District I
1625 N. French Dr., Hobbs, NM 88240
District II
1301 W Grand Avenue, Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources
Department
Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-144 CLEZ
July 21, 2008

For closed-loop systems *that only use above ground steel tanks or haul-off bins and propose to implement waste removal for closure*, submit to the appropriate NMOCD District Office.

Closed-Loop System Permit or Closure Plan Application

(that only use above ground steel tanks or haul-off bins and propose to implement waste removal for closure)

Type of action: [X] Permit [ ] Closure

Instructions: Please submit one application (Form C-144 CLEZ) per individual closed-loop system request. For any application request other than for a closed-loop system that only use above ground steel tanks or haul-off bins and propose to implement waste removal for closure, please submit a Form C-144.

Please be advised that approval of this request does not relieve the operator of liability should operations result in pollution of surface water, ground water or the environment. Nor does approval relieve the operator of its responsibility to comply with any other applicable governmental authority's rules, regulations or ordinances.

1.

Operator: The Kelly Family Land Company, Inc., c/o BHP Billiton San Juan Coal OGRID #: 262908

Address: P. O. Box 561, Waterflow, NM 87421

Facility or well name: Kelly #1

API Number: 30-045-26494 OCD Permit Number:

U/L or Qtr/Qtr SE Section 25 Township 30N Range 15W County: San Juan

Center of Proposed Design: Latitude Longitude NAD: [ ]1927 [ ] 1983

Surface Owner: [ ] Federal **X** State [ ] Private [ ] Tribal Trust or Indian Allotment

2.

[X] **Closed-loop System:** Subsection H of 19.15.17.11 NMAC

Operation: [ ] Drilling a new well [ ] Workover or Drilling (Applies to activities which require prior approval of a permit or notice of intent) **X** P&A

X Above Ground Steel Tanks or [ ] Haul-off Bins

3.

Signs: Subsection C of 19.15.17.11 NMAC

[ ] 12"x 24", 2" lettering, providing Operator's name, site location, and emergency telephone numbers

[X] Signed in compliance with 19.15.3.103 NMAC

4.

Closed-loop Systems Permit Application Attachment Checklist: Subsection B of 19.15.17.9 NMAC

Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

[X] Design Plan - based upon the appropriate requirements of 19.15.17.11 NMAC

[X] Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC

[X] Closure Plan (Please complete Box 5) - based upon the appropriate requirements of Subsection C of 19 15.17.9 NMAC and 19.15 17.13 NMAC

[ ] Previously Approved Design (attach copy of design) API Number:

[ ] Previously Approved Operating and Maintenance Plan API Number:

5.

Waste Removal Closure For Closed-loop Systems That Utilize Above Ground Steel Tanks or Haul-off Bins Only: (19.15.17.13.D NMAC)

Instructions: Please indentify the facility or facilities for the disposal of liquids, drilling fluids and drill cuttings. Use attachment if more than two facilities are required.

Disposal Facility Name: Envirotech Disposal Facility Permit Number: NM-01-0011

Disposal Facility Name: Basin Disposal Disposal Facility Permit Number: NM-01-005

Will any of the proposed closed-loop system operations and associated activities occur on or in areas that *will not* be used for future service and operations?

[ ] Yes (If yes, please provide the information below) X No

Required for impacted areas which will not be used for future service and operations:

[ ] Soil Backfill and Cover Design Specifications - - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC

[ ] Re-vegetation Plan - based upon the appropriate requirements of Subsection I of 19.15.17.13 NMAC

[ ] Site Reclamation Plan - based upon the appropriate requirements of Subsection G of 19.15.17.13 NMAC

6.
Operator Application Certification:

I hereby certify that the information submitted with this application is true, accurate and complete to the best of my knowledge and belief.

Name (Print): John Mercier Title: Senior Mine Geologist

Signature: John Mercier Date: 10/29/08

e-mail address: Telephone: (505) 598-2000

7.
OCD Approval: ☒ Permit Application (including closure plan) ☐ Closure Plan (only)

OCD Representative Signature: Brandon Powell **Approval Date:** 11-10-08

Title: Envirospec **OCD Permit Number:**

8.
Closure Report (required within 60 days of closure completion): Subsection K of 19.15.17.13 NMAC

Instructions: Operators are required to obtain an approved closure plan prior to implementing any closure activities and submitting the closure report. The closure report is required to be submitted to the division within 60 days of the completion of the closure activities. Please do not complete this section of the form until an approved closure plan has been obtained and the closure activities have been completed.

☐ **Closure Completion Date:**

9.
Closure Report Regarding Waste Removal Closure For Closed-loop Systems That Utilize Above Ground Steel Tanks or Haul-off Bins Only:

Instructions: Please indentify the facility or facilities for where the liquids, drilling fluids and drill cuttings were disposed. Use attachment if more than two facilities were utilized.

Disposal Facility Name: Disposal Facility Permit Number:

Disposal Facility Name: Disposal Facility Permit Number:

Were the closed-loop system operations and associated activities performed on or in areas that *will not* be used for future service and operations?

☐ Yes (If yes, please demonstrate compliance to the items below) ☐ No

Required for impacted areas which will not be used for future service and operations:

☐ Site Reclamation (Photo Documentation)
☐ Soil Backfilling and Cover Installation
☐ Re-vegetation Application Rates and Seeding Technique

10.
Operator Closure Certification:

I hereby certify that the information and attachments submitted with this closure report is true, accurate and complete to the best of my knowledge and belief. I also certify that the closure complies with all applicable closure requirements and conditions specified in the approved closure plan.

Name (Print): Title:

Signature: Date:

e-mail address: Telephone:

The Kelly Family Land Company, Inc., c/o BHP Billiton San Juan Coal Closed-loop Plans

Closed-looped Design Plan

Redwolf Production, Inc., c/o BHP Billiton San Juan Coal's closed-loop system will not entail a drying pad, temporary pit, below grade tank or sump. It will include an above ground tank suitable for holding the cuttings and fluids for rig operations. The tank will be sufficient volume to maintain a safe free board between disposal of the liquids and solids from rig operations.

1. Fencing is not required for an above ground closed-loop system
2. It will be signed in compliance with 19.15.3.103 NMAC
3. A frac tank will be on location to store fresh water

Closed-loop Operating and Maintenance Plan

Redwolf Production, Inc., c/o BHP Billiton San Juan Coal's closed-loop tank will be operated and maintained to contain liquids and solids in order to prevent contamination of fresh water sources, in order to protect public health and the environment. To ensure the operation is maintained, the following steps will be followed:

1. The liquids will be vacuumed out and disposed of at the Basin Disposal facility (Permit #NM-01-005). Solids in the closed-loop tank will be vacuumed out and disposed of at Envirotech (Permit #NM-01-0011) on a periodic basis to prevent over topping.
2. No hazardous waste, miscellaneous solid waste or debris will be discharged into or stored in the tank. Only fluids or cuttings used or generated by rig operations will be placed or stored in the tank.
3. The division district office will be notified within 48 hours of the discovery of compromised integrity of the closed-loop tank. Upon the discoveryof the compromised tank, repairs will be enacted immediately.
4. All of the above operations will be inspected and a log will be signed and dated. During rig operations, the inspection will be daily.

Closed-loop Closure Plan

The closed-loop tank will be closed in accordance with 19.15.17.13. This will be done by transporting cuttings and all remaining sludges to Envirotech (Permit #NM-01-0011) immediately following rig operations. All remaining liquids will be transported and disposed of in the Basin Disposal facility (Permit #NM-01-005). The tanks will be removed from the location as part of the rig move. The operator of this well is also the land owner; San Juan Coal will reclaim the well site in compliance to the mine's reclamation plan and to the land owners satisfaction. . See Attached plan BP

Subpart 906

RECLAMATION PLAN: GENERAL REQUIREMENTS

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LIST OF APPENDICES

APPENDIX NUMBER	APPENDIX TITLE
906 A	Diversity Structures
906 B	Slope Stability Analysis Piñon Pit Post Mining Bluffs
906.C	Grazing Plan for Gravel Hill and Sage/Yucca Pits
906.D	Post Mining Land Use Management Livestock Grazing Demonstration
906.E	Grazing Plan For All Reclaimed Areas Starting in 1998
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906.G	Summary of Linear Regression
906.H	Reference Area Proposal for Determination of a Revegetation Success Standard

Subpart 906

RECLAMATION PLAN: GENERAL REQUIREMENTS

LIST OF MODIFICATIONS DURING PERMIT TERM

MOD. NUMBER	MODIFICATION DESCRIPTION	DATE APPROVED
05-03	Modification to the Post Mining Topography for Changes to the Pinion Pit Main Channel Design	06-Jun-05
05-08	AOC Revision Juniper Pit for the Area Between Gravel Hill and the South Lease Extension Reclaim	30-Jan-06
06-01	Electronic Merger of both the Surface and Underground Permits 04-01	
07-02	Update of Juniper/South Portal area West of South Lease	

SECTION 906 RECLAMATION PLAN: GENERAL REQUIREMENTS

906.A Reclamation Plan for Lands Within the Proposed Permit Area

The information provided in this section consists of a comprehensive reclamation plan for all areas disturbed during the surface operation and any proposed disturbance with the underground operations within San Juan Mine (SJM) existing permit area. Limited surface disturbance will occur as a result of underground mining activities. The existing pit where the entries are located will be backfilled and reclaimed in accordance with the approved reclamation plan in this subpart. Reclamation requirements for mitigation of subsidence features, sealing of mine entries, and removal of support facilities unique to the underground operation are addressed in this subpart and Subpart 918 (Subsidence Information and Control Plan). The information is intended to satisfy reclamation performance standards pursuant to Sections 69-25A-19 and 69-25A-20 NMSA 1978 of the Act and corresponding sections of the surface mining regulations 19NMAC 8.2.

San Juan Coal Company (SJCC) is committed to the successful reclamation of all areas disturbed during coal surface mining and related activities. The following subsections provide a description of reclamation operations for lands disturbed directly by mining operations and areas disturbed by mine facilities construction, roads and associated activities. It is the objective of SJCC to establish a diverse, effective, and permanent vegetative cover composed of species native to the area. Final vegetative cover will be compatible with the post mine land use of grazing and wildlife habitat and will be effective in stabilizing the soil resource and providing vegetal production of equal utility to that which existed prior to mining.

906.B Specific Reclamation Plan: San Juan Mine Surface and Underground

906.B(1) Reclamation Time Table

It is SJM's intent to reclaim all mining areas as quickly as practicable. However, most un-reclaimed areas that remain from surface operations mining disturbance are to be utilized for ash placement. Coal combustion by-products (CCB) from the San Juan Generating Station will be utilized for backfill in final pits created during surface operations. This CCB comes from coal that is now being mined underground at SJM. Therefore, the mining operation cannot be clearly categorized according to the mining methods identified in 19 NMAC 8.2 Subpart 20 (2054). This requires that the timing of contemporaneous reclamation be defined by SJM personnel and approved by the Director of Mining and Minerals Division (MMD).

The regrade schedule and an estimate of annual regrade acres for the 5-year permit term are shown on Exhibit 906.B(1)-1 (Primary Regrade Schedule). The CCB backfill schedule is also provided in Exhibit 906 B(1)-1. This schedule shows the primary ash placement sites in each period. CCB placement is described in Subpart 900. Primary grading activities are described in detail in Section 906.B(3).

The timing of reclamation activity is dependent upon many factors. The major factors are:

1) Coal Sale Schedule
2) CCB Management
3) CCB Cover (spoil)
4) Natural topography (including drainage)
5) Approximate Original Contour (AOC) criteria
6) End Use of Support Facilities

The regrade schedule for Juniper and Piñon Pits is dependent on the CCB placement schedule. This includes several large areas of spoil materials that have been set aside for covering CCB and creating the final reclamation surface.

The regrade schedule for Cottonwood Pit (South of Juniper) is not dependent on CCB placement but on closure of the South Underground Portal. CCB's will not be placed in this area except up against the exposed coalface to help control spontaneous combustion of the coal. Once the South Underground Portal is no longer required, the portal will be plugged and the pit area around the portal backfilled with spoil.

Reclamation associated underground activities will be minimal, with most of the disturbance being associated with facilities such as the mine entries and vent shafts. These support facilities will be reclaimed upon final closure of the underground mine, or sooner if a facility has reached the end of its life, such as the District 200 ventilation shaft (estimated life: 5 years). The current estimated life-of-mine extends through 2024.

Mitigation of subsidence will occur on an as needed basis upon discovery of problematic subsidence features

906.B(2) Reclamation Cost Estimate

The reclamation cost estimate for SJM is considered confidential and has been provided to MMD under separate cover.

906.B(3) Backfilling and Grading Plan

The following performance standards 1 through 14 were used to develop the AOC design through the Cottonwood Pit reclamation beginning in the year 2001. Beginning in 2001, with the Cottonwood Pit reclamation, SJM shifted its hydrologic reclamation approach to create a final surface configuration (FSC) that is not dependent on riprap, terraces, or other "hard engineering" approaches to stabilize drainages and control erosion (see Piñon FSC design Exhibit 906.B(3)-1 (1 of 2) and Juniper FSC design Exhibit

906 B(3)-1 (2 of 2). The changes incorporated after the Cottonwood Pit reclamation in 2001 are described in item 14 below.

1) It is shaped to accommodate the designated post-mining land use of grazing.

2) It is designed so that the overall soil loss value for the post-mining topography is similar to the pre-mining soil loss value. The pre-mining soil loss value is 2.19 tons/acre/year as documented in Subpart 805, Surface Water Information.

3) Diversity structures will be incorporated into the post-mining topography. These structures will be placed in opportunistic locations during the regrade process and shall not be sampled for production and cover. Examples of diversity structures are described below and in Appendix 906 A (Diversity Structures)

   a) Rock Structures – structures built with rock ranging from loose piles of durable rock (rabbit condos) to rocky ledges. Such structures will be less than 15 feet in height, less than 500 feet in length, and will utilize durable rock ranging in size from 0.5 feet to greater than 10 feet. Approval will be sought for rock structures that exceed this height and length.

   b) Small local depressions, with a capacity less than one acre foot. It is designed so that all interior slopes will not exceed 6.5 horizontal to 1 vertical and all exterior slopes will not exceed 3 horizontal to 1 vertical (with the exception of the final bluffs and rock structures see items 3 and 9 of this section).

4) Slopes with complex profiles are used when appropriate to minimize soil loss.

5) The post-mining drainage density approximates the pre-mining drainage density.

6) All exposed mineable coal seams are covered with four feet of non-combustible material.

7) A 27% swell factor is used for the dragline material and a 23% swell factor is used for the pre-stripping material. These swell factors are based on actual experience at SJM.

8) Final bluffs are incorporated into the AOC design to provide cliff type habitats similar to those that existed in the pre-mining topography. Section 905, Fish and Wildlife Plan and Section 809, Wildlife Survey, demonstrates the need to replace the cliffs. Sections showing typical configurations of the final bluffs is presented on Exhibit 906 B(3)-2, (Piñon Final Bluff Cross Sections), with the section locations shown on Exhibit 906.B(3)-1 (1 of 2), (Piñon Final Surface ...). The final bluffs will be incorporated into the AOC based on the following parameters:

9) The final bluffs will have a safety factor of 1.3 or greater and will not pose a hazard to persons or wildlife in the area. Final bluffs in the Piñon Pit area are being developed within the permit term. A geomechanical study performed by MSE, Inc. of Butte, Montana documenting the safety factor for the Piñon Pit final bluffs is included in Appendix 906.B (Slope Stability Analysis...).

10) Total length for the major post-mining final bluffs are approximately 2,500 feet, compared to 12,000 feet of pre-mining cliff type habitat. All the cliff type habitat talus/rimrock that existed prior to mining is identified on the map labeled Wildlife Habitat Study, 1990, located in Appendix

809 B. Locations of major pre and post-mining bluff type habitats are shown on Exhibit 906 B(3)-3, (Pre-Mining Cliff ...).

11) The ends of the final bluff will be blended into the surrounding topography with slopes that are less than three horizontal to one vertical.

12) Spoil will be retained on the solid portion of existing or new benches.

13) Drainage channels in the reclaimed areas will be designed using standard engineering practices to safely pass design velocities and may include the use of protective channel lining (i.e. rip-rap). Final designs shall be submitted for approval to MMD before construction of the channels begins.

14) The methods that will be used to design the final surficial hydrologic features are outlined in Subpart 907.A.1, "re-establishment of drainageways". Beginning in 2001 with the Cottonwood pit reclamation, SJM shifted its hydrologic reclamation approach to create a FSC that is not dependent on riprap, terraces, or other "hard engineering" approaches to stabilize drainages and control erosion. The earlier mine permits describe the methods used for re-establishment of drainages then. Generally, SJM will control soil erosion through the use of shorter, flatter slopes. The FSC design will have stable drainages by using fluvial geomorphic principles to create channels that are appropriate for the post-mining slope, aspect, earth materials, vegetation, and land use. The backfill and grading plan will show the valley location for each major drainage. A major drainage is generally defined as a higher order channel that occupies a valley floor and collects water from lower order channels draining upland slopes. The backfill and grading plan will show the valley slope and meander belt width that SJM has determined are necessary for the channel type that will occupy the valley. The backfill and grading plan will depict the drainage density that SJM has determined necessary for valley wall slopes as blue lines on the plan. Drainage density is defined as length of channel divided by area of land drained by the channel. The necessary channel length for each subwatershed area will be shown on the plan, but the location of the subwatershed boundaries and channels may shift slightly during the earthwork. Any field changes made will not alter the specified drainage densities. In summary, the backfill and grading plan will show:

    a) The valley location for each major drainage,

    b) The valley slope and meander belt width for the channel type that will occupy the valley, and

    c) The drainage density for the valley wall slopes represented by blue lines for the channel length.

The FSC design that will result from this backfill and grading plan will have increased topographic diversity to allow for a more diverse plant community and wildlife habitat, and provide geomorphically suitable and stable landforms. MMD will approve this FSC prior to San Juan Mine spreading topsoil over the regraded surface.

906.B(4) Soil Handling Plan

Topsoil/Topdressing removal and distribution will affect the physical, chemical, and biological qualities of a soil. SJCC will endeavor to manage topsoil resources to minimize the negative effects of salvaging, stockpiling, and replacing soils to the extent practicable.

The need for salvaging suitable soil resources has significantly decreased since the discontinuation of surface operations. However, there may be a need to remove small strips of topsoil along undisturbed areas to facilitate tie-in of future reclaim areas. If this occurs, undisturbed, suitable soils will be laid- back to the extent needed for tie-in and re-spread over the tie-in spoil materials. Areas requiring tie-ins are not expected to be significant in size (maximum of 20 ft. wide strips if need), but if larger areas are required, SJCC will consult with MMD for approval.

Special soil handling criteria established for the underground activities are discussed below:

Prior to surface disturbance for any facility that is five acres or greater in size, a site-specific investigation will be conducted to identify sources of suitable topsoil and to determine the salvageable depth.. In this case, sampling will be done within a 100-foot radius beyond the projected disturbance at 200-foot centers. Upon completion of the field investigation, a soils report will be provided to MMD for review and approval that includes a map (1:6,000), volumetrics, and a site-specific soil handling plan.

For linear disturbances approximately 20 feet in width (i.e., minor access roads, powerline corridors, etc.) and disturbances less than five acres, a qualified environmental scientist will be present when the site is initially disturbed to identify suitable materials for salvage or submit a site-specific soils investigation report, as described above. In this instance, salvaged topdressing material will be stored in windrows and seeded, or stockpiled in approved areas.

All other soils activities not described for the special handling criteria for underground will be handled according to the specific information that follows.

Topdressing Sampling

An intensive soil sampling program, preceding disturbance, is conducted to identify soil material suitable as topdressing for reclamation. The majority of the sampling program is conducted during the summer season because of dry weather conditions (less surface disturbance) and increased manpower. Soil samples are collected in advance of planned disturbance.

Soils will be sampled on an average grid system of 200 feet. Soil is sampled either by digging test pits with a backhoe, or a drill rig using a core barrel auger. Backhoe test pits will only be used in shallow soils, not to exceed five feet. At depths greater than five feet it becomes a safety hazard with the possibility of

collapsing walls. As an alternative, a soil hydraulic probe with a Shelby tube sampler may be used for sampling surficial soil (upper 5 feet of material). However, extraction will continue until a restrictive layer/physical impedance is encountered. Deeper soils are sampled by a core barrel auger or similarly effective piece of equipment, which is used to sample from the surface to any desired depth.

Topdressing samples for analyses will be taken from representative profiles at each visually distinct horizon to a depth of five feet, to a lithic or paralithic contact, or to an unsuitable horizon (e.g., carbonaceous parent material), whichever comes first. The sampling activity will be coordinated by a qualified professional soil scientist.

Potentially suitable topdressing material below five feet (regolith) will be sampled by regolith drilling. This is core drilling of soil from the surface to bedrock. This program is only conducted in areas where the baseline soil survey and surface soil sampling program indicates potential for large quantities of suitable topdressing below five feet. The locations of the drilling program will be determined by a qualified professional soil scientist based upon the analytical results of the surface sampling program. Samples for analyses will be taken by a qualified professional soil scientist at each visually distinct horizon through the regolith profile. Such visual distinctions will include but are not limited to: paralithic contacts, carbonaceous layers, gravel layers, and accumulations of carbonates/salts/gypsum.

Soil samples will be sent to a soil analytical laboratory for the following analyses to determine topdressing suitability.

1) Texture
2) pH
3) Electrical Conductivity (EC)
4) Calcium (Ca)
5) Magnesium (Mg)
6) Sodium (Na)
7) Sodium Adsorption Ratio (adjusted) (SAR)
8) Saturation Percentage (SP)
9) Percent Coarse Fragments (Ocular estimate)

Determination of topdressing suitability for an individual soil sample is based on criteria presented in Table 906.B(4)-1, Topdressing Suitability Rating Guide. Soils that have one or more parameters falling into the unsuitable category are classified unsuitable and are not salvaged.

Topdressing Removal

Suitable topdressing will be salvaged from all areas to be affected by surface operations or construction of major structures, except in the following situations.

1) Equipment and personnel safety requirements prohibit operating equipment on slopes that are steeper than 3H:1V. Therefore, topdressing on slopes steeper than 3H:1V will not be salvaged.

2) Where removal of thin surface layers will likely cause excessive contamination from unsuitable subsurface layers. Field inspections will be made to determine the depth limit that suitable topdressing can be salvaged. These limits range from a few inches to six inches depending on equipment utilized.

3) Where removal of small patches or pockets causes excessive contamination from surrounding unsuitable material. Field inspections will be made to determine the size limit of the patches or pockets. The limits are affected by size, shape and depth of the area. Typically, areas of less than one acre cannot be removed. However, each area will be evaluated.

4) Topdressing material will not be removed in areas where safety and operational hazards such as rock rims and outcrops are present.

Topdressing materials are removed by scrapers or a truck and loader operation. Scrapers are used to remove topdressing in areas with generally less than 10 feet of suitable material and/or the topdressing is being directly re-spread on regraded areas. The truck and loader operation is used when the topdressing is thick and/or the hauls are long. The following procedures are followed to insure that topdressing resources are fully utilized:

1) The depth of suitable topdressing is determined as described in Subpart 810, Soil Resource Information.
2) Prior to topdressing removal the boundaries and depth of the area to be salvaged are surveyed and staked.
3) Cut stakes will be located on a grid with approximately 200 foot centers. Complex landscapes will typically have closer spacing and homogeneous landscapes will have more distant spacing. The maximum distance between sample sites will be 600 feet.
4) During topdressing removal operations, frequent inspections are made to assist operations and to insure that all, and only, suitable topdressing material is being removed. Cut stakes are reset if necessary to provide continued control for the removal operations.
5) The topdressing removal area will be designed to minimize the potential for erosion.

Topdressing Storage

Removed topdressing material will be stockpiled only when it is impractical to directly re-spread it on regraded areas. SJM does not intend to construct any new topsoil stockpiles in this Permit Term. However, the following procedures will be used when topdressing is stockpiled:

1) Topdressing stockpiles are located on stable areas within the permit area.
2) Topdressing material is not removed from the topdressing stockpile until it is needed for re-distribution on regraded areas.
3) Topdressing stockpiles are constructed by scrapers or end dump trucks. Traffic operating on the stockpile during construction is limited to minimize compaction.
4) Drainage and sediment control structures are built around topdressing stockpiles, if necessary.
5) Topdressing stockpiles generally are not seeded to control wind or water erosion. Seeding of inactive stockpiles would yield limited results in terms of establishing a vegetative groundcover sufficient to control erosion. Irretrievable losses of soil due to wind or water erosion from soil stockpiles at SJM are usually negligible. Overland flow from topsoil stockpiles is intercepted by ring ditches/berms that prevent topsoil from washing beyond the stockpile perimeter. On steeper stockpile faces, a series of waterbars or berms may be installed to intercept and promote infiltration of runoff. In addition, berms left on the tops of the stockpiles serve to reduce wind velocity and its ability to detach and transport soil particles via saltation or suspension. If a determination is made that current methods are ineffective in controlling erosion on existing topdressing stockpiles, other erosion control strategies may be implemented following MMD consultation and approval.
6) Topdressing stockpiles are marked and numbered to assist in resource management.

Topdressing Balance

The amount of suitable topdressing material available was determined based on the soil survey presented in Subpart 810, Soil Resource Information. The volumes of suitable topdressing resources are summarized in Subpart 810, Soil Resource Information.

The volumes may change as more information is gathered and evaluated. A significant change could have serious repercussions in the latter years of the mine life (i.e., a shortage or excess of topdressing could exist). For this reason, SJM compiles a complete topdressing balance study each year based on the most current information and submits the new information each year in the Annual Report to the Director of MMD. The topdressing replacement depth will be adjusted annually for Piñon Pit and Juniper Pit based on new information.

Topdressing Placement

Topdressing from stockpiles or directly from insitu soil reserves is placed on regraded areas for the purpose of reclamation. Topdressing will be distributed over the entire area affected by mining or mining-related activities. The revegetation plan for SJM (906 B(5)) was developed to support post-mining landuses and specifies that two seed mixes (grassland and shrubland) will be applied to reclamation areas. Variable topdressing thickness will be used to promote the overall revegetation effort. Shallow topdressing will be replaced on sloping areas targeted for the shrubland seedmix and thicker topdressing will be replaced on the more level topographic positions targeted for the grassland seedmix.

As stated previously in this section, topdressing is subjected to annual soil balance adjustments provided in the Annual Mine Progress Report. In 2005, the estimated thickness of topdressing available for respread in Juniper and Piñon was 7 and 22 inches, respectively. The minimum, average thickness of topdressing material replaced in Juniper and Piñon pits will be 9 and 12 inches respectively. Additional topdressing material potentially needed to meet minimum replacement requirements in Juniper will be sourced from topdressing stockpiles in Piñon or from suitable insitu soils. The Juniper Pit area has historically contained shallow soils resulting in less topdressing than is available from Piñon Pit. Consequently, topdressing replacement thicknesses will not be varied in Juniper Pit.

In Piñon Pit, the overall balance of topdressing material will be maintained within each reclamation block. The topdressing thickness within a reclamation block will be varied based on landform, aerial extent, and soil balance. Landforms with slopes greater than 5% will be targeted for shallow topdressing placement (approximately 9 inches in Piñon). Landforms with less than 5% slopes will be targeted for thick topdressing placement. The thickness of topdressing on the more level landforms (<5%) will be calculated using a weighted average approach based on relative aerial extent and soil balance as follows:

$$((\text{Predetermined thickness A}) \times \frac{(\%\text{ of reclamation block area with } >5\%\text{ slopes})}{100}) + ((\text{Thickness B}) \times \frac{(\%\text{ of reclamation block area with } <5\%\text{ slopes})}{100}) = \text{SB}$$

Where, Thickness A (shallow) = 9 inches for Piñon Pit

Thickness B (deep) = Determined based on above formula

SB = Applicable Pit soil balance

Topdressing thickness will vary from the targeted depth within close proximity to designed features including drainage channels, rock structures, and small area depressions. Delineations of shallow and thick topdressing replacement areas will be provided to MMD in the Annual Mine Progress Report.

Heavily compacted regrade surfaces will be ripped or disked to depth of approximately 12 inches prior to placement of topdressing materials. Alternative implements such as a V-ripper has been successfully used by SJCC to alleviate compaction after respread of topdressing. The V-ripper or similar types of implements may be used in lieu of ripping. Generally, compaction of final regraded surfaces is minor because dozers are used for final shaping. Compaction is generally more likely to occur when rubber tired equipment such as rock trucks and scrapers repeatedly follow the same travel route. Deep ripping or disking will be completed as needed on heavily trafficked areas to enhance the physical properties of regraded materials.

All ripping and disking will be done on the contour to conserve water and minimize erosion, except on slopes that are too steep for safe equipment operation.

906.B(5) Revegetation Plan

Revegetation will be initiated on areas that have been graded and topdressed during the first normal period for planting the year following completion of topdressing activities. All seeding, mulching, and crimping will be done during the months most favorable for reclamation success.

The goal of all revegetation activities at SJM will be to establish a diverse, effective and permanent vegetative cover composed of species native to the area. This vegetative cover will be compatible with the post-mining land use and capable of stabilizing the soil resource and providing vegetal production of equal or superior utility to that which existed prior to mining.

Seedbed Preparation

Topdressing material used for seedbed preparation will be handled according to the procedures and methods described in Section 906.B(4) Soil Handling Plan. The topdressing material that has been redistributed on regraded areas will be scarified as soon as possible following placement. This will be done in order to:

- Reduce soil compaction caused by heavy equipment used in regrading and redistribution of topdressing,
- Promote water infiltration and storage, and
- Help control wind and water erosion.

In order to maximize the above objectives, all scarification will be done on the contour to the greatest extent possible with consideration given to the safety of men and equipment.

Fertilization

Fertilization has been found to encourage unfavorable competition from non-native or undesirable species, and will not be employed in seedbed preparation or reseeding operations. Native grass hay mulches presently used typically have lower carbon to nitrogen ratios than straw, substantially decreasing the need for soil amendments. If it is found that specific areas are nutrient-deficient, amendments may be added accordingly.

Seed Mixes and Seeding Techniques

Since 1974, the seed mix (species and amounts) has been the subject of extensive research. Generally, the number of species seeded has increased since the first seeding; while the seeding rates (pounds of pure live seed planted) have decreased. In 1974, only five species were seeded including one shrub species (*Atriplex canescens*) compared to 1980 when ten species were seeded, including three shrub species. The number of seeds per square foot has gone from a high of about 90 to 40.3 viable seeds per square foot in 1988. The seeding rate is the subject of continual investigation to determine its impact on revegetation survival. The present rate is based on past field observations and may be modified as more research data becomes available.

From the research and field observations, SJCC has developed a revegetation species list of native plant species occurring at SJM. These species have adapted, over time, to the site specific conditions and vegetation types presented at SJM. These adaptations lead SJCC to expect these species to succeed following mining. The species selected for inclusion into revegetation species list are dominant native species exhibiting desirable characteristics for seed availability, viability, revegetative capability, palatability, provision for seed cover, and/or erosion control. The characteristics of the species selected for the revegetation species list are presented in Table 906.B(5)-1 (Revegetation Species List...).

From this revegetation species list, SJCC has devised two standard reclamation seeding mixes for use at SJM (Table 906.B(5)-2 (Standard Seeding Mixes...)). These standard seeding mixes include a grassland seeding mix and a shrubland seeding mix. Both seed mixes contain combinations of grasses, forbs and shrubs; however the percentage of seeds per square foot for each life form varies between the different mixes. The grassland standard seed mix, targeted for 0 to 5% slopes, is comprised of 57% grass species, 23% forb species, and 20% shrub species, while the shrubland standard seeding mixture, targeted for >5% slopes, is comprised of 30% grass species, 15% forb species, and 55% shrub species.

Within a reclamation area, approximately 75% of the area (<5% slopes) will be planted with the grassland seeding mix, while approximately 25% of the area (>5% slopes) will be planted using the shrubland seeding mix. These ratios are intended to comply with the technical standard for shrub density. The

shrubland seeding mix will be generally applied to areas with steep slopes; however, it may also be applied to gentle slopes, depending on the reclamation area, to create a diverse vegetative community structure.

In the event that a species is unavailable or cost prohibitive for seeding, the standard seeding mixes can be modified with the alternative species list in the revegetation species list (Table 906 B(5)-1 (Revegetation Species List...)). These modifications will maintain the percentages of seeds per square foot for each life form. These modifications to the standard seeding mixes will be documented for future reference in the annual report.

The species will be obtained on the basis of availability and cost from reputable suppliers. To ensure that good quality seed is used, state certification standards and standards outlined under the Federal Seed Act will be followed.

Research on other species that are adapted to the mine area and are considered to be compatible with the post-mining land use is continuing at the SJM. Should other native or introduced species indicate suitability for revegetation and compatibility with post-mining land use, they will be added to the revegetation species list with the approval of the Director of the MMD.

Seeding will be accomplished using a rangeland drill and/or broadcasting techniques. The techniques used will be determined on a site specific basis. Drill rows will be eight to twelve inches apart. To the greatest extent possible, all seeding will be done with the contour of the land.

South Lease Extension Seed Mix

In consultation with MMD, the post-mine land use in the South Lease Extension has been designated as wildlife (bird) habitat. To support this land use, the seed mix has been amended to incorporate more shrubs for cover and food. The seed mix is composed of species that are all native to the South Lease Extension. The seed mix is found in Table 906.B(5)-3 (Seed Mixes for...).

Mulching and Crimping

Native grass hay mulch is applied after seeding at a rate of approximately two tons per acre.

Irrigation

Based on research conducted in 1974 and 1975 at San Juan Mine (SJM) (primarily by W. Gould of New Mexico State), it was concluded irrigation was required to consistently achieve rapid and successful vegetation establishment. Similar conclusions were being reported at the Navajo Mine (NJM) during this same period of time. During the 1980's irrigation schedules were being reviewed with the objective of potentially reducing both the amount and frequency of irrigation. In the early 1990's (1991 – 1994),

several irrigation studies were conducted to develop both effective and efficient schedules for the reclamation programs at SJM and NJM. A study conducted by the Plant Material Center (USDA, 1994) concluded reduction in irrigation would not significantly affect perennial plant cover. A similar study conducted at Navajo Mine compared three irrigation rates (low, medium and high) on vegetation establishment and performance. The study revealed no significant difference among the irrigation treatments. These studies suggest irrigation rates could be reduced at the two mines. The reclamation programs that followed for the next few years used a reduced irrigation schedule. The results were mixed, but generally early seedling establishment was failing.

Now, over 10 years later, the reductions in irrigation are generally unsuccessful in establishing reclamation species. Successful reclamation, with limited irrigation, occurs only in years with above normal precipitation. The average annual precipitation at the Fruitland National Weather Station near the SJM is 8.2 inches. Precipitation data from the past 50 years show that above normal rainfall occurs less than three times per ten years and below normal seven of ten years. The conclusion at SJM is that to consistently establish reclamation on a year-to-year basis, the reduced irrigation schedules are high risk and failure can be expected seven out of ten years.

The irrigation program at SJM is generally conducted for a two growing season periods, depending on availiblity of irrigation water and natural precipitation. An exception are small areas of reseeding/interseeding or first time seeding which may not be irrigated based on their size and proximity to irrigation equipment (e.g. delivery lines and pumps). These small areas are typically seeded with twice the rate of the standard SJM seed mix to ensure adequate germination and establishment of seeded species. The following is a description of the irrigation program utilized at SJM.

First Growing Season Irrigation

The irrigation program for the first growing season consists of three treatments; 1) initial irrigation treatment, 2) germination irrigation treatment and 3) root development irrigation treatment. These treatments are described as follows:

- Initial Irrigation Treatment

  An initial irrigation treatment of 1 to 2 inches is applied to the reclamation area after seeding. The objective of this initial irrigation is to provide sufficient subsurface moisture for seedling growth. This application is only performed when subsurface moisture reserves are insufficient to initiate germination, which is frequently the case when winter and spring drought conditions exist. The extent of the initial irrigation application is based on the following criteria; 1) soil type, 2) infiltration rates, and 3) soil moisture content.
- Germination Irrigation Treatment

The germination irrigation treatment consists of applying 0.5 inch of irrigation to the reclamation area every second or every third day for a period of four to six weeks. The amount and duration of this treatment is also dependant on soil type, infiltration and moisture content.

- Root Development Irrigation Treatment
  During the remainder of the year one growing season, irrigation is applied at a rate of one (1) inch per week to encourage root development and deep storage of soil water.

Second Growing Season Irrigation

Irrigation applications will continue into the second growing season, only if drought conditions (soil moisture) dictate additional applications. The purpose of this second season irrigation is to assure adequate plant growth and long term vegetation establishment. This application will be applied during periods of high vegetation stress and is intended to simulate a high period of rainfall. The second season irrigation will typically be a single application but may be applied more frequently based on occurrences of rainfall.

The irrigation program described above has largely been developed from research projects and from 25 years of experience reclaiming arid minesoils. SJM seeks to continually improve irrigation practices by monitoring vegetation success with irrigation rates and field observations. Irrigation rates may be adjusted during the irrigation season based on observations and seasonal rainfall.

SJM utilizes a portable solid set sprinkler irrigation system for applying irrigation waters to seeded areas. This system is easily manipulated in the field, low maintenance, and adaptable to existing site conditions (i.e., field shapes and slopes). An investigation of various irrigation systems for reclaimed mine lands, found that this particular system is useful in applying limited quantities of water and is highly adaptable to a variety of field shapes, topographic and edaphic conditions, and irrigation timing requirements encountered at surface coal mines in arid climates.

Surface water from the San Juan River is the source of irrigation water used at SJM. Irrigation water is supplied via pipeline from the San Juan River to PNM's water storage pond. Irrigation water from the PNM pond is delivered via pipeline to smaller ponds located adjacent to reclamation areas. Water from the small ponds is pumped to the sprinkler system.

Surface water from the San Juan River is used extensively for irrigation throughout the San Juan River Valley. Surface water samples have been collected by the USGS at station 09367540 located near Fruitland NM from 1977 to 1996. The following are mean concentrations of EC (483 uS/cm), pH (8.48 s.u.), calcium (56.2 mg/L), magnesium (10 mg/L), sodium (31.6 mg/L), sodium adsorption ratio (1.0 calculated), sulfate (126 mg/L), and alkalinity (110 mg/L $CaCO_3$) from surface water samples collected by

the USGS from April 1995 through April 1996. These data show very good water quality and no restrictions for irrigation use.

Irrigation activities are monitored on a continuous basis by the SJM reclamation crew and environmental staff to assure that the system is functioning appropriately and no pipe leakage, runoff, pooling, erosion, surface crusting, or salt precipitation is occurring as a result of irrigation. If these problems arise, irrigation is discontinued and (1) the irrigation system is adjusted and/or (2) fitting mitigation measures, if necessary, take place. Irrigation records are kept at the mine to track application rates of irrigation waters on reclamation parcels. These records are available at the mine for review by MMD inspection and permitting staff.

Management of Reclaimed Lands

Range management can be defined as the art and science of planning and directing the use of rangelands to obtain optimum, sustained returns based on the objectives of land ownership and on the needs and desires of society (Vallentine 1980). Range improvements are special treatments, developments, and structures used to improve range forage resources or to facilitate their use by grazing animals (Vallentine 1971).

To enhance productivity of desirable forage on reclaimed lands for meeting the needs of the post-mining land use, and to hasten nutrient cycling and decomposition processes, SJM has employed standard rangeland management (husbandry) practices. Livestock grazing as a husbandry practice began in Northwest Piñon Pit in December of 1995 and the following year in Gravel, Sage and Yucca Pits (see Appendix 906.C (Grazing Plan for. .) for Grazing Plan for Gravel Hill and Sage/Yucca Reclaimed Areas). In September 1997, a formalized plan was developed for the NW Piñon Reclaim (see Appendix 906.D, Post Mining Land Use Management Livestock Grazing Demonstration). In 1998, a plan was initiated to begin grazing husbandry practicing (Appendix 906.E (Grazing Plan for All...) to all mature reclaimed area on the mine site. A summary (Appendix 906.F (Grazing Report on Reclaimed...)) was completed, reporting on the grazing activities from 1995 through 1999.

Often, for reasons of logistics, or safety of mine personnel and livestock, it is impractical to graze all reclaimed lands using livestock. In the absence of grazing animals to provide an essential link in the function of the ecosystem, alternate methods of stimulating vegetation and breaking thin soil crusts may be employed. SJM has been testing the viability of a number of physical and mechanical treatments (to possibly include, at minimum, mowing, pitting, burning, harrowing, interseeding, etc.) to stimulate the l'regrowth of seeded perennials by opening vegetation canopy and removing dead, oxidized aboveground plant material. Early observations from trial plots initiated in spring of 1994 indicate potential for invigorating reclaimed lands utilizing physical and mechanical treatments as range improvement tools.

SJM will progressively continue to employ range husbandry practices to revitalize and stimulate reclaimed lands.

Measures to Determine the Success of Revegetation

Measures to Determine the Success of Revegetation for All Mining Areas Except the South Lease Area

The method to determine revegetation success at SJM has two basic premises:

Implementation of a set of standards that will establish the basis for comparisons of the performance of reclaimed lands to undisturbed (non-mined) lands for two out of the last four years of bond release, starting no sooner than year eight of the responsibility period, and establishment of a set of standards that will ensure that the reclaimed areas are capable of supporting the post-mining land uses of livestock grazing and wildlife habitat.

In the early development of Permit 2-5P the availability of site-specific data was limited. Therefore, MMD and SJM relied upon general information to develop a starting point for success standards. The general information utilized included U.S. Department of Agriculture Soil Conservation Service (SCS) range site descriptions (USDA 1980), regional climatological data, and current scientific literature. Since that time, SJM has collected and summarized site-specific data for ten years (1983-1993, excluding 1987) from eight vegetation communities. Data collection from those communities has provided an historic record taken from areas that are representative of the pre-mine permit area. Several comparisons of the historic site-specific data to SCS range site descriptions have been made. The SCS information represents values for total vegetation, yet the success standards for cover and production pertain to perennial vegetation only. This document references both total and perennial vegetation values to facilitate comparisons between SCS and mine data. Annual vegetation data is not a component of the revegetation success standards. The standards for cover and production will include only the current year's perennial vegetation.

The eight communities historically sampled at SJM represent 96% of the lease area before mining (Talus slopes and Badlands jointly represent approximately 4% of the pre-mine permit area). As a result of discussions with MMD, the 1985 historic record sampling program included data collection from three communities. The communities are:

1) Galleta/Fourwing Saltbush
2) Shadscale/Galleta
3) Shadscale/Alkali Sacaton

These vegetation types were selected because they were thought to closely resemble the shrub-grass mixture that is desired on reclaimed areas. However, those vegetation types represent only 39% of the land occupied by the undisturbed communities. Furthermore, this limited community sampling scheme did not

take into account substantial area occupied by such communities as Alkali sacaton/Broadscale (34% of total undisturbed Lease Area). For these reasons, and to facilitate the mathematical weighting of vegetation communities by relative areal extent, in 1991 SJM reinitiated sampling of eight vegetation communities. Again, these communities represent 96% of the Lease Area before mining started. The results (means and summary statistics) of sampling are presented in Table 906.B(5)-4 (Perennial Cover (%). .), Table 906.B(5)-5 (Perennial Production (lbs/acre)...), Table 906.B(5)-6 (Total Cover (%)...) and Table 906.B(5)-7 (Total Production (lbs/acre) ..). Appendix 906.G (Summary of Linear...) provides linear regression determinations for estimating missing data for each of the four tables.

The entries in Tables 906 B(5)-4 through 906.B(5)-7 for each vegetation community, by year, represent the means for undisturbed (pre-mine) vegetation. The summary statistics represent:

1) The yearly mean value (Y) of each community
2) The relative percent of the lease area (W_i) represented by each community before the start of mining.
3) The normalized yearly weighted mean (Y_W), which is the sum of the products (Y and W_i) for each of the five vegetation communities for each year:

$$\bar{Y}W = \Sigma YWi$$

Where, Y_W = normalized weighted mean for a given year for all communities.

Y = mean value for each community for a given year.

W_i = relative fraction of total area for a given community.

The key conclusions resulting from this historic data are:

1) Seasonal and annual fluctuations in climatic factors dramatically affect cover and production values.
2) Vegetal response on reclaim areas clearly parallels that on undisturbed areas.
3) An effective standard of measurement must properly account for seasonal and annual variability in climatic factors affecting vegetal response.
4) The undisturbed rangeland exhibits resilient characteristics and the ability to respond to favorable climatic conditions.

The seasonal and annual fluctuations of production and cover values make it inappropriate to use a long term average (i.e., ten years average) to establish the production and cover standards (Figure 906.B(5)-1 (Mean of Vegetation Production) and 906.B(5)-2) (Mean of Vegetation Cover) For example, the yearly mean for perennial cover for 1983 through 1993 ranged from 1.3% to 5.3% (Table 906 B(5)-4 (Perennial Cover (%)...)). During the same period, the yearly mean for perennial production varied from 133 to 811 lbs/acre (Table 906.B(5)-5 (Perennial Production (lbs/acre).)). The yearly mean for total cover for 1983 through 1993 ranged from 2.4% to 8.2%. The total production values for this period ranged from 204 to 1053 lbs/acre. This evidence indicates the need to establish a normalized standard that will account for climatic fluctuations year to year.

Due to the climatic fluctuations experienced at this site, MMD and SJM personnel agreed that a yearly mean would be superior to a long term mean (i.e., ten year) for measuring vegetal success. This yearly mean will provide a normalized standard that will properly account for the variations in climatic fluctuations.

Establishing the validity of using site-specific data to define this normalized yearly mean was accomplished by meeting with MMD and comparing the historic site-specific data to the SCS information. The SCS range site descriptions indicate that under favorable conditions the soil types (e.g. Shiprock and Fruitland) in this area could realize total production values as high as 900 lbs/acre. The site specific data values shown on Table 906 B(5)-7 (Total Production (lbs./acre)...) confirms that the vegetation in the proximity of SJM meets SCS's potential production values when favorable conditions exist. In 1992 the yearly mean for the five communities was 1053 lbs/acre. It is also important to recognize how quickly the vegetation responds to favorable conditions. The total production from 1989 through 1991 was about 300 lbs/acre. In 1992, total production was 1053 lbs/acre. This is a three-fold increase from one season to the next. This dramatic difference in vegetal response from 1991 to 1992 verifies that pre-mine lands demonstrate the potential to respond quickly to favorable conditions.

The standard to determine vegetal success at SJM will include criteria for cover, production, and woody stem density over all of the San Juan Mine with the exception of the South Lease Extension Area which will have fixed criteria (discussed later). The values for percent cover and lbs/acre production will consist of a yearly weighted mean of perennial cover (%) and a yearly weighted mean of production (lbs/acre) using five undisturbed vegetation communities. The means of these five communities will be weighted by the relative areal extent of each pre-mine community; the sum of the weighted means will represent the success standard for cover and production in the year the vegetation data is taken. This value is identified as the "Yearly Weighted Mean" on Table 906.B(5)-4 (Perennial Cover (%)...) and Table 906.B(5)-5 (Perennial Production (lbs/acre)...). For Phase III bond release purposes, this mean will be determined as required under 19 NMAC 8.2, Subpart 20, 2065 by sampling the five undisturbed vegetation communities

that comprise the reference area approved in 1997. These yearly weighted means will then be compared to the values for perennial cover and production for the land submitted for Phase III bond release. This sampling will be conducted as follows:

1) Randomly located 50 meter transects
2) Data collection for perennial cover (using point-intercept method) and production (maximum forty samples).
   a) Cover: points located at 0.5m intervals for a total of 100 points per transect. Record first intercept. Vegetation by species, litter, rock or bare-ground placed at the randomly located point where the 50 meter transect initiates.
   b) Production: One square $1m^2$ plot randomly located along the 50m transect. Clip all perennial species by species. Record dry weight. Dry to constant weight at 60^0 C.
3) Five vegetation communities will be sampled, representing 78% of the pre-mine lease area[1]
   a) Shadscale/Sacaton
   b) Sacaton/Broadscale
   c) Galleta
   d) Galleta/Fourwing Saltbush
   e) Winterfat/Galleta
4) The sample collection for undisturbed and reclaimed land will occur within the same time each year.
5. Generally, cover and density data will be collected one time during the growing season, June through September. The time selected to collect the data will be approved by MMD.

[1] Criteria for inclusion of these vegetation communities are; 1) each community represents a significant portion of the total areal extent of the pre-mine lands (i.e., permit area), and 2) the dominant vegetation found in each community is a significant component of the vegetation on reclaimed land.

Sample Adequacy Determination

The test to be used is a mean stabilization technique described by Clark, 2001. Sample adequacy will be demonstrated using the standard deviation of the running sample means in the formula:

$$N_{min} \geq \frac{(ts)^2}{(0.1\bar{x})^2}$$

Stratified Random Sampling for Woody Shrub Species Density Determination

The distribution of shrubs can be highly skewed in some reclamation areas. In other words, shrub densities are unevenly distributed throughout the reclamation areas. Therefore, when simple random sampling

procedures are applied to these heterogeneous distributions, a very large sample size is required to accurately estimate the shrub density parameter. Small sample sizes may not be representative.

Therefore reclamation areas will be delineated into classes or strata based on shrub density. This process of delineating the reclamation areas into strata, selecting random samples from each stratum, and combining the data from all strata into a single sample, to estimate shrub density, is called stratified random sampling.

There are several reasons for conducting stratified random sampling. The most important reason is to increase accuracy and precision of the estimate. Another important reason is to increase the efficiency of sample collection. Stratification can reduce the number of samples required to adequately estimate a population parameter over standard random sampling procedures.

The following is a discussion of how the shrub class method will be applied at SJM to determine shrub density for the reclaimed areas.

The area that is eligible for bond release will be evaluated by a qualified scientist to determine if the area requires stratification to accurately measure shrub density. Simply, the scientist will determine if the shrubs, in the area, are evenly distributed or if they are clumped. Delineation of shrub density classes will be accomplished using whatever means are available to determine if classes are needed. Current aerial photographs, of eligible areas, could be used. Satellite data, if it is appropriate, could also be used. Walking surveys may also be used, if they are appropriate. Generally, one to three shrub classes are sufficient to stratify shrub density. Boundaries of all delineations will be established by the qualified scientist. The shrub class delineations will be transformed to an orthophotograph base map and reviewed with MMD before field sampling. Once the shrub classes and delineations are established, field sampling can proceed.

Sampling Methods

Sample Size

A standard sampling procedure will be used to determine shrub density. Mature shrubs having the majority of their main stem within a 50 x 2 m belt transect are counted. The shrub density measurements collected during the standard plant cover sampling will be used as a part of the shrub class procedure when appropriate. A minimum of 15 randomly located transects will be established for each shrub class. A sample adequacy test will be applied using these 15 transects. A maximum of 40 transects will be sampled per shrub class.

Sampling Periods

Woody species density sampling will be conducted at the same time as the plant cover sampling.

Analysis and Reporting

Woody species density will be determined as a weighted average based on mean shrub density and acreage for the shrub classes within the area eligible for release. The 190 shrubs/ac is the standard to be met or excluded and applies to the area as a whole. The standard (190 shrubs/ac) needs to be met in one of the four years of bond release studies. Therefore, if the technical standard is achieved during the first years sampling, shrub density measurements will not be collected for the following years. Conversely, if shrub density estimates are below the standard, data will be collected in subsequent years.

The shrub density data will be analyzed in a timely manner and reported along with cover, production, and diversity data, when these are collected. The shrub class reporting is a weighted mean that will be compared to the SJM shrub density technical standard. Also included will be maps showing the location and proportion of the various class delineations, and transect locations.

Management of the reference area will be comparable to that which is required for the post-mining land use of the permit area.

The revegetation success standards are based on the best information available to date. It must be emphasized that these standards are based on data and the professional judgment of industry and government personnel. Both the MMD and SJM agree that if future research or an unexpected and significant deviation from these standards occurs, then the standards will be reviewed and could be changed to reflect the findings of the data or new scientific research.

As stated in 19 NMAC 8.2, Subpart 20, 2065 ground cover and productivity will meet the approved standard for at least two of the last four years starting no sooner than year eight of the responsibility period. The revegetation success standards for SJM are summarized in Table 906.B(5)-8 (Revegetation Success Standard). Additional information on the reference area is contained in Appendix 906.H (Reference Area Proposal...).

South Lease Extension (Cottonwood) Revegetation Success

The reclamation success standard for the South Lease Extension Area (Wildlife Land use) will be a fixed standard. The sampling methodology will be the same for the South Lease Areas as found in the rest of mine (grazing land use) with the exception of production, which will not be measured. The success criteria will be based on premine data rather than a reference area.

To meet these goals a technical standard has been formulated for the Cottonwood area. The standard is based on historic data collected for a period of ten years, beginning in 1983 from undisturbed vegetation

communities at San Juan Mine. The Cottonwood reclamation community will consist of both steep and gentle slopes with mainly southern exposures. Various micro-topographic features, such as drainages, small shallow depressions and water retention ponds will be included.

The native vegetation types at SJM were originally classified into eight major plant communities. Five of these undisturbed communities account for more than 75% of the original mine lease, Table 906.B(5)-4 (Perennial Cover (%)). The respective area of these five communities and their perennial plant cover (%) for the period from 1983 to 1993 is presented in Table 906.B(5)-4. The weighted average perennial cover (%) for the five communities, for the ten-year period, is 2.88%. The yearly weighted mean only exceeds the 2.88% value in four of the ten years and it is below the 2.88% value in six of the ten years, Table 906.B(5)-4. The most extensive vegetation community at SJM in the Cottonwood Area is the atco/hija type (approximately 80% of the Cottonwood Area.) The ten year mean cover value for this community is 3.49%, Table 906.B(5)-4. This vegetation type is similar to some of the existing vegetation types that have been established on the reclaimed lands and to the expected vegetation types that will be established for the Cottonwood reclaim area. These species and similar shrubs and grasses have been successfully established at the mine. In addition, these plant types meet the goals for a wildlife habitat required for the Cottonwood area. A cover standard of 3.5% is to be applied to all reclaimed areas in the Cottonwood area. This value is based on the vegetation data collected from the atco/hija native community, for the period of 1983 to 1993 at SJM, Table 906.B(5)-4.

Total perennial vegetation cover in the Cottonwood reclaimed area will be acceptable at values of 3.15% total perennial cover (90% of 3.5%) or greater. Total relative cover of the perennial grasses will not exceed 95% nor be lower than 20%. A variety of perennial forbs will be seeded but not included as part of the revegetation success standard. Shrub density will average at least 390 stems per acre of living shrubs. Production will not be considered in the standard.

Numerous practices are being used in the Cottonwood area of SJM to ensure diverse vegetation types. Various slopes and exposures are being constructed with various topdressing depth applications. In addition, different seed mixes are being used to enhance diversity. Diversity in micro-topography will also be constructed in an attempt to create vegetation diversity.

Plant diversity at SJM is expected to be satisfactory without measurement, based on the diverse landscape practices that are being proposed. However, some measurements of plant diversity will be made at bond release. They will be simple, relatively easy to conduct and considered only representative of the successional stage expressed at the time the data are collected. Three species of perennial grasses will each comprise at least 5% of the relative perennial herbaceous cover. Three species of shrubs or half-shrubs,

will each comprise at least 5% of the relative shrub cover. All diversity measurements will be based on cover data.

906.B(6) Coal Conservation Plan

The proposed underground mine plan employs the longwall retreat method. This method has been chosen to maximize recovery of the coal resource in a manner that affords high levels of safety for the miners. Longwall panels will be as wide as economically feasible (currently 1000 feet at SJDM), thereby minimizing the number of development gateroads where coal will remain unmined in pillars. Pillar sizing will be appropriate to ensure the safe operation of the mine.

The longwall operation will remove the majority of the seam section, however a small amount of top coal will be left for maintaining a stable roof. This coal is of poor quality. The supporting continuous miner operations will have a nine-foot mining section, leaving top and bottom coal in most cases. The nine foot mining section has been determined to be a safe working height for development operations from the San Juan South Underground Mine.

1906.B(7) Measures Employed to Address Acid Forming, Toxic Forming, or Alkalinity Producing Material and Materials Posing a Fire Hazard.

Regraded Spoil Monitoring and Mitigation Plan

Based on historical regraded spoil data, a large percentage of spoil materials manipulated during the backfilling and grading process at SJM are saline and sodic in nature and are characteristically high in exchangeable sodium (Na), sulfate, saturation percentage, and swelling type clays (smectitic). Sodic materials are fairly commonplace in the natural, undisturbed geologic and edaphic environments within the permit area. Sodium enriched materials often occur in the in situ surface soil horizons and/or alkaline shales encountered during overburden shovel/dragline stripping activities. Topdressing materials placed over saline and sodic spoils provide a chemical and physical buffer between the reconstructed soil surface and regraded spoil surface. Historic regraded spoil data show that recently placed materials have similar scales of vertical heterogeneity. Therefore, analysis of a single sample from the regraded spoil profile provides similar levels of characterization as multiple depth increment samples collected from the same zone. Applegate et al. (2001) found that a single composite sample of the 0 to 4 ft increment provided a similar level of characterization as individual samples from the 0 to 1, 1 to 2, 2 to 3, and 3 to 4 foot increments. Peabody Western Coal Company's Kayenta Mine's analysis of historical regraded spoil data provided a similar justification to OSM for collecting one composite sample from the secondary root-zone in place of individual depth samples.

A regraded spoil monitoring and mitigation plan for Juniper and Pinion Pit areas is described below. The objectives of this plan are to (1) physicochemically characterize the surficial regraded spoil material and

identify any sources of potentially acid and/or toxic forming materials (PATFM) within the prospective root-zone and (2) prescribe appropriate measures for mitigating PATFM prior to topdressing replacement.

The South Lease Extension area will not be subject to the spoil monitoring and mitigation plan as describe for Juniper and Pinion Pits The topsoil resource is very limited on the South Lease There are skeletal (cobble) materials available in the South Lease area that will be salvaged and used as a topdressing substitute to help further the topdressing resources for the area. However, even with the additional quantity of skeletal material there still are insufficient volumes of topdressing resources to allow variations for spoil mitigation. Given the available topdressing resource, the plan for replacement will be to replace topsoil materials on gentle slopes (<5:1) at an average depth of 7 to 8 inches and skeletal materials on steeper slopes (>5:1) at an average depth of 12 to 13 inches. The skeletal materials are targeted on steep slopes for the purpose stabilizing and controlling erosion.

Regraded Spoil Sampling Methodology

Upon completion of final grading activities, regraded spoil will be sampled from sites located on a grid with 330-foot centers. Test Pits will be excavated to a maximum depth of 4 feet using a backhoe. At each site, one sample of spoil material will be collected from a 3 ft horizontal plane of the regraded spoil profile to a depth of 3.5 ft. Collected materials will be passed through a 1-inch sieve in sufficient volume to yield 2 to 4 kg. The composite sample will be placed on a tarp and mixed using a corner-to-corner technique. A cone will be developed in the center of the tarp and the sample volume split. One sample split will be bagged and submitted to an analytical laboratory for analysis the remaining split will be returned to the excavation. Additional site information such as dominant lithology and excessive compaction will be recorded as needed This sampling methodology will result in characterization of regraded spoil occurring within the viable reconstructed root-zone (upper 4 feet of surficial earthen materials) consisting of a combination of redistributed topdressing and spoil.

A second phase spoil monitoring program may be implemented to further delineate the areal extent of suspect spoil. The need for this more intensive sampling will be determined following review of results of regraded spoil analysis and will primarily occur in areas where spoil appears to be heterogeneous.

Regraded Spoil Analysis

Regraded spoil samples will be analyzed for the suite of parameters and using the laboratory analytical methods indicated in Table 906.B(7)-1 (Analytical Parameters and Methods...). Spoil suitability will be determined based on suitability criteria shown on Table 906.B(7)-2 (SJM Regrade Spoil...).

Results of regraded spoil analysis will be reviewed by SJM Environmental Quality Department (EQD) staff to determine the need for additional sampling or mitigation measures. Regraded spoil data and sample

locations maps will be kept on file at SJM and available for review by MMD inspection or permitting personnel. In addition, regraded spoil data and sample locations maps will be provided to MMD as part of the Annual Mine Progress Report submittal.

Mitigation Measures for Suspect Spoil Materials

Once all regraded spoil sampling and analysis has been completed, data will be reviewed and, if necessary, appropriate mitigation measures will be taken prior to topdressing laydown. Mitigation will consist of a number of practices including deep ripping of regraded spoils, variation in soil replacement thicknesses, emphasizing salt tolerant plant species in seed mixtures, and alteration of irrigation techniques to reduce the probability of salt migration into the reconstructed root zone. Each mitigation alternative is discussed at length below.

Deep Ripping of Regraded Spoil

Should mitigation measures be necessary for regraded spoil, the spoil surface will be scarified to a minimum depth of 12 inches prior to topdressing laydown. Similarly effective implements such as a V-ripper, cultivator, or chisel may be used subsequent to topdressing laydown. These practices will alleviate compaction and increase spoil permeability and macroporosity. Increased spoil hydraulic conductivity and aeration will result in leaching of sodium salts from the reconstructed root-zones. Pre-topdressing scarification will be accomplished utilizing a blade with a 5-shank ripper that provides excellent scarification coverage. However, when numerous boulders are unearthed during the ripping process, a 3-shank ripper will be used to reduce the number of boulders brought to the surface which interferes with topdressing laydown activities. If this procedure is used, the area will be cross-ripped to provide adequate coverage. At all times, SJM will endeavor to rip regraded spoils on the contour.

Salt Tolerant Plant Species in Seed Mixtures

Historically, SJM has emphasized salt (saline) tolerant native plants common to the Salt Desert Shrub vegetation community in its seed mixtures. A significant number of research studies have been conducted at SJM since 1974 to evaluate the viability of native plant species which are highly adaptable to on-site sodic and saline edaphic conditions. Salt tolerant species included in SJM's seed mixtures shown on Table 906.B(5)-2 (Standard Seeding Mixes...) are shown as follows:

Grasses:	Galleta (Hilaria jamesii)
	Indian ricegrass (*Achnatherum hymenoides*)
	Sand dropseed (Sporobolus crytandrus)
	Alkali sacaton (Sporobolus airoides)
Shrubs:	Fourwing saltbush (*Atriplex canescens*)
	New Mexico Saltbrush (Atriplex obovata)

Winterfat (Krascheninnikova lanata)

Rubber rabbitbrush (*Ericamerica nauseosus ssp. nauseosus)*

Adjustments to Irrigation Practices

Some significant adjustments have been made to standard irrigation practices at SJM with the objectives of (1) applying an initial wetting irrigation to provide deep storage of water that promotes salt translocation from the upper part of the reconstructed root-zone and seedling establishment and (2) reduce the incidence of upward migration of salts into the reconstructed root-zone. These adjustments are discussed in detail in Subpart 906B (5) Revegetation Plan, Irrigation.

Plan for Mitigating Materials Posing a Fire Hazard

All materials posing a potential fire hazard encountered during the process of mining will be disposed in the ash pit and covered with ash to ensure the hazard is eliminated.

In the event of a spoil fire, measures will be taken during the regrade process to extinguish the fire and eliminate the potential for reigniting. Due to the geology and intrinsic nature of the past stripping operations, spoil fires can occur. Spoil fires are generally controlled during regrading operations by smothering or by spreading out the fire so the fuel supply is exhausted. Topdressing is not placed on an observed spoil fire until the fire is extinguished. If a spoil fire occurs after an area has been reclaimed, the fire will be monitored until all evidence shows it has burned out. If vegetal damage from the fire has occurred, SJM will take the necessary steps to re-vegetate the area.

906.B(8) Sealing of Mine Openings, Plugging of Drill Holes and Abandonment of Wells

At closure, the mine entries will be backfilled to a distance of approximately 25 feet as illustrated in Figure 906.B(8)-1 (Typical Portal Closure). Backfill material will be compacted to a density practical by standard equipment. Backfill material will be incombustible. The highwall/pit area where the mine entries are located will be backfilled to the approved Approximate Original Contour (AOC) as prescribed in Chapter 21 of Permit No. 94-01.

All exploration drill holes will be plugged as shown on Figure 906 B(8)-2 (Typical Exploration Drill...). They are filled with BLM or other responsible agency-approved plugging material from the total depth to a minimum of 50 feet above the upper coal seam. Then they are filled with dirt to five feet below the collar and then stemmed to the collar with a minimum of five feet of approved plugging material.

All abandoned wells will be plugged according to the requirements of the State Engineer. There are not any plans to transfer any exploratory or monitoring wells.

Utility Boreholes

To facilitate safe recovery of the coal resource, utility boreholes will be required throughout the life of the San Juan Underground mine. These boreholes, which will extend from the topographic surface down to the underground workings, will be used to deliver concrete, gravel, water, communications, power, etc. as well as to provide other utility-type functions as required. The definition of a utility borehole will not include a Gob Vent Borehole (GVB) or a ventilation borehole, which will be described separately from this type. A GVB or ventilation borehole may be converted for use as a utility borehole or the converse, but it is recognized that the specifications for a utility borehole are typically different, requiring a significantly reduced area of surface disturbance by comparison.

Typically, two or more utility boreholes may be needed per longwall panel. This is a direct result of the longwall panel length, the need to deliver construction materials to the mining face and the resulting logistics issues. Although locations will undoubtedly vary, the boreholes will typically be designed to intersect the headgate workings at approximately the mid-panel point and the longwall take-off point, near the mains. These locations are thought to provide for the most effective utilization in distributing construction materials. Other locations may be necessary depending upon application, i.e. boreholes constructed for the purposes of communications, sampling, monitoring, etc.

A typical utility borehole will be drilled from the surface following conventional exploration drill hole procedures as practiced in the past at San Juan Mine. The borehole will intercept the underground mine workings and usually be finished in the coal seam horizon or the immediate roof. The diameter of the hole will typically be 4 to 12 inches, with a corresponding borehole casing having an appropriate diameter to protect the opening. The casing material may be metal or plastic in nature, depending upon the function of the borehole. The borehole will be finished on either end as appropriate for the designed function. This could include, but is not limited to, material hoppers, storage tanks or valving.

It is anticipated that surface disturbance due to utility boreholes will be kept to a minimum. Typically, a small pad of not more than 2-acres in area will be constructed at the collar of the borehole. If multiple boreholes are needed, more than one borehole may share the same pad in order to minimize disturbance. The collars will typically need to be formed and small concrete structures constructed to facilitate usage. Pads will be constructed in a manner similar to the conventions used for exploration drilling. Ancillary roadways will be needed to access the sites and will also be constructed in the convention used for exploration drilling. The first borehole location is shown on Figure 906.B(8)-3 (Proposed Utility Borehole...) adjacent to the vent shaft area.

Utility borehole life is expected mimic the cycles of the longwall panels, typically lasting for a period of one year or less. It is possible, however, that some may have a useful life for the term of a mining district

or longer. When a utility borehole ceases to be useful, it will be closed and reclaimed following the procedures already established in the permit for Exploration Drill Hole Plugging, Sec 906 (8), p.906-22. Any casing and collar materials will be removed during reclamation The pad and ancillary road will be graded and seeded per practices already adopted within the Subpart 906.

Degasification Boreholes/ Gob Vent Boreholes

A specialized type of utility borehole is also required for the longwall panels called Degasification Boreholes which include Gob Vent Boreholes (GVB's). These boreholes will be systematically used to facilitate either the collection and controlled release of accumulating methane in the developing "gob" (collapsing roof strata behind the retreating longwall face), or used simply to remove dangerous gasses prior to mining. These holes will form an integral part of the Mine's ventilation system and will also help to minimize spontaneous combustion potential in the mined out zones.

The GVB's will be installed/drilled from the surface above the longwall panels prior to the mining of the coal in the panel. Spacing, location, and design of GVB's will ultimately be dependent on encountered volumes of gas and the performance of the holes themselves. As noted, other vertical or directionally drilled holes may be utilized to lessen risk to the underground personnel by pre-mining gas drainage. Initially, these holes will be spaced 500 feet or less (as needed) apart as shown on Exhibit 906 B(8)-1 (Location GOB Vent...). In some cases a GVB may plug before an area is completed (degassed) and therefore require a new GVB to be drilled near to the plugged GVB.

Typically, the holes will be drilled to accommodate a casing of up to 7" inches in diameter. Each GVB will generally be drilled to a depth of approximately 30 to 50 feet above the Fruitland No 8 coal seam, or drilled through all coal seams of interest, geophysical logged and then cemented to approximately 30 to 50 feet above the coal seam to be mined. Perforated casing will be installed to approximately 10 feet above the Fruitland No. 9 Seam for a distance of 100 feet to above the No 8 seam. Above the 100 feet of perforated casing, solid steel casing will be installed in the borehole and grouted around the annulus to prevent percolation/migration of ground water or gasses. The GVB's are activated when the producing longwall face retreats past the hole location, thereby fracturing roof strata and interconnecting with the overlying open hole.

All GVB's shall be installed with a sample section, gate valve, a T-Off for collection, a check valve and a flame arrestor. An eight-inch PVC stack and rain hood will extend approximately 10 feet from the ground level. A means to collect gas samples will be maintained at each active GVB. Detail of a typical Gob Vent Borehole is illustrated in Figure 906 B(8)-4 (GOB Vent Borehole Design).

Access to and from the GVB's will be via ancillary roads as described in Subpart 916, Transportation Facilities

Fencing will be installed surrounding the surface vent stack of the GVB to prevent unauthorized persons and livestock or wildlife from interfering with the operation of the GVB and fire extinguishers. No smoking signs or warning signs shall be installed on the surface installation. To protect against wind or snow loading, the pipes will be supported. Installations will be inspected weekly for cracking or failure of PVC pipe. Broken or cracked pipe will be replaced. Regular monitoring will include the determination of the quantity and concentration of discharging gases.

Upon determination that the borehole is no longer operational, the hole will be closed and reclaimed following the procedures already established in the permit for Exploration Drill Hole Plugging, Sec 906 (8), p. 906-22. The surface will then be reclaimed as per stipulations incorporated in the Subpart 906.

906.B(9) Compliance with Applicable Air and Water Quality Regulatory Requirements
Compliance with the Clean Air Act will be achieved through the same general methods described in the fugitive dust control plan in Subpart 900.B(6). The Air Quality Monitoring Plan is described in Subpart 904.A(1).

Based on groundwater modeling (Subparts 804 and 907) and other groundwater data, limited quantities (gal/yr/panel) of groundwater are anticipated to drain from the coal face into the underground workings. The mine water inflows are likely at times to exceed operational mine requirements and underground storage capacity. Consequently, it is anticipated that there will be a periodic need to discharge mine water to the surface. In such event, the additional water will be pumped outside the portal into a one or more sumps or surface pits and allowed to evaporate or pumped to Public Service Company of New Mexico Power Plant to be used for industrial purposes within their operations. In no instances will water from underground workings be allowed to discharge to waters off the permit area.

Surface water will not be allowed to enter the mine workings and will be controlled with berms and ditches on the highwall and routed to highwall impoundments as described in Section 909. The portal area will only receive water that falls directly upon it, and this precipitation will be routed to the sump at the low end of the pit.

A Pollution Prevention Plan and a Spill Prevention, Containment and Countermeasure Plan (SPCC) have been developed for the SJM.

Personnel

Persons or organizations responsible for data collection, analysis and preparation of permit application section:

Tim Ramsey	Buchanan Consultants, Ltd
Brent Musslewhite	Farmington, NM 87401
Collette Brown	
Orlando Estrada	
BHP San Juan Coal Company	

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