State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
Lowell P. Braxton
Division Director

1594 West North Temple, Suite 1210
PO Box 145801
Salt Lake City, Utah 84114-5801
801-538-5340
801-359-3940 (Fax)
801-538-7223 (TDD)

March 4, 1999

TO: File

THRU: Joe Helfrich, Permit Supervisor

THRU: Daron Haddock, Permit Supervisor

FROM: Robert Davidson, Soils Reclamation Specialist RAD

RE: Soils Technical Analysis of the West Ridge Permit Application Package, West Ridge Resources, Inc., West Ridge Mine, PRO/007/041, Folder #2, Carbon County, Utah

SUMMARY:

The first PAP submittal for the West Ridge mine was received on January 26, 1998. The Division completed and replied with their initial Technical Analysis response on August 20, 1998. West Ridge Resources made a second PAP re-submittal on October 7, 1998. The Division responded with a Technical Analysis on November 27, 1998. A third submittal was received on January 11, 1999. The Division responded with memos from each of the review team disciplines in a meeting held with West Ridge Resources on January 27, 1999. A fourth submittal was received on February 1, 1999 in response. This Technical Analysis for soils is in response to the fourth submittal.

TECHNICAL ANALYSIS:

ENVIRONMENTAL RESOURCE INFORMATION

SOILS RESOURCE INFORMATION

Regulatory Reference: 30 CFR Sec. 783.21, 817.200(c); R645-301-220, -301-411.

Analysis:

Chapter 2, Soils, Sections R645-301-220 through -224, discuss the soil resources within the proposed West Ridge Mine area. Relevant soils information includes prime farmland investigation, current and published soil surveys, soil characterizations, and substitute topsoil identification. The Analysis section discusses resource information as follows:

- Prime Farmland Investigation
- Soil Survey Information
- Soil Characterization
- Substitute Topsoil Borrow Area

Prime Farmland Investigation

Prime Farmland site investigations were performed by the Natural Resources Conservation Service (NRCS). No prime farmland or farmland of statewide importance were found within the proposed permit area, mine site and topsoil borrow site because of slope and soil erodibility. The determination letter from the NRCS dated August 7, 1998, was sent to West Ridge Resources, Inc., and is included in Appendix 2-3.

Soil Survey Information

The soil survey information contains both general and site specific surveys as follows:

(1) General, Third Order Soil Survey

Appendix 2-1 and Soils Map 2-1 make up the general Order-III soil survey. Relevant portions of soil survey for the proposed permit area and regional soils map for the proposed permit area are reproduced from the Carbon County Soil Survey, published by the United States Department of Agriculture, Soil Conservation Service, National Cooperative Soil Survey, issued in June 1988.

(2) Site specific, First Order Soil Surveys

A site specific Order-I soil survey was performed and prepared by Mr. James Nyenhuis, Certified Professional Soil Scientist (ARCPACS #2753). The different Order-I soil surveys performed and reported are as follows:

- Appendix 2-2 and Soils Map 2-2 - proposed disturbed area mine site.
- Appendix 2-4 and Soils Map 2-3 - proposed topsoil borrow area.
- Appendix 2-5 - proposed gravel borrow areas.

Soil identification and soil descriptions are contained in each of the respective Appendices (2-1, 2-2 & 2-4) for each of the soil surveys. All mapping and soil survey work were performed according to the standards of the National Cooperative Soil Survey. The First Order Soil Surveys for the proposed disturbed area mine site area, topsoil borrow area, and gravel borrow area were correlated with the published National Cooperative Soil Survey. Based on the site-specific soil descriptions, and laboratory data, each of the soils were classified according to current NRCS soil taxonomy, and correlated to specific soil series names. Correlation of site-specific soils with NRCS soil series criteria allows for subsequent reference to and use of established NRCS soil interpretation values for these soils.

For the disturbed area mine site, four mapping units are delineated (Map 2-2) and include Rock Outcrop-Rubbleland-Travessilla complex, Midfork very stony fine sandy loam, Brycan loam and Strych stony fine sandy loam. In the proposed topsoil borrow area, three soil units were mapped (Map 2-3) as Strych stony fine sandy loam, Atrac fine sandy loam and Gerst-Badland-Rubbleland complex. For the gravel borrow area, one soil series, Strych gravelly loam, is present across the entire sampled area.

Soil productivity of existing soils was determined by Mr. George Cook from the Natural Resources Conservation Services and results are shown in Appendix 3-1.

Soil Characterization

Soil pedons were characterized by the soil horizons at each sampling location. All profile descriptions were recorded on standard NRCS "232" forms and are provided in each of the appendices.

The soil horizons at each sampling location were sampled and characterized according to the State of Utah Division of Oil, Gas and Mining (DOGM) guidelines for topsoil and overburden[1]. Sampled parameters included: soil texture; pH; organic matter percent; saturation percent; electrical conductivity; $CaCO_3$; soluble potassium, magnesium, calcium and sodium; sodium absorption ratio, and extractable selenium and boron. Available water capacity, alkalinity, total nitrogen and available phosphorus were not analyzed at this time; these parameters can be tested at reclamation time. Organic matter percent was substituted for organic carbon. Soil texture by hand-texture method, rock fragment content (% by volume), Munsell color, and qualitative calcium carbonate content were determined in the field by Mr Nyenhuis.

No unacceptable criteria were found for salvageable soils and substitute soils except for percent rock content within the mine site disturbance or proposed facilities area. Although DOGM suitability criteria considers >30% (by volume) rock fragments (for both gravels <3" in size and cobbles 3 to 10" in size) to be unacceptable, and >10% stones and boulders >10" in size to also be unacceptable, the recent trend by DOGM is to salvage "**native soils**" with "**intrinsic rock content.**" Appendix 2-2 reports that native soils can be salvaged containing a higher rock content than the DOGM guidelines deems acceptable. Ultimate site reclaimability using these rocky soils enhances reclamation success by providing an environment similar to native conditions. Higher rock content soils provide for a more stable reclaimed surface, aid in water

[1]Leatherwood, J., and Duce, D., 1988. Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining. State of Utah Department of Natural Resources, Division of Oil, Gas and Mining.

harvesting and ultimate water holding capacity of interstitial soils, and create wildlife habitat and niches on the surface were surface boulders and larger cobble sized rocks are placed.

Substitute Topsoil Borrow Area

A supplemental soil resource areas has been identified in the event that reclamation efforts are not successful utilizing the topsoil Resources at the mine site. The borrow topsoil site has been investigated to document the physical and chemical characteristics of this material and to determine the soil's suitability (see Appendix 2-4).

Appendix 2-5 gives the soil resource assessment of the gravel borrow material that will be used for fill during culvert installation and pad construction. The appendix contains information for two separate borrow sites as follows:

- *Original Gravel Borrow Site*
  - Report by Mt. Nebo Scientific, Mr. James H. Nyenhuis
  - Submitted January 1998
  - Location is SE¼, SE¼, Section 16, T14S, R13E. The pediment cap is located immediately south and adjacent to soil borrow area, just at the base of the Book Cliffs and just outside the C Canyon.
  - Description characterizes the soil and surficial geologic Resources for the pediment cap as glacial fan terrace-outwash plain material. Soil cover is primarily Strych. Soil and native parent material are suitable as fill material and substitute topsoil for reclamation of the West Ridge Mine and should be considered suitable growth medium. The PAP, Appendix 5-5 describes the material as " . . . chemically and physically identical to the native materials existing naturally in the vicinity of the mine site." Approximately 15 feet of suitable material is available for use as construction fill.

- *Himonas Pit Soil/Gravel Borrow Area*
  - Report by Mr. James H. Nyenhuis
  - Submitted October 1998
  - Location NW¼, Section 1, T15S, R12E.
  - Private, commercial lease area proposed to supply a mix of soil and gravel material as fill for the West Ridge Mine. Material from this lease is currently being used for construction of the new Carbon County C Canyon road.
  - Soil cover is primarily Hernandez family, 1 to 3 percent slopes. The chemical and physical characteristics of the material described in the addendum to Appendix 2-5 are very dissimilar to the materials at the mine site. Analyses of the material indicate it has moderately high salt, SAR and selenium concentrations and that it is less suited for reclamation than the material at the proposed mine site. While not all samples showed elevated salt and selenium levels, those that did represent the majority of the depth of the sampled horizons.

Based on additional field sampling and analyses results for material from the Himonas pit, the main problems rest primarily with SAR and selenium levels. The majority of the samples and primary volume of material have SAR values rated in the fair range. The few samples that showed elevated SAR values in the poor to unacceptable range, primarily occurred in the 5 to 11 foot depth range. Material located 11+ feet deep showed elevated selenium values greater than 0.1 mg/Kg which is unacceptable.

Findings:

The information provided meets the regulatory requirements of this section.

OPERATION PLAN

TOPSOIL AND SUBSOIL

Regulatory Reference: 30 CFR Sec. 817.22; R645-301-230.

Analysis:

Chapter 2, Soils, Sections R645-301-230 through -234, and R645-302-200 through -218, discusses the soil's operation plan for the proposed West Ridge Mine. Topsoil protection incorporates traditional methods of salvaging/stockpiling and an experimental practice method for protecting soils in-place beneath operational-pad fills. The **Experimental Practice** is unique by taking a **Reclamation Approach** for topsoil protection. Relevant analysis information includes soil salvage, stockpiling, topsoil substitutes and supplements, and experimental practice. The Analysis section discusses operation information as follows:

- Topsoil and Subsoil Removal - Traditional Methods
- Topsoil and Subsoil In-Place Protection - Experimental Practice Methods
- Topsoil Substitutes and Supplements
- Topsoil Storage

Topsoil and Subsoil Removal - Traditional Methods

For the purpose of maximizing topsoil recovery during construction, all topsoil salvage will occur under the on-site supervision of a Soil Scientist. Traditional methods for protecting topsoil resources will occur in (1) excavated topsoil areas and (2) excavated RO/RL Travessilla Complex areas.

(1) Excavated Topsoil areas

Traditional topsoil salvage methods will occur from those areas of the mine yard where material will be excavated in order to achieve final yard configuration. Topsoil salvage areas are identified by the First Order soil survey as Brycan, Midfork and Strych soil units. A total of 6500 CY of topsoil is projected for salvage from 2.69 acres. Topsoil material will be excavated using a trackhoe, then trucked to the topsoil storage piles. The primary Topsoil Storage Pile is located in the right fork as shown on Map 2-4, Proposed Topsoil Storage Areas.

Topsoil salvage areas are identified on Map 2-2, Mine Site Order 1 Soil Survey, and on Map 5-10, Construction/Reclamation Area-types. Map 5-10 shows topsoil salvage areas as dark blue and labeled as Slope/Topsoil/Cut (S/T/C). Map 2-2 identifies topsoil salvage as follows:

Topsoil Salvage Areas and Volumes

Soil Name	Location	Acres	Volume (yd^3)
Midfork	M1	0.23	552
	M2	0.22	537
	M3	1.5	3634
Strych	S1	0.27	656
	S2	0.14	342
Brycan	B1	0.32	785
Total		2.69	6506

(2) RO/RL Travessilla Complex

The Permit Application Package (PAP) and Soil Resource Assessment report conclude the following for the RO/RL Travessilla Complex mapping unit:

- The RO/RL Travessilla Complex mapping unit is dominantly unsuitable for soil salvage.
- Topsoil salvage from the RO/RL Travessilla complex is limited to salvaging pockets of Travessilla soil under the direction of a soils specialist.

Since the RO/RL Travessilla Complex occupies the majority of the surface disturbance area within the West Ridge Mine site, then the "unsuitable" nature of this mapping unit for soil salvage renders the site generally "unsuitable" for reclamation success unless soil salvage occurs from these areas. The Soil Resource Assessment report further concedes that attempting to salvage the RO/RL Travessilla Complex soils might de-stabilize immediate upslope areas endangering equipment operators with possible boulder slides. However, the PAP operation plan clearly shows (as shown on Map 5-5, Surface Facility Map) that nearly every slope located along the entire length of "C" canyon, including the left and right hand forks, will be cut to widen the pad surfaces. The majority of these cut slopes are contained exclusively within the RO/RL mapping unit. Either the RO/RL surface slopes are safe for constructing cut slopes and likewise soil salvage, or they're not safe for either activity. If the RO/RL soils and surface materials render themselves suitable for constructing purposes using conventional construction equipment, (e.g., sediment pond basins, and pad fill), then these same indigenous soil and rock material from the unconsolidated RO/RL surfaces can likewise be salvaged and stockpiled for later reclamation use.

The plan states that the RO/RL areas contain limited topsoil resources. The NRCS soil survey identifies the RO/RL Travessilla Complex mapping unit as containing significant amounts of soils (35% soils by volume - 25% Travessilla plus 10% other) that support a significant vegetation community - 750 lbs/acre of Pinyon/Juniper versus 1500 lbs/acre of Douglas Fir/Rocky Mountain Juniper in the Midfork soils. These "rocky" soils have intrinsic value for restoring RO/RL slopes and surfaces during reclamation to match current soil and vegetation conditions. The current vegetation community evolved to fit environmental conditions as they currently exist. Successful reclamation will therefore require the same soil and rock parameters as currently exist to establish revegetation success standards.

The plan identifies mixtures of rock and soil in the RO/RL Travessilla Complex mapping areas as naturally occurring **Colluvial Growth Material** (CGM). Since the RO/RL Travessilla Complex mapping unit contains 35% soils, CGM is in all aspects, a true soil and will therefore be protected and preserved as any other soil resource. These RO/RL soils will either be protected by salvaging the pockets of Travessilla soil first within the cut areas, or by preserving the soil and rock in-place in the fill areas. Soil preservation in-place is described under experimental practices. After salvaging the pockets of Travessilla soils from CGM areas, the remaining CGM material will be salvaged and stockpiled. Therefore, during construction and excavation of cut slopes in the RO/RL areas, the plan commits to salvage soil from the RO/RL Travessilla Complex unit as follows:

- During construction in the loop area and the coal pad slope area, the identified topsoil deposits, including the pockets of Travessilla soil, will be salvaged first and stored in the right fork soil storage area.

- The remaining colluvial growth/surface material (CGM) is also considered a reclamation resource. Therefore, the remaining CGM will be salvaged from the truck loop area and the west side of the left fork coal storage area as shown on Map 5-10, Construction/Reclamation Area-Types. The plan addresses CGM salvage in terms of dimensions, depth, and projected volumes of salvaged soil materials. The loop area CGM covers an area of about 59,400 square feet; the coal slope CGM covers about 21,600 square feet (see Map 5-10). Assuming an average salvage depth of 12 inches, approximately 2,200 cubic yards of CGM should be salvaged from the loop area, while 800 cubic yards is expected from the coal pile area.

- The plan states that isolated pockets of Travessilla soil will be salvaged from the RO/RL Travessilla Complex units outside the CGM areas where cut slope excavation will occur. Since these pockets of Travessilla soil are not delineated on the soils map, an on-site soils specialist will be present to ensure that these soils are salvaged during this phase of mine development.

Topsoil and Subsoil In-Place Protection - Experimental Practice Methods

Appendix 2-6, West Ridge Mine Experimental Practice In-Place Topsoil Protection, details protecting topsoil resources in-place for (1) buried topsoil areas, and (2) buried RO/RL (rock outcrop/rubbleland) Travessilla Complex soil area. These two combined areas account for 16.75 acres of the total 29 acres of disturbed area.

(1) Buried Topsoil Areas

West Ridge Resources is proposing a topsoil protection plan which incorporates **Experimental Practices (R645-302-200) for protecting in-place soil with a layer of geotextile fabric.** The geotextile fabric provides a protective barrier between the existing soils and the imported fill materials used to construct the mine pads. By utilizing this procedure, soils are not only preserved in-place, but the existing stream channel geomorphology and original ground surface configuration are preserved likewise. Approximately 4.75 acres of the proposed 29-acre disturbed area will be affected using the geotextile fabric.

(2) Buried RO/RL Travessilla Complex Areas

The buried RO/RL Travessilla Complex mapping unit will be included in the Experimental Practices. As stated in the Order-III soil survey, the RO/RL Travessilla Complex unit contains 35% soils by volume (25% Travessilla plus 10% other soils) that support a significant vegetation community. Successful reclamation requires the same soil and rock parameters that currently exist to establish revegetation success standards. By preserving these soils in-place underneath the pad fills, successful revegetation should be achieved. Placing the RO/RL Travessilla Complex mapping unit under Experimental Practices will not require the use of geotextile fabric. As stated in the plan, the RO/RL areas will not be covered with geotextile, but instead, fill will be placed directly over the existing ground surface which will be marked with brightly colored marker flagging strips placed on 8-foot centers for the purpose of identifying the original surface during reclamation and excavation of the pad fills. Marker strips will be used on approximately 12 of the 29 acres of the disturbed area.

Topsoil Substitutes and Supplements

Imported Gravel Fills

Appendix 2-5 gives the soil resource assessment of the gravel borrow material that will be used for fill during culvert installation and pad construction. There are presently two borrow sites which are the most probable sources of borrow for the mine. The first borrow site is located on Utah School Trust property and is presently under lease to Carbon County. This site is located approximately 2 miles from the mine site in Section 16 T.14S., R.13E. Based on DOGM's soil and overburden guidelines, gravel fills located on these pediment terraces located at the base of the Book Cliffs suitable as substitute topsoil based physical and chemical characterization. The School Trust site is undeveloped and is located in a previously undisturbed area.

An addendum to Appendix 2-5 describes a second commercial gravel borrow source. The area is identified as the Himonas Pit and is located about 7 miles from the mine site in NW¼, Section 1, T15S, R12E. The Himonas borrow site is part of an existing commercial gravel crushing and screening operation, complete with a developed water source and roadside access to the newly constructed C Canyon County road. These gravel fills are very dissimilar to the native materials in C-Canyon and contain higher levels of salt, sodium and selenium. Therefore, all gravels and fill materials from the Himonas pit will be pre-tested and approved prior to loading and hauling to the West Ridge site. Based on the Division's Guidelines for Topsoil and Overburden, suitability of the material will be appraised on pH, EC, SAR and AB-DTPA extractable Se. Any material that falls outside the Division's acceptable criteria range will be rejected, segregated out, and not used as fill for the West Ridge site.

Topsoil Storage

The PAP states that soil salvaged from the cutslopes above the pads and from the M1, M2, B1, and S1 areas will be stockpiled, segregated in separate pile locations and preserved for final reclamation. Two separate sites are identified for soil storage. The primary stockpile is located in the right fork and the secondary pile is located in the left fork.

The sites are located up and away from the active mine yard area. The stockpiled soils will be seeded and mulched to minimize erosion. Both stockpile areas combined hold about 11,000 CY of soil with outslopes of 2:1 and depths ranging up to 15 feet. The outslope surfaces will be surface roughened and pitted to help retain moisture and minimize runoff. Map 2-4 shows details for each stockpile.

The primary topsoil storage area will be located in the right fork. This area is large enough to accommodate the total projected volume of salvaged topsoil. If extra capacity is needed, then the left fork area will be utilized for soil storage.

Construction of the topsoil stockpiles will begin by vegetation removal and installing the bypass culvert in the drainage channel. The stockpiles will be built up over the bypass culvert with diversion ditches installed along both flanks.

The CGM repository areas within the coal stockpile pad area, the sediment pond impoundment dams' out slopes, and the office pad are identified on Maps 5-10 and Map 7-4. Map 7-4 illustrates the sediment pond cross sections which show the CGM stored in the impoundment dam's interior core and out slope. A structural face of imported fill material, compacted to 95%, is placed over the CGM on impoundment dam's in slope embankment. Salvaged surface colluvium from the RO/RL Travessilla Complex unit contains significant quantities of soil (25% Travessilla and 10% other soils) in addition to rock and native parent material. The following apply for salvaging and stockpiling CGM:

- Salvage of all topsoil, including pockets of Travessilla soil, and CGM will be under the direction of an on-site soils specialist.

- Topsoil and pockets of Travessilla soil will be salvaged separately from the CGM and stockpiled with the other topsoil in the right fork topsoil storage area. CGM salvage areas include the loop area and the coal pad slope area.

- The Loop CGM storage areas, located on the sediment pond out slopes (Map 5-10), will be identified as topsoil storage areas, properly signed and protected.

- The CGM material placed on the out slopes of the pond embankments will be roughened and seeded with the interim revegetation seed mix. The reseeded area will then be mulched.

Construction Sequence Summary

Map 5-11, Construction Sequence, illustrates the different stages of construction for the West Ridge Mine site. Steps 2 and 3 illustrate the experimental practice steps for installing geotextile fabric and marker strips. Construction sequence steps are outlined as follows:

- Steps 1 through 4 are preparatory steps prior to topsoil salvage. Step 1 is removing vegetation; Step 2 is installing culvert and culvert backfill while placing geotextile in channel bottom and placing marker strips in RO/RL areas; Step 3 is installing geotextile fabric over topsoil fill slopes, and placing marker strips in RO/RL areas; and Step 4 is pulling boulders from the surface of slopes that will be cut. Topsoil salvage occurs in Step 5. After topsoil salvage has occurred from the topsoil area and RO/RL areas, excavation of the side slopes will occur in Step 6. These excavated native materials will be used as pad fill and will be placed over the backfilled culvert adjacent to the cut slopes. Step 7 shows completion of the pad level by hauling in imported fill from offsite, commercial gravel borrow areas. A final cap layer of road base material is placed over the imported fill surface as shown in Step 8.

Findings:

The information provided meets the regulatory requirements of this section.

RECLAMATION PLAN

TOPSOIL AND SUBSOIL

Regulatory Reference: 30 CFR Sec. 817.22; R645-301-240.

Analysis:

Chapter 2, Soils, Sections R645-301-240 through -244, discusses the soil's reclamation plan for the proposed West Ridge Mine. The Analysis section discusses reclamation information as follows:

- Soil Redistribution
- Experimental Practices
- Soil Nutrients and Amendments
- Soil Stabilization

Soil Redistribution

Reclamation sequence is shown on Map 5-12 and the sequence detail is explained in Appendix 5-5, Part II, for both cut slopes and buried soils. Section 2 gives a summary of the various area-types within the mine site and include (1) Channel or Slope, (2) Topsoil or Rock, and (3) Fill or Cut. Key reclamation tasks are summarized in Section 3 and detailed in Section 4 as follows:

4a) Remove Surface Structures
4b) Remove Pad Cap Layer
4c) Remove Excess Pad Fill

4d) Remove Remaining Pad Fill; Backfill All Cut Slopes
4e) Reclaim Portal Highwall
4f) Reapply Topsoil to Backfilled Cut Slopes
4g) Re-expose and Revitalize the Left-in-Place Topsoil
4h) Re-establish the Original Rubbleland Surface
4i) Sediment Control
4j) Vegetate the Newly Re-established Slopes
4k) Remove the Bypass Culvert/Re-establish the Original Stream Channel

The sequence for removing the pad fill areas and reclaiming the adjacent cut slope areas will be accomplished in reverse order from the construction sequence. The uppermost part of the fill (excess, imported fill) will be removed first hauled into the mine for underground disposal. The remaining native fill materials (primary native fills) located in the lower, deeper pad levels will be used to backfill the adjacent cut slopes to reach approximate original contour (AOC). Fill material will be inspected and tested to insure that it is free of salts, oil, petroleum products and any other contaminants before being used as backfill in the cut areas.

Co-mingling of native and imported fills will occur to a limited extent. Imported fill quality will be assured by previous testing . However, imported fills from the Himonas pit may contain elevated salts and are therefore not of equal quality to the native soils and fills. To diminish any negative environmental impacts to native soils and fills from salt contamination, the following efforts will be made to minimize co-mingling of the imported fills with native fills and soils:

- Imported fills will be tested to ensure compliance with DOGM guidelines.

- The interface boundary between the imported and native materials will be clearly marked during construction using flagging on an 8 foot grid. This marker boundary will serve as a visual reference for equipment operators and will make it easier to minimize co-mingling during final reclamation and removal of the imported fills.

- After imported fill has been removed, the top layer of native fill will be reclaimed first and placed as backfill in the deepest parts of the adjacent cutslopes. This upper layer of native fill is most likely to be co-mingled and impacted by imported fills. By being buried in the deepest parts of the cutslope, the potential effects of elevated salts will be negated for the purposes of final reclamation and revegetation.

Colluvial Growth Material (CGM) will be used to backfill and soil the cut slopes in the truck loop and coal storage areas.

Buried pad-fill boulders will be retrieved and placed back on the backfilled cut slopes.

Segregated stockpiled topsoil (Brycan and Midfork) will be retrieved and re-applied to their respective areas. Midfork soils will be replaced on the north facing slopes; Brycan soils will be replaced in the flatter, open confluence area. Replacement depth is 12 to 18 inches. After topsoil replacement, the soil surface will be roughened, gouged, mulched and revegetated.

Experimental Practices

During fill removal, a 12- to 18-inch deep working layer will be left over the experimental practice slopes. Care will be taken not to subexcavate or disturb the geotextile soil surfaces. Equal care will be taken to protect the "ribbon" surfaces in the RO/RL areas. Fill removal from the slopes will be done carefully without disturbing the in-place soils located under the geotextile and marker strips. Fill removal will be done by small earth moving equipment and/or by hand labor if necessary to minimize disturbance of the topsoil. After the pad fill has been removed, the backfilled culvert will serve as the primary access way for machinery and materials associated with the remaining reclamation efforts.

Once the geotextile fabric has been exposed, the fabric will be carefully peeled away from the soil and the condition of the underlying soil materials observed at this time. The soil will be re-exposed in 5-10 foot horizontal zones that can be easily accessed and worked by hand from the adjacent pad fill level.

In RO/RL fill areas, fill will be removed down to the original, undisturbed surface as delineated by the marker strips. Because of the roughness of the ground surface, pad fill be removed to the extent possible.

To relieve soil compaction and increase the ability of the soil to absorb moisture, the re-exposed soil surface will be gouged and hay worked into the soil at the rate of 2,000 pounds per acre. Gouging depressions will approximately measure 24" X 36" X 18" deep and will create a pattern of depressions that help control erosion through water retention, minimize siltation, and allow for air and water penetration into the soil horizon.

Field Trials

In order to evaluate the effects of the geotextile and fill over the existing in-place topsoil resources, a test plot study area will be established in the upper right fork northeast of the topsoil stockpile. The purpose for the test plots is to evaluate the experimental practice reclamation plan proposed for the mine yard area.

The test plots will be established in an areas upstream from the topsoil stockpile in the right fork. As in the experimental practice, soil will not be salvaged from the west half of the test plot area. First, geotextile will be placed in the west half of the test plot area with the culvert and fill material placed on top of the geotextile in the same sequence and manner as used in the mine yard construction. Next, topsoil will be salvaged from the two different soil types in the east half of the test plot area and placed separately on the fill on the west side of the test plot area. Geotextile will then be placed on the northeast portion of the test plot area where soil was stripped (Strych soil) and the culvert extended through this area. Cut material from the southeast portion of the test plot area from which Midfork topsoil had previously been salvaged will be placed on top of the culvert. Finally, the test plot topsoil stockpiles on the west side of the test plot area and the cut and fill on the east half will be seeded with the interim seed mix.

After the test plot area is constructed, the cut/fill area will remain intact for five years to simulate the operation phase of the mine yard. Following the five year period, reclamation will be performed on the test plot area to actually implement and test the final reclamation plan in comparison to conventional reclamation techniques. Appendix 2-6 contains a complete discussion of the experimental practice test plot plan.

The resulting four test plots will be grouped into two categories, the "removed topsoil test plot" and the "in-place topsoil test plot". One portion of the test plot area could be treated/inoculated with a commercially available soil activator designed for revitalizing soil in order to evaluate whether inoculating the topsoil promotes faster or more diverse revegetation. Although this is not currently being proposed in the final reclamation plan, it could be used to assist vegetation establishment in the geotextile area at the time of final reclamation.

After the surface treatments have been applied, the plots will be seeded with the final reclamation seed mix. Canyon sweetvetch will also be seeded on the test plots. Because of the small area to be treated (about 0.31 acre), the seed will be broadcast on the surface and raked in by hand. Straw mulch will be applied over the seed bed of the test plot at a rate of 2,000 pounds per acre. Then the surface will be sprayed with a mulch and tackifier.

The test plot area will be accessed via the extreme edge of the topsoil stockpile and the adjacent cutslope during late summer or early fall. Any compaction or disturbance to the stockpile surface will be ripped and reseeded following completion of the test plot installation and reclamation of this area.

Vegetation monitoring will compare the results of plant growth between the experimental practice in-place soils to replaced topsoil. Monitoring will compare re-vegetation response for each soil type (Strych and Midfork) for each of the two soil surfaces (channel bottom and hillside). For example, comparisons will be made between in-place soils and replaced soils for the channel bottom soils consisting mainly of Strych; likewise, comparisons will be made for hillside Midfork soils. The experimental test plot area will also be compared with the reference area for the Douglas Fir/Maple vegetation type. Vegetation will be monitored for five years or until a determination of success has been made for the experimental practice. WEST RIDGE Resources will consult closely with the Division regarding the results of the test plot study. Should the results show a need to revise the reclamation plan, WEST RIDGE

Resources will work with the Division to amend the plan and incorporate the changes needed to ensure reclamation of the mine yard area will be successful. As a last resort, West Ridge Resources will utilize the soil borrow area for obtaining soils to reclaim the site if the experimental practice is determined to be unworkable.

Analysis of the Proposed Experimental Practice

The soils regulations are intended to protect and preserve topsoil resources for the purpose of revegetation thus providing a stable surface capable of supporting the postmining land use. The proposed experimental practice, including operation and reclamation procedures, provides protection equal to or greater than what would be obtained through traditional methods required in the regulations. The Division has analyzed issues related to the proposed experimental practice, and the applicant has adequately addressed each of these concerns as follows:

1. **Compaction.** Pad fill material will compact the soil, but in reclamation, the applicant intends to gouge the surface eighteen inches deep and incorporate alfalfa hay. Below eighteen inches, there should be few effects from the fill. This procedure, combined with natural processes (e.g., freeze/thaw), should adequately alleviate compaction and allow vegetation to become established.

2. **Decreased microbial activity.** Soil that is buried for several years has been demonstrated to have few, if any, microorganisms when it is uncovered. Many microorganisms are beneficial in plant establishment and growth.

   While soils in the experimental practice area may have few live microorganisms when uncovered during reclamation, natural inoculation is likely to occur quickly since the site is surrounded by undisturbed areas. Nearly all of the proposed disturbed area would be less than 200 feet from undisturbed areas with the farthest being about 250 feet away. The Division is aware of a nearby area where cryptobiotic soils have become established naturally on a soil borrow area after eight years. The applicant will try a soil activation treatment on the test plots, and if the test plots are unsuccessful, a commercial soil inoculant could also be tried.

   Soil sterility is also a problem where soil is salvaged, stored for several years, and respread, so there is little difference between the proposed practice and what would normally be required.

3. **Preserving channel geomorphology.** The experimental practice will not only allow preservation of soils in place, it will also preserve the channel geomorphology resulting in decreased erosion and a more stable channel very similar to what currently exists.

4. **Contamination.** Native soils could be contaminated by imported fill material; however, no imported fill will contact the undisturbed soils. In reclamation, the imported fill will be taken away and the native fill from adjacent slopes will be replaced in the cuts (see Map 5-12). In all cases, there will be a buffer of native fill between the imported fill and the native soils. In order to minimize the impact of any deleterious effects of the imported fill, bright marker flagging will be placed between the native and imported fills to delineate between the two fills during reclamation for the purpose of ensuring complete excavation and removal of the native fills.

   After removing the imported fills, the native fills will be excavated and placed in the cutslopes to achieve approximate original contour. The native fill should not mix with the undisturbed Brycan soils because of the geotextile. There will be some mixing in RO/RL areas, but the native fill is essentially the same material as the RO/RL soil.

   The imported fill may mix with and contaminate some of the native fill; however, this potentially-contaminated material will be the first to be replaced on cutslopes and will be buried the most deeply.

Reclamation should be successful with the procedures shown in the application; however, to ensure these practices will be successful, the experimental practice procedure will be tested in the field trials. In addition, the applicant has included a topsoil borrow area from which additional soil could be taken if necessary. The Division considers it highly unlikely the experimental practice will fail and that the topsoil borrow area will be needed. The proposed reclamation plan should result in vegetative cover that meets or exceeds performance standard requirements.

Soil Nutrients and Amendments

Topsoil will be sampled and tested as they are redistributed and re-exposed. Fertilizer needs will be assessed based on analyses for soil nutrients. Nutrients and other amendments can be added by hydroseeding, by broadcasting or by other conventional methods.

Soil Stabilization

After AOC is met for each cut area, the surface will be prepared according to the roughen, vegetate and mulch method (R-V-M). Gouging will be the primary method used to roughen the surface and consists of imprinting the surface with a pattern of depressions measuring approximately 18" x 24" x 8" deep. The purpose of the pocks, or gouges, is to capture and retain water, reduce erosion and provide a cradle for seedling germination and development. Soils on steep slopes need to be protected from erosion prior to vegetation establishment. Soil erosion methods in addition to gouging will include best technology currently available at the time of reclamation (e.g., SOIL LOC®, Tackifier, etc.). Vegetation will be the primary source for erosion control and surface stabilization. Revegetation efforts will include regrading, topsoiling, fertilizing, mulching and seeding.

Reclamation Sequence Summary

Map 5-12, Reclamation Sequence, illustrates the different stages of reclamation for the West Ridge Mine site. Steps 3 through 8 illustrate all experimental practice steps involved with reclamation for removing fill, restoring buried soils and reclaiming the original soil surface. Reclamation sequence steps are outlined as follows:

- Steps 1 through 5 show reclamation steps prior removing geotextile and reclaiming the original soil surface. Step 1 is removing cap layer and surface structures; Step 2 is removing excess imported pad fills; Step 3 is removing remaining native pad fill and backfilling cutslopes; Step 4 is replacing topsoil on re-established slopes; and Step 5 is relocating boulders on re-established slopes and preparing soiled surface for revegetation. Steps 6 through 7 show removal of geotextile, soil restoration steps and revegetation; Step 8 shows final culvert removal and restoration of Channel, which includes geotextile removal and re-exposure of the original soil surfaces while maintaining the geomorphology of the stream channel.

Findings:

The information provided meets the regulatory requirements of this section.