

SECTION 36

POST-RECLAMATION SOIL

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LIST OF REVISIONS DURING PERMIT TERM

REV. NUMBER	REVISION DESCRIPTION	DATE APPROVED
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SECTION 36 POST-RECLAMATION SOIL

~~BHP Navajo Coal~~Navajo Transitional Energy Company (BNCCNTEC) will use the same topdressing and root-zone suitability criteria for the Pinabete Mine Plan permit area (permit area) as those approved for the adjacent Navajo Mine (Office of Surface Mining Reclamation and Enforcement [OSM] permit number NM-0003F) (BNCC 2009). The use of consistent topdressing and root-zone suitability criteria between Navajo Mine and the permit area is justified given the proximity of the two operations and similarity of controlling factors including climate, vegetation, soils, and geology.

The Pinabete Mine Plan permit area and Navajo Mine permit area are located adjacent to one another within the contiguous BNCCNTEC mining lease. The mining lease occupies approximately 33,400 acre and covers a linear distance of approximately 25 miles from Area 1 on the north to Area 5 on the south. The same geologic formations are present throughout the lease area, and both operations extract coal from the Fruitland Formation. Since the same geologic formations are present in both operations, the overburden material characteristics will be similar for both the Pinabete Mine Plan permit area and Navajo Mine permit area. The overburden analysis, presented in Section 17 (Geologic Information), concluded that the materials in Area 4 North and Area 4 South are net alkaline and there are no widespread occurrences of potentially acid- or toxic- forming materials (PATFM) or material that exceed the Navajo Mine root-zone suitability criteria for selenium (total and soluble), boron, and pH. These results are similar to overburden characterizations performed for Navajo Mine. Lastly, the same soil-forming factors (parent material, biota, climate, topography, and time) exist across the BNCCNTEC mining lease and have resulted in soils with consistent physical and chemical properties (Keetch et.al. 1980).

36.1 Soil Resources

The soil resources used for reclamation within the permit area are classified as topdressing, regolith, root-zone, or spoil material. How the soil resource is classified is a function of its position within the soil profile. Topdressing refers to unconsolidated material capable of supporting plant growth in the upper 60 inches of the native in-situ soil profile. This includes all topsoil material (A and E soil horizons) and suitable topsoil substitute material (B and C soil horizons). Topdressing is replaced on top of the regraded root-zone and spoil material during the reclamation process. Regolith is unconsolidated material capable of supporting plant growth located deeper than 60 inches the native in-situ soil profile. Regolith material may be used as either root-zone or topdressing material depending upon its chemical and physical characteristics. Root-zone material is the upper 3.5 feet of the overburden (spoil) material which has been regraded to the approximate original contours (AOC) or final surface configuration (FSC). Spoil is the remainder of the overburden material (i.e., deeper than 3.5 feet) in the soil profile which was removed and replaced to facilitate surface coal mining.

Section 14 (Soil) identifies and describes the location and estimated volumes of available topdressing material within the permit area. The estimated volume of topdressing material within the entire permit area is approximately 7,238,000 bank cubic yards (bcy) (Section 14, Soil). The estimated volume of topdressing within the Pinabete Mine Plan disturbance area is approximately 4,285,370 bcy. This volume of available topdressing will provide an approximate average replacement depth of 9.7 inches (Section 36.3.2).

The interpretations made in the baseline soil surveys with regard to topdressing suitability are limited to the upper 60 inches of unconsolidated material. The permit area likely contains sources of material below a depth of 60 inches that are capable of supporting plant growth (i.e., regolith). The baseline soil surveys did not evaluate and describe the potential volume of available regolith resources that may exist within the permit area. **BNCCNTEC** does not anticipate needing the regolith material for reclamation purposes for the permit area; if a need is identified, the regolith resources will be handled according to the procedures and processes described in Section 36.2.2.

36.1.1 Topsoil Substitutes and Supplements

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) defines topsoil as the A and E soil horizons (30 CFR 701.5). These are the uppermost soil horizons of a soil profile and are characterized by accumulations of organic matter (A horizon) or intensely weathered and leached horizons that have not accumulated organic matter (E horizon) (Brady and Weil 1996). The baseline soil resources within the permit area consist of Aridisols and Entisols soil types (Section 14, Soil). These soil types contain negligible resources that meet the SMCRA topsoil definition; therefore, **BNCCNTEC** relies on topsoil substitute material, or topdressing, for reclamation.

36.1.2 Soil Borrow Areas

BNCCNTEC may require soil borrow areas to provide additional fill material for the construction of roads and other support facilities. This fill material is necessary to achieve and/or maintain the designed grade of the structures and for structural backfill material. Borrow areas will be sampled and tested for topdressing resources according to the topdressing sampling and testing plan discussed in this section. Suitable topdressing resources will be salvaged and stockpiled or hauled directly to regraded areas. The borrow areas within the planned pit disturbance areas will be temporarily reclaimed and stabilized, regraded and seeded in accordance with Section 37 (Post-Reclamation Vegetation) and Section 38 (Post-Reclamation Surface Stabilization and Sediment Control). Borrow areas outside of planned pit disturbance areas will be regraded and reclaimed according to this section and Section 37 (Post-Reclamation Vegetation).

BNCCNTEC does not anticipate the need for topdressing borrow areas to facilitate reclamation of the permit area. This section will be updated in consultation with OSM if topdressing borrow areas are determined to be needed in the future.

36.2 Topdressing Sampling and Testing Plan

BNCCNTEC will conduct an intensive pre-salvage soil sampling program in advance of planned disturbance in order to identify soil material that is suitable for use as topdressing. The purpose of this program is to refine estimates and locations of available topdressing resources. The methodologies utilized in the topdressing sampling plan are based on the baseline soil surveys conducted for **BNCCNTEC** mining lease and are described below.

36.2.1 Topdressing Sampling Plan

The conditions observed during the baseline soil surveys, discussed in Section 14 (Soil), served as a guideline to develop the topdressing sampling plan. **BNCCNTEC** will use a square grid with a maximum of 200-foot centers to establish test sites for evaluations of potential topdressing sources. This spacing results in minimum density of approximately one test site per acre and provides adequate representation of soils within the most heterogeneous mapping units. The badlands and natric (natrargids and natrigypsids) soil types typically lack perennial vegetation and have historically been unsuitable sources of topdressing, therefore, these soil types will not be sampled.

At each site, a test pit will be excavated with a backhoe or similarly effective piece of equipment, to an observable unsuitable layer (e.g., bedrock, paralithic contact, extreme clay accumulations, rock fragments, or extremely hard consistence) or to a depth of 5 feet, whichever is shallower. At depths greater than 5 feet, the possibility of the test pit wall collapsing increases and the test pit becomes a safety hazard. The test pit side walls will be benched during the excavation of the test pit to mitigate the risk of the test pit wall collapsing. A soil hydraulic probe outfitted with a Shelby tube sampler, or similar sampling method, may be used as an alternative to an excavated backhoe test pit to sample surficial soils (upper 5 feet of material).

A soil scientist, or similarly qualified environmental specialist, shall oversee the sampling of each test pit. The horizons of the soil profiles shall be described by depth, dry consistence, texture, and other physical characteristics which will aid in the classification of the soil type. Samples of representative soil horizons will be collected for topdressing suitability analysis. The collected samples for laboratory analysis will include on the sample container the following information: date of collection, sample site, and depth interval. Field notes and/or soil profile descriptions for each sample site and test pit are maintained on file at the mine site. If an unsuitable layer is identified in the field, the characteristics and depth of the layer are included as part of the field notes and/or soil profile description.

Collected soil samples are submitted to a soil analytical laboratory, and the suitability of all potential topdressing sources are determined according to the methods and criteria provided in [Table 36.2-1](#) and [Table 36.2-2](#), respectively, prior to salvage. Soils that have one or more parameters that meet the

unsuitable category are designated as unsuitable for use as topdressing and, therefore, are not salvaged. Results of the topdressing analysis will be submitted annually to OSM in the annual soil resource report described in Section 36.6.

BNCCNTEC performed a comprehensive evaluation to calculate site-specific erosion factor, or K factor, values of the topdressing material within the permit area. The purpose of this evaluation was to assist in developing the baseline flood flow and sediment yield modeling presented in Section 18 (Water Resources). The baseline soil mapping units, presented in Section 14 (Soil), were assigned a soil texture class (i.e., fine, fine loamy, coarse loamy, and sandy) based on surface texture. A composite sample for each surface texture class was created from multiple samples randomly located within the respective soil texture delineation. Inter-Mountain Laboratories, of Sheridan, Wyoming, analyzed each of the composite samples according to the algebraic approximation of the Wischmeier nomograph described by Renard et.al. (1996) and Wischmeier and Smith (1978). The calculated erodibility values for topdressing resources range from 0.10 for coarse loamy soil textures to 0.27 for sandy and fine loamy textures ([Table 36.2-3](#)).

OSM has recommended an upper erodibility value threshold of 0.37 ~~erodibility value as a~~ suitability guideline for all topsoil and topsoil substitute materials (OSM 1999). The results of **BNCCNTEC**'s evaluation indicate that potential topdressing materials from the permit area have erodibility values less than OSM's recommended value and are therefore are suitable for reclamation and continued erodibility value analysis is unnecessary ([Table 36.2-3](#)).

36.2.2 Regolith Sampling Plan

As stated earlier, **BNCCNTEC** does not anticipate a need to use regolith to meet the reclamation goals for the permit area. However, regolith material may be salvaged and used either as topdressing or root-zone material or it may be spoiled if deemed necessary. The decision to salvage or spoil regolith will be based on the reclamation needs within the particular resource area (Area 4 North or Area 4 South).

Regolith material used for reclamation purposes will be sampled in-situ and evaluated using the suitability criteria outlined in [Table 36.2-2](#). The topdressing criteria are prescribed for suitability determinations since salvaged regolith may be stockpiled and used as either topdressing or root-zone material. Topdressing suitability criteria are generally more stringent than root-zone suitability criteria (Section 36.4.2) and a determination to a single suite of suitability criteria eliminates the need for segregated regolith stockpiles.

BNCCNTEC may propose to conduct a regolith characterization study to characterize the regolith resources in the permit area. If **BNCCNTEC** does conduct the regolith characterization study, a plan describing the areas of investigation and the sampling methods will be submitted to OSM for approval prior to commencing the study. Similar characterization studies completed at Navajo Mine were conducted on 800-foot centers using a drill rig outfitted with core barrel auger. **BNCCNTEC** may use these same general

methods or modify them to best characterize the regolith resource found within the permit area. If conducted, the results of the regolith characterization study would be submitted to OSM as part of the annual soil resource report (Section 36.6).

BNCNTEC may utilize regolith for topdressing or root-zone material prior to developing and implementing a characterization study. In the absence of a complete characterization study, the regolith resource will be sampled in-situ, or after placement according to the appropriate suitability criteria each time it is used. Results of this sampling will be submitted to OSM within the annual soil resource report described in Section 36.6.

36.3 Soil Handling Plan

The following describes the methods and procedures **BNCNTEC** will use for the removal of vegetation and soils and the stockpiling of suitable topdressing material for the Pinabete Mine Plan. This information is also presented in Section 20 (Mining Operations).

36.3.1 Soil and Topdressing Handling Methods

36.3.1.1 Vegetation and Soil Removal

BNCNTEC will salvage suitable soil materials for use as topdressing during reclamation. Topdressing salvage operations may occur anytime during the calendar year as equipment and personnel are available. Existing vegetation will be removed with the salvaged topdressing to improve the organic content. If the existing vegetation is too large to facilitate topdressing salvage operations, **BNCNTEC** will use a bulldozer, or similarly effective piece of equipment, to grub the vegetation in advance of salvage operations. Where practical and feasible, **BNCNTEC** will salvage and direct haul suitable topdressing material to graded areas. If direct haul is not practical or feasible, the salvaged topdressing material will be stockpiled in approved stockpiles in accordance with the procedures described in Section 22 (Support Facilities).

BNCNTEC will salvage topdressing material from all areas affected by mining operations or construction of major structures. Certain topdressing resources cannot be salvaged without jeopardizing the safety of the operators and equipment or diminishing the quality of the topdressing removed. Due to these limitations, topdressing is not salvaged where:

1. Slopes are greater than 4:3 horizontal to 1 vertical (~~4h:1v~~ or > 2533%),
2. Suitable surface deposits are less than 6 inches— ~~(This soil is too shallow to allow removal without considerable contamination from underlying unsuitable material),~~
3. Areas less than 1 acre in size (pockets),
4. Areas where rock rims and/or rock outcrops exist

The maximum allowable limit of topdressing removal in advance of the active mining area is 1,800 feet beyond the current extent of mining (e.g., highwall crest). Topdressing is removed far enough ahead of highwall drilling and blasting to prevent contamination from blasting flyrock, and to accommodate mining support infrastructure such as roads and power lines. In the event that a greater area is needed for topdressing removal, OSM will be notified prior to topdressing removal and the appropriate adjustments to the reclamation bond will be made. The extent of topdressing removal will fully consider and comply with the applicable hydrology performance standards.

BNCCNTEC will conduct topdressing salvage operations with haul trucks and front-end loaders, tractor scrapers, or similarly effective equipment. The salvaged topdressing will be hauled to a stockpile or to an area where it will be redistributed on regraded suitable root-zone material.

36.3.1.2 Topdressing Storage

BNCCNTEC shall use numerous stockpiles within the permit area for storing topdressing and, if needed, regolith material. The locations and information regarding the construction, operation, and maintenance of the topdressing stockpiles are presented in Section 22 (Support Facilities). Methods used to stabilize the surface of the topdressing stockpiles are presented in Section 25 (Sediment Control Plan). **BNCCNTEC** shall place signs at all stockpiles indicating the stockpile name and the type of material (e.g., topdressing or regolith) contained within the stockpile.

36.3.2 Topdressing Redistribution

All areas disturbed by mining or mining-related activities (e.g., ramps, primary haulroads, and support facilities) will have topdressing material replaced for the purpose of reclamation. Topdressing will be removed from stockpiles or direct hauled from salvage areas and redistributed on regraded areas. Traffic on replaced topdressing will be limited to reclamation equipment to minimize compaction of topdressing materials.

Areas of minimal surface disturbance (e.g., ancillary roads, power-line disturbances, drill sites) will not receive additional topdressing material. These features are typically constructed in the existing landscape without salvaging the topdressing material. The surface materials at these sites will be disked to create a suitable seedbed and seeded according to the methods and procedures described in Section 37 (Post-Reclamation Vegetation).

Occasionally, spoil fires may naturally ignite within the regraded spoil material. **BNCCNTEC** will not redistribute topdressing on areas of known active coal spoil fires. The measures **BNCCNTEC** will use to address coal spoil fires are presented in Section 20 (Mining Operations).

Prior to the placement of topdressing materials, heavily compacted regraded surfaces will be ripped or disked to alleviate compaction. Alternative implements, such as a V-ripper, may be used in lieu of ripping. Compaction of final regraded surfaces is minor when dozers are used for final shaping activities. Compaction can be more prevalent when rubber-tired equipment, such as haul trucks and scrapers, repeatedly follow the same travel route. These heavy traffic areas will be deep ripped or disked to minimize compaction. With consideration to safety of operators and equipment, ripping and disking will be done on the contour whenever possible.

~~Applying topdressing at variable depths on regraded areas will help to promote the intent of the revegetation plan, presented in Section 37 (Post-Reclamation Vegetation), to “establish a diverse, stable, and self-sustaining vegetation community composed of native species capable of meeting the post-mining land use.” Various studies (Bowen et.al. 2005; Buchanan et.al. 2005) and BNCC’s experience have shown that variable topdressing depths promote plant diversity within the reclamation areas. Typical variances include applying deeper topdressing on level topographic areas to create a plant community typically dominated by grass species and applying shallower topdressing depths on slopes or lowland areas typically dominated by shrub species. BNCC will not design topdressing depth variances; rather, topdressing depth variances will occur opportunistically as a result of the replacement methods and equipment selection.~~

Topdressing will be replaced year-round with the equipment (i.e., scrapers or haul trucks) best suited for the conditions of the reclamation area. Compaction resulting from replacing topdressing material will be alleviated as discussed above and in Section 37 (Post-Reclamation Vegetation).

An average topdressing depth of 9.7 inches will be applied to all reclamation blocks in the permit area. The replaced topdressing depth will be approximated by load counts per reclamation block or survey staking. Variations in topdressing depth will be opportunistic and result from the equipment and process used for topdressing replacement. The average topdressing depth will be calculated over the entire reclamation block. BNCCNTEC will conduct topdressing depth verification surveys to ensure each area meets the average topdressing depth requirement. The methods used to verify the replaced topdressing depths include: physically sampling the topdressing depths, using surveyed elevation information, or using grade stakes.

When physical sampling of replaced topdressing depths occurs, it will be conducted at sample points arranged in a regular 330-foot grid. These topdressing verification sample points are coincidental with the root-zone subplot sampling points discussed in Section 36.4. Test holes are dug at each of the topdressing verification sample points and the depth of topdressing material is recorded for that location.

Survey elevation information may be used in lieu of physically digging samples, in which case the depth of topdressing replacement is calculated from the difference between the topdressing and regrade surface surveyed elevations. If grade stakes are used in an area to direct topdressing replacement, these may be used to verify replacement depth. Wooden lath will be placed throughout the regraded area with the appropriate replacement depth indicated on each side of the lath. The lath will be clearly marked and visible to the equipment operators. The lath shall remain in place until an OSM inspector has verified the topdressing depth.

If any of these methods determine the redistributed topdressing depth within the verification area does not meet the average topdressing depth of 9.7 inches or any of the sample point do not have a minimum sample depth of one half the required average depth, **BNCCNTEC** will spread additional topdressing material until the area meets the average topdressing depth requirement. The location of topdressing verification points and topdressing depths sampled between July 1 and June 30 will be submitted annually to OSM on or before August 31 in the annual soil resource report (Section 36.6).

BNCCNTEC will not operationally target placing topdressing material within the channel bottoms. However, topdressing material may migrate to the channel bottoms due to mechanical (e.g., equipment operations and placement activities) and natural means (e.g., wind and water movement of material).

36.3.2.1 Temporary Distribution of Soil Materials

BNCCNTEC will not temporarily distribute soil materials in the permit area. Therefore, this section is not applicable.

36.3.2.2 Variance from Redistribution of Topsoil on Embankments

An embankment is an artificial deposit of material that is raised above the surface of the land used to contain, divert, or store water, support roads or railways, or for similar purposes (30 CFR 701.5). OSM may grant applicants a variance, allowing them not to redistribute topsoil or topsoil substitute on post-reclamation embankments (30 CFR 816.22(d)(3)) provided the embankments will be stabilized and prevent sedimentation. **BNCCNTEC** is not requesting this variance since structures meeting the definition of embankments are not anticipated in the post-reclamation surface in the permit area.

The methods and practices **BNCCNTEC** will utilize to stabilize and prevent sedimentation in post-reclamation surfaces are presented in Section 38 (Post-Reclamation Surface Stabilization and Sediment Control). Sediment and drainage control associated with operational embankments are discussed in Section 25 (Sediment Control Plan) and Section 26 (Drainage Control Plan).

36.3.3 Topdressing Balance

The pre-mine topdressing material balance and summary of topdressing resources within the permit area is determined based on the soil survey information presented in Section 14 (Soil). ~~BNCNTEC~~ will estimate the topdressing material balance from multiple sources of information including stockpile volumes, pre-salvage topdressing survey results, and baseline soil survey information. Topdressing stockpile volumes will be estimated by aerial flight, vehicle load counts, or survey data. The pre-salvage topdressing survey (Section 36.2) will estimate the volume of in-situ topdressing within the 1,800-foot pit disturbance limits. The volume of topdressing resources away from the active mining areas is calculated using the baseline soil survey information, presented in Section 14 (Soil). From the in-situ surveys and volume estimations, ~~BNCNTEC~~ predicts a 10% loss of suitable topdressing material as a result of salvage, transportation, storage, and respread. Topdressing balance information will be submitted to OSM annually on or before August 31 as part of the annual soil resources report (Section 36.6).

36.4 Root-zone and Mitigation Sampling

The root-zone ~~in reclaimed areas is subdivided material for permit area is separated~~ into two zones ~~based on spoil depth.~~ ~~The primary root-zone extends from the surface of regraded spoil to (0-1 feet-foot~~ below the ~~spoil surface, of the regraded spoil)~~ and the secondary ~~root-zone consists of the interval from (1-3.54~~ feet below the ~~spoil surface of the regraded spoil)~~. The classification of these root-zone intervals is based ~~upon the root development characteristics of revegetation species in soil/spoil, including rooting depths and densities, and the resulting differences in utilization of the two zones by and intervals of the greatest root concentrations of the~~ revegetation species. Various studies have demonstrated that ~~the greatest concentration of roots from the~~ revegetation species ~~relay predominantly on will remain within~~ the primary ~~root-zone for initial establishment and long-term subsistence~~ rather than the secondary ~~root-zone as evidenced by the greater concentration of roots within the primary root-zone.~~

~~Sandia National Laboratories evaluated the rooting depth and root distribution of galleta (*Pleuraphis jamesii*), spike dropseed (*Sporobolus contractus*), and fourwing saltbush (*Atriplex canescens*) at a laboratory located near Albuquerque, New Mexico (Peace et.al. 2004). These native species are either present in the baseline vegetation communities or included in the revegetation species mixes for the Pinabete Mine Plan. Sandia National Laboratories' (Peace et.al. 2004) study concluded that galleta and spike dropseed have the greatest concentration of roots within the upper foot (30 cm) of the soil profile (Peace et.al. 2004). Fourwing saltbush has a different root structure than grass species and is characterized by a well-developed, pronounced taproot and a lateral root system. Within the Sandia National Laboratories study, Peace et.al. (2004) observed fourwing saltbush plants had the greatest concentration of roots within the upper 5.5 feet (170 cm) of the soil profile. Rooting depth studies on fourwing saltbush conducted at Navajo Mine observed similar results (Stutz and Buchanan 1987). Stutz and Buchanan observed that on native and reclaimed lands, fourwing saltbush had 92% and 68% of total root mass within~~

upper ~~the~~ 4.9 feet (150 cm), respectively. Within reclaimed lands of the study, fourwing saltbush had 35% and 54% of its root mass in the upper 10 in (25 cm) and 20 in (50 cm), respectively.

To ensure that spoil material within the primary and secondary root-zones is suitable for plant establishment and growth, BNCNTEC will evaluate root-zone material after spoil placement. The procedures used to sample and determine root-zone suitability and mitigate unsuitable root-zone sites are described below.

36.4.1 Root-zone Sampling

Final regraded material will be sampled to determine suitability as root-zone material prior to placement of topdressing. Regraded root-zone material sampling takes place on a 330-~~feet-foot~~ regular square grid with the intersection of the northing and easting grid lines serving as the centroid of a 2.5-acre plot.

Each 2.5-acre plot is subdivided into four equal subplots (0.625-acre subplot area). A backhoe, or similar piece of equipment, will excavate a ~~45-feet-foot~~ deep test pit at the center of each subplot (Figure 36.4-1). Samples of root-zone material ~~are will be~~ collected from ~~both~~ the following vertical intervals along a 3-foot horizontal cross-section of the test pit profile: 0-1-foot, 1-4-foot, 1-2-foot, 2-3-foot, 3-4-foot, and 4-5-foot and 1-3.5-foot vertical intervals along a 3-foot horizontal cross-section of the test pit profile. Collecting the samples along a horizontal cross-section improves the representativeness of each sample. The ~~collected individual~~ samples ~~is will be~~ passed through a 1-inch sieve and sampling continues until approximately 2 liters of material are collected from ~~each interval~~ the 0-1-foot and 1-4-foot intervals and 1 liter of material is collected from the 1-2-foot, 2-3-foot, 3-4-foot intervals, and 4-5-foot intervals. The 0-1-foot and 1-4-foot interval samples will be saved and set aside for further mixing. The 1-2-foot, 2-3-foot, 3-4-foot, and 4-5-foot interval samples will be retained and archived for a minimum of 6 months while laboratory analyses of plot and subplot composite samples are performed. This process is repeated at ~~all the remaining~~ subplot test pits within the 2.5-acre plot.

Once all subplots have been sampled, the eight individual samples (four 0-1-foot interval samples and four 1-~~3.54~~-feet interval samples) are split in the field using a corner-to-corner tarp sampling technique (U.S. Department of Agriculture 1996). An equal volume of sample (approximately 1 liter) is collected from each subplot interval split and combined into a single composite sample representing the specific interval (i.e., 0-1 foot and 1-~~3.54~~ feet) for the respective plot. The remaining sample material from each subplot interval is retained and archived for a minimum of 6 months while laboratory analysis of plot composite samples is performed. If the results from laboratory analysis show a plot composite sample to be unsuitable, then the archived ~~subplot sample material~~ composite sample materials (0-1-foot and 1-4-foot) is analyzed for root-zone suitability. If the laboratory analysis results show an archived composite subplot samples to be unsuitable then the archived subplot interval samples (1-2-foot, 2-3-foot, and 3-4-foot) are

analyzed for root-zone suitability. However, the 4-5-foot subplot interval sample material is analyzed only if the subplot 0-1-foot composite sample material is shown to be unsuitable. The process of analyzing the plot, subplot, and subplot interval samples assists BNNC in identifying ~~to further identify~~ the extent of unsuitable material, and not placing unnecessary mitigation material on suitable subplots. The composite sampling procedure is presented in detail in [Figure 36.4-2](#).

Only disturbed and regraded root-zone materials are sampled using the above procedure. When native materials are encountered (i.e., the area has not been mined), the following field observations will be collected:

1. Depth and thickness of interval,
2. Identification of lithological constituents,
3. Munsell color and if incompetent/unconsolidated, and
4. Texture-by-feel analysis will be recorded to define each soil horizon of native material and a photograph will be taken of the test pit wall clearly showing the in-place native materials will be taken. To substantiate the existence of native materials, field observations and photographs will be included in the annual soil resource report submitted to OSM (Section 36.6).

36.4.2 Root-zone Suitability

Root-zone suitability will be determined using the methods of analysis and parameters listed in [Table 36.2-1](#) and [Table 36.4-1](#), respectively. When unsuitable material is identified from the plot composite samples, the archived subplot samples will be analyzed to further identify the extent of the unsuitable material. Results of the root-zone suitability analysis will be submitted to OSM in the annual soil resource report described in Section 36.6.

36.4.3 Mitigation

The permit area will does not contain widespread occurrences of unsuitable or PATFM based on the overburden characterization conducted in Section 17 (Geologic Information) and an analysis of spoil and root-zone samples collected at Navajo Mine. The overburden characterization for the permit area indicated the occurrences of unsuitable strata within the geologic column are largely isolated to thin interburden layers between the coal seams. However, when the geologic column is analyzed as a composite of all the overburden and interburden layers, these occurrences are attenuated and chemical and physical analytes are within the suitability criteria limits. This is demonstrated by the suitability of the majority of spoil and root-zone samples collected at Navajo Mine. ~~BNNC~~ BNNC analyzed over 13,000 spoil and root-zone samples, sampled between August 1990 and December 2011, to characterize the central tendency and variability of the chemical and physical analytes of the spoil and root-zone material at Navajo Mine ([Table 36.4-2](#)). This analysis of the Navajo Mine spoil and root-zone samples indicates there are no widespread occurrences of unsuitable materials present at Navajo Mine. This characterization is applicable for the

permit area, as both the permit area and Navajo Mine permit area are in the same geologic region, the same coal seams will be mined, and the same overburden and interburden layers will be spoiled. In addition to the permit area overburden characterization and the analysis of Navajo Mine's spoil and root-zone samples, the Section 17 (Geologic Information) overburden analysis ~~in Section 17 (Geologic Information)~~ demonstrates that there is a sufficient amount of suitable overburden above the first coal seam to be mined to establish a suitable ~~root~~root-zone throughout the permit area.

~~BNCCNTEC will establish a minimum of four (4) feet of suitable root-zone prior to topdressing replacement. When unsuitable root-zone material is identified using the process described in Section 36.4.1, the extent and depth of unsuitable root-zone material will determine the appropriate mitigating action. BNCCNTEC will not mitigate native *in-situ* soil materials encountered during root-zone sampling; however, topdressing will be placed on the regraded surface as described in Section 36.3.2. Mitigation measures may include one or more of the following options:~~

- ~~1) Removing the unsuitable material and placing it in a mining pit, resulting in burial with at least four feet of suitable root-zone material.~~
- ~~2) Covering the affected area with suitable root-zone material (i.e., suitable spoil or regolith) to a required depth and that ensures four feet of suitable root-zone material.~~
- ~~3) Treating or amending the unsuitable material. If this option is selected, BNCCNTEC will consult with OSM on the alternative treatment plans prior to implementation.~~

~~Subplots with samples exceeding the suitability criteria, as determined in previous sections, will be mitigated by either removing the upper 12 inches of material and replacing it with 12 inches of suitable root zone material or burial with 12 inches of suitable root zone material and covering with a minimum topdressing thickness of 12 inches. BNCC will monitor the secondary root zone (1-3.5 foot); however, the benefits of using the geomorphic reclamation approach would be negated by altering the final surface elevations with additional root zone material. Traditional reclamation mitigated exceedances of suitability criteria in the secondary root zone by burial with up to 4 foot of root zone material. This can create an erosionally unstable raised "island" on the reclamation area surface. The additional root zone material will alter the hillslope configuration and impact the designed channels and drainages densities. Based on expected limited occurrences of PATFM, the benefits of geomorphic reclamation far outweigh the potential benefits of additional mitigation material.~~

Suitable mitigation material will be obtained from various sources, including in-situ overburden ahead of the mining pits, regolith, or nearby ungraded spoil. All material used for mitigation will meet the suitability criteria listed in [Table 36.4-1](#). The results of the mitigation sampling will be provided to OSM in the annual soil resource report as described in Section 36.6.

36.5 Prime Farmland Soils Handling Plan

There are no prime farmlands identified within the permit area; therefore, this section is not applicable. The prime farmland determination is described in Section 14 (Soil).

36.6 Annual Soil Resource Reporting

BNCCNTEC will submit post-mining soil resource information, when available, annually to OSM. This information will be included in the annual soil resource report submitted on or before August 31. Post-mining soil resource information presented in this report will be from the period July 1 through June 30. Typical information to be provided in this report includes:

1. Topdressing resource information
 - Pre-salvage sampling results (sample sites, depths, laboratory analyses, and maps of survey area at 1:6000 scale [1 in = 500 feet]),
 - Topdressing replacement results (sample sites, depths, and maps of survey area at 1:6000 scale), and
 - Topdressing balance (estimated volume of soil stockpiles and in-situ resources [pre-salvage topdressing sampling and baseline soil survey]).
2. Root-zone sampling information
 - Northing and easting of each 330-foot plot sampling site,
 - Laboratory analyses from each grid location sampled during the reporting period,
 - Recorded field observations and photographs of native materials encountered during sampling, and
 - Maps of the regraded area and sampling sites presented at 1:6000 scale.
3. Root-zone mitigation results
 - Plot locations requiring root-zone mitigation (locations and maps of mitigated sites presented at 1:6000),
 - Laboratory analyses of mitigation material.

36.7 Post-Reclamation Soil Information Collection and Analysis

BNCCNTEC relied on existing site specific data from Navajo Mine and Pinabete Mine Plan permit area information to complete this section. Soil and geology baseline information discussed in this section are presented in Section 14 (Soil) and 17 (Geologic Information), respectively.

Personnel

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

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