

**APPENDIX 6.4-D**

**Reclamation Performance  
Criteria**

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## ***DEWEY-BURDOCK PROJECT RECLAMATION PERFORMANCE CRITERIA***

### **1.0 INTRODUCTION**

The primary goal of the reclamation program is to rehabilitate the affected land to a condition that meets the selected postmining land uses (ARSD 74:29:07:01). The designated postmining land uses include rangeland (ARSD 74:29:07:20) and agricultural or horticultural crops (ARSD 74:29:07:21). This appendix presents the reclamation performance criteria to establish the success of revegetation for each of these postmining land uses. For agricultural and horticultural cropland, the final bond release criteria will be a demonstration that the productive capacity is equal to or exceeds that of similar crop production areas in the surrounding region for two consecutive crop years. For rangeland, four criteria will be used to establish successful revegetation: vegetative ground cover, usable forage production, species composition and reclamation sustainability. Each of these is briefly described in the following subsections. Section 2 describes the specific methodology to measure reclamation performance for rangeland, Section 3 describes the comparison process, and Section 4 provides references.

#### **1.1 Vegetative Cover**

To meet final bond release criteria for rangeland, the total vegetative cover (not including noxious weed) in a revegetated unit must equal or exceed the total vegetative cover on reference areas.

#### **1.2 Usable Forage Production**

To meet final bond release criteria, the reclaimed rangeland must support a livestock carrying capacity equivalent to reference areas (ARSD 74:29:07:20). The carrying capacity will be determined by measuring the usable forage production (biomass of usable forage) of the land. Usable forage is defined as the average palatability of individual plant taxa (for consumption by cattle) based on the U.S. Forest Service publication, "Check List, Palatability Table and Standard Symbol List of Colorado and Wyoming Range Plants (USFS, 1937). As indicated in the publication, the list is appropriate for plants of the Black Hills of South Dakota.

#### **1.3 Species Composition**

According to ARSD 74:29:07:06, postmine vegetative species and composition must be appropriate for the designated postmining land use. Species composition of the reclamation will be measured to document that species present are appropriate for the rangeland postmining land use.

#### **1.4 Sustainability of the Reclamation**

Disturbed lands will be revegetated in accordance with SDCL 45-6B-39, which requires that a diverse, effective, and long lasting vegetative cover be established that is capable of self-regeneration and at least equal in extent of cover to the natural vegetation of the surrounding



area. Compliance with the cover requirement will be demonstrated using the reference area concept, as described in Section 3.0 below. As stated in ARSD 74:29:07:20, rangeland reclamation will be complete when the reclaimed range is capable of withstanding proper stocking rates for 2 consecutive years prior to bond release. Disturbance will be reclaimed using methods outlined in Section 6.4 of the LSM permit application and monitored using methods described below. These reclamation techniques and monitoring methods were developed in accordance with SDCL 45-6B-39 and ARSD 74:29:07:20 and will ensure that adequate cover, species composition, usable forage production, and reclamation sustainability will be attained on the reclamation.

## 2.0 SAMPLING METHODOLOGY

### 2.1 Vegetative Cover

The initial step in determining the success of the rangeland revegetation is to determine vegetative cover and production using line transect/point-intercept transects. Due to the two distinct configurations of reclamation (large area parcels associated with well fields and facilities) and linear parcels associated with corridor disturbance, transect locations will be determined based on the configuration of the reclamation unit. Linear reclamation units will be no wider than an average of 50 feet over the length of the unit.

**Large Area Parcels:** For each 10 acres of revegetated rangeland, one randomly located line transect/point-intercept transect will be used to collect percent absolute vegetative cover data. For parcels of revegetated rangeland smaller than 10 acres, one transect will be used. Transects will be located randomly in the field within each 10-acre unit using a computerized systematic grid (through AutoCAD or ArcGIS). These computer-generated random numbers will be uploaded to a hand-held GPS unit for actual location in the field. Random numbers between 1 and 360 will be generated to determine cover transect direction, and compasses will be used to orient transects to the nearest 1/8 of 360° in the field. Each 50-meter transect will represent a single sample point. Transects that exceeded the boundaries of the vegetation community being sampled will be redirected back into its vegetation community at a 90° angle from the original transect direction at the point of intercept. In instances where a 90° angle of reflection does not place the transect within the sampled community, a 45° angle of reflection will be used. Percent cover measurements will be taken from point-intercepts at 1-meter intervals along the 50-meter transect. Transect locations will be submitted to DENR for review and verification prior to sampling.

**Linear Parcels:** One 50-meter transect will be located for each 1,640 feet (500 meters) of linear rangeland reclamation unit. The initial transect of a linear unit will be randomly located in the field within the first 50 feet of the unit using a computerized systematic grid (through AutoCAD or ArcGIS). These computer-generated random numbers will be uploaded to a hand-held GPS unit for actual location in the field. Subsequent transects will start 1,640 feet from the end of the preceding transect until a transect no longer fits entirely within the linear unit. Percent cover



measurements will be taken from point-intercepts at 1-meter intervals along the 50-meter transect. Transect locations will be submitted to DENR for review and verification prior to sampling.

**General:** Percent cover measurements will record “first-hit” point-intercepts by live foliar vegetation species, litter, rock, or bare ground. Hits on lichen, moss, or fungi will be counted toward total ground cover only. Multiple hits on vegetation will be recorded, but used only for the purpose of constructing a plant species list for each plant community.

**Reference Areas:** Reference areas will be used that are representative of the rangeland postmining land use. Reference areas will be established in the upland grassland community, since the rangeland seed mixture is an upland grass mixture. At least four reference areas will be established for each of the Dewey and Burdock portions of the permit area. Reference areas are depicted on Plate 6.4-2. All reference areas are outside of the affected area boundary and therefore are not anticipated to be affected by future mining. Reference areas will be at least 2 acres in size, which will be an adequate size to sample vegetation along three randomly located transects annually without significantly affecting the vegetation in the reference area. Powertech (USA) will work with the landowners to manage the reference areas in a similar manner to revegetated areas. During years that the reference areas are used to determine vegetation success, this may involve fencing the reference areas to exclude livestock or rotating livestock out of the pastures in which reference areas are located.

Reference areas will be sampled during each year that reclaimed areas are sampled to determine revegetation success. In each reference area, three 50-meter transects will be randomly located, with different transects located each year to avoid impacts from sampling during previous years.

## 2.2 Usable Forage Production

**Large Area Parcels:** At each reclamation unit sample site, current annual production for forage will be collected from a 0.5 m<sup>2</sup> quadrat placed 90° to the right (clockwise) of the ground cover transect to allow avoidance of vegetation trampled by investigators during sample site location. All aboveground current annual growth of forage within the vertical boundaries of the frame will be clipped and bagged separately by species for each quadrat. Listed noxious weeds will not be included.



Methods used to evaluate forage production at the reference area sample sites will be similar to those described above for the reclamation sample sites.

**Linear Parcels:** At each reclamation unit sample site, current annual production for forage will be collected from two 0.5 m<sup>2</sup> quadrats: one at the beginning of the transect and one at the end of the transect. The quadrats will be placed 90° to the right (clockwise) of the ground cover transect to allow avoidance of vegetation trampled by investigators during sample site location. All aboveground current annual growth of forage within the vertical boundaries of the frame will be clipped and bagged separately by species for each quadrat. Listed noxious weeds will not be included.

Methods used to evaluate forage production at the reference area sample sites will be similar to those described above for the reclamation sample sites.

**General:** All forage production samples will be returned to the laboratory for oven drying and weighing (to the nearest 0.1 gram). Drying will occur at 105°C until a stable weight is achieved (usually after 24 hours). Samples then will be reweighed to determine the biomass of the forage. Usable forage will be calculated by multiplying the biomass of forage (by species) by the percent palatability (usability) for the species, as determined from USFS (1937).

### 2.3 Species Composition

The total number of plant species encountered during revegetation success monitoring will be summarized for all combined revegetated areas. The results will be expressed as a summary of species by lifeform (annual grass, cool season grass, warm season grass, annual forb, perennial forb, and perennial shrub). Plant names from *Rocky Mountain Vascular Plants of Wyoming*, 3rd Edition (Dorn, 2001) will be utilized. The overall appropriateness for the rangeland species composition of the reclamation will be evaluated by noting the palatability of species present (percent palatability), as determined from USFS (1937).

### 2.4 Sustainability of the Reclamation

Sustainability of the reclamation will be determined by visual inspections of reclaimed units by DENR personnel, following two years of grazing under proper stocking rates.

## 3.0 COMPARISON PROCESS

The comparison process for cover will begin by calculating the average ground cover values (excluding listed noxious weeds) for the revegetation unit. Revegetation will meet the criterion



for cover if the vegetative cover for the revegetation unit is within one standard deviation of the average vegetative cover in the associated reference areas (i.e., reference areas in the Dewey portion of the permit area for revegetation units in the Dewey portion of the permit area and reference areas in the Burdock portion of the permit area for revegetation units in the Burdock portion of the permit area).

Regarding usable forage production (biomass), the current annual production of the forage for each revegetation unit, converted to the amount of usable forage, will be compared with the usable forage production in the associated reference areas. Revegetation will meet the criterion for production if the sample amount of usable forage is within one standard deviation of the average usable forage production in the associated reference areas.

The overall appropriateness for the postmining species composition of the reclamation will be evaluated by noting the palatability of species present, as determined from USFS (1937). A majority of the species present must have a percent palatability greater than or equal to 50 percent to meet the criterion for adequate species composition.

The requirement for sustainability of the reclamation will be satisfied if DENR personnel determine that the reclaimed units have withstood two years of grazing under proper stocking rates, based on visual inspections of the units. Powertech (USA) will have the opportunity to request independent verification of DENR's findings on the sustainability of the reclamation.

#### **4.0 REFERENCES**

Dorn, R.D., 2001, *Vascular Plants of Wyoming*, 3<sup>rd</sup> Edition, Mountain West Publishing, Cheyenne, Wyoming, 289 p.

USFS (U.S. Department of Agriculture, U.S. Forest Service), 1937, Check List, Palatability Table, and Standard Symbol List of Colorado and Wyoming Range Plants.

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