THE PERMIT APPLICATION PACKAGE

A review of the topsoil and revegetation specifications contained in the Permit Application Package (PAP) will provide the inspector with information on how the operator plans to remove, store, and redistribute topsoil, and how vegetation will be established, maintained, and evaluated. Where this information is compared with on-site conditions as part of a premining inspection, the inspector can make a number of judgments about the suitability of the specifications and the resulting postmining land use.

Thorough review of the PAP soils and revegetation specifications will provide information such as:

- Location of topsoil storage areas.
- Protective measures for stored topsoil.
- Methods and timing of topsoil redistribution.
- Soil tests for determining lime and fertilizer requirements.
- Herbaceous species, seeding rates, and methods.
- Woody species, planting densities and methods.
- Use of temporary cover for erosion control.
- Mulch application, rates, and methods.
- Other information on vegetation and postmining land uses.
- Criteria for measuring revegetation success.

A thorough knowledge of the plan will help the inspector visualize the reclamation process and expedite the on-site inspection. For example, this information may be useful during an inspection to determine if an operator is contaminating topsoil or failing to store the required amount of topsoil. The plan should detail how the topsoil will be protected from wind and water erosion and contaminants. Measures may range from mulching to covering with plastic. Procedures for redistributing topsoil on the backfilled area should be detailed in the plan. Also, the PAP usually describes the equipment to be used in topsoil removal, storage, and redistribution.

Information concerning soil testing methods and soil amendments is an important part of the PAP. Needed soil amendments such as lime, nitrogen (N), phosphorus (P), and potassium (K) are listed and rates of application (usually in pounds/acre), based on soil tests, are given. Methods for application and incorporation of these soil amendments are detailed and described. Methods for clearing, grubbing, and disposing of debris, if applicable, should be defined in the permit.

The permit must specify the success standards that will be used to determine whether or not cover and other vegetative criteria are adequate for bond release. Depending on geographic region and the particular regulatory program, revegetation success will be measured against either reference areas or performance standards. Reference areas, usually undisturbed plots typical of the soils, topography, and vegetation of the area, are sometimes used as the basis for comparing the vegetative cover, productivity, and other parameters on the revegetated mine site. Technical performance standards specify the percent ground cover, maximum size of bare-areas productivity, or other constraints to be met on the revegetated area.

While reviewing the PAP soils and revegetation information, it is essential to consider the existing and proposed hydrologic characteristics of the mine and adjacent areas. In some instances, mining will reduce or change water availability schemes and consequently modify expectations of success compared to premining conditions. During the field review portion of the inspection, attention should be focused on the differences between proposed or anticipated resoiling and revegetation activities and the actual implementation and early performance and effectiveness of the activities.

In preparing for the field inspection and documenting report, the inspector should reduce the PAP information to a short but concise set of notes that might include:

Topsoil

- Type survey (SCS-county-site specific) to determine confidence level.
- Special characteristics and handling methods for prime farmland.
- General characteristics of the major soils for later visual review, i.e. depths, color, dominant soils names.
- General distribution of major or soil components as shown on soils map—consider erodibility and slopes.
- Timing and sequence of removal of topsoil or other materials to be segregated.
- Preparation of ground prior to redistribution of topsoil, i.e., scarification or liming.
- Redistribution of topsoil to avoid overcompaction and achieve uniform depth.
- Location of topsoil storage areas and type of protection.
- Soil testing to be done prior to revegetation efforts.
- Types and amounts of fertilizers or other soil amendments proposed.
- Approval for mixed overburdens or topsoil substitutes for the site.

Revegetation

- Type, seeding period, and methods for temporary and permanent cover seedings.
- Mulching practices to be observed.
- General or specific measures for area stabilization.
- Proper timing for seeding and planting of species and use of in situ mulch.
- Compatibility of species with surrounding area and proposed postmining land use.

Geology and Hydrology

- Location and nature of reference areas.
- Appropriate success standards for bond releases.
- General subsoil and overburden characteristics associated with the mine area.
- General subsurface flow and estimated impact of mining indicated in the probable hydrologic consequences (PHC).

Where a premining inspection of the site is made, the inspector can gain valuable insight about the suitability of the proposed postmining land use in relation to the premining land use. Soil type, slope, aspect, and the type and vigor of indigenous vegetation all provide clues to land productivity and the suitability of the proposed postmining land use. The approved permit can then be used through the life of the mine to ensure proper reclamation.

The inspector will want to prepare for the field review by accumulating a few essential pieces of equipment to be carried when away from the vehicle. At a minimum, the items should include:

- A camera and extra film.
- A segmented soil probe.
- An individual soil sample (pH indicator) kit.
- Several self-sealing plastic bags (approximately 12 inches × 12 inches).
- A 12-foot retractable tape measure.
- A note pad.

These items and the notes compiled during the PAP review should be supplemented with the soil survey maps for the site or portion of the site to be checked. Upon arrival at the mine site and attending to the routine procedural matters, the inspector can begin his or her ambulatory inspection of the soils and revegetation aspects of the operation.

Because sites and areas usually are quite different, the particulars of the inspection will vary greatly. However, most surface coal mining and reclamation operations usually will have three distinct areas:

- The undisturbed portion.
- The active mining portion in various phases of mining and reclamation.
- The reclaimed portion.

When operations have all three areas, primary attention should be given to the removal, storage, and redistribution of the topsoil. Each element in the process is fundamentally aimed at preventing soil loss and deterioration and should be reviewed with that perspective. Mismanagement of topsoil operations are indicated by:

- Lack of appropriate equipment on the site to remove or redistribute topsoil according to approved plans.
- Significant bare and pit areas with no existing topsoil stockpiles.
- Topsoil pushed or blown into pits or downslopes.
- Drill holes for explosives in grass covered areas of original ground.
- Topsoil in spoil areas or fill constructions.
- Unprotected topsoil piles with signs of erosion or contamination.
- Extensive tire marks or signs of compaction on retopsoiled areas.
- Unrevegetated areas with wind or water erosion.
- Topsoil being redistributed on unprepared spoil or subsoil base.
- Obvious lack of uniformity in redistribution of topsoil indicated by bare spots or exposed spoil (conduct a few test probes of retopsoil areas and measure depths).
- Topsoiled areas not graded in accordance with approximate original contour (AOC) or other plans, or with exposed coal or waste materials.

Being satisfied that topsoil has been removed, handled, and replaced satisfactorily, the inspector should turn his or her attention to areas that have been seeded and mulched. Procedures to determine the implementation of proper seeding and mulching practices include:

- Observe on-going seeding and mulching operations, including a look at the evidence around these types of operations such as presence and condition of equipment and empty seed and fertilizer sacks.
- Examine seed coverage on recently seeded but unmulched areas.
- Examine the effectiveness of mulching, e.g., moisture retention and quick plant growth.
- Assess the diversity of seed or species.
- Note additional soil stabilizing practices such as dozer cleating slopes or tar to tack mulches.
- Measure or estimate the distance between planted trees and shrubs.
- Assure that planting is appropriate and timely for the species; for example, Bermudagrass usually is not sprigged in the fall without a temporary cover crop for controlling erosion.
- Look for "hot spots" or other adversely affected areas that may need lime or fertilizer.

Before concluding the inspection, the inspector should at least on a random basis, and routinely if suspicious of ongoing activity, review an operator's records and receipts that clearly demonstrate soil testing is being conducted before seeding and soil amendments are being purchased and applied. Where topsoil substitutes or overburden mixing has been approved, review of plans versus results in the field should be given special attention.

During various periods of the permit life, the inspector will want to periodically compare revegetation success. These primarily visual reviews will be helpful in discussing problem prevention with the operator and will be used during release application and release periods to determine the appropriateness of bond reductions. Initial inspections should include identification of the reference areas followed by seasonal reviews to familiarize oneself with postmining expectations. Where reference areas are not utilized, the operator will need to be familiar with approved success standards.

For prime farmlands, the release is often based on productivity results and involves the assistance of the USDA Soil Conservation Service (SCS) or other agencies preceding release determinations. Where alternate postmining land uses have been approved, re-examination of the postmining land use section of the PAP during reclamation phases is recommended.

Different or varied considerations may be required where relatively new and long-term mining operations are associated with older prelaw mines on which topsoil was not salvaged. These sites usually belong to one or more of the following types.

Coal processing sites usually are required to have a reclamation plan. While the plan may discuss only final reclamation of the site, the inspector generally is required to observe performance standards for the revegetation of such areas. Areas not actively used should be covered with topsoil where possible after acid/toxic-forming substances are removed and disposed of. Where removal of the toxic material is not possible, adequate layers of nonacid/nontoxic materials suitable as subsoil mediums should be spread before topsoil is distributed. Where topsoil is not available, use of chemical treatments and appropriate species on marginal nontopsoil materials may be adequate for effective cover and plant growth.

In reviewing coal waste disposal sites and waste impoundment structures, the inspector is confronted with

various topsoiling and vegetational situations. In general, outslopes, faces, buttresses, diversions, and exit channels should be vegetated to control erosion and maintain stability. In the case of prelaw portions of structures, the inspector should consider the effectiveness of the existing vegetative cover on controlling erosion. Where prelaw portions of mines are used to facilitate postlaw surface coal mining and reclamation operations, it is generally accepted that those areas must meet applicable performance standards. As with coal processing facilities, the specific treatment, topsoiling, and revegetation requirement may vary by plan and program.

There are situations where topsoil removal as a primary surface coal-mining and reclamation operation has been waived. Where other reclamation methods have been approved in the PAP such as the substitution of mixed overburden, the inspector should carefully review the substitution analysis and requirements in the PAP and note field deficiencies where the plan is implemented properly. Where the plan is not properly carried out, the inspector usually will need to correct the situation as required by his or her approved program.

OVERBURDEN CHARACTERISTICS

A detailed examination of the soils and geologic strata above the coal seams before surface mining of any permit area is needed for use in 1) developing a soil reconstruction plan, 2) evaluating the success of reconstruction, and 3) determining amendments and species for revegetation.

Soil Properties

The chemical, physical, and biological properties of a soil determine the suitability of that soil as a medium for plant growth. Ideally, the objective of soil reconstruction is to replace and restore a plant-growth medium that has characteristics similar to and is at least equally suited for plant growth and production as the soils that were in place before mining. In some situations it may be possible to reconstruct a growth medium with properties superior to those before mining. A knowledge of soil and overburden properties or characteristics can help the operator and inspector identify those materials most suitable for replacement as plant-growth media. Similarly, this knowledge can be helpful in identifying materials with properties that limit or prevent plant growth and that should be avoided or, where necessary, amended.

Chemical Properties

The chemical properties of minesoils most often of concern in revegetating mined lands are chemical reaction (pH), toxic concentration of certain elements, and deficiencies of essential elements (nutrients).

Soil Reaction (Acidity and Alkalinity)

Soil reaction is the degree of acidity or alkalinity, usually expressed as pH. It is a measure of hydrogen-ion activity in solution, expressed on a scale of 0 to 14. A pH of 7.0 is neutral. The lower values indicate acidity and the higher values alkalinity. The pH scale is logarithmic. The intensity of acidity and alkalinity changes tenfold for each unit change in pH. For example, a pH of 4.0 is 100 times more acid than a pH of 6.0.

Soil reaction (pH) is a useful criterion for predicting and defining many of the problems associated with the revegetation of surface-mined land. Not only is plant growth affected by pH, but inferences can also be made about other qualities of soil. For example, the availability of some nutrients to plants is limited in strongly acid, extremely acid, strongly alkaline, and very strongly alkaline soils, but these nutrients are readily available to plants in soils that are moderately acid to slightly alkaline.

Some plant species are more tolerant than others of acid or alkaline soil conditions. Using acid-tolerant or alkaline-tolerant species in revegetating minesoils may in some situations be more practical than applying soil amendments. However, in many cases, acidic and alkaline soils will have to be amended if the areas are to be revegetated satisfactorily.

Oxidation of iron sulfides is the most common cause of extremely acid soil conditions. Attempts to revegetate these materials will have limited success unless amendments are used to raise the pH to at least 5.5 because most species will grow where soils have pH levels of 5.5 or higher. Some species will tolerate strongly acid (pH 5.1 to 5.5) and very strongly acid (pH 4.5 to 5.0) soil conditions. Few species will survive or grow well in extremely acid (pH < 4.5) soils. These limits will vary depending on the overall chemical and physical characteristics of soils and geologic strata. *Eragrostis curvula* (weeping lovegrass) and *Robinia fertilis* (bristly locust) are examples of species that are tolerant of extremely acid soils. Lower pH limits for selected species are listed in the chapters titled Revegetating Coal Surface-Mined Lands in the Eastern Coal Region and Revegetating Coal Surface-Mined Lands in the Western Coal Region.

Some species, such as *Sporobolus airoides* (alkali sacaton) and *Atriplex canescens* (fourwing saltbush), are more tolerant than other species of alkaline conditions. Many species grow well in soils with a pH lower than 7.9. A few species will tolerate moderately alkaline (pH 7.9 to 8.4) and strongly alkaline (pH 8.5 to 9.0) conditions; and even fewer species will survive very strongly alkaline (pH 9.1 and higher) conditions. In many areas with these alkaline conditions, there is the added problem of arid or semiarid climatic conditions.

Taking pH readings of the minesoils can provide an indication of where soil amendments are needed to neutralize acidity (lime) or to correct problems of alkalinity (gypsum). Field test kits are available to check pH but they should be calibrated against an approved laboratory pH meter. Generally, test kits with several indicator reagents are more accurate than kits with one reagent. Properly calibrated and maintained portable pH meters usually are more accurate than indicator test kits.

Investigations of the geologic strata by deep core drilling, collection, and analysis of samples for toxic levels of selected elements are needed. Preventive and corrective actions based on these investigations will minimize the