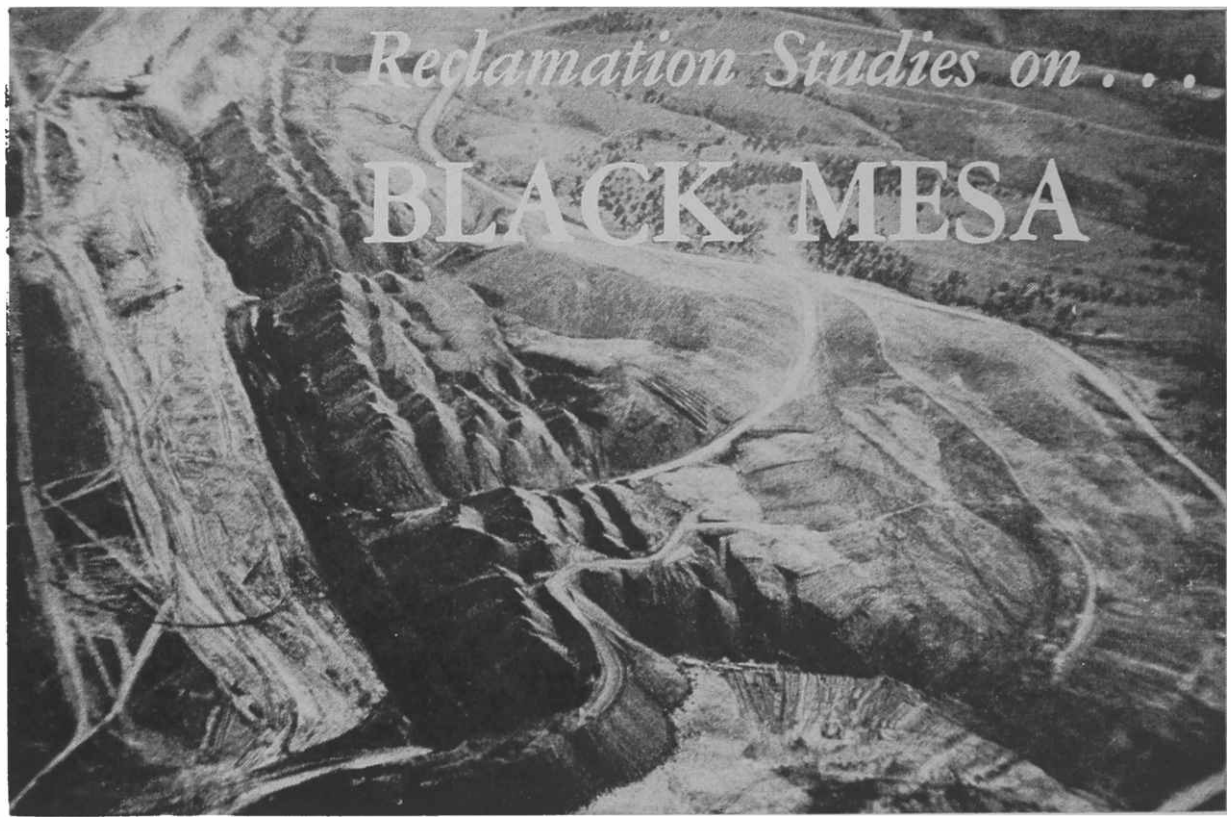

Figure 1. The surface mining operation on Black Mesa is shown at left. Note that along the left margin of the aerial photograph in the upper left hand corner the strip being mined is uncovered by a dragline capale of removing 80 cubic yards of overburden at a time. The coal in the strip is removed by 15 cubic yard shovels and loaded into 100 ton haul trucks. After the coal is removed the strip is filled with overburden from the next strip and recontoured to conform with the natural topography as shown in right hand, lower half of picture.

Reclamation Studies on . . . BLACK MESA

*by J. L. Thames & E. J. Crompton**

The Department of Watershed Management is conducting a research project with the Peabody Coal Company on the Black Mesa. The purpose of the project is to obtain quantitative data on the hydrology and soil materials of mined areas to serve as a basis for developing sound practices in surface mine reclamation in northeastern Arizona.

Severe criticism, often without factual basis, has been leveled at the mining operation and its impact on the environment. The project should help clarify any misconceptions arising from this criticism, indicate significant problems that may exist, and point the way to remedial solutions.

Surface mining is the only feasible means of extracting coal on the Black Mesa. However, it may disturb the surface to 100 feet or more. Reclamation of these areas challenges the conservationist to integrate the extraction of critical energy fuels and subsequent reclamation of mined areas into the multiple use concept of natural resource management.

In the arid West, methods for rehabilitating surface mined areas have not been developed to the point of routine application. Although there is a backlog of experience to draw from rehabilitation efforts in the humid East, little is directly transferable.

Water, and its conservation, is the dominant factor that will largely determine the success or failure of reclamation efforts in arid areas. Choice of species, selection of planting sites, time of planting, erosion potential, water quality, and development of water supplies for livestock or recreation are all dependent upon the hydrologic characteristics of the site. A knowledge of these characteristics will provide the basis for sound planning in order to return the area to as good or better condition than existed before mining. The goal is to provide range land for sheep — a primary source of income for Indians of the Navajo nation.

* *Professor and Graduate Research Assistant, respectively, Watershed Management Department, U of A .*

The Study

Two small experimental watersheds, one on the recontoured mine land and another on a nearby undisturbed area, have been instrumented to monitor a variety of hydrologic variables. H-flumes are used to measure the quantity and timing of surface runoff from the watersheds. Small runoff plots, two replicates on each of two slopes on both watersheds, are used to measure the chemical quality of surface water and rates of erosion and sedimentation from watershed slopes. Access tubes for neutron soil moisture probes have been installed on the mined area to monitor the soil moisture regime. Depth of measurement extends 55 feet down to the impermeable fire clap underlaying the area.

The mined site is graded and recontoured to hold nearly all of the precipitation falling on-site. Only that falling on the perimeter of the recontoured area has the potential for moving off-site. Computer models that have been developed for the project will be calibrated with the

Figure 2. The workman in foreground is installing a flume to measure surface runoff from a five acre experimental catchment on the recontoured area. Water runoff plots above the three men at left are used to monitor water quality and erosion rates.

Figure 3. On the recontoured experimental area, drilling rigs as the one above are used to install neutron probes access holes for measuring soil moisture as deep as 60 feet. A knowledge of soil moisture is important for selecting appropriate species and planting times to achieve successful revegetation.

Figure 4. This photo shows a permeability study being made to determine the rates of water movement through the recontoured mined material. At right of picture is an infiltration ring, 25 feet in diameter which holds 2,000 gallons of water. As the water seeps into the soil, its movement is measured and charted.

watershed runoff data and used to estimate the contribution of the perimeter area to the surface water regime of the surrounding area.

Runoff data from the watersheds will be used to evaluate the effectiveness of revegetation efforts on the distribution and yield of surface water within the mined area. The information is also needed to determine the water available for stock ponds to be established in the final cut when mining has been completed.

Data from the runoff plots are used to evaluate water quality, a primary concern in mine land rehabilitation. Water will be analyzed for minerals, chemicals and suspended sediment. The data will be compared between the mined and unmined areas.

Soil moisture, its amount, distribution and availability for plant growth will be a determining factor in revegetation efforts. Thus, the water regime is being followed by periodic measurements. In addition, the rate movement of soil water through the mantle is important. It would be desirable in order to insure a steady

Black Mesa Reclamation

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supply of water to have the last cut filled for stock water from moisture that percolates through the mined material. The mining operation has been designed so that the final cut is on the down slope side of the impermeable layer underlying the coal bed. The rate of water movement through the mined soil is being synthesized on the computer and validated with the moisture measurements to predict if and when the final cut can be supplied from percolating water.

Preliminary Results

The installations were completed in September, but because of the dry fall conditions results are still tentative. They indicate that chemically and physically the soil material of the mine area is similar to that of the natural area. Texture of both soils are loam however, the mine soil has a greater range of water availability for plant growth than the natural area. Total nitrogen, total phosphorus and total potassium are all higher on the mined than on the natural watershed. The pH of the mined watershed soil is a neutral 6.9. There is enough natural lime on the area to neutralize about 50 tons of sulphuric acid per acre. Sodium is higher on the mine site but far below levels that would lead to a sodic condition. Total salts primarily bicarbonates, sulphates and clorides of calcium and magnesium are higher for the mined soils, but are four to five times lower than an amount that would be detrimental to grass species suitable to the climates.

The mine soil, of course, has developed no structure. It therefore tends to puddle and form crusts on the surface. This condition should be of little consequence once a vegetative cover has been established, and may be alleviated in the interim by the addition of small amounts of organic matter. When the condition is overcome, the mine soil should, because of its great depth, have a high hydrologic potential and an adequate nutrient level for the production of good range forage.

Capital Needs & Sources for . . . Cattle Feeding in Arizona

(From page 3)

ally banks in this area have required clients to put up a 30 percent margin. The remaining 70 percent is provided as needed in the feeding operation by the lending institution.

Commercial banks are, of course, not the only source of funds. Production Credit Associations have been providing increasing amounts of funds. Institutional investments from trust funds, pension funds and other capital pools are becoming common in cattle feeding.[2] Individuals with private sources of funds, as well as some large corporate firms, have been attracted to the cattle feeding industry.

Some financing has been carried out through the sale of limited partnership interests. These partnership programs typically include a parent corporation, a general partner and one or several limited partnership series (i.e., cattle feeding funds). Purchase of a limited partnership by an outside investor generally requires a minimum investment of $10,000 for periods of three to six years. Penalties may be assessed for premature withdrawals. The general partner provides all of the management service for which he charges a fee and often shares in any profits realized by the limited partner. Limited partnerships in cattle feeding initially became popular during 1970-71.[3] They still do not provide a significant source of capital for Arizona feeders.

Outside sources of capital have made it possible to finance modern feedlot operations at sizes considered economic. However, they do make the industry more vulnerable when market conditions and profit margins are unfavorable. During the last quarter of 1973 the stability of these capital sources has been severely tested. High feeder prices and feed costs have resulted in heavy losses being sustained by investors as the fat cattle market declined following decontrol of prices in September. If conditions do not soon become more favorable, considerable amounts of capital can be expected to be withdrawn. This situation would put many feedlot owners in jeopardy as costs per unit rise with reduced use of capacity.

Expectations are that feeder calf prices will continue to decline and feed costs should move downward in 1974. Placements have been down for some time, and fat cattle prices are expected to strengthen in the coming months. These events should improve the investment climate but the industry will continue to face considerable uncertainty and instability in the near future.

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