

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 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 comparable adjacent undisturbed area.

1.2 Usable Forage Production

To meet final bond release criteria, the reclaimed rangeland must support a livestock carrying capacity equivalent to a comparable adjacent undisturbed area (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

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.

2.0 SAMPLING METHODOLOGY

2.1 Vegetative Cover

The initial step in determining the success of the rangeland revegetation is to determine ground cover and production using co-located 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, 1 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, 1 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.

For comparison purposes, the same number of randomly located line transect/point-intercept transects will be placed in adjacent or similar native vegetation. The methods used to locate the random sample sites and to lay out the transects will be similar to those described above for the



revegetation transects. 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.

For comparison purposes, transects will be placed in native vegetation and located by offsetting the start of the native transects at a 90° angle from the starting point and direction of the adjacent reclamation transect. Each native transect will be located 50 meters from the edge of the linear unit and will run parallel to the corresponding reclamation 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.

2.2 Usable Forage Production

Large Area Parcels: At each co-located revegetation sample site, current annual production for forage will be collected from a 0.5 m² 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 co-located native sample sites will be similar to those described above for the reclamation sample sites.



Linear Parcels: At each co-located revegetation sample site, current annual production for forage will be collected from two 0.5 m² 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 co-located native 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 not less than the vegetative cover on comparable adjacent undisturbed area based on statistical methods approved by DENR.



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 contrasted with a comparable adjacent undisturbed area. Revegetation will meet the criterion for production if the sample amount of usable forage is not less than the sample amount of usable forage of the adjacent undisturbed area based on statistical methods approved by DENR.

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*, 3rd 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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