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A Guide to State Programs for the Reclamation of Surface Mined Areas



GEOLOGICAL SURVEY
CIRCULAR 731

*Resource and
Land Investigations
(RALI) Program*

A Guide to State Programs for the Reclamation of Surface Mined Areas

By Edgar A. Imhoff, Thomas O. Friz, and James R. LaFevers

GEOLOGICAL SURVEY CIRCULAR 731

*The status, content, and general trend
of State programs for the reclamation
of surface mined areas.*

*Resource and Land Investigations
(RALI) Program*

United States Department of the Interior

THOMAS S. KLEPPE, *Secretary*



Geological Survey

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GLOSSARY OF SELECTED TERMS

[These definitions of terms are generalized. Consequently, the definitions will probably not conform in detail to the "official" definitions of a State. Nor will one State's definitions—official or as used informally—necessarily equate with those of another State.]

Area mining. A method of surface mining in lands of relatively gentle slopes and flat-lying bedrocks or mineral deposits through the digging of a succession of contiguous parallel pits. In a given pit or cut, overburden removed is cast (placed) in the mined-out cut immediately adjacent.

Auger mining. The process of extracting coal at a cutface or highwall by drilling holes laterally into an exposed coalbed with a large-diameter auger type bit that delivers coal at the point of entry as the bit advances into the wall or face.

Backfill and grade. To place soil, overburden, or waste rock into a surface mine excavation and level or shape this fill material to a desired surface configuration.

Bench. (1) The surface of an excavated area at some point between the material being mined and the original surface of the ground on which equipment can move or operate; (2) A working road or base below a highwall as in contour mining for coal.

Box cut. A rectangular excavation made at the initiation of a surface mine by removing the overburden from bedrock so that essentially vertical walls result.

Contour mining. The general term for surface mining in steep terrain, in which overburden is removed and the mineral or rock is mined by cutting into a sloping land surface and then "following" the mineral or bedrock along a hillside with continuous excavations being made at approximately the same elevation.

Cutface. An unmined steep side of a pit, mine cut, or quarry.

Highwall. (1) The unexcavated face of exposed overburden and bedrock in a surface mine; (2) The face or bank on the uphill side of a contour mine.

Last cut. In area mining, the last linear excavation made as a result of which a highwall remains.

Original contour. The pre-mining surface configuration of the land, not necessarily the pre-mining elevation.

Overburden. Soil, rock, and other materials which overlie mineral deposits and are removed in surface mining.

Reclamation. The process of converting mined land to its former or other productive uses. (Modified from Bituminous Coal Research, Inc., 1974.)

Spoil. Overburden or mineral waste excavated and re-deposited in surface mining.

Spoil ridge. A series of contiguous piles of spoil deposited adjacent and roughly parallel to the mine excavation.

Spoil peak. The highest point of an individual spoil pile.

Strike-off. To reduce the height and slope of spoil piles by mechanically truncating the peaks and smoothing out narrow ridges, generally with a motor grader or dozer.

Subsoil. The B soil horizon or profile, or, in soils with weak profile development, the soil below the surface soil in which roots normally grow. (Modified from Bituminous Coal Research, Inc., 1974.)

Substitute lands. Lands previously mined that are reclaimed in lieu of the reclamation of lands at the active or planned mine site.

Survival standards. Standards to measure the effectiveness of the revegetation phase of reclamation by the extent to which seeded or planted species become capable of self-regenerative growth (usually measured by percent of area having specific types of growing plants and the sizes of plant-devoid areas).

Terraced. Land that is cut or graded into a succession of gently sloping benches and steep inclines. *Terrace types:*

(a) Absorptive—a ridge type of terrace used primarily for moisture conservation;

(b) Bench—a horizontal or gently sloping terrace approximately on the contour, having a steep drop to the slope below;

(c) drainage—a broad channel-type terrace used primarily to conduct water from the area at a low velocity; adapted to less absorptive soil and regions of high rainfall. (Modified from Bituminous Coal Research, Inc., 1974.)

Topsoil. The surface portion of the soil profile or overburden, which may be darkened by organic material; usually the most suitable medium for plant growth.

Toxic material. Any substance present in sufficient concentration or amount to injure plant or animal life.

A Guide to State Programs for the Reclamation of Surface Mined Areas

By EDGAR A. IMHOFF,¹ THOMAS O. FRIZ,¹ and JAMES R. LAFEVERS²

ABSTRACT

During 1975 inquiries of agencies in each State and review of State statutes and related administrative codes revealed that 38 States have established programs requiring the reclamation of surface mined lands. Results of analyses of those programs and ancillary data are presented in: (1) A table (matrix) which has been designed for the notation and elaboration of information pertaining to the mined-area reclamation programs of the 50 States; (2) a primer on surface mining activities and related reclamation practices and problems; and (3) a listing of types of non-Federal governmental controls applicable to reclamation. Interpretations of the status and content of State programs suggest that although a common thread runs through State statutory language, administrative requirements vary from State to State in order to meet different natural, economic, social, and political considerations. A general trend is seen in State programs toward the requiring of an integration of land-use planning and mine planning, with increased local governmental involvement.

INTRODUCTION

Reclamation of surface mined lands in the United States is a topic of considerable interest to environmentalists, resource developers, energy suppliers, and ultimately, every citizen who enjoys the fuel, metals, chemicals, building materials, and increased agricultural productivity that result from such mining activities. In 1975 the Geological Survey, through the Department of the Interior Resource and Land Investigations program, interviewed agencies in the 50 States, in order to determine the existence, status, and general content of State regulatory programs which address the statutory objectives of reclamation of surface mined lands for long-term beneficial land use. Because of the increased interest during 1975 in energy and other resources within the United States, this report should be of interest and utility to land and resource planners, as well as to the

administrators, technicians, and elected officials who are involved in decisions relating to resource development requiring surface mining and the subsequent reclamation of mined areas.

The number of State programs designed specifically for mined-area reclamation has increased from one in 1939, with the initial action of West Virginia, to 38 States in 1975. Thirty-two of the State programs became effective during 1970-75. In several of the remaining 12 States, draft legislation abounds and all 50 States are likely to have programs by 1980.

If present legislative and administrative trends continue, mined-area programs of States will appear largely as separate responses to individually perceived needs. As this report will show, however, most of the programs now coming on line are directed toward increasing integration of the formerly separate activities of local public planning, private mining, and State-private reclamation. Resource managers and planners, private as well as public, are being called upon to join mine operators, engineers, and scientists in addressing the complex technical tasks required in an integration of land planning, mining, and reclamation.

The aim of this report is modest—it is intended to be a cursory display, analysis, and interpretation of the State programs for the reclamation of surface mine lands. Underground mining, lands underlying freshwater lakes, and submarine lands of the Continental Shelf are not covered. “Orphan” mined lands (lands mined but not reclaimed) are not discussed. State public land laws and Federal land and mineral laws receive only brief mention, and local planning considerations are treated in very cursory fashion. These omissions in coverage are due entirely to logistical considerations and should not be interpreted as rendering unimportant the omitted topics.

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There is no intention to indicate or present an overall judgment of the merit of the State role or to assess the effectiveness of the various State reclamation programs. Such undertakings would indeed require a very bold charter and a program familiarity far beyond that possessed by the authors.

SOURCES OF INFORMATION

The principal sources of information for this report consist of the printed laws, rules and regulations, and guidelines of the individual States, plus oral and written communications with many of the State mined-area reclamationists.³ State officials and agencies providing information are listed in the "Directory."

This report is also based on field visits by the authors to surface mining and reclamation sites in 27 of the 50 States.

ACKNOWLEDGMENTS

We acknowledge especially the many diligent skilled professionals in State governments who took precious time from actual mined-area reclamation activities to review and comment upon much of the information supporting this report. Any residual errors of fact and all interpretations are the responsibility of the authors.

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A PRIMER ON SURFACE MINING AND RELATED RECLAMATION

"In the early years of surface mining, major emphasis was placed on 'recovery of the mineral,' with little or no regard to 'recovery of the land.' Initial lack of concern for the environment caused increasingly stringent strip mine legislation. Reclamation has now become an integral part of most surface mining operations, and has caused some major revisions in mining techniques, particularly in the East. Current practice is to incorporate reclamation with the mining sequence, and not to regard it as a separate operation." (Skelly and Loy, Engineers and Consultants, 1975, p. 2-5.)

³A term adopted informally by State regulatory personnel to describe the function of administering a program for the conversion of mined lands to productive use.

Resource and land-use planning practices can be enhanced through awareness of the importance and nature of surface mining and related mined-area reclamation. As reported by Paone and others (1974, p. 7), 86 percent of the crude ore handled by the U.S. mining industry in 1971 came from surface mines. This included all the sand and gravel and phosphate, 98 percent of the clay, 96 percent of the stone, 94 percent of the iron ore, 90 percent of the copper, and 51 percent of the coal. From 1930 through 1971, land utilized in surface mining included 2,170,000 acres (870,000 hectares) for mine excavations, 733,000 acres (293,000 hectares) for overburden and waste rock



FIGURE 1.—Open pit copper mine in Arizona, near Tucson. Vertical scale is indicated by the 60-foot masts of two drill rigs on bench in center foreground. More than 99 percent of the material removed from this open pit has been deposited on nearby lands.

disposal, and 454,000 acres (182,000 hectares) for process waste and tailings. Of the 3,357,000 total acres (1,343,000 hectares) disturbed over this period, 1,436,000 acres (574,000 hectares) were reclaimed. The unreclaimed acreages represent active open pits and quarries and strip mines operated before the advent of State mined-area reclamation laws.

The variety of State mining laws and regulations shown in table 1 covers all the surface mining methods now in use in the United States, with the possible exception of subaqueous coastal zone mining.⁴ The major methods are open pit, quarry, pit, area, contour, auger, and dredge mining. A brief description of each of these mining methods is included to define the method, point out basic characteristics, and show the wide range of surface disturbance that can occur. Basic mined-area reclamation techniques and associated constraints are also presented.

⁴Grant (1973) describes ocean mining methods and outlines the status and content of State regulations on mining (petroleum excluded) on the Continental Shelf.

OPEN PIT MINING

Open pit or open cut mines (fig. 1) are used primarily to extract metallic minerals from near-surface ore bodies. These mines tend to be deep—some in excess of 1,000 feet (305 metres). Mining usually continues uninterrupted for many years and produces large amounts of waste rock and “tailings,” the term for the finely ground waste rock and chemically leached material from which valuable minerals have been extracted.

Reclamation of open pit mines is difficult because of the constraints represented by: (1) Large volumes of wastes (up to 99 percent of material mined in copper mines is waste); (2) sharp differences in physical and chemical characteristics of wastes from the same pit; and (3) the deep excavation left when mining is concluded. Large acreages of land—sometimes hundreds of acres per mine—are used for waste disposal. Reclamation of tailing ponds is difficult because of the fine-grained nature of the waste, which tends to become windblown when dry and physically unstable when wet. Because of textural and chemical problems, tailings (fig. 2) are difficult to revege-

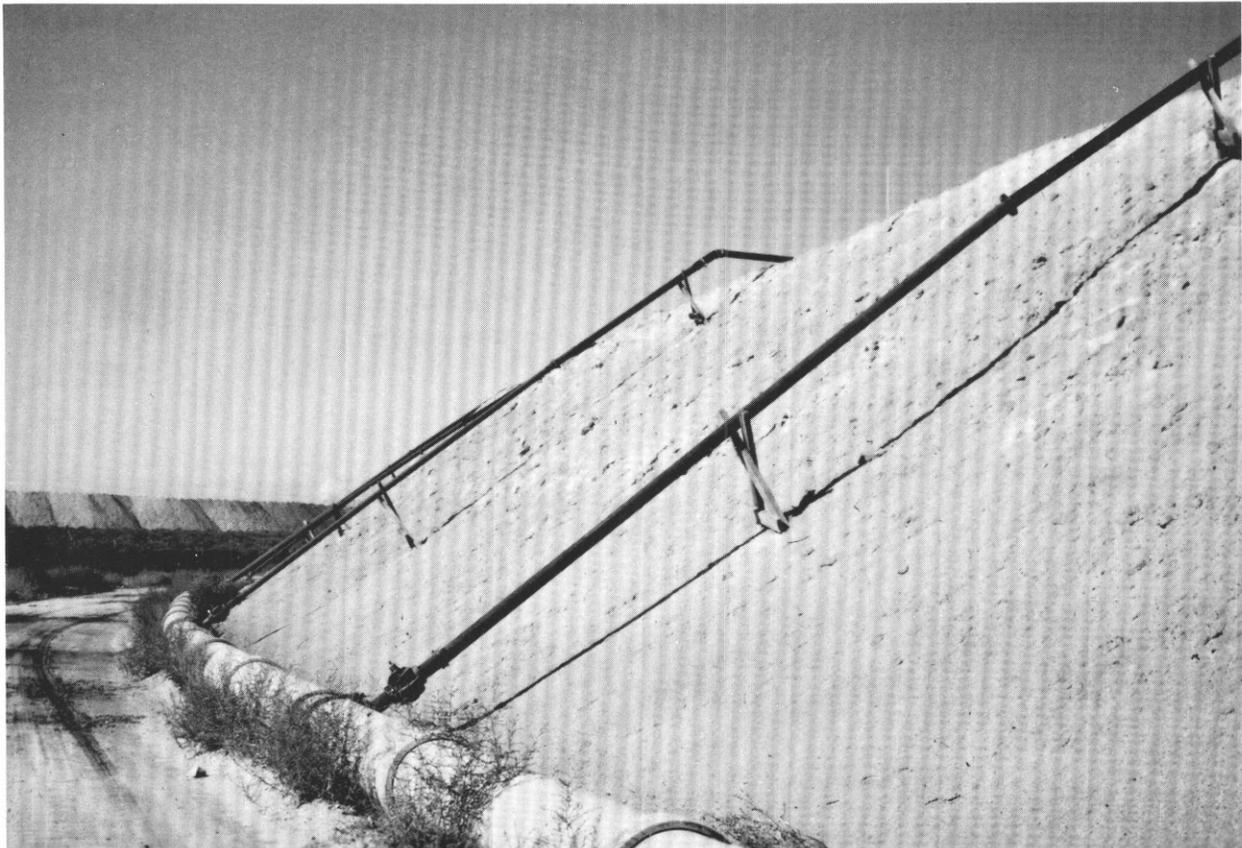


FIGURE 2.—“Tailings” consisting of fine-grained rock products that have been transported by pipeline from a nearby site of copper-ore processing near Tucson, Arizona. Reclamation of tailings is still in experimental stages.

tate. As indicated in figure 3, revegetation has been accomplished on some of the wastes from open pit mines. Coarse rock wastes are sometimes used as aggregate, and overburden has been used for agriculture. A study team at the University of Arizona (Matter and others, 1974) designed comprehensive plan alternatives (using scale models) for open pit copper mines and mine waste disposal areas. Zube (1963) suggested land uses and landscape design principles for the reclamation of taconite areas in Wisconsin. Active open pits, as compared to area coal mines, provide fewer opportunities for simultaneous mining and reclamation because of inherent conflicts in land use that prevail as long as mining is underway. When mining ceases, the problem of sequential use of the pit is tied primarily to economic feasibility.

QUARRYING

Quarries are used to extract stone for ornamental and building purposes or as a source of



FIGURE 3.—Reclamation of copper mine waste rock in Arizona has been accompanied by the irrigation of introduced (nonnative) species of grasses, shrubs, and trees.

crushed stone for construction materials or chemicals. Quarries vary considerably in size and depth, depending upon the quality, use, and physical characteristics of the rock mined (fig. 4). Quarries generally are not as deep as open pit mines, although depths to 200 feet (61 metres) are not uncommon. Normally, quarries are active for extended periods of time, some operations continuing for more than 100 years. Waste rock production from quarries is small, and therefore surface disposal of waste is usually not a serious problem. Reclamation of a quarry site commonly is difficult because of steep sides, great depths, and lack of drainage. Recreation (fig. 5) is probably the most common reclamation objective. An imaginative reclamation plan was prepared by Angster and others (1970) for the eventual conversion of a crushed stone quarry to a site for an apartment complex.

PIT MINING

Pits are the most common type of excavation for sand, gravel, or clay. They tend to be shallow—rarely exceeding 100 feet (30 metres) in depth—and generally have limited surface extent (fig. 6). The large number of pits is the result of the high demand for sand and gravel and the relatively small volume of these materials normally in any one deposit. Most communities are served by one or more sand and gravel pit. Clay pits are dug less frequently than sand and gravel pits but are nonetheless numerous. Relatively little waste is produced by pit mining. Unmarketable overburden or other materials may be bypassed during mining or returned to the pit after processing. The extent of reclamation of pits varies rather directly according to the nearness of urban communities. Urban lands are generally valuable, and reclamation of pits for planned sequential use is often required by local units of government. In the Midwestern United States many pits have been reclaimed for water-oriented residential development (fig. 7).

AREA MINING

Area mining is used to extract near-surface bedded deposits in flat-lying terrain. Coal and coastal plain phosphate are most commonly extracted using area mining methods. The overburden is removed from the first cut, followed by removal of the mineral material. A second paral-



FIGURE 4.—Limestone quarry in Wisconsin. The life of a quarry usually spans many years, with significant reclamation possible only after final shutdown.

lel cut is then made, and the overburden removed is placed into the pit resulting from the first cut. The series of parallel cuts progresses across the property until the depth of overburden and coal characteristics make the mine uneconomic or until property boundaries are reached. Some area mines now reach depths of 200 feet (61 metres). Large tracts of land tend to be disturbed by area mining, but only a narrow tract of land is unreclaimed at any given time. Figure 8 shows a mine in which grading or levelling of spoil has taken place only two ridges away from an active mine cut. Area mines reclaimed for agricultural, residential, and recreational purposes are shown in figures 9 and 10.

CONTOUR MINING

Contour mining is used principally to extract coal that crops out along the sides of steep hills, the mine following the coal seam around the hill-

side. The overburden above the coal is removed, followed by the coal. Overburden up to 150 feet deep (46 metres) can be handled—depending on coal thickness and quality. Auger mining may be used to extract additional coal from the coal seam exposed in the highwall. Handling of overburden creates problems in contour mining because of the little working space available. Historically, reclamation involved casting the overburden down hill slopes. Modern practice emphasizes replacing overburden in the contour mine immediately after coal removal. Mountaintop mining is a variation of both contour and area mining. Some of the overburden removed to expose the coal is placed in head-of-hollow fills (fig. 11), and the remaining overburden is placed in the previous cuts. The entire coal seam is mined progressively, as in area mining. Grading of the spoil creates flat to gently rolling topography which can support a variety of sequential land uses.

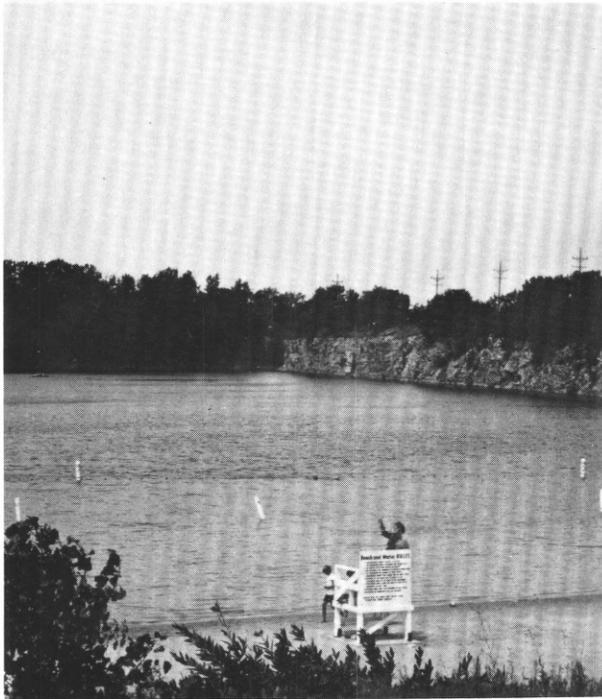


FIGURE 5.—Abandoned quarry which has been converted into a park for water-oriented recreation, Wisconsin.

AUGER MINING

Auger mining utilizes auger drills several feet in diameter that can penetrate several hundred feet (usually in a horizontal direction) into a coal seam and extract the coal. Auger mining is used commonly with contour mining to recover additional reserves of coal from the bank or highwall (fig. 12). When the overburden becomes too thick to allow economical contour stripping to continue and underground mining would be uneconomical or hazardous, an auger is used to remove additional coal.

Auger mining requires that the last strip cut be left open for access of equipment and removal of the coal. Thus the final reclamation of the contour mine must be delayed until extraction of coal by the auger is complete.

DREDGE MINING

Dredge mining involves the continuous removal and processing of unconsolidated mineral deposits. The dredge is basically a floating platform (fig. 13) containing continuous digging or suction equipment to extract the mineral and processing equipment to segregate and remove the valuable



FIGURE 6.—Sand and gravel pit in Los Angeles area of California. Reclamation of sand and gravel pits in urban areas is facilitated by high land values.

mineral fraction. Dredges are used in the United States to mine sand and gravel deposits and placer gold deposits where water is available to float a dredge. Dredges are limited to digging depths of about 120 feet (36 metres). Dredging of sand and gravel results commonly in creation of a lake, as most of the excavated material is removed for sale. Dredging for gold, however, results in removal of but a minute portion of the material handled by the dredge. Waste disposal and subsequent reclamation of gold-dredged land is a considerable problem because waste material from gold dredging is stacked behind the dredge, creating spoil piles not unlike those of area mining. Reclamation of this waste is difficult because of the gravelly nature of the waste, lack of topsoil to re-establish plant growth after mining, and potential for flooding due to the location of most dredging operations in stream beds and valley floors.



FIGURE 7.—Mined-out gravel pit converted to prime residential area through grading, water control, and revegetation in Wisconsin.

NON-FEDERAL GOVERNMENTAL CONTROLS

STATE LEGISLATION: ORIGIN AND TRENDS

The reclamation of surface mined lands in the United States began in the Midwest in the 1920's as a voluntary experimental program initiated by coal companies attempting to establish, at minimum costs, quick-growth forests on ungraded spoil heaps (Carter and others, 1974). Successful reforestation was demonstrated in West Virginia and was followed in Indiana by the successful conversion of strip mined land to pasture and to row crops at Meadowlark farms, near Terre Haute. The demonstration of reclamation capability and of the potential for recovery of costs (if not profit) provided substantial impetus for the first State mined-land reclamation laws, enacted in West Virginia in 1939, Illinois in 1943, Indiana in 1941, Pennsylvania in 1945, Ohio in 1947, and Kentucky in 1954.

Early State reclamation laws addressed only coal mining. Rules were promulgated requiring revegetation and, in some cases, reduction of spoil pile slopes as a means of converting strip mined land to a land-cover type that would be of economic value and would reduce erosion.

In the 1950's and 1960's, revisions in the early laws and the new laws of additional States normally added requirements for soil conservation and for water quality control at the site (an objective addressed also by intensified activities in Federal and State pollution control laws).

Near the close of the 1960's, States began expanding coverage of the law to all minerals, and the new State laws tended to address land-use planning relationships to reclamation. Detailed standards were developed relating to all the major activities that occur at a mine site—before, during, and after mineral removal—and to the impact of the mining and reclamation activity on the surrounding environment.





FIGURE 9.—Farmlands and ponds created through the reclamation of area mine in Indiana. Techniques for such reclamation were developed during the 1930's.

The decade of the 1970's has been characterized by new programs that treat mining as an interim land use. This emerging concept, illustrated in figure 14, is being expressed increasingly in State legislation.

STATE AND LOCAL CONTROLS

Besides the governmental programs specifically termed "mined-area reclamation," a great number of other local and State controls of various kinds pertain to the integrated set of activities that occur over time at the "average" surface mine site. The number and type of controls vary by locale and by State. The hypothetical example given in table 2 suggests that the mine operator may have

to obtain literally dozens of governmental permits (excluding Federal) if the mining, reclamation, and land-use activities that ensue at the site are to be lawful. Table 2 is based on a review of State and local legislation, State and local plans, and environmental impacts statements. See also Bisselle and others (1975, p. IV-22.).

THE MATRIX: APPROACH AND TERMS USED

A matrix of 24 items by 50 items (table 1) is the focal point of this report. The following text explains the rationale of the matrix and establishes the meaning of the terms used in subtitles and in column headings.

◀ FIGURE 8.—Area mine in Indiana showing soil removal underway on left, overburden removal by drag-line in background, coal removal from floor of cut in the center, and ungraded spoil ridges in the right foreground. Cut is about 60 feet (18 metres) deep. Area in upper right is reclaimed land mined 1 to 2 years before.

Explanation of entries in table 1

<i>Entry</i>	<i>Meaning</i>
-----	Indicates the absence of a specific requirement or program element. No specific mention of this topic is made in the State Act or in the rules or regulations, but the topic may be addressed in administrative orders or in current professional practice extant in that State.
× -----	Affirms the existence of a requirement or program element; means that the wording in the column heading applies to the given State.
An entry phrase ----- or sentence not in parentheses	Affirms that the subject of the column heading is covered in the State. Also supplies detailed information useful in showing the individual character of the State program.
(A note set in ----- parentheses)	Used to modify an × entry or note entry by giving an example, showing an exception (if so stated), or refining the main information presented.

<i>Explanation of Symbols</i>	
>	Greater than
≧	Greater than or equal to
≦	Less than or equal to

<i>Conversion Equation For English to Metric Units</i>	
1 foot (ft)	=0.30 metres (m)
1 acre	=0.40 hectares (ha)

Definition of Technical Terms
See "Glossary", page IV.

Special Note on Heading of Column 21

The provision cited is a possible pre-application, blanket exclusion of surface mining from areas declared "off limits" on the basis of explicit criteria.

MATRIX ENTRIES

All 50 States are listed in the matrix even though there are no entries or notations under some column headings. Blank spaces signify the absence in a given State of a regulatory program for the reclamation of surface mined areas pertaining to *all* lands within a State. Where State laws on mined-area reclamation cover only certain lands (for example, Arizona), this is indicated by a note across the columns. Several States require reclamation of State-owned lands. Some States (e.g., Rhode Island) have little State-owned land open to mining, but local land-use control processes address mineral extraction. In addition, proposed Federal rules for reclamation apply in the States that have Federal lands open to mining.⁵ This report, however, concentrates upon the specifically named programs that apply mined-area reclamation laws to the total area of a State.

COLUMNS 2-4, STATE OF PROGRAM DEVELOPMENT

The sequence of the headings 2 through 4 follows the normal order of progression of State legislation and follow-up administrative action, deliberately omitting a bill phase. At any given time, some States are initiating new programs and other States are revising existing programs. The heading *Act(s)* refers to the existence of a legis-

lative mandate establishing a mined-area reclamation program for the whole State. Note that *Act(s)* does not refer to other State legislation that may be important to the successful establishment and conduct of a mined-area reclamation program—such as constitutional amendments, enabling legislation, administrative codes, and pollution control laws.

Rules and Regulations refers to the promulgation, by the authority stipulated in the Act, of requirements giving specific direction and setting minimum levels of performance. In practice, rules and regulations grade into "technical guidelines"—a term which in strict definition means instructional material. In this report, however, *guidelines* includes both standards and instructional materials, whether mandatory or recommendatory.

COLUMNS 5-8, STATE LAW

Title of Act(s) refers to the official name, or statutory citation, of the State mined-area reclamation program. Governmental reorganization and statutory amendments may have changed the administrative agency and the Act from that originally cited. *Administering Agency* is the department of State government presently assigned the staff work of developing information, processing applications, and issuing and monitoring permits for mining and related reclamation.

Mineral or Commodity Covered and *Rules (that) Vary By Mining Methods* refer to the gen-

⁵For example, see Coal Mining Operating Regulations, 43 CFR Parts 23, 3040 and 30 CFR Parts 211, 216, p. 41122-41139, Federal Register, vol. 40, no. 173, 9-5-75.



FIGURE 10.—High-value residences in Indiana on a lake occupying the “last cut” of an area mine. Streets trend along the crest of ridges of spoil graded moderately to remove peaks.

eral coverage of the Act. In this report the terms “*mineral*” and “*commodity*” are used interchangeably to refer to essentially solid natural substances occurring in the earth and sought for commercial purposes. Natural gases, liquid petroleum, and water are excluded. The heading of column 8 addresses the fact that rules and regulations may differ according to the type of mining operation. An entry in column 8 usually necessitates entries in subsequent columns to note the nature of the variances.

COLUMNS 9-15, RECLAMATION—MAIN ACTIONS AND STANDARDS

These column headings give, generally, the sequence of major actions in mined-area reclamation. The wording is in popular but by no means

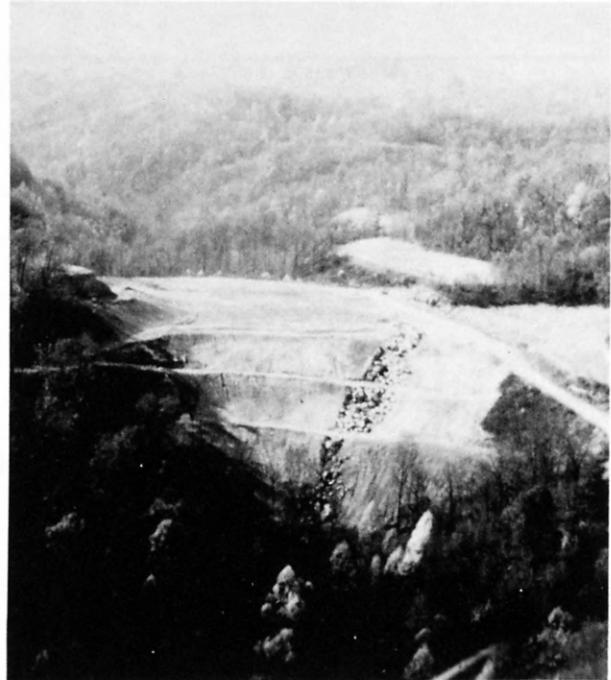


FIGURE 11.—Results of head-of-hollow fill method of disposing of overburden and rock waste from contour mine, West Virginia. Fill has been terraced to reduce slope. A rock gutter (center foreground) has been constructed to control runoff.

universal terms. The following partial listing of synonymous phrases is presented to help explain the headings. Specific terms are defined in the “Glossary.”

<i>Column and heading</i>	<i>Synonymous phrases</i>
(9) Control water flow and quality	<ul style="list-style-type: none"> ----Institute water management. Follow good soil and water conservation practices. Secure adequate drainage and meet water pollution control standards.
(10) Conserve and replace topsoil	<ul style="list-style-type: none"> ---Segregate and re-spread topsoil. Stockpile and re-use soils. Remove and re-apply most suitable plant-growth materials.

TABLE 1.—Matrix of information on State surface-mined-area reclamation programs, December 1975
[For explanation of symbols and terminology, see p. 10 and the "Glossary"]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20-22 Special Provisions			23	24	
Stage of program development				State law				Reclamation—Main actions				required and standards set				Requirements for land-use planning				Minerals protected from nonmining development	Exclusion of areas from consideration for mining	Long-range or regional mine planning	Substitute lands allowed	Financial or economic analyses required
State	Act(s)	Rules and regulations	Technical guidelines	Title of Act(s)	Administering agency(ies)	Mineral or commodity covered	Rules vary by mining method	Control water flow and quality	Conserve and replace topsoil	Backfill and grade	Reduce highwall or pitwall	Bury or neutralize toxic wastes	Revegetate for beneficial use	Other rules or remarks	Resources information required	Alternative uses will be considered	End use will be declared	Role of local public planning						
ALABAMA	×	×		Alabama Surface Mining Act of 1969 and Alabama Surface Mining Reclamation Act of 1975.	Department of Industrial Relations and Surface Mining Reclamation Commission.	All minerals except limestone, marble, and dolomite (coal covered by 1975 Act).		×	×	Strike-off top of spoil ridges to width ≥ 15 ft and cover coal seam with spoil to depth ≥ 10 ft.	Eliminate coal mine highwall, except at final cut.	With 2 ft of earth or permanent water body.	Standards for forests, grasses, and legumes; soil additives may be required.	Construct two access roads per each mile of coal mine highwall. Depth of lakes ≤ 6 ft.	Hydrology and land use.	×	×	1975 Act is "... to preempt local... regulation of coal surface mining..."						
ALASKA	NOTE: On State lands, reclamation requirements are established by the State of Alaska—on a case-by-case basis—as part of the terms a condition of leasing).											of leases to mine operators. Most of the mineral deposits of Alaska lie on State or Federal lands (where reclamation requirements are												
ARIZONA	NOTE: The State of Arizona applies standard reclamation requirements to State Lands as a condition of mineral leases. Arizona also controls (e.g., zoning) and activity permits (e.g., minerals proceeding) to encourage reclamation.											contains Federal lands where reclamation requirements are a condition of mineral leases. Some local units of government use land-use con-												
ARKANSAS	×	×	×	The Arkansas Open Cut Land Reclamation Act of 1971.	Department of Pollution Control and Ecology.	All minerals		×	Standards vary according to original natural conditions.	All grades will be $\leq 33\%$; blade and grade to approximate original surface conditions.	×	With 3 ft of earth or permanent water body.	×	Construct fire lanes or access in areas of reforestation.	Soils	Any "productive use."	×						×	
CALIFORNIA	×			Surface Mining and Reclamation Act of 1975.	Department of Conservation (Policy); local governments (Permits and Plans).	All minerals		×							Climate, geology, land use, minerals, population, topography, and water resources.	Operator must declare "potential uses."	×	Act on permits and reclamation plans and establish mining policy in general plans.	State may designate areas reserved for mining.					
COLORADO	×			Colorado Open Mining Land Reclamation Act of 1973.	Department of Natural Resources.	Coal, sand, gravel, quarry aggregate, and construction limestone.		×		Strike-off top of spoil ridges to width of ≥ 15 ft. Achieve level or undulating skyline.					Geology, land use, minerals, topography, and water resources.		×	Review for conformity with local land-use controls.				×		
CONNECTICUT	NOTE: Local governmental land-use controls and permit											activities may be applicable to mining and reclamation.												
DELAWARE	NOTE: Local governmental land-use controls and permit											activities may be applicable to mining and reclamation.												
FLORIDA	×	×		Chapter 211, II Florida Statutes.	Department of Natural Resources.	All minerals		×	×	All grades will be $\leq 25\%$. Blend peaks, ridges, and valleys. Develop uninterrupted drainage.				Plant coverage $> 80\%$; bare areas $\leq 1/4$ acre.	Established lakes must be at least 3 acres in size and 6 ft in depth.	Land use, minerals, soils, topography (USGS), and water resources.	Consider "landowner's desires."	×	Must certify excavations intended for property improvement.				×	
GEORGIA	×	×	×	Georgia Surface Mining Act of 1968, as amended.	Department of Natural Resources.	All minerals		×	×	Blend peaks, ridges, and valleys into a rolling topography suitable for plant growth.	×	With 2 ft of soil supporting vegetation.	×	Attain high quality permanent cover.	Land use, minerals, population, topography, and water resources.		×						×	Rules provide for long-range planning updated by annual permits.
HAWAII	×			Chap. 181, Subtitle 3, Hawaii Statutes.	Department of Land and Natural Resources.	All minerals, except sand, rock, gravel, and construction materials.		×	If necessary for end-use objective.	Strike-off peaks and ridges of spoil and fill depressions.				Quick cover grass crop, followed by reforestation, or conversion to farming.	Carrying capacity of pasture lands will be ≥ 1 cow per 3 acres.	Soils, topography, and water resources.	Land uses comparable, at least, to premining conditions.							
IDAHO	×			The Idaho Surface Mining Act.	Department of Lands.	All minerals		×	Replace overburden to extent reasonably available.	Strike-off ridges to width of ≥ 10 ft and peaks to width of ≥ 15 ft.				Revegetate to compare to premining conditions.		Minerals and water resources.								
ILLINOIS	×	×	×	Surface-Mined Land Conservation and Reclamation Act.	Department of Mines and Minerals.	All minerals		×	Row crops, 18 in.; other uses, replace as practicable.	Varies by planned use, i.e.: original grade for row crops; $\leq 30\%$ forest and wildlife; $\leq 50\%$ hay and pasture.	To grade of $\leq 50\%$.	With 4 ft of water or suitable material.	Replant row crops if soils suitable. Detailed standards for other uses.	Separate permits required for refuse disposal (landfill).	Geology, land use, minerals, soils, topography (USGS), vegetation, water resources, and wildlife.	Agency will "encourage" consideration of multiple land use.	×	County board may recommend land use, and may request hearings.				×	Land values, tax base, state & regional economy, employment & effect of plan.	

TABLE 1.—Matrix of information on State surface mined- area reclamation programs, December 1975—Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20-22 Special Provisions			23	24	
Stage of program development				State law				Reclamation—Main actions				required and standards set				Requirements for land-use planning				Minerals protected from nonmining development	Exclusion of areas from consideration for mining	Long-range or regional mine planning	Substitute lands allowed	Financial or economic analyses required
State	Act(s)	Rules and regulations	Technical guidelines	Title of Act(s)	Administering agency(ies)	Mineral or commodity covered	Rules vary by mining method	Control water flow and quality	Conserve and replace topsoil	Backfill and grade	Reduce highwall or pitwall	Bury or neutralize toxic wastes	Revegetate for beneficial use	Other rules or remarks	Resources information required	Alternative uses will be considered	End use will be declared	Role of local public planning	Minerals protected from nonmining development					
INDIANA	×	×	×	Chap. 344, Acts of 1967, Indiana Statutes.	Department of Natural Resources.	Coal, clay, and shale.		×		Grades: row crops $\leq 8\%$, pasture and hay $\leq 25\%$, forest and range $\leq 33\%$ (slope lengths limited).	To grade of $\leq 33\%$ or create lake in pit.	With 2 ft of soil, overburden, or water.	×	Other standards pertain to lakes, soil texture, and waste disposal.	Geology, land use, minerals, soils, topography, and water resources.	×	×						Prohibited.	
IOWA	×	×	×	An Act Relating to Surface Mining, as amended.	Department of Soil Conservation.	All minerals		×	In coal mine reclamation, strata more suitable than top soil may be used.	Grade spoil to $\leq 25\%$, except where original land was steeper, then, blend with adjacent land.	To grade of $\leq 33\%$.	With 2 ft of spoil.	×	(Detailed guidelines available.)	Mineral, soils, and water resources.									
KANSAS	×	×	×	Mined-Land Conservation and Reclamation Act.	State Corporation Commission.	Coal		×	As necessary to provide plant growth material.	Rolling topography traversable for planned use. Grade $\leq 25\%$ (slope lengths limited).	To grade of $\leq 25\%$, unless supported, as by a lake.	With 2 ft of spoil or permanent water body.	×	Other standards pertain to removal of boulders and formation of lakes.	Geology, soils, topography (USGS), and water resources.		×					Rules allow 5-yr plans for "contiguous" mined areas.	×	
KENTUCKY	×	×	×	Chapter 350, Kentucky Revised Statutes.	Department for Natural Resources and Environmental Protection.	All minerals	For contour mining, limits are placed on cut benches and slope.	Detailed standards.		Approximate original contour. Grade bench tables to $\leq 10\%$.	Auger mining face to $\leq 45^\circ$; other mining, backfill and cover coal to 4 ft.	With 4 ft of overburden.	×	(Detailed guidelines available, e.g., time of planting.)	Soils, topography (USGS), and water resources.			State permits must comply with local zoning laws.				Rules allow the development of "area plans" for mined areas.		
LOUISIANA																								
NOTE: Local governmental land-use controls and permit activities may be applicable to mining and reclamation.																								
MAINE	×	×		(1) Mining and Rehabilitation of Land Act, and (2) Site Location of Development Act.	Department of Environmental Protection.	All minerals (sand and gravel are covered only by Site Act).		×	×	×			×		Minerals, soils, topography (USGS), vegetation, and water resources.									
MARYLAND	×	×	×	Maryland Strip Mining Law.	Energy and Coastal zone Administration.	Coal	Backfilling rules vary by area, terracing, or block-cut methods of mining.	×	(pH range 6.8 to 8.5.)	Area: approximate contour. Terracing: grade the bench to $\leq 9\%$ and outer slope grade to $\leq 70\%$.	Eliminate highwall by backfill and cut.	With 2 ft of overburden.	Quick cover grass crop, followed by vegetation for end uses.	Specific survival standards for the vegetation established through reclamation.	Minerals, soils, topography (USGS), and water resources.	×	×	Agency takes cognizance of county planning, zoning, and grading permits.		Land sloping more than 20° (any 200 ft cross-section) is excluded.	"Encouraged." Annual permit renewals provide update.	Prohibited.		
MASSACHUSETTS																								
NOTE: Local governmental land-use controls and permit activities may be applicable to mining and reclamation.																								
MICHIGAN	×			Mine Reclamation Act of 1970, as amended.	Department of Natural Resources.	All minerals except clay, gravel, marl, peat, or sand.									Environmental planning information may be required.									Act mandates studies of economic effects of regulations.
MINNESOTA	×			Mineland Reclamation Act of 1971, as amended.	Department of Natural Resources.	Metallic minerals.												"Rules . . . shall conform with any State and local land-use planning program."		Agency identifies areas not reclaimable under present technology.			Act mandates consideration of economic effects of regulations.	
MISSISSIPPI																								
NOTE: Local governmental land-use controls and permit activities may be applicable to mining and reclamation.																								
MISSOURI	×			(1) Reclamation of Mining Lands and (2) The Land Reclamation Act.	Department of Natural Resources.	Act (1) coal and barite; Act (2) clay, limestone, sand, and gravel.				Act (1) traversable for farming; Act (2) traversable for intended uses and strike-off top of spoil ridges to width of ≥ 20 ft (forest and pasture).	Act (1), slope of face will be $\leq 25\%$.	With 4 ft of earth supportive of vegetation.	Appropriate to type of end use declared.	Exceptions allowed in grading on: Act (1), subdivisions and wildlife; Act (2), flood plains.			×	×					×	

TABLE 1.—Matrix of information on State surface mined-*area* reclamation programs, December 1975—Continued

1	2	3	4	5	6			8	9	10	11	12-15				16-19				20-23			24
					State law							Reclamation—Main actions				Required and standards set				Requirements for land-use planning			
Stage of program development	Act (s)	Rules and regulations	Technical guidelines	Title of Act (s)	Administering agency (ies)	Mineral or commodity covered	Rules vary by mining method	Control water flow and quality	Conserve and replace topsoil	Backfill and grade	Reduce highwall or pitwall	Bury or neutralize toxic wastes	Revegetate for beneficial use	Other rules or remarks	Resources information required	Alternative uses will be considered	End use will be declared	Role of local public planning	Minerals protected from nonmining development	Exclusion of areas from consideration for mining	Long-range or regional mine planning	Substitute lands allowed	Financial or economic analyses required
OREGON																							
PENNSYLVANIA	×	×		Surface Mining Conservation and Reclamation Act, as amended.	Department of Environmental Resources.	All minerals		×	Approximate original contour; terrace; or, serve approved end use.	Approximate original contour; terrace; or, serve approved end use.	Eliminate highwall.	Varies with existing conditions.	×	Clean Streams Law also directly applicable.	Fisheries, zoology, land use, minerals, and water resources.	×	×						Applicant provides detailed estimate of reclamation.
RHODE ISLAND																							
NOTE: Local governmental land-use controls and permit activities may be applicable to mining and reclamation.																							
SOUTH CAROLINA	×	×		South Carolina Mining Act.	Land Resources Conservation Commission.	All minerals		×	Minimizing slides and consistent with future land use.	Minimizing slides and consistent with future land use.		×	(with appropriate local or state agency approval.)	Visual screening may be required.	Land use, topography (USGS), vegetation, and wildlife.		×	Local soil and water conservation districts review and comment.			×		
SOUTH DAKOTA	×	×		Surface Mining Land Reclamation Act, as amended.	Department of Agriculture.	All minerals		×	"Achieve contour most beneficial to the proposed land use."	"Achieve contour most beneficial to the proposed land use."	Slope will be $\leq 14^\circ$.	With 8 ft of topsoil or suitable overburden.	To create self-regenerative growth without irrigation.	Noxious weeds must be controlled.	Land use, soil, minerals, topography, wildlife, vegetation, and water resources.		×	Incompatibility with local land plans can be basis for rejection of mining request by Agency.				Applicant provides detailed estimate of reclamation costs.	
TENNESSEE	×	×	×	The Tennessee Surface Mining Act.	Department of Conservation.	All minerals except dimension stone, limestone, and marble.	Contour mining rules apply on slopes $>15^\circ$; area mining on slopes $<15^\circ$; quarries are a special case.	Detailed standards are in effect.	×	Contour: Fill benches prohibited on slopes $>28^\circ$. Area: Approximate original land surface.	Eliminate highwall with complete backfill, sloped to bench $\leq 35^\circ$.	With 4 ft of compacted material or permanent water body.	Where approved, permanent growth serving purpose at least as useful as pre-mining.	Standards differ by mineral: coal, phosphate, sand and gravel, clays, shale, and barite.	Land use, soil, topography (USGS), and water resources.		×						
TEXAS	×			Texas Surface Mining and Reclamation Act.	Railroad Commission of Texas.	Coal, lignite, and uranium.		×	Use stratum best for plant growth.	Approximate original contour.	×	×	Establish diverse self-regenerative cover suitable for approved end use.	Principles stated on lakes, water rights, and ground water; 4-yr responsibility for vegetation.	Hydrologic effects, land capability, land use, minerals, soils, topography, vegetation, water resources, and wildlife.	Determine capacity of land for alternative uses.	×	Notified and comment is recorded.	Agency can declare "areas unsuitable for mining" (6 criteria).	Applicant must anticipate effects of reclamation over life of mine.		Agency conducts economic studies relating to item (22).	
UTAH	×	×		Mined Land Reclamation Act of 1975.	Department of Natural Resources.	All minerals (including oil-shale and bituminous sands).		×	×	(where "practical").		×	(Priority to non-noxious native plants.)	Program is implemented through orders that recognize individual site and mine conditions.	Land use, soil, vegetation, and water resources.	Explore capabilities of land to support a variety of uses.	×	Notified and comments taken under advisement.					
VERMONT	×			Vermont's Land Use and Development Law.	District Environmental Commissions and the Environmental Board.	All minerals								Application for permit is viewed for conformity with State plan or planning principles.	Land capability and land use.	×	×	Action must accord with local plans.	×	(Land development permits.)			

TABLE 1.—Matrix of information on State surface mined-area reclamation programs, December 1975—Continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20 Special Provisions			23	24	
Stage of program development				State law				Reclamation—Main action				required and standards set				Requirements for land-use planning				Minerals protected from nonmining development	Exclusion of areas from consideration for mining	Long-range or regional mine planning	Substitute lands allowed	Financial or economic analyses required
State	Act(s)	Rules and regulations	Technical guidelines	Title of Act(s)	Administering agency(ies)	Mineral or commodity covered	Rules vary by mining method	Control water flow and quality	Conserve and replace topsoil	Backfill and grade	Reduce highwall or pitwall	Bury or neutralize toxic wastes	Revegetate for beneficial use	Other rules or remarks	Resources information required	Alternative uses will be considered	End use will be declared	Role of local public planning						
VIRGINIA	×	×	×	(1) 45.1-198, and (2) Title 45.1-180, chap. 16.	Department of Conservation and Economic Development.	Act (1) coal, Act (2) All other minerals.	Quarries are a special case—especially in back-filling.	×		"... retain spoil on bench insofar as feasible..."	"... reduce... to the maximum extent practicable."	With 4 ft of material suitable for plant growth.	×	Standards for access roads across highwall; special preparation of soils in erosion-prone areas.	Environmental impact study (implied), land use, minerals, topography, (USGS), and water resources.	×	×	Local soil and water conservation districts advise.						
WASHINGTON	×	×		Surface-Mined Land Reclamation Act.	Department of Natural Resources.	All minerals	Quarries are a special case.	×		Conform to surrounding land area.	Grade of wall in unconsolidated, ≤66%; wall slope in rock, ≤45°.	With 2 ft of clean fill.	×	Requirements of other agencies relate to water rights, flood plains, and fish and wildlife.	Land use, minerals, topography, and water resources.		×	Applicant must show legality of action with regard to local zoning.						
WEST VIRGINIA	×	×	×	Article 6, Chap. 20, Code of West Virginia, as amended.	Department of Natural Resources.	All minerals	Grading and back-filling rules vary by area mining or contour mining.		×	Standards set forth in <i>Drainage Handbook for Surface Mining</i> .	Fill benches denuded on grades >65%; contour mined areas will be suitable for farm machinery.	With 4 ft of material suitable for plant growth.	Detailed standards.	Other detailed requirements exist for back fill and for stream crossings.	Land use, minerals, soils, topography, and water resources.	×	×							
WISCONSIN	×			Metallic Mining Reclamation Act.	Department of Natural Resources.	Metallic minerals.		×	×	×		×	×	Screening of site required.	Geology, land use, soils (suitability), topography, and water resources.			Mining, reclamation, and comprehensive plan shall conform to local zoning.	Act mandates a State program discouraging the preclusion of mining.		Agency may require comprehensive long-term plan.		Applicant may be required to show costs data.	
WYOMING	×	×		Wyoming Environmental Quality Act of 1973.	Department of Environmental Quality.	All minerals	Rules vary by soft rock mining or hard rock mining.	×	Use most suitable plant growth materials.	Approximate original contour; terrace; or serve approved end use.	Stabilize; slope; minimize effect on landscape.	×	×	Protect soil stockpile from winds. Delay mining for archeological or paleontological surveys.	Geology, land use, soils, topography (USGS), vegetation, water resources (use & rights), and wildlife.		Must be highest previous use of site (as declared by Agency).	County involvement in administration of act.					Socioeconomic analyses may be needed by Agency to set use.	

TABLE 2.—Hypothetical example of State and local controls and permits required for a surface mine¹

Time period/activity	Zoning and related local land-use controls	State reclamation controls	Water, air, and noise pollution controls	Other controls, as named
<i>Pre-mining (years 0-4):</i>				
Existing land use -----	×	--	×	-----
Prospecting the area -----	--	×	--	-----
Mineral and economic evaluations ---	--	×	--	-----
Acquisition of rights -----	--	×	--	State water rights.
Surveying & design of mine -----	--	×	--	-----
Natural resources studies -----	--	×	×	-----
Reclamation planning -----	--	×	--	-----
End land-use planning -----	×	×	--	-----
Costs analyses -----	×	×	×	State and local environmental controls.
Obtaining mine permit ² -----	×	×	--	Waste discharge permits.
Constructing roads and buildings ² -----	×	×	×	State location of development (e.g., as in Maine).
Obtaining utilities -----	×	--	--	State utilities regulation.
Drainage and erosion control ² -----	--	×	×	State water board.
Fencing and screening ² -----	×	×	--	State fish and game.
Environmental monitoring ² -----	--	×	×	-----
<i>Joint mining and reclamation (years 4 to 30):</i>				
Removal and segregation of soils ² --	×	×	--	Local soil & water conservation.
Disposal of debris ² -----	×	×	×	Sanitary land fills.
Drilling and blasting ² -----	×	×	×	State permit.
Extracting and hauling minerals ² --	×	×	×	State severance taxes.
Filling and grading ² -----	×	×	×	-----
Reducing pitwalls or highwalls ² ----	×	×	×	-----
Burying toxic materials ² -----	×	×	×	-----
Revegetation ² -----	--	×	--	-----
<i>Post-mining (4 to 36):</i>				
Vegetation survival studies ² -----	--	×	--	State agriculture.
Pest and weed control ² -----	×	×	--	State agriculture.
Land capability studies -----	×	×	--	State agriculture.
Divesting ownership or rights -----	×	--	--	Official acceptance of lakes and roads.
Water quality performance -----	×	×	×	State agriculture.
Decommissioning mine (dismantling, demolishing, etc). -----	×	×	--	State mine abandonment laws.
Established end use -----	×	--	×	-----
Recovery of bonds -----	×	×	--	-----

¹ Does not include controls pertaining to mine safety.

² A process that tends to be maintained or repeated, as necessary, throughout much of the life of the mine.

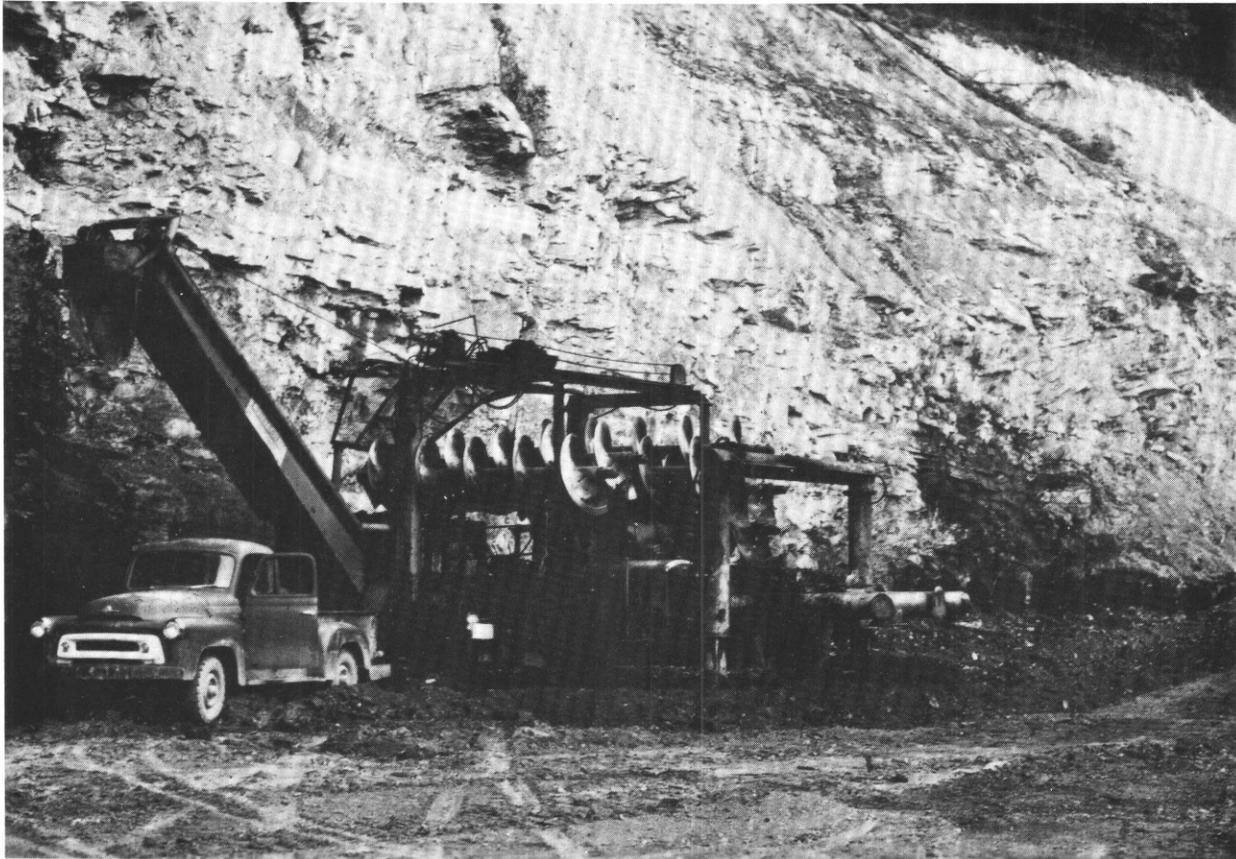


FIGURE 12.—Equipment used to drill laterally into a coalbed exposed in contour mining. Holes shown to the right of auger bits will be plugged, and the mined area will be covered with earth materials suitable for plant growth. (Photograph by West Virginia Department of Natural Resources, Division of Reclamation.)

<i>Column and heading</i>	<i>Synonymous phrases</i>	<i>Column and heading</i>	<i>Synonymous phrases</i>
(11) Backfill and grade -----	Smooth and shape spoil. Fill pit and contour. Terrace backfill. Strike-off spoil.		Seed, plant, and establish desired plant species.
(12) Reduce highwall or pitwall -----	Smooth pitwalls. Backfill highwall. Knockdown cutface.		
(13) Bury or neutralize toxic wastes ----	Cover mineral seam with clean fill. Isolate and seal off toxic wastes.		
(14) Revegetate for beneficial use ---	Establish permanent and diverse plant growth on spoils.		

COLUMNS 16-19, REQUIREMENTS FOR LAND-USE PLANNING

Column headings 16, 17, and 18 refer primarily to mandates requiring the applicant to investigate, to analyze, to report, and to declare. *Information* is used to indicate a requirement for analytical information, rather than uninterpreted inventory data. *Resource* refers to a natural resources subject (for example, a study such as geology, or an activity such as land use). The term "*Alternative Uses*" takes the meaning commonly applied in land-use planning. The applicant is admonished to consider several possible long-term uses of the land to be reclaimed. This requirement differs from the practice common to some mined-area reclamation programs in which a list of acceptable end uses is presented to an applicant who then



FIGURE 13.—Dredge mining for gold near Yuba City, California. (Photograph by Ward Sharrer, *Sacramento Bee*.)

may elect to propose an alternative to the uses on the given list. *End Use Will Be Declared* is a self-explanatory term. In certain States, end use may also be called subsequent land use, beneficial land use, ultimate land use, and even after use. *Role of Local Public Planning* means the roles set forth, in the Act or regulations, for local units of government in the integrated process of mining, reclamation, and land use. It is important to note that this is a role that seems to be cast in the Act, whereas the actual role played by local public planning bodies in mined-area reclamation and related land use may be otherwise.

COLUMNS 20-22, SPECIAL PROVISIONS

The heading for column 20, *Minerals Protected* . . . , shows the existence in the law of provisions that are, in effect, the other side of the coin of reclamation. This column provides a place to note programs that address not the reclamation of

mined lands for multiple use but, instead, the protection of valuable mineral deposits from other land uses (for example, residential development) that tend to preclude mining. *Exclusion of Areas from Consideration for Mining* refers to a program provision that enables a State to deny any mining in certain carefully predetermined areas. Such a provision, it should be noted, is not to be confused with routine administrative denials of mining applications for inadequacies of information, infeasibility, or similar reasons. For example, the West Virginia agency has broad powers to deny applications. *Long-Range* . . . refers to an authorized time frame for reclamation and related planning that exceeds the usual 1-4 year periods now required by most State rules and regulations. *Regional* . . . refers to the geographic expansion of the planning boundaries from one mine site to two mines or more that are contiguous or in the same mining area.

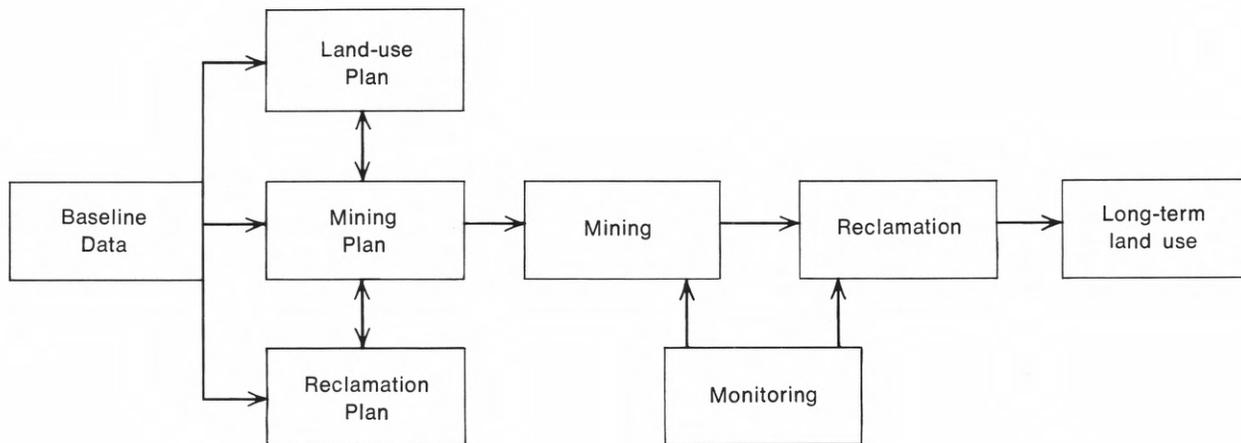


FIGURE 14.—Sketch of the concept of integrated mining, reclamation, and land-use planning.

COLUMN 23, SUBSTITUTE LANDS, AND COLUMN 24, FINANCIAL OR ECONOMIC ANALYSES

These headings treat miscellaneous categories. Planners should know that some States allow mine operators to reclaim selected lands, such as previously mined (orphan land) areas, in lieu of or as a *substitute* for reclamation at the active mine site. *Financial* refers to the requirement that the applicant estimate the costs of reclamation for the subsequent use of the regulatory agency in determining the size of the surety (performance) bond and the like. *Economic*, in column 24, refers to a statutory mandate requiring the regulatory agency to study and report on the effect of proposed rules and regulations on social and economic factors.

THE STATE PROGRAMS: COMMON THREADS, DIFFERENCES, AND TRENDS

The following analysis of the State mined-area programs is based on table 1, supplemental information accessible primarily in the various State statutes, rules and regulations, and guidelines. Several strong commonalities, many differences, and a few obvious trends characterize the State programs as a whole.

STAGES OF DEVELOPMENT

Mined-area programs tend to go through a process of becoming more sophisticated with time. For example, in 1975 California passed new legislation that is bereft of many specific requirements.

A similar situation prevails in other States which have not yet had sufficient time to promulgate rules and regulations, for example New York and Wisconsin. In contrast, a few of the States (e.g., West Virginia) have experienced many years of legislation and administration of a reclamation program, and the programs have become technically sophisticated.

Michigan is an example of a State in which the promulgation stage of program development has been delayed by legislative amendments (from 1971 to 1975).

The wording of the legislation of some States suggests that the promulgation of rules and regulations is permissible, not mandatory. Evidently, all States can issue orders and conduct certain licensing activities without rules and regulations. Nevertheless, in many States, there is a trend toward specificity in stating what is expected of the mine operator regarding the land during and after mining. States that have been involved in reclamation a comparatively long time have developed detailed standards that lay out mandatory steps and manuals that set forth recommended practice, or the state-of-the-art. Noteworthy manuals have been prepared by Iowa (undated), Kentucky (undated), Maryland (1975), and West Virginia (1975).

THE PERMIT PROCESS

The process of examining a mine operator's credentials and plans, and requiring a surety bond

before a permit is given, has a common thread in all States. There are significant differences, however, in time aspects, in size of bonds, and particularly in the information requirements for licensing.

All State mined-area programs require that the applicant submit to the administering agency a notarized professional report that shows how and when the mining operation and accompanying reclamation will occur. The documents submitted are called "Master Plan for Extraction" in Colorado, "Mined Land Use Plan" in Georgia, "Mine and Rehabilitation Plan" in Iowa, or a number of similar terms. The number and designation of the permits that are issued may vary, also, but the effects are the same: an applicant is licensed to mine and to reclaim according to an agreed upon plan of scheduled, specifically located activities subject to inspection and periodic relicensing.

The following States require separate prospecting permits and related reclamation plans: Alabama, California, South Dakota, Texas, and Virginia.

MINING METHOD

Mining methods seem to be determined largely by economic, financial, and natural factors. Nevertheless, State mined-area reclamation programs are said by Skelly and Loy, Engineers and Consultants (1975) to have a significant impact on the mining method selected by the mine operator. Several States (e.g., Kentucky) set forth clearly the reclamation rules pertaining to different mining methods employed because of different natural factors in a given State. Many States are not so explicit in the printed rules and regulations, preferring instead to establish appropriate measures in the orders issued to an individual mine operator. A number of States have had little experience with surface mine regulation. In such States it is likely that reclamation rules and mining methods will reach a sort of "mutual accommodation" as actual experiences unfold.

OVERRIDING OBJECTIVES

As indicated in table 1, State mined-area programs are not equivalent in terms of stage of development. But all the programs seem to be directed toward two interrelated objectives: (1) conversion of mined lands to planned productive use, and (2) minimization of deleterious effects

stemming from the mine site. A review of rules and regulations and discussions with State reclamationists suggest that flexibility is sought in carrying out the reclamation program—but not at the expense of the objectives.

In practice, meeting the productive use objective might cause a land slope in Illinois "to violate" the basic grade and backfill standards—because planned use of the site for estate-type residences would be enhanced by leaving a steep slope and a mine cut filled with water. To hold rigidly to the restoration of land to the original contour (a common standard) could preclude, for example, the development of recreation and residential lakes in the flat lands of Kansas and Indiana. In practice, in specific instances, other common standards such as "restoral of native vegetation" and "replacement of topsoil" have proven to be inadvisable and have been replaced or amended by standards aimed at serving better the productive use objective.

The minimization of deleterious offsite effects is an underlying provision of State programs which, in the older programs, predates pollution control laws. State Reclamation Acts declare that the site will not be a source of siltation, of acid-mine drainage, of noise pollution and will not constitute an eyesore. Hence, the adoption of rules requiring control of water flow and quality, neutralizing of toxic materials, erosion control, visual screening, and the explicit statement in State rules and regulations that State water quality criteria will be addressed and discharge standards will be met by the mine operator.

THE DOCTRINE OF REASONABLENESS

Inspection of the State laws and rules shows that the doctrine of being reasonable underlies most of the State mined-area programs. For example, in Idaho, the State-licensed mine operator must conserve and replace topsoil to the extent "reasonably available."⁶ In Oregon visual screening with vegetation will be pursued "if economically practicable."⁷

This doctrine of reasonableness tends to dissuade the State from asking for the physically impossible and from placing too heavy an economic burden on the mineral industries.

⁶ Idaho Title 47, Chapter 15, Section 47-1509(7).
⁷ Oregon Statutes 517.790, Subsection (2) (f).

FLEXIBLE INTERPRETATION OF STATE LAWS

In an analysis of surface mining and reclamation in 11 Midwestern States, Carter and others (1974) have shown that it is often the interpretation of the law rather than the law itself that dictates reclamation procedures. That study shows that although the reclamation requirements and the landscapes of adjoining States of Illinois and Indiana are similar, very different land-use patterns have emerged on reclaimed lands: 86 percent of Illinois permit lands⁸ were reclaimed for row crops and pasture, whereas 90 percent of Indiana permit lands were reclaimed for forest and range.

In revegetation, flexibility in interpretation of laws is being applied to the problems of revegetation of mined lands in arid climates. Much is yet to be learned about the time required for establishing plant growth and suitable species. Consequently, State standards applied to arid lands tend, presently, to be skeletal and may remain so until experience has demonstrated attainable conditions. In contrast, Iowa requires that revegetation be accomplished 24 months after the completion of mining, and Iowa provides detailed guidelines on the planting of desired species.

ATTENTION CALLED TO OTHER LAWS

A common characteristic of the State mined-area programs is the State's admonition to the mine operator applicant that other State and local licensing and permitting requirements are not necessarily satisfied in the approved reclamation program—that State waste discharge permits, State water rights, sanitary landfill requirements, local zoning permits, and the like must also be obtained. Several State mined-area programs require evidence of compliance with other applicable governmental requirements. With respect to land use, *the long-term trend is clearly toward integrated mined-area licensing and local permitting* (table 2).

THE PLANNING PROCESS

As used herein, the term "planning" refers to successive steps that, disregarding complexities, usually proceed as follows: (1) statement of objectives, (2) gathering of information and determination of factors critical to attainment of the objectives, (3) consideration and evaluation of

⁸ "Permit" lands are lands for which a State reclamation permit has been granted.

alternative means of meeting the objectives, and (4) selection and design of future actions—in amount, type, time, and place.

In general, all State mined-area regulatory agencies require the mine operator applicant to engage in a planning process. As manifest in State mined-area programs, the particular detail of the process that is actually applied varies from State to State.

Approaches to declaring the end-use or land-use objective vary by State and by age of program. Recent State legislation seems expansive in terms of requiring the mine operator applicant to look at "potential uses," as in California, or at "multiple land use," as in Illinois. Pre-1970 acts and regulations tend to accent attainment of the objectives of stabilizing slopes, preventing water pollution, and removing eyesores, by any reasonable method for any possible beneficial end use.

Present State programs tend to offer the applicant a "shopping list" of several potential land uses from which a specific end use will be chosen. Several States allow the applicant to propose a use that is not on the official list.

An analysis of recent State legislation and related rules indicates a trend toward stiffer requirements for information to support end-use choices, the evaluation of potential consequences, and the design and implementation of the mine-reclamation plan. The following phrases from State legislation suggest a need for high-quality analytical information:

[The application requirements . . . include . . .] "the anticipated hydrologic consequences of the mining operation"⁹

"the capacity of the land to support its anticipated use following reclamation, including . . . the capacity of the reclaimed land to support alternatives uses"¹⁰
". . . current surface values and its [the lands] capabilities to support a variety of uses or proposed uses"¹¹

The general subject coverage of State information requirements is shown in column 16 of table 1. A comparison of columns 16, 17, and 18 suggests that a positive correlation exists between a State's requiring detailed baseline information consideration of alternative uses, and declaration of an end use.

⁹ Texas Senate Bill 55, (1975), sec. 8 (3) (5).

¹⁰ Texas Senate Bill 55, (1975), sec. 10(2) (3).

¹¹ Utah Rule M-3 (2) (a).

The planning phase of mined area programs appears to be changing in two important respects. Time frames are being extended from the customary yearly licensing target to 5 years for contiguous mined areas (Kansas), to 10 years in "extended mining plans" (North Dakota), and even to the life of the mine (Montana). Also, State mined-area programs are being related increasingly to other planning programs, especially programs involving local government.

Roles for local planning bodies range from rather benign review activities to active participation in the licensing process. In the latter instance, private land-use objectives are scaled presumably against the declared public policy and adopted plans that pertain to the area. (See especially entries for California, Colorado, Illinois, Kentucky, Minnesota, South Dakota, and Wisconsin in column 19, table 1.) Provisions illustrative of a possible trend are quoted as follows:

"No permit shall be issued . . . [where] surface mining would be incompatible with Federal, State, or local plans for land development . . ." ¹²

". . . the mining and reclamation plan and the comprehensive plan [shall] conform with all applicable zoning ordinances . . ." ¹³

It is important to note that the Wisconsin Act is rather skeletal and not yet filled out with rules and regulations that amplify the comprehensive planning requirement to be placed upon the applicant mine operator. It is one thing to require coordination with, or conformity with, comprehensive planning, but quite another to require comprehensive planning by an applicant.

CONCLUSIONS

"The Utah legislature finds that: Reclamation requirements must be adapted to the diversity of topographic, chemical, climatic, biologic, geologic, economic, and social conditions in the areas where mining takes place." ¹⁴

1. State mined-area reclamation laws address a progression of private actions or initiatives which vary according to time, place, technology, and economic conditions. These laws function as "constraints" which affect the activities that occur before, during, and after mining.

¹² South Dakota Century Code, Chapter 45-6A, as amended (1975).

¹³ Wisconsin, Chapter 318, sec. 144.85 (3) (d), Laws of 1973.

¹⁴ From sec. 2(3), H.B. No. 323, 1975. This bill became the Mined Land Reclamation Act of 1975 (Utah).

2. Surface mining—the principal means of providing the present needs of the United States for sand and gravel, clay, stone, phosphate, iron ore, copper ore, and coal—involves diverse methods of mining. The specific method applied at a given site is dependent on the site's physical characteristics and, increasingly, on reclamation requirements.
3. Techniques of reclamation are generally well advanced, but the presence of physical and temporal constraints still makes difficult the reclamation of certain types of mines. Mining and reclamation in arid and semiarid climates pose special problems of great complexity.
4. As of December 1975, mined-area reclamation programs which affect surface mining, associated reclamation, and subsequent land use of mined sites have been enacted by 38 States.
5. Most of the State mined-area programs have arisen since 1970, a fact which reflects: (1) A response to the "environmental movement," (2) increased competition for land use, and (3) increased surface mining activity as the "energy crisis" unfolded.
6. Differences in the details of State mined-area programs are common, as individual States face their own peculiar natural, economic, political, and social conditions.
7. Commonalities arise among many State reclamation programs, as similar conditions are recognized and as the accumulating mass of State experience is understood and adapted by new States coming on line.
8. Mined-area reclamation programs can be very sophisticated in terms of the regulatory approaches and the particular requirements placed on the mine operator applicant. As a general rule, in any given State, reclamation requirements are becoming progressively more comprehensive in coverage and more detailed in terms of definition through standards and guidelines.
9. There is a trend in the new State programs toward an integration of land use and

mine planning, and toward requiring longer time frames and a more comprehensive approach to reclamation planning. State mined-area programs and advances in technology have already effected an integration of mine planning and reclamation planning.

10. All State mined-area reclamation laws recognize the possible role for local government in such activities as zoning; several of the mined-area programs require evidence of compliance with local planning controls. A few mined-area programs place local governments directly in the decisionmaking process with regard to the issuance of mining permits.
11. A great deal of high-quality information on natural resources is needed now and will continue to be required on a regular basis. Natural science monitoring is required if State mined-area reclamation mandates are to be adhered to and if the concept of integrated land use and mining for long-term beneficial use, private and public, is to be realized.
12. To serve the States, other interested units of government, and private parties, an efficient information system is needed for the recording and reporting of the status and content of State mined-area reclamation programs.

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**A DIRECTORY TO STATE SOURCES OF INFORMATION ON SURFACE
MINED-AREA RECLAMATION PROGRAMS, 1975**

<i>State</i>	<i>Agency</i>	<i>Individual</i>	<i>Location</i>
Alabama	Strip-mining Section Division of Safety and Inspection Department of Industrial Relations	H. T. Williams, Chief of Safety and Inspection	1816 8th Ave., North Birmingham, AL 35203 205-251-1181
Alaska	Division of Lands Department of Natural Resources	Michael Smith, Director, and Pedro Denton, Minerals Officer	323 E. Fourth Ave. Anchorage, AK 99501 907-279-5577
Arizona	Arizona State Land Department	Andrew L. Bettwy, Commissioner	1624 W. Adams St. Phoenix, AZ 85007 602-271-4621
Arkansas	Department of Pollution Control and Ecology	S. Ladd Davies, Director Milton Bonner, Geologist	8001 National Drive Little Rock, AR 72209 501-371-1701
California	Bureau of Mines and Geology Department of Conservation	Robert Streitz, Advanced Planning Officer	1416 Ninth St. Room 1341 Sacramento, CA 95841 916-445-0514
Colorado	Reclamation Section Department of Natural Resources	Director	c/o Division of Mines 1845 Sherman St. Denver, CO 80203 303-892-3401
Connecticut	The Natural Resources Center Department of Environmental Protection	Hugo Thomas, Director	165 Capitol Ave. Room 561 Hartford, CN 06115 203-566-3540
Delaware	Division of Environmental Control Department of Natural Resources and Environmental Control	N. C. Vasuki, Director	Dover, DL 19901 302-678-4764
Florida	Bureau of Geology Division of Resource Management Department of Natural Resources	Charles Hendry, Chief Steve Windham, Deputy Chief	903 W. Tennessee St. Tallahassee, FL 32304 904-488-4191 or 3636
Georgia	Land Reclamation Section Division of Environmental Protection Department of Natural Resources	Sanford Darby, Chief	P.O. Box 4845 Macon, GA 31208 912-744-3346
Hawaii	Department of Land and Natural Resources	Christopher Cobb, Chairman and Member, Board of Land and Natural Resources	P.O. Box 621 Honolulu, HI 96809 808-548-6550
Idaho	Division of Earth Resources Department of Lands	Terry Maley, Director, Norman Day, Supervisor, Conser- vation Section	Statehouse, Room 120 Boise, ID 83720 208-384-3280

**A DIRECTORY TO STATE SOURCES OF INFORMATION ON SURFACE
MINED-AREA RECLAMATION PROGRAMS, 1975—Continued**

<i>State</i>	<i>Agency</i>	<i>Individual</i>	<i>Location</i>
Illinois	Division of Land Reclamation Department of Mines and Minerals	Eugene Filer, Supervisor, and Charles Medvick, Resource Planner	State Office Bldg. Room 704 Springfield, IL 62706 217-782-4970 618-993-5450
Indiana	Division of Reclamation Department of Natural Resources	Richard McNabb, Director	613 State Office Bldg. 100 N. Senate Ave. Indianapolis, IN 46204 317-633-6217
Iowa	Division of Mines and Minerals Department of Soil Conservation	Marvin B. Ross, Mine Inspector	Grimes State Office Building Des Moines, IA 50319 515-281-5774
Kansas	Mined-Land Conservation and Reclamation Board State Corporation Commission	G. T. Van Bebber, Chairman, and Charels F. Bredahl, Member	Fourth Floor State Office Bldg. Topeka, KS 66612 913-296-3325 or 3600
Kentucky	Division of Reclamation Department for Natural Resources and Environmental Protection	Kenneth Ratliff, Director	5th Floor, Capitol Plaza Tower Frankfort, KY 40601 502-564-6940
Louisiana	Department of Conservation	Ray Sutton, Commissioner	P.O. Box 44275 Capitol Station Baton Rouge, LA 70804 504-389-5161
Maine	Bureau of Land Quality Control Department of Environmental Protection	Henry Warren, Director	State House Augusta, ME 04330 207-289-2111
Maryland	State Bureau of Mines Maryland Energy and Coastal Zone Administration	Harry Buckley, Director	City Building Westernport, MD 21562 301-359-3057
Massachusetts	Department of Public Works	Joseph Sinnott, State Geologist	100 Nashua Street Room 805 Boston, MA 02114 617-727-6398
Michigan	Geological Survey Division Department of Natural Resources	R. Thomas Segall, Geologist in Charge	Stevens T. Mason Bldg. Lansing, MI 48926 517-373-1256
Minnesota	Division of Minerals Department of Natural Resources	Elwood Rafn, Director Paul Pojar (Staff)	Centennial Office Bldg. St. Paul, MN 55155 612-296-4810
Mississippi	Mississippi Geological, Economic and Topographical Survey	William H. Moore, Director	P.O. Box 4915 Jackson, MS 39216 601-354-7011
Missouri	Office of Land Reclamation Department of Natural Resources	Robert Neuensch- wander, Director	P.O. Box 1368 Jefferson City, MO 65101 314-751-2357

**A DIRECTORY TO STATE SOURCES OF INFORMATION ON SURFACE
MINED-AREA RECLAMATION PROGRAMS, 1975—Continued**

<i>State</i>	<i>Agency</i>	<i>Individual</i>	<i>Location</i>
Montana	Division of Reclamation Department of State Lands	C. C. McCall, Administrator	Capitol Station Helena, MT 59601 406-587-2074
Nebraska	Office of State Planning and Programming	W. Don Nelson, Director	P.O. Box 94601 Lincoln, NE 68509 402-471-2414
Nevada	Nevada Bureau of Mines and Geology	William Dubois, Inspector of Mines	University of Nevada Reno, NV 89507 702-885-5243
New Hampshire	Department of Forests and Lands	Sargent Goodhue, Chief of Forest Management, and Glenn Stewart, State Geologist	Statehouse Annex P.O. Box 856 Concord, NH 03301 603-271-3456 James Hall University of New Hampshire Durham, NH 03824 603-862-1216
New Jersey	Bureau of Geology and Topography Division of Natural Resources	Dr. Kemble Widmer, State Geologist	John Fitch Plaza P.O. Box 1889, Room 709 Trenton, NJ 08625 609-292-2576
New Mexico	Bureau of Mines and Mineral Resources	Frank E. Kottlowski, Director	Campus Station Socorro, NM 87801 505-835-5420
New York	Bureau of Minerals Department of Environmental Conservation	Richard Arieda, Assistant Director	50 Wolf Road Albany, NY 12233 518-457-7480
North Carolina	Land Quality Section Division of Environmental Management Department of Natural and Economic Resources	Craig McKenzie, Chief	P.O. Box 27687 Raleigh, NC 27611 919-829-4740
North Dakota	Division of Reclamation Public Service Commission	Ed Englerth, Chief, and Allen D. Klein	Capitol Bldg. Bismark, ND 58501 701-224-2410
Ohio	Division of Reclamation Department of Natural Resources	Ken Faulk, Chief (Acting)	Fountain Square Columbus, OH 43224 614-466-4850
Oklahoma	Department of Mines	Ward Padgett, Chief Mines Inspector	253 Capitol Bldg. Oklahoma City, OK 73105 405-521-3859
Oregon	Mined Land Reclamation Office Department of Geology and Mineral Industries	Standley Ausmus, Administrator, and Tom Ehmett	P.O. Box 1028 Albany, OR 97321 503-928-5386
Pennsylvania	Bureau of Surface Mine Reclamation Department of Environmental Resources	William Guckert, Director Ralph V. Zampogna, Geologist	P.O. Box 2063 Harrisburg, PA 17120 717-787-5103

**A DIRECTORY TO STATE SOURCES OF INFORMATION ON SURFACE
MINED-AREA RECLAMATION PROGRAMS, 1975—Continued**

<i>State</i>	<i>Agency</i>	<i>Individual</i>	<i>Location</i>
Rhode Island	Statewide Planning Program	Daniel W. Varin, Director	265 Melrose St. Providence, RI 02907 401-277-2656
South Carolina	Department of Mining and Reclamation Land Resources Conservation Commission	Murray Wood, Director, and Jack S. Whisnant, Geologist	P.O. Box 11708 Columbia, SC 29211 803-758-2823
South Dakota	Division of Conservation Department of Agriculture	Al Griffiths, Director	Joe Foss Bldg. Room 110 Pierre, SD 57501 605-224-3258
Tennessee	Division of Surface Mining and Land Reclamation Department of Conservation	Chase Delony, Director, and George Laughlin	2611 W. End Ave. Nashville, TN 37203 615-741-1046
Texas	Division of Surface Mining and Reclamation Railroad Commission of Texas	Roy D. Payne, Director, and J. Randel Hill	Capitol Station P.O. Drawer 12967 Austin, TX 78711 512-475-4639 or 6520
Utah	Division of Oil and Gas Conservation Department of Natural Resources	Cleon B. Feight, Director, and Ron Daniels, Mined Land Coordinator	1588 W. N. Temple Salt Lake City, UT 84116 801-533-5771
Vermont	Agency of Environmental Conservation	Martin L. Johnson, The Secretary, and Edward Koenemann, Director, Division of Planning	State Office Bldg. Montpelier, VT 05602 802-826-3357
Virginia	Division of Mined Land Reclamation Department of Conservation and Economic Development	Grant Hollett, Reclamation Specialist, and William D. Roller, Director	Drawer U Big Stone Gap, VA 24219 703-523-2925
Washington	Division of Geology and Earth Resources Department of Natural Resources	Donald Ford, Geologist	Public Lands Bldg. Olympia, WA 98504 206-753-6183
West Virginia	Division of Reclamation Department of Natural Resources	Benjamin G. Greene, Chief	State Office Bldg. No. 3 Room 322 Charleston, WV 25305 304-345-3267
Wisconsin	Bureau of Water Regulation and Zoning Department of Natural Resources	Floyd Stautz, Director	Box 450 Madison, WI 53701 608-266-8034
Wyoming	Division of Land Quality Department of Environmental Quality	Walt Ackerman, Administrator	State Office Bldg. W Cheyenne, WY 82002 307-777-7756

