SPECIAL CONSIDERATIONS

This section places emphasis on the special considerations associated with soil removal; stockpiling; replacement; reconstruction; and proof of productivity for prime farmland soils, remined areas, and refuse piles.

Prime Farmland Soils

Special considerations are required for prime farmland soils historically used as cropland. Achieving crop productivity on reconstructed prime farmland soils similar to that on nonmined soils requires careful attention to soil removal, soil transport, soil storage, and soil replacement so that the reconstructed soil will be similar in all aspects to the soil before it was disturbed by mining. The establishment of specifications for soil removal, storage, replacement, and reconstruction of prime farmland soils is the responsibility of the USDA Soil Conservation Service within each state.

Removal

Prime farmland soils are to be removed from areas to be disturbed before drilling, blasting, or mining begins. In general, the minimum depth of soil and soil materials removed and stored for use in reconstructing the prime farmland soils generally should be enough to reconstruct a soil 48 inches deep. Specific depth requirements are established by the Soil Conservation Service and defined in the PAP.

Methods

The operator should remove separately the topsoil, B and C horizons, and/or other soil materials suitable for reconstructing soils with an equal or greater productive capacity than that which existed before mining. The thickness of topsoil to be removed is determined from the soil survey. Topsoil is defined as the A and E horizons taken together. The Ap horizon, consisting mostly of B horizon, also is considered as topsoil. If not used immediately, the topsoil and each horizon or soil material from the prime farmland soils should be stockpiled separately from spoil and other excavated materials.

The equipment selected for soil removal and transport should produce minimum damage to the soil structure and pore space but still allow for effective segregation of the soil layers. Machinery available for soil removal includes bucket-wheel excavators, dozers, scrapers, road graders, and crescent scrapers.

Timing

All vegetative cover that would interfere with salvage of the topsoil and other soil horizons should be removed before soil removal begins from the portion of the permit area to be disturbed. The soil is to be removed before any drilling, blasting, mining, and other surface disturbance.

Soil removal on a nearly continuous basis can be done on some mining operations where the soil materials are placed directly on regraded spoil materials. Other operations will involve stockpiling of topsoil and other soil horizons until they can be placed. Either approach should be timed to take advantage of suitable moisture and possibly temperature conditions to avoid excessive compaction of soil material.

Moisture—Soil removal when the soil is relatively dry, or, more precisely, when moisture content is less than 75 percent of optimum (Standard Proctor Test), will help maintain soil structure, reduce compaction, and reduce loss of pore space. Moving soil materials while wet will cause problems throughout the soil handling, soil reconstruction, and revegetation processes.

Temperature—Moving soil when it is frozen caused a minimal amount of compaction and maintained favorable soil structure and pore space. It is desirable that the entire layer of soil being lifted and moved is frozen. The benefit of moving frozen soil would be negated if only a part of the layer was frozen, especially if the soil were wetter than desired.

Protection

The prime farmland soil materials should be protected during the soil removal and stockpiling stages to minimize compaction and to prevent or retard wind and water erosion and contamination. Mixing with rock, vegetative debris, and other nonsoil materials is the most likely form of contamination to occur during soil removal.

Storage

Selection of suitable sites for stockpiles is important for maintaining the quality of the stored soils. Stockpiles of prime farmland soil material should be placed within the permit area where they will not be disturbed or subjected to excessive wind or water erosion nor contaminated by acid or toxic overburden materials, acid drainage, flooding, and fluids and lubricants drained from equipment. Stockpiles of topsoil and B and C horizons from prime farmland soils should be segregated from stockpiles of other soil and overburden materials.

The soil survey provides information that can assist in site selection for stockpiles. Important features to be considered are the surface relief, slope length, slope gradient, slope direction (aspect), surface and internal drainage conditions, flood hazard, and susceptibility to slippage.

Sufficient area should be prepared for each stockpile to allow easy access and to provide space for building temporary structures, such as diversion terraces, needed to protect the stockpiles from erosion and contamination. The Approved Regulatory Program may contain standards on the steepness and length of each side slope of the stockpiles. Each stockpile should have positive drainage to assure that precipitation and surface flow drains away from the stockpile.

Wind and Water Erosion

Erosion by wind and water may be a hazard during the removal and stockpiling of prime farmland soil materials. Protecting these materials from erosion is necessary during all phases of handling. Berms, diversions, or other temporary structures may be needed to prevent surface runoff from entering and eroding soil materials from areas where the soils are being removed and from stockpiles.

The use of mulches and soil stabilizers also may be needed along with the use of temporary vegetative cover.

Water erosion is the main concern in the Appalachian and Interior Coal Regions. Sheet and rill forms of water erosion can be a potential hazard on areas where the soil materials are being removed and on stockpiles, particularly during times of the year when substantial rain can be expected for extended periods. Stockpiles of soil that will not be spread within 30 days may need to be mulched or seeded and mulched. Where needed, quick growing annual or perennial cover crops should be seeded or planted as soon as weather and seedbed conditions allow after the stockpile is established.

The Western Coal Region has potential for both wind and water erosion. Areas where prime farmland soil is being removed and the stockpiles of these soil materials are vulnerable to both types of erosion because of the absence of protective plant cover. Mulches and soil stabilizers may be needed to control wind erosion even on stockpiles that will be used in a few days. Stockpiles that will not be used within 30 days may need to be seeded and mulched. Irrigation may be required to obtain vegetative cover quickly.

Reconstruction

The placement and reconstruction of prime farmland soil material should be such that the reconstructed soils will have the capacity of achieving yields equal to or higher than those on nonmined prime farmland in the surrounding area. Specifications for reconstruction of prime farmland soil are established by the SCS within each state and include, as a minimum, physical and chemical characteristics such as soil horizon depths, densities, and pH.

Land Shaping and Drainage

The land surface must be shaped to obtain adequate surface drainage before the topsoil and root zone materials are replaced and graded. Broad, flat areas should be avoided because any differential settling of materials will create ponding. Gentle slopes of about 2 percent are preferred.

Surface drainage should be designed on the assumption that the final reconstructed soil will be slowly permeable and runoff will be relatively high. Drainageways with sufficient capacity to handle this higher runoff may be required. Where surface mining of adjacent unmined land is anticipated, it may be advisable to plan for the handling of runoff from that land, particularly where drainage from both areas may need to be handled in common drainageways.

Depth of Soil Reconstruction

In general, the depth of reconstructed prime farmland soil should be 48 inches. Specifications for greater or lesser depths will be provided by the SCS based on the soil survey and established crop yields.

A depth less than 48 inches for reconstructed soil may be permitted where a subsurface horizon that inhibits or prevents root penetration is found in the natural soil at a depth less than 48 inches. Soil horizons are considered as inhibiting to root penetration where their physical or chemical properties or water supplying capacities restrict or prevent penetration by roots of plants common to the area, and these properties or capacities have little or no other beneficial effect on productive capacity of the soil.

Depths greater than 48 inches may be required for some prime farmland soils to assure restoration of productivity. This may occur where the rooting depth of plants common to the area generally is greater than 48 inches.

Topsoil

The operator should replace the topsoil or other suitable soil materials that have been approved by the regulatory authority as being capable of creating a soil with equal or greater productive capacity than that which existed before mining. This surface soil layer should equal or exceed the thickness of the original surface soil layer, as determined by the soil survey.

- Density—The density of the replaced and reconstructed topsoil should be within the range for the A and E horizons cited in the soil survey and given in the permit application (to qualify for phase one bond release). Where a scraper has been used to redistribute the topsoil and no ripping or other practice is used to break the compaction caused by the scraper, the soil will be considered as not meeting the regrading standard because of overcompaction. Acceptable methods of placement of topsoil material include the use of trucks (base level dumping) with dozer spreading. One method that leaves the soil in a favorable physical condition and minimizes compaction is the final placement of soil by conveyor belt followed by dozer spreading.
- Texture—The texture of the replaced topsoil should be of the same soil textural class as that of the prime farmland soil before mining, unless an approved substitute topsoil is used. Where more than one prime farmland soil occurs on a permit area, the texture of the reconstructed topsoil may be that which would result from a mixture of the topsoil from each of these prime farmland soils.
- Thickness—The thickness of the reconstructed topsoil should be the same as the average thickness of the prime farmland soil in the permit area before mining. Where more than one prime farmland soil occurs on a permit area, the thickness of the topsoil should be representative of each of the prime farmland soils being reconstructed.
- pH—The pH should be the same as that of the prime farmland soils in the permit area before mining. Modifications due to mixing of nontopsoil materials should result in raising the pH to no more than 8.0 or lowering it to no less than 5.0.
- Other Properties—Available water capacity, cation exchange capacity, and porosity of reconstructed topsoil should be similar enough to the prime farmland soil before mining to allow restoration of productivity.

Subsoil

The B horizon, C horizon, or other suitable material that has been removed should be replaced to the thickness that meets the minimum depth requirements for restoring soil productivity.

- Density—Subsoil materials should be replaced with proper compaction. Proper compaction of regraded subsoil generally means that no layer within the subsoil has

a bulk density (1) greater than that of the most dense layer of the B horizon of the prime farmland soil before mining or (2) greater than the most dense value for the horizon cited in the SCA SOI-5 form for the prime farmland soil.

There is no optimum density applicable to all prime farmland soils because of the differences in the makeup of soils. Soil-density specifications are a part of the soil reconstruction specifications developed by SCS in each state. SCS will determine proper compaction for each prime farmland soil to be reconstructed.

Replacing the prime farmland soil materials when they are relatively dry or, more specifically, when moisture content is less than 75 percent of optimum (Standard Proctor Test), will help minimize compaction. The optimum moisture content for plant growth is about that of ⅓ bar tension (field capacity) in most soils.

Where scrapers are used to place and regrade the subsoil, some form of ripping or chiseling generally is required to correct excessive compaction. It is important to monitor and correct the density of lower layers while they can be reached with the rippers or chisels. Placing soil amendments such as lime on the subsoil layer before ripping or chiseling will help correct strongly acid soil conditions and may help achieve restoration of productivity.

- Texture—The texture of the reconstructed subsoil should be that which would result from the mixing of the subhorizons of the B horizon, or from a mixture of these subhorizons and approved portions of the C horizon. Where more than one prime farmland soil occurs on a permit area, the texture of the reconstructed subsoil may be that which would result from a mixture of subsoil materials from each of the prime farmland soils. No material should be mixed into reconstructed subsoil that is toxic or otherwise harmful to plant growth.
- Thickness—Subsoil material should be returned uniformly at a thickness not less than the combined average thickness of the unmined B and C horizons above 48 inches or to a restrictive layer if less than 48 inches.
- pH—The pH should be the same as that which would result from the mixing of the subhorizons of the B horizons or from these subhorizons mixed with approved portions of the C horizons of the prime farmland soil or soils. If the resulting pH is less than 5.0, the operator can raise the pH of the subsoil by adding lime.

Timing

The reconstructed prime farmland soils should be seeded or planted when most of the crops, grasses, trees, and shrubs are customarily seeded or planted in the area. Replacement and reconstruction of the prime farmland soils would ideally be timed to take advantage of the best planting and seeding seasons of the year. However, this may not coincide with the best time to move, handle, place, and grade soils. In some regions, spring is the best time to seed and plant, but the winter months preceding usually are not a desirable time for handling soil because of high precipitation and low evaporation. Thus, soils are subject to severe erosion and remain wet and in some areas do not freeze deep enough to move layers of soil that are entirely frozen. The best alternative in these regions is to reconstruct soils during the dryer summer months and seed and plant in the fall. Handling of soil in the summer may be a high risk because of excessive wind erosion in some regions or storms with high-intensity precipitation in other regions. Reconstruction during any season of the year may be accompanied by erosion hazards, overcompaction, and difficulty in establishing vegetative cover. Thus, proper timing for reconstructive soils depends partly on choosing the most appropriate season in a given region and partly on the good fortune of receiving favorable weather regardless of the season of the year.

Bond Release

Permit areas containing prime farmland have special requirements for two phases of bond release.

Phase One

The State regulatory authority may release 60 percent of the bond when the operator completes backfilling, regrading, and drainage control on the bonded area in accordance with the approved reclamation plan. Bonded areas containing prime farmland soils must meet specific requirements for phase-one bond release. The requirement that will be the most troublesome for the operator is to replace and regrade the soil horizons or other root-zone materials within limits of proper compaction and uniform depths.

Phase Two

An additional portion of the bond may be released after soil productivity for the prime farmlands has been returned to levels of yield equivalent to nonmined land of the same soil type in the surrounding area under equivalent management practices.

Soil productivity should be measured within 10 years after soil replacement is completed. Soil productivity is measured on a representative sample or on all of the mined and reclaimed prime farmland area using the approved reference crop. The measurement period generally is for a minimum of 3 years before release of the operator's performance bond. The level of management applied during the measurement period should be the same as that used on nonmined prime farmland in the surrounding area. Restoration of soil productivity is considered complete when the average yield during the measurement period equals or exceeds the average yield of the reference crop grown during the same period on comparable nonmined prime farmland soils in the surrounding area under equivalent management practices.

The approved regulatory program provides requirements for reconstructed prime farmlands specific to the State concerned.

Remined Areas

Revegetation of remined areas is a special consideration because of the previous disturbance. Topsoil may or may not be present on the previously mined area depending on the age of the minesoil and the amount and type of vegetation. If the site has dense and productive vegetational cover, a relatively thin layer at the surface of the minesoil will most likely be the best available plant-growth medium and should be reserved for that purpose. If vegetation is

sparse or absent, soil samples should be collected on a grid pattern and analyzed to determine the best available plant-growth media. Careful labeling and mapping are necessary to identify the location from which each sample was collected. Analysis of the minesoils will show amendment requirements to achieve proper pH and nutrient levels.

Hot spots, i.e., areas of minesoil containing materials toxic to plant life, should be identified before mining. These materials should then be segregated when mining starts and buried as part of the reclamation procedure.

After mining, revegetation can follow standard procedures for applying amendments, selecting species, and seeding, planting, and mulching to achieve the desired land-use objective.

Refuse Piles

Refuse piles resulting from coal preparation plants or deep-mine operations present a unique revegetation problem. Usually, topsoil or substitute materials are not available. The dark color of the refuse can absorb enough solar energy to raise temperatures to levels that are lethal to plants. The materials are often highly acidic and deficient in plant nutrients.

A complete analysis of the refuse material is necessary before a revegetation prescription can be developed. Topsoil or substitute material available for covering the refuse should be analyzed at the same time. The analyses will identify lime and fertilizer requirements.

Where topsoil or substitute materials are available and the refuse is very acid, it may be necessary to neutralize the refuse before applying the surface layer of plant-growth media. The surface layer should then be limed and fertilized according to the results of the soil tests. Seeding, planting, and mulching can then be performed following accepted procedures.

Where there is no topsoil or substitute material available, revegetation of the refuse is more difficult. Lime and fertilizer requirements, as determined by the soil tests, should first be satisfied. Seeding and planting should be followed by a very heavy application of mulch. Coarse mulches such as bark, wood chips, or straw provide more protection from solar insolation than the cellulose fiber mulches. Enough mulch must be applied to completely cover the refuse and provide some shading of the newly germinated plants.

Incorporating organic materials, such as sewage sludge, composted municipal wastes, livestock and poultry manures, shredded bark, composted leaves, papermill sludge, mushroom compost, and mixtures of some of these materials, has greatly enhanced revegetation of coal refuse piles as well as abandoned acid-mine spoils. In some cases, additions of lime and fertilizer were not needed where moderate to high rates of these organic materials were applied.

Fall seeding with a mixture containing a temporary cover species, such as winter wheat or rye, and permanent species has proved successful in test plantings. The cool fall weather promotes the development of the cover species which provide a living mulch to protect the other species as they germinate and start growth in the spring. Tree and shrub seed can be included in the fall seeding mixture or seedlings can be planted in the spring.

Due to the severity of this type of site, germination and plant establishment may be spotty. The land manager should be prepared to spot treat open areas to obtain an overall cover.

VEGETATION ESTABLISHMENT AND CULTURAL PRACTICES

The use of appropriate cultural practices and amendments and adherence to proper seeding and planting techniques will greatly increase chances for success in establishing vegetation. In fact, success in revegetating minesoils may be more dependent on the proper use and application of these practices and amendments than on the selection of plant species.

Soil Amendments

Successful establishment of vegetation on minesoils usually requires the applications of one or more soil amendments. Amendments are materials applied and incorporated into soils to cause immediate changes in soil physical and chemical properties. Amendments should not be confused with mulches, which are used to alter surface characteristics and environment. Field and laboratory soil chemical and physical tests are needed to determine amendment requirements.

Fertility Management

Several criteria may need to be considered in determining the kind and amount of fertilizer to use: (1) nutrient availability in the spoil or soil, (2) nutrient requirements of plant species to be established, (3) effect of fertilizers on minesoil properties, (4) cost, (5) requirements for refertilization, and (6) availability of water.

Fertilizer requirements and recommendations vary with different land uses and management situations. For agricultural uses, fertilizer application is based mainly on soil tests and follows the recommendations of local agricultural specialists for the crop being planted. Criteria for agricultural use may include split applications for crop establishment and periodic applications thereafter for crop maintenance.

For forestry and wildlife habitat land uses, fertilizer is applied primarily for the initial establishment of a vegetative cover for erosion control. Generally, this requires a lower fertilizer rate than for agricultural uses, and maintenance applications usually will not be required. Ideally, without maintenance applications, density of the initial cover will gradually diminish or composition will change and thereby improve the chances for planted and naturally seeded woody species to develop.

Soil testing for needed fertilizer is less important for forestry or wildlife-habitat land uses, or where herbaceous cover is established primarily for erosion control or esthet-