

DEVELOPMENT OF REVEGETATION SUCCESS STANDARDS FOR

LA PLATA COAL MINE IN NORTHWESTERN NEW MEXICO<sup>1</sup>

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Abstract.--The development of appropriate and reasonable revegetation success standards is a major concern to both coal mining companies and regulatory agencies in the Western United States. The regulations promulgated following the passage of the Surface Mining Control and Reclamation Act in 1977 proposed two basic approaches to determining revegetation success: (1) the use of reference areas and (2) the use of published technical guidelines. The reference area approach has been used extensively in the Western United States, but has been criticized because of concerns with ecological validity, long-term management and cost. Published technical guidelines for determination of revegetation success have not been widely used because of a lack of understanding by both industry and the regulatory authority on how this approach should be applied. The paper describes the process of using the technical guideline approach to develop a set of revegetation success standards for the proposed La Plata coal mine in northwest New Mexico. The standards were developed using on-site baseline vegetation data in conjunction with published Soil Conservation Service range site descriptions. This information was used by San Juan Coal Company and the New Mexico Mining and Minerals Division to cooperatively formulate a set of site-specific standards, addressing the concerns of post-mining livestock grazing and wildlife habitat.

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INTRODUCTION

The development of appropriate and reasonable revegetation success standards is a major concern to both coal companies and regulatory agencies in the Western United States. The regulations promulgated following

the passage of the Surface Mining Control and Reclamation Act in 1977 proposed two basic approaches to determining revegetation success: (1) use of reference areas or a similar approach (like the historic record method in New Mexico) and (2) the use of technical guidelines. The reference area approach has been used extensively in the Western United States, but has been criticized because of concerns with ecological validity, long-term management and costs. The use of technical guidelines to determine revegetation success has not been widely used because of a lack of understanding by both industry and the regulatory authority on how this approach should be applied. This paper describes the process of using the technical guideline approach in developing a set of revegetation success standards for the proposed La Plata coal mine in northwestern New Mexico. The standards were developed using on-site baseline vegetation data, published Soil Conservation Service (SCS) range site descriptions, published wildlife management

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guidelines, and other data from good quality range and wildlife sites relevant to the La Plata location. This paper discusses how this information was used by San Juan Coal Company (SJCC) and the New Mexico Mining and Minerals Division (MMD) to cooperatively formulate a set of site specific standards; standards which address the concerns of post-mining livestock grazing and wildlife habitat which both the coal company and the regulating agency found acceptable.

#### CHARACTERIZATION OF THE SITE

La Plata mine proposes to disturb approximately 1100 acres in northwestern New Mexico, just south of the Colorado state line. The site typically has a 4 month growing season, the precipitation is 11 to 12 inches per year. The rain is sparse in the spring, the heaviest precipitation falling during July and August averaging 1 to 1-1/2 inch per month, and averaging 1/2 to 1 in. per month from September through June.

The soils range from sandy loam to clay loam, with most falling in the loamy category. The areas proposed for disturbance have relatively good quality overburden in the surface 20 feet (suitable for topdressing), and geological material very unsuitable for topdressing below that 20 feet, primarily clays and shales. The surface four feet of overburden is a clay loam to a sandy clay loam texture, and falls within the criteria ranges for overburden in order for it to be an acceptable rooting medium (MMD, 1985). The plan for mining calls for selective handling of the overburden to insure that the top 4 feet of the final topography is good quality material.

The areas to be disturbed by mining are part of a winter/spring grazing allotment which is managed by BLM (La Plata Mine Plan, 1982). It has also been identified as part of an important wintering area for mule deer (Jim Ramakka, Dan Persley, Jack Reynolds). The deer primarily use the area for thermal and hiding cover, and part of a travel corridor between the La Plata river and the main feeding area east of the planned disturbance.

In addition to the mule deer, elk, mountain lion, bobcat, coyote, nearly a dozen species of raptors including the bald eagle, and well over a dozen species of small mammals and small birds have been observed on or immediately adjacent to the permit area (La Plata Mine Plan, 1982).

The area proposed for disturbance consists of 5 vegetative communities (see table 1).

Table 1.--Vegetative Types on the La Plata Mine Expected to be Disturbed.

Community	Percent Disturbance	Acres
Pinyon-Juniper Chained	46%	510
Pinyon-Juniper	31%	340
Sagebrush-Grassland	18%	200
Greasewood-Sage	4%	50
Grassland	1%	11

Source is the La Plata Mine Plan.

The P-J chaining was done in the early 1960's, and now has cover and production equally divided as 1/3 herbaceous, 1/3 shrubs, and 1/3 trees. The grassland community produces approximately 370 lbs. of non-tree forage per year, and averages approximately 8% cover. The data from these two communities were most important in devising the cover and production success standards. Data for all 5 communities are presented below in table 2.

Table 2.-- Cover and Production of the Vegetative Communities on the La Plata Mine. The P/J community cover is 80% trees.

Vegetative Type	Production (non-tree)	Cover (total veg.)
Pinyon-Juniper Chained	616 lb./acr.	9.8%
Pinyon-Juniper	275 lb./acr.	16.5%
Sagebrush-Grassland and Greasewood-Sage	840 lb./acr.	14%
Grassland	370 lb./acr.	11%

Source is the La Plata Mine Plan.

#### RECLAMATION REQUIREMENTS

The New Mexico Reclamation Act and Regulation require, as do most of the states and the Federal government, specific reclamation success standards. The New Mexico Act requires a demonstration that the productivity can be reestablished, comparable to the pre-mining land under good management. The New Mexico regulations require coal mining companies to establish a diverse, effective, and permanent vegetative cover comparable to that which existed prior to mining and supports the post mining land use.

Revegetation success can be determined by comparing the reclaimed landscape to reference areas, as an appropriate historic record (NM Rule 80-1, 1979), or a technical standard. A reference area is a plot of land (or group of

plots) which represent the entire areas to be disturbed, and exhibit: (1) the potential of the land, (2) cover sufficient to control erosion, (3) the diversity to insure the stability of the community, and (4) the density of woody plant species necessary for supporting the approved post-mining land use. For La Plata mine, this means a good quality grazing area for livestock and wildlife habitat.

Upon close examination of the permit baseline data, and the proposed permit area, it soon became apparent that the vegetative communities at the La Plata site were poor examples of grazing communities and inappropriate for success standards. Annual cheatgrass (*Bromus tectorum*) has seriously invaded the landscape, and the shrubs present (*Artemisia*, *Gutierrezia*, etc.) have little value to livestock. The surrounding area did not have sites in better condition. The Chained community did have some reasonably good mixes of trees, shrubs, and grasses, but it has been so heavily used in the part that a large portion of the herbaceous species are annuals. The pinyon and juniper adjacent to grasslands, sage communities, and in the chained P-J community are heavily browsed, and the serviceberry looked as if someone had taken the hedge trimmers to it. The cover, production, diversity, and the density of species desirable for grazing purposes were definitely missing or reduced because of the use it had received in the past. Neither the mine site, nor any sites that were examined around it, could be considered as representing the potential of the area under good management.

Additionally all agreed it was not feasible to reestablish a mature P-J forest to the 10% cover which existed in premining levels (La Plata Mine Plan, 1982). Industry and regulators realized that the reference area approach to evaluating reclamation success would not apply to this site.

This put SJCC and the MMD in a quandary, because the requirement to establish a diverse, effective, and permanent vegetative community after mining, based on standards comparable to equivalent land under good management, capable of supporting wildlife and range cattle, still remain. At this point, SJCC and MMD entered into discussions to evaluate the feasibility of developing a set of technical standards applicable to La Plata Mine, which would satisfy these requirements.

#### DATA USED TO DEVELOP THE TECHNICAL STANDARD

To develop reasonable standards which would meet these requirements, a considerable variety of data was used. This included La Plata mine plan data, published SCS range site descriptions, published wildlife management guidelines, and other detailed vegetative data on good quality grazing areas.

La Plata mine baseline data for climate, vegetation, soils, overburden, and wildlife were used. Soil and overburden were examined to gain an understanding of the quality of the root zone which will be reconstructed on the mined areas. The texture, depth, and chemical characteristics of the root zone after mining will not be the same as any community before disturbance. It was recognized that the standard should reflect potential productivity on this new environment as much as possible. Wildlife studies of the area proposed to be mined are invaluable in determining the types of habitats which need to be reconstructed. Vegetative data, even if the site has been overgrazed and is in poor condition, gives an indication of the variability in the communities because of changes in climate from year to year.

Published SCS Range Site Descriptions were used. These descriptions provide some guidelines and ideas on the potential cover and production of the land. While the information from the range site descriptions is not "statistically valid", and not always representative of a broad area, it does describe "hypothetically" excellent areas characterized by physiographic features such as slopes, aspects, elevations; climate including precipitation amounts and pattern, length of growing seasons, temperatures, winds; soil texture, depth, permeability, and classification. The range site descriptions also discuss the potential natural plant community composition from grasses, shrubs and trees, and forbs; potential vegetative cover and canopy cover; production during favorable and unfavorable years, and the use of these communities.

Published Wildlife Management Guidelines were used. There is a great deal of information which has been published on habitat requirements for mule deer, other large game, raptors, small mammals, and small birds observed on the proposed La Plata mine. This is important information to insure good quality wildlife habitat will be reestablished during reclamation.

Data from the Lee Ranch mine, and the Salt River Project area on good quality winter grazing land relevant to the La Plata mine was used as guidance for reconstruction of good quality cattle grazing areas with proper balance of shrubs, grasses, and forbs.

#### THE TECHNICAL STANDARD

After a great deal of discussion, SJCC and MMD agreed to the following revegetation success standards at La Plata mine (see table 3).

Table 3.--Revegetation Success Standards for La Plata Mine. Sources is San Juan Coal Company, 1982.

<u>Parameter</u>	<u>Grazing Areas</u>	<u>Wildlife Open Areas</u>	<u>Wildlife Clumps</u>
Cover <sup>1</sup>	14 percent	12 percent	14 percent, at least 70% composed of perennial non-tree cover.
Production <sup>1</sup>	500 pounds per acre	400 pounds per acre	400 pounds per acre
Woody Species	190 per acre	400 per acre	400 per acre; 80 of which are mature tree transplants with not more than 30% composed of Juniper.
Diversity <sup>1</sup>	3 grasses and 2 woody species <sup>2</sup>	3 grasses and 2 woody species <sup>3</sup>	3 grasses and 2 woody species <sup>3</sup>

1 Cover production and diversity will be of only perennial plant species.

2 Three grass species with relative herbaceous cover values equal to or greater than 5 percent, with no one species comprising 70 percent relative herbaceous cover. Two woody species with density values equal to or greater than 10 percent of the total woody species density, with no one species making up more than 85 percent of the total woody species density.

3 Three grass species with relative herbaceous cover values equal to or greater than 5 percent with no one species comprising more than 70 percent relative herbaceous cover. Three woody species with density values equal to or greater than 10 percent of the total woody species density, with no one species making up more than 70 percent of the total woody species density.

#### Grazing Areas

Seventy-five percent of the mined areas will be reclaimed with the primary emphasis on supporting livestock grazing during the winter months. Cover, production, diversity, and density standards were derived as follows.

1. Cover and production standards were derived using data collected on site (La Plata Mine Plan, 1982), and published SCS data. The SCS data used is for areas which closely approximate La Plata in the soil conditions which will be reconstructed, the vegetation which is native to the area, the pattern and amount of precipitation the site will receive, and other characteristics (SCS Range Site Descriptions, 1984 and 1978). The mean annual precipitation of this range site varies from nine to fourteen inches with vegetative cover ranges from ten to twenty-five percent. Adjusting the cover value for the 11.2 inches of mean annual precipitation received at La Plata, a value of sixteen percent cover is obtained. This cover value would be considered at the high end of what could be obtained on this range site because it assumes excellent range condition and includes one to two percent of vegetative cover from annuals.

Historic record data was collected for the years 1981-1984 on all vegetative communities to be disturbed at La Plata. Because of the mining

methods and reclamation involved at La Plata, the only data relevant to the post-mining landscape was that collected from the Pinyon-Juniper Chained and Grassland communities; as they more closely resemble what is being planned for reestablishment on reclaimed areas. The mean perennial vegetative cover on these two communities was measured at eight percent. Since both communities are in poor to fair range condition, the cover value needs to be increased to more closely reflect what could be obtained from the land in good range condition. It was noted that the highest total perennial cover value obtained for any transect measured on these two communities was thirteen percent. It was first summarized that an increase of fifty percent over the historic record mean cover, eight percent, to twelve percent was a reasonable estimate for these areas in good condition. SCS data, on the other hand indicated sixteen percent cover, but this was at the high end of the range site description. As the sixteen percent was considered high and the twelve percent from the historic record was considered low because of the poor condition of the range sites, the mid-point value of fourteen percent was determined to be a reasonable standard for total perennial cover.

2. Diversity of woody plant species success standard is based on the nutritional requirements of livestock on winter ranges (Cook, 1971; Merrill, 1971). It was also influenced by good quality cattle wintering ranges in New Mexico. The data used was from areas with high quality forage consisting of a good nutritional balance (Lee Ranch Mine Plan, 1981; Salt River Project, personal communication).

3. Production from perennial vegetation on revegetated grazing areas will be considered acceptable if it is not less than ninety percent of five hundred pounds per acre with ninety percent statistical confidence. The SCS data, which closely approximates the post mining landscape, has an average production of 450 pounds per acre, with a portion of that made up of tree species. It was recognized that this 450 pounds per acre may be low because the production of tree species will be replaced by herbaceous and fast growing shrub species on the grazing areas. Historic record data showed that the average production figure for the Pinyon-Juniper Chained and Grassland communities was 250 pounds per acre. Both areas are heavily used by domestic livestock and deer. It was agreed that a 100 percent increase over the historic record to a standard of 500 pounds per acre was a more realistic estimate of potential production on areas designated as livestock grazing areas.

4. Density of shrubs on land reclaimed to grazing areas will be considered acceptable if it is within 90 percent of 190 woody species per acre with 90 percent statistical confidence. This is expected to result in a grazing landscape with Atriplex canescens the dominant shrub. This density is approximately one shrub every 225 square feet (15ft. X 15ft.) and will provide the shrub component necessary for the winter nutritional requirements of grazing cattle (Cook, 1971; Severson, 1983).

#### Wildlife Open Areas and Tree/Shrub Clumps

Twenty-five percent of the disturbed area will be reclaimed to wildlife habitat. Fifteen percent reclaimed to wildlife open areas, supporting a mixture of herbaceous and shrub vegetation to provide forage and hiding cover for wildlife. Ten percent of the disturbance will be reclaimed to tree and shrub clumps with "mature" tree and shrubs to provide thermal and hiding cover for wildlife. These clumps will be located adjacent to or surrounded by the wildlife open areas whenever possible, and will also be located in drainages. The cover, production, diversity, and density standards were derived as follows.

Reestablishment of wildlife areas needs to include adequate cover to control erosion, sufficient good quality vegetation to support mule deer winter feeding (as well as other

mammals and birds), good nutritional balance in the reestablished vegetation, thermal and hiding cover, and establishment of optimum edge effect (Severson, 1983).

#### Open Areas

The revegetated area for the benefit of mule deer should include a mix of trees, shrubs, forbs, and grasses to allow deer to select the most favorable nutritional balance and to help to assure some plant species are available under all winter conditions (Bartman, 1983). Mule deer diets, during the fall and winter in Colorado and New Mexico, consist of between 70% and 90% shrubs and trees, 10% to 15% forbs, and 5% to 10% grasses (Kufeld, 1973; Fish and Wildlife, 1979). Winter forage consists primarily of serviceberry (Amelanchier utahensis), mountain mahogany (Cercocarpus montanus), juniper (several species), pinyon pine (Pinus edulis), gambles oak (Quercus gambelii), bitterbrush (Purshia tridentata), cliffrose (Cowania spp.), and skunkbush (Rhus spp.) (Kufeld, 1973; Bartman, 1983). Artemesia in general is low in palatability, and is taken in quantity by mule deer only when alternate forage is exhausted (Carpenter, 1979).

The success standard needs to contain sufficient herbaceous component to provide for a quick cover for erosion control and habitat for small animals and birds. At the same time it must not be a community so dominated by grasses and forbs that the shrubs and trees can not be successfully established (Forest Service, 1979).

Production needs to be sufficient for good wildlife carrying capacity. It must also be dominated with forage and browse preferred by wildlife. The 500 pounds per acre production for grazing areas was reduced to 400 pounds per acre to take into consideration the slow growing shrubs preferred by wildlife.

Density of woody plants must be sufficient to provide a nutritional balance necessary for a healthy wildlife population. There must also be sufficient shrub and tree densities to provide the foundation necessary to allow the reclaimed community to develop into a good quality wildlife habitat as the site "matures". The density of 400 woody plants per acre is a recommendation based on Severson (1983), the U.S. Forest Service (1977), and takes into consideration the native shrubs to be reestablished at La Plata Mine.

There must be sufficient diversity of life forms and species of each of the life forms to help insure stability of the reestablished plant community, and provide a diversity of habitats. The actual numbers of each life form is based on baseline data and SCS data.

## Tree/Shrub Clump

For trees to provide minimal thermal cover, they must be islands at least 2-5 acres in size with a minimum width of 300 ft., and the trees should be at least 5 ft. high. The revegetation should maximize the "edge effect". Island of trees should be established on slopes and along drainages with interseeding of forbs, grasses, and shrubs (Severson, 1983). These stands should have at least 75 trees per acre with openings between 100 and 600 feet wide to be usable by the deer (Short, 1977). MMD and San Juan Coal Co. agreed that as a criteria for reclamation success, wildlife habitat would be reestablished on 25% of the disturbed area.

At least 10% of the reclaimed area will consist of 5 acre islands of pinyon and juniper tree/shrub clumps. The trees should be 6 feet tall or taller. Establishing trees at least 6 feet tall will minimize die-back from browsing damage, provide a usable deer habitat, and a seed source. These juvenile conifers will be established at a density of at least 80 per acre. At least 70% of the trees will be pinyon. Commercial landscapers have 90% survivability with transplanting 6-8 foot tall "juvenile" pinyons with a commercially available tree spade, and somewhat less success with junipers (Trees of New Mexico, 1985). Pinyon trees grow very slowly (typically an inch per year for the first 10 years or so), and do not produce cones in quantity until they are 75 to 100 years old, standing 10 feet high or higher (Little, 1977). The 6 ft. trees will provide some seed.

The cover, production, diversity, and density standards for the wildlife clumps is the same as for the wildlife open areas with the exception that at least 80 of the 400 woody species per acre must be trees 6 feet tall or taller, and 70 percent of the trees will be pinyon.

## MONITORING AND RESEARCH

The revegetation success standards are based on the best information available to date and are estimates of what is believed achievable on reclaimed areas of La Plata under good management practices. These standards are projections based on data, and the professional judgement of industry and government personnel. SJCC will design research to examine various ways to establish the tree, shrub, and herbaceous cover necessary to meet these revegetation success criteria, and evaluate which is economical. The company will work closely with the regulatory authority in the design of this research, and the data generated from it. The revegetated areas and research results will be monitored closely to evaluate the standards. MMD and SJCC agree that if this data shows a significant deviation from these revegetation standards, they will be reviewed, and changed appropriately.

The research will include evaluating a variety of means of transplanting "mature" trees and shrubs. Variables planned to be examined include survivability of transplants of various sizes, various ages, in various rooting materials (rock under topsoil, etc.), "hardening" of shrubs, water harvesting (pits, in furrows, etc.), and the effects of the density of herbaceous strata. Another aspect which will be carefully evaluated is the economics of various alternatives.

This research will provide the detailed procedures and methods for reestablishing the wildlife habitat.

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