applied;
- meet AER and AEP reclamation standards; and
- have manageable on-going maintenance requirements.

Lands will be progressively reclaimed and adaptive management techniques will be incorporated when selecting the appropriate revegetation techniques.

One of the goals of the revegetation program is to reduce erosion and sedimentation in the watershed. Typically, in moderate to high erosion risk areas, a grass-legume cover is established immediately after soil placement to control erosion. One to four years after the grass-legume mix is seeded, woody species establishment commences with the planting of tree and shrub seedlings. Fertilizer is applied at the time of seeding to increase vegetative growth.

In low erosion risk areas, seed application (grass-legume) will be reduced or eliminated and the planting of shrub and trees and transplantation of plant and plant materials will be done concurrently. Benga will reduce fertilizer application rates and usage.

Revegetation techniques and equipment typically include:

- broadcast seeding and fertilizing using a range of equipment from hand-held seeders to aerial means;
- the direct placement of salvaged reclamation material on recontoured areas, where possible;
- collection of local tree/shrub seed and cuttings;
- contracted greenhouse production of quality tree and shrub seedlings, produced from seed or cuttings which are collected from native (genetically local) plants;
- individual tree and shrub fertilization at the time of planting; and
- rough soil surface and incorporating LFH and woody debris during the final stages of spoil dump construction to create microsites.

The advantages of the direct placement of reclamation material are well documented including utilizing the plant propagules contained in the soil to aid the establishment of native vegetation. To enhance ecosite development, Benga will identify opportunities for direct placement of salvaged reclamation material. The scheduling of direct placement opportunities is limited to having recontoured lands available in proximity to reclamation material salvage areas.

Risks and uncertainties involved with revegetation include:

- availability of native and agronomic seed;
- impact of browsing on newly established deciduous species; and
- extreme weather events.

F.3.6.3.3 Revegetation Prescriptions

Natural Recovery

Natural recovery can be an effective means to encourage presence of native species and improve biodiversity, and is most appropriate for revegetation of linear corridors or disturbed lands within approximately 25 m of a desired plant community. If erosion is a concern, erosion control materials (e.g., silt fences) can be placed strategically over bare ground to limit erosion potential. Seeding an annual cover crop, such as annual ryegrass, will also be implemented to control erosion potential on natural recovery sites.

Seeding

Seeding after soil placement is an effective means of increasing vegetated ground cover at a variety of spatial scales, to limit erosion, to control the spread of weed and invasive species, and to allow for the return of ecological structure and function (including succession) over time. The primary method for the application of seed will be aerial broadcasting. This method has been proven the most cost effective delivery system on larger areas of reclaimed land. In small areas, a broadcast seeder, manual or mounted on an ATV, may be used. Species used in seeding and planting are limited by cost, availability, and growth attributes. This technique, along with tree planting, is likely to represent the major revegetation activity by Benga in reclaimed areas.

The conceptual seed mixes have been prepared in line with the Native Plant Revegetation Guidelines for Alberta (Native Plant Working Group, 2000) and included a review of the native plant communities in the pre-disturbance and surrounding landscapes to develop the species composition and distribution required for each ecological reclamation unit. Where necessary, a nurse crop is included to promote establishment of the native species by limiting early successional species (such as

tickle grass), to support early establishment and to provide cover for later successional species such as foothills rough fescue and needle grass species.

The seed mixes and specific species proposed for each ecological unit were selected based on:

- availability of high quality seed sources from the local natural region;
- likelihood of successful germination and survival;
- performance and seed purity that is appropriate for the project goals;
- likelihood of achieving reclamation and revegetation objectives; and
- economic viability.

The recommended seeding rates are designed to promote establishment of species for erosion control and soil conservation while allowing natural encroachment of native species. Forested mixes promote vegetative establishment that is not expected to outcompete establishing tree species as the cover crop and early successional species are seeded at a low rate.

Table F.3.6-3 provides the conceptual seed mixes and seeding rates proposed for the Project.

Table F.3.6-3 Seed Mixes	
	% by wt
1a. Direct placement monoculture (15-35 kg/ha, no fertilizer)	
Foothills rough fescue	60
Annual ryegrass	40
	100
1b. Direct placement (50 kg/ha, no fertilizer)	
Annual ryegrass	65
Tufted hairgrass	8
Slender wheatgrass	25
Ticklegrass	2
	100
2. Grassland, Open Forest (60-70 kg/ha)	
Foothills rough fescue	15

Table F.3.6-3 Seed Mixes	
American vetch	5
Awned slender wheatgrass	10
Annual ryegrass	40
Mountain brome	10
Junegrass	10
Richardson needlegrass	5
Columbia needlegrass	5
	100
3. Closed Conifer Forest (60-70 kg/ha)	
Foothills rough fescue	10
Fringed brome	10
Tufted hairgrass	15
Awned slender wheatgrass	15
American vetch	5
Annual ryegrass	40
Ticklegrass	5
	100
4. Mixed Forest (60-70 kg/ha)	
Foothills rough fescue	10
Fringed brome	5
Tufted hairgrass	5
Awned slender wheatgrass	10
American sweet vetch	2
American vetch	3
Annual ryegrass	40
Ticklegrass	5
Fowl bluegrass	5
Sloughgrass	5
Streambank wheatgrass	10

Table F.3.6-3 Seed Mixes	
	100
5. Treed Wetland (60-70 kg/ha)	
Streambank wheatgrass	10
Sloughgrass	20
Fowl bluegrass	20
Annual ryegrass	45
White clover	5
	100

These conceptual seed mixes have been discussed with the local Alberta Environment and Parks land manager and comply with the expectations of the *Operating Ground Rules for the C5 FMU* (ASRD, 2012). The mixes are considered conceptual and, through the mine adaptive management and continuous improvement processes, may require substitutions resulting from species availability and as new species (native and agronomic) are developed. These seed mixes will therefore be reviewed and approved with the local land managers in advance of seeding.

During the reclamation process, Benga will inspect the lands being reclaimed and evaluate the erosion potential. If the potential for erosion is low, there may be opportunities to limit the seeding program or the seeding rate. The reduction in seeded species should allow natural succession to aid in the revegetation of the site.

After seeding has been completed and the soils are demonstrated to be stable, tree/shrub planting will be conducted.

Fertilization

Typically, all replaced soils are fertilized during the initial revegetation program. The quick establishment of a vegetative cover is one of the primary tools used at the mine to protect the soils resource from erosion. Fertilization is used to ensure that the initial vegetative cover is established as quickly as possible. Fertilizer will not be used on direct placed soils or organic soils used in wetland reclamation.

The fertilizer commonly used by regional mines is a blend of ammonium phosphate (27-27-0) with an application rate of approximately 180 kg/ha. Benga will use advice from the seed supplier for the

type of fertilizer and application rates for the seed mixes being used. The application rate will be based on historical usage at regional coalmines with good results.

It is recognized that the use of fertilizer can slow the ingress of native species by promoting the establishment of the agronomic species in the seed mix. It is anticipated that more emphasis will be put on tailoring the fertilization process to the specific needs of the revegetation program. The slope and aspect of the revegetation areas coupled with an assessment of the erosion potential will be used to assist in the determination of the fertilizer requirements.

Woody Species

Tree and shrub plantings will typically be undertaken two to four years after initial revegetation. By this time, the grass-legume cover has lost its nurse crop species, leaving opportunities for less aggressive plants to establish. A preliminary tree and shrub species selection is provided in [Table F.3.6-4](#).

Table F.3.6-4 Native Woody Plant Species for Reclamation	
Coniferous	Deciduous
White spruce (<i>Picea glauca</i>)	Trembling aspen (<i>Populus tremuloides</i>)
Lodgepole pine (<i>Pinus contorta</i>)	Balsam poplar (<i>Populus balsamifera</i>)
Whitebark Pine (<i>Pinus albicaulis</i>) or limber Pine (<i>Pinus flexilis</i>) as available	Dwarf birch (<i>Betula glandulosa</i>)
Engelmann spruce (<i>Picea engelmannii</i>)	Green alder (<i>Alnus crispa</i>)
Douglas fir (<i>Pseudotsuga menziesii</i>)	Prickly rose (<i>Rosa acicularis</i>)
Subalpine fir (<i>Abies lasiocarpa</i>)	Willow (<i>Salix sp.</i>)
Ground juniper (<i>Juniperus communis</i>)	Dogwood (<i>Cornus stolonifera</i>)
	Buffalo-berry (<i>Shepherdia canadensis</i>)
	Common Bearberry (<i>Arctostaphylos uva-ursi</i>)
	Snowberry (<i>Symphoricarpos sp.</i>)
	Currant (<i>Ribes sp.</i>)

This list includes some, but not all, of those woody species that will regenerate naturally on the Project reclaimed areas, particularly on directly placed soil.

All woody plants used in the program will be grown from locally collected seed or cuttings. Coniferous tree planting densities will be determined by the planned end land use. Shrubs will be

interplanted with tree species. Planting will be completed by professional tree planters and will typically occur in the spring to provide a full growing season for the trees to develop a root structure prior to winter.

Plant and Plant Material Transplantation

Transplanting plants and propagules into recently reclaimed areas can assist in increasing the presence of naturally occurring vegetation and/or accelerating a reclaimed area's rate of increasing natural species cover. Examples of transplantation include:

- collection of local tree/shrub seed and cuttings;
- collection of root cuttings;
- LFH plugs from lowland and upland areas to preserve naturally occurring plants and propagules. LFH plugs can be placed in clusters to act as propagule sources to adjacent areas to improve biodiversity; and
- transplanting individuals or small clusters of grass, forb, shrubs, seedlings, and saplings to appropriate reclaimed ecological units. This practice can be categorised as a localised and strategic activity to improve biodiversity, structural diversity, and age distribution.

Rare or culturally valued plants can be transplanted to suitable positions in the reclaimed landscape, if there is a reasonable expectation that relocation will be successful; however, persistence of the species after relocation cannot be ensured.

Cuttings or seed from local sources may also be used to propagate seedlings at a greenhouse or tree nursery for future outplanting. Planting will be completed by professional tree planters and will occur in the spring to provide a full growing season for the trees to develop a root structure.

Weed Control

Weed management is conducted in accordance with the *Weed Control Act*. Benga environmental personnel will be trained in weed identification and will complete visual inspections of reclamation, active mining areas, and legacy mining areas prior to mine development for the occurrence of noxious weeds. All weed occurrences are controlled on an 'as needed' basis. Mechanical treatment and herbicide applications are utilized for control. Control methods will be dependent upon factors such as:

- the type of weed;
- the scale of the weed problem; and
- the location of the weed problem.

Control methods that require the application of a herbicide will be completed by a licensed weed control specialist.

F.3.6.4 Lake Development

Part of the reclamation and closure plan for the Project will include the development of an end pit lake. The lake will have the following general characteristics:

- water level 1,700 m
- perimeter 2,577 m
- littoral area 1.8 ha
- surface area 18.4 ha
- maximum depth 105 m
- average depth 36 m
- volume 6,500,000 m³
- drainage area 1,032 km²
- filling time 15.1 yrs

The lake is expected to discharge, east toward Gold Creek. Water in the lake should not contain elevated levels of selenium. Selenium enriched water will be captured and passed through the saturated backfill areas. The saturated backfill areas will remove the selenium from the water, and will eventually discharge from the saturated backfill zones into Blairmore Creek.

F.3.7 Targets and Indicators

Table F.3.7-1 presents the targets and indicators Benga will use to assess reclamation success.

Table F.3.7-1 Criteria, Indicators and Targets of Successful Reclamation at Time of Certification	
Criteria:	
1.	Ecosystem diversity – conserve ecosystem diversity at the landscape level by minimizing disturbance to existing communities and by reclaiming communities that naturally occur in the area.
2.	Species diversity – conserve species diversity at the landscape level, ensuring that functional habitats are re-established in the reclaimed landscapes and that disturbance to existing habitats is minimized.
3.	Genetic diversity – conserve genetic diversity within local populations within the range of natural variability.
4.	Ecosystem resilience and productivity - Conserve ecosystem resilience by minimizing disturbance to communities and by reclaiming communities to equivalent pre-disturbance capability.

Indicator	Target
Species diversity	Increasing trend in number of locally native species
Vertical structure	Trend towards increased vertical structure in all communities except grasslands
Downed woody debris	Clumped and scattered distribution
Native species presence and trends	All woody species are locally native; herbaceous species have trend towards increased native composition
Woody species density and trend in height growth	All woody species are locally native; densities are stable or increasing and increasing trend in height growth at similar level to baseline
Ground cover (erosion control)	No active erosion; ground cover is stable or has increased stability
Vegetation community diversity	Reclaimed habitat types have increasing trend in number of locally native species
Presence of noxious weeds	No prohibited noxious weeds are present
Presence of plant species favoured by targeted wildlife species	Species targeted for introduction as part of the reclamation and revegetation program allow for increased trend in native composition
Habitat availability for targeted species (e.g. grizzly bear, lynx, marten, moose, elk, western toad, Columbian spotted frog, olive-sided flycatcher, great grey owl, and little brown myotis)	Mosaic of reclaimed landforms and target reclamation species trend towards increased native composition
Connectivity between reclaimed communities and adjacent communities	Vegetation communities established on reclaimed lands provide an increasingly effective connection with adjacent communities in terms of safe wildlife movement

F.3.8 Maintenance

When the monitoring program identifies issues requiring mitigation, Benga will undertake maintenance activities such as erosion control and in-fill planting of areas with selected species to increase biodiversity, structural diversity, and stocking requirements. The adaptive management program will allow for specialized responses to specific issues that may arise.

F.3.9 Research and Monitoring

Benga will have an extensive monitoring and research program involving a wide range of environmental values including water quality, fisheries, soils, wildlife and revegetation as part of the Project's overall monitoring requirements. The following sections summarize the Project's research and monitoring initiatives as they relate to land reclamation.

F.3.9.1 Reclamation Research and Monitoring Program (RRMP)

Additional research will focus on identifying and resolving issues associated with mine development and reclamation. The research programs will continue to build on the successes made in these areas.

Benga's RRMP will focus on the soils and vegetation resources that are essential to the attainment of the end land use objectives.

Objectives of the RRMP are to:

- assess operational and experimental techniques of soil handling and vegetation establishment against the achievement of stated end land use objectives;
- provide opportunities for comparison with "baseline" or "accepted target" soil and vegetation characteristics in terms of productivity, species composition, capability, and biodiversity;
- identify trends or changes in soil and vegetation characteristics on reclaimed lands over time; and
- assess land capability on reclaimed sites as part of the documentation needed in preparation for reclamation certification.

F.3.9.2 Research Focus

Benga's RRMP will focus on the establishment of plant communities that will have ecological functions similar to those in the surrounding landscape. The main elements of the research component of the program include:

- soil management practices that encourage natural recovery and ecological function;
- the establishment of local native plant species;
- re-establishment of a commercially productive and ecologically appropriate forest cover including whitebark pine and limber pine; and
- achievement of biodiversity objectives to promote biodiversity, such as:
 - landform design including rough soil placement and irregular contour development; and

- revegetation practices such as natural recovery, nurse crop establishment, direct soil replacement

F.3.9.3 Monitoring Focus

An important component of the reclamation program will be the monitoring of the biophysical aspects of the program. The identification of successes and limitations early in the reclamation process will allow modifications to be made through the adaptive management program to be used at the Project. In addition to providing important feedback on the effectiveness of reclamation techniques, it will also provide data to use in planning the certification of reclaimed lands and the release of lands back to the Crown.

The monitoring component of Benga's RRMP involves those aspects that are important in reclamation certification:

- soil replacement characteristics (*e.g.* depth and quality); spoil/regolith characteristics;
- revegetation patterns and performance; and
- wildlife response to reclamation.

On all reclaimed sites, soil audits will be conducted to confirm that soil placement depth and quality criteria have been met. These audits will be conducted as per provincial guidelines and will be performed within one to two years following soil replacement. .

Long-term monitoring will be established on undisturbed and reclaimed sites of the Project. Monitoring of post reclamation landscapes for stability, drainage, and the interaction of the vegetation communities in the reclaimed landscapes will be completed after reclamation and revegetation. Revegetation patterns and characteristics will be assessed using a number of methods, including permanent transects (*e.g.* modified Whittaker) and temporary plots. Assessment includes vegetation cover, species composition, vegetation competition indices and vegetation/tree changes over time. These plots will also monitor the response of wildlife usage to the newly created habitats, and how they change over time.

Monitoring specific to reforestation will include temporary plots established at the time of planting to measure planting density, planting quality and initial species composition; permanent transects (*e.g.* modified Whittaker) and forest regeneration surveys (modified Alberta forest regeneration surveys). The forest regeneration surveys will be conducted between years 4 and 8 following planting, and between years 10 and 14, with at least 5 years between each survey. These programs address tree/shrub seedling survival, densities, stocking, productivity and limitations, ground cover composition and change over time, and downed woody debris. Benga will integrate both soils and

vegetation monitoring programs where possible to allow analysis and evaluation of reclamation performance.

In addition to the assessment of techniques and the measurement of reclamation outcomes for certification, measurable reclamation criteria must be monitored.

F.4 CLOSURE PLAN

The Closure Plan provides the principles and objectives that will define the reclamation end points needed to achieve equivalent land capability following mine closure. The timing of reclamation efforts throughout the life of the mine is essential to ensure the Project maintains a trajectory towards the desired end land uses and ultimately achieve equivalent land capability. This section describes the C&R and Closure principles that Benga will use for the development of the Project. The implementation of environmental management practices and reclamation efforts designed to achieve these end points are discussed in the following sections.

Through a progressive reclamation program, Benga will have reclaimed almost two-thirds of the mine footprint by the end of the mine life (Year 24). The remainder of the area will be reclaimed within three years of completion of mining (Year 27) with only the infrastructure required for the selenium management program remaining to be reclaimed at a later date (after monitoring).

F.4.1 Reclaimed Landscapes

Although new landscapes will be created during development and reclamation of the Project, they will be stable and able to support a variety of end land uses. The reclaimed landscapes are shown in [Figure F.3.6-7](#). Cross-sections are provided on [Figures F.4.1-1, F.4.1-2, F.4.1-3 and F.4.1-4](#). The new landscapes will be integrated with the surrounding undisturbed lands and will have a diversity of slope classes similar to the pre-disturbance landscapes ([Table F.4.1-1](#)). In general, some of the steeper slopes that currently exist will be replaced by shallower slopes that will be purposely leveled to a maximum angle of 23° (2.5:1 ratio). There will be some highwall areas on the north side of the pit area left standing (barren land) ([Figure F.3.6-7](#)), with slopes of approximately 55° to 60°. A comparison of the pre-mine and post mine topography are shown on [Figure F.4.1-6](#).

A total disturbance of 1,522.3 ha is estimated for the life of the Project. Developments within the minimal disturbance areas will be subject to similar objectives as the minesite, thereby ensuring that these areas are also reclaimed to equivalent capability.

Table F.4.1-1 Comparison of Pre-mining and Reclaimed Terrain at Closure

Slope class	Slope (%)	Approximate Slope (°)	Pre-disturbance (ha)	Pre-disturbance %	Post Reclamation (ha)	Post Reclamation %
1	0-0.5	0	3	0.17	232	15.24
2	>0.5-2	0.3-1.1	13	0.84	104	6.83
3	>2-5	>1.1-3	51	3.35	77	5.04
4	>5-10	>3-5	68	4.45	95	6.24
5	>10-15	>5-8.5	139	9.16	88	5.80
6	>15-30	>8.5-16.5	338	22.21	798	52.50
7	>30-45	>16.5-24	360	23.66	67	4.38
8	>45-70	>24-35	441	28.98	53	3.49
9	>70-100	>35-45	109	7.18	7	0.48
Total:			1,520.7	100.00	1,520.7	100

F.4.2 Soil Management

The reclamation material that will be replaced during reclamation will consist of upland surface soil which includes the litter layer (LFH), A horizon, part of or the entire B horizon, and salvaged deep organics where present. The reclamation material will be able to provide:

- adequate moisture retention capability;
- adequate nutrient supply; and
- ability to support an erosion resistant vegetative cover.

The basis of the reclamation material salvage practices for the Project is discussed in detail in [Section F.3.4](#) of the reclamation plan. During the development and operations of the Project, adaptive management and continual improvement programs may introduce changes to the salvage practices.

The total volume of reclamation material that is available for salvage within the Project footprint is approximately 3.35 million m³ and the total required for replacement will be approximately 2.9 million m³ (this is provided in [Table F.2.2-2](#)). There is a small surplus estimated, which will get used as appropriate within the reclamation program.

At closure, there will be approximately 1,462.6 ha of recontoured area that will have had an average of 20 cm of reclamation material replacement. Reclamation material replacement practices are discussed in detail in [Section F.3.6.2](#). During the development and operations of the Project, the adaptive management program may introduce changes to the replacement practices. All salvaged reclamation material will be replaced on the recontoured areas.

The soil management plan will ensure that unsuitable overburden materials will not be present in the rooting zone. Overburden material samples will be analyzed to determine the suitability of the material. Benga will ensure that 1 m of suitable overburden/reclamation material exists over top of unsuitable material.

F.4.3 Revegetation

Established revegetation procedures will be used for the Project's revegetation program. The objectives of the revegetation program relate to issues of wildlife, erosion, recreation and tourism, ecological succession, diversity, and traditional land use.

Upon closure, much of the reclaimed landscape will be in various stages of development because of the progressive reclamation program. The revegetation techniques in use at closure will be a continuation of practices employed during development and progressive reclamation of the mine. These practices may be modified by adaptive management and continuous improvement programs at the mine.

The goals of the revegetation program include:

- establishment of an erosion-resistant plant cover on disturbance areas;
- provision of a diverse range of plant species at the start of reclamation to increase the potential of achieving a biodiversity level equivalent to pre-development conditions; and
- establishment of self-sustaining viable plant communities.

Information from the environmental assessment summarized in [Section F.2.1.6](#), was used to select the target plant communities for the various disturbance areas. The revegetation program is expected to, over time, provide the capability to establish ecosite phases. The development of the ecosite phases are determined by the following factors:

- slope and aspect;
- moisture regime;
- soil type (capability class) and drainage conditions; and
- plant succession.

Vegetation communities are expected to evolve into a biologically diverse forest suitable for commercial forest harvesting, traditional land uses, wildlife and recreational uses. Natural processes and succession will augment the vegetation program and will provide the framework for the revegetated areas to evolve into ecosystems similar to those naturally present in the region.

Slash and deadfall material add value as an amendment to the replaced soils when incorporated into the soil or spread on the soil surface. Woody debris provides habitat for micro and mega fauna by supplying cover, nesting or denning sites. Woody debris also facilitates revegetation as it provides microsites for plant establishment and decomposing wood provides a moist and fertile seedbed.

A comparison of pre-disturbance and post-reclamation ecological unit cover across the Project footprint is provided in [Table F.4.3-1](#). [Figure F.3.6-6](#) and [Figure F.3.6-7](#) depict the distribution of ecological units at mine closure and following closure of the selenium management plan, respectively.

Table F.4.3-1 Comparison of Cover of Pre-Disturbance and Post-Reclamation Ecological Units in Project Footprint					
Ecological Unit	Applicable Ecosite Phases	Baseline Cover		Post-Reclamation Cover	
		Area (ha)	Relative Cover (%)	Area (ha)	Relative Cover (%)
CLOSED CONIFER FOREST					
Montane:	b1, c1, c2, d2, d3, e1, e3	874.4	57.5	987.9	65.0
Subalpine:	a1, b1, e1, e2, e3, e4, f1, f2, h1				
GRASSLAND OPEN FOREST					
Montane	a1 ¹	160.0	10.5	276.7	18.2
Subalpine	d1				
	HG, SO, SC				
MIXED FOREST					
Montane:	b2, b3, c3, c4, d1, e2, f1, g1, g2	139.7	9.2	141.8	9.3
TREED WETLAND					
Subalpine:	g1 ¹ , h2 ¹	0	0	18.2	1.2

Table F.4.3-1 Comparison of Cover of Pre-Disturbance and Post-Reclamation Ecological Units in Project Footprint					
	FONG/MONG ¹ , FONS ¹ , FTNN ¹ & STNN ¹				
OPEN WATER					
	NWF, NWL, NWR ¹ (WONN ¹)	0.1	0.01	18.4	1.2
BARREN LAND/DAM					
	AIH, AII ¹ , AIM, ASC, CC, CIP, CIW, CL, CO, CP, NMR	306.8	20.2	38.0	2.5
INCIDENTAL PHYSICAL ACTIVITY (GOLF COURSE AND HELIPAD ACCESS)					
		39.7	2.6	39.7	2.6
TOTAL		1,520.7		1,520.7	100

¹ Ecosite Phase or AVI Unit mapped outside of the Project Footprint but within the terrestrial LSA

F.4.4 Water Management

During operations and closure of the Project, the groundwater and surface water will be managed such that water draining from the mine area will meet accepted water quality standards. At closure, a sustainable system of drainage courses, wetlands and an end pit lake will be developed to manage groundwater and surface water. The topographical characteristics of the final closure landscape have been modified by the mine plan and will have similar drainage patterns. Slope angles will be slightly reduced and all slopes will be revegetated which may reduce the runoff coefficients from pre-disturbance conditions. The surface details will be configured to meet the requirements of a sustainable surface water drainage system with flows being directed towards Gold Creek and Blairmore Creek.

F.4.4.1 Sustainable Drainage

As each mining phase is completed, progressive recontouring operations will be undertaken. The pit will be backfilled with rock to create the final rough landscape. These areas will then be contoured and will have reclamation material replaced. Reclamation material will be either directly placed soil from new disturbance areas on the mine or will be hauled from stockpile sources on the mine. Final landforms will consist of micro- and meso-scale topographies that support re-vegetation and valuable wildlife habitat components while maintaining positive drainage across the site.

During operation, landscape features will establish positive surface and subsurface drainage across the site as runoff and rainfall. Water will be managed appropriately for each onsite feature:

- Water collecting in the pit will be directed through a combination of drainage ditches, sumps and pumps to one of the constructed sediment ponds to be sampled (as needed), treated and eventually released into the local drainages (Gold Creek or Blairmore Creek and eventually to the Crowsnest River).
- Water collecting in the rock disposal areas and surge ponds will be directed through the saturated backfill areas for circulation and passive treatment as outlined within the Selenium Management Plan and ultimately discharged into Blairmore Creek.

At mine closure, landscape features will continue to provide positive surface and subsurface drainage across the reclaimed landscape and will contain the following features:

- Water collecting on the north side of the mine will drain towards and fill the end pit lake until the lake capacity is achieved. Outflow from the lake will be established through subsurface drainage channels towards Gold Creek.
- Water collecting in the former pit and rock disposal areas will be managed (separated from clean water in the end pit lake) and circulated through the saturated backfill zones ([Figure F.4.4-1](#)) until treatment is complete, then it will be released into Blairmore Creek.
- When selenium levels in the mine wastewater and seepage from the rock disposal areas is below release limits, management of the surge ponds will no longer be required. The dams of the surge ponds will be removed, wetlands created and drainage will follow reclaimed patterns to local drainages ([Figure F.4.4-2](#)).

The final landscape pattern will result in a self-sustaining drainage scheme that is consistent with surrounding undisturbed terrain, consisting of replaced reclamation material that is stable and will mimic natural soils over time. The quality of reclamation material placed across the mine will maintain equivalent water holding capacity of the soils across the mine and is expected to improve water holding capacity in higher elevation due to incorporation of finer material and organic debris into sandy soil. The slash and woody debris spread with the soil tends to remain on the surface, providing micro-site diversity and additional cover. The resulting micro-relief provides shelter from dry wind, collects and holds snow during chinook wind episodes, and utilizes more snowmelt moisture. The re-established soils and landscape patterns will provide stable substrate, multiple soil nutrient and moisture regimes within variable slope and aspect positions, and will support diverse native vegetation communities with equivalent pre-disturbance capability. Multi-layer plant communities will be established based on natural analogues and input provided from public engagement and aboriginal consultation.

The initial reclamation will seek to establish the plant community, including open forest, mixed forest and treed wetland that best fit the final landscape position (slope, slope position, aspect) and expected long-term ecological conditions. The variety of seed mixes and tree species included in the C&R plan are intended to mimic the natural distribution of plant communities from dryer and poor crests and top slope positions to moist and richer lower slope, toe and northern aspect positions.

Diverse and complex landscape features consisting of a variety of multi-layer plant communities with complex understories and remnant forest patches will result in wildlife habitat suitable for key wildlife indicator species of ungulates, carnivores, amphibians, birds, and bats. Creation of early successional plant communities and forests will provide increasing complexity of wildlife habitat as the ecosystems develop over time.

As this system develops and matures the species diversity, community structure, and ecological function will improve and over time will more closely resemble that of the pre-development conditions.

F.4.4.2 Groundwater

The assessment of potential Project effects on groundwater resources considers changes to groundwater levels, flow patterns and quality, including groundwater/surface water interactions. A Hydrogeological Impact Assessment was completed for the Project application and is included in [CR #3](#) (Hydrogeology).

The development of the Project is expected to change the groundwater drainage characteristics of developed sub-catchments. The natural catchments within the mine footprint tend to have zones of groundwater recharge at higher elevation near the mountain ridges. At lower elevations, mid-slope or near the valley bottom, the groundwater regime transitions to groundwater discharge zones. In groundwater recharge zones, soil and sub-soil moisture is replenished only by precipitation and overland flow. In groundwater discharge zones, soil moisture is also replenished by groundwater.

The waste rock areas within the site footprint are expected to become groundwater recharge zones following development and reclamation. Groundwater infiltration into the waste rock is expected to discharge near the toe or bottom of the waste rock dump, or potentially recharge deeper groundwater aquifers. The reclaimed groundwater drainage characteristics will have no material effect on reclamation as the dominant pine and grassland species to be used are naturally found from crest to lower slope positions and are tolerant of low moisture conditions.”

The creation of saturated backfill zones in the operating and reclaimed landscape is required to provide an effective selenium management plan. There is some groundwater that previously reported to Gold Creek that will now report to Blairmore Creek. Blairmore Creek drainage will see

slightly higher groundwater flows at closure and Gold Creek might see a slight reduction. This is one of the potential effects of the selenium management program.

At closure, the groundwater quality and quantity on the reclaimed lands is expected to be similar to the natural groundwater conditions. Groundwater monitoring will be implemented to validate these predictions and monitor change.

F.4.4.3 Surface Water

Throughout mining operations, the sediment ponds and surge ponds actively manage the surface water for the project. At completion of mining, the sediment ponds will be incorporated into the reclaimed landscape as treed wetlands. The surge ponds will remain active, as the selenium management program will continue until water quality is suitable for release. At this point, the selenium management program will be discontinued with the pipelines removed, the dams lowered, and treed wetlands created. Neither the sediment ponds nor surge ponds are expected to require significant reclamation work at closure and are likely to resemble their end landuse several years prior to closure.

Mineral wetlands have been strategically planned at major collection points to provide the benefit of water treatment and flow attenuation. The re-constructed watercourses will be developed as riparian areas by maintaining undisturbed areas or redeveloping on reclaimed areas.

The reclaimed wetlands and treed wetlands (swamps) will target the small marsh and subalpine h (horsetail), montane g (horsetail), ecosites common in lower slope and valley bottom positions. Wetlands will be established on wet (Hygric to Hydric) poorly drained soils. These treed wetland communities are characterized by spruce (Engelman, white) trees, poplar trees, and a diverse shrub community including dogwood, alder, rose, dwarf birch and willows. The understory is also diverse with abundant horsetail and sedges (*Carex* spp.) generally increasing with greater moisture.

Small marsh wetlands dominated by sedges with variable cover of shrubs will also be established on mineral soil where the water is maintained at or above the surface. These marsh communities will be interspersed within the treed wetlands and at the margins of open water within the reclaimed areas. The establishment of treed wetland and shallow marsh will supply suitable habitat for amphibians and other wildlife. This includes western toad and Columbian spotted frogs that require wetlands and fishless aquatic habitats for breeding.

Reclamation of wetlands will progress as suitable saturated soil conditions allow with the planting of trees and shrubs. Water levels will be maintained due to slope position and drainage characteristics of surrounding lands and also by design at final closure with removal of berms and dams to both maintain water stability within the wetlands and also restore natural drainage. Because the tree and

shrub species targeted for use in wetland reclamation are adapted to a range of moisture conditions, planting of trees and shrubs will proceed progressively around the margins of ponds and other water control infrastructure. Generally, forbs and grasses adapted to wet conditions are quick to establish naturally from surrounding undisturbed or reclaimed land. Where natural regeneration is not sufficient the proposed seed mix for treed wetlands will be used (Table F.3.6-3). The understory community will change significantly as the planted trees and shrubs mature and increase the amount of shade and humidity. The cooler and more humid conditions will facilitate natural succession toward the characteristic horsetail dominated forb understory community.

F.4.4.4 Erosion Control

Erosion will occur on the new landscape at the Project. In order to reduce the negative impact of erosion the landscape will be shaped to provide dips and swales that will reduce slope steepness and slope length, thereby reducing surface flow rates and distance. Some erosion of replaced reclamation material is expected to occur on steep slopes and long slopes. The natural process of erosion, sediment transport and re-deposition within the reclaimed landscape may modify the thickness and texture of surface layers. The loss and deposition of soil adds to diversity and develops more natural soil landscapes. As vegetation cover becomes established and provides effective protection, the frequency and magnitude of erosion will decrease.

Drainage courses on the reclaimed landscape will shift over time as erosion occurs. The drainage courses will be designed to accommodate these changes through the use of erosion control systems such as the use of armouring with boulders and the establishment of vegetation. The reclaimed landscape will be monitored for erosion and excessive erosion will be identified and mitigation will be planned as required. To obtain a reclamation certificate, the lands need to be free of erosion, have a self-sustaining vegetative cover and must be safe and stable.

F.4.5 Closure Landscape

The Project development and reclamation process will establish new landforms. These features are common to coalmine developments and form the landscape of the reclaimed mine. These components include:

- reclaimed powerline, access road and conveyor right of way;
- reclaimed coal handling processing plant and associated infrastructure;
- reclaimed temporary construction camp;
- reconstructed sediment ponds, streams and wetlands;
- reclaimed coal load out and railway loop;
- reclaimed pit and rock disposal areas;

- reclaimed end pit lake;
- highwall and escape terrain feature; and
- miscellaneous features such as haul roads, powerlines and other corridors.

Cross sections that show the pre-mining topography and the reclaimed conditions are shown on [Figures F.4.1-1 to F.4.1-5](#). In general, the topography will be less steep and have lesser slope angles, with the exception of the highwall feature. All new landforms will have an equivalent land capability as the pre-mining conditions.

The closure landforms were designed such that they are integrated with the adjacent undisturbed lands and watershed systems:

- the location of land uses in areas or on landforms provide physical, biological, social and economic value; and
- forest productivity of reclaimed landscape will be equal to or greater than pre-development conditions.

[Figure F.3.6-7](#) shows the proposed closure landscape for the Project. Benga is committed to ensuring that the final reclamation plan for the Project is integrated and compatible with adjacent undisturbed landforms.

F.4.5.1 Reclaimed Access Road/Conveyor Right of Way

At the time of mine closure, the conveyor right of way and the main site access road will be reclaimed. All of the infrastructure will be removed and the disturbed areas will be recontoured to blend with the adjacent undisturbed lands. Compacted areas will be ripped to relieve compaction. Conserved reclamation material will be replaced and the disturbed areas will be revegetated.

F.4.5.2 Reclaimed Plant Site

At the time of mine closure, all associated facilities will be reclaimed. The plant building, maintenance shops and the administration building will be dismantled and removed from the site. The building sites, access roads and coal storage areas will be ripped to relieve compaction and recontoured. Conserved reclamation material will be replaced and the sites will be revegetated.

F.4.5.3 Reclaimed Temporary Construction Camp

The temporary construction camp will be dismantled and removed from the site prior to mine operations. The camp area will have reclamation material replaced, will be decompacted and revegetated following decommissioning.

F.4.5.4 Reconstructed Sediment Ponds, Drainages and Wetlands

During the operations of the mine, there will be four sediment ponds, four surge ponds, and drainage ditches constructed to manage the mine wastewater generated during the development of the mine. During mine closure, the drainage ditches and sediment ponds will be reclaimed. The sediment ponds can be fully decommissioned and reclaimed once they have demonstrated that sedimentation has been reduced to naturally occurring levels. The areas will be recontoured, reclamation material will be replaced and the sites will be revegetated to the requirements of the revegetation program. Three surge ponds will remain intact beyond mine closure until the completion of the selenium management requirements, at which point they will also be revegetated to the requirements of the revegetation plan.

The sediment ponds will be removed with remnant freshwater ponds or wetlands remaining as discussed in [Section F.4.4.3](#). Western toad and Columbian spotted frogs require wetlands and fishless aquatic habitats for breeding, which these features will provide.

Final detailed plans for these activities will be provided during the closure planning phase.

F.4.5.5 Reclaimed Loadout and Rail Loop

The coal conveyor will transport the clean coal to a rail loadout facility that will be constructed adjacent to the town of Blairmore and will consist of a rail loop, track addition, and supporting infrastructure. The track will connect to Canadian Pacific Railway's (CPR) existing rail line along Highway 3.

At mine closure, the rail loop and supporting infrastructure will be fully reclaimed. The track will be dismantled and all associated infrastructure will be removed. The area will be recontoured to meet the sloping requirements, compaction will be alleviated and conserved reclamation material will be replaced. The area will be revegetated to integrate with adjacent lands.

F.4.5.6 Reclaimed Pit and Rock Disposal Areas

The rock disposal areas will be progressively recontoured and reclaimed throughout the life of the mine. As each disposal bench is completed, final contouring will be conducted and reclamation material will be replaced. Revegetation efforts will be conducted as prescribed in the revegetation plan to achieve the ecological units desired for closure.

F.4.5.7 End Pit Lake

An end pit lake will be developed in the northeast portion of the mine development area. The conceptual physical characteristics for the end pit lake are provided in [Table F.4.5-1](#).

Table F.4.5-1 Lake Characteristics	
Water level (m)	1,700
Lake Surface Area (ha)	18.4
Maximum Depth (m)	105
Average Depth (m)	36
Lake Volume (x 1000 m ³)	6,500
Littoral Zone (ha)	1.8
Littoral Zone (%)	10.0
Drainage Area including lake (km ²)	1,032
Mean Annual Outflow (mm/yr) ¹	738

1. No surface outlet, discharge will flow subsurface through saturated backfill zones for treatment and Se removal.

Based on a review of the post mining hydrology, a design water surface elevation of 1,700 m was determined for the end pit lake.

The lake is expected to discharge, east toward Gold Creek (Figure F.4.4-1). Water in the lake should not contain elevated levels of selenium. Selenium enriched water will be captured and passed through the saturated backfill areas. The saturated backfill areas will remove the selenium from the water, and will eventually discharge from the saturated backfill zones into Blairmore Creek.

The end pit lake will have a highwall feature on the west side that has slopes of 55° to 60°. The remaining slopes around the lake will have a maximum reclaimed slope angle of 23°. The lake is planned to be an aesthetic waterbody and not to have a fisheries component.

F.4.5.8 Highwall Escape Terrain Feature

The north end of the pit is the final area of mining completed for the Project and, when completed, there is no opportunity to backfill the remaining mined-out hole resulting in a highwall (Figure F.4.1-6). A portion of the highwall along the north end of the pit will be left standing, shown on cross-section 17, Figure F.4.1-5. The maximum height will be 330 m above the lake level, with an average of 250 m. The length of the highwall will be 2,050 m and the overall area will be 42 ha. A lake will be created at the bottom of the pit and the lake will fill with water to an elevation of 1,700 m.

The highwall will provide some of the steeper terrain in the reclaimed landscape. Much of the existing steep terrain (>45°) will be reduced to 23° after reclamation. The steeper highwall slopes will

provide valuable escape terrain for bighorn sheep and mountain goats. It will also provide valuable habitat for various bird species such as peregrine falcon, black swift, cliff swallow, and golden eagle.

F.4.5.9 Reclaimed Linear Corridors

All roads, powerlines and linear corridors will be reclaimed to equivalent capability during the closure of the mine. Access and haul roads will have all of the culverts removed, be ripped to relieve compaction and will be recontoured to integrate with the surrounding landscape. With the replacement of reclamation materials, it is anticipated that the roads will become part of the productive land base.

F.4.5.10 Proposed Golf Course Development

The construction of the rail loop and loadout will displace eight of eighteen holes of the existing Crowsnest Pass Golf and Country Club; as a result, a portion of the golf course will be reconstructed to the northwest of its existing location on Benga private land. The construction of the proposed golf course development is an “incidental physical activity” resulting from the mine development. Upon development of the golf course, the end land use will convert to recreational. The construction, operation and closure responsibilities associated with the proposed golf course development are the responsibility of the Crowsnest Pass Golf and Country Club.

F.4.5.11 Proposed Helipad Access

The construction of the helipad access road will provide access to the forestry helipad for fire suppression. As with the proposed golf course development, the helipad access is an “incidental physical activity” and the reclamation responsibilities will reside outside of Benga, with the Department of Agriculture and Forestry.

F.5 FINANCIAL SECURITY

The Mine Security Financial Program (MSFP) and the associated Mine Financial Security Program Standard (AER 2014) and Guide to the Mine Financial Security Program (AER March 2014) have been reviewed and will be complied with by Benga. Upon completion of the EA Review process, Benga will make the appropriate submission to MFSPSubmissions@aer.ca with the requisite information.

As the Project is as yet not approved and development has not commenced, Benga believes that the MFSP submission will be as outlined below.

According to the MFSP four types of financial security deposits, focusing on various potential risks in the lifecycle of a mine, are contemplated:

- **Base Security Deposit (BSD):** existing and new projects will be required to provide a base security. Among other things, this security will be used for suspension care and custody to maintain security and safety at the site until a new company takes over or the site is closed.
- **Operating Life Deposit (OLD)** addresses the risks at the end of mine life. A company is required to start posting financial security when there are less than 15 years of reserves left so that all outstanding abandonment, remediation and surface reclamation costs are fully financially secured by the time there are less than six years of reserves left.
- **Asset Safety Factor Deposit (ASFD)** addresses the risks if a company's cash flow falls below a level deemed adequate to ensure that all MFSP liabilities can be fully funded. The company posts financial security when the MFSP asset to MFSP liability ratio falls below 3.00. Sufficient financial security must be posted to bring the ratio to 3.00.
- **Outstanding Reclamation Deposit (ORD)** addresses the risks posed by a company deferring reclamation. The company posts security when they do not reduce liability according to a reclamation schedule approved by the Alberta Energy Regulator.

Benga understands from the MFSP that overall liability is calculated as:

$$\text{MFSP Liability (\$)} = \text{ARO Liability (\$)} + \text{Other Liability (\$)}.$$

Schedule-MFSP 003-March 2014

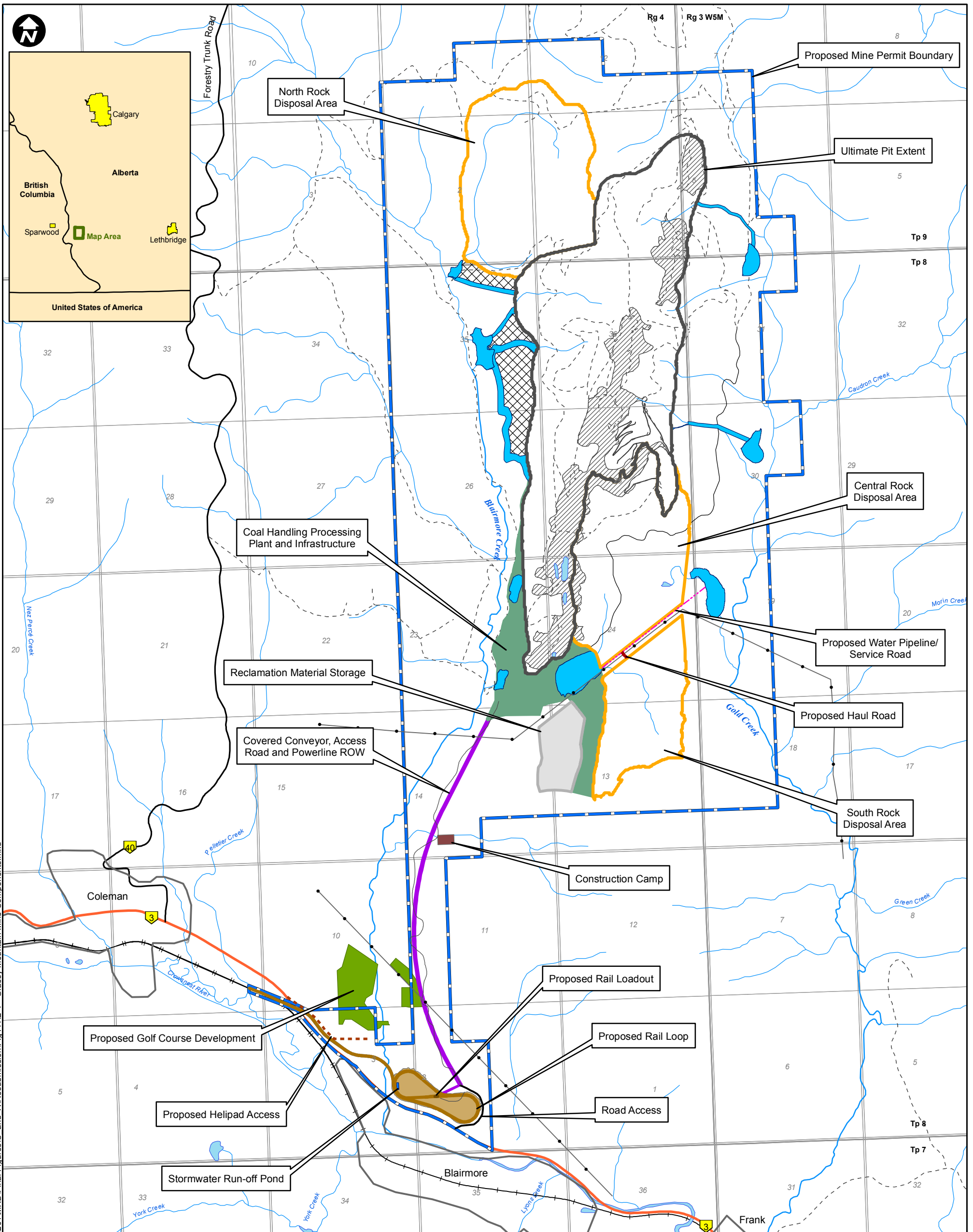
Benga also understands that operators under the MFSP can elect to provide full financial security under the Program and that amount is equal to the MFSP Liability as calculated above. Further, as the Project is a new mine, the direction provided in the MFSP Guide (*Guide to the Mine Financial Security Program, AER March 2014 p.16*) is that the cost of reclamation of the new mine is to be forecast to December 31 of the reporting year.

Benga will follow the MSFP process. As the timing of the mine approval is uncertain, Benga proposes to submit the MFSP report, as outlined above, a minimum of 90 days prior to the expected approval issuance. At this point, the calculation the assets associated with the Project, the deemed netback proposal to the AER and the offsetting environmental liability is impractical. The amount of security is therefore uncertain, but will be no less than the BSD amount for new export coal mines of \$7,000,000. This security and the manner of calculating the liability to asset relationship will be reviewed annually as required under the MFSP.

F.6 CONCLUSIONS

The reclamation plan for the Project outlines the vision, goals, approach and detailed plans for reclaiming all areas disturbed through the life of this Project. The primary reclamation goal of the Project is to return the lands to a capability that is equivalent to predevelopment conditions and consistent with end land use objectives.

Appendix A: Conservation and Reclamation Figures



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LEGEND	
	Primary Highway
	Secondary Highway
	Existing Trails
	Existing Railway
	Existing Access Road
	Existing Powerline
	Proposed Water Pipeline/Service Road
	Proposed Helipad Access
	Surface Water Drainage
	Waterbody
	Proposed Mine Permit Boundary
	Ultimate Pit Extent
	Ultimate Rock Disposal Extent
	Reclamation Material Storage
	Construction Camp
	Ponds and Ditches
	Coal Handling Processing Plant and Infrastructure
	Covered Conveyor, Access Road and Powerline ROW
	Railway Loop
	Stormwater Run-off Pond
	Proposed Golf Course Development
	Undisturbed Area
	Legacy Mine Disturbance

PROJECT

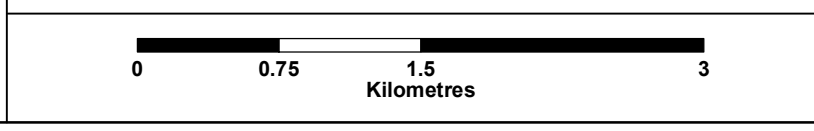
GRASSY MOUNTAIN COAL PROJECT

TITLE

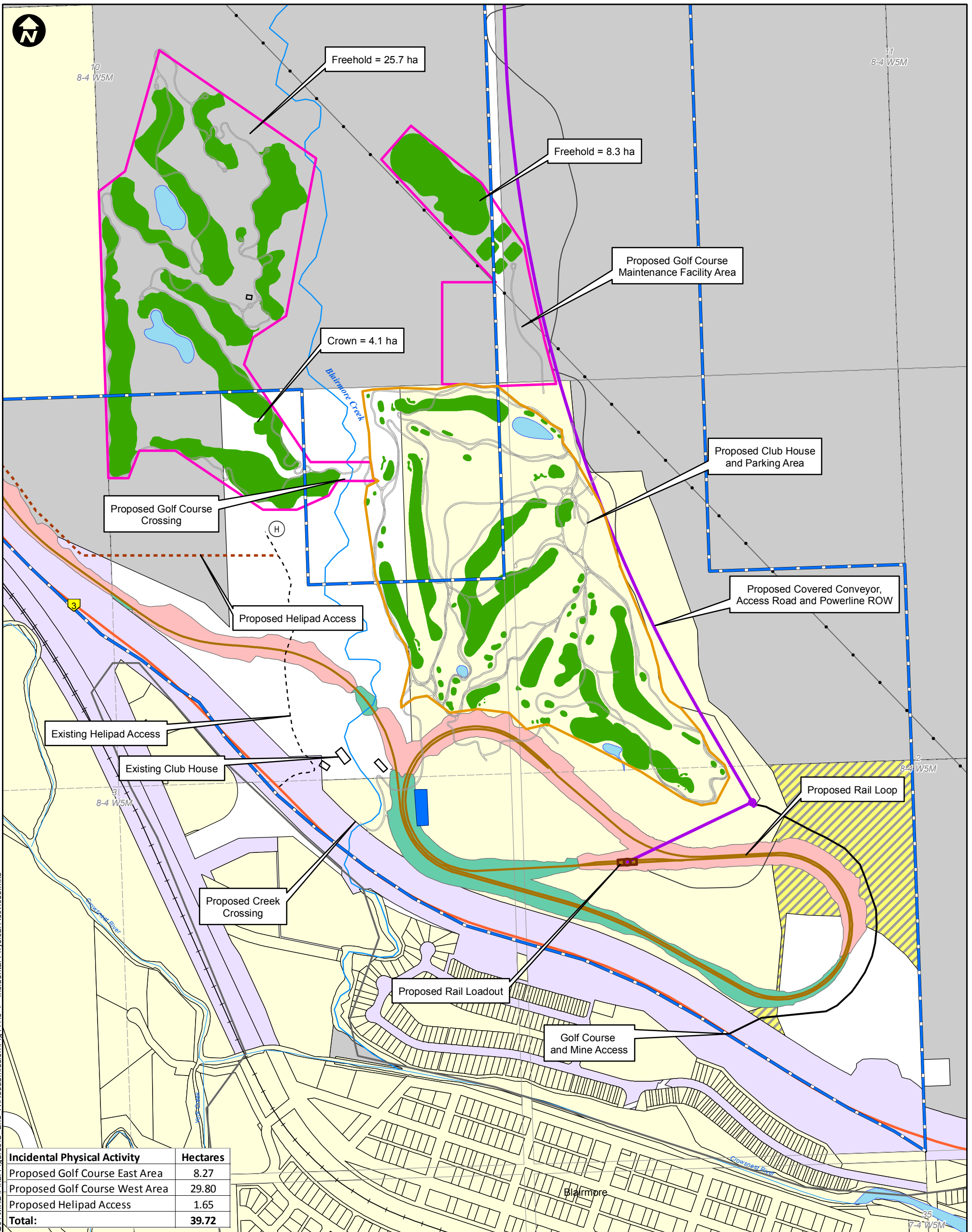
GRASSY MOUNTAIN MINE COMPONENTS

NOTES

AltaLIS, 2016; MEMS, 2016; Riversdale, 2016
 Datum/Projection: UTM NAD 83 Zone 11



PROJECT: 14-00201-01
DRAWN BY: SL/JL
CHECKED BY: DM
DATE: JULY 8, 2016
FIGURE
F.1.2-1



Incidental Physical Activity	Hectares
Proposed Golf Course East Area	8.27
Proposed Golf Course West Area	29.80
Proposed Helipad Access	1.65
Total:	39.72

LEGEND

- (H) Helipad
- Primary Highway
- Existing Railway
- Main Access Road
- Existing Powerline
- Existing Helipad Access
- Proposed Helipad Access
- Covered Conveyor, Access Road and Powerline ROW
- Railway Loop
- Proposed Mine Permit Boundary
- Stormwater Run-off Pond
- Proposed Golf Course Development
- Existing Golf Course Area
- Proposed Rail Layout (Proposed Cut Area)
- Proposed Rail Layout (Proposed Fill Area)

Golf Course Features

- Cartpath
- Water
- Fairway
- Building

Land Ownership

- Freehold - Benga
- Freehold - Benga 50%, CNP Golf & Country Club 50%
- Freehold - Other
- Registered Roadway

PROJECT

RIVERSDALE RESOURCES **GRASSY MOUNTAIN COAL PROJECT**

MILLENNIUM EMS Solutions Ltd.

TITLE
INCIDENTAL PHYSICAL ACTIVITIES: PROPOSED GOLF COURSE DEVELOPMENT AND HELIPAD ACCESS AREAS

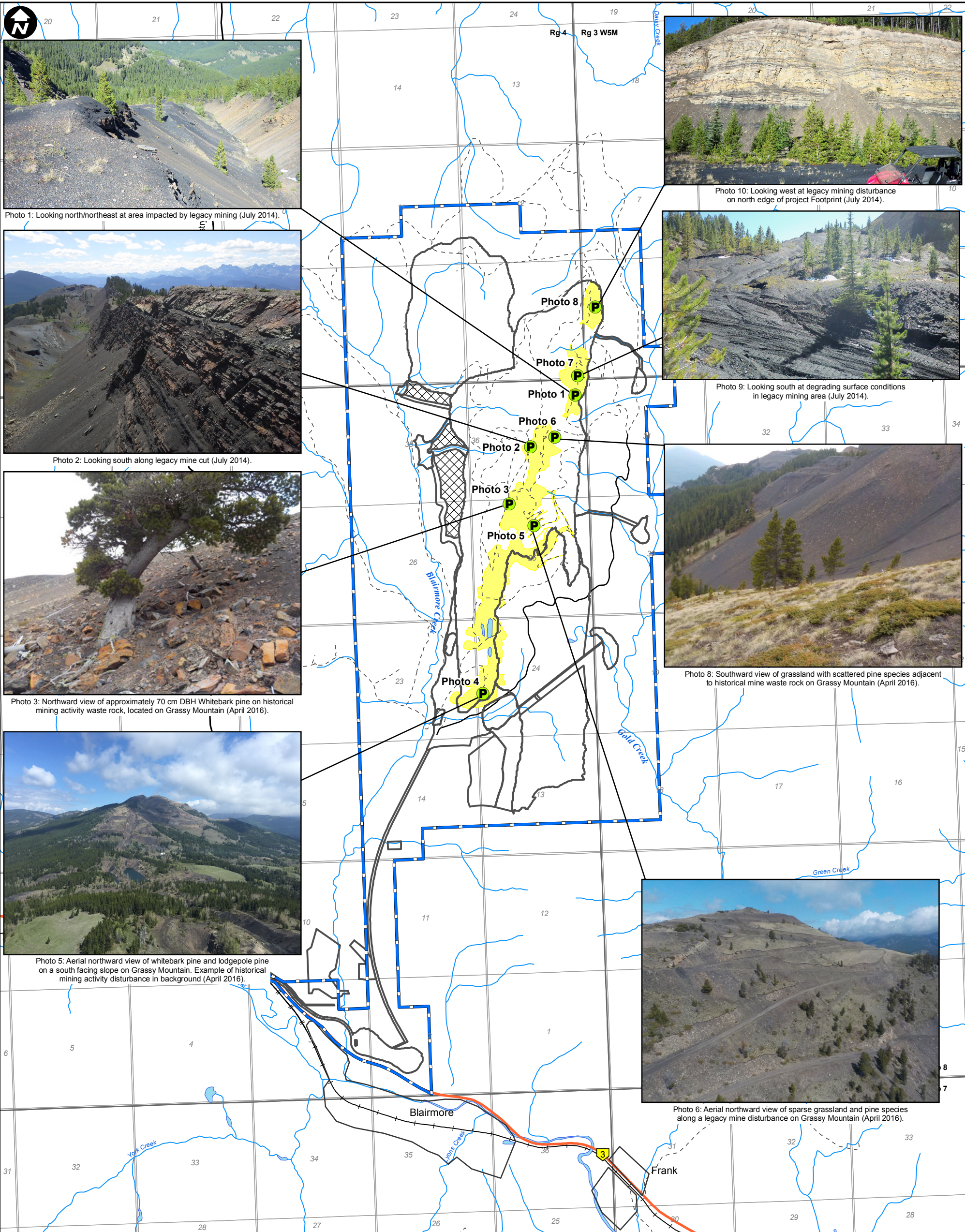
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PROJECT: 14-00201-01
 DRAWN BY: SL/JL
 CHECKED BY: DM
 DATE: JULY 8, 2016

FIGURE
F.1.3-1

0 125 250 500 Metres

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LEGEND

- Photo Location
- Surface Water Drainage
- Primary Highway
- Secondary Highway
- Road Access
- Existing Trails
- Existing Railway
- Proposed Mine Permit Boundary
- Proposed Mine Permit Boundary Addition
- Project Footprint
- Undisturbed Area
- Legacy Mine Disturbance

PROJECT



RIVERSDALE GRASSY MOUNTAIN
RESOURCES COAL PROJECT



MILLENNIUM
EMS Solutions Ltd.

TITLE
**PREVIOUSLY DISTURBED LANDS
ON THE PROJECT FOOTPRINT**

NOTES

AltaLIS, 2016; Geobase, 2016; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01
DRAWN BY: SL/JDC
CHECKED BY: DM
DATE: JUNE 10, 2016

FIGURE
F.2.1-1



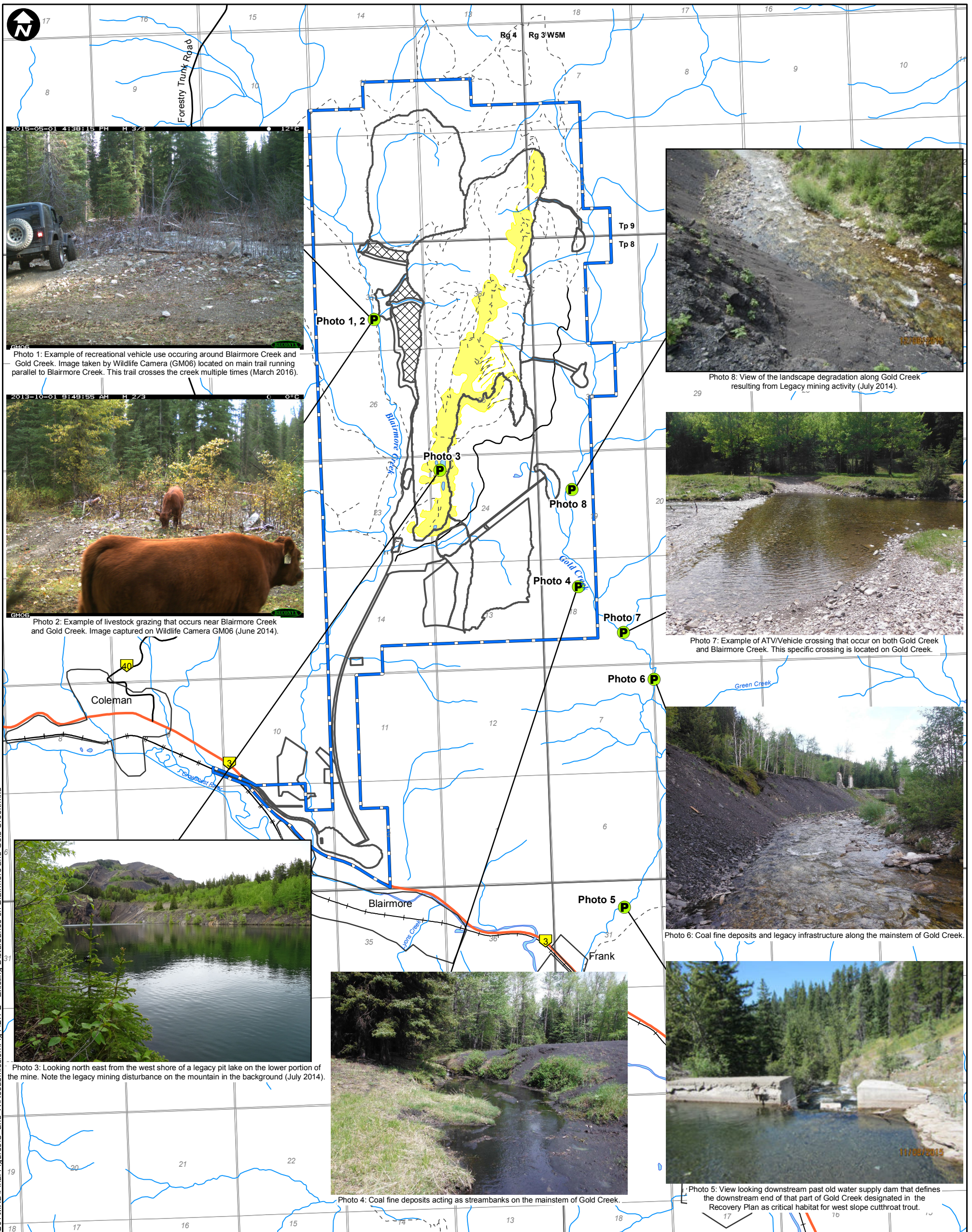


Photo 1: Example of recreational vehicle use occurring around Blairmore Creek and Gold Creek. Image taken by Wildlife Camera (GM06) located on main trail running parallel to Blairmore Creek. This trail crosses the creek multiple times (March 2016).



Photo 2: Example of livestock grazing that occurs near Blairmore Creek and Gold Creek. Image captured on Wildlife Camera GM06 (June 2014).

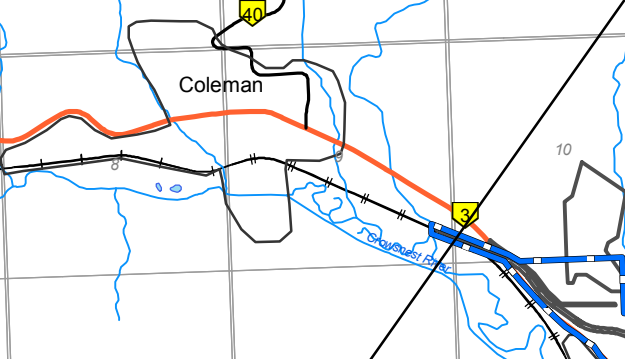


Photo 3: Looking north east from the west shore of a legacy pit lake on the lower portion of the mine. Note the legacy mining disturbance on the mountain in the background (July 2014).



Photo 4: Coal fine deposits acting as streambanks on the mainstem of Gold Creek.

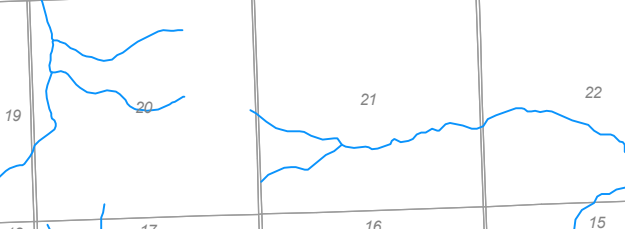


Photo 5: View looking downstream past old water supply dam that defines the downstream end of that part of Gold Creek designated in the Recovery Plan as critical habitat for west slope cutthroat trout.



Photo 8: View of the landscape degradation along Gold Creek resulting from Legacy mining activity (July 2014).



Photo 7: Example of ATV/Vehicle crossing that occur on both Gold Creek and Blairmore Creek. This specific crossing is located on Gold Creek.



Photo 6: Coal fine deposits and legacy infrastructure along the mainstem of Gold Creek.



Photo 5: View looking downstream past old water supply dam that defines the downstream end of that part of Gold Creek designated in the Recovery Plan as critical habitat for west slope cutthroat trout.

- LEGEND**
- Photo Location
 - Surface Water Drainage
 - Primary Highway
 - Secondary Highway
 - Road Access
 - Existing Trails
 - Existing Railway
 - Proposed Mine Permit Boundary
 - Proposed Mine Permit Boundary Addition
 - Project Footprint
 - Undisturbed Area
 - Legacy Mine Disturbance

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

EXISTING DISTURBANCE OCCURRING ON THE BLAIRMORE CREEK AND GOLD CREEK

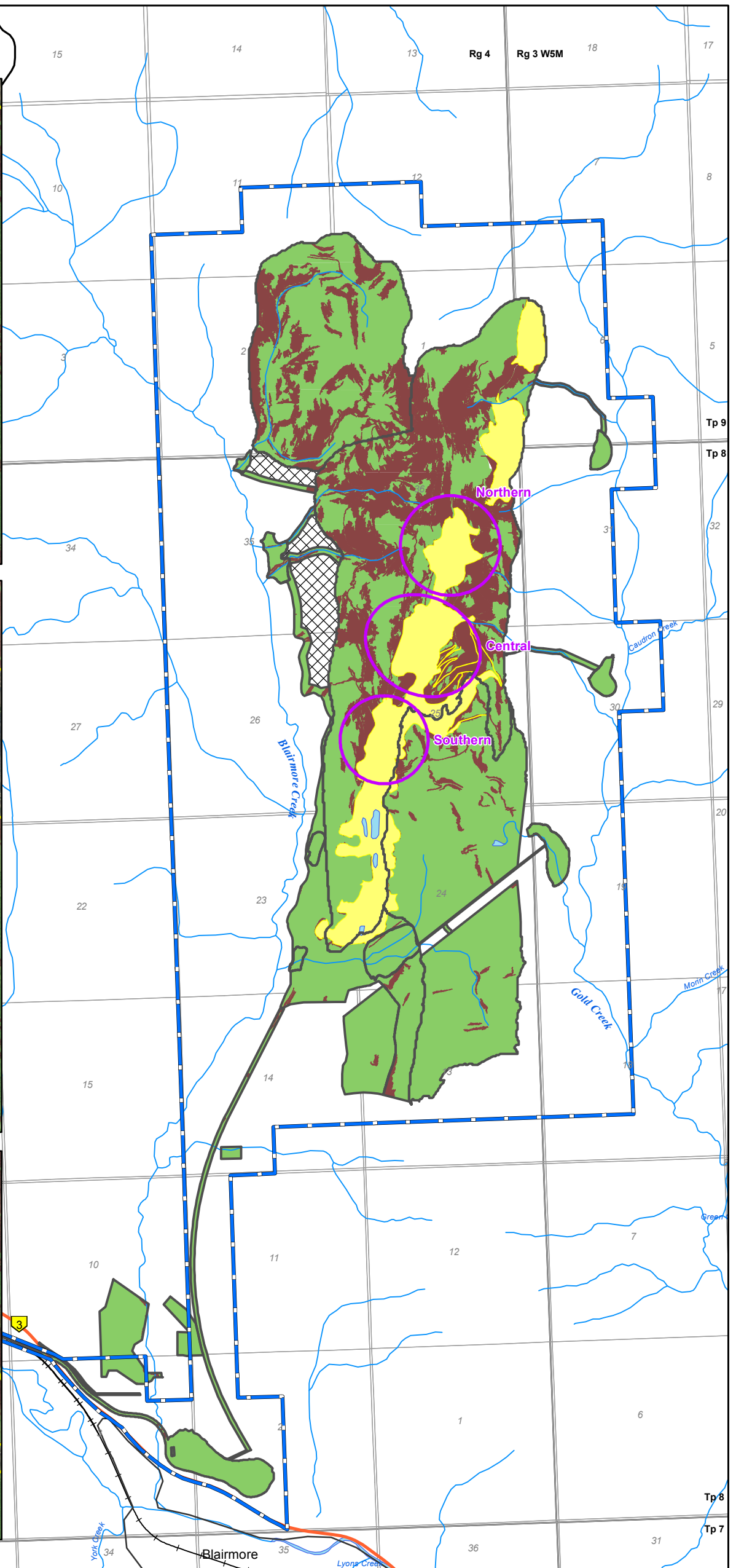
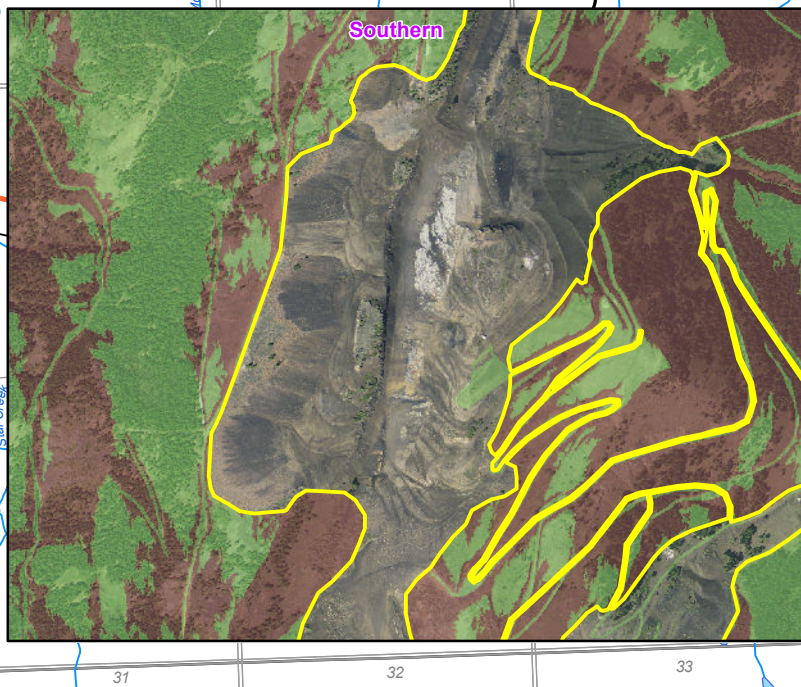
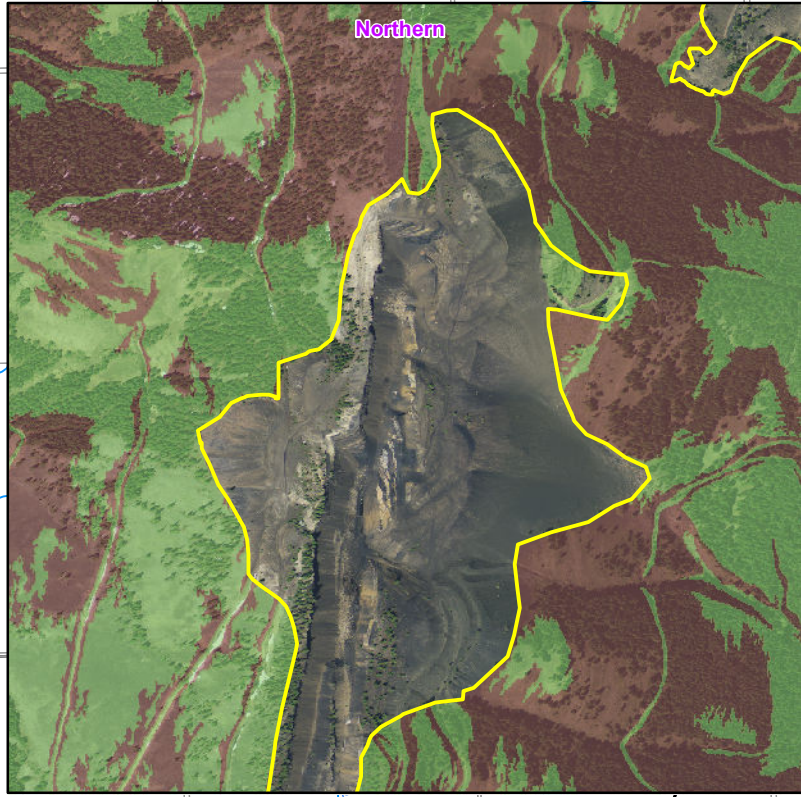
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AltaLIS, 2016; Geobase, 2016; MEMS, 2016; Riversdale, 2016
 Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01
 DRAWN BY: SLJL
 CHECKED BY: DM
 DATE: JULY 8, 2016
FIGURE F.2.1-2



Document Path: K:\Active Projects\2014\AP_14-00201 to 14-00250\14-00201\WXD\Final\Figures\C_and_R\Resubmission\Fig F.2.1-2 - Existing Disturbance on Blairmore and Gold Creek.mxd



LEGEND

- Surface Water Drainage
- Primary Highway
- Secondary Highway
- Existing Railway
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Steep Slope (>27 degrees)
- Previously Disturbed Lands
- Soil Salvage Area

PROJECT



RIVERSDALE
RESOURCES

**GRASSY MOUNTAIN
COAL PROJECT**



TITLE

SOIL SALVAGE AREA ON THE PROJECT FOOTPRINT

NOTES

AltaLIS, 2016; Geobase, 2016 MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01

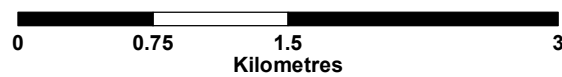
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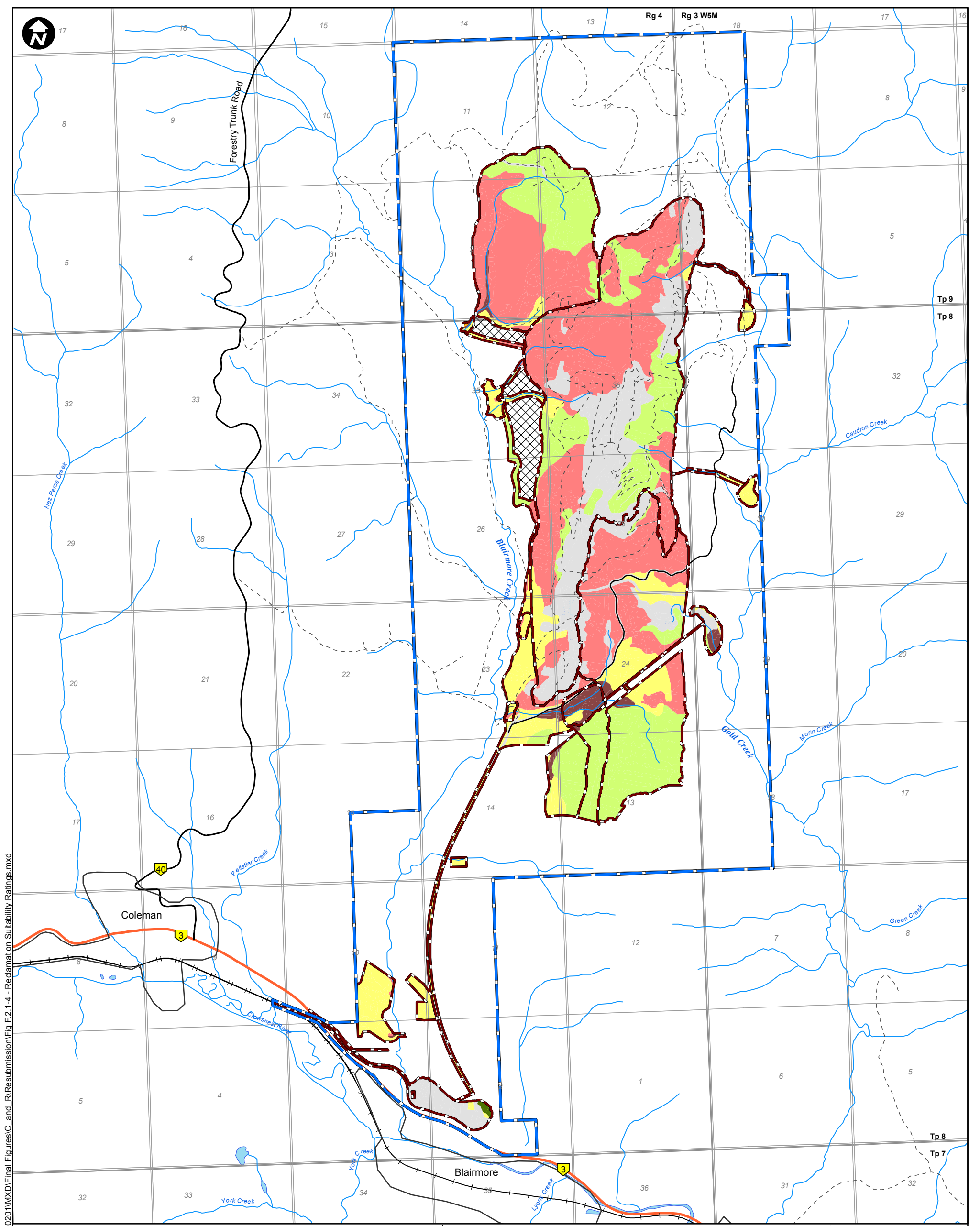
DATE: JUNE 10, 2016

FIGURE

F.2.1-3



Document Path: K:\Active Projects\2014\AP_14-00201 to 14-00250\14-00201\MXD\Final Figures\C and R\Resubmission\Fig.F.2.1-3 - Soil Salvage Area Project Footprint.mxd



Document Path: K:\Active Projects 2014\AP_14-00201-14-00201-14-00201\MXD\Final Figures\C and R\Resubmission\Fig.F.2.1-4 - Reclamation Suitability Ratings.mxd

LEGEND

- Primary Highway
 - Secondary Highway
 - Existing Railway
 - - - Existing Trails
 - Surface Water Drainage
 - Waterbody
 - Soils Regional Study Area
 - Soils Local Study Area
 - Undisturbed Area
-
- Reclamation Suitability (A and B Horizons)**
- Good - Fair
 - Good - Poor
 - Fair
 - Fair - Poor
 - Poor
 - Unsuitable
 - Not Rated

PROJECT



RIVERSDALE
RESOURCES

**GRASSY MOUNTAIN
COAL PROJECT**



TITLE

RECLAMATION SUITABILITY RATINGS

NOTES

AltaLIS, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01

DRAWN BY: SL

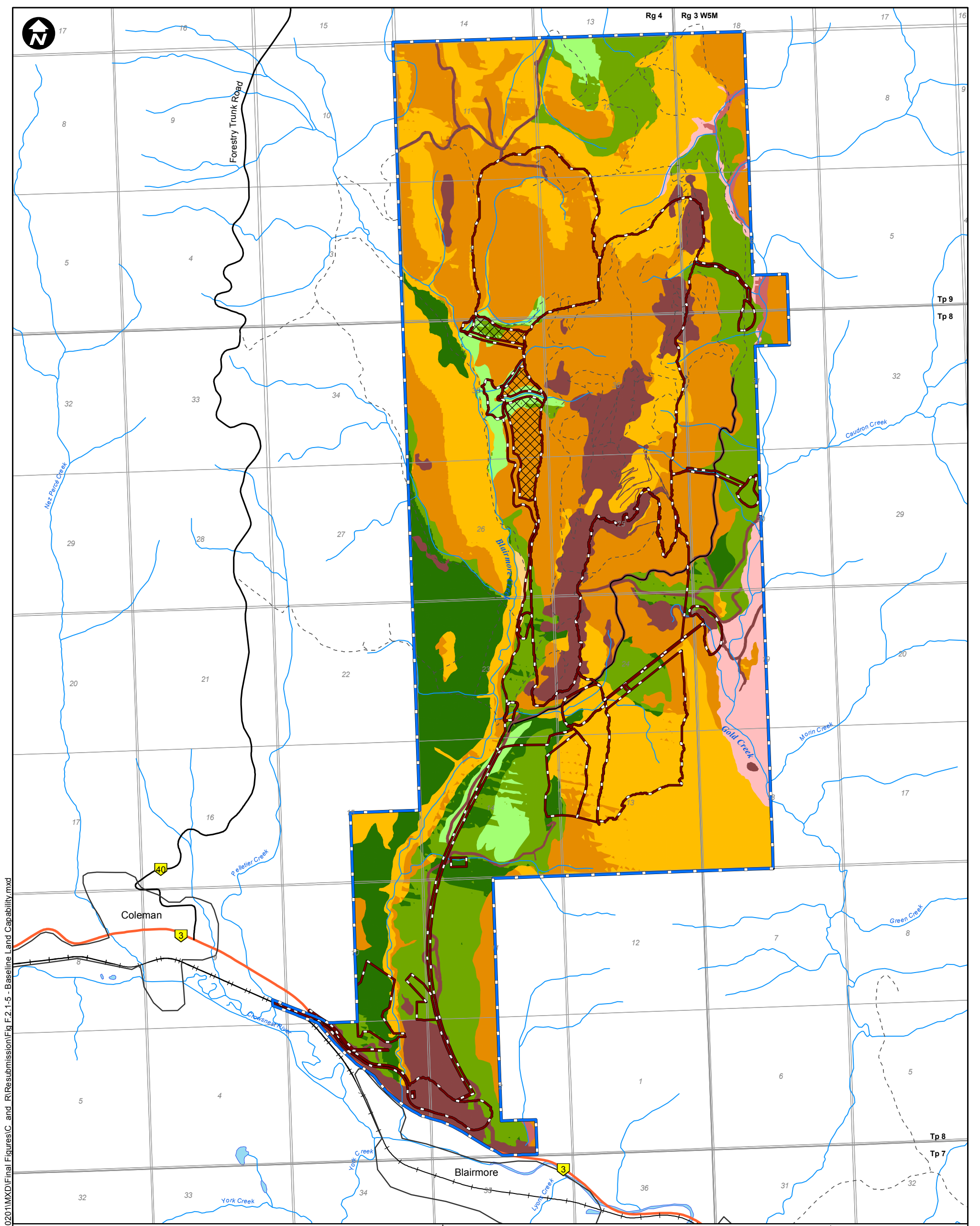
CHECKED BY: DM

DATE: JUNE 10, 2016

FIGURE

F.2.1-4





Document Path: K:\Active Projects 2014\AP_14-00201-14-00201-14-00201-14-00201-14-00201\MXD\Final Figures\C and R\Resubmission\Fig.F.2.1-5 - Baseline Land Capability.mxd

LEGEND

- Primary Highway
- Secondary Highway
- +— Existing Railway
- - - Existing Trails
- Surface Water Drainage
- Waterbody
- Soils Regional Study Area
- Soils Local Study Area
- Undisturbed Area

Baseline LCC Class

- 4
- 4-5
- 4-6
- 5
- 5-6
- 5-7
- 6
- 6-7
- 7
- NA

PROJECT



RIVERSDALE
RESOURCES

**GRASSY MOUNTAIN
COAL PROJECT**



TITLE

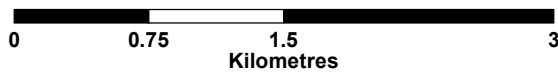
BASELINE LAND CAPABILITY

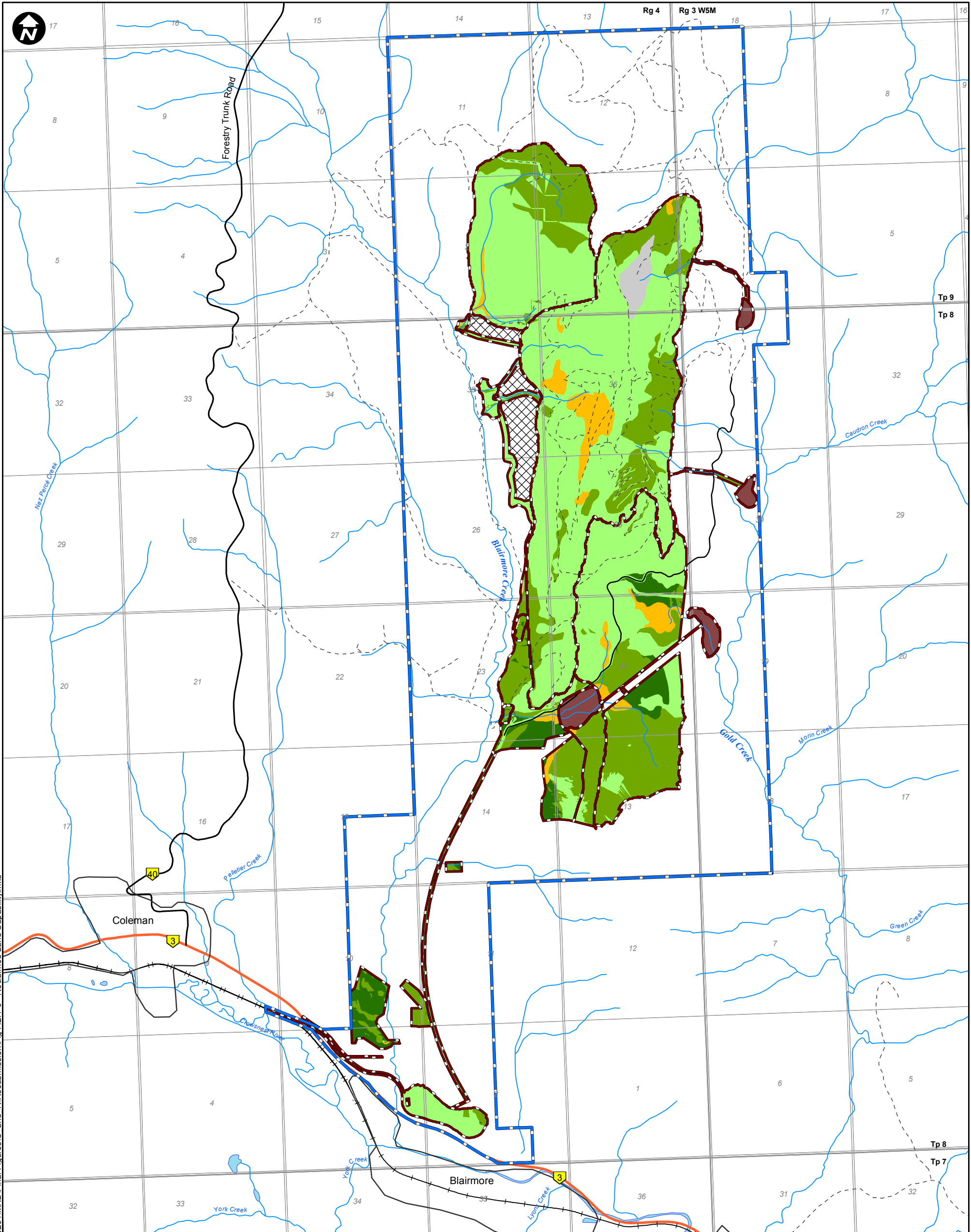
NOTES

AltaLIS, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01
DRAWN BY: SL
CHECKED BY: VL
DATE: JUNE 10, 2016

**FIGURE
F.2.1-5**





Document Path: K:\Active Projects 2014\AP 14-00201-14-00201-14-00201\MXD\Final Figures\C and R\Resubmission\Fig.F.2.1-6 - Reclaimed Land Capability.mxd

LEGEND

- Primary Highway
- Secondary Highway
- Existing Railway
- - - Existing Trails
- Surface Water Drainage
- Waterbody
- Soils Regional Study Area
- Soils Local Study Area
- Undisturbed Area

Reclaimed LCC Class

- 4
- 4-5
- 4-6
- 5
- 5-6
- 7
- NA

PROJECT



RIVERSDALE
RESOURCES

**GRASSY MOUNTAIN
COAL PROJECT**



TITLE

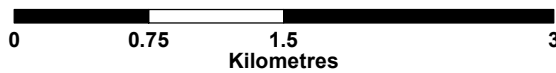
RECLAIMED LAND CAPABILITY

NOTES

AltaLIS, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

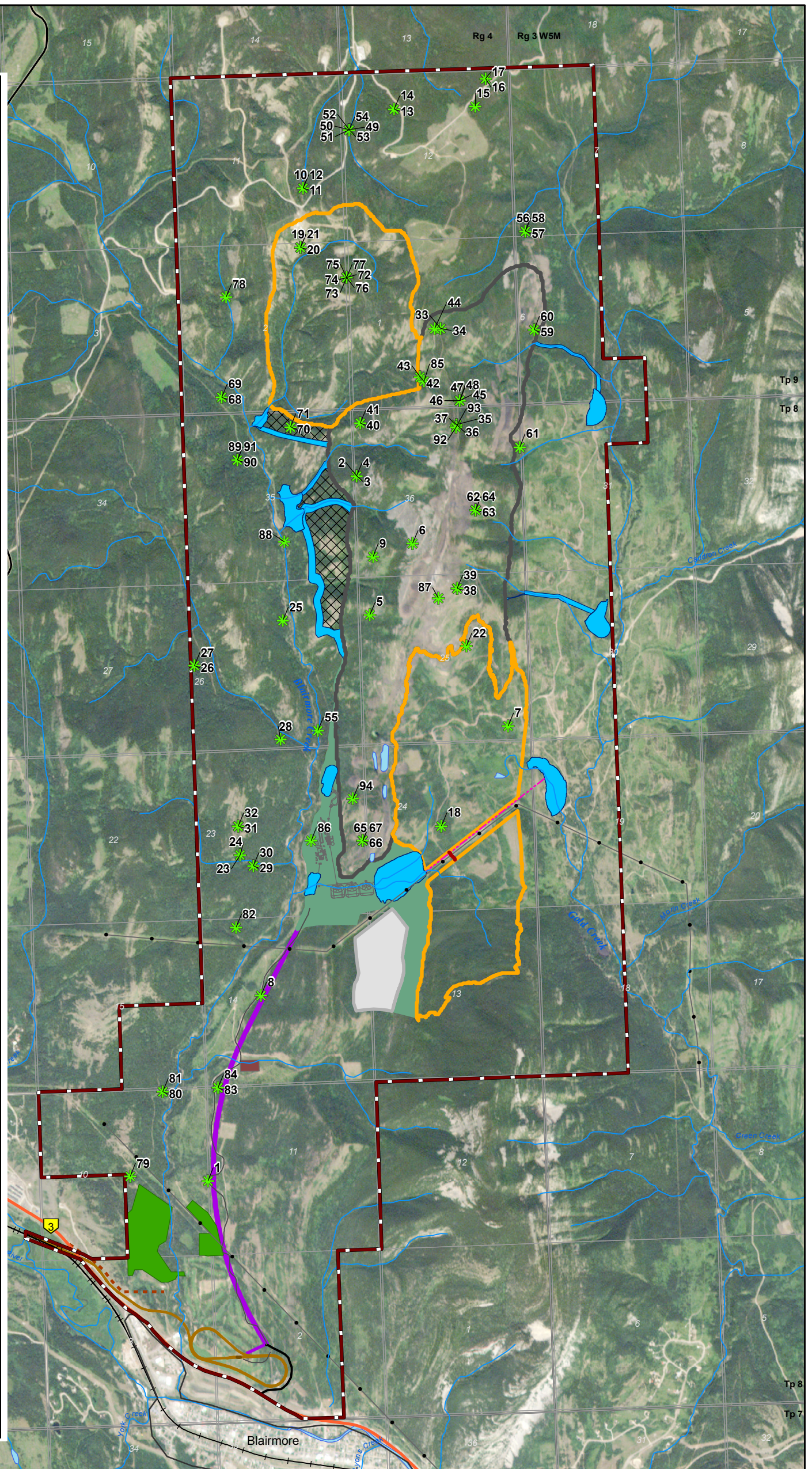
PROJECT: 14-00201-01
DRAWN BY: SL
CHECKED BY: VL
DATE: JUNE 10, 2016

**FIGURE
F.2.1-6**





Label ID	Scientific Name	Common Name
1	Crepis Atribarba	Slender Hawk's-Beard
2	Angelica Dawsonii	Yellow Angelica
3	Eucephalus Engelmannii	Elegant Aster
4	Piperia Unalascensis	Alaska Bog Orchid
5	Cladonia Symphyrcarpia	Split-Peg Lichen
6	Pinus Flexilis	Limber Pine
7	Piperia Unalascensis	Alaska Bog Orchid
8	Streptopus Roseus	Rose Mandarin
9	Angelica Dawsonii	Yellow Angelica
10	Angelica Dawsonii	Yellow Angelica
11	Piperia Unalascensis	Alaska Bog Orchid
12	Nodobryoria Abbreviata	Tufted Foxtail Lichen
13	Angelica Dawsonii	Yellow Angelica
14	Hypogymnia Enteromorpha	Budding Tube Lichen
15	Angelica Dawsonii	Yellow Angelica
16	Buxbaumia Aphylla	Bug On A Stick Moss
17	Nodobryoria Abbreviata	Tufted Foxtail Lichen
18	Hypogymnia Rugose	Wrinkled Tube Lichen
19	Eriogonum Cernuum	Nodding Umbrella-Plant
20	Phacelia Hastate	Silver-Leaved Scorpionweed
21	Phacelia Hastate	Silver-Leaved Scorpionweed
22	Phacelia Hastate	Silver-Leaved Scorpionweed
23	Piperia Unalascensis	Alaska Bog Orchid
24	Dicranum Tauricum	Broken-Leaf Moss
25	Angelica Dawsonii	Yellow Angelica
26	Anastrophillum Hellerianum	Heller's Notchwort
27	Peltigera Cinnamomea	Cinnamon Dog Pelt Lichen
28	Streptopus Roseus	Rose Mandarin
29	Conocephalum Salebrosum	Liverwort
30	Dicranum Tauricum	Broken-Leaf Moss
31	Piperia Unalascensis	Alaska Bog Orchid
32	Cladonia Symphyrcarpia	Split-Peg Lichen
33	Lophozia Ascendens	Liverwort
34	Vulpicida Canadensis	Brown-Eyed Sunshine Lichen
35	Pinus Albicaulis	Whitebark Pine
36	Schistidium Tenerum	Thread Bloom Moss
37	Umbilicaria Americana	American Rock Trip Lichen
38	Pinus Albicaulis	Whitebark Pine
39	Pinus Albicaulis	Whitebark Pine
40	Dicranella Crispa	Curly-Leaved Fork Moss
41	Rhytidiopsis Robusta	Pipercleaner Moss
42	Chiloscyphus Polyanthos	Liverwort
43	Pellia Neesiana	Liverwort
44	Pinus Albicaulis	Whitebark Pine
45	Angelica Dawsonii	Yellow Angelica
46	Lophozia Longidens	Liverwort
47	Lophozia Wenzelii	Liverwort
48	Vulpicida Canadensis	Brown-Eyed Sunshine Lichen
49	Streptopus Roseus	Rose Mandarin
50	Tellima Grandiflora	Fringe-Cups
51	Chiloscyphus Polyanthos	Liverwort
52	Jungmannia Exsertifolia	Liverwort
53	Pellia Endiviifolia	Liverwort
54	Cladonia Symphyrcarpia	Split-Peg Lichen
55	Cladonia Umbricola	Shaded Cladonia
56	Racomitrium Aciculare	Moss
57	Cladonia Ochrochlora	Smooth-Footed Powderhorn
58	Nodobryoria Abbreviata	Tufted Foxtail Lichen
59	Dicranum Tauricum	Broken-Leaf Moss
60	Xylographa Parallela	Black Woodscrip Lichen
61	Nodobryoria Abbreviata	Tufted Foxtail Lichen
62	Carex Petasata	Pasture Sedge
63	Pinus Albicaulis	Whitebark Pine
64	Pinus Albicaulis	Whitebark Pine
65	Dicranum Tauricum	Broken-Leaf Moss
66	Hypogymnia Rugose	Wrinkled Tube Lichen
67	Nodobryoria Abbreviata	Tufted Foxtail Lichen
68	Angelica Dawsonii	Yellow Angelica
69	Dicranum Tauricum	Broken-Leaf Moss
70	Angelica Dawsonii	Yellow Angelica
71	Racomitrium Aciculare	Moss
72	Carex Petasata	Pasture Sedge
73	Phacelia Hastate	Silver-Leaved Scorpionweed
74	Pinus Albicaulis	Whitebark Pine
75	Pinus Albicaulis	Whitebark Pine
76	Pinus Albicaulis	Whitebark Pine
77	Pinus Flexilis	Limber Pine
78	Angelica Dawsonii	Yellow Angelica
79	Aulacomnium Androgynum	Little Groove Moss
80	Streptopus Streptopoides	Twisted-Stalk
81	Aulacomnium Androgynum	Little Groove Moss
82	Dicranum Tauricum	Broken-Leaf Moss
83	Carex Petasata	Pasture Sedge
84	Caloplaca Sinapisperma	Firedot Lichen
85	Pellia Neesiana	Liverwort
86	Berberis Repens	Creeping Mahonia
87	Phacelia Hastate	Silver-Leaved Scorpionweed
88	Peltigera Cinnamomea	Cinnamon Dog Pelt Lichen
89	Angelica Dawsonii	Yellow Angelica
90	Bromus Vulgaris	Woodland Brome
91	Peltigera Cinnamomea	Cinnamon Dog Pelt Lichen
92	Pinus Albicaulis	Whitebark Pine
93	Pinus Flexilis	Limber Pine
94	Pinus Flexilis	Limber Pine



LEGEND

- Location of Rare Species
- Primary Highway
- Secondary Highway
- Existing Railway
- Existing Access Road
- Existing Powerline
- CHPP Facilities
- Proposed Water Pipeline/Service Road
- Railway Loop
- Proposed Helipad Access
- Surface Water Drainage
- Waterbody
- Vegetation Local Study Area
- Ultimate Pit Extent
- Ultimate Rock Disposal Area Extent
- Reclamation Material Storage
- Construction Camp
- Ponds and Ditches
- Coal Handling Processing Plant and Infrastructure
- Covered Conveyor, Access Road and Powerline ROW
- Proposed Golf Course Development
- Undisturbed Area

PROJECT

RIVERSDALE GRASSY MOUNTAIN COAL PROJECT



TITLE

RARE PLANT OCCURRENCES IN THE LSA AND FOOTPRINT

NOTES

AltaLIS, 2016; Geobase, 2016; Golder, 2016; MEMS, 2016; RapidEye, 2015 (Image Date: Jul 26/13); Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01

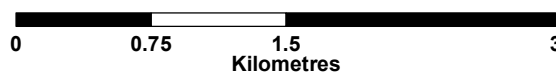
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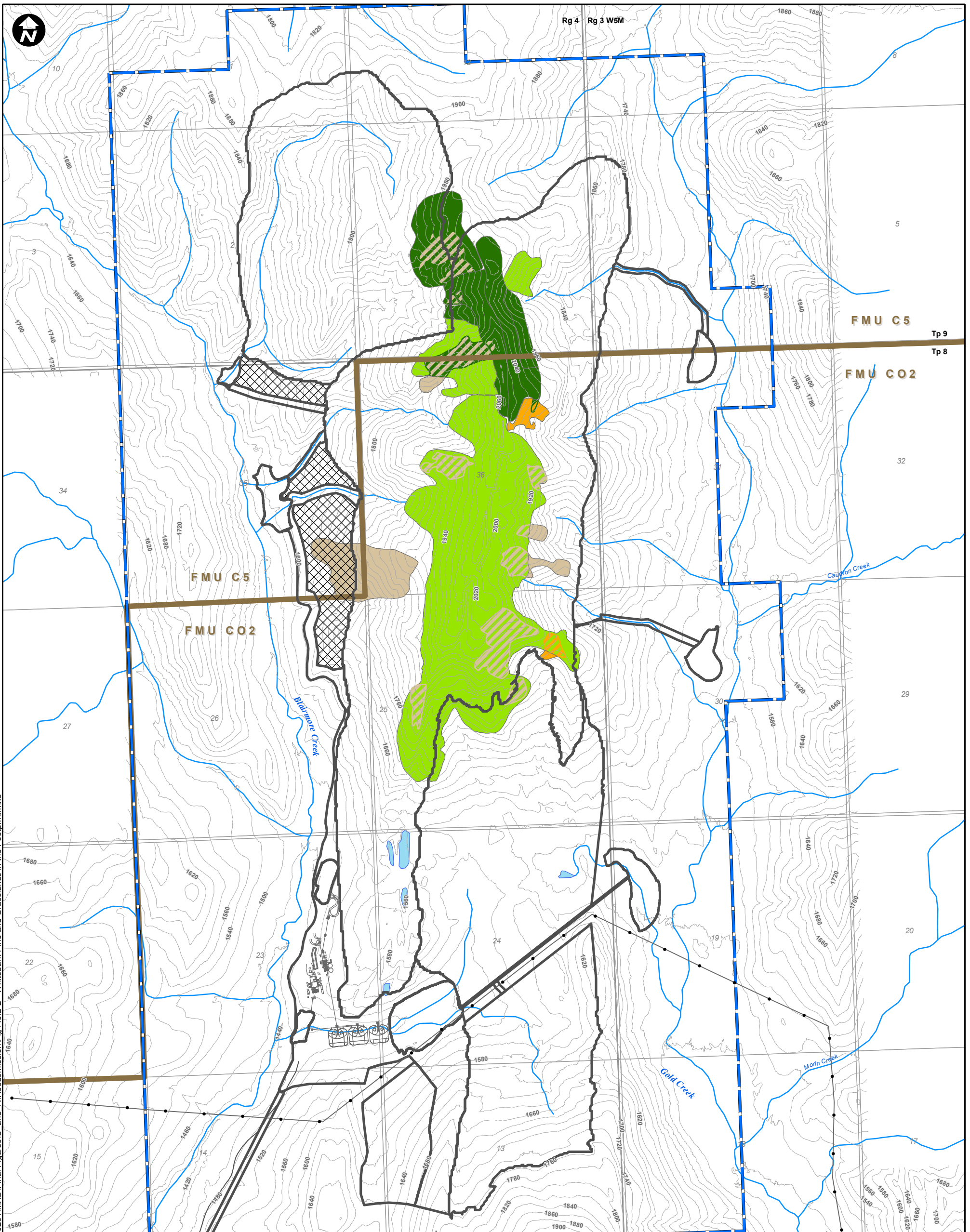
CHECKED BY: DM

DATE: JULY 11, 2016

FIGURE

F.3.2-1





LEGEND

- Existing Powerline
- Existing Access Road
- CHPP Facilities
- Topographic Contour (20m interval)
- Watercourse
- Waterbody
- ▭ Proposed Mine Permit Boundary
- ▭ Project Footprint
- ▨ Undisturbed Area
- ▭ FMU Boundary
- Whitebark Pine/Fescue/Grassland**
- Whitebark
- Whitebark Sparse
- Fescue
- Grassland Sparse

PROJECT

RIVERSDALE RESOURCES **GRASSY MOUNTAIN COAL PROJECT**

TITLE

WHITEBARK PINE AND GRASSLANDS DISTRIBUTION IN THE FOOTPRINT

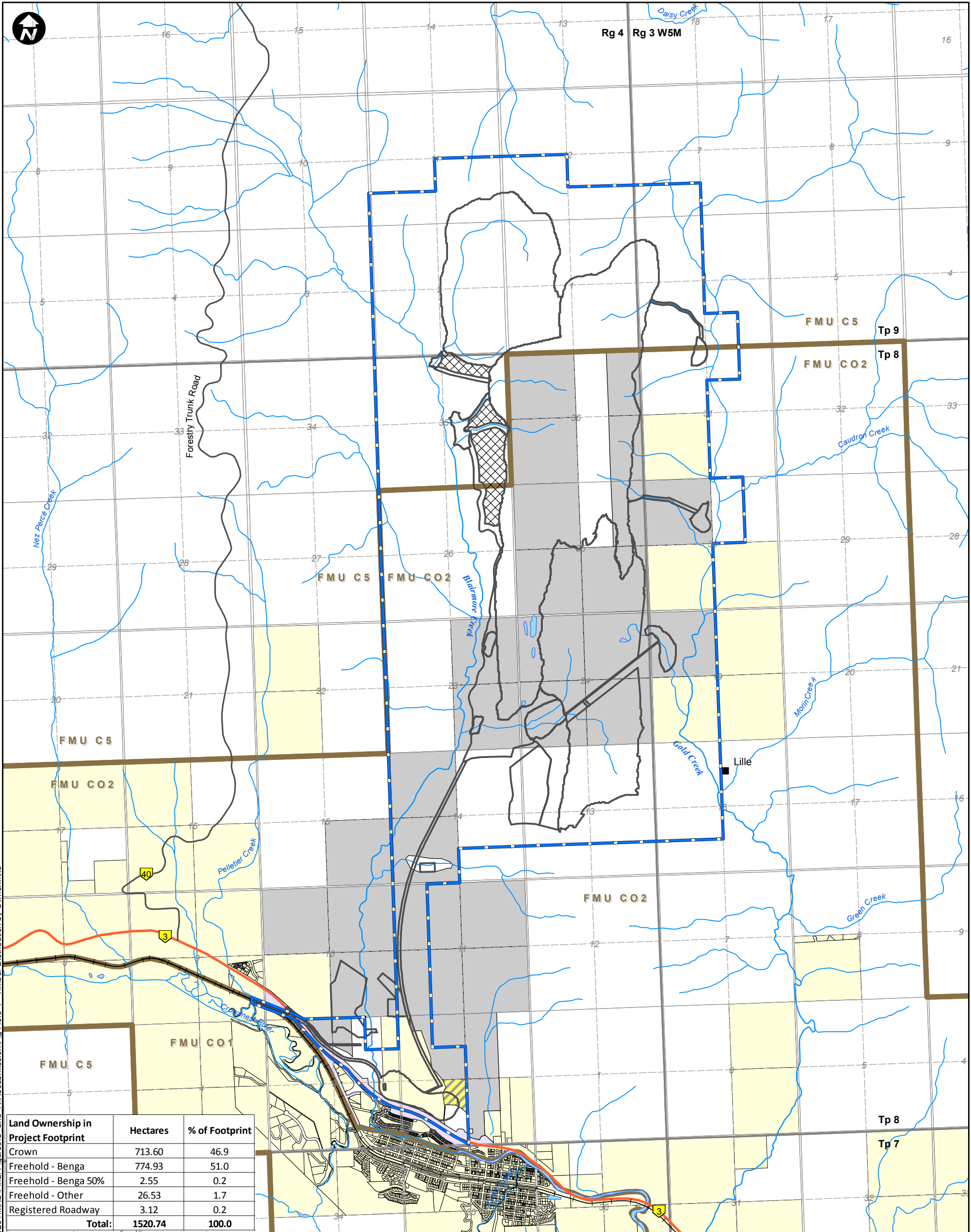
NOTES

AltaLIS, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

0 0.5 1 2
Kilometres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201-01
DRAWN BY: SL/JDC
CHECKED BY: KK
DATE: JUNE 7, 2016
FIGURE F.3.2-2



Land Ownership in Project Footprint	Hectares	% of Footprint
Crown	713.60	46.9
Freehold - Benga	774.93	51.0
Freehold - Benga 50%	2.55	0.2
Freehold - Other	26.53	1.7
Registered Roadway	3.12	0.2
Total:	1520.74	100.0

LEGEND

- Primary Highway
- Secondary Highway
- Existing Railway
- Surface Water Drainage
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- FMU Boundary

Land Ownership

- Freehold - Benga
- Freehold - Benga 50%, CNP Golf & Country Club 50%
- Freehold - Other
- Registered Roadway

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

TIMBER DISTRIBUTION BY OWNERSHIP

NOTES

AltaLIS, 2016; DialecticResearch, 2015; GeoBase, 2011; NRCAN, 2015; Riversdale, 2015
 Datum/Projection: UTM NAD 83 Zone 11

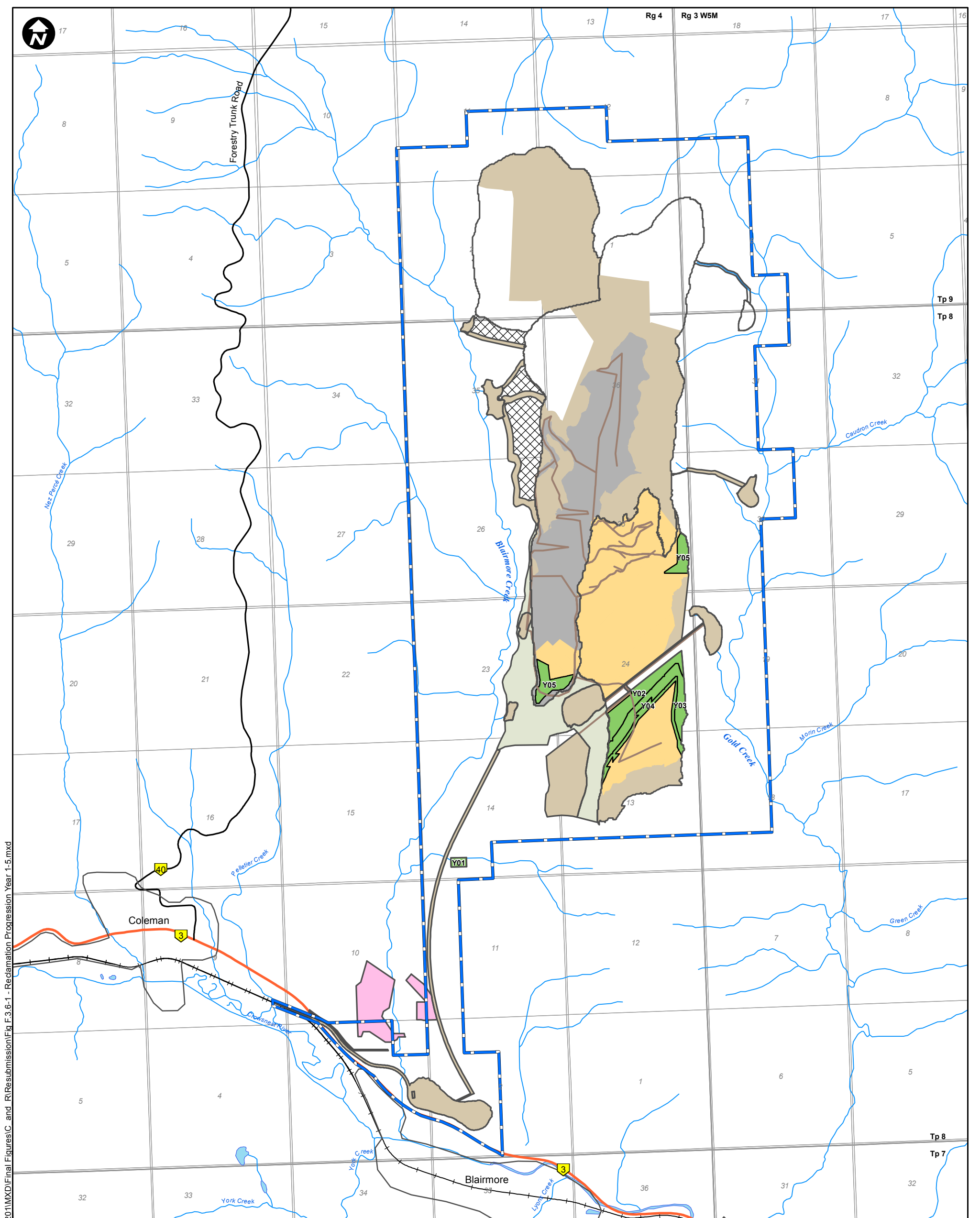
PROJECT: 14-00201-01
 DRAWN BY: SL
 CHECKED BY: DM
 DATE: JUNE 10, 2016



FIGURE

F.3.3-1

Note: Accuracy of land ownership is not guaranteed.



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LEGEND

- Primary Highway
- Secondary Highway
- Existing Railway
- Haul Road
- Surface Water Drainage
- Waterbody
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Reclaimed Area (Labelled with Year of Reclamation)
- Active Rock Disposal Area
- Active Pit
- Soil Stripping
- Coal Handling Processing Plant and Infrastructure
- Golf Course

PROJECT



RIVERSDALE
RESOURCES

**GRASSY MOUNTAIN
COAL PROJECT**



TITLE

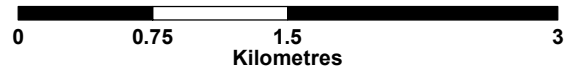
RECLAMATION PROGRESSION YEAR 1-5

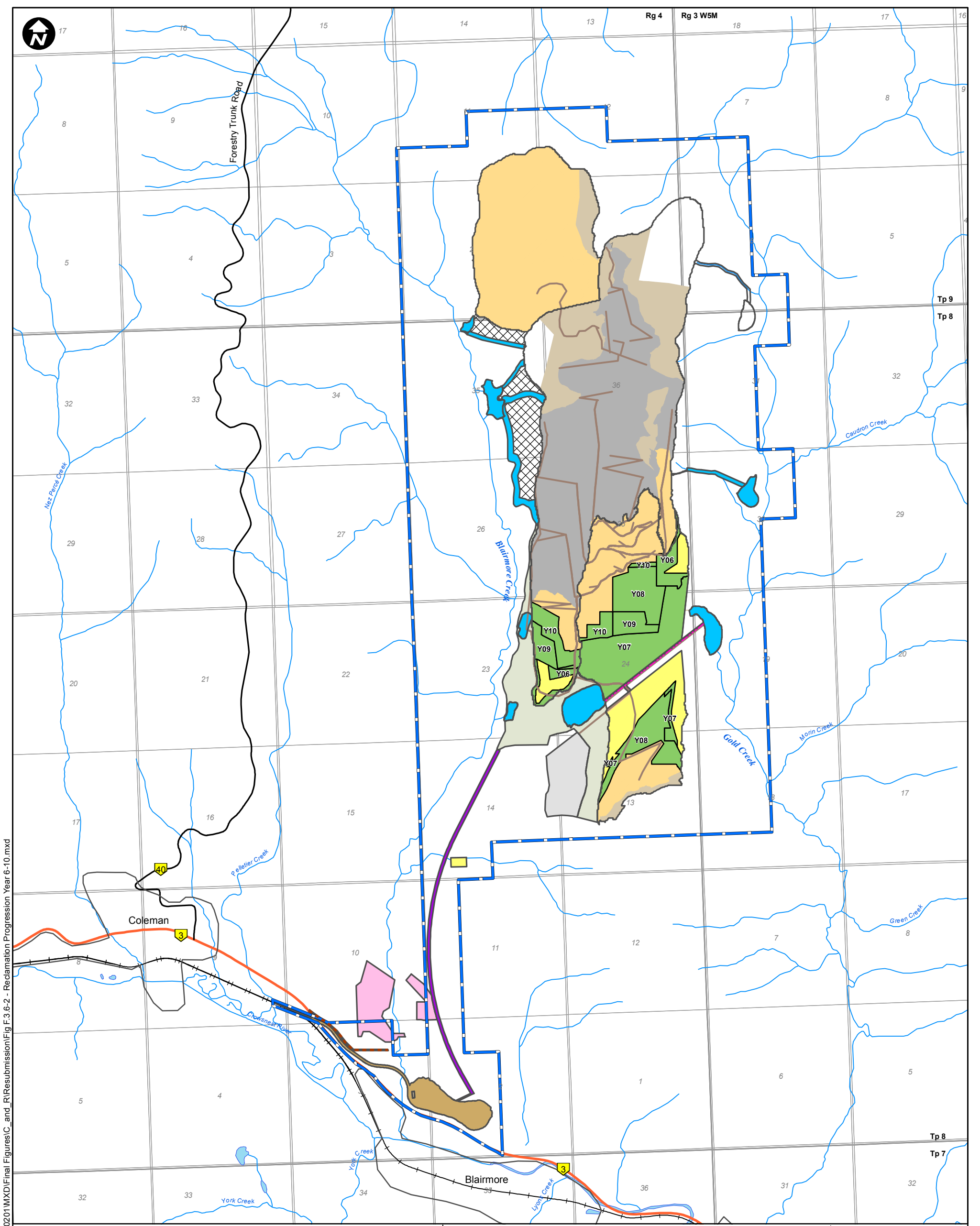
NOTES

AltaLIS, 2016; Deswik, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01
DRAWN BY: SL
CHECKED BY: DM
DATE: JUNE 10, 2016

**FIGURE
F.3.6-1**





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LEGEND

- Primary Highway
- Secondary Highway
- Existing Railway
- Haul Road
- Water Pipeline/Service Road
- - - Helipad Access
- Surface Water Drainage
- Waterbody
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Reclaimed Area (Labelled with Year of Reclamation)
- Previously Reclaimed
- Soil Stripping
- Active Rock Disposal Area
- Active Pit
- Coal Handling Processing Plant and Infrastructure
- Reclamation Material Storage
- Water Management
- Covered Conveyor, Access Road and Powerline ROW
- Railway Loop
- Golf Course

PROJECT



RIVERSDALE
RESOURCES

**GRASSY MOUNTAIN
COAL PROJECT**



TITLE

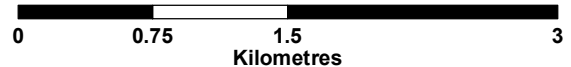
RECLAMATION PROGRESSION YEAR 6-10

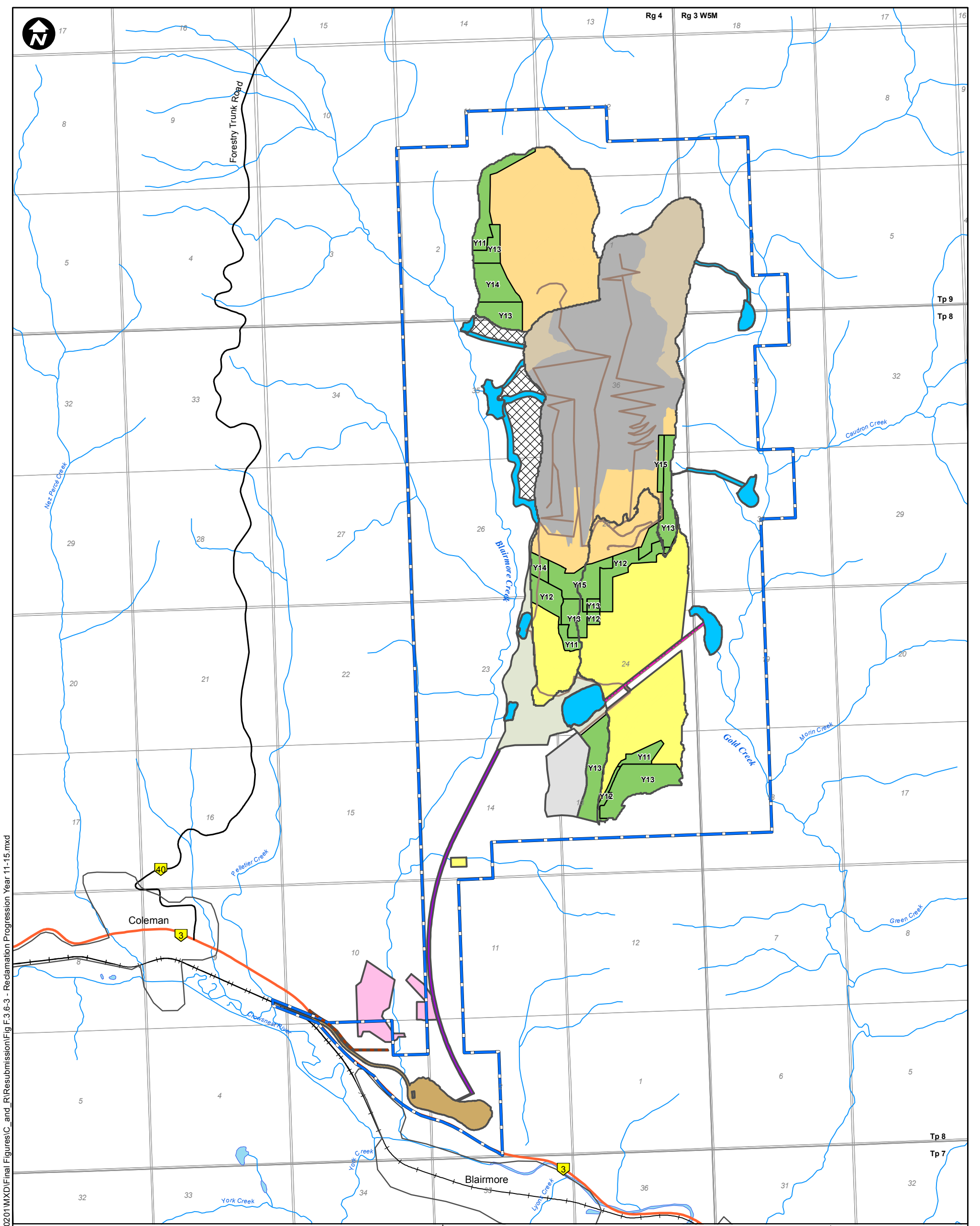
NOTES

AltaLIS, 2016; Deswik, 2016; Geobase, 2016; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01
DRAWN BY: SLJ/L
CHECKED BY: DM
DATE: JULY 12, 2016

**FIGURE
F.3.6-2**





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LEGEND

- Primary Highway
- Secondary Highway
- Existing Railway
- Haul Road
- Water Pipeline/Service Road
- Helipad Access
- Surface Water Drainage
- Waterbody
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Reclaimed Area (Labelled with Year of Reclamation)
- Previously Reclaimed
- Active Rock Disposal Area
- Active Pit
- Soil Stripping
- Coal Handling Processing Plant and Infrastructure
- Reclamation Material Storage
- Water Management
- Covered Conveyor, Access Road and Powerline ROW
- Railway Loop
- Golf Course

PROJECT



RIVERSDALE
RESOURCES

**GRASSY MOUNTAIN
COAL PROJECT**



TITLE

RECLAMATION PROGRESSION YEAR 11-15

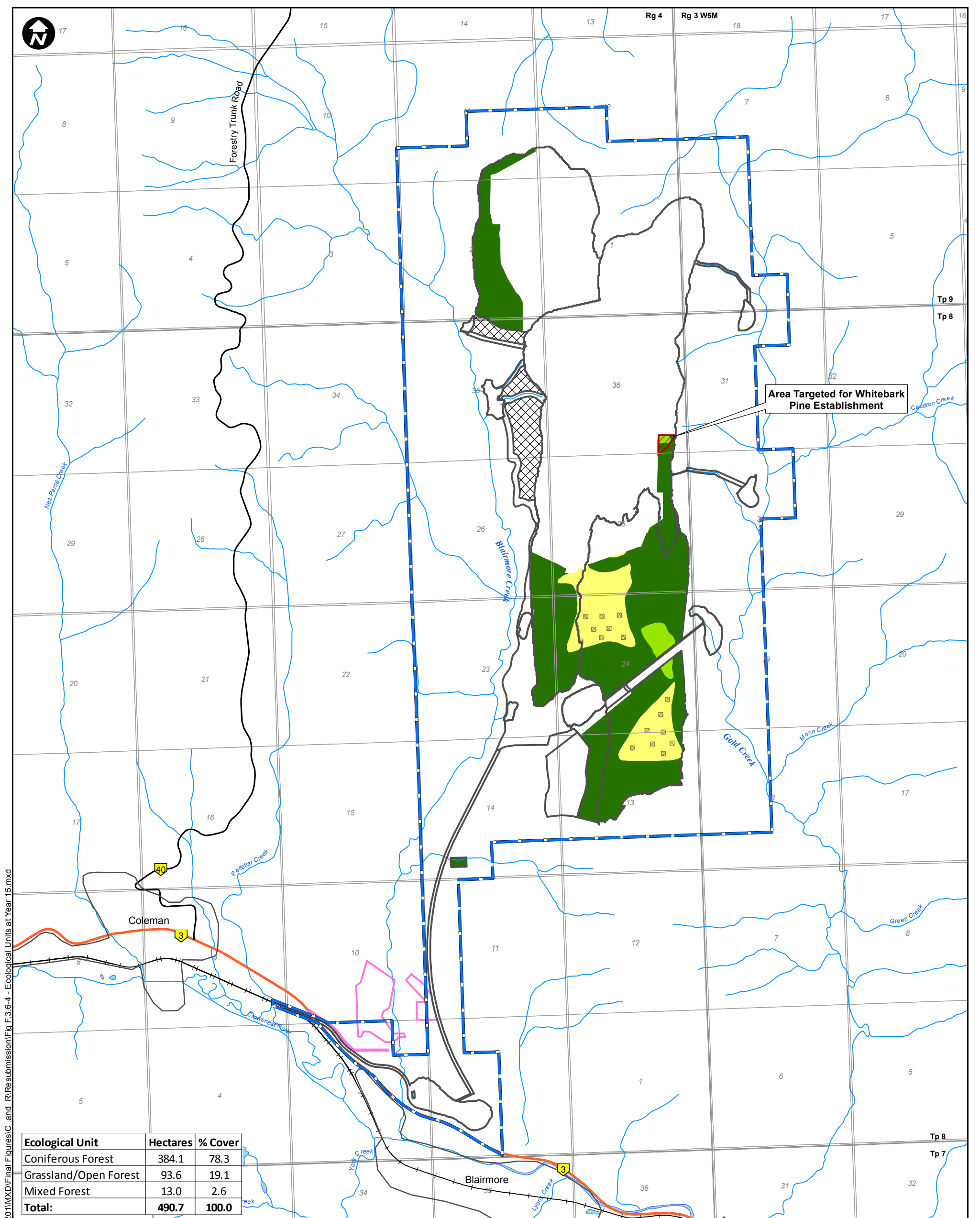
NOTES

AltaLIS, 2016; Deswik, 2016; Geobase, 2016; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01
DRAWN BY: SLJ/L
CHECKED BY: DM
DATE: JULY 11, 2016

**FIGURE
F.3.6-3**





Ecological Unit	Hectares	% Cover
Coniferous Forest	384.1	78.3
Grassland/Open Forest	93.6	19.1
Mixed Forest	13.0	2.6
Total:	490.7	100.0

LEGEND

- Primary Highway
- Secondary Highway
- Existing Railway
- Surface Water Drainage
- Waterbody
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Coniferous Forest
- Grassland/Open Forest
- Mixed Forest
- Golf Course
- Area Targeted for Foothill Rough Fescue Establishment
- Area Targeted for Whitebark Pine Establishment

PROJECT

RIVERSDALE GRASSY MOUNTAIN
RESOURCES COAL PROJECT

MILLENNIUM
EMS Solutions Ltd.

TITLE

ECOLOGICAL UNITS AT YEAR 15

NOTES

AltaLIS, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01

DRAWN BY: SL

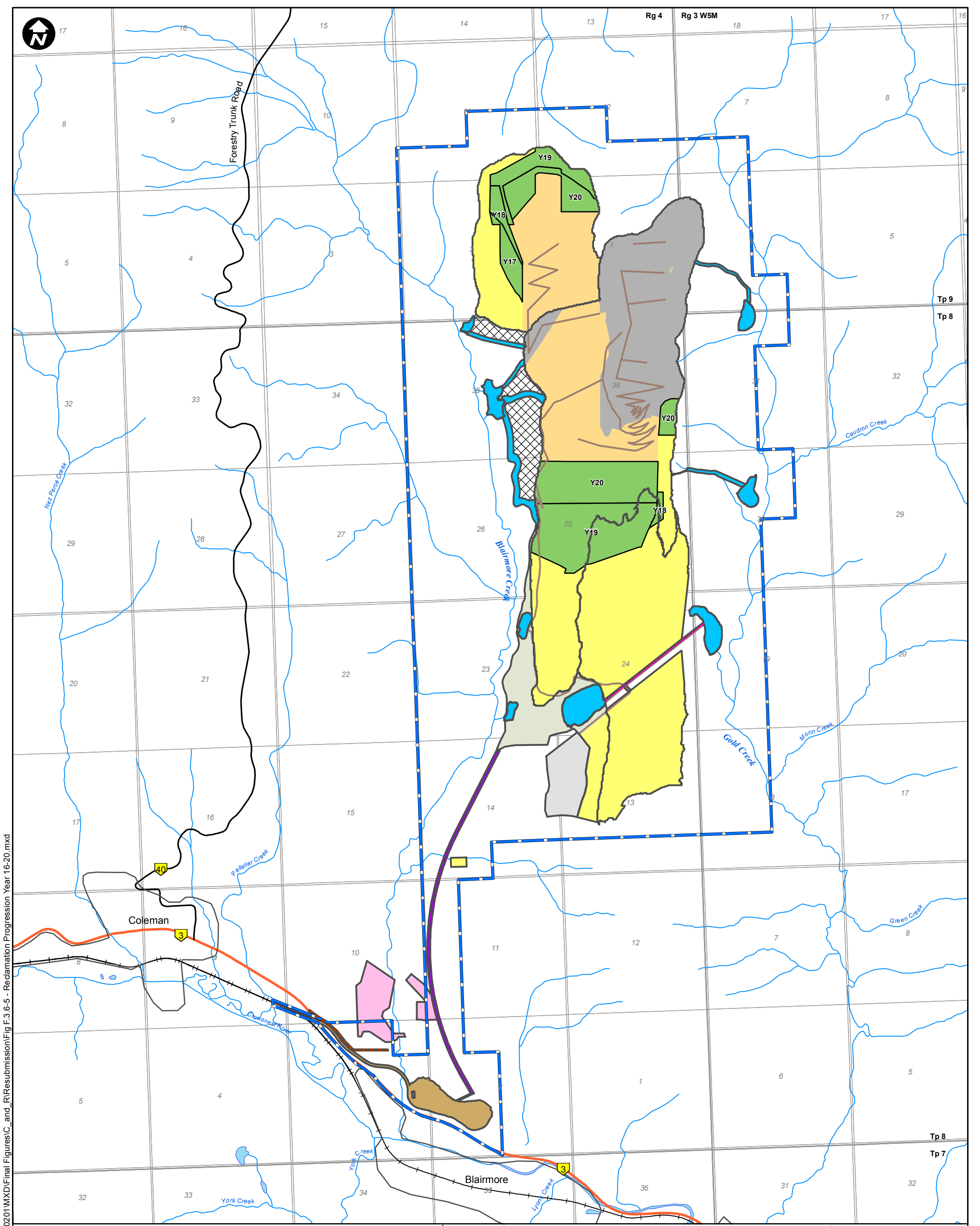
CHECKED BY: DM

DATE: JUNE 10, 2016

FIGURE
F.3.6-4



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LEGEND

- Primary Highway
- Secondary Highway
- Existing Railway
- Water Pipeline/Service Road
- Helipad Access
- Haul Road
- Surface Water Drainage
- Waterbody
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Reclaimed Area (Labelled with Year of Reclamation)
- Previously Reclaimed
- Active Rock Disposal Area
- Active Pit
- Soil Stripping
- Coal Handling Processing Plant and Infrastructure
- Reclamation Material Storage
- Water Management
- Covered Conveyor, Access Road and Powerline ROW
- Railway Loop
- Golf Course

PROJECT



RIVERSDALE
RESOURCES

**GRASSY MOUNTAIN
COAL PROJECT**



TITLE

RECLAMATION PROGRESSION YEAR 16-20

NOTES

AltaLIS, 2016; Deswik, 2016; Geobase, 2016; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01

DRAWN BY: SL/JL

CHECKED BY: DM

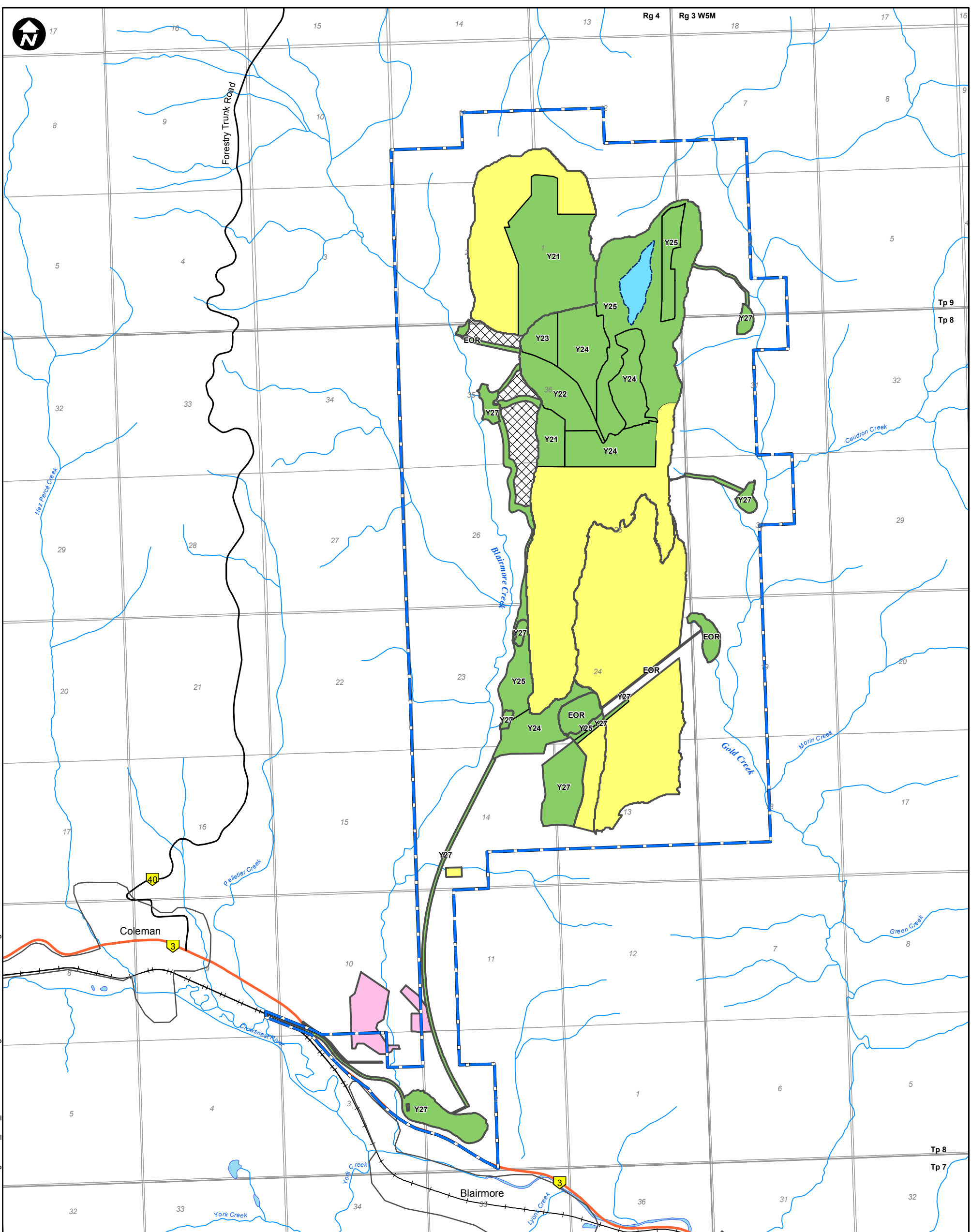
DATE: JULY 12, 2016

FIGURE

F.3.6-5



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LEGEND	
	Primary Highway
	Secondary Highway
	Existing Railway
	Surface Water Drainage
	Waterbody
	Proposed Mine Permit Boundary
	Project Footprint
	Undisturbed Area
	Reclaimed Area (Labelled with Year of Reclamation)
	Previously Reclaimed
	Active Rock Disposal Area
	Active Pit
	Soil Stripping
	End-Pit Lake
	Golf Course

PROJECT



RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT



MILLENNIUM EMS Solutions Ltd.

TITLE
RECLAMATION PROGRESSION YEAR 21 TO END OF RECLAMATION (EOR)

NOTES
 AltaLIS, 2016; Deswik, 2016; Geobase, 2016; MEMS, 2016; Riversdale, 2016
 Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01
 DRAWN BY: SL/JL
 CHECKED BY: DM
 DATE: JULY 12, 2016

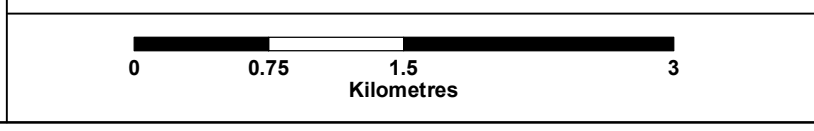
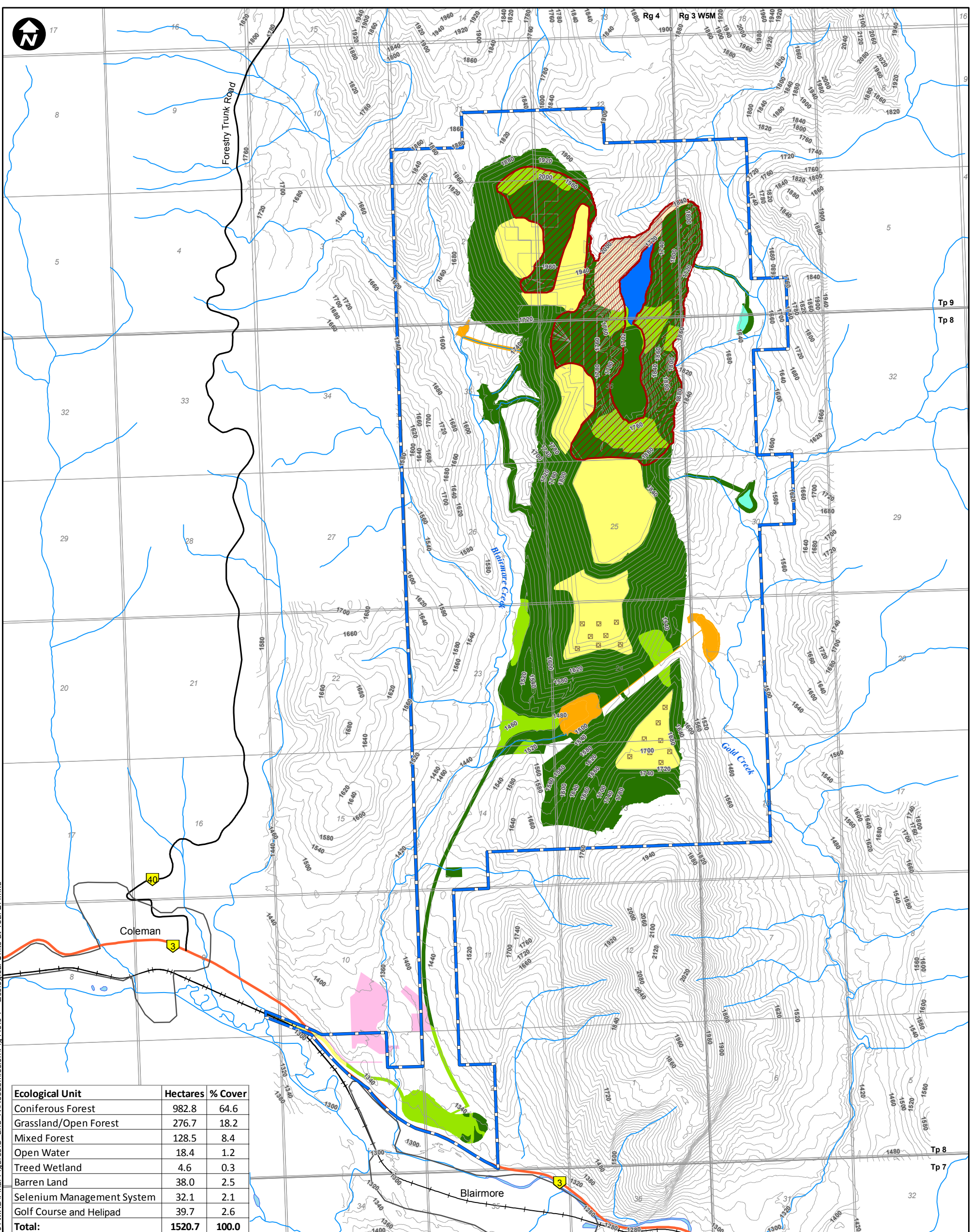


FIGURE
F.3.6-6



Ecological Unit	Hectares	% Cover
Coniferous Forest	982.8	64.6
Grassland/Open Forest	276.7	18.2
Mixed Forest	128.5	8.4
Open Water	18.4	1.2
Treed Wetland	4.6	0.3
Barren Land	38.0	2.5
Selenium Management System	32.1	2.1
Golf Course and Helipad	39.7	2.6
Total:	1520.7	100.0

LEGEND

- Primary Highway
- Secondary Highway
- Existing Railway
- Reclaimed Topographic Contour (20m interval)
- Surface Water Drainage
- Waterbody
- Proposed Mine Permit Boundary
- Coniferous Forest
- Grassland/Open Forest
- Mixed Forest
- Open Water
- Treed Wetland
- Barren Land
- Selenium Management System
- Golf Course and Helipad
- Area Targeted for Foothill Rough Fescue Establishment
- Area Targeted for Whitebark Pine Establishment

PROJECT



GRASSY MOUNTAIN COAL PROJECT



TITLE

ECOLOGICAL UNITS AT YEAR 27

NOTES

AltaLIS, 2016; Deswik, 2016; Geobase, 2016; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01

DRAWN BY: SLJ/L

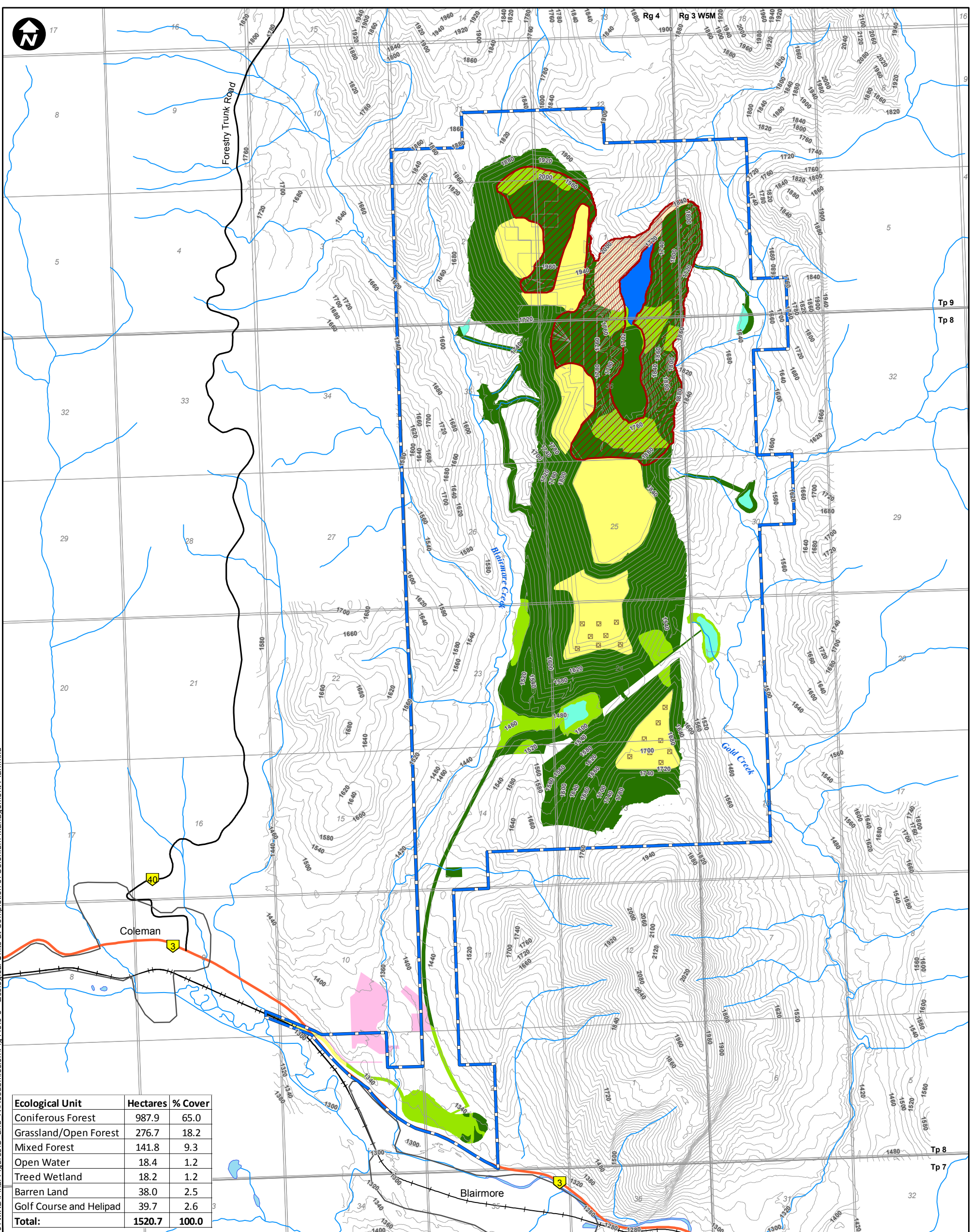
CHECKED BY: DM

DATE: JULY 11, 2016

FIGURE

F.3.6-7





Ecological Unit	Hectares	% Cover
Coniferous Forest	987.9	65.0
Grassland/Open Forest	276.7	18.2
Mixed Forest	141.8	9.3
Open Water	18.4	1.2
Treed Wetland	18.2	1.2
Barren Land	38.0	2.5
Golf Course and Helipad	39.7	2.6
Total:	1520.7	100.0

LEGEND

- Primary Highway
- Secondary Highway
- Existing Railway
- Reclaimed Topographic Contour (20m interval)
- Surface Water Drainage
- Waterbody
- Proposed Mine Permit Boundary

- Ecological Unit**
- Coniferous Forest
 - Grassland/Open Forest
 - Mixed Forest
 - Open Water
 - Treed Wetland
 - Barren Land
 - Golf Course and Helipad
 - Area Targeted for Foothill Rough Fescue Establishment
 - Area Targeted for Whitebark Pine Establishment

PROJECT



GRASSY MOUNTAIN COAL PROJECT



TITLE

ECOLOGICAL UNITS AT COMPLETION OF SELENIUM MANAGEMENT PLAN - CLOSURE

NOTES

AltaLIS, 2016; Deswik, 2016; Geobase, 2016; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 14-00201-01

DRAWN BY: SLJ/L

CHECKED BY: DM

DATE: JULY 11, 2016

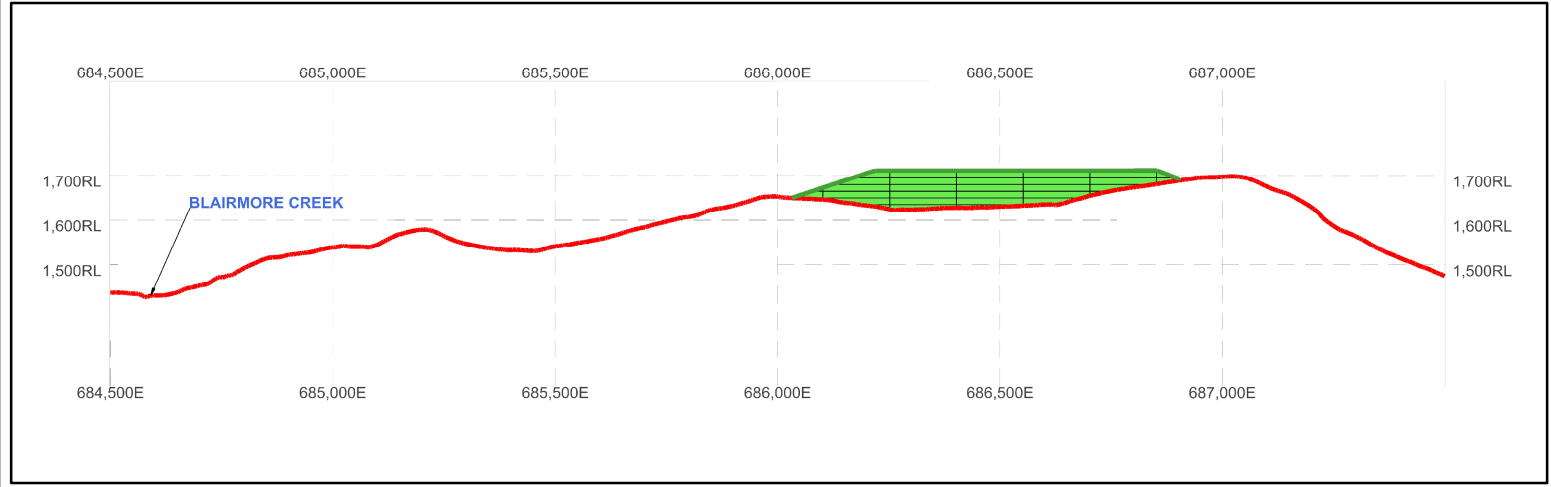
FIGURE

F.3.6-8

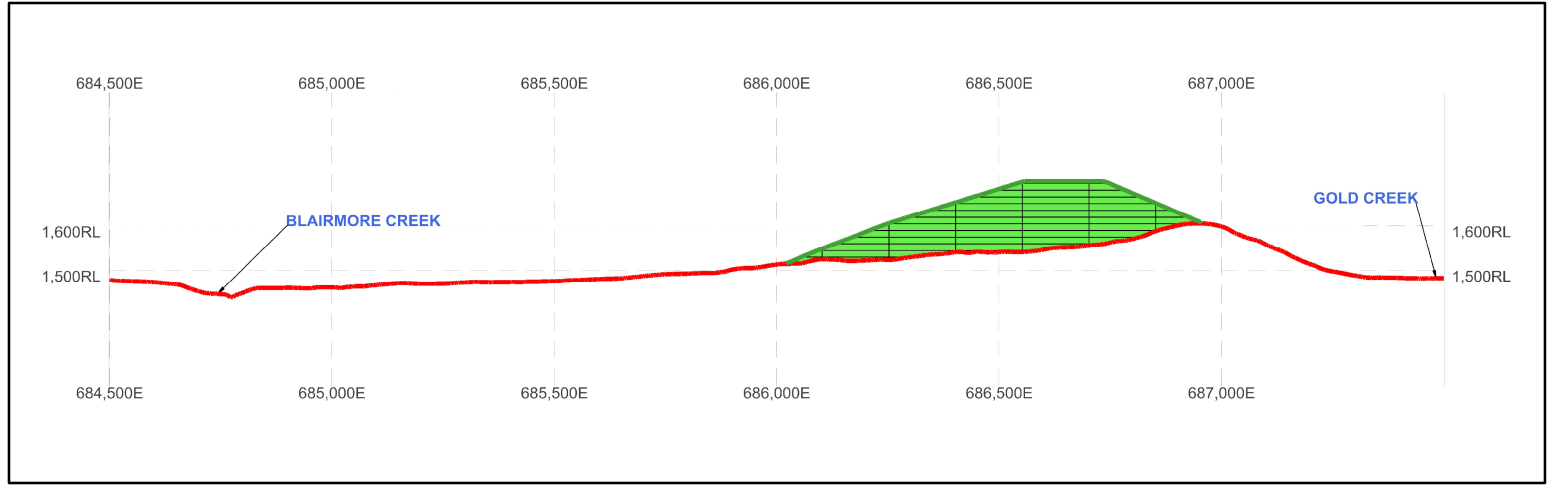


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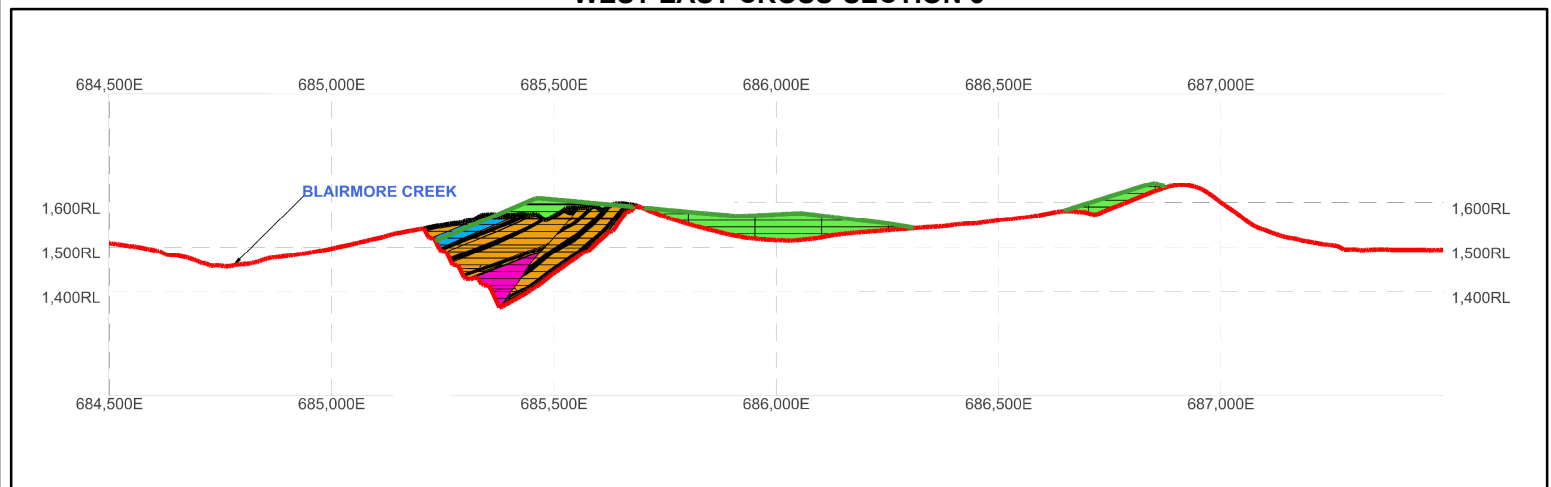
WEST-EAST CROSS-SECTION 1



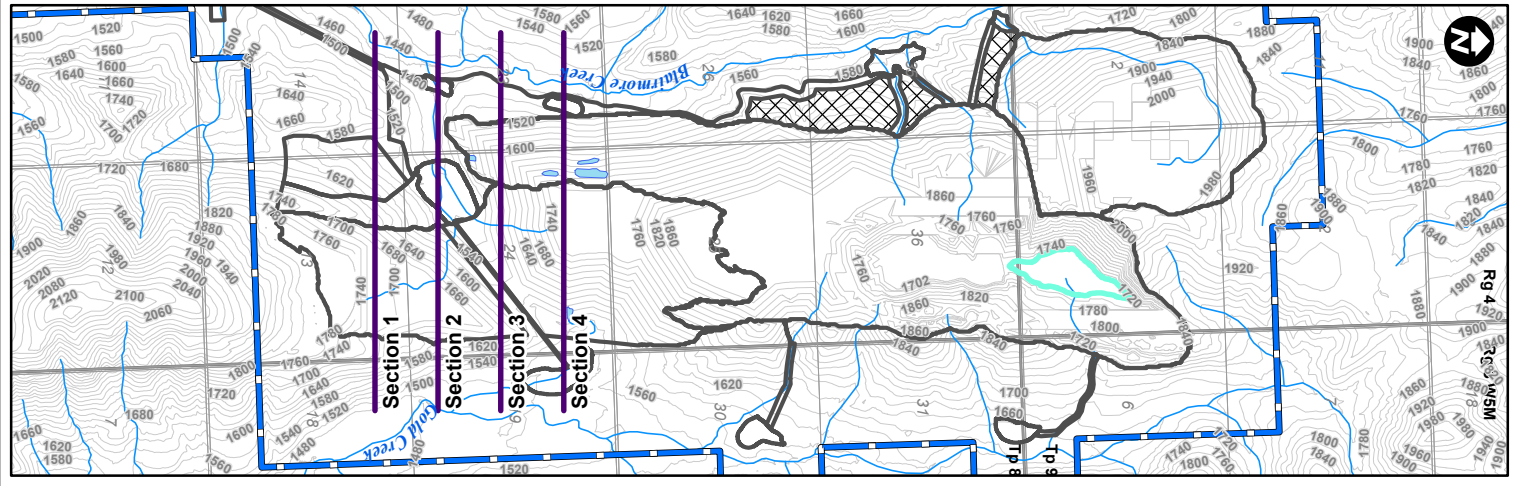
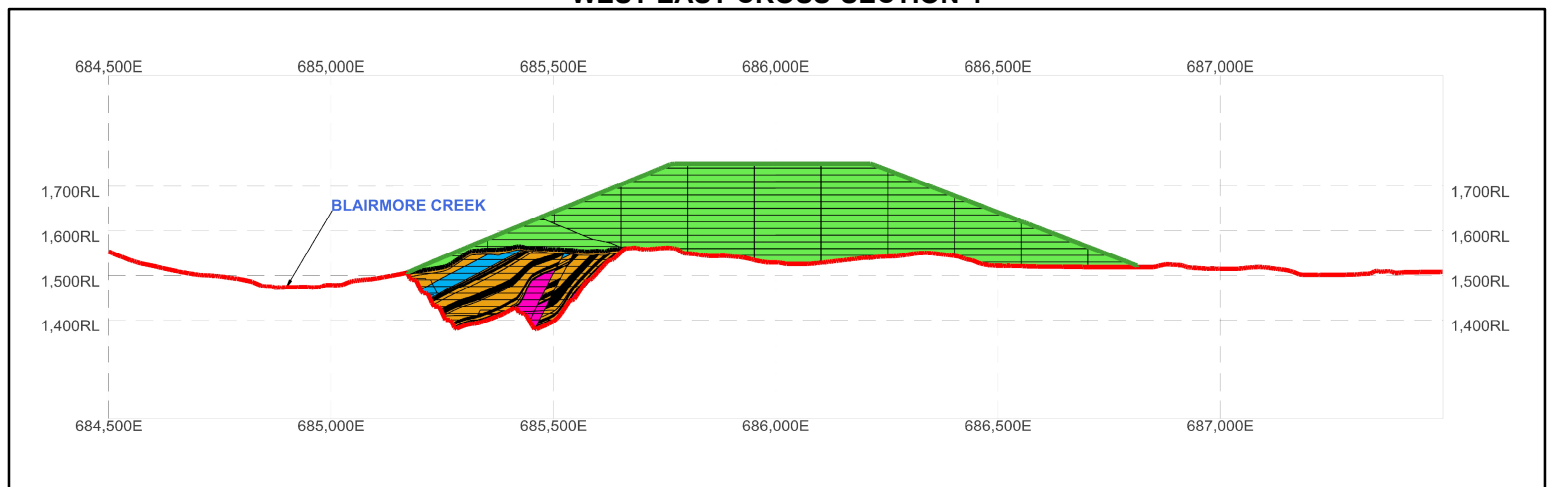
WEST-EAST CROSS-SECTION 2



WEST-EAST CROSS-SECTION 3



WEST-EAST CROSS-SECTION 4



LEGEND

- Original Topography
- Final Pit Profile
- Reclaimed Disposal Profile
- Reclaimed Disposal Area
- Coal Seam
- Overburden
- Underburden
- Conglomerate
- Cross-Section Location
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- End-Pit Lake
- Reclaimed Topographic Contour (20m interval)

PROJECT
RIVERSDALE RESOURCES **GRASSY MOUNTAIN COAL PROJECT**

TITLE
RECLAMATION CROSS-SECTIONS 1-4

NOTES
 AltaLIS, 2016; Deswik, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
 Datum/Projection: UTM NAD 83 Zone 11

CROSS-SECTION SCALE

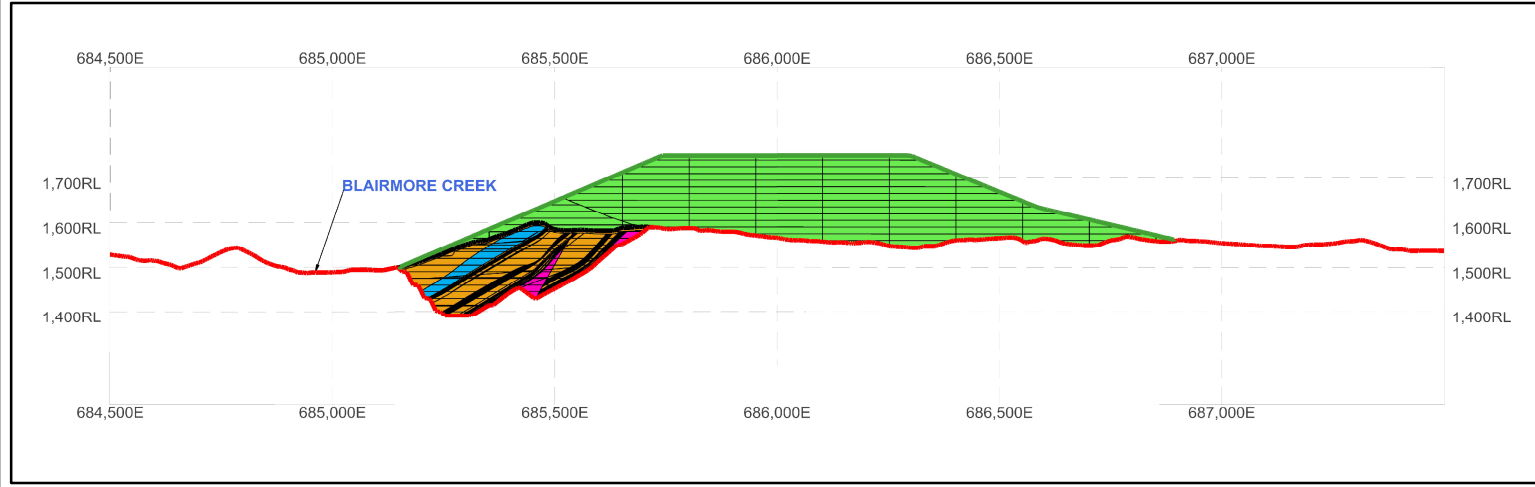
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PROJECT: 14-00201
 DRAWN BY: DESWIK/SL
 CHECKED BY: DM
 DATE: JUNE 8, 2016

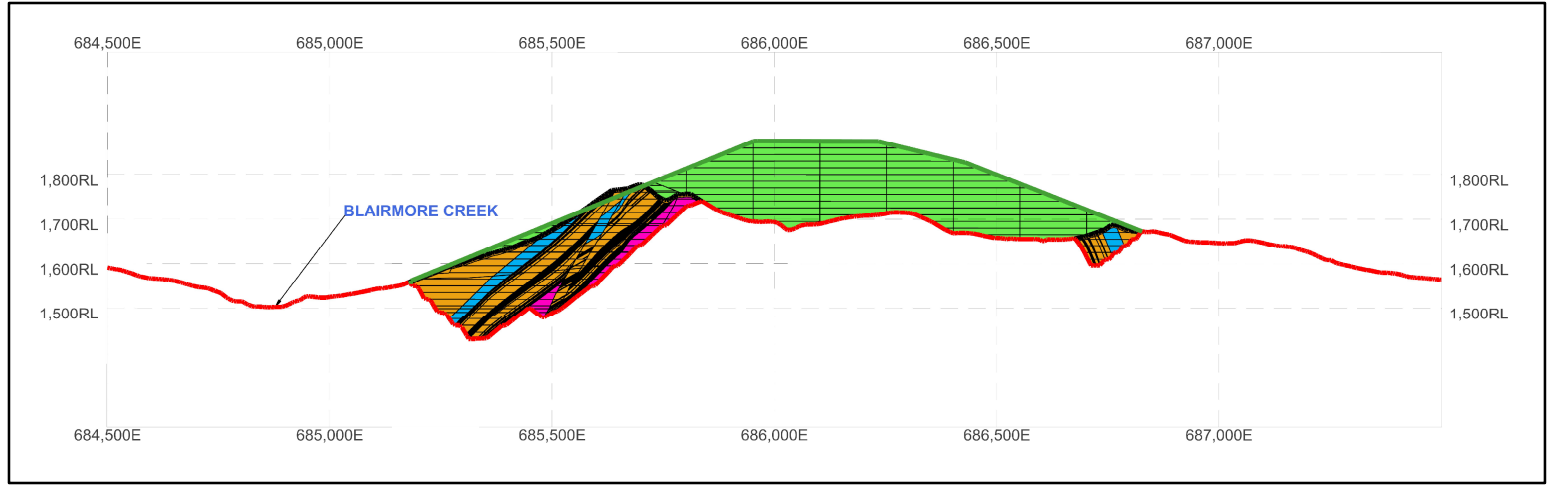
FIGURE
F.4.1-1

Document Path: K:\Active Projects\2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\C_and_R\Reissued_May2016\Fig F.4.1-2 - Cross-sections 5-8.mxd

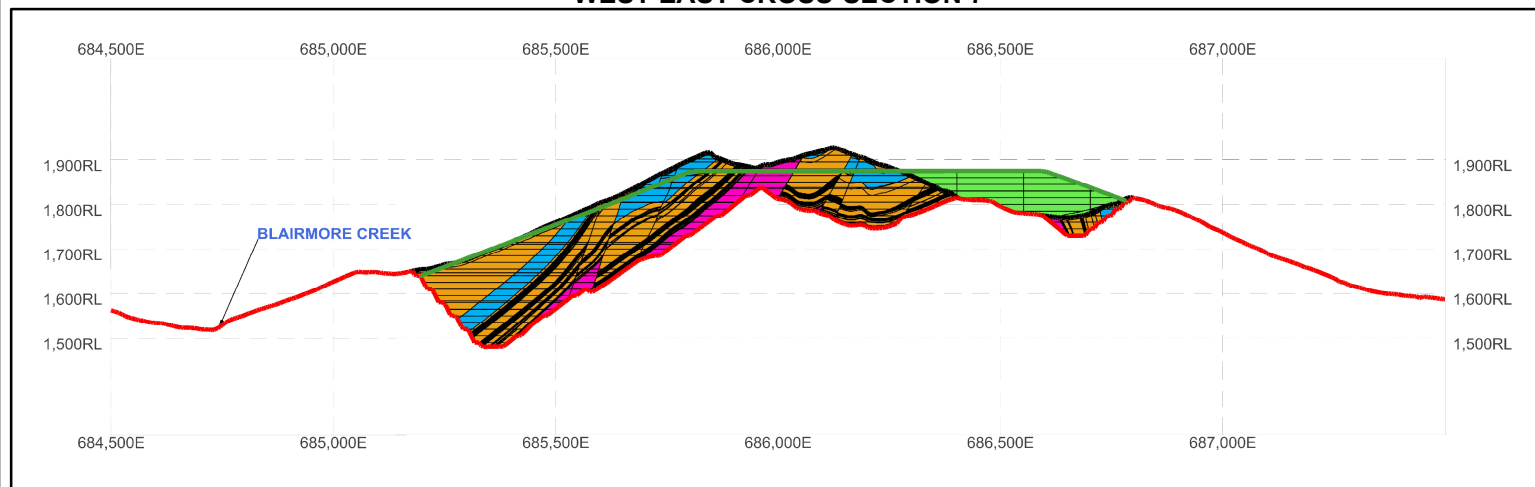
WEST-EAST CROSS-SECTION 5



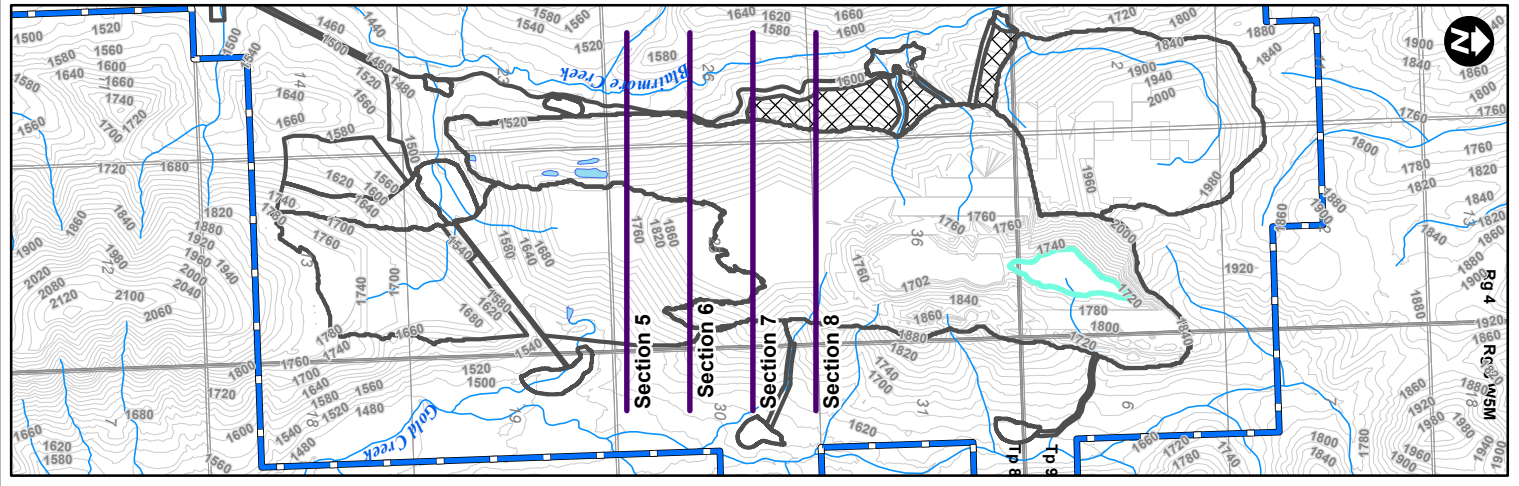
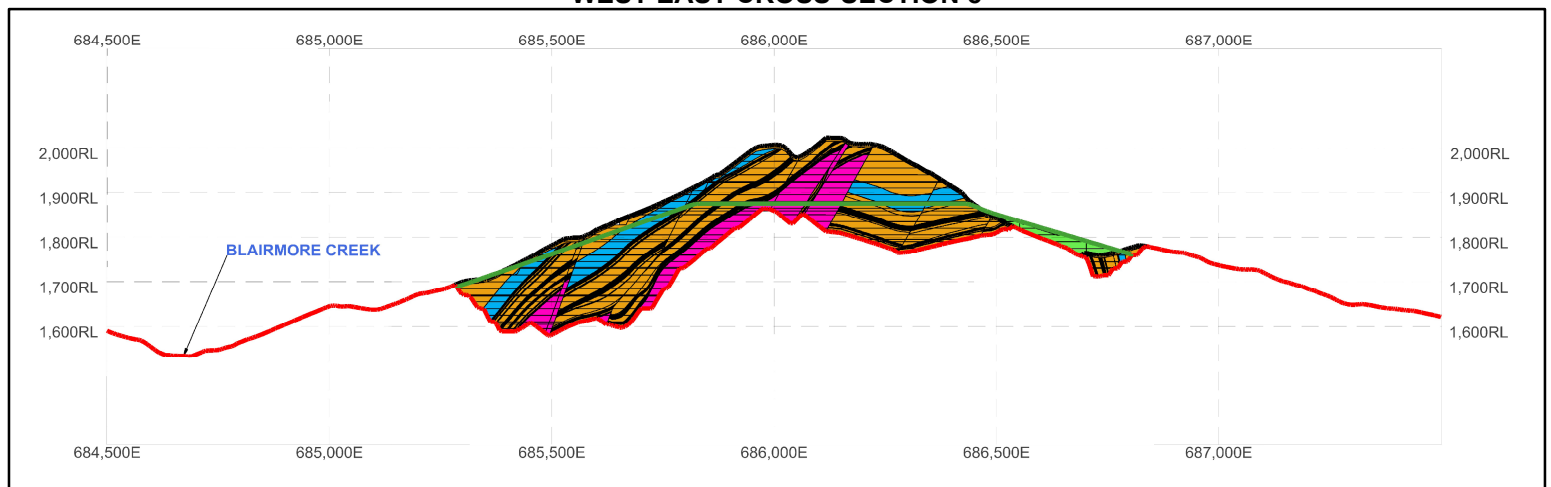
WEST-EAST CROSS-SECTION 6



WEST-EAST CROSS-SECTION 7



WEST-EAST CROSS-SECTION 8



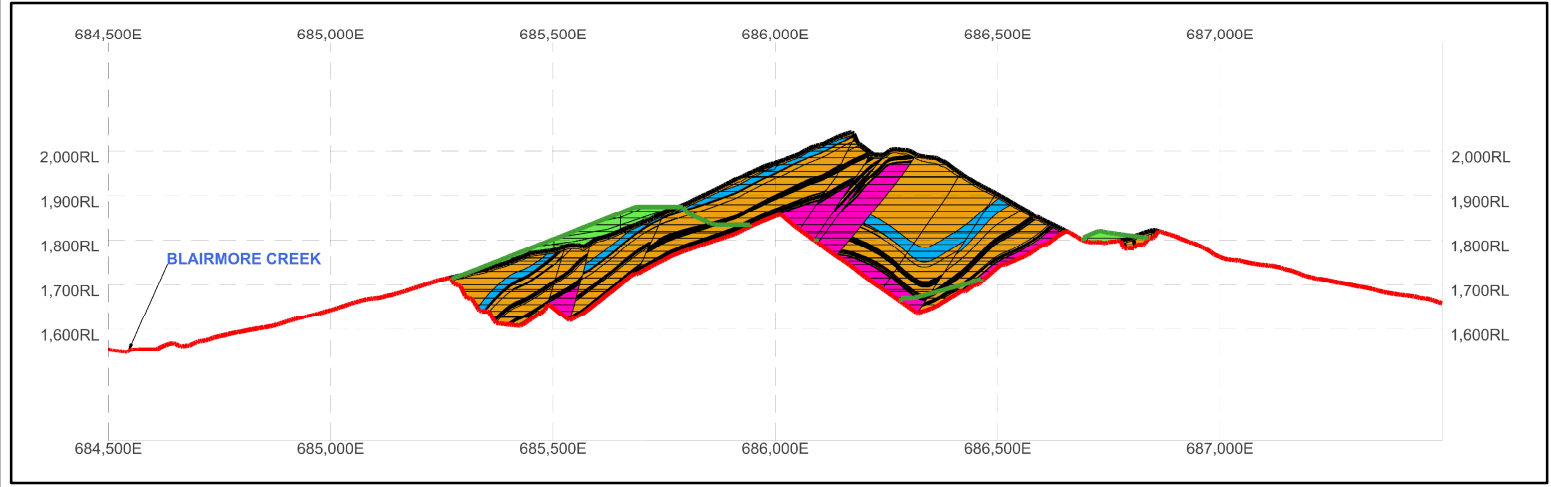
LEGEND	
	Original Topography
	Final Pit Profile
	Reclaimed Disposal Profile
	Reclaimed Disposal Area
	Coal Seam
	Overburden
	Underburden
	Conglomerate
	Cross-Section Location
	Proposed Mine Permit Boundary
	Project Footprint
	Undisturbed Area
	End-Pit Lake
	Reclaimed Topographic Contour (20m interval)

PROJECT RIVERSDALE RESOURCES		GRASSY MOUNTAIN COAL PROJECT	
TITLE RECLAMATION CROSS-SECTIONS 5-8			
NOTES AltaLIS, 2016; Deswik, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016 Datum/Projection: UTM NAD 83 Zone 11		CROSS-SECTION SCALE 	

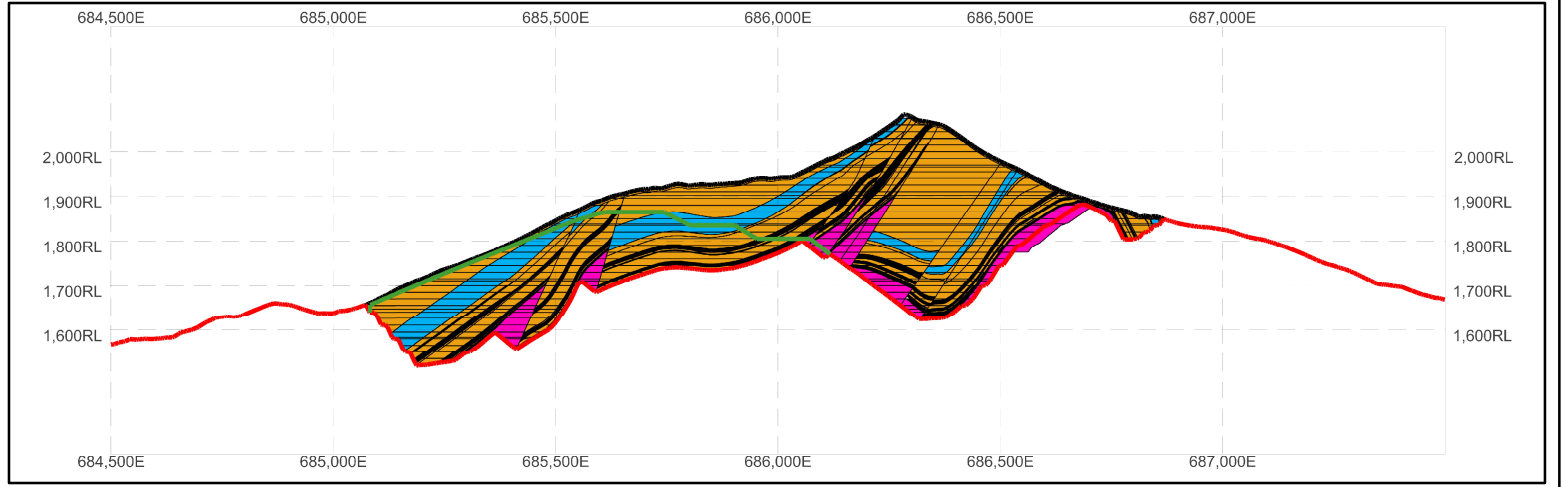
PROJECT: 14-00201	
DRAWN BY: DESWIK/SL	
CHECKED BY: DM	
DATE: JUNE 8, 2016	
FIGURE F.4.1-2	

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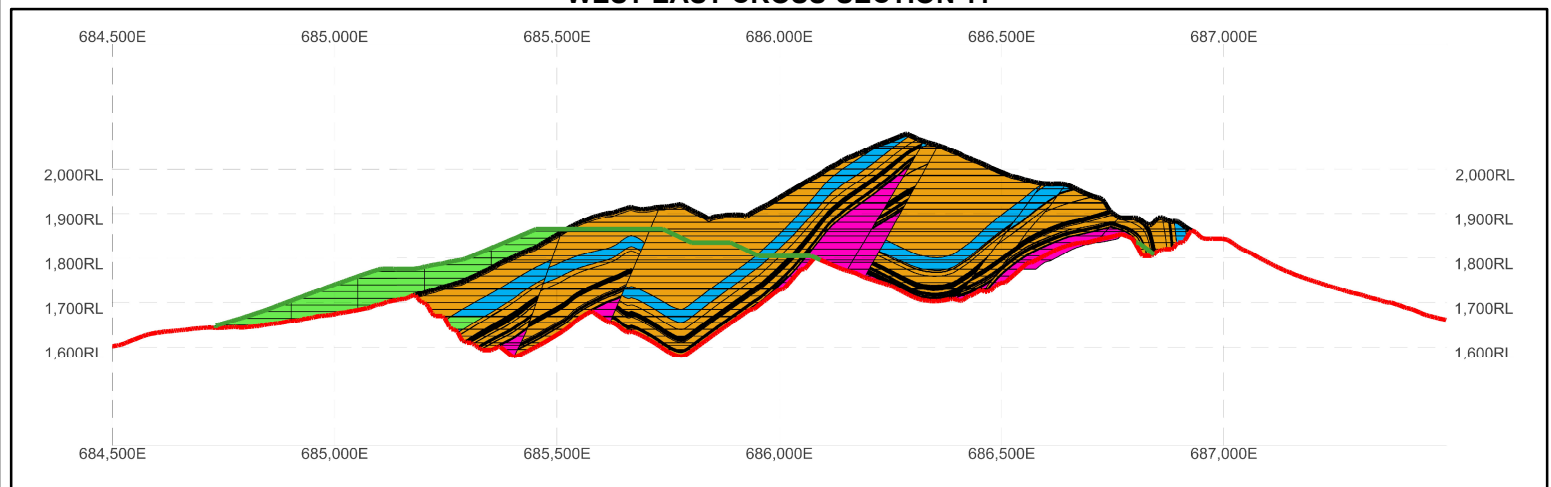
WEST-EAST CROSS-SECTION 9



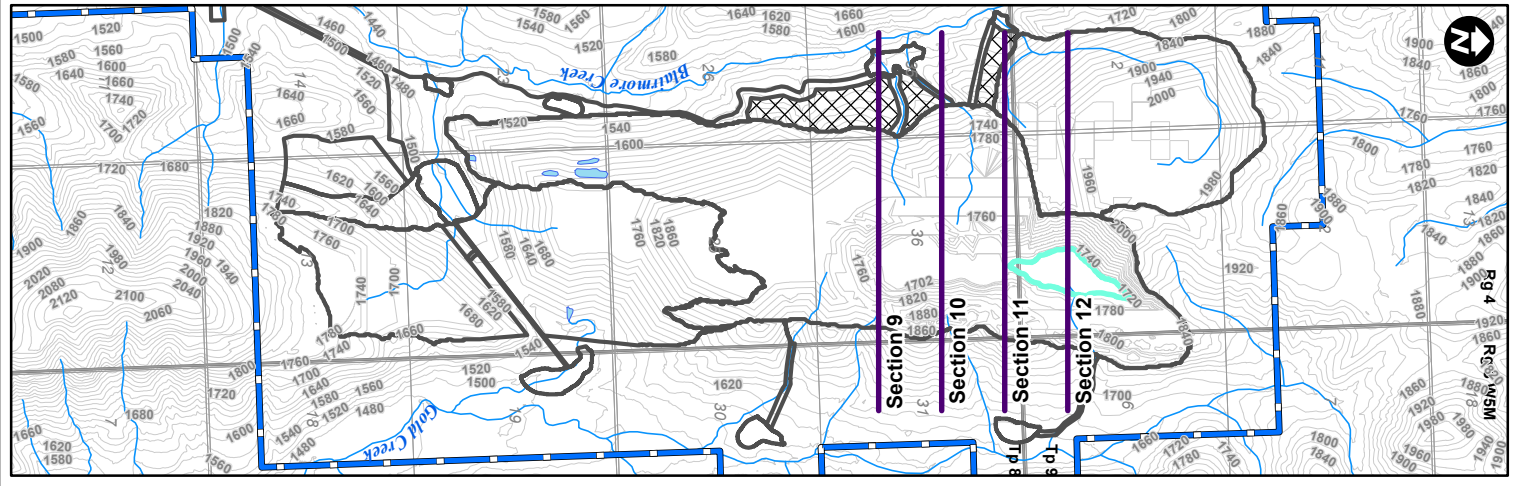
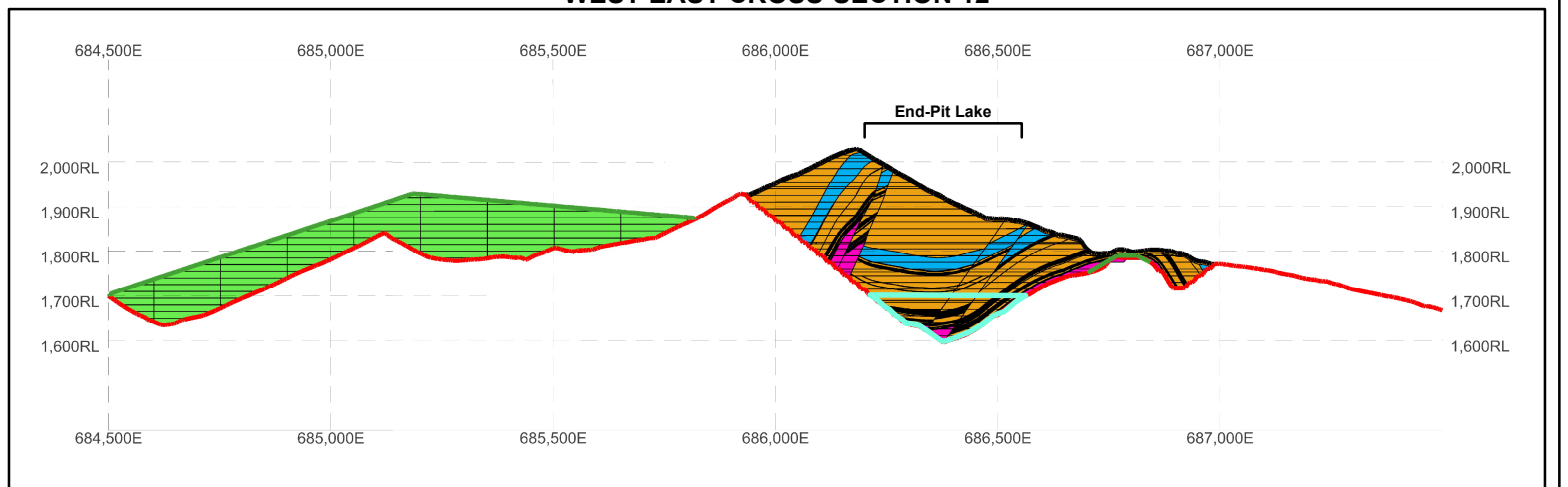
WEST-EAST CROSS-SECTION 10



WEST-EAST CROSS-SECTION 11



WEST-EAST CROSS-SECTION 12



LEGEND

- Original Topography
- Final Pit Profile
- Reclaimed Disposal Profile
- Reclaimed Disposal Area
- Coal Seam
- Overburden
- Underburden
- Conglomerate
- Cross-Section Location
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- End-Pit Lake
- Reclaimed Topographic Contour (20m interval)

PROJECT
RIVERSDALE RESOURCES
GRASSY MOUNTAIN COAL PROJECT

TITLE
RECLAMATION CROSS-SECTIONS 9-12

NOTES
 AltaLIS, 2016; Deswik, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
 Datum/Projection: UTM NAD 83 Zone 11

CROSS-SECTION SCALE

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 Metres

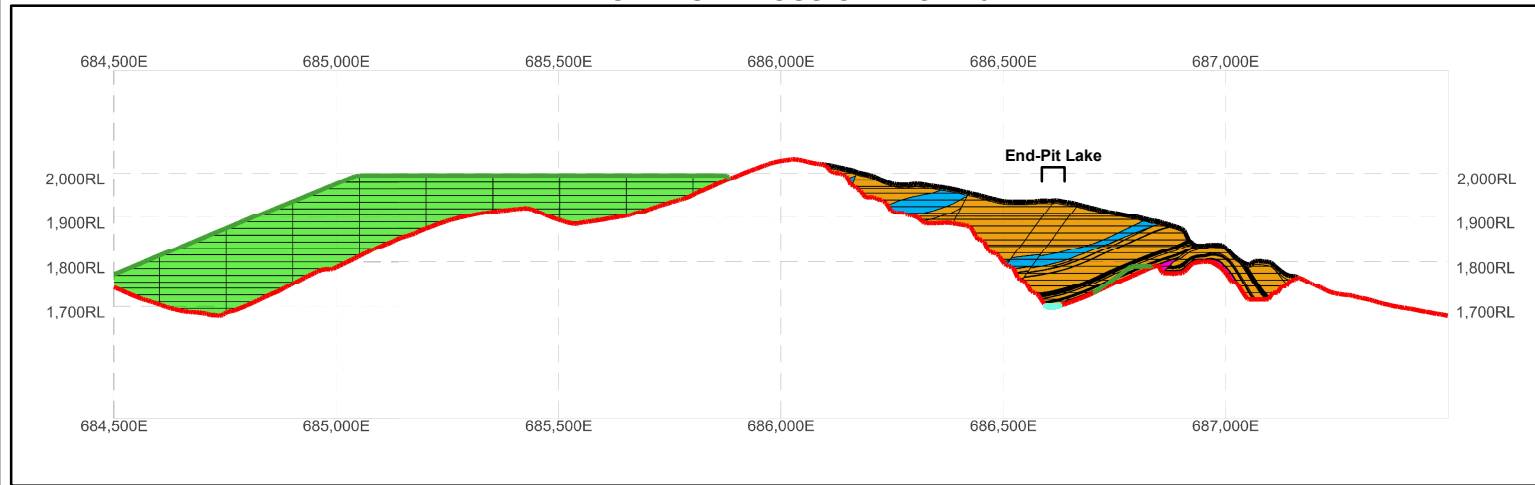
MILLENNIUM
 EMS Solutions Ltd.

PROJECT: 14-00201
 DRAWN BY: DESWIK/SL
 CHECKED BY: DM
 DATE: JUNE 8, 2016

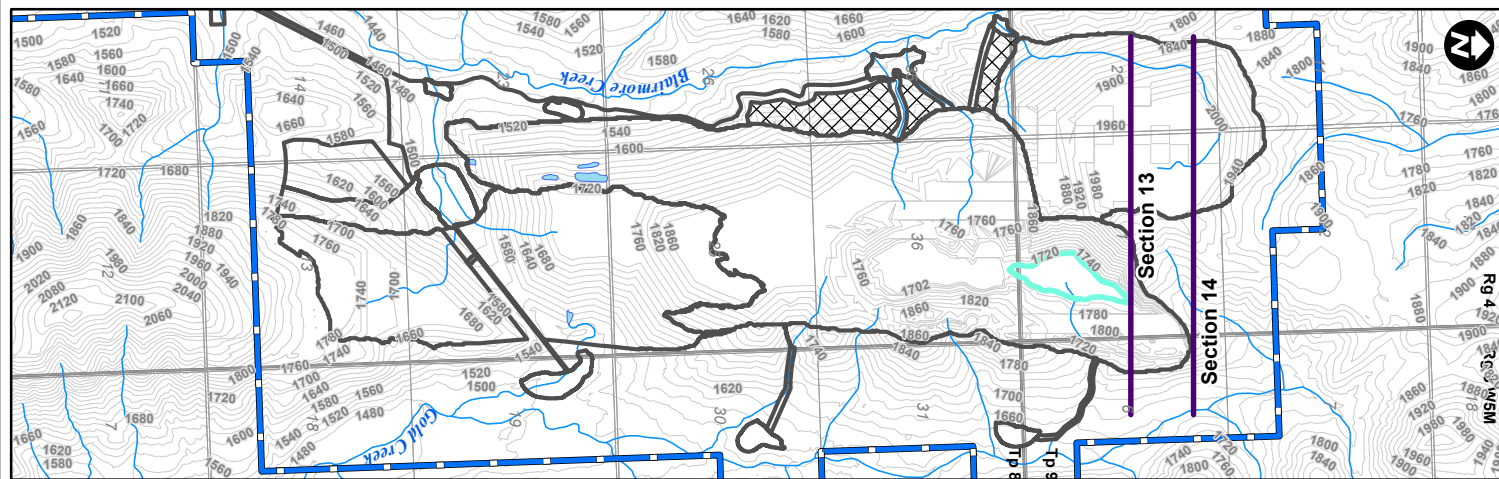
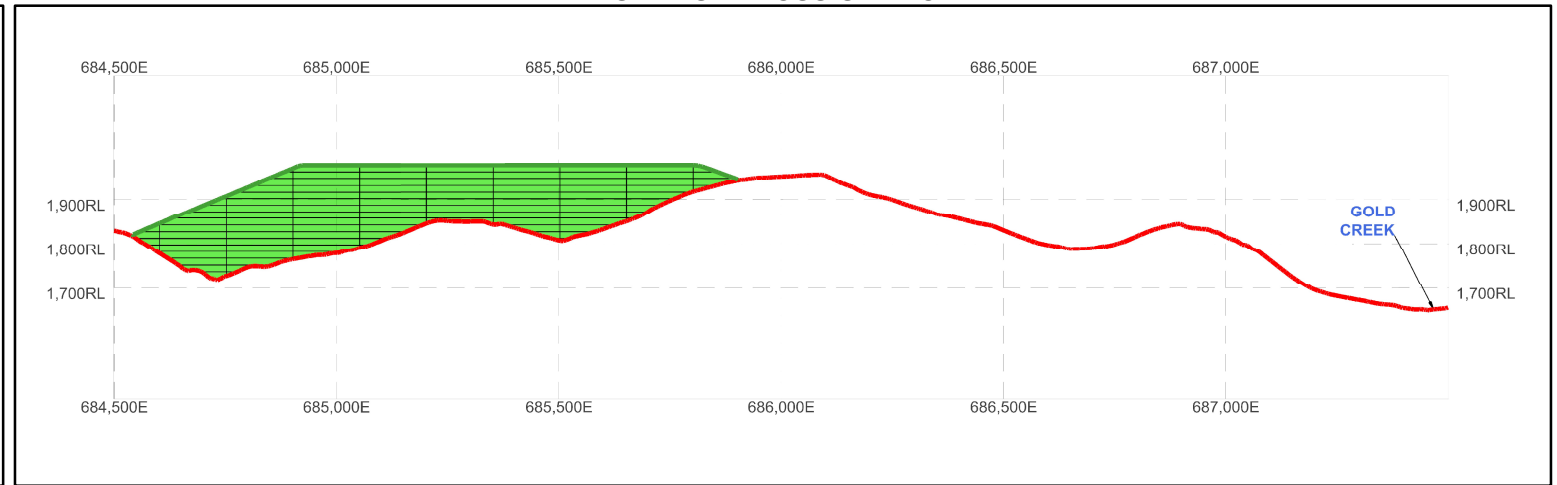
FIGURE
F.4.1-3

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WEST-EAST CROSS-SECTION 13



WEST-EAST CROSS-SECTION 14



LEGEND

- Original Topography
- Final Pit Profile
- Reclaimed Disposal Profile
- Reclaimed Disposal Area
- Coal Seam
- Overburden
- Underburden
- Conglomerate
- Cross-Section Location
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- End-Pit Lake
- Reclaimed Topographic Contour (20m interval)

PROJECT



GRASSY MOUNTAIN COAL PROJECT

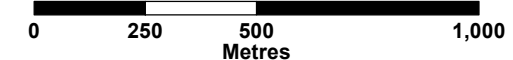
TITLE

RECLAMATION CROSS-SECTIONS 13-14

NOTES

AltaLIS, 2016; Deswik, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

CROSS-SECTION SCALE



PROJECT: 14-00201

DRAWN BY: DESWIK/SL

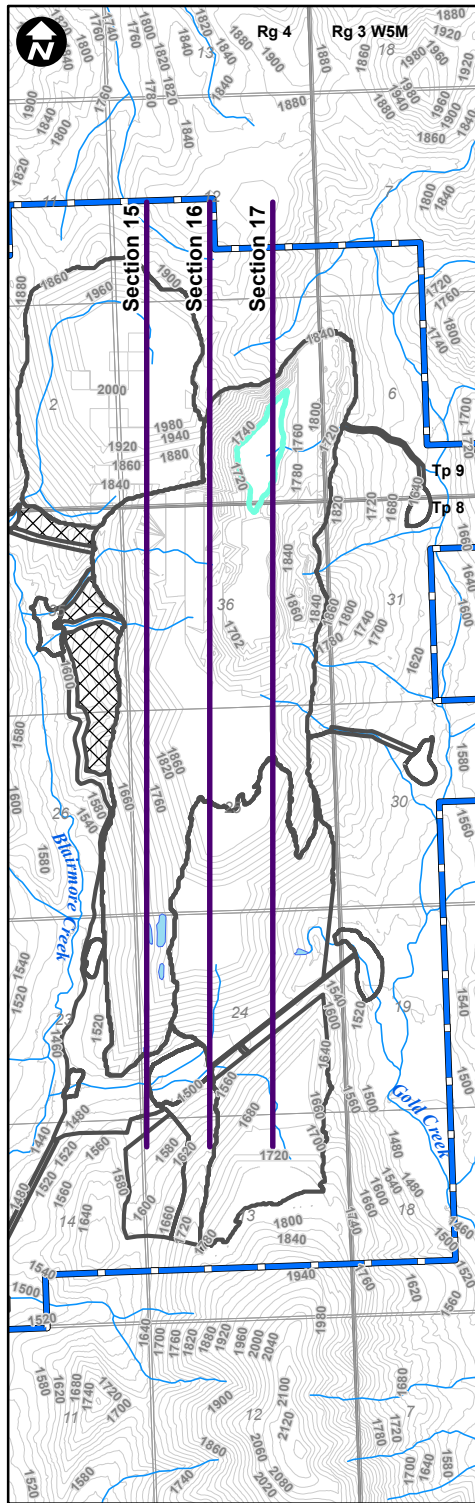
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DATE: JUNE 8, 2016

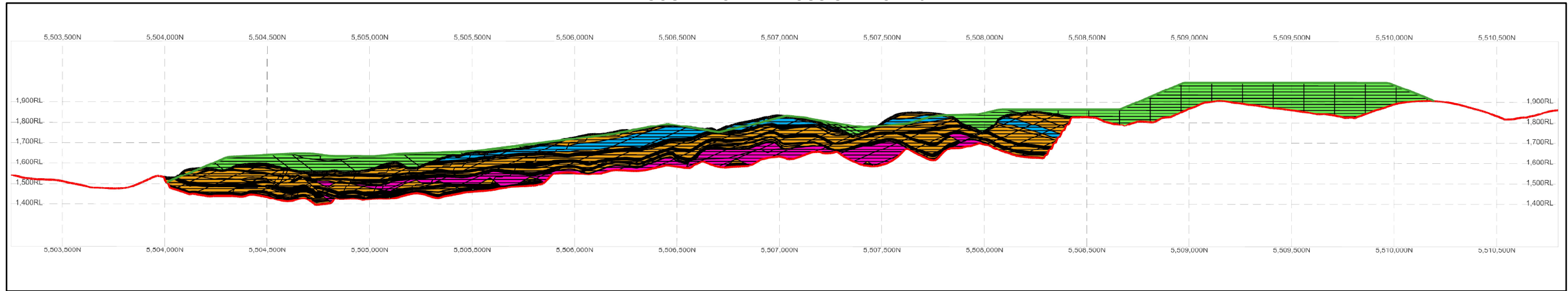
FIGURE

F.4.1-4

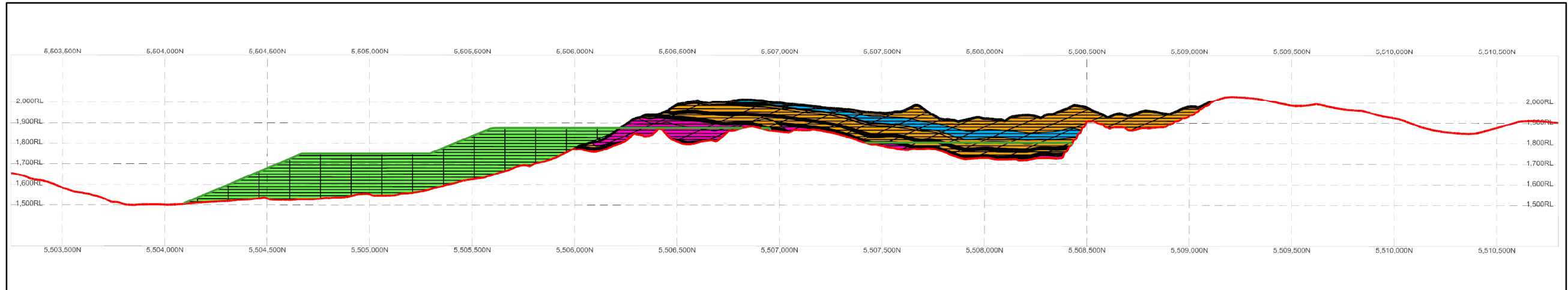
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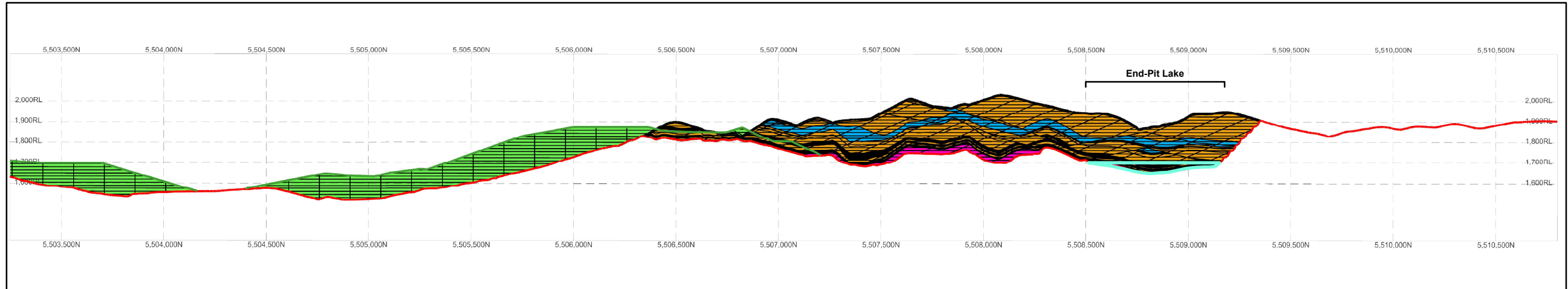
SOUTH-NORTH CROSS-SECTION 15



SOUTH-NORTH CROSS-SECTION 16



SOUTH-NORTH CROSS-SECTION 17



LEGEND

- Original Topography
- Final Pit Profile
- Reclaimed Disposal Profile
- Reclaimed Disposal Area
- Coal Seam
- Overburden
- Underburden
- Conglomerate
- Cross-Section Location
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- End-Pit Lake
- Reclaimed Topographic Contour (20m interval)

PROJECT



GRASSY MOUNTAIN COAL PROJECT

TITLE

RECLAMATION CROSS-SECTIONS 15-17

NOTES

AltaLIS, 2016; Deswik, 2016; Geobase, 2015; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

CROSS-SECTION SCALE



PROJECT: 14-00201

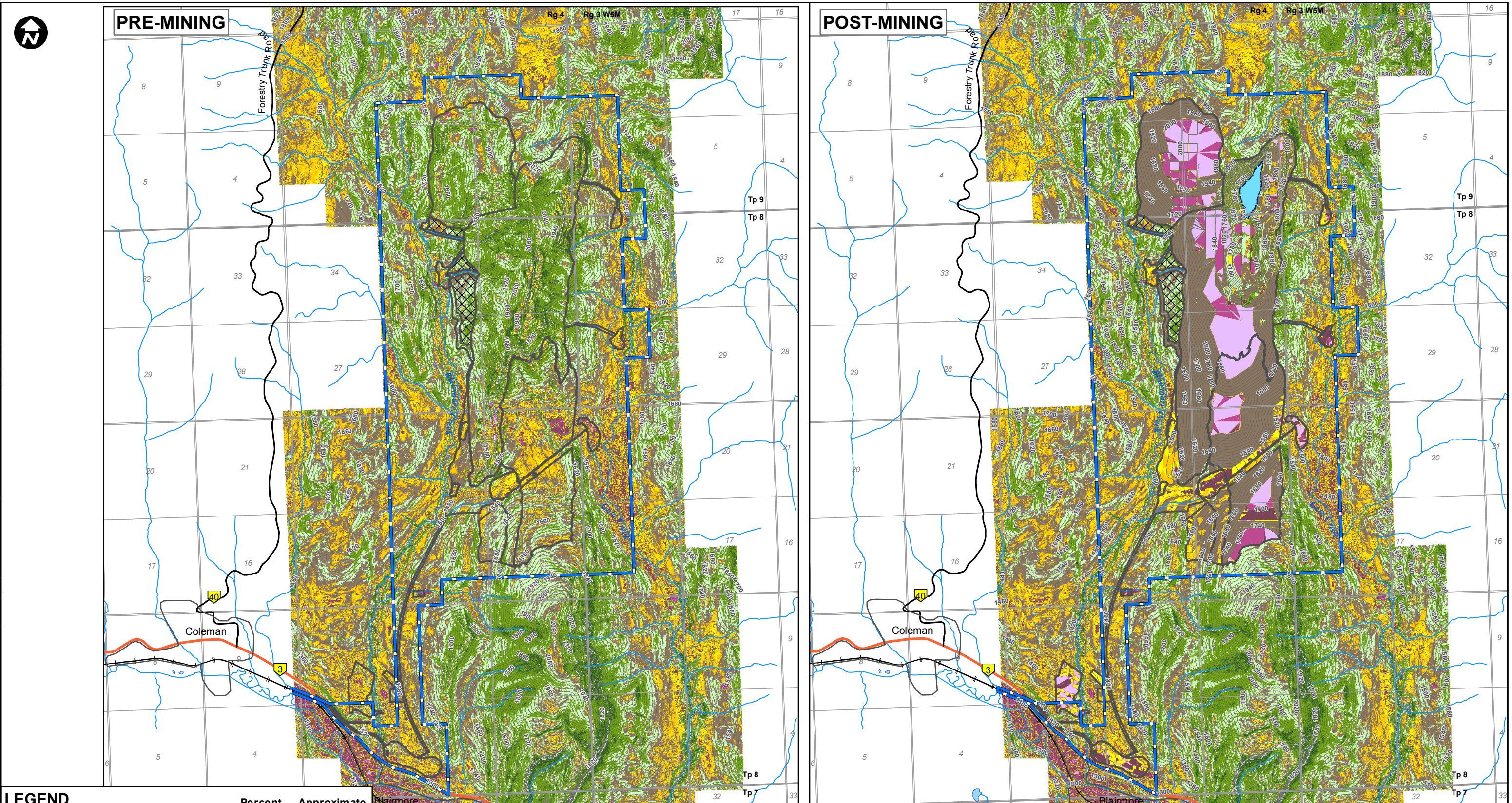
DRAWN BY: DESWIK/SL

CHECKED BY: DM

DATE: JUNE 8, 2016

FIGURE

F.4.1-5

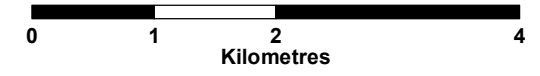


LEGEND			
	Proposed Mine Permit Boundary		
	Project Footprint		
	Undisturbed Area		
	Primary Highway		
	Secondary Highway		
	Existing Railway		
	Surface Water Drainage		
	Waterbody		
	Topographic Contour		
	(20m interval)		
	Slope Class	Percent slope (%)	Approximate degrees (°)
	1	0-0.5	0
	2	>0.5-2	0.3-1.1
	3	>2-5	>1.1-3
	4	>5-10	>3-5
	5	>10-15	>5-8.5
	6	>15-30	>8.5-16.5
	7	>30-45	>16.5-24
	8	>45-70	>24-35
	9	>70-100	>35-45

PROJECT
RIVERSDALE RESOURCES **GRASSY MOUNTAIN COAL PROJECT**

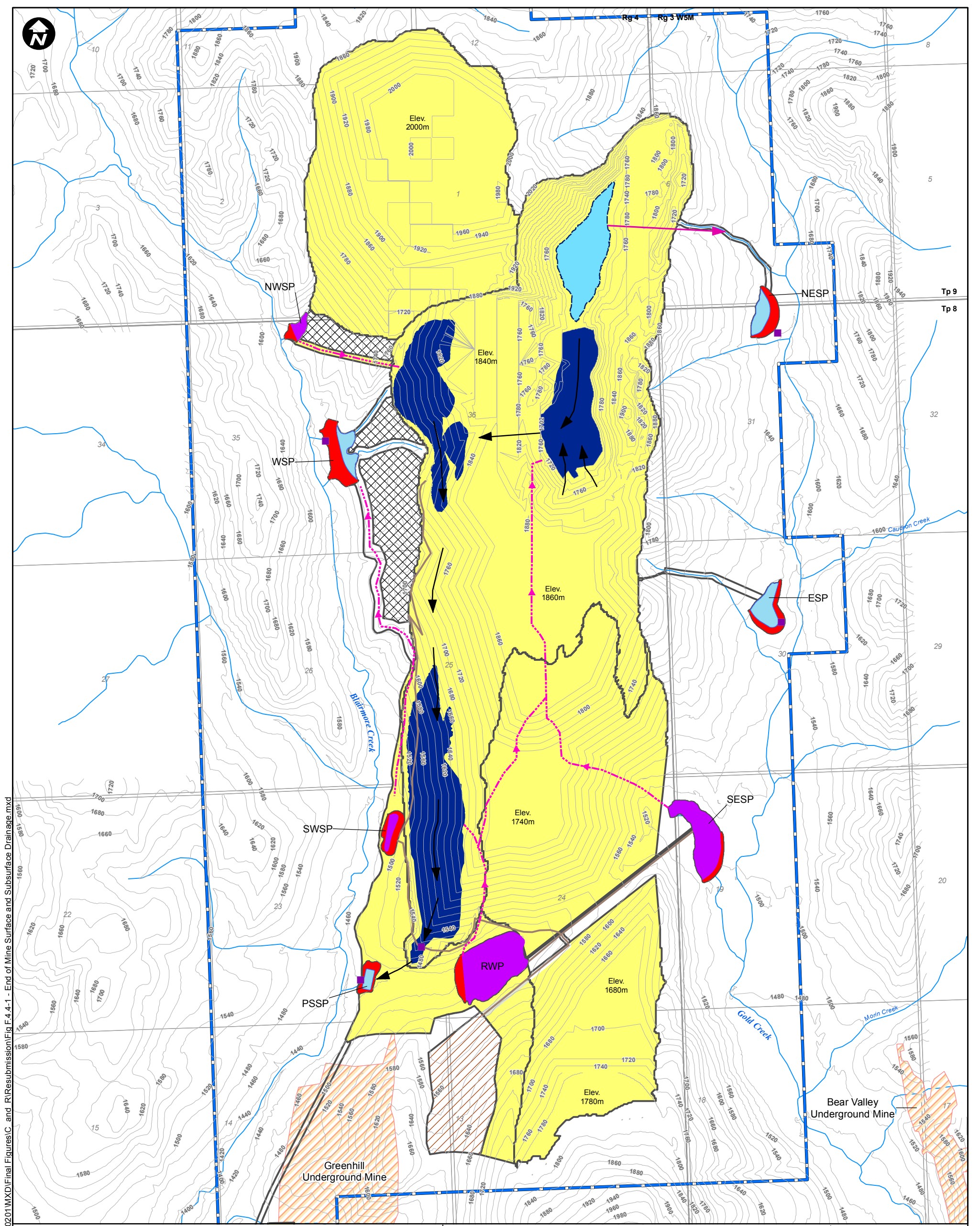
TITLE
PRE AND POST MINING TOPOGRAPHY

NOTES
 AltaLIS, 2015; Deswik, 2016; Geobase, 2015; Golder, 2015; MEMS, 2015; Riversdale, 2015
 Datum/Projection: UTM NAD 83 Zone 11



PROJECT: 14-00201
 DRAWN BY: SL
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 DATE: JUNE 10, 2016

FIGURE
F.4.1-6



Document Path: K:\Active Projects\2014\AP 14-00201\14-00201\MXD\Final Figures\C and R\Resubmission\Fig F.4.4-1 - End of Mine Surface and Subsurface Drainage.mxd

LEGEND

- Release Point
- Haul Road
- Reclaimed Topographic Contour (20m interval)
- Subsurface Direction of Flow (Selenium Attenuated Water)
- Subsurface Lake Discharge
- Water Transfer Pipeline
- Surface Water Drainage
- End-Pit Lake
- Dam
- Release Pond
- Surge Pond (No Release)
- Saturated Zone
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Previously Reclaimed
- Reclamation Material Storage
- Coal Handling Processing Plant and Infrastructure
- Underground Mine

PROJECT

RIVERSDALE RESOURCES **GRASSY MOUNTAIN COAL PROJECT**

TITLE

END OF MINE SURFACE AND SUBSURFACE DRAINAGE

NOTES

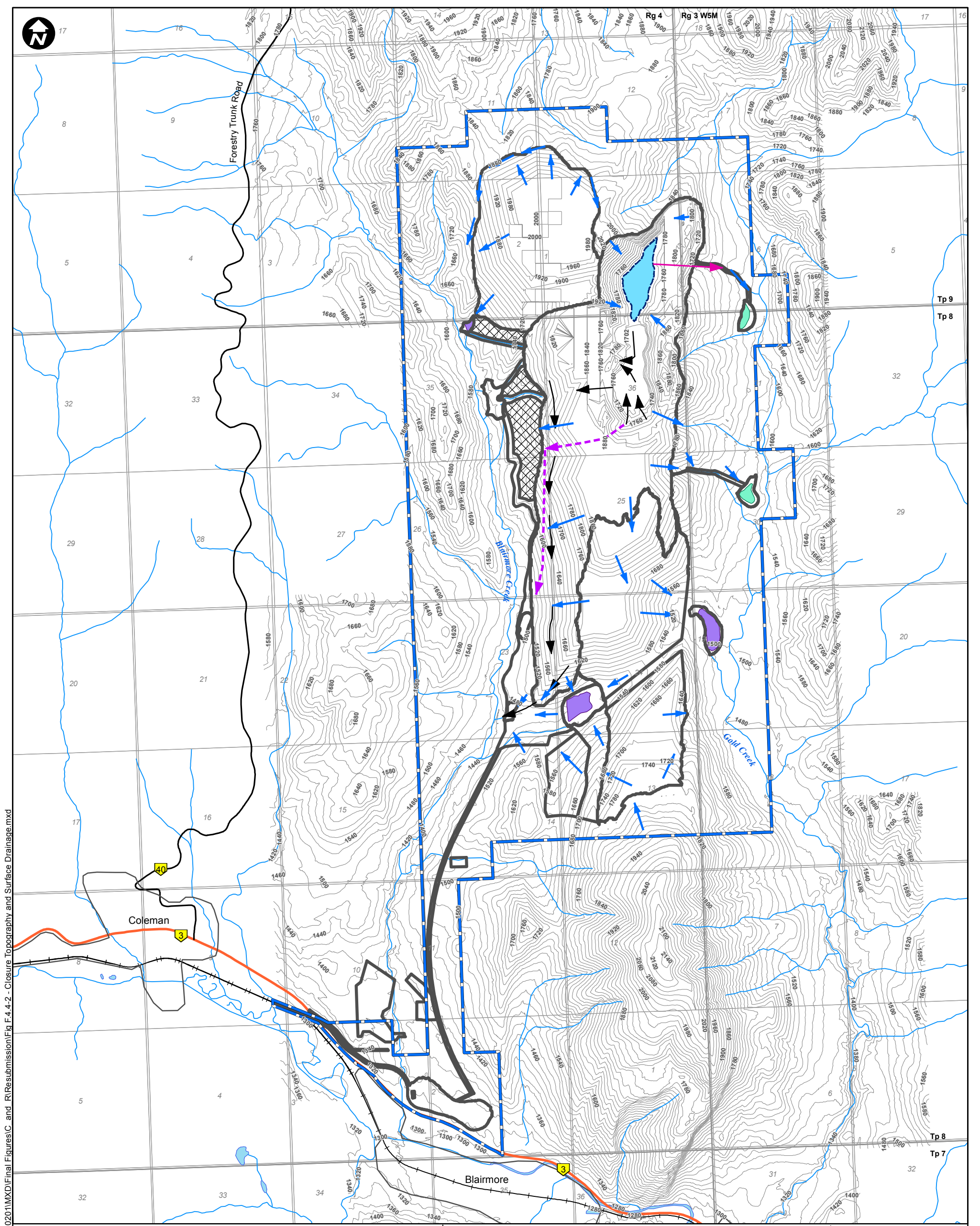
AltaLIS, 2016; Deswik, 2016; Geobase, 2016; MEMS, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

0 0.5 1 2
Kilometres

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PROJECT: 14-00201-01
DRAWN BY: JDC/JL
CHECKED BY: DM
DATE: JULY 11, 2016

FIGURE
F.4.4-1



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LEGEND

Proposed Mine Permit Boundary	Surface Water Drainage
Project Footprint	Existing Waterbody
Undisturbed Area	End-Pit Lake
Primary Highway	Wetland
Secondary Highway	Constructed Wetland
Existing Railway	
Reclaimed Topographic Contour (20m interval)	
Subsurface Direction of Flow (Selenium Attenuated Water)	
Subsurface Lake Discharge	
Subsurface Drainage	
Drainage Direction	

PROJECT

RIVERSDALE GRASSY MOUNTAIN COAL PROJECT

TITLE
CLOSURE RECLAMATION LANDSCAPES WITH SURFACE DRAINAGE

NOTES
 AltaLIS, 2016; Deswik, 2016; Geobase, 2015; Golder, 2016; MEMS, 2016; Riversdale, 2016
 Datum/Projection: UTM NAD 83 Zone 11

MILLENNIUM
EMS Solutions Ltd.

PROJECT: 14-00201-01
 DRAWN BY: SL
 CHECKED BY: DM
 DATE: JUNE 10, 2016

FIGURE
F.4.4-2

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