

DEVELOPMENT OF A PROCEDURE FOR LAND USE POTENTIAL EVALUATION FOR SURFACE-MINED LAND Final Report

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Foreword

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The authors gratefully acknowledge the cooperation and information provided by many mining companies and governmental agencies. Specific mention of numerous individuals in these various organizations has been made in the Forewords of the respective case study reports. The following is a summary list of organizations that are acknowledged for their assistance in this research effort.

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Chapter 1

INTRODUCTION

1.1 Summary

This report presents the results of a three-year research effort into developing procedures for land use potential evaluation for surface-mined land. The research project was funded by the Office of Surface Mining, U.S. Department of the Interior. The specific objective to be achieved through research was to aid both mine operators, land owners and land use planning agencies in their efforts to determine optimum use of mined lands by developing a step-by-step planning process which addressed the technical, social, economic and legal aspects of mine and land use planning. The plan of work included library search, literature review, visits to local, state and federal agencies, data collection and investigative visits to active, reclaimed, and abandoned mining operations, and case history development at three specific sites. The data and information gathered during these activities were analyzed to develop a rationale for land use potential evaluation and finally, to develop the planning process itself.

The guidelines for improved land use planning are divided into three categories, based on the areas of responsibility and levels of planning. These three areas are the site planning aspects, the local land use planning activities, and the regional land use planning considerations. The guidelines address the technical, organizational and management aspects of the land use planning activities at each level.

This report has five chapters and three appendices. This chapter, Chapter 1, summarizes the major recommendations of the research efforts and details the background to the research problem and the methodology adopted to conduct the research. Chapter 2 addresses the federal, state and local legislative measures that require land use planning for minable lands. Chapter 3 analyzes the technical, economic and social factors that impact land use planning and the selection of a particular land use for minable lands. Chapter 4 presents a summary of the three appendices, each of which is a detailed report of land use planning alternatives and their evaluations for a specific mining site. Chapter 5 synthesizes the results of the study and presents the guidelines for land use planning for minable lands.

This research has confirmed that land use decisions are not easily made. The large number of variables to be considered in the analyses, the impact of land use decisions on such matters as jobs, housing, and taxes, and the socio-political nature of the issues are the principal reasons. The land use plans developed are very sensitive to the factors considered and the relative importance attached to each of them. Therefore, guidelines, recommendations or suggestions for land use planning and land use potential evaluation are generally broad. However, there exists a fair amount of control on land development and management through a number of federal, state and local laws pertaining to such things as air, water, soil, solid waste, noise, wilderness preservation and wildlife protection. The passage of these laws itself is an indication of a general recognition that the trend in land use determination

is towards creating some form of an agreed upon system for land development and control by land owners and operating companies with participation from local, state, regional and federal agencies. As such, a significant component of the guidelines presented in this report is directed to this end.

The process that will lead to the integration of surface mining, reclamation and land use planning is presented conceptually in Figure 1.1. This diagram does not delineate the definitive tasks involved and identify the residence of the responsibilities. In Figure 1.2, two distinct land use planning processes are recognized - comprehensive and site planning. The major tasks of each process are also identified. The respective roles of the public planners and the mining companies in these two processes are identified in Figure 1.3. The site planning process itself is outlined in Figures 1.4 and 1.5. In the site planning process, a number of feasible alternatives is to be evaluated through an iterative procedure applying social, economic, and environmental impact measurement techniques.

The recommendations resulting out of applying the guidelines to individual mining operations can be specific as illustrated by the three case studies. The case studies are examples of the application of the guidelines to drastically varying natural and socio-economic conditions.

The present project has addressed the land use planning aspects for lands where mining is a reality. In addition to broad and overall recommendations for improving the land use planning and decision-making processes, the report has specific recommendations for implementing site planning procedures. The major concern of the research, however, was the development of effective land use plans for surface-mined land. Further research and field-oriented studies are necessary. These include the development of computer-oriented land use planning and evaluation studies and cost-benefit analysis. The report has considered land use planning for virgin lands only peripherally. In these lands, characterization of resources is the first priority item, even prior to land use planning. This will be followed by valuation of the resources. Needless to say, research into land use planning for lands with minable resources is critical. It is essential for increasing the potential for conservation and utilization of mineral resources. More importantly, it is vital for avoiding the chances for sterilization of mineral resources.

1.2 Background

Concern on government's part for effective reclamation of mined land has been evidenced through the years in both the message of regulations and increased research and development efforts. Prior to 1965, only seven states had specific laws requiring postmining land reclamation.

The first state surface mine reclamation act was adopted by West Virginia in 1939 followed by Indiana (1941), Illinois (1943), Pennsylvania (1945), and Ohio (1947). By 1977, when the Federal Surface Mining Control and Reclamation Act was passed, 31 of the 37 states with coal surface mining operations were exercising some degree of control over those operations. The first state laws basically addressed themselves to revegetation and in some

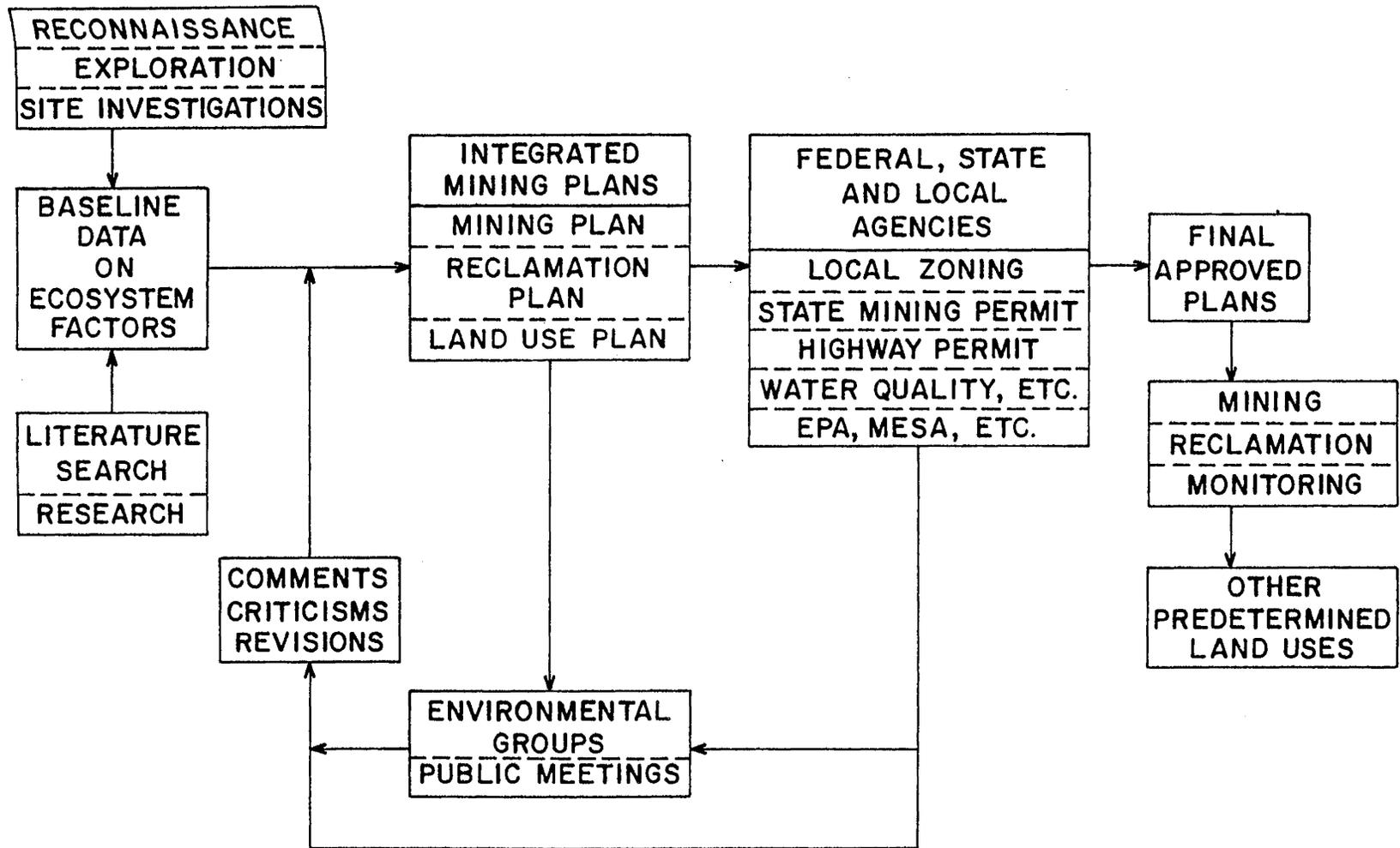


Figure 1.1 Process for the integration of surface mining, reclamation, and land use planning.

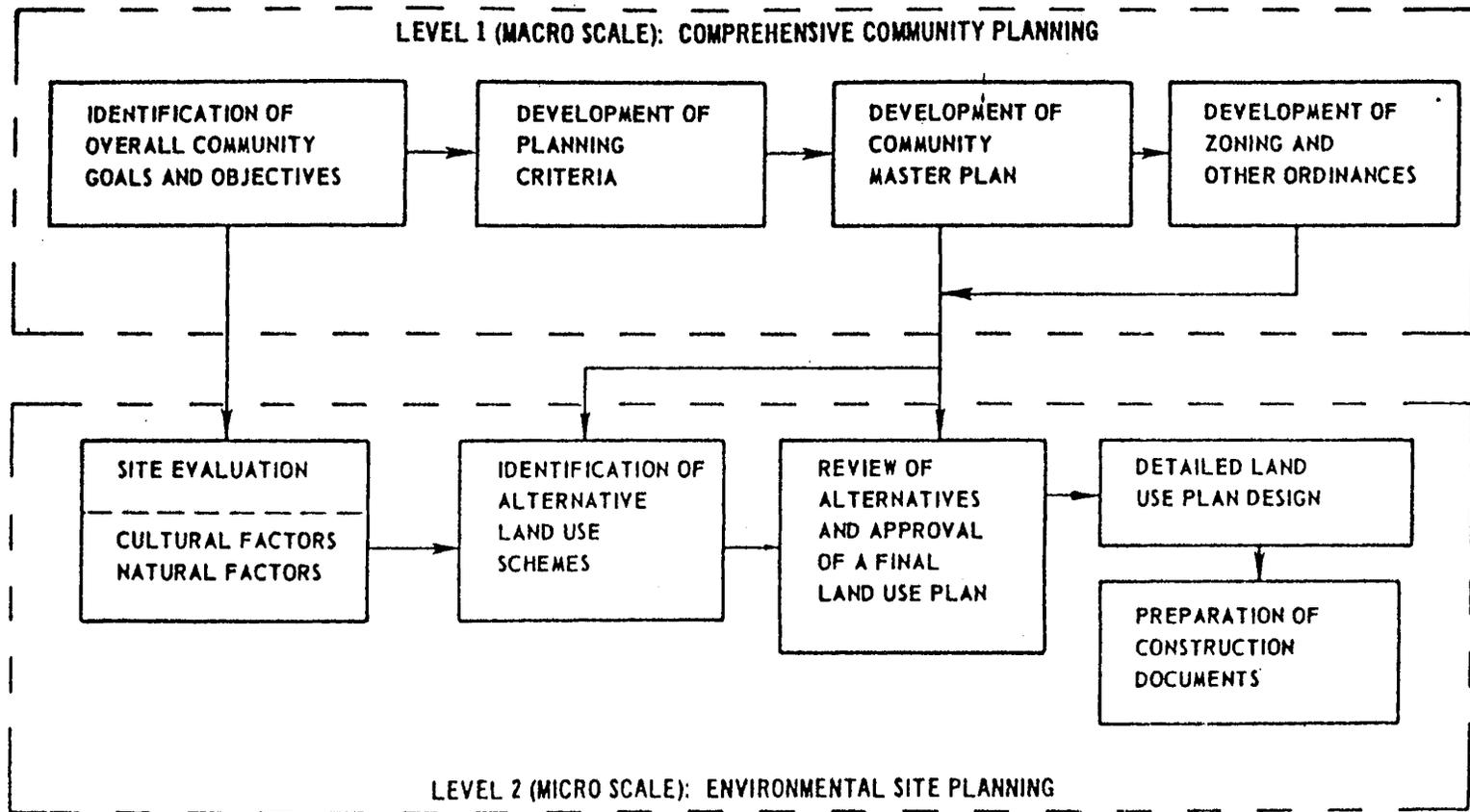


Figure 1.2 Two levels of the land use planning process.

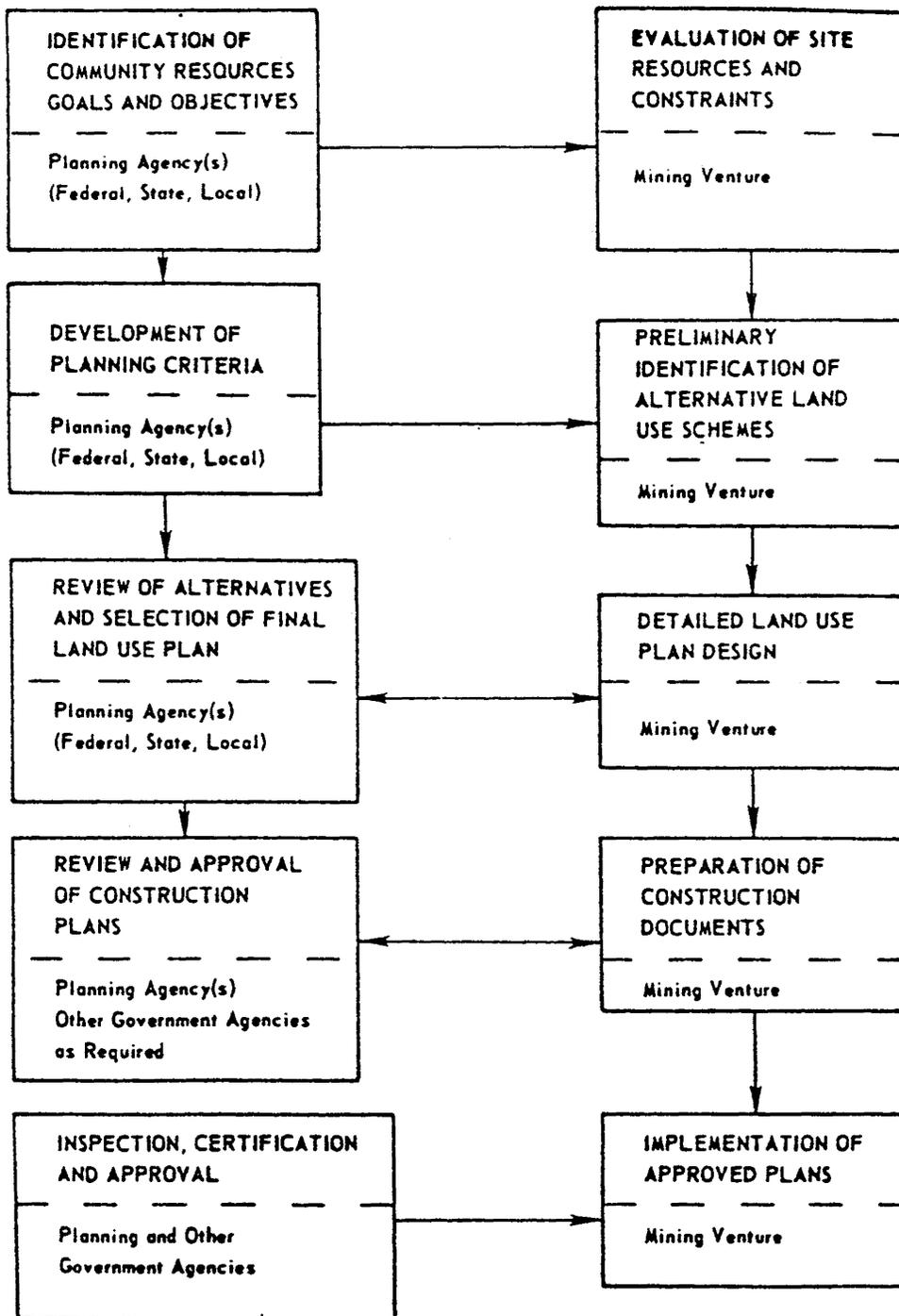


Figure 1.3 Integrated public planning and mine planning.

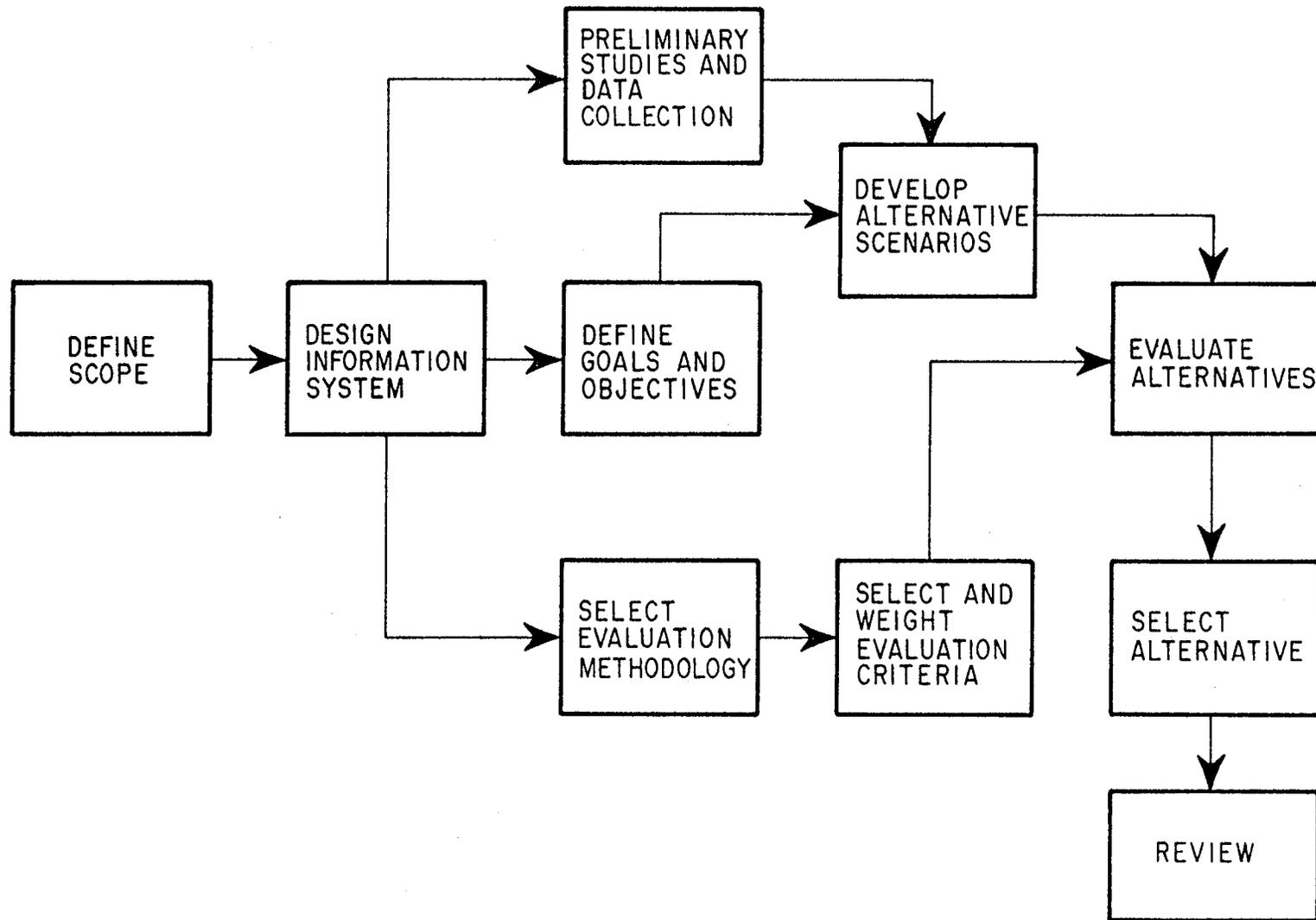


Figure 1.4 Detailed land use planning process.

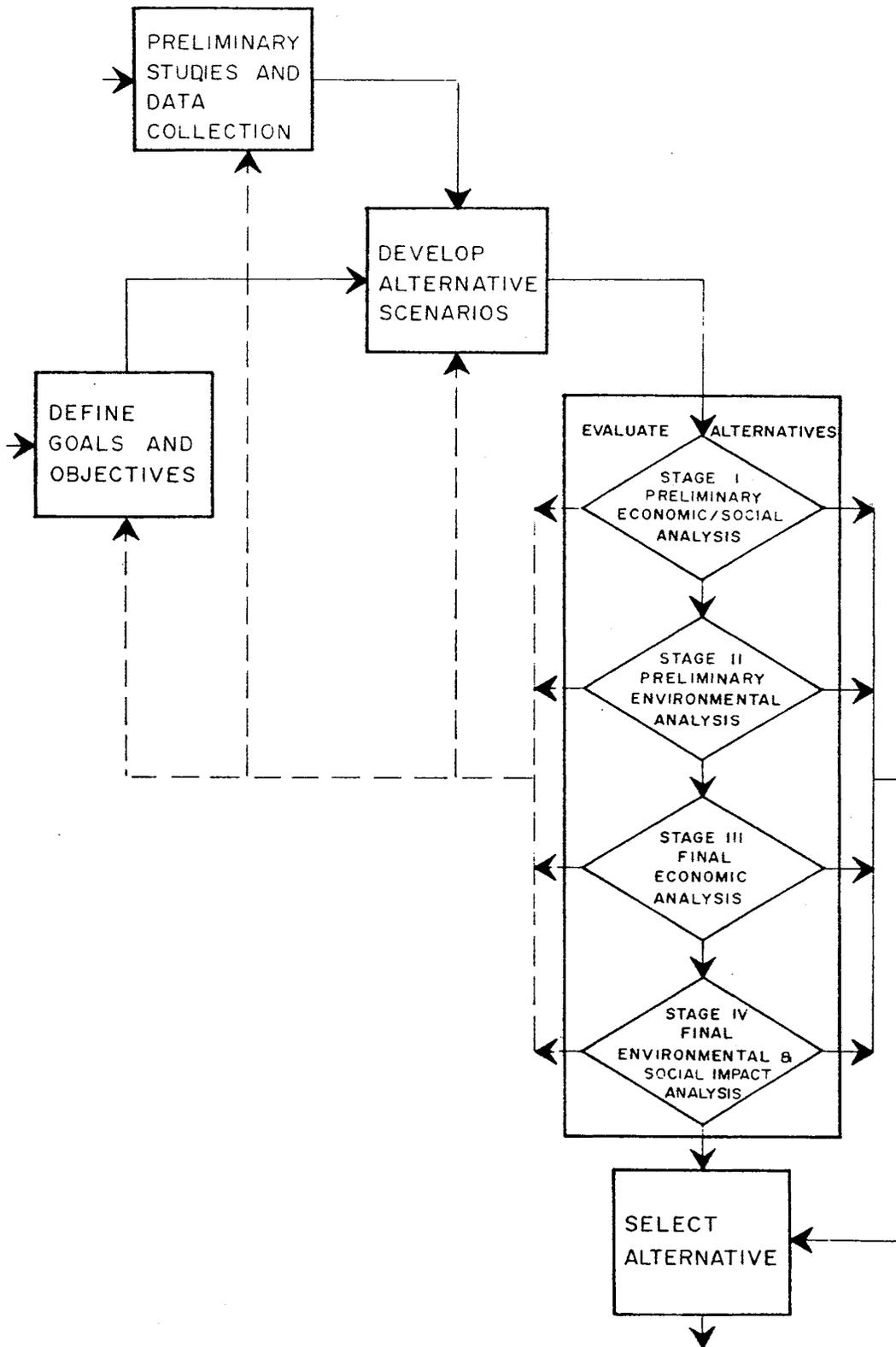


Figure 1.5 Process for the evaluation of land use alternatives.

cases, to limited grading of spoil piles. State laws evolved through various stages as modifications and amendments were added.

The earliest laws were modified in the 1950s and 1960s to include soil conservation measures and water quality control. Also, later amendments generally imposed stricter grading requirements than the initial legislation. Modifications in the late 1960s and 1970s went beyond simple reclamation standards to the control of all major activities before, during, and after mining. Not all state programs addressed each of the major areas of concern and those that did address these general areas did so with varying levels of control. It can be observed that those states with the longest history of surface mine regulation had developed the most comprehensive and detailed regulatory programs. One of the most recent developments in public policy has been the realization that surface mining in an area should be coordinated with long-range land use plans for the region (Imhoff, et al., 1976).

In 1977, after nearly ten years of legislative efforts and three presidential vetoes, the federal government took a major step to standardize public policy with the passage of the Surface Mining Control and Reclamation Act (PL 95-87). Although the gradual evolution of various state laws and regulations had an impact on surface mine planning and design, PL 95-87 had immediate and far-reaching effects. With an objective to eliminate the detrimental effects that unequal standards had on interstate commerce and to provide adequate protection of all natural resources, the federal government implemented a plan that included, among other provisions, minimum performance standards and comprehensive data requirements for mining permit applications. This action has had many direct and indirect impacts on surface mine planning and design. It has also affected the way mining companies organize to perform these new or expanded functions.

Several provisions of the Act and the regulations promulgated thereunder deal with the protection of the environment from surface mining damages. Specifically, with regard to obtaining a mining permit, a reclamation plan must be submitted which shall be of such a detail to demonstrate that reclamation can be achieved as required by federal or state programs. Such a plan must cover, among other aspects, the following important points with regard to the uses of land:

- the uses existing at the time of the application, and if the land has a history of previous mining, the uses which preceded any mining;
- the capability of the land prior to any mining to support a variety of uses giving consideration to soil and foundation characteristics, topography, and vegetative cover;
- the use which is proposed to be made of the land following reclamation, including a discussion of the utility and capacity of the reclaimed land to support a variety of alternative uses and the relationship of such use to existing land use policies and plans, and the comments of any owner of the surface, state and local governments or agencies thereof which would have to initiate, implement, approve or authorize the proposed use of the land following reclamation;

- a detailed description of how the proposed postmining land use is to be achieved and the necessary support activities which may be needed to achieve the proposed land use;
- the consideration which has been given to making the surface mining and reclamation operations consistent with surface owner plans, and applicable state and local land use plans and programs;
- the consideration which has been given to developing the reclamation plan in a manner consistent with local physical environmental, and climatological conditions.

The requirement that companies must submit a reclamation plan is not new. However, that surface mine planners must investigate "the utility and capacity of the reclaimed land to support a variety of alternative uses (PL 95-87, Sec. 502(a)(8))" was not a requirement in most state laws. This analysis goes beyond the scope of traditional reclamation planning and enters into the area of environmental site planning or land use planning. Although environmental site planning is not new, it had rarely been applied to surface-mined land. This provision of the law will require additional expertise in and involve the inclusion of many disciplines in the mine planning process.

In short, the planning of surface mines, in general and that of reclamation and postmining uses of land, in specific, have become very complex. This research project has addressed the topic of premining definition of long-range land use plans for minable lands. Premining definition of such plans makes it possible to minimize any disturbance of the land that is not part of the normal mining or land use plans and also to limit reclamation activities to those required by the future use plans. The integrated mining, reclamation, and land use planning concept requires an identification of the interactions that must take place between the various levels of land use planners and the development of a procedure to evaluate the land use alternatives for mined lands. These requirements have enabled the definition of the research objectives and the scope of work under the project.

The current research project addresses one aspect of a larger problem that arises out of the special characteristics of the mineral resources and of mining as a land use.

Mineral resources are integral components of the land. They are rare and non-renewable. They are locationally fixed. However, they are often evasive to detection even with pervasive search. Even when detected and proven minable, the start of mining operations is dictated by a complex interaction of geological, mining, economic, social and strategic factors.

Mining, as a land use, is also distinct from other uses of land. It is common in land management literature to separate land development and land use, land development being the means that prepare the land for an end use. Mining operations are, at one and the same time, development and use of the land. In addition to consuming land in a real sense, mining operations have to come to an end, if not for any other reason, due to the finite nature of the mineral resource.

This larger problem has to deal with the increasing demands that are being placed on available lands due to increase in population and industrial expansion. From the mineral resources point of view, there is a limited choice available for siting a mine, and, once in operation, it has finite life. Thus, in effect, surface mining, like any type of mining, is a temporary and non-renewable use of land. The land itself is a permanent resource having many concurrent as well as sequential uses. Only through proper planning can such a resource be preserved and its multiple uses enjoyed. There are two major aspects to planning. The first is resource characterization, and the second is land use planning to achieve the overall goal of full resource utilization and conservation. Otherwise, some of its uses may not be possible, and, in extreme cases, it may be of no use and might even become a major source of problems.

1.3 Research Objectives

It is common knowledge that many community land improvement projects never get beyond the planning stage due to the high cost of earthmoving and rehabilitation equipment and processes, and the high cost of building the transportation and communication networks. On the other hand, a surface mining operation involves massive movement of earth; it must develop an infrastructure such as transportation networks, communications, power lines, office buildings, water and sewage facilities. In essence, the high cost, alluded to above, that inhibit desirable community land development (or improvement) activities, can be substantially reduced by retaining and improving the mine infrastructure for concomitant or later use. This requires both planning and orderly development. Integration of surface mining, reclamation and land use planning to ensure the orderly development of the multiple and sequential land uses cannot be achieved without the cooperation of the mining companies, the land owners and the land use planning authorities. To make this planning process a success, each must be cognizant of the scope and limitations of the other parties. A selected but important list of these factors are as follows:

- i.) Activities of local/regional planning, coordination, and development are usually the responsibility of local, regional, state or federal agencies and not the mining companies.
- ii.) Government or other public land use planning groups are concerned more with the surface utilization of land. More often such expertise may not extend to such matters as surface mine engineering, and long-term impacts of mining.
- iii.) While some big mining companies may have the capability to perform the required premining and postmining land use analysis, the specific expertise in this area may not be present in most mining companies, specifically in many small operations.
- iv.) Governmental planning for land use usually exists at a macro-level dealing with large areas within local, state and federal control for the social good. On the other hand, the company planning usually is at a very micro-level, specific to a

particular mining site more designed to operate at a profitable level though in compliance with the various legislative constraints.

- v.) Land use regulation is predominantly a function of local government, which runs into several thousands, each exercising control over the land within its jurisdiction. The domain of these local governments is often not based on physiographic considerations, but on political subdivisions. On the other hand, there is a growing recognition that the effects of mining, and mining itself may transcend several political sub-divisions; the logical planning unit for mining activities, and therefore, reclamation activities, must be bounded by physiographic considerations and may encompass several local governments.
- vi.) Application of land use controls to privately owned land has been a topic of great constitutional importance and fraught with legal issues.
- vii.) Ability of private land owners, who are not the mining company or the government, to address the technical, economic and social issues of land use planning may be severely constrained due to both technical and financial reasons.

The above list illustrates the complexity of the problem of integrating land use planning and surface mining, and serves to outline the objectives of the research undertaken in this study. The broad objectives of this research project were to:

- i) investigate the current postmining land use planning procedures in mining companies;
- ii) identify analyses that are necessary to select a suitable post-mining land use;
- iii) examine the relationship between natural and cultural factors and various land uses for surface-mined lands;
- iv) identify the data needs for technical and economic evaluation of alternative postmining land uses;
- v) investigate the availability and sources of the data needed for mined land use planning;
- vi) develop a procedure for postmining land use planning;
- vii) integrate the procedure with surface mine planning, identifying the organizational framework and technical disciplines necessary;
- viii) investigate the current interactions between the mining company, the land use planning agencies and the land owners and examine alternative mechanisms to enhance the integration of surface mining and land use planning activities;

- ix) develop a set of recommendations for environmental site planning, and local and regional land use planning.

1.4 Procedures

The research was conducted in the following three phases, each phase lasting approximately a year.

Phase I: Review and Identification of Current Status of Mined Land Planning.

In this phase, the work concentrated on developing an indepth background into land use planning with regard to laws and regulations, regulatory agencies, sources of data and technical assistance for mined land use planning. Analyses of land use trends on surface-mined lands and classification of the principal factors that determined the land uses were also performed during this phase. Surface mines, reclaimed areas, and abandoned sites were visited in Pennsylvania, West Virginia, Indiana, Wisconsin, North Dakota, Wyoming, and Texas. The results of the first phase are presented in Chapters 2 and 3.

Phase II: Evaluation of the Current Mined-Land Planning Program.

In the Phase II, three surface mines were selected for as detailed analysis of the site specific land use planning considerations and land use realizations. The eastern U.S. case study site is located in Central Pennsylvania where there is a long history of surface coal mining near populated communities. The second site is located in Indiana, in a rural community but not far away from major urban areas. However, the terrain is more uniform than in the eastern U.S. The third site is located in the western U.S., where communities are springing up around new and large surface coal mines. Specifically, the case study site is a large surface lignite mine in North Dakota. In each of these areas, there were differences in several cultural and natural factors such as ownership patterns, scale of operations, land use concerns, land use agencies, length of mining, geology, climate and land use demands. For each site, data was collected from the mine, and local and regional agencies and detailed discussions were held with mine planners, public planners and regulatory authorities. Furthermore, an analysis was made of the current land use planning activities. Potential alternatives to the current plans were developed and evaluated. The results of the second phase are summarized in Chapter 4, and documented in the three appendices to the report, each appendix detailing the analysis performed for a particular site.

Phase III. Development of Mined-Land Planning Guidelines.

In the third phase, the results of the first two phases were synthesized and used to identify the critical factors, processes, and procedures that influenced the decisions on postmining land use. The differences between the comprehensive land use planning efforts (macro-scale planning) and the environmental site planning efforts (micro-scale planning) in terms of needs and objectives were analyzed. While the former is, for the most part, in the

domain of the land use planning agencies, the latter is mainly the concern of mine operators. Comprehensive planning fosters the development, conservation and use of natural resources; the site planning objectives are to control the onsite and offsite effects of mining so as to preserve, and if possible, to enhance, the land use capability. An analysis was also made of the expanded role of mine planning for land use planning. With regards to mine planning, the land use planning components were identified and incorporated into traditional mine planning steps. The expertise needed for the integration of surface mining, reclamation, and land use planning were also identified. Various site and regional planning processes were evaluated. A site planning process, including a model for evaluating postmining land use alternatives, was developed. The recommendations for mined land planning were developed for regional and local land use planners and mine planners. These, along with a description of the site planning process, are presented in Chapter 5.

1.5 Other Contributions

The research project was funded under the Mining and Mineral Resources Research Institute's program (MRI) of the Office of Surface Mining. In addition to specific research accomplishments, the project has contributed to the advancement of MRI objectives. These include cooperation with the industry, scientific training of students, and technology transfer to industry. Several mines were visited during the course of the project. These are detailed in Exhibit 1 (see page 109). Discussions were held with personnel from federal, state, and local agencies, mining companies, and consulting organizations. A select list of the personnel contacted is provided in Exhibit 2 (see page 110).

The project supported a research assistant in mining engineering at The Pennsylvania State University. He is working on a doctoral degree. The contribution to the undergraduate and graduate program and faculty research is unquestioned. The research assistant won the SME/AIME best student paper award in 1980 based on work conducted on this project. Currently, he is being supported partly by an award from the Henry Dewitt Smith Scholarship Trust of AIME, based on a show of need to continue the work. A number of publications listed in Exhibit 3 (see page 114), also resulted from the research grant aiding in the rapid dissemination of project results.

Chapter 2

REGULATORY AUTHORITIES

2.1 Overview

The legal authority for regulating surface mine reclamation and for controlling land use decisions originated and developed along different lines. The primary objective of surface mine reclamation is to preserve or restore the premining land use capabilities. The general goal of land use planning, as conducted by the public sector, is to protect the public health, morality, and well being. This is generally done through the formulation of plans that are intended to guide development, conserve resources, and prevent hazardous or conflicting uses of the land. Although the overall goals may differ, the relationship between surface mine reclamation and land use planning becomes apparent when decisions must be made concerning the use of reclaimed surface-mined land. The jurisdiction over these matters can become confusing, particularly, since it involves both public and private interests. An understanding of the legal authority at the various levels of government will add to one's appreciation of the relationship between surface mine reclamation and land use planning. It is important to realize that the legislative and judicial approaches to these two issues have undergone many changes over the years and the potential for further changes is still present.

When discussing surface mine reclamation and land use planning it is important to distinguish between federally-owned land and privately-owned land. Mining of federal lands has traditionally been under the jurisdiction of the federal government. Specifically, the Bureau of Land Management (BLM) has determined where and when the coal should be mined and the United States Geological Survey (USGS) has assisted with the technical aspects of data collection and reclamation planning. Although the federal government has, in the past, enacted laws which have impacted surface mine operations on private lands, it has been left to the individual states to establish reclamation standards and procedures for controlling surface mine reclamation. This position changed with the enactment of the Surface Mining Control and Reclamation Act of 1977 (PL 95-87). While the Act allows for states to obtain primacy in regulating mining and reclamation, this legislation created national standards for reclamation and required certain minimum standards to be included in the state programs.

The formulation of land use plans and the imposition of land use controls is considered to be a right of each state. Most states have, however, passed this authority to the local governments. This rule does not apply to federal land. The Federal Land Policy and Management Act of 1976 required the BLM to prepare comprehensive plans for the management of all public lands. Attempts in the past to institute a national land use policy, or even to pass legislation that might pressure states to require comprehensive planning which would affect private land, have not been successful. A federal land use bill was proposed in 1975 but it never reached the floor of the House, having been defeated in the House Interior Committee. Although the federal government has ostensibly avoided any land use planning legislation that would interfere with privately-owned land, the

impact of several bills on land use planning is apparent. Several bills enacted by Congress, which affect the use of both public and private land, are summarized in Table 2.1. The following sections take a closer look at the roles of federal, state, and local governments in surface mine reclamation and land use planning.

2.2 Federal Authority

2.2.1 Surface Mining and Reclamation

The federal government made a major impact on the coal industry in 1977 with the passage of PL 95-87. This Act created the Office of Surface Mining Reclamation and Enforcement (OSM) and charged OSM to promulgate regulations (OSM, 1979b) and enforce a national surface mine reclamation policy. It was the intention of Congress for states to assume primacy in controlling surface mining, however, the Act does provide for OSM to establish an enforcement plan for any state which does not submit a suitable plan. Regardless of whether the Act is administered by OSM or a state regulatory agency, environmental protection performance standards were set by Section 515 which will govern all future surface mining of coal.

The impact of PL 95-87 on land use was addressed by OSM in the Final Environment Statement on the Permanent Regulatory Program (OSM, 1979a) This document states:

The regulations allow a permit to be issued for surface coal mining only after the permittee has considered the premining and proposed post-mining land uses and has made provisions in a reclamation plan that assure attainment of the postmining land use. In all cases, the permittee must restore the affected land to a condition capable of supporting the premining land use or higher or better land use. When a permittee proposes to change the land use, he must provide assurance of:

- . compatibility with adjacent land use and (or) local planning and zoning;
- . feasibility of postmining land use as related to local and regional needs;
- . adequate planning of public facilities,
- . financial feasibility of the postmining land use;
- . the development of a postmining land use plan that conforms to accepted planning standards, the premining land capability, and information contained in the resource inventory; and
- . planning so that postmining land use does not present hazards to public health and safety.

TABLE 2.1

FEDERAL LEGISLATION WHICH AFFECTS LAND USE PLANNING

<u>PUBLIC LAW</u>	<u>DATE OF ENACTMENT</u>	<u>TITLE OF ACT</u>	<u>MAJOR PROVISIONS</u>	<u>DEPT./OFFICE/AGENCY RESPONSIBLE FOR EXECUTION</u>
PL 88-577	September 3, 1964	Wilderness Act	Establish the National Wilderness Preservation System	Depts. of Agriculture and Interior
PL 91-190	January 1, 1970	National Environmental Policy Act	Stated that it was the Nation's policy to: assure all Americans of safe, healthful, productive, and esthetically pleasing surroundings; attain widest range of beneficial uses of the environment without degradation; preserve historic, cultural, and natural aspects of our National heritage; achieve a balance between population and resource use.	Council on Environmental Quality and all other Federal agencies
PL 92-203	December 18, 1971	Alaska Native Claims Settlement Act	Granted title to 40 million acres of land to be divided among native villages and 12 regional corporations; established a joint State-Federal Land Use Planning Commission for a period of 5 years; authorized withdrawal from selection of up to 80 million acres for possible inclusion in the National Park, Forest, Wildlife Refuge or Scenic River Systems.	Department of Interior
PL 92-500	October 18, 1972	Federal Water Pollution Control Act Amendments	Provided for areawide waste treatment management plans in all areas having substantial water quality problems and establishment of planning agency to develop and implement plan; authorized the use of land use requirements to control pollution from	Environmental Protection Agency

TABLE 2.1 (continued)

<u>PUBLIC LAW</u>	<u>DATE OF ENACTMENT</u>	<u>TITLE OF ACT</u>	<u>MAJOR PROVISIONS</u>	<u>DEPT./OFFICE/AGENCY RESPONSIBLE FOR EXECUTION</u>
PL 92-500	October 18, 1972	Federal Water Pollution Control Act Amendments (Continued)	construction activity, mined-related sources, and agricultural, silvicultural, or livestock production.	
PL 93-205	December 28, 1973	Endangered Species Act	Authorized acquisition of lands and waters for the purpose of protecting, restoring, or propogating any endangered or threatened species.	Depts. of Interior and Commerce
PL 93-234	December 31, 1973	Flood Disaster Protection Act	Required that priority consideration be given to establishing conservation areas in formulating land use and control measures under the flood insurance program; made community participation in such a program requirement for individuals to be eligible to buy flood insurance at the subsidized rate and receive disaster relief in case of flood.	Department of Housing and Urban Development
PL 93-378	August 17, 1974	Forest and Rangeland Renewable Resources Planning Act	Authorized a renewable resource assessment and management program; defined National Forest System; provided for development of land management plans for units of the National Forest System which would be coordinated with State and Local governments.	Forest Service, Dept. of Agriculture
PL 93-383	August 22, 1974	Housing and Community Development Act	Consolidated into one funding mechanism programs for: public facilities, advance planning, open space land, land acquisition, neighborhood development, model cities, etc.	Department of Housing and Urban Development

TABLE 2.1 (continued)

<u>PUBLIC LAW</u>	<u>DATE OF ENACTMENT</u>	<u>TITLE OF ACT</u>	<u>MAJOR PROVISIONS</u>	<u>DEPT./OFFICE/AGENCY RESPONSIBLE FOR EXECUTION</u>
PL 94-223	February 27, 1976	Amendments to National Wildlife Refuge System	Required all areas of the National Wildlife Refuge System to be administered through the Fish and Wildlife Service; permitted cooperative administration of Alaskan refuges; prohibited most transfers of land from system without approval of Congress.	Fish and Wildlife Service, Dept. of Interior
PL 94-370	July 26, 1976	Coastal Zone Management Act Amendments	Provided Planning Grants for states with approved coastal zone management program to study and plan for any economic, social, or environmental consequences of coastal energy development; also provided loans for new or improved public facilities and services needed as a result of coastal energy development.	Department of Commerce
PL 94-337	August 4, 1976	Federal Coal Leasing Amendments Act	Required that Federally-owned lands containing coal deposits be included in a comprehensive land use plan and that coal development be compatible with that plan before any lease is sold; provided for consolidation of mining tracts into logical mining units.	Department of Interior
PL 94-429	September 28, 1976	Mining in National Parks	Declared that mining in the National Park System is contrary to the purpose of the parks; banned new claims in 6 units which had allowed mining; put a 4-year moratorium on new activities within existing claims in 3 parks.	Department of Interior

TABLE 2.1 (continued)

<u>PUBLIC LAW</u>	<u>DATE OF ENACTMENT</u>	<u>TITLE OF ACT</u>	<u>MAJOR PROVISIONS</u>	<u>DEPT./OFFICE/AGENCY RESPONSIBLE FOR EXECUTION</u>
PL 94-579	October 21, 1976	Federal Land Policy and Management Act	Authorized BLM to manage the public lands in accord with the principles of multiple use and sustained yield; provided for inventory of public land resources and development of a comprehensive land use plan; authorized withdrawals of Federal lands from uses such as mining or grazing subject to veto by both houses of Congress.	Bureau of Land Management Dept. of Interior
PL 94-588	October 22, 1976	National Forest Management Act	Provided for a national renewable resource program based on assessment of anticipated uses, demand for, and supply of renewable resources.	Forest Service, Dept. of Agriculture
PL 95-87	August 3, 1977	Surface Mining Control and Reclamation Act	Required reclamation plans which must include historical and existing land use, capability of land to support a variety of uses before and after mining, proposed use of land after reclamation, and relationship of proposed use to existing land use policies; provided for a program to designate certain areas as unsuitable for all or certain types of surface mining.	Office of Surface Mining, Dept. of Interior
PL 95-95	August 7, 1977	Clean Air Act Amendments	Provided for a permit program in non-attainment areas for new or modified major facilities (no permits issued unless pollution offset requirements are met or new source would not exceed new growth allowance); established 3 classes of areas with air cleaner than national ambient standards for the purpose of nondeterioration.	Environmental Protection Agency

Compatibility between the adjoining land uses has historically been determined through planning, zoning and subdivision ordinances at the local and state level (Council of State Governments, 1975). The requirement in the regulations to include a written statement from the authority responsible for land use plans with the permit application assures that local planning authorities are aware of the alternative proposed postmining land use. The compatibility requirement is nonspecific which will provide flexibility in recognition of local variation in environmental, economic and social conditions and needs. This regulation will encourage interaction between the permittee and planning authority prior to postmining land use development.

Section 522 of the Act requires each state seeking primacy to establish a program for the purpose of designating certain areas unsuitable for all or certain types of surface coal mining operations. An approval program must include a data base and inventory system for evaluating the capacity of different land areas and the program must outline methods for implementing land use planning decisions concerning surface mining operations. In discussing regulations pursuant to this section, OSM concludes in the Final Environmental Statement on the Permanent Regulatory Program that (OSM, 1979a):

There are two major categories of unsuitability designations. First, the regulations implement the prohibitions or limitations on mining declared by Congress. Under that action, all environmental resources on those lands would be protected from the adverse effects of coal mining.

The second major category of unsuitability designations will be for those lands which are selected through a petition process. The petition process provides for both mandatory and discretionary designations. Where reclamation is technically or economically infeasible, the regulatory authority must designate that area unsuitable for coal mining. Where mining would be incompatible with existing federal, state and local land use plans, cause significant damage to important cultural, scientific and esthetic values and natural systems, result in a substantial loss or reduction of long range food or fiber productivity, or substantially endanger life and property in areas subject to frequent flooding or unstable geology, the regulatory authority has discretion to designate such areas unsuitable for coal mining. The regulations will protect some nationally, regionally and locally significant lands, resources and land use values from permanent alteration or destruction.

Since its creation, OSM has become the chief federal agency involved with surface mining regulation and enforcement. However, other federal agencies have retained control over various aspects of surface mining. Of the other federal agencies involved, the Environmental Protection Agency (EPA) may have the greatest responsibility. EPA is responsible for administering the Federal Water Pollution Control Act of 1972 (FWPCA) and the Clean Air Act Amendments of 1977. If a state does not have an EPA-approved water pollution control plan, then surface mine operators must obtain National Pollution Discharge Elimination System (NPDES) permits from EPA for every point source. Under the 1977 Clean Air Act Amendments, Part C - Prevention of Significant Deterioration of Air Quality, strict limits were set on the amounts of sulfur dioxide and particulate matter which can be emitted in or near national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value. A permit is required before any facility can be opened in one of these areas. This Act is particularly significant to western surface mines where frequently a power generating station is located nearby. EPA is explicitly authorized to use land use requirements to control mine-related sources of water and air pollution.

The Bureau of Land Management (BLM) does not act as a regulatory authority over surface mining operations, however, BLM does conduct competitive coal lease sales of federal lands. The Federal Land Policy and Management Act of 1976 (BLM Organic Act) authorized BLM to manage the public lands in accordance with the principles of multiple use and sustained yield. This Act also requires BLM to conduct an inventory of public land resources and develop a comprehensive land use plan. The United States Geological Survey (USGS) evaluates data and provides advice to BLM concerning areas proposed for leasing. The USGS is also responsible for approving mining plans and supervising operations conducted under BLM coal leases. PL 95-87 gave the USGS responsibility for inspecting and enforcing the terms and conditions of coal exploration licenses and approving exploration plans on federal coal leases outside a permit area. OSM, however, has taken the responsibility for approval or disapproval of permit applications for surface coal mining reclamation operations on federal lands.

The United States Forest Service (USFS) regulates access roads that lead across USFS lands to areas leased for coal production. In addition, the USFS reviews leasing actions proposed by BLM and recommends stipulations to be included in such leases. The Bureau of Sports Fisheries and Wildlife (BSF&W) also has the authority to recommend stipulations for inclusion in BLM coal leases.

The Mining Safety and Health Administration (MSHA) promulgates and enforces worker health and safety regulations in all coal mines. A ground control plan must be approved by MSHA before a surface mining permit is issued. MSHA also sets training and educational requirements for certification of mining personnel. The Occupational Health and Safety Administration (OHSA) establishes and enforces worker health and safety regulations in areas not regulated by other federal agencies or by states under plans approved by OHSA.

The United States Army Corps of Engineers (COE) may be involved in permit review, monitoring, and enforcement functions if the mine operation involves any aspects related to navigable waters. Also, the COE reviews NPDES discharge permits for EPA to determine the impact of permitted discharge upon navigation. A permit must be obtained from the United States Coast Guard (USCG) if a surface mine operator plans to build a bridge over navigable waters.

The Interstate Commerce Commission (ICC) is responsible for issuing railroad service extension permits and the Federal Communications Commission (FCC) issues permits for the mining company to operate 2-way radios.

2.2.2 Land Use Planning

At the present time there is no federal authority charged with regulating land use planning for private land. As stated previously, certain federal agencies, such as EPA, do exercise a fair amount of power in controlling land use for the prevention of noise, air, and water pollution. Such regulation is assumed to be within the police power of the federal government to protect the public health, morality, and well being. This power is interpreted from Section 8 of Article I of the Constitution wherein Congress is charged to "provide for the common defense and general welfare of the United States." (Howard and Remson, 1978).

Several attempts at passing national land use legislation have failed. The most recent Bill, H.R.3510 or the Land Use and Resource Conservation Act of 1975, would have established the Federal Office of Land Use Policy and Planning Administration. This bill stopped short of giving the new agency power to formulate comprehensive land use plans which would impact private land. Instead, the Office of Land Use Policy would act as a coordinator for state and local planning agencies and public land management agencies. The bill, however, would have given the federal agency authority to issue grants to state and local planning agencies, and in doing so, the federal agency could possibly set performance standards for state and local agencies.

The key issue that arises when a land use bill is introduced is that of "taking". The Fifth Amendment to the Constitution has a clause which states, "...nor shall private property be taken for public use without just compensation." Initially, this clause was interpreted in the strictest sense. However, this interpretation began to change in the latter nineteenth century. Then, in 1922, Justice Holmes stated, "The general rule at least is, that while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a taking." (Bosselman and Callies, 1975). Therefore, land use controls which apply to private land can be considered as an uncompensated taking by the federal government. This is the issue that led to the defeat of H.R.3510 in 1975 and other similar bills in 1970, 1972, 1973, and 1974. While many legislators argued that these bills simply provided a framework for the states to follow in setting up land use plans, still others feared that the legislation would lead to federal control of state and local decisions affecting land use and amount to an unconstitutional taking of private land (Congressional Quarterly Almanac, 1975).

In the period from 1975 to the present, there have been no land use planning bills introduced similar to the ones proposed in the first half of the 1970s. Two possible explanations for this change are offered. In the first place, some of the fervor for national land use planning legislation may have diminished. For example, a bill that would have authorized a federal study into the problem of increased prime farmland conversion was defeated in February, 1980 because some opponents felt that this bill was a first step toward national land use planning (Congressional Quarterly Weekly Report, 1980). Another possible reason for the change since the early 1970s is that several bills, particularly environmental legislation, have significant land use impacts. Many of the laws listed in Table 2.1 have been enacted since 1975.

2.3 State Authority

2.3.1 Surface Mining and Reclamation

Before the enactment of PL 95-87 in August of 1977, the federal government did not have any comprehensive legislation which applied to all aspects of coal surface mining and reclamation. Certain areas were affected by federal air and water pollution and mine safety acts, however, the overall responsibility for regulating surface mining and reclamation on non-federal lands was left to the state authorities. States began enacting reclamation laws in 1939 and continued to enact new laws and amend existing laws up to the time PL 95-87 was signed into law. OSM reported in the Final Environmental Statement on the Permanent Regulatory Program that every coal-producing state was regulating surface mining to some degree when the Act was passed.

One of the main concerns which led to federal action was the wide variation in state regulations. Congress reasoned that these differences had a deleterious impact on interstate commerce because coal could be mined much more cheaply in states with minimum environmental and reclamation standards than in states which had strict controls. Although the Act mandates certain performance standards, it was not intended to replace state regulatory authorities. Under PL 95-87, states may continue to exercise primary responsibility for regulating surface mining operations if a state submits a satisfactory program plan to OSM. To receive approval the proposed program must meet all of the minimum performance standards listed in the Act. If a state fails to submit a plan or submits a plan that does not receive approval, OSM will impose a federal program which gives OSM the responsibility for regulating surface mining and reclamation in that state.

The reclamation plan requirement which is included in Section 508 of the Act requires, among other things, that consideration must be given to alternative postmining land uses. The reclamation plan must include the premining use of the land and an evaluation of the land's capability to support a variety of uses prior to mining. The specific characteristics which are to be evaluated are soil and foundation characteristics, topography, and vegetative cover. Before a postmining land use is proposed, the utility and capacity of the reclaimed land to support a variety of alternative uses must be investigated. The relationship of the proposed land

use must be consistent with surface owner plans and applicable state and local land use plans.

In the Final Environmental Statement on the Permanent Regulatory Program, OSM concluded that the impact of the state program requirements on state regulatory programs will depend on the type of operations that are presently regulated and on the current level of control. Although most states already have systems for permitting, bonding, inspection, and enforcement, few have programs to control surface effects of deep mining, or to designate areas unsuitable for mining and no state previously had established a Small Operator Assistance Program (SOAP) as required by the Act. One possible impact is that states may need to enact new legislation giving one agency the authority for expanded areas of responsibility. These additional requirements will most assuredly require an increase in state regulatory personnel. While problems are foreseen for the immediate future, on the long run an increased ability to solve mining related problems using state agency expertise is assumed by OSM (1979a).

2.3.2 Land Use Planning

The concept of state control over various types of development is not new. Land use planning and regulation is just one method by which states can direct their economic growth, however, this method has largely been ignored in favor of other activities such as transportation and public facilities planning. Planning at the state level was conducted by State Planning Boards in the 1930s. These boards were mainly concerned with the planning of federally-funded public works projects. When the federal funding for these projects disappeared in the late 1940s, so did the planning boards. Some necessary functions were transferred to other state agencies. In the 1960s, state planning emerged again; however, at this time the state planners were interested in identifying abstract developmental goals and objectives. Although the state agencies acted as coordinators for various federal agencies interested in housing, transportation, and other developmental activities, the state planners were not called upon to make any real land use decisions. The environmental concern of the 1970s has prompted state planners to retreat somewhat from the philosophical advisor role and begin making policy decisions and enforcing regulations to insure proper consideration of all environmental aspects for future land development (American Law Institute, 1975).

The legal issue of which level of government has jurisdiction over land use planning decisions predated the State Planning Boards of the 1930s. The need for comprehensive planning was first recognized in the congested urban areas of the East. The need was not viewed as statewide but only of local importance. Therefore, the states each passed a law similar to the standard State Zoning Enabling Act prepared by the U.S. Department of Commerce in 1922. The Standard State Zoning Enabling Act addressed six specific issues. These issues are: (1) formation of a local planning commission; (2) content of the master plan; (3) provisions for adoption of the master plan; (4) planning commission approval of public improvements; (5) control of private subdivisions; and (6) establishment of a regional planning area (American Law Institute, 1975). These state laws, therefore, transferred to the municipalities the authority to form a local planning commission and to draw

up a master plan for each municipality. The state also delegated police power to the local authorities for the enforcement of the local regulations. The manner in which the local plans have been carried out has been almost exclusively through the promulgation of zoning ordinances and the division of the planning areas into specific zones. This type of planning has concentrated on preventing undesirable development but has done little to promote desirable use of the land.

This system of land use planning has come under severe criticism in recent years. Land use planning is no longer restricted to the large cities. Thousands of local governments have adopted zoning regulations each aimed at maximizing their tax base and minimizing their social problems with little regard for neighboring communities (Bosselman and Callies, 1975). Another factor which has stretched the limits of local planning is the concern for the environment and the use of zoning regulations to preserve wilderness and open spaces. The result of these criticisms has been a gradual reallocation of responsibilities between state and local governments. The trend has been for states to preempt local governments where "issues of greater than local significance" are involved (Bosselman and Callies, 1975). This movement is sometimes referred to as "The Quiet Revolution" and has resulted in the adoption of statewide land regulatory systems in several states. Hawaii was the first state to enact such legislation in 1961 to protect its sugar cane and pineapple industries from urban sprawl (Council of State Governments, 1975). In 1969 Vermont enacted a state land use law primarily to control large vacation home developments. Maine took similar action in 1970. Since the initial action by Hawaii in 1961, many states have passed laws to regulate land use where issues of greater than local significance are involved. Table 2.2 lists the status of land use planning in all 50 states.

The American Law Institute has proposed a Model Land Development Code (1975) for adoption by any state interested in regulating land use decisions which affect either the entire state or a particular region of the state. Although no state has adopted this entire document in its final form, several states have patterned their legislation after earlier drafts of the Model Code. The Model Code is a good example of the type of legislation states have either enacted or are presently considering.

Briefly, the purpose of the Model Land Development Code is to allow states to establish and carry out a state land use policy by controlling the location and intensity of activities which use land and by regulating the type, design, and location of structures and facilities. The authors of the Model Code define those matters of state or regional interest in two ways:

1. Areas which, because of natural resources or the characteristics of previous development, future development of any kind would be an issue of state concern.
2. Certain types of development such as airports, major highways, or large scale developments which, regardless of their location, would be of greater than local significance.

Article 8 of the Model Code authorizes a State Land Planning Agency to undertake a comprehensive process of statewide or regional land use planning

TABLE 2.2

STATUS OF STATE LAND USE LEGISLATION (CEQ, 1975)

State	Enabling legislation				Functional programs									State land use program ²
	Municipalities	Counties	Regional agency advisory only	Regional agency review authority	Procedures for coordination of functional programs	Land use-value tax assessment law	Surface mining	Flood plain regulations	Power-plant siting	Wet-lands management	Critical areas	Coastal zone ¹ management program participation		
Alabama	Yes	Yes	Yes	No	No	No	Yes	No	Yes	No	No	Yes	1	
Alaska	Yes	Yes	N/A	N/A	Yes	Yes	Yes	No	Yes	No	No	Yes	2	
Arizona	Yes	Yes	Yes	N/A	Yes	No	No	Yes	Yes	No	No	N/A	2	
Arkansas	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	N/A	2	
California	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	2	
Colorado	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	N/A	3a-c	
Connecticut	Yes	N/A	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	2	
Delaware	Yes	No	Yes	No	Yes	Yes	No	No	No	Yes	No	Yes	2	
Florida	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	3a-e	
Georgia	Yes	Yes	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes	2	
Hawaii	No	Yes	N/A	N/A	Yes	Yes	No	Yes	No	No	No	Yes	3a-e	
Idaho	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	N/A	2	
Illinois	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	Yes	2	
Indiana	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	Yes	2	
Iowa	Yes	Yes	Yes	No	No	Yes	No	Yes	No	No	No	N/A	2	
Kansas	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	N/A	2	
Kentucky	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No	N/A	2	
Louisiana	Yes	Yes	Yes	No	Yes	Yes	No	No	No	Yes	No	Yes	2	
Maine	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	2	
Maryland	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	3a-c	
Massachusetts	Yes	Yes	Yes ¹	No	No	Yes	No	No	Yes	Yes	No	Yes	2	
Michigan	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No	No	Yes	2	
Minnesota	Yes	Yes	Yes ⁴	No	No	Yes	No	No	Yes	Yes	Yes	Yes	2	
Mississippi	Yes	Yes	Yes	No	No	No	No	No	No	No	No	Yes	2	
Missouri	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes	No	N/A	2	
Montana	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	N/A	2	
Nebraska	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	No	N/A	2	
Nevada	Yes	Yes	Yes	No	Yes	Yes ⁵	No	No	Yes	No	Yes	N/A	3a-c	
New Hampshire	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	No	Yes	2	
New Jersey	Yes	No	Yes	No	No	Yes	No	Yes	No	Yes	No	Yes	2	
New Mexico	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	No	N/A	2	
New York	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	2	
North Carolina	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	3a-c	
North Dakota	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No	N/A	2	
Ohio	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No	Yes	2	
Oklahoma	Yes	No	Yes	No	No	No	Yes	Yes	No	No	No	N/A	2	
Oregon	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	3a-c	
Pennsylvania	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	Yes	2	
Rhode Island	Yes	N/A	No	No	Yes	Yes	No	No	Yes ⁶	Yes	No	Yes	2	
South Carolina	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	Yes	2	
South Dakota	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No	No	N/A	2	
Tennessee	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes ⁷	No	No	N/A	2	
Texas	Yes	No	Yes	No	Yes	Yes	No	No	No	Yes	No	Yes	2	
Utah	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	Yes	N/A	2	
Vermont	Yes	N/A	Yes	No	Yes	Yes	No	No	No	No	Yes	N/A	2	
Virginia	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	N/A	3a-e	
Washington	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	2	
West Virginia	Yes	No	Yes	No	Yes	No	Yes	Yes	No	No	Yes	N/A	2	
Wisconsin	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	2	
Wyoming	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	No	N/A	3a-d	

¹No state has an approved coastal zone management program at present.²State land use program code

1. No activity at state level

2. Study (executive or legislative) or state legislative consideration in progress

3. State land use program legislation enacted

(a) inventorying existing land resources, data and information collection

(b) policy study or promulgation by agency or commission

(c) identification of land areas or uses of more than local concern

(d) regulation or management of land areas and uses identified

(e) direct state implementation or state review of local government implementation.

³Area-wide Council for Martha's Vineyard has authority to administer controls.⁴Twin Cities Metropolitan Council has regulatory authority.⁵Must be ratified in a referendum to take effect.⁶In the coastal zone a development permit from the Coastal Council is required.⁷Powerplant siting is conducted by TVA only.

Source: U.S. Department of the Interior, Office of Land Use and Water Planning.

(American Law Institute, 1975). The State Land Planning Agency would have the authority to promulgate regulations for development in certain areas, disapprove any local plan which conflicts with the state plan, intervene in judicial and administrative proceedings, and adopt a state or regional land development plan to guide public and private development. The state agencies may choose to establish regional divisions to carry out their policies. These regional divisions would be able to exercise the police power of the state and thus would be different than regional planning commissions which are forced to operate only in an advisory capacity to local governments.

In response to this "Quiet Revolution," many local municipalities are fighting to keep states from preempting any more of their land use control authority. This is not necessarily a throwback to pre-Quiet Revolution conditions where zoning was conducted by a Planning Board with little attention given by the general public. The new trend is towards greater public participation and greater influence being given to the public in land use planning decisions.

In addition to passing comprehensive state land use planning legislation, many states have passed more specific acts aimed at controlling certain land use or environmental problems. Some of the activities controlled by these laws are power plant siting, strip mining, coastal zone management, wetlands management, flood plain management, and designation of critical areas. Table 2.2 includes legislation dealing with these specific areas of concern for each state. The State Coastal Zone Management Programs are an excellent example of state planning action as a result of federal legislation. Thirty-one of the thirty-five states and territories affected by the Coastal Zone Management Act of 1972 have either enacted new legislation or have improved implementation of existing laws as part of their State Coastal Zone Management Programs (CEQ, 1979).

Another recent development of particular interest to the coal industry is state legislation which tries to alleviate some of the community problems resulting from inland energy development. Wyoming, North Dakota, Montana, and Colorado have already adopted mechanisms which include planning requirements and severance taxes. The main purpose of these acts is to provide planning and financing of public facilities and housing made necessary by extremely rapid growth in certain areas as a result of mining and other energy development activities.

All of the state legislation can be categorized into four separate mechanisms for control of land use. These mechanisms are:

- (1) Use of police power,
- (2) Use of public agencies to provide direction,
- (3) Use of tax manipulation,
- (4) Public acquisition of land.

One of the main catalysts of state land use planning legislation has been the inadequacy of local planning to handle certain issues. Another hypothesized stimulus may be the belief that decisive state action may forestall mandatory federal planning requirements. It is very unlikely that

state agencies will replace local planning authorities, particularly, with the increase in public participation at the local level. However, there will most likely be continual redefinition of state and local responsibility over the next several years.

2.4 Local Authority

At the present time, land use regulation is predominantly a function of local government (Clar and Ramani, in press). In the U.S., there are approximately 10,000 local governments with authority to exercise control over the land within their jurisdictions. The primary means of exercising this control has been through the use of zoning ordinances. There are four main types of zoning ordinances: building-size regulations, building-tract regulations, population density regulations, and use regulations. Use regulations are generally considered to be the most powerful. They allow the county or municipality to divide its area into various zones and then regulate the use of each zone. Local governments have been criticized for failure to exercise their powers and for backing down easily when they have been challenged in court. Another area of expressed concern is the belief that many local governments despair of reaching any reasonable accommodation with landowners and decide to prohibit everything, leaving the issue up to the courts to settle.

Figure 2.1 outlines the political system of the local planning commission. (Clar and Ramani, in press). The formulation of land use plans is clearly a complex undertaking, transcending many local, state, and federal bureaucracies.

Although local governments have, in the past, exercised primary control over land use planning decisions, they generally have not attempted to regulate surface mining within their boundaries. Recently, however, some local governments have been exercising a certain amount of control over surface mining through zoning regulations, specifically, special use permits. A detailed report concerning the power of local governments to regulate surface mining has been prepared by Curry and Fox (1978) for the state of Pennsylvania. The following discussion addresses some of these local controls.

Purely locational controls have been applied to surface mining in two ways: (1) a total ban can be placed on surface mining, or (2) surface mining can be restricted to particular use districts. Zoning ordinances generally do not attempt to exclude surface mining altogether, since this would require the municipality to prove that the total prohibition is necessary to protect the public health, safety, welfare, or morals. Although a total ban would be difficult to justify, municipalities can easily prohibit surface mining in specific zones, particularly, where the operation would be incompatible with other permitted uses. When challenged in court, such zoning ordinances are entitled to the presumption of reasonableness and validity. However, a surface mine operator may be able to show that certain zoning classifications, which prohibit mining, are unreasonable due to specific conditions within the district or municipality.

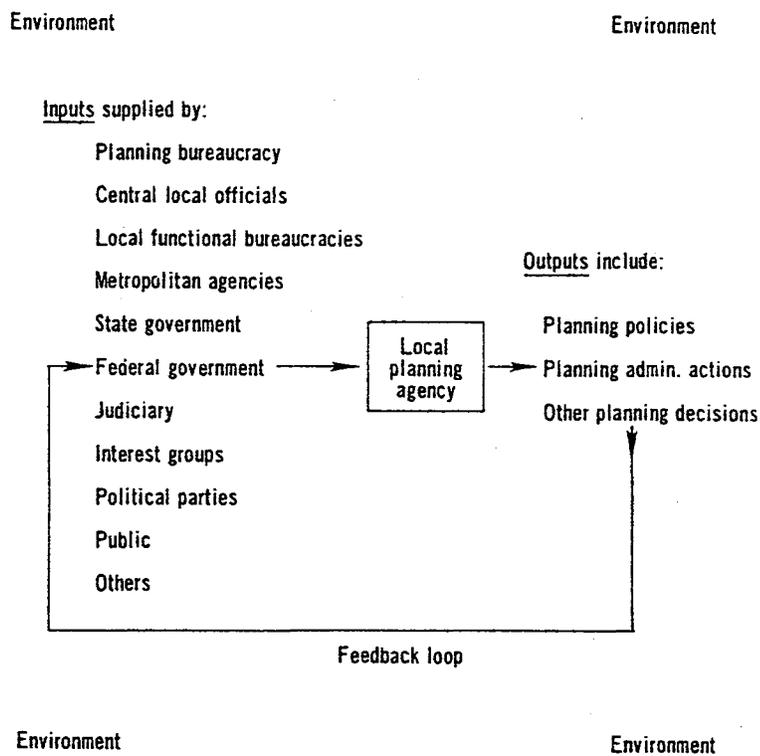


Figure 2.1 The political system of the local planning commission (Linowes and Allensworth, 1975).

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Locational controls are the simplest and least expensive to administer. They require almost no technological expertise. Some municipalities, however, are choosing a combination of locational and performance controls in an effort to achieve greater flexibility. The principal device used for regulating land use by both locational and performance controls is the special use permit. There are two types of special use permits: (1) the conditional use, which is granted by the governing body, and (2) the special exception, which is granted by the zoning hearing board. Both the special exception and the conditional use are uses permitted in particular zoning districts by the express terms of the zoning ordinance. However, these uses are allowed only when the applicant for a permit can show that the use will meet certain additional locational and operational criteria set forth in the zoning ordinance.

Locational decisions can be controlled in two ways. First, surface mining may be allowed as a special use only in selected use classification districts. Second, among the conditions that can be imposed on the granting of the permit are varying setback or other requirements that depend upon the uses of adjoining lands. The applicant may be subjected to additional performance standards designed to insure that the proposed mining operation will not have an adverse impact upon the community or upon stated community environmental values.

Another feature of surface mining, directly related to the protection of significant community values that can be achieved through the special use technique, is control of the usefulness of the land once mining operations have been completed or have ceased for a given period of time. The municipality can insist that the land remaining after mining be left in a condition that will enable it to be used for ecologically and economically productive purposes consistent with proposed long-range uses allowed in the zoning district where the mine was located.

Special use permits may also be employed to control the pace of mining in the community. Regulations may be utilized to accomplish any one or more of the following objectives: (1) control of the amount of land under active surface mining at any particular time, (2) relating the amount of new land allowed under mining to the effectiveness of the reclamation of preceding operations, and (3) creation of incentives for the re-mining of inadequately reclaimed mining sites.

Chapter 3

LAND USE FACTORS

3.1 Overview

Land use plans are rarely based upon structured decisions. Data collection may be conducted in a rigorous manner and certain analyses may be performed on the data, however, the decision to put the land to a specific use is finally based upon the intuitive judgment of one or several individuals. One reason that land use decisions remain unstructured is simply the number of factors that potentially influence land use. Pugliese and others (1979) have identified at least 135 environmental characteristics that can have an impact on postmining land use. The inclusion or exclusion of certain factors by the planner may influence the land use decision. Also, the relative importance of the various factors to the decision-maker can alter the outcome. Although the land use factors discussed in this chapter are not exhaustive, they are presented as the major factors that determine the use of surface-mined land. It should also be recognized that several of the land use factors presented here are general categories and could be subdivided into many more minor categories.

Various approaches have been taken to the classification of land use factors (Clar and Ramani, in press). In this chapter, these factors will either be classified as natural or cultural. Natural land use factors include, at least, the geomorphic, climatic, hydrologic, and soil characteristics of a site. Although these characteristics can be altered by man, they were initially the result of nature. Cultural factors include all of those geographic, demographic, and economic characteristics that are the result of man's activities. The relative importance of natural versus cultural factors in determining land use can be argued. In general, however, it seems that natural factors are most significant in determining the suitability of a site for a particular use and the cultural factors determine the practicality of a given use. While both types of factors are important, final decisions are often based upon cultural factors after a review of natural factors has eliminated the unsuitable uses.

Land use factors are not all of equal importance in determining postmining land use. Likewise, a factor that is extremely important for one type of land use may be relatively unimportant with regard to a different land use. The natural factors and cultural factors discussed in this chapter are tabulated at the end of each respective section and an estimate is made concerning the relative importance of each factor in determining the suitability of several land uses. The land use types considered are: forestry, wildlife, recreational, agricultural, residential, institutional, commercial, and industrial uses.

3.2 Natural Factors

3.2.1 Topographic Relief

Relief is the difference in elevation between high and low points for a specific site or for a region. Relief and its relationships to climate, soils, hydrology, and plants are of concern to mine planners. The configuration or topographic relief of the land surface, the direction in trends of mountain chains, and the proximity to large water bodies must be considered together since these factors largely determine the direction of prevailing winds, humidity of the atmosphere, and amount of precipitation (Toumey and Korstian, 1947).

Rainfall tends to be heavier on the windward site of a ridge than on the leeward site. In addition, differences in rock formations, such as the difference in inclination of the strata, influence the soil water supply and the location of springs. These factors can result in varying plant associations from one side of the ridge to the other. Also, the constant natural erosion process usually causes areas below and adjacent to slopes to have more fertile soil than neighboring slopes (Clar, 1982).

3.2.2 Slope

Slope or gradient is the angle formed by the surface of the soil with the horizon. An important effect is the control that it exerts on runoff and drainage and, through these, upon water content of the soil. Another important effect is the control that it exerts through insolation on the temperature and moisture of the surface soil. Slope modifies the intensity of insolation by shifting the angle of incidence of the sun's rays. It also has some influence upon light, wind, and indirectly, the distribution of snow. The depth of soil and water content vary almost directly with the gradient when other conditions are similar (Toumey and Korstian, 1947).

It has been observed that the degree of slope is the most important limiting factor in cultivation. Likewise the degree of slope will limit the density of development that can occur. Residential, commercial, institutional, and industrial activities generally have similar slope requirements, ranging from 1 to 15 percent slope (the highest slope best suited for small buildings). The general relationship between slope and land use suitability is illustrated in Figure 3.1 (Clar, 1982).

3.2.3 Altitude

Altitude, which is height above sea level, has a pronounced effect on the climatic characteristics of a site. The atmosphere is less dense at higher altitudes and consequently is incapable of absorbing and retaining as much heat as is retained at lower altitudes. A fall of 1°F in temperature results from a rise of 300 ft. in altitude. This decrease in temperature accounts largely for the greater amount of precipitation on the windward side of mountains, ridges, or hills. The lowering of temperature, however, is greatly modified by the configuration of the land and by the air currents. Valleys, coves, and ravines may be more exposed to danger from frost than the

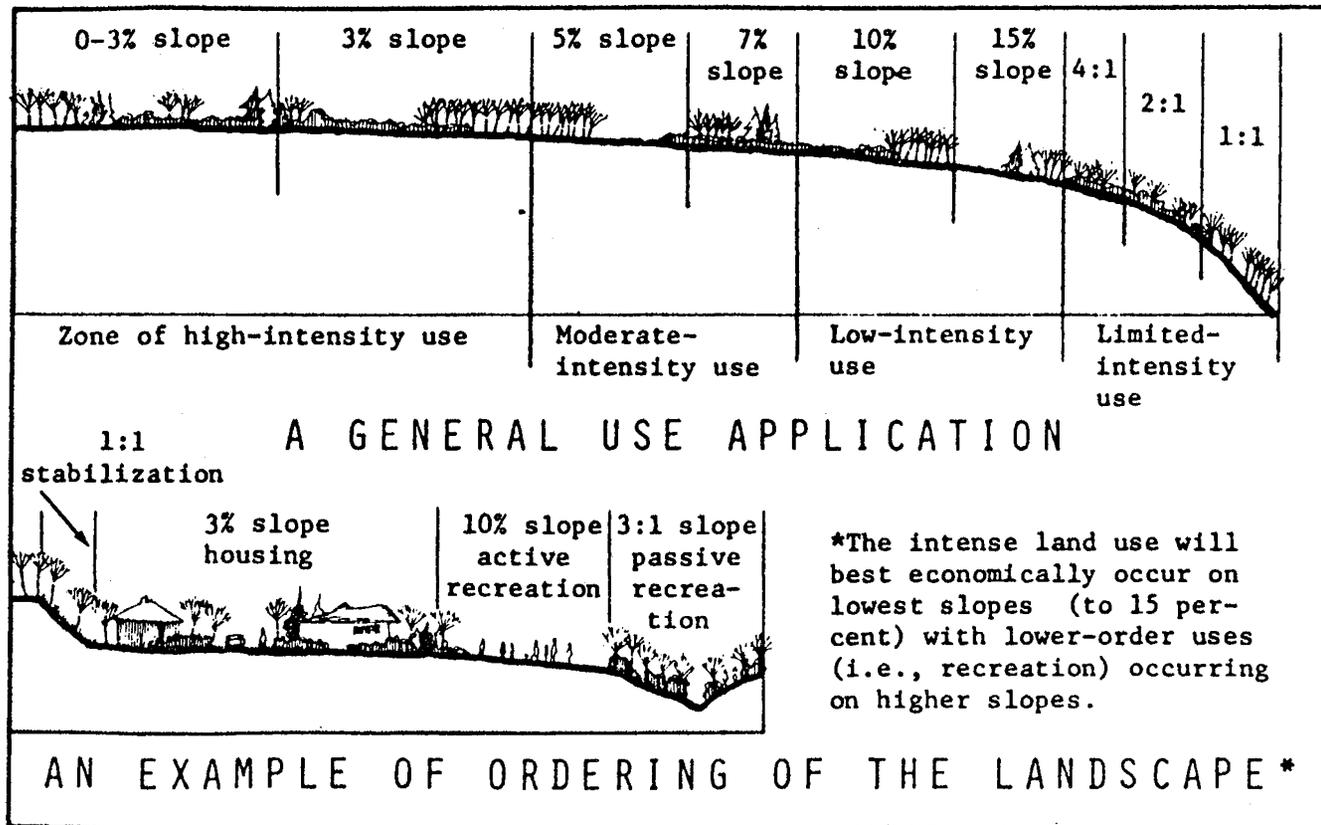


Figure 3.1 Relative ordering of land use referenced to slope (Jensen, 1967).

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adjacent slopes several hundred feet higher in elevation (Toumey and Korstian, 1947).

3.2.4 Exposure

Exposure or aspect refers to the direction of the slope of the land with respect to the points of a compass. The aspect of a slope interacts closely with altitude and slope angle to determine the amount of sunlight received by a site. The sunlight, in turn, modifies the moisture content and the temperature of the soil and air. A northern slope is considerably more moist and cooler than a southern slope. Exposure influences plant growth chiefly through its impact upon temperature and soil water. Thus a slope exposed to the sun and wind often bears a different vegetation from one less exposed to either. Great differences may exist in temperature and atmospheric humidity on different exposures only short distances apart (Clar, 1982).

3.2.5 Drainage

Drainage systems are a complex component of the natural environment and one that greatly influences the land use suitability of a site. An analysis of an existing drainage system requires at least some understanding of stream course delineation, drainage basin delineation, the type of drainage pattern, drainage texture, slope, landform, and the groundwater flow pattern. Drainage system analysis also adds to the understanding of basic bedrock structure and discontinuity patterns (Stranberg, 1967).

Land uses, other than forestry or passive recreation, generally require modification of the natural or existing drainage system. Urban land uses normally require that provisions be made to intercept and dispose of surface water flow by using an elaborate arrangement of storm drainage structures. Agricultural land uses may also require that excessive surface flows be removed from the land surfaces, either by using drainage ditches or a system of buried drain pipes. Frequently the need also arises to lower the groundwater table below the root zone to improve plant growth or reduce the accumulation of soil salts (Clar, 1982).

Surface mining operations create a significant impact on the drainage system. They necessitate the complete restructuring of the surficial and bedrock geology down to and slightly below the coal seam. Blasting and fragmentation of the consolidated strata and the spoiling sequence employed can result in substantial changes in numerous elements of the drainage systems. These generally include changes in the infiltration capacity of the surface soil and in the permeability, porosity, and conductivity of the subsoil and bedrock materials, and in the geochemical processes at work in these materials. Variations in the characteristics of these fundamental properties can result in marked changes in drainage patterns, watershed boundaries, and the availability of water supplies (Clar, 1981).

3.2.6 Temperature

Temperature is an important climatic factor that often acts as a constraint, particularly to agricultural and silvicultural land uses. Cyclic and seasonal changes in temperature determine the length of the growing

season, potential evapotranspiration, precipitation occurring as snow, and frequency of freezing and thawing. These conditions are of prime concern for agricultural purposes, particularly, plant growth. Temperature fluctuations have been noted to be especially severe in the western coal fields, with average annual freeze-thaw frequencies ranging from 90 to > 130 in parts of southern Wyoming. This high freeze-thaw frequency accelerates weathering of overburden materials which substantially increases its infiltration characteristics (Clar, 1982).

3.2.7 Precipitation

Precipitation interacts with several other factors including atmospheric pressure, temperature, solar radiation, wind, humidity, evaporation, and the geology and geomorphology of an area. These interactions determine the potential for water resource availability. The availability of water resources is a major factor in determining the potential of an area for resource development.

A water supply deficiency, such as that encountered in the arid regions, not only makes reclamation of mined lands difficult but may preclude any type of postmining development. In the humid regions, the situation is reversed. Excessive rainfall can represent a major design problem for various reasons, including:

- (a) High water tables and the need to dewater the mine
- (b) Surface erosion potential
- (c) Acid mine drainage problems
- (d) Flooding hazards at the mine.

On the other hand, however, the availability of larger water supplies provides excellent potential for any type of land use development ranging from recreational through industrial uses.

The basic precipitation data are the average annual amounts. However, the annual values are insufficient for an adequate appraisal of moisture conditions, especially as they affect crops, produce floods, etc. The seasonal distribution indicates whether or not the rain falls at a time of year when it will be most beneficial to growing crops. The intensity of the rainfall determines whether or not the amounts falling are absorbed largely by the soil or mainly lost into streams and rivers, possibly producing floods. The frequency of droughts, and many other aspects of precipitation that cannot be determined from the annual, or even monthly, totals are all important factors (Clar, 1982).

3.2.8 Consolidated Overburden

The consolidated overburden has two general impacts on land use suitability. Indirectly, bedrock influences suitability by imparting certain characteristics to the overlying soil mantle. In a more direct sense, however, the presence of toxic or acid-producing material in the overburden

imposes limitations on potential land uses and may dictate that special reclamation practices be employed. This influence is particularly significant if a potential land use is related to the availability of water resources. Land uses requiring groundwater development or surface water impoundments may be unsuitable depending upon the extent and severity of the problem.

3.2.9 Soils

Soil factors can be divided into two distinct groups. The first group of factors relates to the agricultural properties of soil and the second group relates to their engineering properties. The agricultural properties include soil profile, texture, structure, organic matter content, moisture content, permeability, pH, depth to bedrock, and color. Shrink-swell potential, wetness, erodibility, flood hazard, slope, bearing capacity, corrosion potential, and ease of excavation are primary engineering soil properties that influence land use.

Traditionally, land use planning has relied heavily on soil surveys to determine land use suitabilities. Soil survey reports prepared by the Soil Conservation Service provide detailed interpretations of the various soil units with respect to land use limitations. These premining interpretations, however, are of little use once the soils have been disturbed by surface mining operations.

The soil and subsoil materials that result from surface mining operations, commonly referred to as spoils, do not resemble any type of soil that has been classified or studied by soil scientists. The material in this cast overburden is not soil as it is known to agriculture. Soil in an undisturbed area consists of definite layers (horizons) of material that result from the weathering of parent materials near the surface of the earth. Each horizon is characterized by a definite structure.

Spoil material, on the other hand, is usually composed of stones of various sizes, shale fragments, and some sand, silt, and clay particles. It has no natural soil profile or stable structure to provide normal channels for water percolation. The material is usually low in nitrogen, phosphorus, organic matter, and microorganisms. The surface of the spoil is exposed to the elements and is subject to rapid drying. However, spoil materials have greatly increased porosity and permeability characteristics and there is usually adequate moisture beneath the surface to support plant growth in normal seasons. Sloping spoil material is usually erodible unless adequately protected by vegetative cover (Clar, 1981).

Proper topsoil storage and replacement techniques can restore most of the premining capabilities. However, many properties such as soil profile, structure, permeability, and depth to bedrock will be permanently altered. Spoil classification schemes that have been offered do not allow the same level of land use interpretations that can be made for undisturbed soil. Engineering properties of the soil can be influenced heavily by the reclamation techniques that are employed. Although many soil agricultural properties are permanently altered by disturbance, agricultural productivity can generally be restored. This requires careful removal, storage, and

replacement of topsoil followed by soil testing and addition of proper soil amendments.

3.2.10 Summary of Natural Factors

Natural land use factors generally have a greater influence on low intensity land uses than on higher intensity uses. Natural factors are particularly important to agricultural, forestry, wildlife, and recreational uses. An estimate of the relative importance of each natural factor in determining land use suitability is given in Table 3.1.

3.3 Cultural Factors

3.3.1 Location

Geographic location establishes the proximity to population centers and developed facilities, such as transportation systems, power supply, labor pool, manufacturing and supply services, and shops. All of these, if available, enhance the attractiveness of the site. The proximity to cities also increases the potential of the site for intensive postmining use. However, proximity to urban centers can also be an obstacle to new surface mine development due to adverse public pressure.

Unlike many of the other uses of the land surface, there is only a limited choice in the location of mining operations. It depends, of course, on the natural location of the mineral deposits. The location of these deposits is generally well known at the regional level. This general location fixes many of the socioeconomic factors that affect land use. Relationships between coal regions and such related elements as climate, principal types of farming and crops, principal forest types, populations, and transportation, can be developed (Clar and Ramani, in press).

A study conducted by the U.S. Department of Agriculture on the status of surface mine lands revealed the following information related to the distance of surface mined lands from population centers (USDA, 1973):

1. More than four-fifths of the mine lands surveyed were at least one mile from communities with a population of more than 200.
2. More than half of the mine lands surveyed were over four miles distant from the nearest town.
3. Forty percent of the mined land could not be seen from any U.S. highway or passenger railroad.
4. Most mined areas were close enough to communities for a family to reach it for an afternoon recreation outing.
5. No urban growth was evident around two-thirds of the mine lands, suggesting that the majority of these areas continue to remain in rural land use types such as forestry, agriculture, or recreation.

Table 3.1

Relative Importance of Natural Factors as Determinants
of Land Use Suitability (Clar and Ramani, in press).

Natural Factors	Land Use Types						
	Forestry and Wildlife	Recreational	Agricultural	Residential	Institutional	Commercial	Industrial
Topographic Relief	2*	3	1	2	2	2	2
Slope	1	3	1	2	1	1	1
Altitude	2	3	2	3	3	3	3
Exposure	2	3	2	3	3	3	3
Drainage	1	3	1	1	1	1	1
Temperature	1	2	1	3	3	3	3
Precipitation	1	2	1	3	3	3	3
Consolidated Overburden	2	2	1	2	3	3	3
Soils							
-Agricultural Properties	2	2	1	3	3	3	3
-Engineering Properties	3	3	2	1	1	1	1

*1 = Factor has high degree of influence on suitability of site for that particular land use.

2 = Factor has moderate degree of influence.

3 = Factor has low degree of influence.

3.3.2 Accessibility

The value of a parcel of land is directly related to the ease or difficulty of access to roads and streets and the availability of transportation facilities as well as other utilities, including water and gas mains, sewers, and electrical and telephone lines. In addition, other services such as mail delivery, police and fire protection, and garbage, trash, and snow removal are significant (Weimer and Hoyt, 1966).

The accessibility of a site is often measured by two parameters, travel distance and travel time. Distances and corresponding travel times to schools, shopping centers, places of employment, churches, community centers, parks, and playgrounds are of special importance in considering the value characteristics of land used for residential purposes. In the case of business sites, the proximity and access to main arteries of pedestrian traffic and to parking areas is one of major importance. Likewise, nearness to transportation lines or terminals is of importance to industrial sites. Table 3.2 presents a summary of some time-distance standards that have been developed for selected uses in urban areas.

Surface mining operations generally increase the accessibility of a given site. This increase is due to the addition of haul roads necessary for hauling the mined product to the markets or preparation plant for further processing. Sometimes rail lines are provided that may be restricted to onsite operations or that may provide a spur to a trunk line. It is also common to provide electric and telephone lines to the site. All of these positive aspects of the mining operations should be recognized (Clar and Ramani, in press).

3.3.3 Size and Shape of the Site

Size is an important factor in determining land use, and use in turn has a very direct bearing on income-production. Size also determines effectiveness of use; a case in point is the trend toward larger farms as agriculture becomes more highly mechanized. Value, of course, is not directly proportional to size. Up to a point, additions to the size of a parcel of land tend to increase its income-producing capability and hence its value; thereafter, such additions tend to be of diminishing importance.

The shape of the land parcel may determine the possible uses to which it may be put and hence affect its income-producing capability. While lots of irregular shapes may be used to advantage for residential purposes, regularity is usually desirable for business, industrial, or agricultural uses.

Surface mine sites exhibit a great deal of variation in size and shape. They can vary in size from 4 to 6 hectares (10 to 15 acres) of annual disturbance for a small operation to a range of from 120 to 200 hectares (300 to 500 acres) of annual disturbance for large area mines. The shape of the site is also related to the type of mining system used. This is particularly true for contour mining operations which result in long, narrow strips of reclaimed land (Clar, 1981).

Table 3.2

Illustrative Time-Distance Standards for Selected Uses
in Urban Area of 100,000 Population (Chapin, 1979)

Use of facility	Controlling standards
Employment	20 to 30 min.
Central business	30 to 45 min.
Local shopping center	1/2 mile or 10 min.
Elementary school	1/2 mile
Junior high school	1 mile or 20 min.
Senior high school	20 to 30 min.
Playgrounds and local parks	1/2 mile
Playfields and recreation centers	1 mile or 20 min.
Public park or reservation	30 to 60 min.

3.3.4 Surrounding Land Uses

The status of the neighboring lands, particularly with respect to type and intensity of use, and future trends has a strong influence on the suitability of the mine land to support various activities. In general, the use adopted at any specific site should be compatible with surrounding uses in terms of the following elements (Clar and Ramani, in press):

1. Views
2. Prevailing winds
3. Protective belts of planting
4. Open space
5. Noise
6. Access routes.

Postmining land use plans must comply with any existing local land use plans. Compliance with such plans, if they exist, will generally insure compatibility with surrounding land uses.

3.3.5 Land Ownership

Most surface mine lands are privately owned. In 1973 ownership of these lands was distributed as follows (USDA, 1973):

<u>Type of ownership:</u>	%
Public ownership:	
Federal	5
State/local	4
Subtotal	9
Private ownership:	
Mining Industry	52
Farm	23
Other	16
Subtotal	91
Total	100

Since the time that these statistics were gathered, surface mining in the western U.S. has increased rapidly. Most of this land is under federal ownership causing the percentage of federally-owned land to increase slightly. Although most of the western mines have large capacities, the amount of land disturbed is relatively small due to the exceptionally thick

seams. For this reason, mining on federal lands has increased steadily but it still is a fraction of the total area surface mined in the United States.

Ownership of the land and of mineral resources can often provide a source of significant conflict. In many instances, the surface and mineral ownerships have been severed. Often the right to extract the mineral resources is contingent upon providing a postmining land use plan that is acceptable to the owner of the surface rights (Clar and Ramani, in press). It has also been observed that mining companies are more likely to propose an alternative land use for company-owned land than for leased land.

3.3.6 Type and Intensity of Use

A USDA survey of mine lands showed that many were scattered small acreages best treated as part of the total conservation management of the farm and other areas with which they are intermingled (USDA, 1973). Nearly 80 percent of the sites were in forest, farm, or grassland or were reverting to forest at the time of the survey. These same uses were being made of land adjacent to 86 percent of the sites. Less than 2 percent of the acreage had been set aside solely as outdoor recreation or wildlife areas; usually these are compatible with other uses of the land.

Surface coal mining operations are seldom permitted adjacent to highly urbanized areas. Typically the surrounding land will be undeveloped or at best used for agriculture, silviculture, and related activities. It must be kept in mind, however, that the land use selected may in turn restrict the development potential of adjoining property. Communities within the coal regions should carefully study and map their patterns of growth and expansion and seek to apply zoning control mechanisms to minimize the loss of valuable coal resources to urban expansion. When adequately planned and properly integrated into comprehensive planning efforts, surface mining operations can be one of several sequential, productive uses of the land.

Zoning, extensive ruggedness, or some feature of the site such as a lake may limit the land available for actual development. Housing units allowed by zoning may also limit the degree of development or the use intensity of the site. Similarly, the size of industrial buildings may be limited by steep slopes or yield of crops restricted by poor quality soils (Clar and Ramani, in press).

3.3.7 Population Characteristics

Population characteristics of the surrounding area are key factors in determining land use suitability. This information is provided decennially by the U.S. Census Bureau and local planning agencies often prepare updated estimates between censuses. Although the total population is important, the percent change in population over recent years is a more useful parameter. Growth is the primary force behind land use change. If an alternate post-mining land use is to be feasible, there must be some concurrent growth in the area. Percent change in population is one method of gaging growth. This is particularly important for the high intensity land uses, such as community development, but it also has applications for other less intensive uses. For example, statewide growth may result in a need for additional agricultural

land or recreational facilities which may justify a change from premining wilderness or wildlife habitat to grazing land, row crops, or recreational use after mining is completed. To have an impact on postmining land use, the growth need not occur in the immediate vicinity of the mine; instead, it may be on a regional scale. Other demographic parameters such as population density, average household size, and age distribution are useful in determining the potential for various land uses. Certain land uses such as the demand for public parks can be directly related to population density. Age distribution of the population can also be used as an indicator of growth. An area with mostly older residents is usually declining in population. This would be an indication that younger people, who are just starting their families, are leaving the area. Additional high intensity land uses would probably not be practical in such an area.

Finally, two other population characteristics should be examined when considering land use suitability. These characteristics are levels of employment and average household income. The level of employment in an area is generally the determining factor in population growth or decline. High levels of unemployment will cause people to relocate until a more acceptable level of employment is obtained. Those who are required to move are often the younger people just entering the work force. This artificially raises the average age of the local population and compounds the problem of declining population. The average household income can be used as a guide to the types of land use which will be in demand. Community development should be suited to the incomes of the residents (single family dwellings, multi-family units, mobile home parks, etc.). Also, the demand for recreational land use and open space will likely be affected by the average income.

3.3.8 Regulatory Constraints

Regulatory constraints, as a factor in land use suitability, result from federal, state, and local actions which take the form of reclamation standards or direct land use controls. The role of federal, state, and local authorities in determining postmining land use was discussed in detail in Chapter 2.

Two important factors can be identified from the earlier discussion. The first factor is the increased emphasis that has been placed upon local planning agencies in the review of postmining land use plans. Increased public participation at the local level has also been included as part of this emphasis. The other factor that has emerged as a land use constraint is the justification process that is required of a surface mine operator if an alternative postmining land use is proposed.

It is apparent that a trend of returning land to its premining use has developed. The primary reason that is cited for this practice is that the additional justification required to change the land use, particularly when it means deviation from approximate original contour, is burdensome and causes long delays in permit approval for the company. Therefore, this concern has overshadowed the benefits that can be obtained from an alternate land use. The question of alternate land use is complicated by the land ownership situation. Particularly, the residence of the burden to provide the required technical input and institutional commitments necessary to

justify the alternate land use is a problem. Surface mine operators are not concerned solely with the additional data requirements but also with the possibility of a lengthy delays in receiving approval of permit applications due to a protracted review process.

3.3.9 Company Attitudes

A company's willingness to seriously consider alternative postmining land uses is influenced by a number of factors including company size, location, and land ownership. While the primary business interest of a mining company must be maintained, opportunities for land use improvement may be overlooked if alternative land uses are ignored.

3.3.10 Summary of Cultural Factors

Cultural factors have a greater influence over land use suitability for higher intensity uses such as residential, institutional, commercial, and industrial uses. These uses are closely related to economic demand and the proximity of population centers. An estimate of the relative importance of each cultural factors in determining land use suitability is given in Table 3.3.

Table 3.3

Relative Importance of Cultural Factors as Determinants
of Land Use Suitability (Clar and Ramani, in press).

Cultural Factors	Land Use Types						
	Forestry and Wildlife	Recreational	Agricultural	Residential	Institutional	Commercial	Industrial
Location	3*	1	2	1	1	1	1
Accessibility	3	2	3	1	1	1	1
Size and Shape of Site	3	3	1	2	2	1	1
Surrounding Land Uses	3	2	3	1	1	1	3
Land Ownership	3	2	3	2	2	2	2
Type and Intensity of Use	3	3	3	1	2	1	2
Population Characteristics	3	2	2	1	2	1	2
Regulatory Constraints	3	2	2	1	1	1	1
Company Attitudes	2	2	2	1	1	1	1

*1 = Factor has high degree of influence on suitability of site for that particular land use.

2 = Factor has moderate degree of influence.

3 = Factor has low degree of influence.

Chapter 4

OVERVIEW OF CASE STUDIES

4.1 Scope

As part of this investigation, three case studies of active surface mining operations were conducted in order to determine the extent of current mined-land planning efforts. These case studies included site visits, data collection, and discussions with mine planners, public planners, and regulatory authorities. Recognizing that regional differences do exist, the authors have chosen three mines in different regions of the United States to study current reclamation and postmining land use practices. It was believed that such an approach could aid in the development of effective planning methods for achieving productive utilization of reclaimed lands. The major emphasis of these case studies was not on the recommendation of specific land use plans, but rather, on observing existing planning practices and developing a planning process. It is necessary that this planning process facilitate consideration of all major site characteristics and result in a feasible preliminary site design.

The case study sites that were selected are located in the Appalachian province of the Eastern U.S., the Interior province of the Central U.S., and the Northern Great Plains province of the Western United States. A complete report on each case study can be found in Appendices, I, II, and III, respectively. In this chapter, a brief description of each mine is provided with particular attention given to current reclamation planning efforts. The regional settings of the mines are described from both an environmental and socioeconomic perspective. The present role played by public land use planning authorities is of particular interest in each case. Finally, the impacts of several alternative postmining land use plans are addressed.

4.2 Description of Case Study Mines

Two important factors were considered in the selection of the case study mines. First, it was essential that the mines were typical of their respective regions with regard to terrain, mining method, size of operation, population density of surrounding area, and local level of community development. Secondly, wherever possible, mines with a relatively long history were selected. This characteristic allowed the observation of postmining uses of land that was reclaimed under varying levels of regulatory control. General characteristics of the case study mines relating to production, size, mining methods, and geologic conditions are summarized in Table 4.1.

4.2.1 Eastern U.S. Case Study

The Spingola No. 1 Mine is located in Clearfield County, slightly west of the geographic center of Pennsylvania. Although the surrounding area is quite rural, the mine is less than a mile from the small community of McCartney. Like many surface mines in the Appalachian region, Spingola No. 1 is worked by a small operator, Simca Mining Incorporated. In this case,

TABLE 4.1 COMPARISON OF CASE STUDY MINES

	<u>Appalachian Region</u> <u>Spingola No. 1 Mine</u> Simca Mining Inc.	<u>Interior Region</u> <u>Chinook Mine - West Field</u> AMAX Coal Co.	<u>Northern Great Plains Region</u> <u>Indian Head Mine</u> North American Coal Corp. - Western Div.
Annual Production of Company (tons)	99,056 ^a	35,463,662 ^b	10,959,928 ^b
Annual Production of Mine	≤ 72,000 ^c	1,079,895	1,125,807
Period of Mine Operation	1976-1979	1928-Present ^d	1917-Present
Mine Employment	11-18	204	78
Mine Area (acres)	430	2,976	1,563
Mining Method	Contour	Area stripping	Area stripping
Major Overburden Removal Equipment	Lima 2400 dragline (7 cu. yd.)	Bucyrus-Erie 2570-W dragline (110 cu. yd.)	Bucyrus-Erie 800-W dragline (28 cu. yd.)
Average Overburden Thickness (feet)	55	80	75
Average Seam Thickness (inches)	28	54	108
Rank of Coal	Bituminous	Bituminous	Lignite
Average BTU Value of Coal	13,300	11,000	7,000
Method of Coal Shipment	Truck	Unit train/Truck	Unit train/Truck

a 1979 annual production

b 1981 annual production

c Based on estimated maximum monthly production of 6000 tons.

d Although the mine has been in active operation since 1928, the West Field was first permitted in 1977.

however, the small operator is under contract to only one larger firm, the Bradford Coal Company, which cleans and markets all of the coal. This mine is also typical of the region in that the most recent operation has had a relatively short life (approximately three years), but a large portion of the site has been disturbed by past surface and underground operations. All of the land is privately owned and the parcel has been assembled through lease agreements with six different land owners. Land uses that existed prior to recent mining include forest land, open fields, and disturbed land that has either been reclaimed to forests, permanent grasses, or left unreclaimed. Neither Simca Mining Inc. nor Bradford Coal Co. employs an environmental staff. Therefore, all reclamation planning and permit application preparation is contracted to consultants.

4.2.2 Central U.S. Case Study

The Chinook Mine of AMAX Coal Co. is located in west central Indiana, approximately six miles east of Terre Haute. The case study concentrated on the West Field which lies on the line between Clay County and Vigo County. Although the area immediately adjacent to the mine is rural in nature, the mine is situated in the heart of the Midwest Industrial Belt. AMAX, Inc. acquired the Chinook Mine in 1969 from Ayrshire Collieries and in 1972 formed AMAX Coal Co. as a subsidiary. The mine has been in operation since 1928 and has the distinction of being the oldest continually operating surface coal mine in Indiana.

Meadowlark Farms, Inc. another subsidiary of AMAX, Inc. performs land holding and land management services for AMAX Coal. Meadowlark Farms carries out all revegetation operations at AMAX Coal Co. mines, operates four corporate farms, and conducts a cropshare-lease program on company land. Approximately 62% of the 2976-acre West Field is owned by Meadowlark Farms. The remainder is leased from private landowners.

Row crops accounted for 54% of the premining land use. Pasture land and forests also occupied significant portions of the premining landscape. Approximately 20% of the field had been disturbed by earlier mining operations and had either been reclaimed to pasture land or was still unreclaimed due to ongoing operations. Minor amounts of land were used for water impoundments, roads, and utilities.

The Environmental Engineering Department of AMAX Coal Co., located at the company headquarters, conducts all environmental engineering and planning activities for the eight AMAX coal mines in Indiana and Illinois. This department consists of approximately 25 professionals and is subdivided into three groups according to the services that they perform. These functional groups are Environmental Design, Environmental Services, and Environmental Studies and Planning. All three groups participate in the permitting process which is coordinated by the Regulatory Affairs Section of the Engineering Department. However, it is the Environmental Studies and Planning Group that is specifically responsible for developing the proposed postmining land use plans.

4.2.3 Western U.S. Case Study

The Indian Head Mine, located in Mercer County, North Dakota, is operated by The North American Coal Corporation - Western Division. Mining operations have been conducted at the present Indian Head Mine location since 1917 under various ownership. The North American Coal Corporation acquired the site in 1957 and reorganized to form the Western Division in 1974 along with the creation of two more subsidiaries, The Falkirk Mining Company and The Coteau Properties Company. All are active in the North Dakota lignite field.

The mine is located in a sparsely-populated region of west central North Dakota near the town of Zap. Beulah, approximately six miles east of the mine, has been impacted by several energy development projects, however, the area surrounding the Indian Head Mine has remained quite rural. Rangeland was the predominant premining land use with lesser amounts of hayland and cropland also existing before disturbance. Almost all of the land that is currently being mined is leased from private landowners. The company does own considerable acreage on the 1,563-acre site, however, much of the company-owned land is permanently dedicated to industrial uses such as the mine office, maintenance shop, preparation plant, and haul roads. The State of North Dakota also owns a small portion of the site.

All of the environmental planning and permitting for the Western Division and the other subsidiaries is performed by the Environmental Control Department which is centered at the Division headquarters in Bismarck, North Dakota. In addition to the centralized staff, one environmental staff person at each mine reports to the Director of Environmental Affairs. The Permit Coordinator is responsible for assembling all of the information supplied by the various members of the Environmental Control Department. This information includes the reclamation plan and proposed postmining land use plan.

4.3 Regional Settings

The environmental differences between the various regions relating to climate, water availability, geologic conditions, and vegetative cover all impact the postmining land use potential of surface-mined lands. These differences are fairly well recognized. The socioeconomic conditions, however, such as population trends, employment, land values, the influence of public planners, regulatory constraints, and the availability of cultural resources may have a greater impact on the actual use of reclaimed land.

4.3.1 Eastern U.S. Case Study

Environmental Conditions: The Spingola No. 1 Mine is located near the southeast edge of the Appalachian Plateau. The area is characterized by gently rolling uplands interrupted by narrow steep-sided valleys. Generally, most slopes are within the range of 3% to 25%, but there are occasional slopes in excess of 25%. The mine lies in the Susquehanna River drainage basin. However, since the mine is situated on a minor drainage divide, there are no major streams in the vicinity of the mine. The nearest aquifer

is found approximately 150 feet below the lowest coal seam mined. Groundwater quality near the mine is generally good with most wells tapping perched water tables above the major aquifer. Some isolated cases of degraded groundwater indicate the presence of localized acid-producing material in the overburden. The primary make-up of the overburden is sandstone and shale. Small amounts of limestone may be present in the area, accounting for the generally high water quality condition.

Soils in this area are relatively thin, particularly on the steeper slopes. In many instances, both at this site and over the entire region, previous mining operations have resulted in a complete loss of topsoil. Two soil types at this mine have been identified as prime farmland by the SCS, however, they have been exempted from prime farmland standards due to either previous stripping, forest cover, or a lack of agricultural activity. Agriculture does not play a significant role in this area, with only about 8% of the land in the county devoted to crops or pasture. In addition to the soil limitations, this area has a fairly short average growing season.

Although much of the county is covered by forests (83%), nearly all of the virgin timber has been removed by the logging industry. Currently, two distinctive types of forest communities can be identified in the area. One type is characterized by White Oaks and Red Oaks. The other type includes Hemlock stands and Beech-Birch-Maple communities. This habitat supports abundant wildlife including deer, bear, wild turkey, and numerous small game animals such as squirrel, grouse, woodcock, and rabbit.

Socioeconomic Conditions: In 1980 the total population of Clearfield County was 83,578. It was estimated that 29% of the population lived in urban areas, while the remaining 71% lived in rural areas of the county. Based on a county-wide average, the population density was approximately 70 persons per square mile. Jordan Township, which includes the Spingola No. 1 Mine, had a 1980 population of 580 inhabitants. The township, therefore, had a population density of only 25 persons per square mile. The entire county experienced a mild population growth in the period from 1970 to 1980 of 12.0%. A six-township area surrounding the case study mine had a similar growth of 10.2% for the same period.

Although the county is generally rural in nature, the manufacturing industry is the leading employer in the county. Most of the manufacturing firms are located in the cities of Clearfield or DuBois, at a considerable distance from the mine. Following wholesale and retail trade, the next largest county employer is the mineral industry.

Distances to major transportation arteries, public utilities, places of employment, shopping centers, public transportation terminals, parks, and other recreational areas play a large part in determining the suitability of a site for various uses (Clar and Ramani, in press). The Spingola No. 1 Mine, like many eastern surface mines, is located in a remote rural area and is accessible only by two-lane secondary roads. Higher intensity land uses in this area are inhibited by its inaccessibility.

Due to the area's rural nature, outdoor recreation is very important to local residents and visitors. Hunting and fishing are popular and many

nonresidents own private camps in the area. There are 25,194 acres of state game lands in the county. Clearfield County also has 70 miles of fishing streams and several lakes which are available for public use.

The primary land use planning agency for this area is the Clearfield County Planning Commission. Jordan Township has no planning board and no zoning ordinances. The County Planning Commission is presently in the process of adopting a county-wide subdivision ordinance. General land use goals and objectives have been outlined by the Clearfield County Planning Commission (1975). These objectives include:

- 1) Allocate land in the County in accordance with the physical capabilities of the land and the locational need for various uses.
- 2) Serve the housing needs of the County population by providing a wide selectivity in choices of residences.
- 3) Channel growth into areas around sub-county population centers, as opposed to further scattering about the County.
- 4) Because of location and physical characteristics, certain land should be preserved as conservation areas.

Clearfield County is also served by the North Central Pennsylvania Regional Planning and Development Commission. This regional advisory council serves a six-county area including Clearfield, Cameron, Elk, Jefferson, McKean, and Potter counties. Although the Commission may prepare plans and make recommendations, it has no authority to regulate land use decisions.

4.3.2 Central U.S. Case Study

Environmental Conditions: Most of Clay County and Vigo County, including the Chinook Mine area, are located in the Wabash Lowland of the Central Lowlands physiographic province. The Wabash Lowland is characterized by low relief with gently rolling uplands. On an average, the local relief varies approximately 70 feet per square mile (Hutchison, 1960). The surface expression in this area has been strongly influenced by glacial action and deposition (Wayne, 1956). The combination of direct glacial deposits, outwash deposits, and windblown glacial deposits provides a rather continuous blanket of unconsolidated material overlying bedrock. This layer varies in thickness from a few feet, overlying bedrock high points, to greater than one hundred feet in preglacial valleys.

Locally, the overburden consists mainly of dark gray to black shales and gray sandstones. A brown oxidized sandstone is also present in some locations. Overburden analyses have shown the consolidated overburden to have high total sulfur values. This is particularly true for the deeper overburden and for the interburden between some of the coal seams. Much of this material has the potential for acid production. Sulfur concentrations in one interval were found to range from 0.6% to 10.28%. The neutralization potential for this material is deficient and would require in excess of 50 tons of lime per 1000 tons of material. Selective overburden handling is practiced in many places to control acid production. Tests also showed high concentrations of cadmium in some of the roof shales and interburden.

The general area surrounding the case study site lies within the Wabash River drainage basin. The Wabash River and its major tributaries occupy broad valleys that are deeply filled with glacial and fluvial sediments (Powell, 1972). Due to the general lack of structural control, all streams in the area exhibit rather well-developed dendritic patterns (Hutchison, 1960). Water quality samples taken in the vicinity of the mine indicated that acid production is not a major problem. High total suspended solid values were observed both for mined and unmined areas. The reason for high suspended solids in unmined areas is attributed to the abundance of cultivated land.

Most wells in the area tap the sand and gravel aquifer which is related to past glaciation. One locally significant sandstone aquifer exists immediately above the III Coal seam. Generally, water bearing units are numerous in this area. However, they are also thin and discontinuous. It has been observed that previously mined areas have increased groundwater storage capacity.

High capability soils are abundant in the area. This fact is evidenced by the percentage of agricultural land. The climate is also conducive to agricultural production with an average growing season of 207 days and average annual precipitation of approximately 40 inches. Besides cultivated fields, plant communities characteristic of fallow fields, old fields (not cultivated for 3 to 10 years), and woodlands are found in the vicinity of the mine. These different plant communities provide a variety of wildlife habitats suited to a wide range of insects, invertebrates, amphibians, reptiles, birds, small mammals, and a few larger mammals.

Socioeconomic Conditions: With a few local exceptions, this portion of Indiana has lagged behind the remainder of the state in population growth and economic development. Over a period of 50 years, from 1930 to 1980, the population of Indiana has increased 69.53 percent. For the same period, the population of the two counties surrounding the mine increased only 9.50 percent. The city of Terre Haute is located in Vigo County accounting for a substantial difference in population between the two counties. In 1970, 71 percent of the Vigo County population was classified as urban. Most of the urban population resided in Terre Haute. At the same time, only 34 percent of Clay County's population was classified as urban (WCIEDD, 1977a). Vigo County experienced rather steady growth from 1940 through 1970, with slightly more rapid growth occurring in the 1940s and 1960s. Since 1970, there has been a general out-migration from the urban areas resulting in a decrease in Terre Haute's population and Vigo County's population. This pattern of migration from urban to rural areas, however, is one factor contributing to the largest population increase in 50 years for Clay County.

One of the principal reasons that the growth of this area has not kept pace with the remainder of the state is the slow transition that has occurred in going from an agrarian economy to an industrial economy (WCIEDD, 1977a). Although this region has been one of high unemployment in the past, changes during the last decade have helped to reverse this trend. One of these changes has been the success of Terre Haute in attracting new industries and in encouraging expansion of existing industries. A second factor has been a diversification of industry in the area. Vigo County has experienced

relatively low unemployment during that period. However, the most drastic improvement was seen in Clay County which went from nearly four percent above the state average in 1971 to 1.4 percent below the state average in 1975. This pattern is typical of the rural counties surrounding Vigo County that have been impacted by improved economic conditions in the Terre Haute area. Manufacturing industries presently employ the greatest percentage of workers in both counties.

Direct employment in agriculture for the two-county area is relatively small and declining. This does not mean, however, that agriculture is not important to the local economy. One of the most important resources of this region is its high quality agricultural land. One reason for the farm employment decline is a trend toward larger and more efficient farms. While the number of farms smaller than 500 acres has been decreasing and the number of farms in the 500 to 1000-acre range has remained nearly constant, the number of farms greater than 1000 acres has been increasing.

The two-county area surrounding the case study site does not abound with public recreational facilities. However, there are several state-owned facilities within driving distance in adjacent counties. Most of the recreational facilities located within Clay County and Vigo County are privately owned facilities, such as campgrounds, or county and municipal parks. A need has been identified in this area for improvements to the existing county and municipal parks and the acquisition of additional park land, particularly, in and around Terre Haute (WCIEDD, 1977a). The available acreage of outdoor recreational facilities in Clay County and Vigo County are 0.097 and 0.040 acres per capita, respectively. These figures are considerably lower than the state average of 0.168 acres per capita.

Regional planning in this area is conducted by the West Central Indiana Economic Development District, Inc. for six counties including Vigo and Clay. The WCIEDD has prepared an Overall Economic Development Plan, 1976-1980 (WCIEDD, 1977a) which considered various development strategies for the region. This document serves as a valuable source of background information on the region. A District Land Use Element (WCIEDD, 1977b) was prepared by the WCIEDD in 1977. Since the WCIEDD has no authority to enact any land use control measures, such as zoning ordinances, the document serves mainly as a recommendation to the member counties. If the county governing bodies chose to do so, they could implement all or portions of the land use plan. None of the six counties have elected to do that. Presently, the land use plan is used only as resource material when the WCIEDD is called upon to review a federal grant application. Some of the more pertinent objectives that were identified in the District Land Use Element include:

- 1) The support of residential housing needs in relationship to geographical suitability and employment.
- 2) Conservation of prime agricultural land.
- 3) Reclamation and usage of former mined lands.
- 4) Protection of water resources.

5) Preservation of rural areas in the region.

Local planning in the project area is conducted at the county level. Of the two counties affected by the Chinook Mine, only Vigo County presently has a planning commission. A visit was made to the Area Planning Department of Vigo County during the site visit stage of the project. At that time, the Area Planning Department was in the process of formulating a county comprehensive plan. No comprehensive plan existed prior to that time. Vigo County has no zoning ordinances, however, a subdivision ordinance is in effect.

4.3.3 Western U.S. Case Study

Environmental Conditions: The case study site is located on the Missouri Plateau of the Great Plains physiographic province. The area west of the Missouri River slopes gradually toward the east and is known locally as the Missouri Slope. Portions of the Missouri Plateau were covered by glaciers that advanced from the northeast. These advances have caused considerable filling of valleys that existed before and during glaciation (Fenneman, 1931). As a result of more recent erosion and sedimentation the present topography of this region is characterized mainly by rolling prairie with some isolated buttes, mesas, and badlands.

Geologically, the region is situated in the southeast portion of a structural basin. The upper most bedrock geology of this region consists of non-marine sediments of the Fort Union Group. The Sentinel Butte Formation of the Fort Union Group is exposed at the surface in the vicinity of the mine. This formation is underlain by the Tongue River Formation, also of the Fort Union Group. These formations are both characterized by interbedded sand, silt, clay, shale, lignite, and isolated "pods" of limestone. A basal sandstone layer marks the bottom of both formations and is used to differentiate between the units which are quite similar lithologically. The major lignite bed in the Sentinel Butte Formation, and the one mined at Indian Head, is the Beulah-Zap bed. It is located approximately 140 feet above the base of the formation. Its thickness ranges from 7 to 11 feet, however, thicknesses up to 22 feet have been reported at some locations. A common environmental problem in the Northern Great Plains is that of high sodium adsorption.

The case study region lies within the Missouri River drainage basin. The immediate area around Indian Head Mine is drained by the Knife River and Spring Creek. Both flow towards the east. The Knife River is a major tributary of the upper Missouri and empties into the main stream near the town of Stanton. Spring Creek flows into the Knife River near Beulah. Due to the variability of precipitation, there are many intermittent streams in the area that flow only during and after storms or during periods of rapid snow melt.

Ground water is generally obtainable from bedrock aquifers and glacial drift. In most upland areas, glacial drift is too thin and impermeable to be a reliable source of ground water. In present and preglacial stream valleys, however, adequate supplies of ground water may be obtained. Most of the ground water used for domestic and agricultural purposes is obtained from

bedrock aquifers. Lignite beds and sand function as local shallow aquifers within the Sentinel Butte and Tongue River Formations while basal sandstone strata in the Tongue River Formation operate as deeper confined aquifers (Carlson, 1973).

Although soil conditions are generally favorable, the semi-arid climate (approximately 17 inches per year) imposes some limits on the range of crops that can be grown without irrigation. Most agricultural land is devoted to small grain crops and hay. Rangeland vegetative cover consists mainly of native grasses interrupted in places by naturally occurring wooded draws or planted shelter belts. Wooded draws are especially important to the wildlife habitat. Many animals also find suitable habitat in areas that have previously been mined. Common varieties of wildlife in the area include small game animals, predators such as red foxes and coyotes, hawks, owls, and deer. This area is also frequented by migratory waterfowl.

Socioeconomic Conditions: Mercer County is included in the Lewis and Clark 1805 Economic Development District. The entire ten-county region has been declining in population from a high of 113,877 residents in 1930 to 104,207 in 1970. This decline was characteristic of the general trend of that period which saw fewer and fewer opportunities in rural areas where agriculture was the main source of income. This trend reversed itself from 1970. During the period from 1970 to 1980, the population of the ten-county region increased 19.7 percent compared to the average state increase of 5.7 percent. The highest percent increase occurred in Mercer County and can be attributed to energy-related development. To be even more specific, the population increase in Mercer County has been concentrated in the Beulah-Hazen area which is the hub of activity for energy development. Hazen experienced a 90.7 percent population increase from 1970 to 1980 while the population of Beulah grew at a rate of 116.4 percent for the same period. In perspective, however, despite the population increase Mercer County still had a population density of only 9.0 persons per square mile in 1980 which is slightly lower than the state average of 9.4. It is, therefore, appropriate to conclude that the region surrounding Indian Head Mine is still quite rural in nature.

Agriculture has traditionally been the mainstay of the regional economy and the largest user of land. While agricultural practices are changing somewhat, agriculture will remain the predominant land use and a major economic force in the ten-county region. In 1977, agriculture employed 20 percent of the work force (Lewis and Clark 1805 Regional Council for Development, 1978). However, the total number of farms has been steadily decreasing. This trend is balanced, in part, by an increase in the average farm size and greater productivity through expanded irrigation.

This region is abundant in outdoor recreational opportunities. Public lands managed by federal, state, county, and municipal governments provide a wide range of outdoor activities including fishing, boating, camping, hiking, hunting, picnicing, biking, tennis, etc. Most water-based recreation in the region is related to large impoundments, such as Lake Sakakawea, constructed by the U.S. Army Corps of Engineers on the Missouri River. In addition to these public areas, the State Game and Fish Commission manages approximately 67,000 acres in the region which are almost entirely open to public hunting.

Regional planning has taken an expanded role in North Dakota due, in part, to the rapid energy development in the west central part of the state. In the first place, North Dakota has a State Planning Division which provides technical assistance to local and regional planners and reviews plans that are prepared at the various levels. The State Planning Division (1978) has prepared the North Dakota Land Use Element outlining general goals, objectives, and legislative proposals for the entire state. The Lewis and Clark 1805 Regional Council for Development serves the region that includes Indian Head Mine. The Regional Council for Development has produced two documents that are particularly pertinent to this case study. The first is the Regional Land Use Policy Plan and Implementation Program, 1975-2000 (1978) and the second is the Overall Economic Development Program (1981). Both of these documents address the potential problems related to energy development, such as land use conflicts and the impact on public services and facilities. However, they do not provide much assistance to the mine planner faced with postmining land use decisions.

Enabling legislation in North Dakota, as in most other states, gives the authority to county governments and local municipalities for the formulation and enforcement of land use plans. Since Indian Head Mine is located in an unincorporated area of Mercer County, the Mercer County Land Use Administration has jurisdiction over all land use decisions. Although the county has adopted a zoning ordinance, the Land Use Administration does not actively endeavor to plan or direct land development (including mineral development) but rather responds to proposed changes in land use to ensure that they are in compliance with the zoning regulations.

Indian Head Mine is situated in an area that has been zoned for agricultural use. Surface mining is not a permitted use in an agricultural district, however, it may be allowed as a conditional use subject to several prerequisites. A conditional use permit has been obtained for the case study mine.

4.4 Postmining Land Use Alternatives

4.4.1 Eastern U.S. Case Study

Although the investigators were cognizant of the fact that the mining company does not own the land on which the mine is located, the site planning process was applied to develop three plans without regard for ownership. The results, therefore, must be viewed as hypothetical or subject to the assumption that the mining company can dispose of the land as it sees fit. The value of such an exercise, then, is in the development of a process rather than in a critique of any work done by the company or its consultant. In addition to the three hypothetical plans that were formulated, one land use plan was designed to reflect current ownership patterns.

The early phases of the land use planning process indicated that economically feasible postmining land use alternatives are basically limited to low intensity uses such as pasture, forest, or wildlife habitat. Many times land use plans evolve through common sense and reason during the data collection and preliminary studies. In this case, it is obvious that a large

portion of the 430-acre site will be preserved as open space. The purpose of this case study is not to generate a large number of plans for revegetation. Rather, this investigation is intended to identify the components of a process that will consider all the major site characteristics and result in a final land use plan that integrates a number of potential uses into one acceptable preliminary site design. Therefore, the following plans are presented for the purpose of comparison and are not intended as alternatives to the work that has already been done by the mining company and its consultant.

Alternative I-A - Recreational Development: Alternative I-A, illustrated in Figure 4.1, includes a 56-acre campground along with 253 acres of forest land and 121 acres of open fields designed to provide a desirable habitat for wildlife. The forested areas are connected by nearly 11,000 feet of hedges and tree rows to provide corridors for wildlife movement. The area selected for the campground site has slopes that vary from 3.0% to 15.0% and has only slight or moderate limitations for recreational development. Such a facility would serve not only summer vacationers, but also hunters throughout the fall hunting season.

Alternative I-B - Large Acreage Residential Development: This plan, shown in Figure 4.2, also combines forest and open fields in such a manner as to encourage wildlife habitation. The unique aspect of this proposal is that it provides for nine large building lots (at least 10.0 acres) that are accessible from existing roads. The major criteria used to select the building locations were minimum slopes (mostly 3.0% to 8.0% with a maximum of 15.0%) and southward sloping orientations to encourage maximum use of solar radiation. The areas selected have only moderate building site limitations. This plan would help satisfy a demand in the area for rural housing that provides a considerable amount of privacy and open space.

Alternative I-C - New Community Residential Development: Although the socioeconomic conditions do not warrant such a development, this alternative is offered as an example of the site potential if a different set of conditions existed. Figure 4.3 illustrates a conceptual design for a residential community based upon the assumption that there is a demand for 100 new homes in the area. The 90-acre development is intended to fit well into the surroundings by having the homes built off the main access road and providing for extensive open space on at least one side of each property.

Alternative I-D - Existing Ownership Land Use Plan: This plan basically incorporates the elements proposed by the environmental consultant in the mine drainage permit application. The alternative is illustrated in Figure 4.4 and consists mainly of revegetating the land to a combination of open fields (permanent grasses and legumes) and forest land. Proper design of this plan still presents a significant opportunity to increase plant diversification and improve the wildlife habitat. The open fields, which are restricted to less steep slopes, have the potential to be cultivated or used for grazing at the owners' discretion. Wildlife habitation would be encouraged through the provision of wooded corridors and increasing the amount of forest edge.

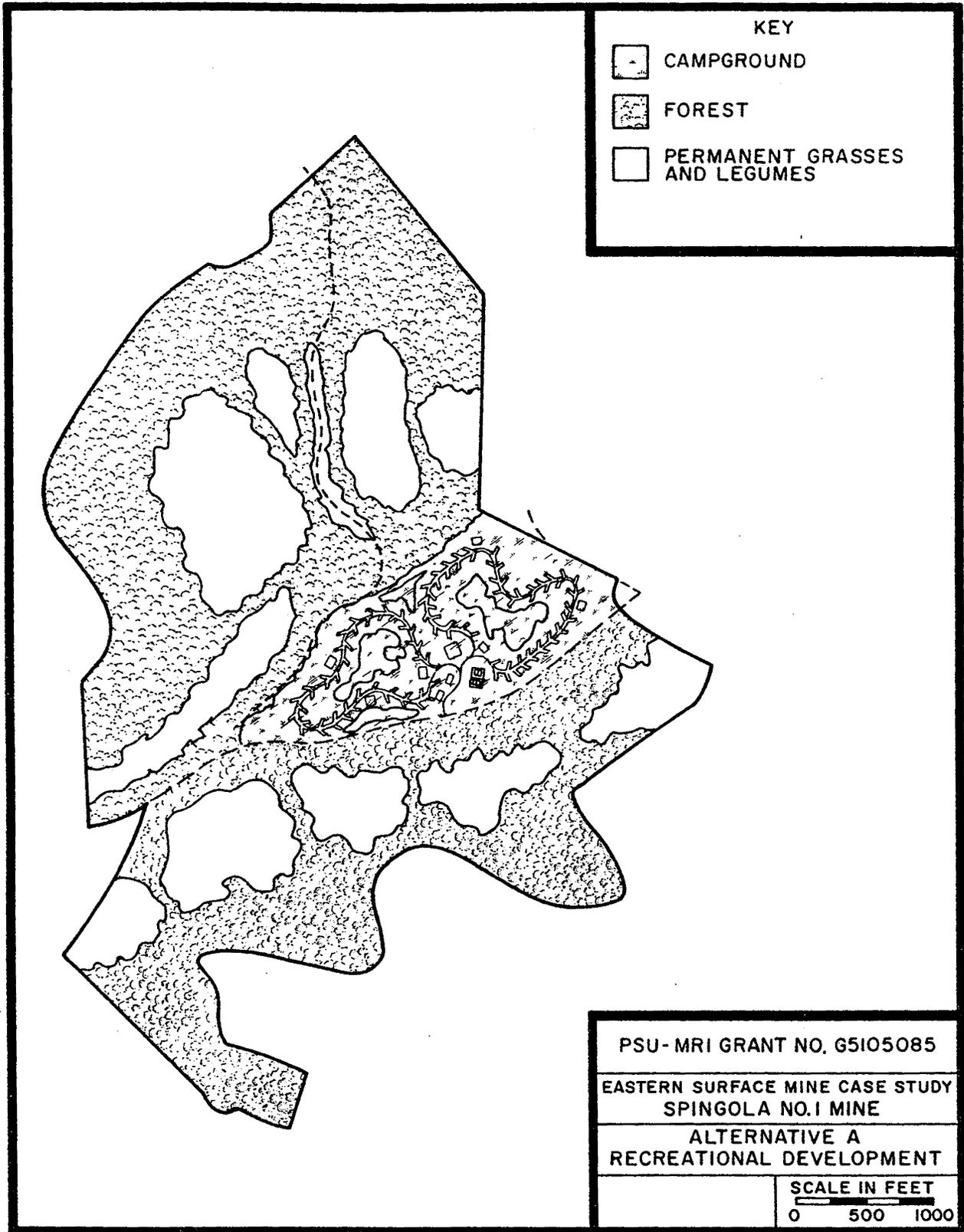


Figure 4.1 Postmining Land Use Alternative I-A - Recreational Development.

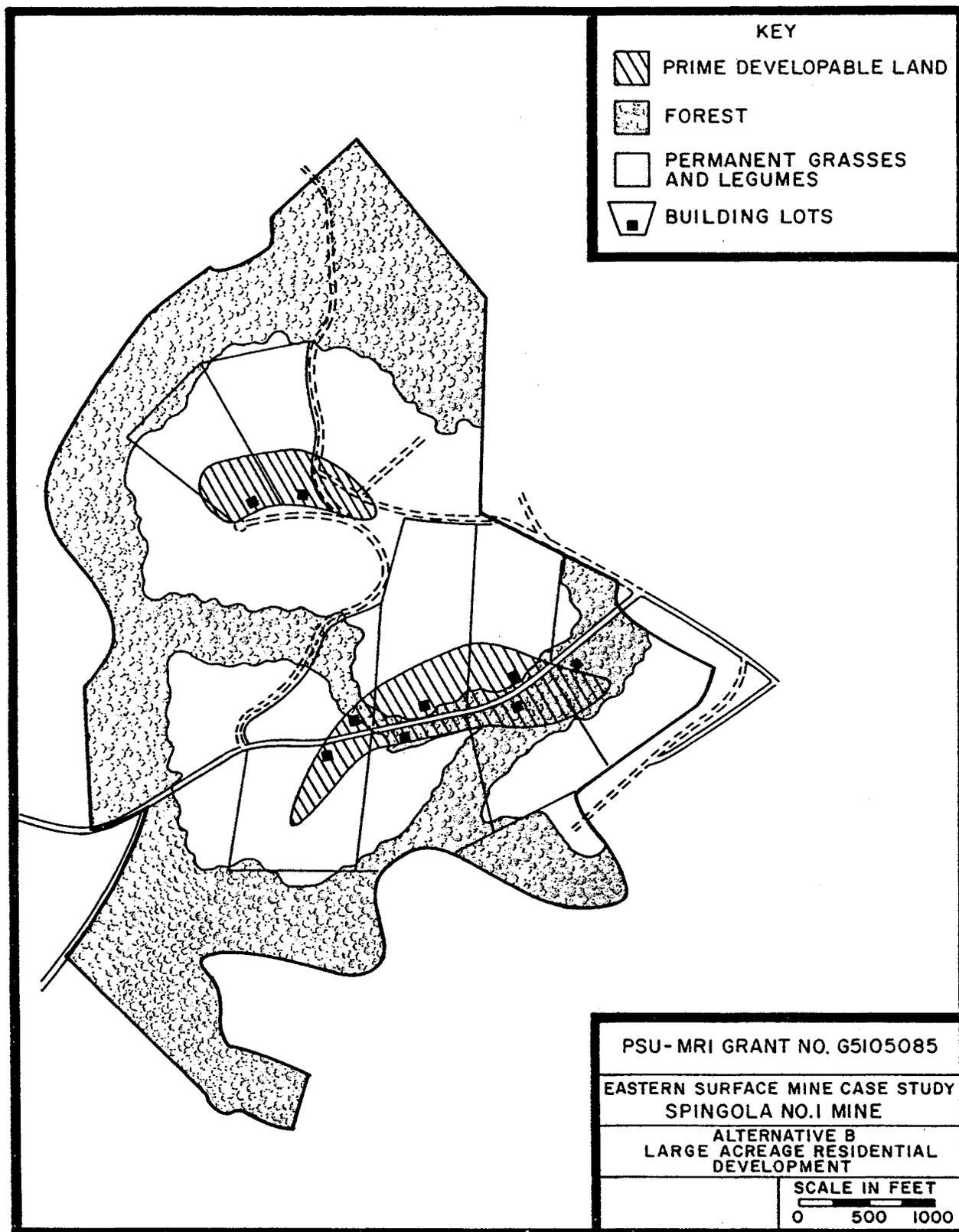


Figure 4.2 Postmining Land Use Alternative I-B - Large Acreage Residential Development.

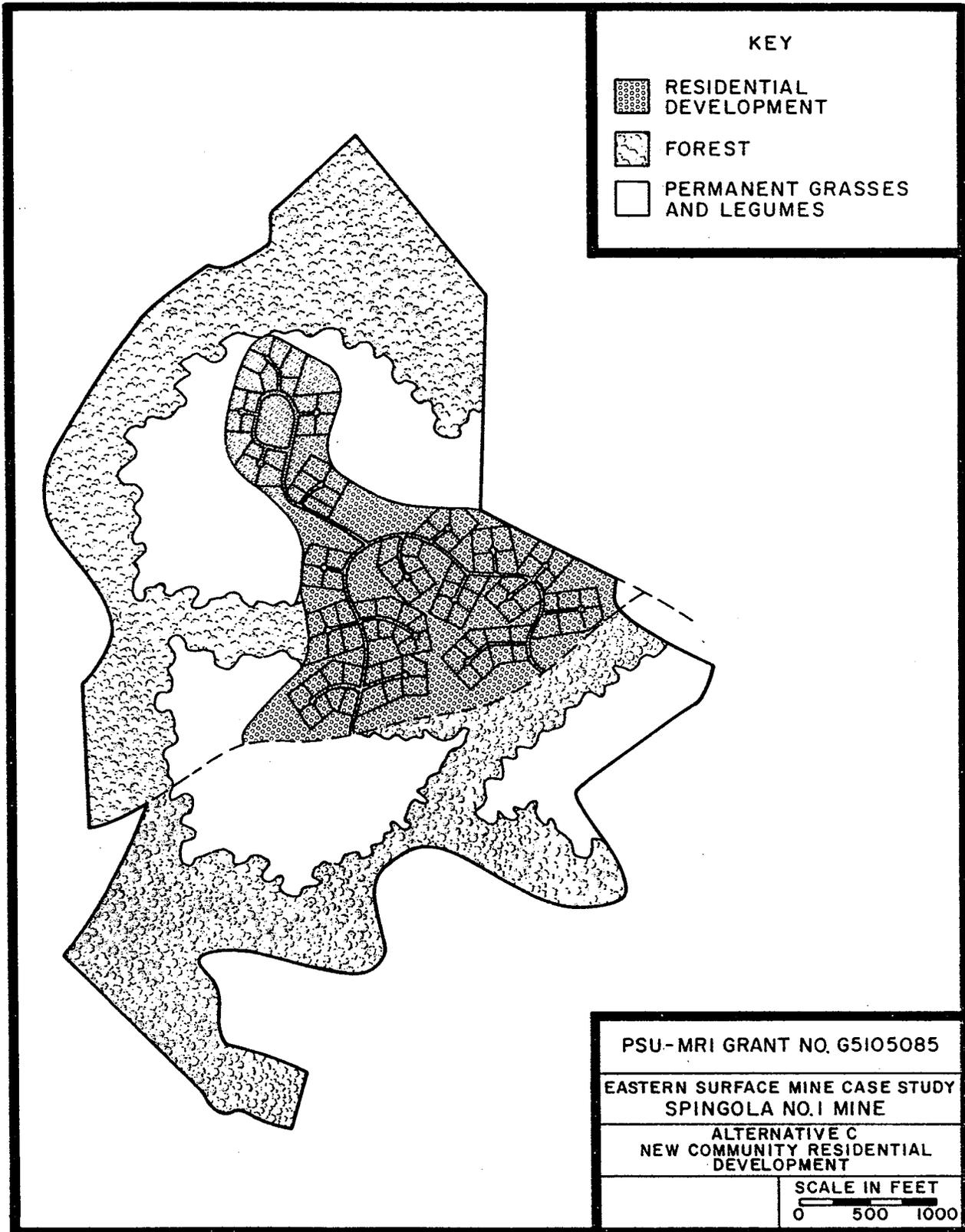


Figure 4.3 Postmining Land Use Alternative I-C - New Community Residential Development.

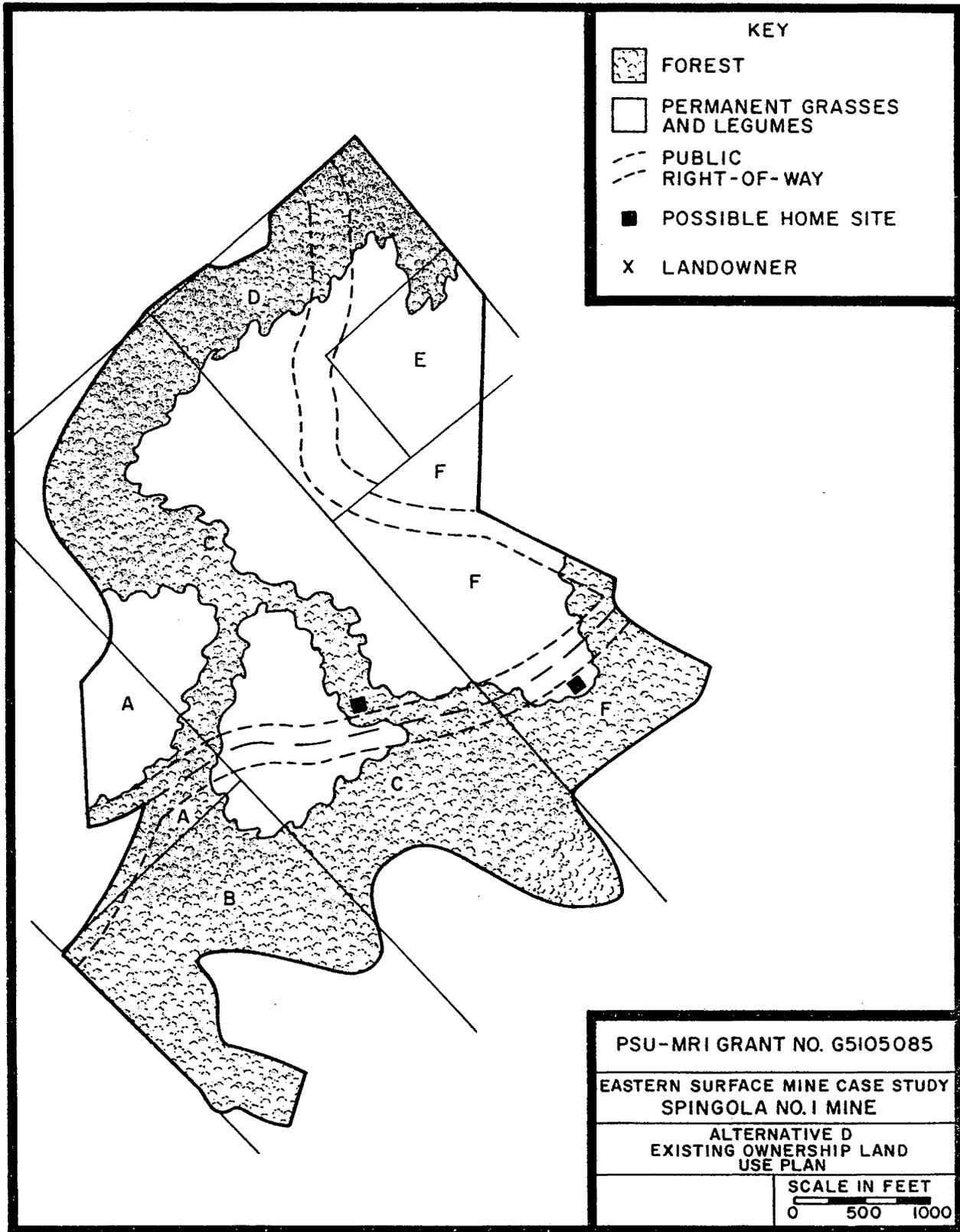


Figure 4.4 Postmining Land Use Alternative I-D - Existing Ownership Land Use Plan.

In addition to the vegetation and wildlife benefits, at least two building sites could be developed on prime developable land (moderate slopes and south-facing orientation). These sites would be located on adjacent properties and would require no subdivision of the existing tracts.

Evaluation of Alternatives: Each of the postmining land use plan alternatives were evaluated from an economic, environmental, and social point of view. Quantitative analyses were performed for the economic and environmental considerations, and the social implications of each plan are discussed.

Estimates of the total reclaimed land values based on the various land use plans are listed in Table 4.2. The unit prices for each land use were determined with the aid of experienced Clearfield County realtors.

In Table 4.2, the values enclosed in parentheses indicate that, in the authors' opinion, sufficient demand does not exist to justify that type of land use. This assumption is based on the hypothesis that if there is no demand for a particular use, the actual value of the land for that use is negligible. The values in parentheses are included for comparison although it is extremely unlikely that the alternatives employing those uses could be realized in the foreseeable future.

Since Alternatives I-A and I-C are presumed to be infeasible due to the market conditions, Alternative I-B would be selected based upon the economic analysis and the assumption that present ownership presents no barrier to such development. Alternative I-D, based upon the existing ownership pattern, demonstrates that initial ownership can act to constrain higher land use realization.

The results of the environmental evaluation are summarized in the environmental impact assessment matrix given in Table 4.3. This technique follows the format of the Leopold Matrix (Leopold, 1971) where a slash is entered in each cell if an impact is anticipated. The number above the slash is an estimate of the magnitude of the impact and the other number is an estimate of its importance. All values range between 1.0 and 10.0 and unsigned values are taken to mean negative impacts.

The environmental evaluation considered four basic factors found in Leopold's list of environmental characteristics and conditions. The relationship of the proposed land use to soil characteristics was considered. Of particular importance were the engineering characteristics such as compaction, settling, and stability. The land use plans were evaluated with respect to groundwater recharge and erosion control. In addition, the extent of wildlife corridors was used in the environmental evaluation process.

Reviewing the matrix of environmental impacts, the proposed alternatives would be ranked in the following order, based upon their environmental acceptability:

- (1) Alternative I-D

TABLE 4.2

ESTIMATED LAND VALUES FOR EASTERN U.S. CASE STUDY MINE POSTMINING
LAND USE ALTERNATIVES

	Total Land Value (\$)	Average Value Per Acre (\$/Acre)
Alternative I-A - Recreational Development	(204,510)	(476)
Alternative I-B - Large Acreage Residential Development	145,410	338
Alternative I-C - New Community Residential Development	(173,400)	(403)
Alternative I-D - Existing Ownership Land Use Plan	102,240	238

TABLE 4.3

ENVIRONMENTAL IMPACT MATRIX FOR EASTERN U.S. CASE STUDY
MINE LAND USE ALTERNATIVES

	Groundwater Infiltration and Recharge	Erosion Control	Wildlife Corridors	Engineering Soil Characteristics
Alternative I-A	2* / 9	2 / 7	+6 / +5	3 / 1
Alternative I-B			+3 / +5	3 / 1
Alternative I-C	5 / 9	5 / 7	2 / 5	7 / 1
Alternative I-D			+3 / +5	

*Unsigned values are assumed to be negative.

- (2) Alternative I-B
- (3) Alternative I-A
- (4) Alternative I-C

It can be concluded that Alternative I-D is the most acceptable plan environmentally since it involves the least amount of change from the premining condition. Alternative I-B also represents a very small change from premining conditions and the only foreseen difficulty could be some stability problems with building foundations. The negative impacts of Alternative I-A are estimated to be small but there would be some decrease in infiltration and a slight increase in erosion. Alternative I-C would have the greatest negative impact due to the high level of development. Many of the negative impacts could be mitigated through construction measures engineered to enhance recharge or improve the soil properties.

Considering the social impact, Alternative I-A is consistent with the county objective of providing outdoor recreational facilities. Possible negative social impacts could be experienced by adjacent landowners and the residents of McCartney. These inconveniences may be offset by the local economic benefits. Aesthetically, a campground could be designed in such a way so as not to detract from the rural atmosphere.

Alternative I-B is consistent with the local desire for rural living. This plan could be aesthetically pleasing if the homes are properly designed and oriented on the lots. There should be negligible social impact on the adjacent landowners or the village of McCartney.

Alternative I-C could result in the greatest social impact due to the addition of 250 to 300 new residents. This increase would cause a strain on community facilities such as schools, medical centers, police, and fire protection. This plan could also likely result in conflict with the existing local residents.

Alternative I-D is viewed as having practically no social impact in that it essentially calls for no changes in the existing social conditions.

Selected Alternative: Based upon the economic analysis, Alternative I-B is considered to be the most feasible of the three alternatives that are not influenced by the existing ownership pattern. Although the calculated land value is not as high as those estimated for Alternative I-A and Alternative I-C, it is believed that these values are unattainable in light of the local real estate market. If Alternative I-D is disregarded, as stated at the outset, the environmental analysis also indicates that Alternative I-B is the most desirable. Finally, the social impact analysis does not indicate that Alternative I-B poses any threat to the social conditions.

Reviewing the local objectives, it can be seen that Alternative I-B conforms to these objectives for several reasons. With regard to the desire to allocate land in accordance with the physical capabilities and the locational need for various uses, this plan is formulated on sound principles of environmental site design while satisfying a demonstrated demand for rural housing. Also, in accordance with physical capabilities and the desire to

preserve open space, this alternative designates 277 acres as undeveloped forest land and open fields for the purpose of improving the wildlife habitat.

4.4.2 Central U.S. Case Study

In this case study, as in the last, the land use potential evaluation was based strictly upon site planning principles. This means that the ownership of the land was not a key factor in determining its land use potential. As stated previously, Meadowlark Farms presently owns approximately 62 percent of the permit area. The assumption was made that additional parcels of land could be acquired if necessary for implementation of the land use plan. Another factor that was not considered directly is the justification that would be required for a change in land use. It is assumed that if a site plan is selected that results in land use changes, the evaluation procedure would produce sufficient information to justify such uses.

From the preliminary studies and data collection stage it became obvious that a large portion of the site should be returned to agricultural production. A review of physical characteristics, socioeconomic conditions, and regional objectives all led to this conclusion. Preliminary studies also indicated, however, the potential for other land uses as well. Therefore, three alternative land use plans were developed. The three plans differ in the amounts of land that would be returned to agricultural uses and in uses that would be made of lands with marginal agricultural potential or lands that are particularly suited to other types of use.

Alternative II-A - Agricultural Use: Alternative II-A, illustrated in Figure 4.5, is very similar to the premining land use condition in the West Field. The primary land use changes are an increase in water area due to the end cut lakes and the creation of wildlife areas on the box cut spoil. These changes result in a slight decrease in agricultural land; however, this decrease is mitigated by the reclamation of some previously unreclaimed land and enhancement of the agricultural management capability through the consolidation of row crop and pasture areas.

This plan endeavors to return nearly all of the suitable land to agricultural production. Areas that are in the 0 to 6 percent slope range would be used for row crops. Areas that may have size or shape limitations or those areas with slopes in the 6 to 18 percent slope range would be used mainly as pasture. The end cut lakes would either be surrounded by pasture or forest areas. Much of the area adjacent to reconstructed drainageways would also be forested. Forestation of these areas would enhance wildlife movement and serve as a buffer between high-runoff cultivated areas and the streams. The box cut spoil areas would be designated as wildlife areas.

Alternative II-B - Low Density Residential Development: Alternative II-B is oriented toward meeting the demand for home building sites that are situated near end cut lakes. This plan provides for the development of approximately 400 half-acre building sites which would be located either adjacent to or near the impoundments that would remain after mining is completed. This plan is illustrated in Figure 4.6. A total of 400 new

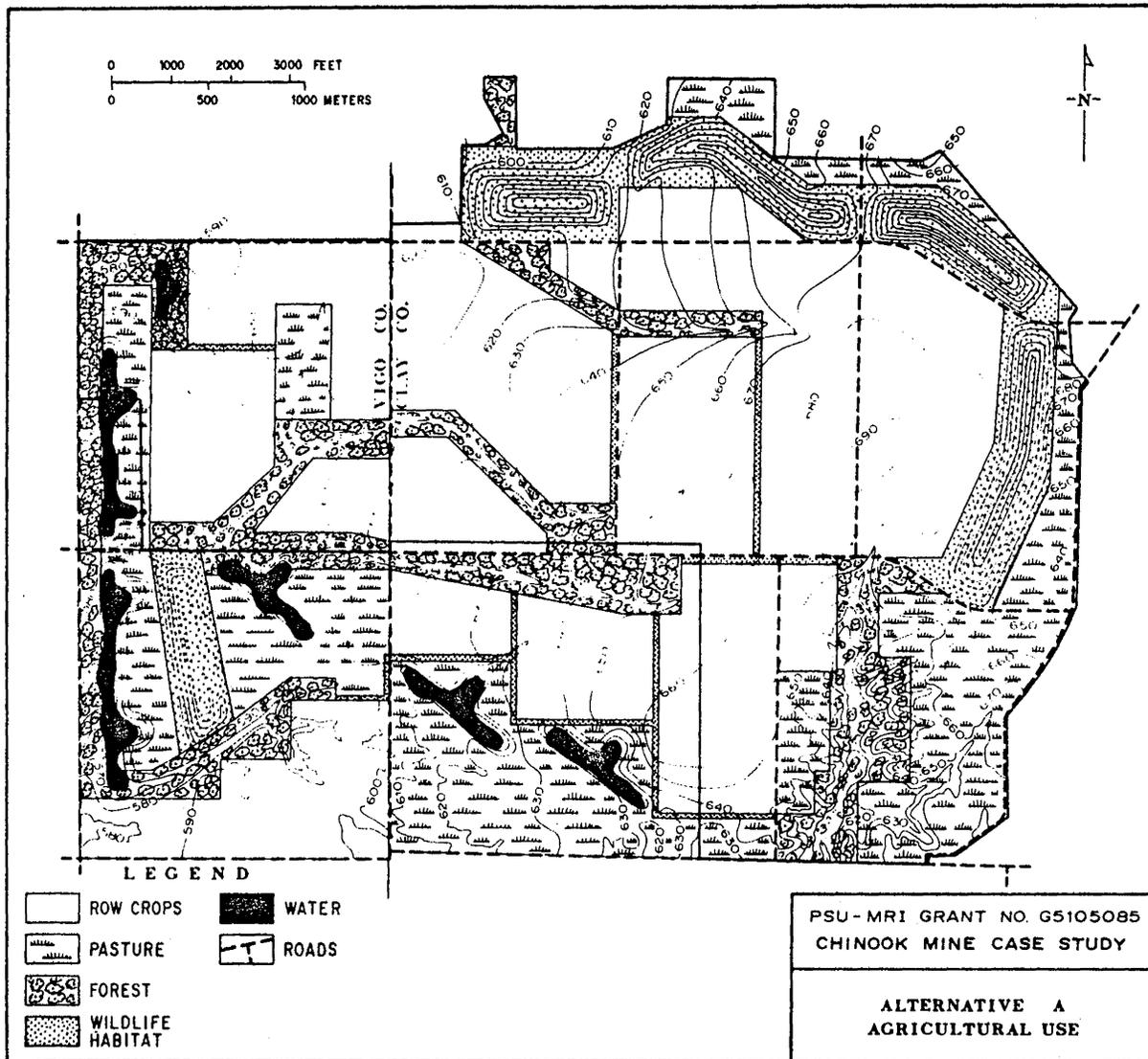


Figure 4.5 Postmining Land Use Alternative II-A - Agricultural Use.

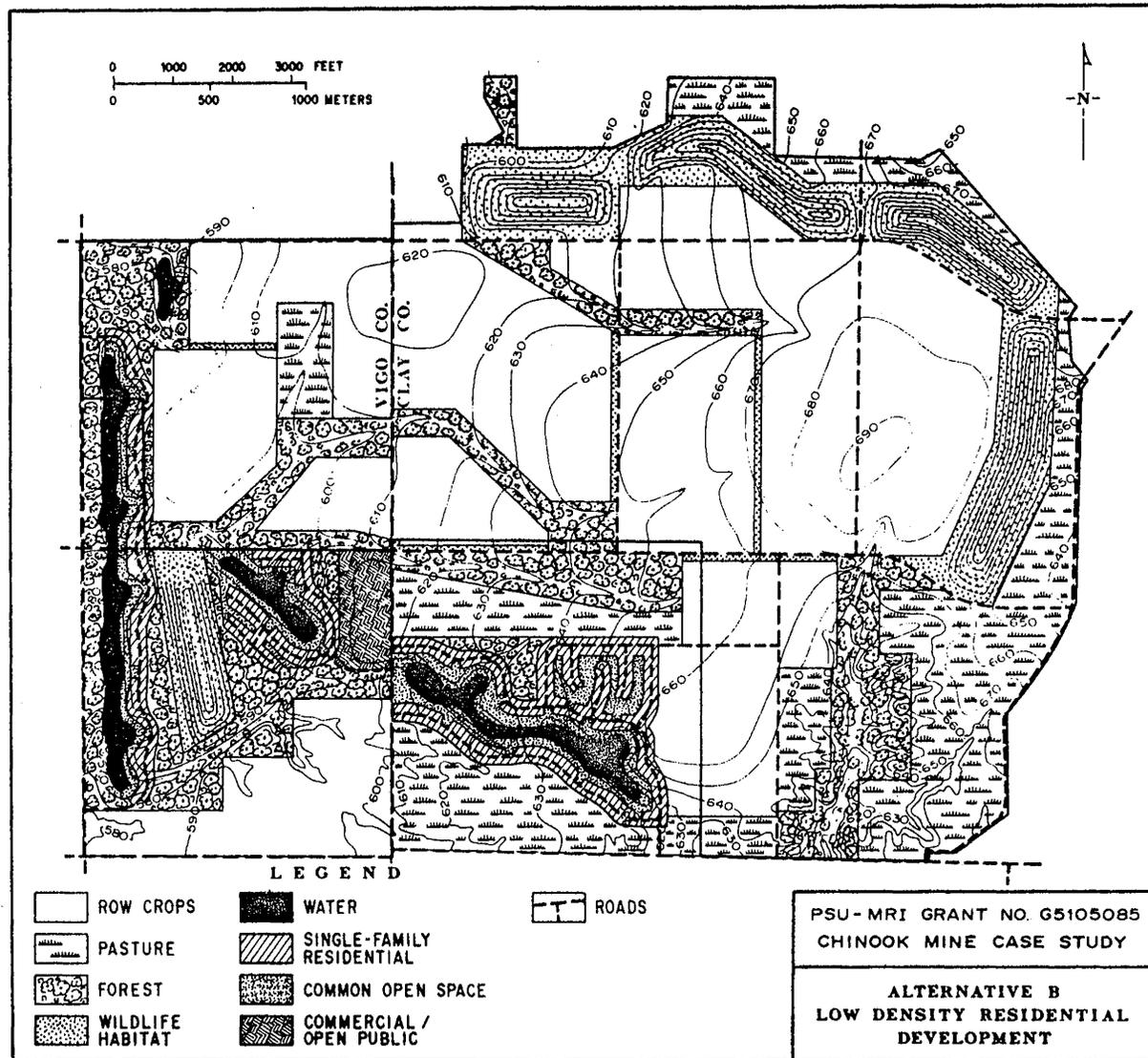


Figure 4.6 Postmining Land Use Alternative II-B - Low Density Residential Development.

housing units would account for nearly 13 percent of the overall two-township demand through the year 2020. The residential development would be concentrated in the southwest portion of the site. The remainder of the site would be reclaimed to agricultural land, forest, and wildlife habitat identical to the pattern described in Alternative II-A. Only about 17 percent of the total surface area is impacted by the residential development plan.

The objective of this plan is to make the best use of the available water front areas. This plan would allow for the connection of final cut lakes whenever feasible to enhance their attractiveness. The two large lakes along the western boundary of the property would be connected providing a lake that is over 1.3 miles long. The shoreline along all of the lakes would be contoured during reclamation to give them a more natural appearance. To protect water quality and to provide all residents with equal access to the water, a band of common open space would be established between the shoreline and the residential properties.

The land use plan outlined in Alternative II-B would require some changes in the existing infrastructure. Other than the streets that would be needed within the residential development, there would be relatively few changes required in the transportation network. The site is very well located with regard to major access roads, particularly those leading to Terre Haute and the industrial park located east of Terre Haute.

Alternative II-C - Residential Development with Integrated Open Space and Recreational Uses: This final alternative is similar to Alternative II-B in that the major portion of the site would be returned to agricultural uses. Unlike the development plan described in Alternative II-B, which provided only single family housing units on half-acre lots, this plan includes cluster homes and multi-family units which are integrated into an open space plan that provides outdoor recreational opportunities as well. Alternative II-C is illustrated in Figure 4.7. The major differences between Alternative II-B and Alternative II-C are the greater diversity that is incorporated into Alternative II-C and the higher density residential uses. Other aspects that remain unchanged are the reestablishment of the overall grid pattern, provision of buffers between developed areas and agricultural areas, and the improvement of lake attractiveness by connecting some water bodies and contouring the shoreline.

The outdoor recreational aspect of the land use plan encompasses approximately 300 acres. Included in the outdoor recreational facilities would be a 158-acre private recreational complex including a golf course with clubhouse, a private beach area, and docking facilities for rowboats and sailboats. A 42-acre public park situated between the lower portion of the western-most lake and the forested area immediately to the east of the lake. The public park would also offer swimming and boating facilities. In addition to water-related activities, the park would provide picnicking, athletic fields, tennis courts, a basketball court, and a playground.

Evaluation of Alternatives: The three alternatives developed for this case study were subjected to the same evaluation procedure that was developed for the previous case study.

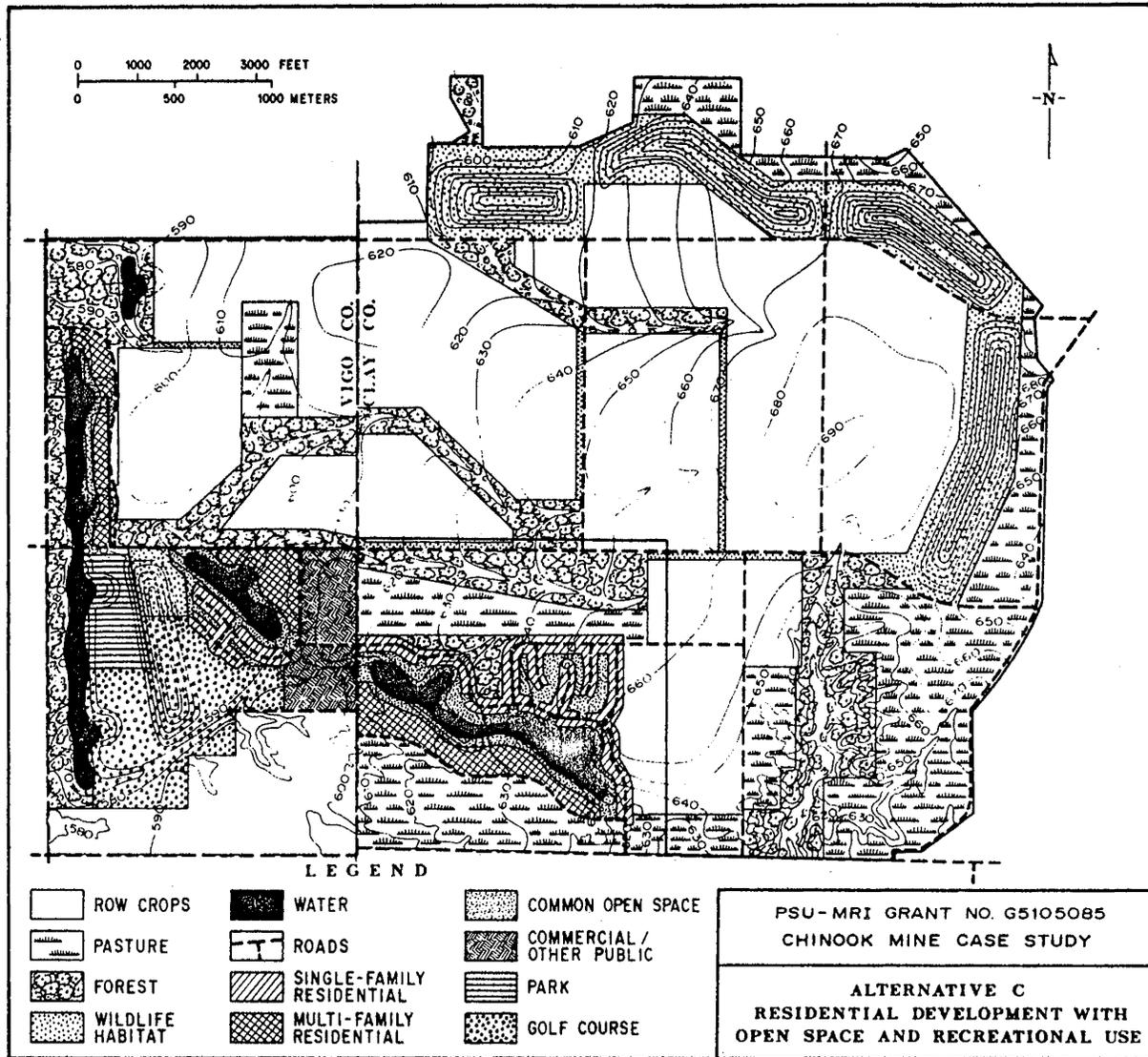


Figure 4.7 Postmining Land Use Alternative II-C - Residential Development with Open Space and Recreational Use.

The economic evaluation attempted to estimate the resale value of the reclaimed land for a variety of alternate uses. This resale value is based strictly upon the physical and geographical characteristics of the site existing at the completion of reclamation. No assumption is made concerning who would develop the site according to the various plans. Also, since only the value of the undeveloped site for potential uses was estimated, neither the construction costs nor the final market value of the individual properties were considered. The only costs that were considered are preliminary site preparation costs that would be incurred during reclamation.

A comparison of the total estimated land value resulting from each alternative land use plan is given in Table 4.4. The unit prices for the different land uses were arrived at through several means including published figures (Seldin, 1980), consultation with AMAX Coal Co. appraisers, and judgment on the part of the investigators.

This analysis indicates that for each alternative, the largest percentage of the total land value is derived from the land's usefulness in agricultural production. Alternative II-C has a slight advantage over both II-A and II-B because it makes better use of the land which has marginal agricultural capabilities. By using some of the residential land for multifamily dwellings, its value is increased. Also, private recreational and commercial uses occupy more land in this alternative than in the other two. Based upon this evaluation procedure, it is estimated that Alternative II-C produces the highest potential total land value. However, the increase over the other two alternatives is rather small.

The environmental evaluation considered the 17 characteristics listed in Table 4.5. These environmental characteristics can be categorized into groups including impacts on land form, water resources, geotechnical properties, vegetation, and wildlife. In reviewing the total environmental impact of the three land use plans, it can be concluded that Alternative II-A has the least impact since it differs the least from the premining uses. Although the impacts of Alternative II-B and Alternative II-C vary slightly on certain points, the overall impacts of the two plans are essentially identical. It should also be noted that while Alternatives II-B and II-C do represent larger negative environmental impacts than Alternative II-A, these impacts are in no way disproportionate from any other development project and can be mitigated, in many instances, through proper design and construction methods.

Considering the social impacts, Alternative II-A would cause the least impact because of the similarity between this land use plan and the premining land uses. Aesthetically, Alternative II-A would be satisfactory since it would be in agreement with the surrounding land uses. It would have no impact on utilities, public services, or the transportation network. This alternative is in harmony with the regional objective to preserve prime agricultural lands.

Alternative II-B would have more drastic social implications, both positive and negative. On the positive side, it would help in meeting the regional objective of satisfying residential housing needs in relation to geographic suitability and employment. Although Alternative II-B would not retain quite as much cultivated land as Alternative II-A, most of the

TABLE 4.4

ESTIMATED LAND VALUES FOR CENTRAL U.S. CASE STUDY MINE POSTMINING
LAND USE ALTERNATIVES

	<u>Total Land Value</u> <u>(\$)</u>	<u>Average Value Per Acre</u> <u>(\$/Acre)</u>
Alternative II-A - Agricultural Use	5,800,914	1328
Alternative II-B - Low Density Residential Development	5,604,425	1283
Alternative II-C - Residential Development with Integrated Open Space and Recreational Uses	5,944,518	1361

TABLE 4.5

ENVIRONMENTAL IMPACT MATRIX FOR CENTRAL U.S. CASE STUDY
MINE LAND USE ALTERNATIVES

	Alternative II-A	Alternative II-B	Alternative II-C
Land form	2 3	2 3	2 3
Surface water quantity	+2 2	1 2	2 2
Surface water quality	2 3	3 5	3 5
Groundwater quantity	+2 4	+1 5	+1 5
Groundwater quality	3 3	3 5	3 5
Erosion	1 4	2 4	2 4
Deposition	1 4	2 4	2 4
Compaction and settling		5 5	5 8
Slope stability	2 1	2 2	2 2
Trees	4 3	4 3	4 3
Crops	3 8	4 8	4 8
Birds	1 5	2 5	2 5
Land animals	2 6	3 6	4 6
Fish	+5 5	+5 6	+5 7
Insects	2 1	2 4	2 4
Wildlife barriers		4 5	3 5
Wildlife corridors	+3 5	+3 5	+3 5

residential development would occur on land that is better suited to grazing than to cultivation. Therefore, this alternative basically satisfies the objective of conserving prime agricultural lands. Alternative II-B also endeavors to preserve the rural areas by establishing a wooded buffer between residential and agricultural areas. The major negative social impact of this alternative is the strain which may be placed on existing utilities, public services, and transportation networks.

Alternative II-C would result in many of the same social impacts already listed for Alternative II-B. The magnitude of the impacts would be increased slightly, however. Since this alternative would provide more housing units, it would have a greater impact on meeting the need for geographically suitable housing. It also would help alleviate the recognized shortage of rental housing. The preliminary studies phase of the investigation has shown a deficiency in outdoor recreational facilities. Alternative II-C would provide a variety of recreational opportunities. As Alternative II-B would have some negative impact on utilities, public facilities, and highways, Alternative II-C would have a slightly larger negative impact.

Selected Alternative: Upon reviewing the three different analyses, it becomes apparent that Alternative II-B is the least desirable. Because of the additional streets that would be required and the relatively small housing demand that would be met, this alternative results in the lowest land value. The environmental impacts would be nearly as great as those caused by Alternative II-C without generating the same proportion of social benefits.

The decision, then, is between Alternative II-A, which is similar to the premining land use, and Alternative II-C. Based strictly upon the maximization of land value, Alternative II-C would be selected. Although this alternative could result in a slightly larger negative environmental impact than Alternative II-A, it would also provide the largest and most diverse social benefits by helping to meet several regional objectives. For these reasons, Alternative II-C is the recommended alternative.

It must be reemphasized that this decision was reached strictly from a land use potential perspective and was not influenced by regulatory requirements. Another point that requires clarification is the time-frame for implementing the selected alternative. Since the field will be actively mined for over ten years, it would be necessary to have an interim land use plan that would productively utilize the land until the entire area is mined. Such an interim plan would likely be similar to Alternative II-A since the land could be used for agricultural production without preempting or diminishing its potential for later development.

4.4.3 Western U.S. Case Study

This case study was approached in a slightly different manner. Rather than making certain assumptions and then proceeding with the formulation of alternatives, a pragmatic approach was taken in the preliminary studies phase of the site planning process. This approach led to the conclusion that reestablishment of premining land uses was the only viable alternative under the conditions of the case study. Minor changes in agricultural usage and some accommodations for wildlife may be designed into the final land use

plan, however, the justification is lacking for any significant land use change.

Key Factors: One of the factors influencing postmining land use at Indian Head is landownership. A large portion (approximately 63 percent) of the area included in the 1981 permit renewal application is owned by The North American Coal Corporation. Much of this land, however, is required for mine support facilities (office, shop, preparation plant, and haul roads) and is not presently scheduled for reclamation to other land uses. The area surrounding the office and shop is considered to be permanently industrial. On the other hand, the areas that are presently being mined and developed are almost entirely owned by private citizens who actually occupy the land. In these cases, which account for over 750 acres, the major land use consideration is the landowners' desires to have the cropland and hayland restored to their initial productivity.

Another key factor in the determination of postmining land uses at Indian Head is the constraint imposed by regulations. Although minor changes can be accomplished within a land use classification with little difficulty, reclamation to a different land use classification requires considerable justification as specified in Section 515 (c) of PL 95-87. In addition to the effort required to justify a change in land use, it is feared that such a request will cause delays in approval of the permit application.

A final key factor that favors restoration to premining land uses is that the local socioeconomic conditions do not warrant significant land use changes. Although the entire county has experienced an influx of population due to energy development projects, the needs of these new residents can best be met by the existing towns and their immediately adjacent rural areas. A high percentage of the new households in Mercer County between 1981 and 1990 will only remain temporarily and then move on after completion of the major energy facilities (Inter-Industry Technical Assistance Team, 1981).

Realization of Land Use Potential: The premining and postmining land use acreages at Indian Head for the various land use classifications are presented in Table 4.6. One way of gaging the success of this postmining land use plan in approaching the potential for this site is through addressing the economic, environmental, and social impacts of the plan.

Probably, the highest economic use of land in the immediate vicinity of the mine is cropland. The postmining land use acreages given in Table 4.6 indicate that all pre-existing cropland will be restored and an additional 13 acres of cropland will be created. This increase comes entirely from land that was previously used only for hay, thus representing a small economic improvement to the landowner. Also, approximately 46 acres of industrial land will be reclaimed to rangeland. This change does not represent an economic loss but rather restoration of some ancillary industrial land that is no longer required for operational purposes. In summary, the postmining land use plan is economically sound. There are no apparent economic losses over the premined condition and there is, at least, a small improvement in cropland. It is unlikely that rangeland could readily be reclaimed for agricultural uses since the soil and slope limitations that hindered such development in the first place would persist after reclamation.

TABLE 4.6

PREMINING AND POSTMINING LAND USE ACREAGE AT INDIAN HEAD MINE

	<u>Premining Acreage</u>	<u>Postmining Acreage</u>
Cropland	305.7	318.7
Hayland	305.8	287.8
Rangeland	690.8	739.9
Woodland	3.0	3.0
Shelterbelt	2.3	2.3
Wetlands	3.0	3.0
Impoundments	2.7	4.7
Farmstead	3.0	3.0
Public Services	6.5	6.5
Transportation	2.0	2.0
Industrial	204.0	157.9

Environmentally, the plan has no apparent negative impact. Successful reclamation will prevent erosion and sedimentation problems from occurring. The minor changes within the agricultural classification will not have any effect on wildlife habitat or corridors. The only probable impact arises from the creation of two additional acres of water. From a hydrogeological standpoint, this action should cause a slight increase in groundwater recharge and from a wildlife standpoint, it will provide additional nesting areas for waterfowl.

Basically, the postmining land use plan creates no significant social impact. Although it has been pointed out that there are some important social problems in the area as a result of rapid energy development, this plan neither contributes to these problems nor does it offer any viable solution. The plan is, in fact, quite consistent with local land use plans which endeavor to keep rural areas rural and deal with the population influx in and around the existing population centers. For these reasons, then, it can be concluded that the postmining land use plan is quite effective in achieving the land use potential of this site.

Chapter 5

LAND USE PLANNING GUIDELINES

5.1 Overview

The guidelines presented here are, in fact, recommendations intended for the improvement of the entire mined-land planning process. These suggestions are based upon the findings of a three-year inter-regional investigation of land use practices, as they relate to surface-mined land. The guidelines are divided into three categories representing different levels of planning effort and different areas of responsibility. At each level, the question of information system requirements is considered.

The first level of planning to be addressed is environmental site planning for surface-mined land. This task is the responsibility of the mining industry. A generalized site evaluation process is presented along with possible managerial approaches to accommodate this task. Although the three surface mine case studies were directed primarily towards identifying an environmental site planning evaluation process, they also provided a basis for observations and recommendations concerning the relationship between the surface mining industry and public land use planning practices. The second level of planning to be addressed, therefore, is the local land use planning authority. Guidelines are offered to both public planners and industry representatives to improve interaction, insure the availability of mineral resources, and, ultimately, to enhance the quality of reclaimed land. The final category to be considered also deals with public land use planning policy, but at the state or regional level rather than the local level. The objective of these final recommendations is to guarantee that mineral resources are given proper consideration in the development of total resource management plans.

5.2 Environmental Site Planning

Because mining companies vary greatly in size and face different regional conditions, it is difficult to make specific site planning recommendations that are applicable in all circumstances. The site planning guidelines presented here are believed to be sufficiently general and flexible so that the concepts could be applied in most cases. However, individual companies must determine the level of effort that is best suited to their circumstances. For companies that purchase all or much of the land on which they conduct their operations, the potential economic benefits of proper site planning are more readily apparent. For companies that operate on leased land, the benefits may be less tangible. These benefits could include greater ease in obtaining properties for mining or more favorable leases when the landowner is given some control in determining the postmining land use.

5.2.1 Site Planning Process

The site planning process that was employed in the three surface mine case studies is illustrated in Figure 5.1. This model was adapted from

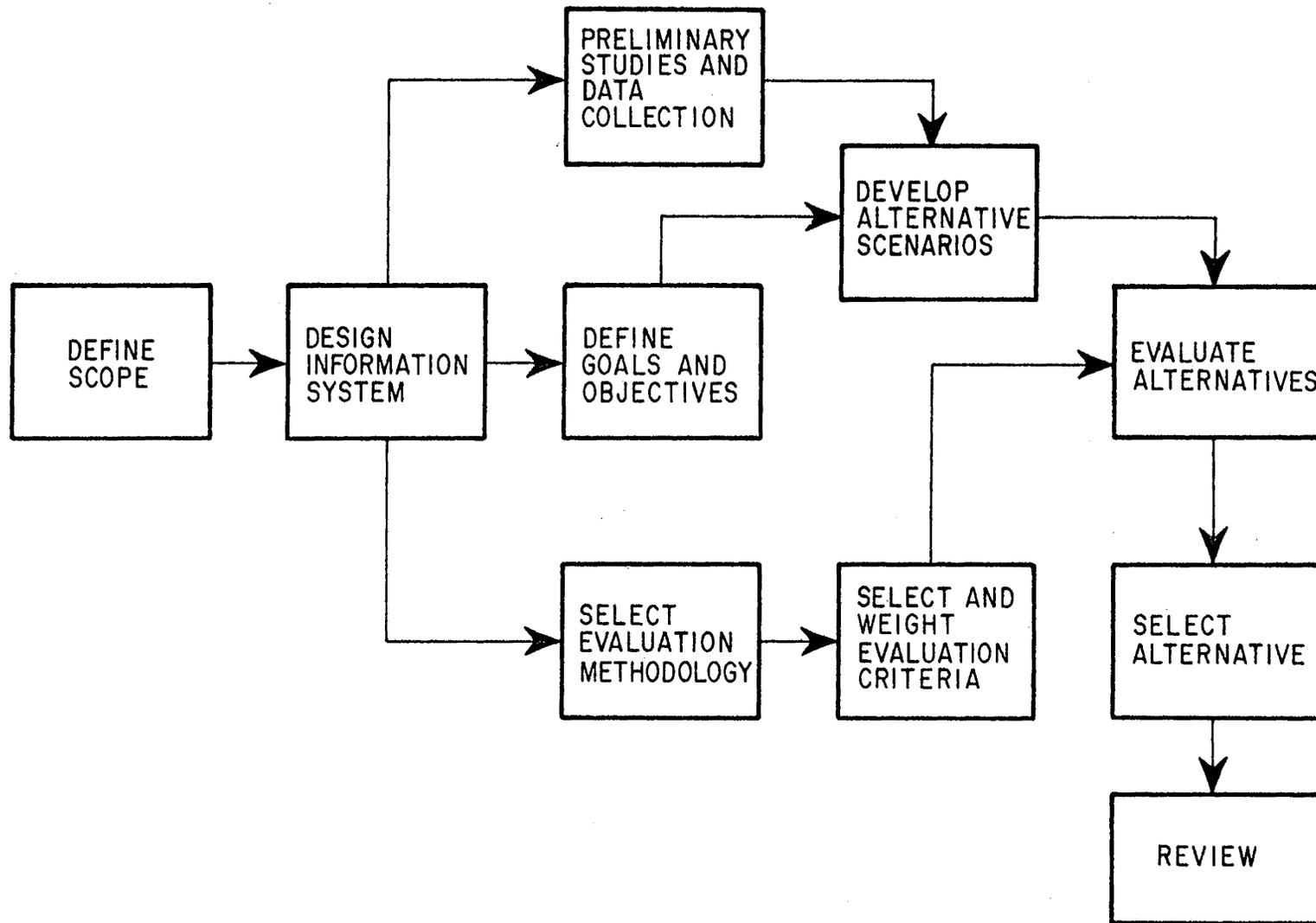


Figure 5.1 Detailed land use planning process.

regional planning sources (Chapin, 1979) with some modifications for site planning purposes. Some of the steps that are central to the regional planning process may become less significant or routine at the site-specific level. For example, once a mining company has defined the scope of its reclamation and land use planning program, this scope will not change drastically for each successive operation. Scope definition should include specifying the type of output required from the planning process (e.g. conceptual plan, final design, etc.), assigning responsibilities, and structuring a planning organization to accomplish the task.

The information system design is directly related to the size and sophistication of the mining company. The site planning process, however, depends heavily on the collection, analysis, storage, and retrieval of many data types. Therefore, some minimum information system needs must be met. These requirements are addressed in a later section.

The preliminary studies and data collection phase of the planning process is typically the most expensive and time-consuming. Mining companies can exercise discretion in determining what information will be pertinent to their postmining land use plans but much of the environmental baseline data collection is mandated by Part 779 of the Permanent Regulatory Program (OSM, 1979b). The list of baseline data specifications which can be required by the regulatory authority includes the following:

- geology description
- ground water information
- alternative water supply information
- climatological information
- vegetation information
- fish and wildlife resources information
- soil resources information
- land use information.

In addition to the environmental baseline and premining land use studies, the mine planners should collect information and analyze aspects of the local economy, population trends, transportation network, and location of public utilities. Because of the expense involved, the preliminary studies and data collection should be planned very carefully so that only pertinent information is gathered. Besides meeting the regulatory requirements, it should be emphasized that the data gathered will be used later in the planning process to help evaluate alternate postmining land use plans.

The definition of local goals and objectives is basically a function of the public planners. This is an area where the mine planners should interact with local and regional planners to insure that the proposed postmining land use plan is compatible with the overall plan of the area. In addition to

satisfying local goals and objectives, the mining company may wish to establish other goals for itself such as improving the value of the land or promoting good public relations. Ideally, comprehensive planning should precede site planning and provide input to the site planning process. It is not uncommon, however, for site planning to be conducted in an area which has no comprehensive plan. In the absence of formalized goals and objectives by a planning agency, the mine planners can either rely solely on company goals or make a limited survey of goals by contacting neighboring landowners and local elected officials.

A number of evaluation techniques are available to the site planner for evaluating alternate land use plans. These techniques can be divided into three categories: economic analysis, environmental impact analysis, and social impact analysis. Once again, care should be exercised in selecting one or several methodologies since complex evaluations can result in considerable expense. The level of effort should be proportional to the size of the operation and the potential for creating benefits. Economic analysis of alternate land uses can range from discussions with informed individuals to detailed benefit - cost accounting or estimation of returns through increased land values. Although traditional engineering analyses alone will not satisfy all evaluation requirements, they have a place and should be considered along with environmental and social impact analyses. There is also a range of complexity in evaluating environmental and social impacts starting with checklists which qualitatively address the various impacts and continuing on to detailed schemes for quantitatively estimating impacts of the various land use plans.

Evaluation criteria should be selected and weighted based upon the evaluation methodologies chosen. A combination of criteria which reflects the economic, environmental, and social aspects of the plan is desirable. Economic criteria may include a minimum profitability or a benefit-cost ratio which exceeds unity. Environmental criteria would be directed toward meeting various performance standards. Social impact criteria are more difficult to establish since social impacts are difficult to quantify. Various techniques such as cost effectiveness analysis have been developed, however, which attempt to subjectively quantify social impacts. Minimum standards can be set based upon one of these techniques.

After the evaluation methodologies and criteria have been selected, several site plans can be proposed for the reclaimed area. Certainly, one alternative to be considered is returning the land to its premining use. Only viable scenarios should be evaluated. Plans which are obviously unacceptable for economic, environmental, or social reasons need not be subjected to a detailed evaluation process. Since the premining condition and postmining land use plan most likely combine two or more land uses, the number of alternatives that can be generated is limitless. The alternative scenarios should be kept to a manageable number. In practice, by the time the mine planner begins formulating alternate land use plans it should be fairly obvious that certain land uses are unacceptable and certain others are potentially acceptable.

Once the alternate scenarios have been completed, they are subjected to the evaluation methodologies selected earlier. The result of this process is

the selection of the desired alternative either by elimination of less desirable plans or ranking all of the plans in order of acceptability. The final step of the process is review by company management and regulatory personnel. In addition to the review made immediately after the plan has been selected, there should be periodic review by the mine planners and company management up until the time that the plan is implemented to insure that the land use plan is still workable. Unforeseen changes in the economic, environmental, or social conditions may require modification of the land use plan before it can be implemented.

5.2.2 Evaluation of Postmining Land Use Alternatives

A proposed model for evaluating postmining land use alternatives is illustrated in Figure 5.2. This model expands the "Evaluate Alternatives" step of the general site planning model shown previously in Figure 5.1. This expansion provides for a four-stage evaluation process and a feedback loop to earlier steps in the planning model.

The four-stage evaluation methodology is analogous to the procedure used in mineral exploration (Bailly, 1968). Mineral exploration investigations proceed from an initial regional appraisal, in the first stage, to a detailed three-dimensional site evaluation, in the final stage. The goal of that procedure is to identify economic mineral deposits. There are decision points built into the exploration model at the conclusion of each stage where it is necessary to evaluate the data already available and decide either to terminate the process or continue into the next stage.

This type of methodology can also be applied to the evaluation of postmining land use alternatives. The goal of this process is to design a postmining land use plan that is well suited to the environmental, social, and economic conditions of the mine site. As the mine planner proceeds with the evaluation, a decision must be made after each stage to either select a final land use plan, enter the next stage, or return to an earlier step in the planning process. The dashed lines in Figure 5.2 feeding back to earlier planning steps indicate that this entire process can be iterative in nature. In practice, the timing of the planning steps will overlap. Therefore, it is best to begin the evaluation procedure with a comprehensive list of general land use classes (e.g., agricultural, forestry, wildlife, residential, recreational, industrial, commercial, etc.) rather than detailed site plans. A preliminary consideration of social and economic conditions will generally eliminate a number of potential land uses. As the process continues, alternative scenarios may need to be reformulated, additional data may be required, or it is possible that the land use goals may need to be redefined if the initial goals prove unattainable.

In the simplest case, data collection will consist mainly of gathering the required data for the permit application. A number of general land uses would be considered, including the premining uses. A preliminary consideration of the economic and social conditions may indicate that there is no justification for further evaluation of alternative land uses and the postmining land use plan will be designed, based upon the premining uses. This is, in fact, the sequence of events that has been documented in the Western U.S. Surface Mine Case Study (see Appendix III).

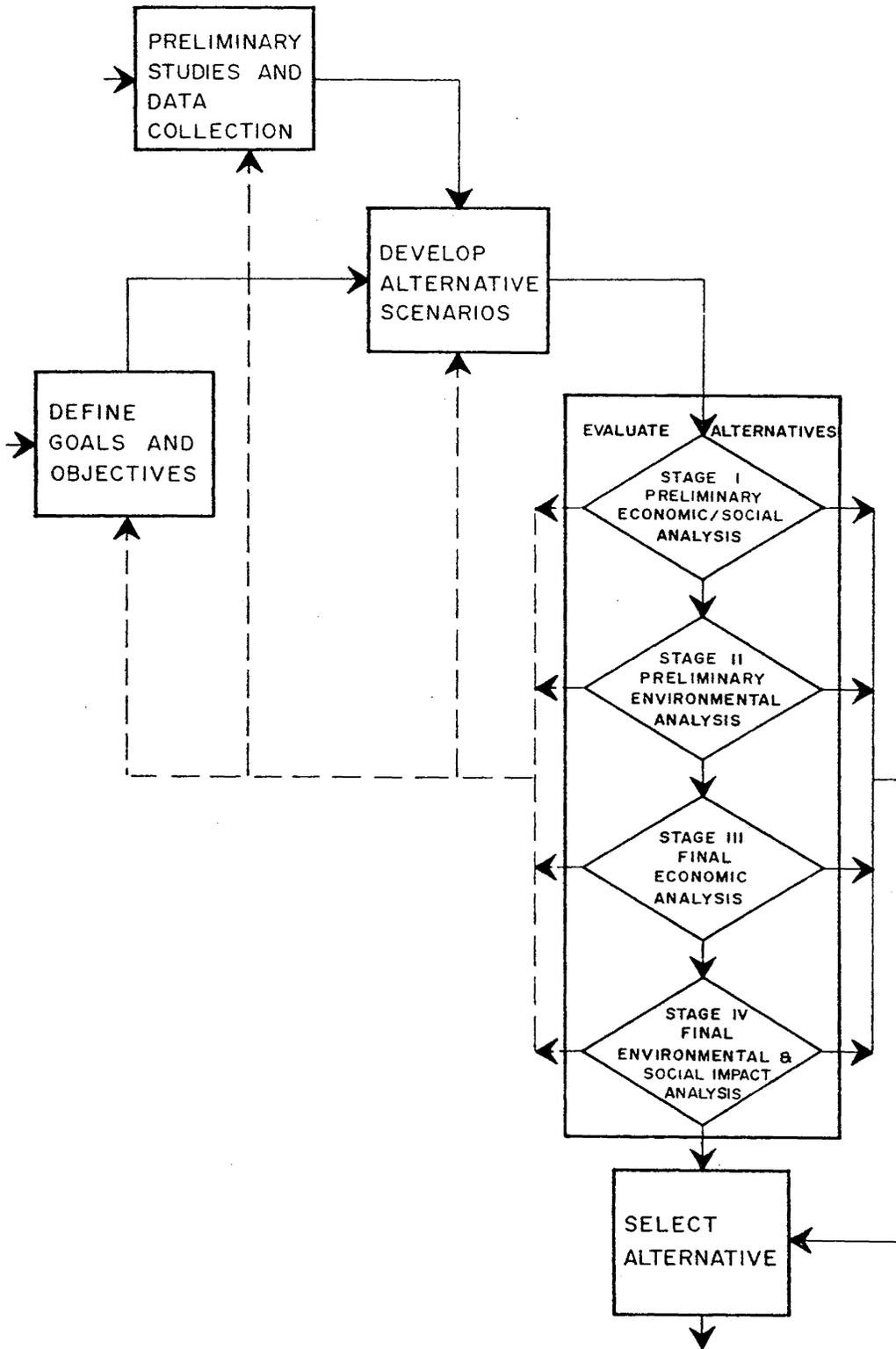


Figure 5.2 Process for the evaluation of land use alternatives.

The various stages of the evaluation process can also be viewed as a sieve. Typically, Stage I would have a short duration and be limited to an overview of such economic and social characteristics as land ownership, current real estate values, current land use patterns, population growth, and development patterns. Consultation with realtors, developers, and local planners may be helpful at this stage.

Those land use alternatives that initially appear to be economically and socially acceptable may then be subjected to a preliminary environmental analysis in Stage II. This analysis should also be relatively short and general in nature. It would entail reviewing a checklist of natural environmental factors, such as those listed in Section 3.2, to determine if there are any physical conditions that would eliminate a given land use from further consideration. For example, poor agricultural soil characteristics may limit agricultural use to pasture rather than row crops, or an abundance of acid-producing material in the overburden would likely eliminate any recreational use that would require a water impoundment.

Some refinement in the alternative land use plans would likely be necessary after the completion of the first two stages. The final economic analysis conducted in Stage III can take a number of forms. The simplest analysis would estimate the resale value of the land upon completion of reclamation based upon real estate transactions in the area. This is the approach that was applied in the Eastern and Central U.S. Surface Mine Case Studies (see Appendices I and II). A more complex alternative would be to consider the final land value or income from retained land (e.g. agricultural production, as in the case of Meadowlark Farms) in the overall cash flow of the project. This approach requires unrestricted access to company financial information and, therefore, was not developed for any of the case studies.

Stage IV of the evaluation procedure would employ analytical techniques that have been developed by environmental scientists and social scientists to differentiate between alternative plans. This stage would only be reached when two or more land use plan alternatives demonstrate significant potential for economically improved land use. A likely method for evaluating the environmental impact of various alternatives is the matrix method developed by Leopold (1971). This method, illustrated in Figure 5.3, combines an estimate of the magnitude of a particular impact, on a scale of one to ten, (number in upper left half of cell) and an estimate of the importance of an impact, also on a scale of one to ten (number in lower right half of cell). Unsigned numbers are assumed to be negative. Positive impacts are indicated accordingly. There are at least 12 methods including checklists, scenarios and surveys, cost effectiveness, and simulation modeling that have been developed to evaluate the social impact of alternative plans (Runyan, 1977).

5.2.3 Organization for Site Planning

The size of the company will likely determine, to a great extent, how a postmining land use plan is selected. Small companies may not employ a staff of engineers and planners. Therefore, consultants are contracted to perform all necessary environmental planning including preparation of permit applications, reclamation plans, revegetation plans, and erosion and sediment control plans. Since the consultant's performance is judged upon successful

ENVIRONMENTAL CHARACTERISTICS

PROPOSED ACTION WHICH MAY CAUSE ENVIRONMENTAL IMPACT		PHYSICAL AND CHEMICAL CHARACATERISTICS							
		WATER							
		SURFACE	OCEAN	UNDERGROUND	QUALITY	TEMPERATURE	RECHARGE	SNOW & ICE	
RESOURCE RENEWAL	REFORESTATION						+2 +4		
	WILDLIFE STOCKING AND MANAGEMENT								
	GROUND WATER RECHARGE				3 5		+9 +5		
	FERTILIZATION APPLICATION				6 8				
	WASTE RECYCLING	+2 +3			+1 +7				

Figure 5.3 Example of the Leopold Matrix Environmental Impact Assessment.

completion and approval of the permit application, postmining land use planning tends to be de-emphasized.

Regardless of where the planning is done, either in-house or by consultants, recent public policy enactments have caused an expansion of mine planning into areas that were not routinely addressed in the past. The land use potential evaluation requirements are a prime example of this expanded role. Expertise in many different disciplines is essential to the overall mining planning effort which includes planning for extraction, reclamation, and postmining land use. A listing of specialization areas required in each phase of the mine planning process is given in Table 5.1 along with the specific land use implications.

For larger mining companies that perform their own premining environmental planning, there are basically two organizational alternatives. Each has its own merit and can be adapted to various circumstances. The first alternative integrates the mined-land planning function into a company's engineering department. Within the engineering department, it would operate as a cost center and be allocated a portion of the overall engineering budget. This allocation would be based upon a specified cost per ton for postmining land use planning. The advantages of this approach are constant interaction with engineers responsible for overall mine planning and a strict accounting of all planning costs. It is important that the mine supervisory personnel have input into the planning process and that the resulting postmining land use plans are adequately communicated to them since they will supervise the actual reclamation operation.

The other general alternative for postmining land use planning involves the formation of an organization charged with overall land management. This organization could take the form of a land management department or it could be a separate subsidiary. The organization would be given responsibility for acquiring land, obtaining permits, developing postmining land use plans, and either managing or disposing of reclaimed land. Effective communications with the operations and engineering departments would be required to insure that land would always be available for continuing operations and that postmining land use plans would be obtainable in light of mining practices and equipment availability. The budget for this organization would have to cover the purchase of land and mineral rights, leases, payments for loss of agricultural production, and the premining planning function. Income from the sale of reclaimed land would be considered as a positive cash flow and the portion of the overall budget allocated to postmining land use planning could be fixed, by a formula, to income from land disposal and reductions in reclamation costs, lost production costs, and leasing costs.

5.2.4 Information System Needs

The amount of data required for environmental site planning is generally large and quite specific in nature. The categories of data include environmental background data (permit application requirements), additional cultural data, cost data (planning, reclamation, and mine closure) and operating factors such as equipment availability. The major functions that must be performed on the data are storage, updating, and retrieval. Although a simple filing system will suffice for smaller operations, many larger

TABLE 5.1

AREAS OF TECHNICAL EXPERTISE ESSENTIAL IN THE MINED-LAND
PLANNING PROCESS

<u>MINE PLANNING PHASE</u>	<u>PLANNING ACTIVITIES</u>	<u>AREAS OF SPECIALIZATION</u>
Legal Requirements Analysis	Identification of regulatory constraints related to land use.	*Land Use Planner Attorney or Paralegal Specialist
Land and Reserve Acquisition	Prepare land use/land cover maps.	Land Use Planner Photogrammetrist/Cartographer Plant Biologist
	Prepare land ownership map.	Photogrammetrist/Cartographer Surveyor
Market Development	Check market potential of site.	Geographer Transportation Engineer Land Use Planner
Financial Evaluation	Check if land development potential of the site will justify reclamation to a higher, more costly land use.	Engineering Economist Land Use Planner Real Estate Specialist Fiscal Planner
Coal Beneficiation Studies and Plant Design	Determine the impact of waste disposal on the postmining uses of land.	Mineral Processing Engineer Environmental Engineer Agronomist Geologist Hydrogeologist
Environmental Impact Studies	Evaluate the impact mining will have on the site with respect to capability and productivity.	Mining Engineer Environmental Engineer Agronomist Geologist Hydrogeologist Terrestrial Ecologist Plant Biologist Agricultural Engineer Archeologist Land Use Planner Social Scientist
Preliminary Mine Planning	Preliminary identification of postmining land uses.	Mining Engineer Land Use Planner Agronomist Engineering Economist
Permits Acquisition	Land use information and postmining land use plan.	Land Use Planner Environmental Engineer Agronomist
Administrative Detail Analysis	Submittal/approval of final land use plan.	
Detailed Mine Planning	Detailed land use plan design.	Land Use Planner (specifically Landscape Architect) Mining Engineer Environmental Engineer Agricultural Engineer Agronomist Hydrogeologist Plant Biologist Engineering Economist

*Refers to someone trained in regional planning, landscape architecture, or site design.

companies may recognize a need for a computerized information system. Companies that presently use computers for bookkeeping purposes may easily adopt a standard format for storing environmental data and other data. To be of most use, site-specific environmental data should be referenced to a common coordinate system. Computer simulation has been used, in some cases, to predict postmining topography, which is a major determinant of land use suitability (Eframian, 1981). A further step in the direction of management information systems could allow site planners to make inquiries of the data base concerning land use suitabilities of specific areas thus expediting the site planning process. The value of such a complex system would have to be weighed against the number of land use plans that a given company must generate in the course of a year.

5.3 Local Land Use Planning

State enabling acts have generally granted the responsibility and power for land use planning to local governments. Local land use agencies are often not formed, however, until some problem arises that requires land use controls. Many times these problems relate to transportation facilities, other public services (sewer, water, etc.) or subdivision standards, but rarely are mineral resources the motivating force behind the formation of a land use planning agency. Consequently, the members of the planning authority may be quite well informed about public facilities and community development but they are often unaware of the importance of mineral resources to the local area. The following guidelines are generally directed toward improving this understanding and insuring the mineral resources are considered in the development of local land use plans.

5.3.1 Recommendations for the Mineral Industries

Representatives of the mining industry should become familiar with and participate in the local land use planning process. The danger that exists, when mineral resources are ignored in the land use planning process, is that the land uses indicated in the plan may conflict with future mineral extraction operations thus preventing the mineral resources from ever being used.

Industry participation to prevent this sterilization can take several forms. First, it is essential that mining company representatives are familiar with existing land use plans. Also, the mining industry should be aware of who the local planners are and attempt to foster an atmosphere of mutual respect. One way in which this relationship can be established is for surface mine planners (particularly, those responsible for postmining land use plans) to meet the technical advisors of the planning board. Another form of industry participation involves offering testimony at public hearings when proposed land use plans are being considered. In this way, the views of the mining industry become part of the planning agency's official record. Also, representatives from the mining industry may become active in the local land use planning process as planning board members. Particularly in areas where mineral resources are very important to the local economy, a representative from the mining industry could provide understanding and balance to the local agency. A different and indirect approach to informing

local planners of the importance of mineral resources involves scholarly contributions to planning literature by representatives of the mining industry. Periodicals read by local planners should be encouraged to publish articles dealing with the advantages of considering mineral resources in the development of land use plans (Saperstein, 1982).

5.3.2 Recommendations for Local Land Use Planners

Since many of the recommendations directed toward the mining industry involved informing public planners of the peculiar problems of the mineral industries and the importance of mineral resources to a local economy, it stands to reason that land use planners should reciprocate by availing themselves to information that will give them an appreciation of mining's importance.

A second, and more concrete, manner in which local land use planners could act to prevent the sterilization of mineral resources is through the establishment of mineral conservation zones. In many states, local governments can designate certain areas as agricultural zones to prevent valuable soil resources from being lost to development. This concept can also be applied to mineral resources by designating the principal potential mineral extraction areas as mineral conservation zones. Low intensity uses such as agriculture would be permitted. However, any type of development that would preclude future mineral extraction would be prohibited unless a variance were obtained. Mineral zones would revert to agricultural or low density residential districts upon completion of mining and reclamation. Also, mineral zone designations could be reviewed periodically and rezoned if the mining industry indicates no interest in timely development of the mineral resources.

The concept of mineral zoning is not without precedent. Wisconsin has proposed a model mineral reservation and mine zoning ordinance (Preston et al, 1974). The purpose of the model ordinance is "to provide for the reservation of mineral deposits, for their orderly development, and for ultimate rehabilitation of the land consistent with social, economic, and environmental considerations". One of the primary concerns in Wisconsin was the loss of sand and gravel deposits to urban sprawl. One of the hindrances to mineral zoning in Wisconsin has been rather poor identification of the minable reserves, particularly, the sand and gravel deposits. Certain coal regions could benefit from mineral zoning since coal reserves are generally better defined on a regional basis than sand and gravel deposits. The greatest benefits would be realized in areas of large surface-minable reserves that are experiencing growth into rural areas. This condition exists in the vicinity of the Chinook Mine described in the Central U.S. Surface Mine Case Study (Appendix II).

There are two basic alternatives to implementing a policy of including mineral resources in local land use plans. The first alternative requires legislative action in revising state enabling acts. Enabling legislation could be revised to require local land use authorities to specifically consider mineral resources in the formulation of land use plans. There are presently no legal barriers to the creation of mineral zones. Therefore, the second implementation alternative involves participation by the mining

industry and pressure from concerned citizens. This approach may require some organization on the part of the mining industry to speak with a common voice. The mining industry is generally viewed differently than agricultural interests, however, both are basic industries that contribute to all other areas of the economy. Likewise, they both rely on geographically fixed resources: high quality soil in the case of agricultural and minerals in the case of mining. It can be argued that many farmers benefit from agricultural zones but only a few mining companies would benefit from the creation of a mineral zone. If, however, one views the number of miners employed by those mining companies and the secondary employment effects, the differences are not so great.

5.3.3 Information System Needs

The discussion of information system needs is limited to that information required by local planners to give adequate consideration to mineral resources. In general, local land use planners can become familiar with mineral resources and the mining industry through the literature and through attendance of continuing education short courses. Much of the opposition to surface mining is based upon an out-dated concept that surface mining will result in irreparable environmental damage. Familiarity with current reclamation practices and standards, for example, can help alleviate the fears of many land use planners.

The creation of mineral zones requires fairly specific information concerning the location of mineral deposits and the overburden thickness. Land use planners should become familiar with the sources of currently available geological information, such as the maps and reports published by the state geological surveys and the U.S. Geological Survey. For example, the Pennsylvania Topographic and Geologic Survey has published a map of the Pittsburgh region showing the thickness of overburden over the Pittsburgh seam (Cortis et al, 1975). Maps such as this could be used to locate areas of potential mineral extraction by surface mining methods. The manner in which the local planning agencies store and retrieve this information would be dependent upon the information system employed to handle other planning data. However, it is preferable that data of this type be referenced to a common coordinate system. It is unrealistic to expect local planning agencies to possess the expertise or resources necessary to gather geological data that is not already in published form. This problem is addressed in the following section.

5.4 Regional Resource Planning

Several attempts at regional resource planning can be cited. The State of North Dakota established the Natural Resources Council (1980) for the purpose of developing a long-range natural resources plan. An interim plan was published in 1980 that summarized the findings to date and listed some preliminary policy recommendations. The U.S. Geological Survey, through its Resource and Land Investigations (RALI) Program, along with the Missouri River Basin Commission have sponsored the Western Coal Planning Assistance Project (1979). The results of this study are published in a four-volume report. The third volume, "Forecasts for Western Coal/Energy Development" (ABT Associates Inc., 1979), explains and illustrates the use of programming

models, econometric models, economic base models, time series models, and simulation models for the purpose of projecting future energy demands and their impacts upon regional development. Finally, on a small scale, The North Central Pennsylvania Regional Planning and Development Commission (1979) has published a "Regional Energy Policies Plan." These citations are simply examples of various regional resources planning efforts encountered during the performance of the case studies. Many other similar reports are available in the planning literature. One common weakness that all of these efforts share is that they lack any force to carry out the policy recommendations. The only way in which any of these recommendations can be implemented is if a local land use authority enacts ordinances that will enforce the recommended policies.

An example of a regional resource planning concept that has been successful for over 50 years is the work of the soil conservation districts (Parks, 1952). This concept emerged in the 1930s when exploitive agricultural practices threatened the future of the nation's agricultural productivity. In an earlier section of this report, a case was made for mineral zoning at the local level, a practice that is presently employed to protect high quality agricultural land. The question arises whether there is a need for regional mineral conservation districts to maintain mineral resources for the public good as soil conservation districts protect soil resources.

Some mineral resources, such as sand and gravel, must be located near the consumer to be economically mined. Conflicts with other land uses are common and have resulted in the loss of tons of sand and gravel resources. Since the three case studies performed as part of this investigation dealt with the surface mining of coal, it is worthwhile to consider whether a large amount of coal reserves are also threatened with sterilization. The problem has not been a serious one in the past. The United States has had abundant coal reserves and mining companies have been able to mine adequate amounts to meet the demand. However, two factors should be considered in planning for future resource development. Coal has been projected to satisfy a larger percentage of the United States' energy demand with the result that production will likely increase annually for the foreseeable future. Secondly, a demographic trend to reverse migration has been observed. This means that while large cities have been declining slightly in population, the population in many rural areas have been increasing. This phenomenon was observed in Clay County, Indiana, the rural area surrounding Chinook Mine (Appendix II). The combination of increasing production and greater development in rural areas presents a real danger of land use conflicts that can result in the sterilization of coal reserves.

Mineral conservation districts would consist of sub-state regions defined by the boundaries of the coal fields. Like the soil conservation districts that grew out of model enabling legislation in the 1930s, these districts would be independent units of local government. The governing body would consist of representatives from the mining industry (both management and labor), owners of mineral lands, and local elected officials. Mineral conservation districts would not have the power to enforce land use controls, since this power has generally been given to counties or municipalities. However, local land use planners would receive benefits from the conservation districts in the form of technical information and planning assistance.

The primary functions of a mineral conservation district would be inventorying and mapping of mineral resources within its boundaries and providing technical assistance to the land use planners. Technical assistance could be offered to local land use planners in the designation of mineral zones and surface mine site planners could be assisted with postmining land use planning. A mineral conservation district should also participate in research and demonstration projects to show how surface mining can fit into a sequence of land uses. Employing some of the concepts found in the Surface Mining Control and Reclamation Act of 1977, mineral conservation districts could assist small operators by conducting the required hydrologic investigations for various watersheds and distributing the information to the small operators. Also, in regard to the federal Act, conservation districts could assist in the reclamation of abandoned mine land by ranking the sites within a district according to severity, assisting with the reclamation projects (either in direct participation or in an overseer role), and preparing land use plans for the reclaimed sites.

The information needs of mineral conservation district would be fairly extensive. Much of this information already exists or is routinely collected for other purposes. For example, Section 522 of the Surface Mining Control and Reclamation Act requires states to develop a data base for the evaluation of unsuitability petitions. Also, hundreds of permit applications are submitted to the states each year. These include not only surface mine permit applications but also permits for water discharge, air discharge, solid waste disposal, and others. Some states have already proposed the inclusion of permit application data into state-wide land use management information systems. Research has also begun on the development of a multipurpose cadastre information system (National Research Council, 1980). The envisioned system would take all information generated by public sources and that which is available from private sources and relate the information to a geographically fixed coordinate system. The effectiveness of mineral conservation districts could be greatly enhanced by participation in a comprehensive land use management information system.

5.5 Conclusion

Public policy has succeeded in expanding the role of planning with regard to surface mining operations. This is particularly true for the land use planning aspects of surface-mined land. The time spent in premine planning has been protracted, as illustrated in Figure 5.4. However, it is not yet apparent whether these changes will actually yield more productive or beneficial postmining land uses. There are many complex issues involved that cannot be resolved by simply collecting more data. Some positive changes in mined-land planning may only take place as attitudes and perceptions change and this may require many years to accomplish.

A prerequisite for improving the usefulness of surface-mined land, as has been stated by others (Imhoff, et al., 1978), is increased cooperation between surface mine operators and public planners. Several suggestions are put forward in these guidelines that can help overcome this problem. Both the mining industry and the land use planning authorities stand to benefit from a better understanding and involvement with each other. Land use

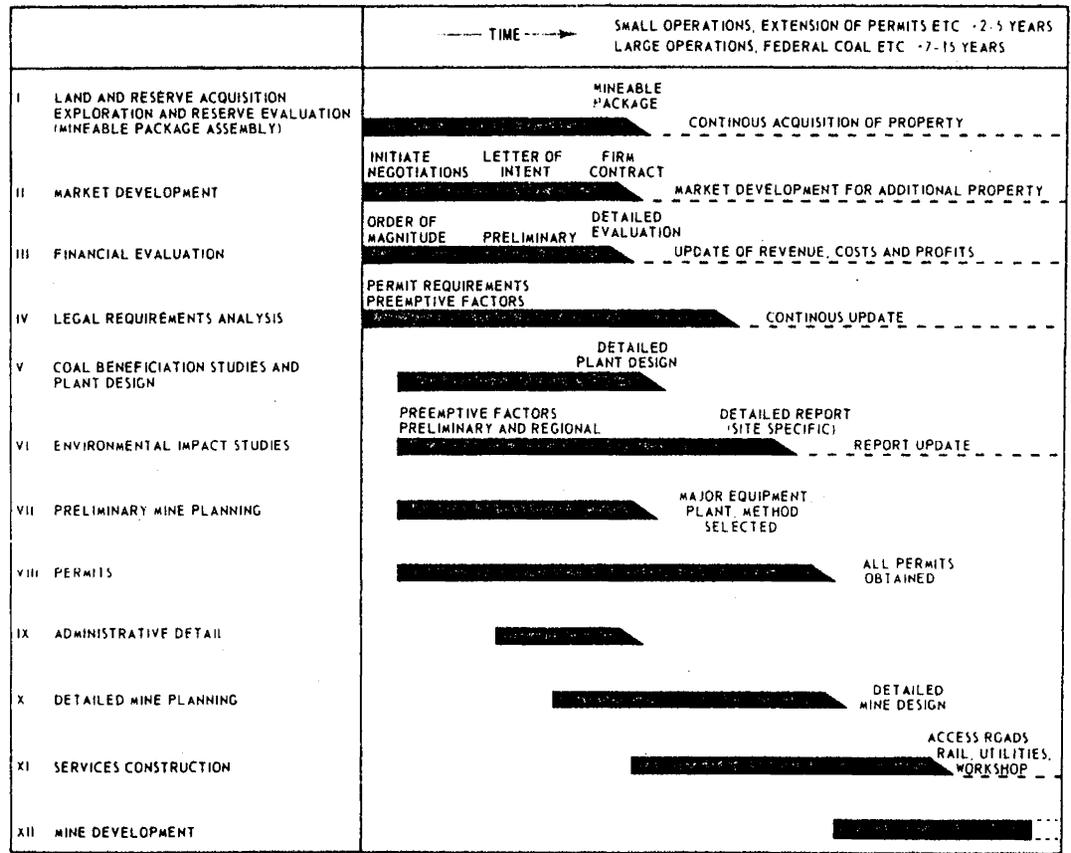


Figure 5.4 A time frame for premine planning (Ramani and Clar, 1978).

planners could have an expanded role as advisors to surface mine planners, thus insuring that local land use goals and objectives are given proper consideration in the mine planning process. Surface mine operators could be assured that their future operations would not be threatened by untimely development.

The importance of maintaining agricultural productivity has long been recognized by public policy-makers. Land use planners and policy-makers must recognize that specific localities and the nation, as a whole, are equally dependent upon mineral resources for survival. Up until the present time, one-sided planning (or negative mineral resource planning) has generally emphasized the exclusion of surface mining where it is not deemed appropriate.

One of the reasons for this exclusionary-type of planning is the negative image a majority of the public holds toward surface mining. This image results largely from pre-law operations that often resulted in orphaned lands and continual sources of pollution. Surface mining and reclamation techniques have advanced steadily, however, to the point that the general public is often not even able to differentiate between mined and unmined sites. Still the negative image remains. The surface mining industry must endeavor to present an enlightened view of mining and reclamation techniques to the public. Also, employment of environmental site planning principles, as outlined in this report, will help to erase this outdated image of surface mining.

Both the surface mining industry and public land use planning agencies must recognize that the value of a parcel of land stems from a unique combination of renewable and non-renewable resources. Although mineral resources are non-renewable, the land still has value after minerals have been removed due to its other resources. These resources include not only the land's natural characteristics but also the value attributed to it because of its geographic location or other cultural significance. Planning for the use of these lands should have the objective that, as far as practicable, no non-renewable uses are pre-empted and no renewable resources are permanently destroyed.

Finally, flexibility is required on the part of regulatory authorities in the review of alternative postmining land use plans. Although the objective of recent public policy has been to encourage more productive and beneficial uses of reclaimed land, many surface mine operators justifiably fear that proposed land use changes may delay approval of surface mining permits. As long as this impression persists, there is little chance that more productive postmining land uses will result.

References

- ABT Associates, Inc., "Forecasts for Western Coal/Energy Development," Western Coal Planning Assistance Project for Missouri River Basin Commission and U.S. Geological Survey, Reston, VA, 1979, 135 pp.
- American Law Institute, A Model Land Development Code, Washington, D.C., 1976.
- Bailly, P. A., "Exploration Methods and Requirements," Surface Mining, E. P. Pfleider, ed., AIME, New York, NY, 1968, pp. 19-42.
- Bosselman, F. P. and D. L. Callies, "The Quiet Revolution in Land Use Control" in Management & Control of Growth, Vol. 1, The Urban Land Institute, Washington, D.C., 1975.
- Carlson, C. G., "Geology of Mercer and Oliver Counties, North Dakota," Bulletin 56 - Part I, North Dakota Geological Survey, Grand Forks, ND, 1973, pp. 3, 23-29, 52-55.
- Chapin, F. S., Jr., Urban Land Use Planning, 3rd edition, University of Illinois Press, Urbana, IL, 1979, p. 82.
- Clar, M. L., "An Analysis of Requirements and Guidelines for Surface Mine Land Planning," M.S. Thesis, The Pennsylvania State University, University Park, PA, 1982, pp. 30-105.
- Clar, M. L., "Factors That Influence the Selection of a Land Use for Surface Mined Lands," AIME Annual Meeting, Chicago, IL, 1981, 36 pp.
- Clar, M. L. and R. V. Ramani, "User's Manual for Premining Planning of Eastern Surface Coal Mining, Volume 6: Mine Land Planning," Industrial Environmental Research Laboratory, EPA, Cincinnati, OH, in press, 201 pp.
- Clearfield County Planning Commission, "Information Summary," Clearfield, PA, 1975, 18 pp.
- Congressional Quarterly Almanac, "House Kills Land Use Bill on Procedural Vote," Vol. 30, Congressional Quarterly, Inc., Washington, D.C., 1975, p. 788.
- Congressional Quarterly Weekly Report, "Land Protection Bill Fails," Vol. 38, No. 8, Congressional Quarterly, Inc., Washington, D.C., February 23, 1980, p. 562.
- Cortis, S.E. et al, "Greater Pittsburgh Region maps of mined-out areas and thickness of rock over the Pittsburgh coal," Pennsylvania Topographic and Geologic Survey, Map #45, Harrisburg, PA, 1975, 2 pls.
- Council of State Governments, "State Housing Actions: Programs and Alternatives" in Management & Control of Growth, Vol. 3, The Land Institute, Washington, D.C., 1975.

- Council on Environmental Quality, "Environmental Quality," GPO, Washington, D.C., 1975.
- Curry, W.J., III and C. A. Fox, Jr., "A Role for Local Governments in Controlling Strip Mining Activities," prepared for the Pennsylvania Department of Environmental Resources, Environmental Planning Information Series, Report No. 3, Harrisburg, PA, 1978, 53 pp.
- Eframian, M., "Computers - A Practical Tool for Mine Planning and Operations," Mining Congress Journal, Vol. 67, No. 11, Nov. 1981, pp. 27-30.
- Fenneman, N.M., Physiography of Western United States, McGraw-Hill, Inc., New York, N.Y., 1931, pp. 61-79.
- Howard, A. D., and I. Remson, Geology in Environmental Planning, McGraw-Hill, Inc., New York, N.Y., 1978.
- Hutchison, H. C., "Geology and Coal Deposits of the Brazil Quadrangles, Indiana," Indiana Geological Survey, Bulletin No. 16, Bloomington, IN, 1960, 39 pp.
- Imhoff, E. A., T. O. Friz, and J. R. LaFevers, "A Guide to State Programs for the Reclamation of Surface Mined Areas," U.S. Geological Survey Circular 731, Reston, VA, 1976, 33 pp.
- Imhoff, E. A., W. J. Kockelman, J. T. O'Connor, and J. R. LaFevers, "Integrated Mined-Area Reclamation and Land-Use Planning; Vol. 2: Methods and Criteria for Land Use and Resources Planning in Surface Mined Areas," Argonne National Laboratory, Argonne, IL, 1978, 56 pp.
- Inter-Industry Technical Assistance Team, "Mercer County Socioeconomic Impact Mitigation Assessment - Volume VIII," Beulah, ND, 1981, 57 pp.
- Jensen, D. R., Selecting Land Use for Sand and Gravel Sites, National Sand and Gravel Assoc., Silver Spring, MD, 1967.
- Leopold, L. B. and others, "A Procedure for Evaluating Environmental Impact," U.S. Geological Survey Circular 645, Government Printing Office, Washington, D.C., 1971.
- Lewis and Clark 1805 Regional Council for Development, "Regional Land Use Policy Plan and Implementation Program, 1975-2000," Mandan, ND, 1978, 112 pp.
- Linowes, R. R. and D. T. Allensworth, The States and Land Use Control, Praeger Publishers, New York, N.Y., 1975.
- Lewis and Clark 1805 Regional Council for Development, "Overall Economic Development Program" Mandan, ND, 1981, 69 pp.
- Mountain Research, Inc., "Source Book for Western Coal/Energy Development," Western Coal Planning Assistance Project for Missouri River Basin Commission and U.S. Geological Survey, Reston, VA, 1979a, 223 pp.

- Mountain Research, Inc., "Fact Book for Western Coal/Energy Development," Western Coal Planning Assistance Project for Missouri River Basin Commission and U.S. Geological Survey, Reston, VA, 1979b.
- Mountain Research, Inc., "A Guide to Methods for Impact Assessment of Western Coal/Energy Development," Western Coal Planning Assistance Project for Missouri River Basin Commission and U.S. Geological Survey, Reston, VA, 1979c, 271 pp.
- National Research Council, "Need for a Multipurpose Cadastre," National Academy Press, Washington, D.C., 1980, 112 pp.
- North Central Pennsylvania Regional Planning and Development Commission, "Regional Energy Policies Plan," Ridgway, PA, 1979.
- North Dakota Natural Resources Council, "Natural Resources Interim Plan," Bismarck, ND, 1980, 60 pp.
- North Dakota State Planning Division, "North Dakota Land Use Element," Bismarck, ND, 1978, 74 pp.
- Office of Surface Mining, "Final Environmental Impact Statement on the Permanent Regulatory Program Implementing Section 501 (b) of the Surface Mining Control and Reclamation Act of 1977," GPO, Washington, D.C., January, 1979 a.
- Office of Surface Mining, "Surface Coal Mining and Reclamation Operations, Permanent Regulatory Program," Federal Register Vol. 44, No. 50, March 3, 1979 b.
- Parks, W. R., Soil Conservation Districts in Action, Iowa State College Press, Ames, IA, 1952, pp. 1-24.
- Powell, R. L., "Coal Strip-Mined Land in Indiana," Indiana Geological Survey, Special Report 6, Bloomington, IN, 1972, 18 pp.
- Preston, J., E. Strauss, and T. Friz, "Model Mineral Reservation and Mine Zoning Ordinance," Wisconsin Geological and Natural History Survey IC 24, Madison, WI., 1974, 43 pp.
- Pugliese, J. M., D. E. Swanson, W. H. Engelmann, and T. R. Bur, "Quarrying Near Urban Areas: An Aid to Premine Planning," USBM Information Circular 8804, Washington, D.C., 1979.
- Ramani, R. V. and M. L. Clar, "User's Manual for Premining Planning of Eastern Surface Coal Mining; Vol. 1: Executive Summary," Industrial Environmental Research Laboratory, EPA, Cincinnati, OH, 1978, 71 pp.
- Runyan, D., "Tools for Community-Managed Impact Assessment," Journal of American Institute of Planners, April, 1977, pp. 125-135.
- Saperstein, L. W., "Accommodating the Land-Use Planning Provisions of the Surface Mining Control and Reclamation Act," AIME Annual Meeting, Dallas, TX, 1982, 5 pp.

- Seldin, M., The Real Estate Handbook, Dow Jones-Irwin, Homewood, IL, 1980, p. 1060.
- Stranberg, C. H., Aerial Discovery Manual, John Wiley and Sons, Inc., New York, N.Y., 1967.
- Toumey, J. W., and C. F. Korstian, Foundation of Silviculture Upon an Ecological Basis, John Wiley and Sons, Inc., New York, N.Y., 1947.
- United States Department of Agriculture, "Restoring Surface-Mined Land," Miscellaneous Publication No. 1087, U.S. Government Printing Office, Washington, D.C., 1973.
- Wayne, W. J., "Thickness of Drift and Bedrock Physiography of Indiana North of the Wisconsin Glacial Boundary," Indiana Geological Survey, Report of Progress No. 7, Bloomington, IN, 1956, pp. 9-45.
- Weimer, A. M., and H. Hoyt, Real Estate, Fifth Edition, The Ronald Press Co., New York, N.Y., 1966.
- West Central Indiana Economic Development District, "Overall Economic Development Program, 1976-1980," Terre Haute, IN, 1977a, 391 pp.
- West Central Indiana Economic Development District, "District Land Use Element," Terre Haute, IN, 1977b, 220 pp.

Bibliography

- Ahearn, V. P., Jr., Land Use Planning and the Sand and Gravel Producer, National Sand and Gravel Assoc., Silver Spring, MD, 1964.
- Bagne, C. N., "State Land Use: Writing a Down-to-Earth Bill" in Management & Control of Growth, Vol. 3, The Urban Land Institute, Washington, D.C., 1975.
- Bartelli, L. J., Klingebiel, A. D., Baird, J. V., Heddleson, M. R., Soil Survey and Land Use Planning, Soil Science Society of America and American Society of Agronomy, Madison, WI, 1966.
- Baxter, J. G., Site Planning for Sand and Gravel Operations, National Sand and Gravel Assoc., Silver Spring, MD, 1969.
- Bogner, J. E., and A. O. Perry, "Integrated Mined-Area Reclamation and Land-Use Planning; Volume 3F - A Case Study: Cannelton Mine No. 9S, Cannelton, West Virginia," Argonne National Laboratory, Argonne, Illinois, Feb., 1977.
- Brice, W. C., M. Korzeniowski, and D. Karasov, "MINESITE - Resource Analysis Results," presented at the AIME Annual Meeting, Las Vegas, Nev., Feb., 1980.
- Burchell, R. W. and D. Listokin, ed., Future Land Use, Center for Urban Policy Research, Rutgers-The State University, New Brunswick, N.J., 1975.
- Burchell, R. W. and D. Listokin, The Environmental Impact Handbook, Center for Urban Policy Research, Rutgers-The State University, New Brunswick, N.J., 1975.
- Burns, C. S., "Impact of Land Withdrawals on Mining," American Mining Congress Journal, Vol. 67, No. 1, Washington, D.C., January, 1981, p. 29.
- Cleckner, E. K., "Highest Land Use as a Planning Tool," Appraisal Journal, 215-223, 1969.
- Committee on Surface Mining and Reclamation, James Boyd, Chairman, "Surface Mining of Non-Coal Minerals," National Academy of Sciences, Washington, D.C., 1979.
- Dames and Moore, "Development of Pre-Mining and Reclamation Plan Rationale for Surface Coal Mines, Vol. III - Legal Controls of Surface Mining," U.S. Bureau of Mines, Washington, D.C., June, 1976.
- Detwyler, T. R., and Marcus, M. G., Urbanization and the Environment, Duxbury Press, Belmont, CA, 1972.
- Emgdahl, D. E., "The Federal Lands Program Under SMCRA," presented at Annual Rocky Mountain Mineral Law Institute Conference, Boulder, CO, 1980.

- Friz, T. O., "Mineral Resources, Mining, and Land-Use Planning in Wisconsin," Wisconsin Geological and Natural History Survey IC 26, Madison, WI, 1975.
- Frye, J. C., "Geological Information for Managing the Environment," Illinois Geological Survey, Environmental Geology Notes 18, 1967.
- Greene, B. C., "Productive Aspects of Reclaimed Surface Mined Lands," Proc. 3rd Conf. on Mine Productivity, The Pennsylvania State University, 1976.
- Gurnsey, J. L., T. E. Miller, and J. R. LaFevers, "Integrated Mined-Area Reclamation and Land-Use Planning: Volume 3D - A Case Study: Area Strip Coal Mining, Peabody Universal Mine, Universal, Indiana," Argonne National Laboratory, Argonne, Illinois, Feb., 1977.
- Hagman, D. G., "The Taking Issue: A Review" in Management & Control of Growth, Vol. 1, The Urban Land Institute, Washington, D.C., 1975.
- Hyde, L. C., "State Land-Use Laws in the Northeast," Northeast Regional Center for Rural Development, Cornell University, Ithaca, N.Y., 1975
- Johnson, W., and J. Paone, "Land Utilization and Reclamation in the Mining Industry, 1930-1980," USBM Information Circular 8862, Washington, D.C., 1982.
- Knuth, W. M., E. L. Fritz, J. A. Schad, and W. F. Nagle, "Development of New Bond Release Criteria for Surface Coal Mines in the Eastern and Interior Coal Provinces of the United States - Final Technical Report," prepared for USBM by HRB-Singer, Inc., State College, PA, 1978.
- Kusler, J. A., "Open Space Zoning: Valid Regulation or Invalid Taking," Minnesota Law Review, 57:1, November, 1972.
- Leopold, L. B., "Hydrology for Urban Land Planning: A Guidebook on the Hydrologic Effects of Urban Land Use," USGS Circular 554, U.S. Govt. Printing Office, Washington, D.C., 1968.
- McComas, M. R., Hinkley, K. C. and Kempton, J. P., "Coordinates Mapping of Geology and Soils for Land Use Planning," Illinois Geological Survey, Environmental Geology Notes 29, 1968.
- Murray, F. X., ed., "Where We Agree: Report on the National Coal Policy Project," Volume 2, Westview Press, Boulder, CO, 1978.
- Office of Surface Mining, U.S. Department of the Interior, "Part 1: The Determination of the Probable Hydrologic Consequences; Part 2: The Statement of the Results of Test Borings or Core Samplings," Washington, D.C., 1980.
- Paone, J., J. L. Morning, and L. Giorgetti, "Land Utilization and Reclamation in the Mining Industry," 1930-1971, USBM Information Circular 8642, Washington, D.C., 1974.

- Patton, H. M., and J. W. Patton, "Harbingers of State Growth Policies," in Management & Control of Growth, Vol. 3, The Urban Land Institute, Washington, D. C., 1975.
- Ramani, R. V., and E. C. Grim, "Surface Mining - A Review of Practices and Progress in Land Disturbance Control," paper presented at Symposium on Reclamation of Drastically Disturbed Lands, Ohio Agricultural Research and Development Center, Wooster, Ohio, August 9-12, 1976.
- Ramani, R. V., L. W. Saperstein, H. L. Lovell, and M. Clar, "Premining Planning for Environmental Control in Surface Coal Mines," Preprint No. 77-E-387, paper presented at SME/AIME Fall Meeting, St. Louis, MO.
- Ramani, R. V., and R. J. Sweigard, "A Review of Public Policy in the United States Impacting the Rehabilitation and Use of Surface-mined Lands," Proceedings of National Seminar on Minerals and Ecology, Indian School of Mines, Dhanbad, India, 1982.
- Ramani, R. V., and R. J. Sweigard, "Impacts of Land Use Planning on Mineral Resources," SME-AIME Fall Meeting, Honolulu, Hawaii, September, 1982.
- "Regional aspects affect planning of surface mining operations," Coal Age, Vol. 18, No. 10, McGraw-Hill, New York, Oct., 1976.
- Rowe, J. E., ed., Coal Surface Mining: Impacts of Reclamation, Westview Press, Boulder, CO, 1979.
- Schaenman, P. S., "Using an Impact Measurement System to Evaluate Land Development," The Urban Institute, Washington, D.C., 1976.
- Skelly and Loy, Inc. A Compliance Manual: Methods for Meeting OSM Requirements, McGraw-Hill, New York, 1979.
- Solberg, E. D., "Suggestions for Planning and Zoning in Appalachia," ERS-330, USDA, 1967.
- Sweigard, R. J., and R. V. Ramani, "Evaluation of the Potential of Alternative Land Use Plans for Surface Mined Land," Proceedings of Conference on the Economics of Mined-Land Reclamation, Argonne National Laboratory, Chicago, IL, 1981.
- Sweigard, R. J., and R. V. Ramani, "Impact of Public Policy on Surface Mine Planning and Design in the United States," Indian Journal of Mines, Metals and Fuels, Calcutta, India, June, 1982.
- Toth, R., "Criteria in Land Planning and Design," Landscape Architecture 62(1), 1971.
- Warner, M. L., "Environmental Impact Analysis: An Examination of Three Methodologies," Ph.D. Thesis, University of Wisconsin, Madison, WI, 1973.

Yelverton, C. A., "The Role of Local Governments in Urban Geology," in
Environmental Planning and Geology in the Urban Environment," ed., by
Donald R. Nichols and Catherine C. Campbell, U.S. Government Printing
Office, Washington, D.C., 1971.

Exhibit 1

Mine Visits

<u>Mine Visited</u>	<u>Location</u>	<u>Mine Operator</u>
Cooper Smokeless No. 2 Aurora No. 2 Mine	Bigler, PA	Bradford Coal Co.
Chinook Mine	Brazil, IN	AMAX Coal Co.
Sand & Gravel Pit	Middleton, WI	Capital Sand & Gravel Co.
Falkirk Mine	Underwood, ND	The Falkirk Mining Co.
Indian Head Mine	Zap, ND	The North American Coal Corp. - Western Div.
Belle Ayr Mine	Gillette, WY	AMAX Coal Co.
Eagle Butte Mine	Gillette, WY	AMAX Coal Co.
Cordero Mine	Gillette, WY	SUNEDCO Coal Co.
Black Thunder Mine	Wright, WY	Thunder Basin Coal Co.
Rawhide Mine	Gillette, WY	Carter Mining Company
Spingola No. 1 Mine	Ansonville, PA	Simca Mining
Kanawha Div. Mines	Montgomery, W VA	Cannelton Industries Inc.
Dandow Mine	Rockdale, TX	ALCOA
San Miguel Mine	Jourdanton, TX	Morrison-Knudson Co.

Exhibit 2

Persons Contacted

Organization

AMAX Coal Co.

Indiana

Harry Yocum, Director of Environmental Engineering
Steven Cecil
Gary Doxtater
Vance P. Wiram
Ravi Kharker
Robert Treirweiler
Robert Marks
Carol Thompson
Todd Lewis
Randy Staley
Donald McCollum
Jesse Fried

Wyoming

David Hipple
Mark Westphal

North American Coal Corp.

Western Division

North Dakota

Robert Murray, President
James Brown, Director of Environmental Control
Peter Nielson
Robert Wright
Dean Peterson
Robert Decker, Mine Superintendent
Jerry Becker

Bradford Coal Co.

Bigler, PA

Clayton Peters, Chief Engineer
Russell Fricke, Vice President for Research

Simca Mining, Inc.

Ansonville, PA

George Shimchock, President

Hess & Fisher Engineers

Clearfield, PA

Wilson Fisher, Jr.
John Hess
William Rowles

Capital Sand & Gravel Co.

Madison, WI

R.A. Gallagher, President

The Falkirk Mining Co.
Underwood, ND
Burl Sorenson

Thunder Basin Coal Co.
Wright, WY
Steven Force

Carter Mining Co.
Gillette, WY
Rick Croote

Industrial Generating Co.
Rockdale, TX
W.E. Davis

Morrison-Knudson Co.
San Antonio, TX
Kraig Grubaugh

Clearfield County Planning Commission
Clearfield, PA
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James Finger

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Joan Hardesty

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Michael Robinson
Michael Rosenthal

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Hays Gamble
Donald Epp
Sonia Kerr

Landscape Architecture Department
Daniel Jones

Mineral Engineering Department
Robert L. Frantz
Lee W. Saperstein

Exhibit 3

List of Publications

- "The Influence of Governmental Land Use Control on Postmining Use of Surface-Mined Lands"
by R.J. Sweigard
1980 SME-AIME Student Paper Contest - Graduate Division Winner
- "Evaluation of the Potential of Alternative Land Use Plans for Surface-Mined Land"
by R.J. Sweigard and R.V. Ramani
presented at Conference on the Economics of Mined-Land Reclamation,
Chicago, Illinois, September, 1981
- "A Review of Public Policy in the United States Impacting the Rehabilitation and Use of Surface-Mined Lands"
by R.V. Ramani and R.J. Sweigard
presented at National Seminar on Minerals & Ecology, Indian School of Mines, Dhanbad, India, March 6-7, 1982
- "Impact of Public Policy on Surface Mine Planning and Design in the United States"
by R.J. Sweigard and R.V. Ramani
in Indian Journal of Mines, Metals and Fuels, June, 1982
- "Impacts of Land Use Planning on Mineral Resources"
by R.V. Ramani and R.J. Sweigard
presented at SME-AIME Fall Meeting, Honolulu, Hawaii, September 4-9, 1982
- "A Regional Comparison of Postmining Land Use Practices"
by R.J. Sweigard and R.V. Ramani
presented at SME-AIME Annual Meeting, Atlanta, Georgia, March 6-10, 1983