



RETURNING MATERIALS:

Place in book drop to
remove this checkout from
your record. FINES will
be charged if book is
returned after the date
stamped below.

740 351

--	--

THE ECONOMICS OF SURFACE COAL MINING
ON MICHIGAN AGRICULTURAL LANDS

By

Mary E. Patrino

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Agricultural Economics

1984

ABSTRACT

THE ECONOMICS OF SURFACE COAL MINING ON MICHIGAN AGRICULTURAL LANDS

By

Mary E. Patrino

Surface coal mine operators have expressed interest in developing coal resources located underneath agricultural land in southeastern Michigan. The use of agricultural land for surface coal mining elicits concern over the impact of mining on the agricultural sector of the state economy, the environment and the communities located near mining sites. This research analyzes surface coal mining on Michigan agricultural lands within an economic framework to provide guidance for future land use policy decisions.

Background for the analysis is provided through data on the location, quality and quantity of the Michigan coal resource, as well as information relating the characteristics and importance of agriculture in the Michigan economy. Economic concepts are utilized to develop an analytical framework within which the allocation of land between farming and surface coal mining can be structured and understood. A procedure is presented and applied to estimate local economic impacts of land conversions from farming to surface coal mining.

The analysis indicates that surface coal mining in Michigan will not significantly affect the state's agricultural sector. Rather, impacts will be experienced primarily by communities located near mining sites.

ACKNOWLEDGEMENTS

Several people deserve recognition for their contributions to the completion of this thesis. My major professor and thesis supervisor, Dr. Larry Libby, deserves special thanks for his guidance and continuing enthusiasm throughout the course of this research.

I also wish to thank Dr. Dan Chappelle and Dr. Milton Steinmueller for serving on my committee and providing helpful comments for improving this study.

A special word of thanks for my friend, Geoff Huntington, for his unwavering support and encouragement throughout my masters program.

Finally, sincere appreciation goes to my family for their enthusiasm and understanding throughout the final months of this research project.

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	vi
LIST OF FIGURES.	viii
 CHAPTER	
1 THE ECONOMICS OF SURFACE COAL MINING ON MICHIGAN	
AGRICULTURAL LAND.	1
Introduction.	1
Exhaustible Natural Resources	3
Overview	3
Coal	4
Economic Determinants of Land Use	5
Overview	5
Coal and Agriculture	6
Approach of Thesis.	7
Organization of Thesis.	7
2 COAL MINING AND AGRICULTURE IN MICHIGAN.	10
Coal Resources of Michigan.	10
History of Coal Mining in Michigan	10
Coal Reserves.	15
Coal Basin.	15
Quality of Michigan Coal.	17
Quantity of Michigan Coal	17
Legislation.	18
Surface Mining Technique	24
Market Characteristics	26
Reclamation.	29
Michigan Agriculture.	30
Role of Agriculture in the Michigan Economy.	31
Description of Michigan Agriculture.	34
Institutional Framework.	39
Private Institutional Framework	39
Public Institutional Framework.	43
The Michigan Farmland and Open Space	
Preservation Act	43
Summary	47
3 ECONOMICS OF A STOCK RESOURCE AND PUBLIC CHOICE	
ECONOMICS.	49
Introduction.	49
The Economics of a Stock Resource	50
Efficiency	51

<u>Chapter</u>	<u>Page</u>
Pareto Efficiency	51
Maximum Social Well-Being	57
Constant Proportional Shares.	58
Pareto Safety	59
Maximum Value Social Product.	59
Potential Pareto Improvement.	60
Sources of Inefficiency.	61
Barriers to Internalizing Externalities.	63
Optimal Allocation Over Time	66
Uncertainty.	69
Intergenerational Equity	71
Resource Scarcity and Resources as Constraints on Growth	72
Public Choice Economics	74
Introduction	74
Nature of Good	75
Structure and Performance of a Regulatory System.	77
Summary	80
4 ANALYSIS OF THE ALLOCATION OF LAND BETWEEN AGRICULTURE AND SURFACE COAL MINING IN MICHIGAN.	83
Introduction.	83
Investment Decisions.	84
Discounting Returns Over Time.	85
Net Present Value Criterion.	87
Choice of Discount Rate.	87
Economics of Allocation of Land Between Agriculture and Surface Coal Mining Uses	89
Summary	90
5 LOCAL IMPACTS OF SURFACE COAL MINING AND PROCEDURE FOR ECONOMIC IMPACT ASSESSMENT	96
Introduction.	96
Distribution of Impacts	98
Identification of Impacts	99
Environmental Impacts.	100
Transportation Infrastructure.	102
Economic Impacts	103
Income Changes and the Multiplier Effect	104
Tax Impacts	105
Employment.	106
Procedure for Local Impact Assessment	108
Estimating Costs and Returns to Michigan Agriculture, by Farm Type and Size.	110
Estimating Costs and Returns to Surface Coal Mining in Michigan	119
6 SUMMARY AND CONCLUSIONS.	128
Summary	128

<u>Chapter</u>	<u>Page</u>
Conclusions	131
General Conclusions.	133
Agricultural Impact Conclusions.	135
Local Impact Conclusions	137
Policy Implications.	139
Future Research Suggestions	141
APPENDICES	143
BIBLIOGRAPHY	171

LIST OF TABLES

<u>Table</u>	<u>Page</u>
2-1 Michigan Coal Production, 1860-1976.	12
2-2 1980 Sources of Michigan Bituminous and Lignite Coal Imports	27
2-3 Michigan's Rank in the Nation's Agriculture, 1981. . . .	33
2-4 Cash Receipts from Marketings, Michigan.	36
2-5 1981 Michigan Counties Leading in Agricultural Production	37
2-6 Farm Production Expenses, Michigan	38
2-7 Gross and Net Income, Michigan	40
2-8 Income Per Farm, Michigan.	41
2-9 Acres Enrolled in P.A. 116 Program, By County, 1983	45
5-1 Potential Environmental Effects of a Surface Coal Mine Operation	101
5-2 Estimated Costs and Returns Per Acre of Farmland, by Acreage and Farm Type, (\$/acre), 1982	112
5-3 Average Multiplier Value and Ranges, By Size Class, for County Employment	114
5-4 Allocation of Costs In and Out of Local Economy, In General and Saginaw Valley Cash Crop Farm (400-800 acres).	115
5-5 Estimated Costs and Returns to the Local Economy, Per Acre, by Farm Type and Size.	116
5-6 Discounted Estimated Agricultural Benefits Per Acre to Local Economy, by Farm Type and Size, For Infinite Period (\$).	118
5-7 Worksheet for Estimating Returns to the Local Economy from an Acre of Surface Coal Mining in Michigan	121

<u>Table</u>		<u>Page</u>
5-8	Worksheet for Calculating Annual Mine Production Costs/Acre	122
5-9	Worksheet for Estimating Expenditure Allocation In and Out of Local Economy.	123

LIST OF FIGURES

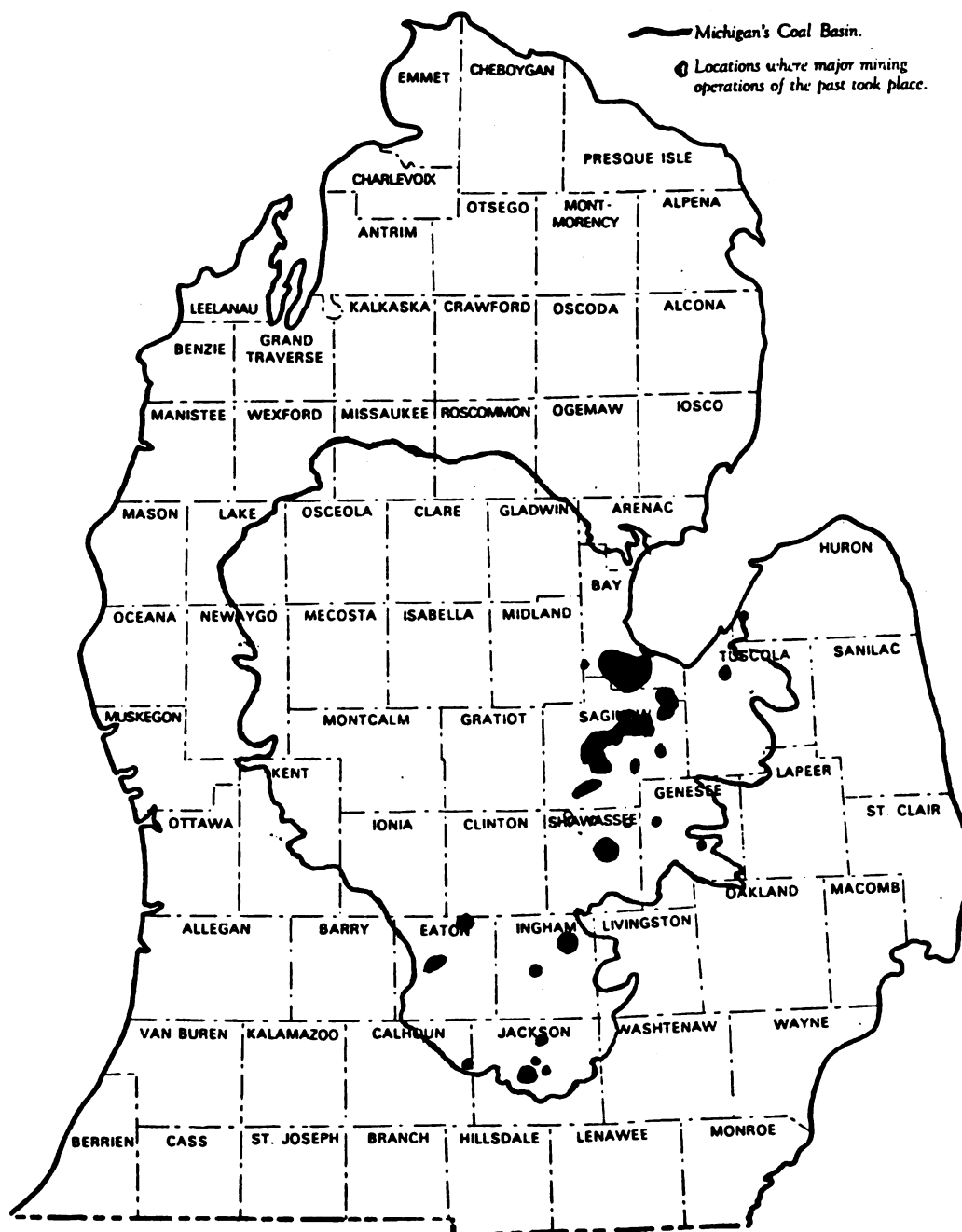
<u>Figure</u>		<u>Page</u>
1-1	Michigan Coal Basin.	2
2-1	Coal Production in Michigan, 1860-1976	13
2-2	Diagram of Area Surface Mining Technique	25

CHAPTER 1
THE ECONOMICS OF SURFACE COAL MINING
ON MICHIGAN AGRICULTURAL LANDS

Introduction

Beginning in the late 1970's, small surface coal mine operators began expressing interest in developing the bituminous coal resources located in the southeastern portion of the lower peninsula of Michigan (see Figure 1-1). Although Michigan has never been a major coal producing state, surface and underground mines produced more than forty-six million tons of coal between 1835 and 1952 (Webber and Ehlke, p. 64, 1981). Higher prices for energy fuels, more efficient extraction methods, an increasing demand for coal and lower transportation costs have led potential investors to conclude that coal mining can be profitable in Michigan during the 1980's and 1990's (Roethele and Parrish, p. 37, 1982). In addition, state officials feel surface coal mining will contribute support to the state's faltering economy by providing employment opportunities, attracting industry into the state, and decreasing the amount of coal imported to meet state energy requirements (Ibid).

A significant amount of the state's strippable coal reserves underlie agricultural land considered to be essential to the future of the Michigan economy. The renewal of surface coal mining in Michigan will cause withdrawals from the supply of land available to meet future demand for farmland and agricultural products. In addition, the impending



Source: Roethele and Parrish (1982).

Figure 1-1
Michigan Coal Basin

actions elicit concern over the impacts surface coal mining will have on the land, the surrounding environment, and the communities in which the mining occurs. In response to these concerns, the state legislature passed the Michigan Surface and Underground Mine Reclamation Act (P.A. 303) on October 12, 1982. This Act, patterned after the Federal Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87), is intended to protect agricultural land and the surrounding environment through the implementation of a regulatory framework designed to control the operation of mines within the state of Michigan (see Appendix A).

The intent of this research is to analyze surface coal mining on Michigan agricultural lands within an economic framework. Application of the conceptual framework provided by the discipline of economics will help to clarify the issues surrounding surface coal mining in Michigan and make more explicit the choices facing state and local policy makers.

Exhaustible Natural Resources

Overview

Randall (1981) defines a resource as "something that is useful and valuable in the condition in which we find it" (p. 13, 1981). In general, natural resources may be classified as either stock, flow or composite resources (Barlowe, pp. 228-9, 1978). The total physical supply of a stock resource is fixed; because new deposits occur only over geologic time periods, withdrawals from the stock may lead to exhaustion of the resource. A flow resource, such as water, is renewable and may either be stored for later consumption or utilized as it becomes available (Randall, p. 14, 1981). Composite resources have characteristics of

both stock and flow resources; included in this category are biological resources, soil resources, and man-made improvements (Barlowe, p. 228, 1978).

The majority of energy resources used in the United States are stock resources. In 1979 coal supplied 18.6 percent of U.S. energy needs, natural gas 27.3 percent, and petroleum 47.2 percent for a total of 93.1 percent of the total national energy requirements (Schurr et al., p. 71, 1979).

Coal

The analysis presented in this paper involves the surface extraction of coal - a stock resource - for use as an energy fuel. Although the United States is believed to hold more than 208 billion tons of coal in proven reserves, this quantity cannot be increased except through discoveries or the development of new technologies (Perry, p. 378, 1983). Around 1900, coal provided 93.0 percent of the energy needs of the United States but from 1900 to 1970 dependence on coal steadily declined. From a low point in 1972 when coal supplied only 17.3 percent of U.S. energy needs, the last decade has seen legislative and policy incentives bolster this figure to 22.1 percent in 1982 (Ibid, p. 377). The prime uses of coal are electrical generation (64 percent), industrial uses (33 percent) and residential and commercial uses (3 percent) (Seitz et al., p. 23, 1981).

Although the supply of coal which exists in the United States makes it an attractive, dependable energy source, there are problems associated with its use. Many environmental problems result from either the production or burning of coal. These problems may be experienced locally

(ex., soil erosion) or at great distances from the mine site (ex., acid rain). As an industry, coal production is also susceptible to capital shortages which result from high interest rates, labor strikes and increasing labor costs, and inadequate transportation facilities (Schurr et al., p. 483-9, 1979).

Economic Determinants of Land Use

Overview

The allocation of land between farming and surface coal mining is determined by the relative value of the land in the alternative uses or mix of uses (Huff et al., p. 16, 1982). Through the market pricing mechanism, land resources tend to gravitate to those uses that command the highest market prices and offer the highest rates of return (Barlowe, p. 129, 1978). Assuming that the market mechanism is functioning perfectly, land that generates high rates of returns to farming relative to the returns from the production of the underlying coal resource may not be mined. Alternatively, land will be converted from farming to surface mining if the value of the coal resource becomes greater than the overlying surface for farming (Huff et al., p. 16, 1982). The returns to coal mining are dependent upon the price of coal, the price of coal substitutes, transportation costs, costs of extraction and other economic factors (Ibid).

The conversion process can be analyzed on the basis of economic efficiency. Under the conditions of a perfectly competitive market system, neoclassical economic theory states that resources will be allocated to their most efficient use through the market pricing system (Solberg, p. 540, 1982). Producers respond to market signals to maximize

profits. However, resource allocation may be less than efficient if a divergence exists between social and private costs. Under these circumstances a "market failure" is said to exist and, although producers are behaving efficiently by private standards, social efficiency is not achieved. A market failure may result when the decisions producers make directly affect other individuals and the producers own production in ways not reflected in cost or benefit calculations. Because they are not accounted for, these costs are said to be external to the market system and are referred to as "externalities." Air pollution is a common example of an externality; while pollution may inflict significant costs to society in terms of increased health care, etc., the polluter is not charged for the right to expell these pollutants into the atmosphere. The economic concepts of efficiency, market failure and externalities will be dealt with more extensively in Chapter 3. Use of an economic framework will help to clarify the issues surrounding the surface mining of coal in Michigan and make more explicit the choices facing state and local policy makers.

Coal and Agriculture

The United States Department of the Interior estimates that more than ten million acres of land may eventually be surface mined for coal (Seitz et al., p. 9, 1981). While this figure appears large, surface coal mining actually accounts for a relatively small percentage of the land diverted from agricultural uses each year. However, the highly visible nature of surface mining, uncertainty of land reclamation success, off-site damages and the (at least) temporary loss of soil productivity have led the Committee on Soil as a Resource in Relation to

S. C. M. a. C. S. C. i. t. C. F. Y. C. S. t. t. t. e. e. J. n. S.

Surface Mining for Coal of the National Academy of Science (1981) to conclude that, "the relatively small size of these losses,..., does not ipso facto mean they are trivial or that the nation can obviously afford them" (Ibid, p. 10, 1981). The implications of the conversion of agricultural land to surface mines is the subject of on-going debate (Singer, p. 255, 1977).

Approach of Thesis

The intent of this research is to analyze the surface coal mining of Michigan agricultural lands within an economic framework. By applying the conceptual framework provided by the discipline of economics to the situational variables existing in Michigan, a perspective can be developed that will be of use in future policy decisions. Another important role of this thesis is to consolidate information on the coal resource of Michigan. The information presented and the conclusions drawn from this analysis are intended to serve as a useful tool for state and local officials and citizens who will be directly involved in the policy formulation and implementation of surface coal mining regulations in the state of Michigan.

Organization of Thesis

To begin the analysis, Chapter 2 presents a discussion of the history, location, quantity and quality of the Michigan coal resource to establish the background for the analysis which follows. The regulatory environment created by the passage of the new state law is also examined. In addition, it is instructive to describe the technique of area surface mining, the characteristics of the state's coal market, and the current status of reclamation procedures.

Agriculture represents a vital component of the Michigan economy at the present time; and, it is likely that its importance will increase in the future. Because surface mining and farming are mutually exclusive land uses, it is important to consider the role of agriculture in Michigan in order to assess the impact of land conversions from farming to surface mining.

With this background, concepts from the neoclassical economic analysis of a stock resource are presented in Chapter 3. The topics which are included are efficiency, resource allocation over time, uncertainty, intertemporal equity, and the macroeconomic issue of resources as a constraint on growth. The regulatory structure established by P.A. 303 (Michigan Surface and Underground Mine Reclamation Act) will then be evaluated in a public choice framework utilizing a situation, structure, performance paradigm.

Chapter 4 begins with an analysis of the investment decision facing a Michigan landowner who has the opportunity to sell or lease his land for surface coal mining. The concepts of discounting, choice of discount rate and economics of the allocation of land between farming and surface mining are discussed as well as the investment criterion of net present value.

The analysis continues in Chapter 5 with an assessment of local community impacts that result from surface mining operations. Included in this chapter is discussion of the distribution of benefits and costs from surface mining, the effect of coal transportation on local road systems, and the environmental impacts of mining. The chapter concludes with discussion of the local economic impacts of surface mining and the

presentation of a framework within which local policy makers can estimate the magnitude of these impacts.

Chapter 6 summarizes and discusses the conclusions to be drawn from this study. In addition, future research needs are suggested.

CHAPTER 2

COAL MINING AND AGRICULTURE IN MICHIGAN

Coal Resources of Michigan

In order to examine the economics of surface coal mining on Michigan agricultural lands, it is necessary to understand the setting in which the mines will operate. This chapter establishes the background for the analysis which follows through a discussion of the history and characteristics of the Michigan coal resource as well as the role of agriculture in the Michigan economy.

History of Coal Mining in Michigan

Coal mining in Michigan began in 1835 when workmen digging the foundation for a grist mill in Jackson County discovered a small seam of coal (Cohee et al., p. 4, 1950). Following this discovery small mines opened in Eaton, Jackson and Shiawassee Counties as early as 1839 (Roethele and Parrish, p. 64, 1982). More than forty-six million tons of coal were produced in Michigan between 1835 and 1952 from an estimated 115 mines. A majority of these mines were underground shaft mines which utilized the room and pillar method of mining (Cohee et al., pp. 4, 48-51, 56, 1950).

In 1860, the first year that records were kept, 2,320 tons of coal were produced in Michigan. With the exception of a period of low production between 1883 and 1894, production rose steadily until the turn of the century. The opening of two underground mines in Bay and Saginaw

Counties in 1897 led to a doubling of coal production and resulted in the coal industry playing a significant role in the state's economy during the late 1800's and the early 1900's. (Cohee et al., p. 4, 56, 1950). Production peaked in 1907 when thirty-seven mines produced 2,035,858 tons of coal with a dollar value of \$3,660,833 (Webber and Ehlke, p. 63, 1982). After 1907 production declined steadily. By 1946 only the Swan Creek Mine, located northeast of St. Charles in Saginaw County was operating with an average output of eighty tons per day. In 1952 more coal was being produced than sold and, when the coal pile reached 2,500 tons late in 1952, the mine was closed (Arnold, p. 101, 1954).

The closing of the Swan Creek mine effectively ended the era of coal production in Michigan (see Table 2-1 and Figure 2-1). As stated earlier, the majority of the mines operating during this time period were underground shaft mines. Located in Bay, Tuscola, Shiawassee, Saginaw, Calhoun, Genesee, Ingham, Eaton and Jackson Counties, these mines ranged in depth from 100 to 300 feet, with an average depth of 110 feet. The average life span of these mines was six to eight years (Roethele and Parrish, p. 31, 1982). The surface mines which operated were located in the southeastern section of the lower peninsula where glacial drift is thin or absent. Due to the limited extent of the coal resources of Michigan, no surface mine covered more than a few acres (Cohee et al., p. 4, 1950). In all, 570 acres of land have been utilized in Michigan for surface coal mining (Johnson and Paone, p. 12, 1982).

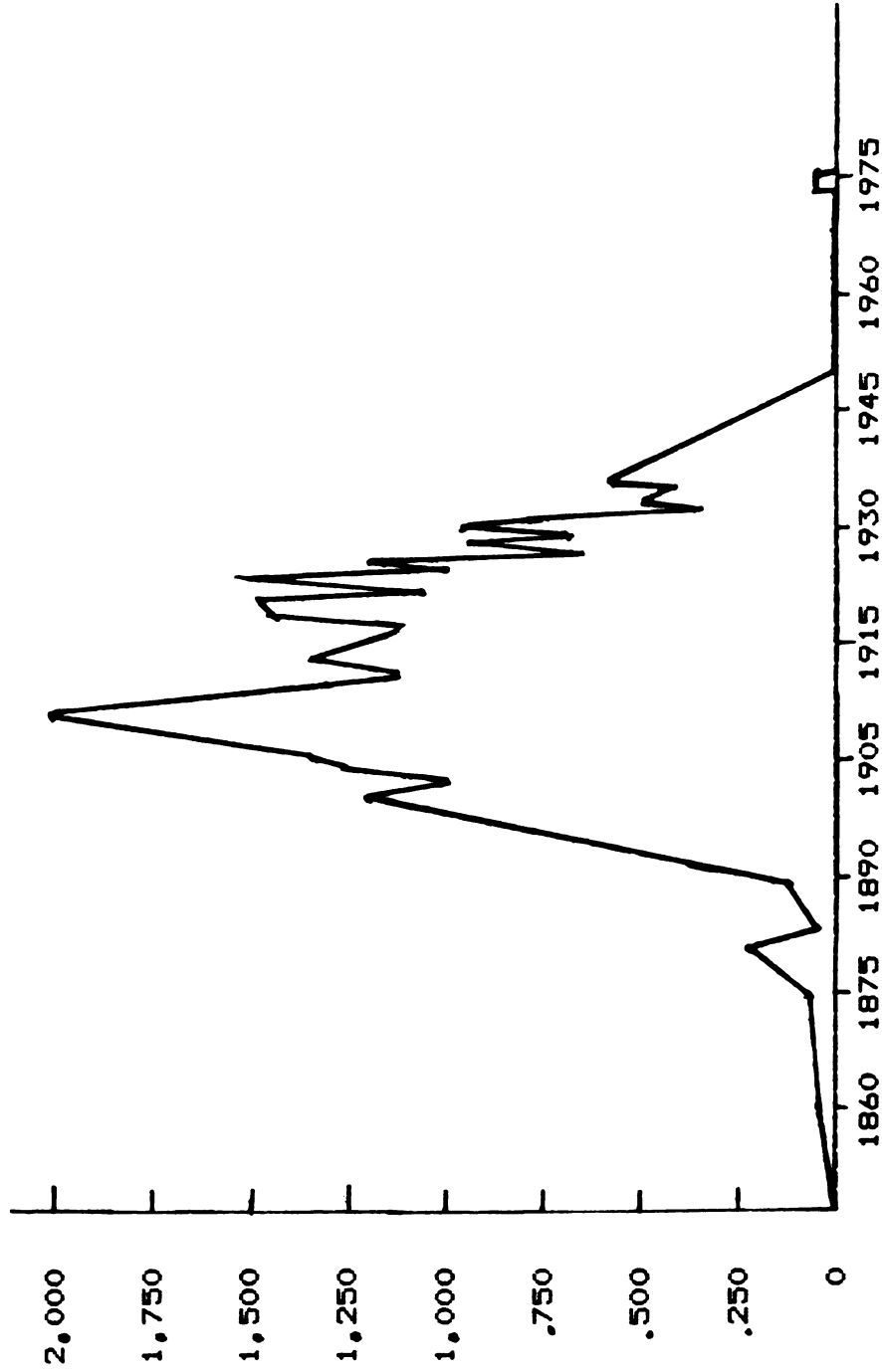
In his review of the Michigan coal era, Arnold (1954) stressed that the decline of the coal industry did not result from a lack of effective demand for coal by state consumers. He noted that eight million tons of

TABLE 2-1. Michigan Coal Production, 1860-1976

Year	Short Tons	Year	Short Tons	Year	Short Tons
1860	2,320	1895	112,322	1930	661,113
1861	3,000	1896	92,882	1931	359,403
1862	5,000	1897	223,592	1932	446,149
1863	8,000	1898	315,722	1933	406,741
1864	12,000	1899	624,708	1934	621,741
1865	15,000	1900	849,475	1935	628,384
1866	20,000	1901	1,241,241	1936	626,145
1867	25,000	1902	964,718	1937	562,262
1868	28,000	1903	1,367,619	1938	494,481
1869	29,980	1904	1,342,840	1939	456,754
1870	28,150	1905	1,473,211	1940	410,169
1871	32,000	1906	1,346,338	1941	310,775
1872	33,600	1907	2,035,858	1942	231,148
1873	56,000	1908	1,835,019	1943	168,615
1874	58,000	1909	1,784,692	1944	139,938
1875	62,500	1910	1,534,967	1945	125,704
1876	66,000	1911	1,476,074	1946	79,990
1877	69,197	1912	1,164,973	1947	14,013
1878	85,322	1913	1,138,639	1948	13,000
1879	82,015	1914	1,283,030	1949	11,450
1880	100,000	1915	1,156,138	1950	12,000
1881	112,000	1916	1,180,360	1951	12,000
1882	135,339	1917	1,374,805	1952	3,000
1883	71,296	1918	1,464,818	1953-	
1884	36,712	1919	996,545	1973	-0-
1885	45,178	1920	1,489,765	1974-	
1886	60,434	1921	1,141,715	1976	20,000
1887	71,461	1922	929,390	1979-	
1888	81,407	1923	1,172,075	1984	-0-
1889	67,431	1924	831,020		
1890	74,977	1925	808,233		
1891	80,307	1926	686,707		
1892	77,990	1927	756,763		
1893	45,979	1928	617,342		
1894	70,022	1929	804,869		

Total (as of May, 1984) = 46,332,240

Source: Cohee et al. (1950), U.S. Bureau of Mines (1971), Webber and Ehlke (1981).



Source: Cohee et al. (1950), U.S. Bureau of Mines (1971), Webber and Ehlike (1981).

Figure 2-1

Coal Production in Michigan, 1860-1976
(Million Tons)

coal were being used for residential heating in Michigan as late as 1950. Rather, Arnold cited the thinness of the coal seams, high water table in coal bearing regions, high sulphur content and physical characteristics of Michigan coal as major contributions to the high production costs which led to high coal prices and the eventual cessation of industry activities (Arnold, pp. 101-2, 1954). Analysts of the era (Cohee et al. [1950], Arnold [1954], and Dorr and Eschman [1970]) agree that the decline can be attributed to three main sources: (1) competition from coal-rich Appalachian states, (2) the high cost and difficulty involved in extracting Michigan coal, (3) the relatively poor quality of Michigan coal. In essence, high prices for Michigan coal led consumers to choose lower priced, higher quality substitutes from the Appalachian states. The oil embargo of the early 1970's and subsequent rise in the price of petroleum fuels induced the re-opening of an abandoned surface mine south of Williamston, Michigan, for a two year period, 1974-1976. The mine, originally owned and operated by the Grand River Coal Company, had ceased production in 1933 and was abandoned in an essentially unreclaimed state. From 1974 to 1976 the Michigan Aggregate Corporation, a gravel extractor, used then-idle gravel machinery and labor to surface mine for coal (Brewczak, p. 5, 1982). The operation produced and sold approximately 20,000 tons of coal to a local utility company (Minerals Yearbook, p. 377, 1976). Since 1977, there has been no commercial production of coal in the state of Michigan.

Assuming a forty percent rate of loss during mining, and given a total production of coal equal to 46,332,240 short tons, the total amount of coal mined and lost during mining in Michigan between 1835 and 1976 exceeded 77 million short tons (Cohee et al., p. 2, 1950). During peak

production in 1907, Michigan coal provided one-sixth of all coal used in the state (Roethele and Parrish, p. 30, 1982).

Coal Reserves

Coal Basin: The geological structure in which the Michigan coal lies is called the Michigan basin. The structure, extending over 11,500 square miles in the central portion of the lower peninsula, is bounded on the north by Houghton Lake, on the south by Jackson, on the east by Bay City and on the west by Big Rapids (see Figure 1-1). On a national level the basin lies within the Northern Interior Province of the United States Bureau of Mines coalfield classification scheme (U.S. Bureau of Mines, Staff, pp. 8-9, 1971).

The rocks in the basin are of Pennsylvania age, being formed of sand, silt and mud that accumulated in swamps approximately 280 million years ago. The formation is supported by a layer of Parma sandstone which ranges in thickness from 15 to 150 feet. No coal exists in this layer. The layer which lies above the Parma sandstone, called the Saginaw formation, ranges in depth from 200 to 650 feet and contains all of the coal found in the basin (Cohee et al., p. 2-3, 1950). On top of the Saginaw formation lies the Grand River group. The sandstones of this group occur sporadically over the basin and are absent in some locations (Dorr and Eschman, p. 130, 1970). The uppermost layer of the basin consists of glacial drift. The drift located in the central and western portions of the basin ranges in thickness from three to eight hundred feet, but is thin or absent and rarely exceeds two hundred feet in areas of past surface mine operations (Cohee et al., p. 3, 1950). At the present time, officials at the Michigan Department of Natural

Resources (DNR) consider 150 feet to be the maximum amount of overburden that can be economically removed during a surface mining operation.

The coal beds are essentially flat, dipping toward the center of the basin at an average rate of twenty to fifty feet per mile and varying in thickness from several inches to several feet (Bureau of Mines, Staff, pp. 41, 1971). While some drill hole tests have recorded coal as thick as seven feet, some doubt exists over the accuracy of these measurements (Cohee et al., p. 4, 1950). Only a few of the coal beds mined in Michigan have averaged more than three feet in thickness. The irregularity of the coal beds is described as "varying in thickness from thirty to fifty feet or more in a quarter of a mile; thicken, thin or pinch out entirely in a few hundred feet; or split into two or more distinct beds" (Cohee et al., p. 4, 1950). These irregularities cause coal beds mined in one location to have different characteristics than beds mined a short distance away. Furthermore, the size of any one bed is relatively limited; most areas of proven coal reserves cover less than 150 acres (Cohee et al., p. 4, 1950). Kalliokoski and Welch (1977) found the distribution of past coal production to be a good indicator of the geographic distribution of the Michigan coal beds (see map, Appendix B).

Another important characteristic of the Michigan coal basin is the proximity of the coal beds to the water table. This factor contributed to higher coal prices and complicated past mining operations by forcing miners to pump water from the mines. A recent study completed by McDonald and Stark (1980) concluded that the nearness of the water table

will not be a significant factor for future mine operations and should, therefore, not discourage potential investors (p. 31).

Quality of Michigan Coal: The poor quality of Michigan coal, frequently described as "flaky," is attributed to insufficient pressure present at the shallow depths where the coal was formed (Arnold, p. 101-2, 1954). Michigan coal is high volatile B and C bituminous, with an ash content of 3-9 percent, volatile material of 31-41 percent, and sulphur content of 1-3 percent (Cohee et al., p. 4, 1950). Coal containing less than one percent sulphur is considered low sulphur coal, greater than two percent is considered high sulphur coal. The BTU value per pound of Michigan coal ranges from 10,500 to 12,300. Michigan coal is suitable for residential heating, electrical generation, and industrial processes; it is not suitable for the production of coke used in making steel.

Quantity of Michigan Coal: Estimates of the amount of recoverable Michigan coal vary widely. These discrepancies can be attributed to different definitions of "physical stock" and recovery rates between studies. For example, Kalliokoski and Welch (1976) based reserve estimates on coal seams 28 inches thick or greater while the Michigan DNR's estimate includes all coal seams. Cohee et al. (1950) based an estimate of 110 million tons on a fifty percent rate of recovery. A more recent study, completed by Kalliokoski and Welch (1976), calculated a total state reserve of 126.50 million short tons, 1.3 million of this total recoverable by surface mining methods. This estimate is based on seams 28 inches thick and an overburden of 100 feet or less. A 1981 report released by the U.S. Department of Energy updates the Kalliokoski report and lists a demonstrated reserve base of coal at 127.70 million tons,

2.
5.
C
ES
P
W
C
C
P
a
L
P
W
(
t
C
t
C
a
s
n
t
t
-
e

4.58 recoverable by surface mining methods. Seitz et al. (1981) report surface mining recovery rates as high as eighty percent. Officials of the Geological Survey Division of the Michigan DNR report that past estimates are too low; they conclude that higher coal prices and improvements in mining technology will allow much higher recovery figures in Michigan. The DNR estimates that approximately 250 million tons of coal are potentially recoverable in Michigan. This estimate is based on an overburden depth of less than 150 feet and significantly lower losses during mining than have been reported in literature (Roethele and Parrish, p. 37, 1982).

Legislation

The legislation that is adopted to control actions relating to a particular activity is important because it "set(s) the legal boundaries within which accepted individual and group behavior takes place " (Barlowe, p. 383-4, 1978). The set of rules implemented to carry out the intentions of a piece of legislation allocates property rights and obligations and guides program performance.¹ Rosenbaum (1978) notes that, historically, environmental policy in the United States has been carried out through the use of a "standards and enforcement" regulatory approach. As explained by Rosenbaum, the "programs create statutory standards for environmental quality, ordain what technical procedures must be utilized by polluters to conform with standards (or what criteria must be used for procedures), empower specific regulatory agencies to elaborate and enforce both standards and control procedures, and

¹See Chapter 3 for a more extensive discussion of public choice economics.

attach penalties for non-compliance" (Rosenbaum, p. 51, 1978). The wisdom of using such a system has been questioned by many economists.¹ These concerns notwithstanding, this is the approach taken to control surface coal mining and reclamation at both the state and federal level in the United States.

Prior to 1977 mining in Michigan was controlled by a relatively weak regulatory statute, Public Act 92 of 1977. The intent of this act was to "provide for reclamation of land subject to the mining of minerals; to control possible adverse effects of mining, to preserve the natural resources; to encourage the planning of future use and to promote the orderly development of mining, the encouragement of good mining practices and the recognition and identification of the beneficial aspects of mining" (Public Act 92 of 1970, p. 1). As a whole, the act and the administrative rules set up to implement the act did little more than list general guidelines for the reclamation of abandoned mine sites, require that notice be given to the DNR upon the commencement of mining, and that an "environment plan" and a report of reclamation activities be filed with the agency. No provisions were made for the protection of a particular class of land. The act required the DNR to consider the economic impact of the regulations on the miners (Institute of Planners, p. 252, 1976).

In 1977, in an attempt to standardize surface mining rules across states while still allowing for individual state differences, the federal

¹Briefly, this is the standards v incentives debate. Many economists feel that the use of regulatory standards slows technological innovation, disregards economic efficiency, and requires the regulating agency to possess the expertise to render fine technical judgements (see Anderson [1977] and Kneese and Schultze [1975] for a more extensive discussion).

government passed the Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87). P.L. 95-87 provides federal jurisdiction in any state that cannot or does not choose to develop its own plan for reclaiming abandoned mine sites or does not wish to assume exclusive control over state-owned resources (P.L. 95-87, sec 503). The states were given eighteen months after the passage of the law on August 3, 1977 to submit a state management plan to the federal Office of Surface Mining Reclamation and Enforcement (OSM) for approval. To be approved, the state program proposals had to contain regulations that were at least as strict as those developed to implement P.L. 95-87. If a state did not meet this deadline, the OSM was to develop and implement a plan for the state within thirty months of the bill's passage date (P.L. 95-87, sec 504). Due to a lack of interest in developing the Michigan coal resource, neither the state DNR nor the OSM attempted to formulate a state plan until 1978. At that time the DNR informed the governor's office that it was receiving inquiries from potential mine operators and that it was able to develop a state management plan. The governor in turn notified the OSM which granted an extension of the deadlines specified in P.L. 95-87 (Michigan Senate Analysis Section, p. 1, 1982). The rationale offered by state officials for developing and implementing a state rather than federal program included the arguments that: (1) state land could be better protected through more stringent state regulations; and (2) that the Reagan administration's emphasis on reducing government regulations might hamper federally-controlled surface mine reclamation programs. In addition, states which elected to develop programs were entitled to federal matching funds to help defray the costs of implementation (Ibid).

On October 12, 1982, the state legislature passed the Michigan Surface and Underground Mine Reclamation Act (P.A. 303). (See Appendix A). The protection of agricultural lands was one of the primary objectives of this comprehensive statute. In addition, the act set up specific environmental performance standards, abandoned mine reclamation requirements, permit rules, bonding requirements, underground mine rules, an inspection and monitoring system and levied fines and penalties. The following are the highlights of the articles contained within P.A. 303:

Article 1: General Provision: This article begins by asserting that the state of Michigan wants to assume exclusive control over state resources. It names the DNR as the regulatory agency in charge and defines the role which the DNR will assume.

Article 2: Abandoned Mine Reclamation: The DNR will establish procedures whereby a state abandoned mine reclamation fund will be administered by the state's Department of Treasury. Monies which go into the fund include: (1) mine operation application fees (100.00 each permit); (2) inspection and reclamation fees (\$.25 per ton); (3) civil fines; (4) funds made available by Title IV of P.L. 95-87; and (5) donations. The act lists, in order of priority, the uses to which this fund will be applied. In addition, Article 2 gives the DNR the power to enter onto private property in the exercise of their prescribed duties.

Article 3: Permits: Each surface mine operator must obtain a permit from the DNR which is valid for a period of three years. The article specifies the information to be included in each permit. The requirement most relevant to this study dictates that an agricultural impact statement and soil survey must be included to confirm the location of

agricultural land and the location of any land enrolled under the Michigan Farmland and Open Space Preservation Act (P.A. 116).¹

Section 311 of Article 3 states that, "if the area proposed to be mined contains agricultural land, the Department (DNR) shall consult with the Director of the Department of Agriculture and the Secretary of the United States Department of Agriculture and shall not grant a permit to mine on agricultural land unless the Department finds in writing that the operator has the technological capability to restore the mined area and any other areas impacted by the surface coal mine operation within a reasonable time period to equivalent or higher levels of yield as non-mined agricultural land in the surrounding area under equivalent levels of management, and also finds that the applicant can meet the soil reconstruction standards of this Act."

Article 4: Environmental Performance Standards: The issuance of a permit to an operator requires that environmental performance standards be met. The operator is obligated to see that reclamation occurs as contemporaneously as possible with mining and that these activities result in the land being restored to the approximate original contour. Agricultural lands require the separation and special handling of soil horizons. It is the operator's responsibility to establish a "diverse, effective and permanent vegetative cover..." and to see that successful revegetation occurs for five years following mining.

Article 5: Bonding: Each permit application must include a certificate stating that the applicant has public liability insurance for the

¹See pp. 52-56 for a discussion of P.A. 116 and its relevance to this study.

mining operation. After an application has been approved, but before a permit is granted, the applicant must file with the DNR a "bond for performance payable to the state of Michigan and conditioned on faithful performance...". No part of the bond may be released until soil productivity of agricultural land has been returned to equivalent or higher levels as non-mined land of the same soil type.

Article 8: Fines and Penalties: The DNR is given the power to levy fines and penalties against operators who do not comply with state surface coal mining regulations.

Article 9: Inspection and Reclamation Fee: Each operator is assessed a reclamation fee of not more than \$.25 per ton of coal mined. All fees are collected by the DNR and are to be deposited into the state's abandoned mine reclamation fund.

Article 10: Miscellaneous Provision: The DNR is directed to formulate the rules through which the act will be implemented. They are also given the power to declare an area unsuitable for mining; an area may be unsuitable if mining results in lower agricultural productivity or adversely affects an agricultural operation.

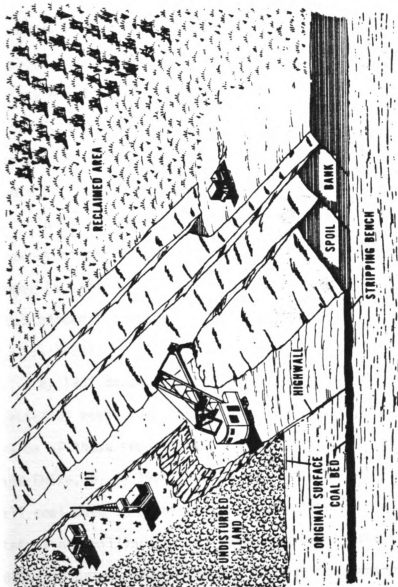
As noted earlier, the legislation enacted to control actions relating to an activity is important because it allocates property rights and guides policy performance. Currently, the DNR is developing the specific rules and regulations necessary to implement the provisions of P.A. 303. Until these rules are developed and approved by the federal OSM, the state program cannot operate. The use of this regulatory framework will significantly influence the impacts of surface coal mining in Michigan and will be discussed more extensively in Chapter 3.

Surface Mining Technique

Throughout the Midwest, a surface mining technique known as "area mining" is used. Mines of this type experience significant economies of scale with increasing size; it is therefore to the operator's advantage to mine a relatively large area (Toubier and Westmacott, p. 20, 1980). "A Handbook for Small Surface Coal Mine Operator" stresses that in order to these mines to be economical, double handling of overburden must be minimized.

Area mining consists of four major steps (Carter et al., p. 11-20, 1974) (see Figure 2-2).

1. site preparation: this step entails the removal of vegetation and other obstructions from the area to be mined. Access roads, haulage roads and waste disposal sites are constructed at this time.
2. removal and disposal of overburden: in this step an initial trench or "boxcut" is made through the overburden to expose the coal. The length of the cut is generally extended from one end of the area to be mined to the other; the width is determined by the size and type of equipment being used. After removal the overburden is placed on unmined land near the cut.
3. excavation and loading of ore: the coal is removed and is then loaded into trucks or some other form of transportation for delivery.



Source: Fung (1981).

Figure 2-2
Diagram of Area Surface Mining Technique

4. transportation: the coal may be transported to a plant for further processing or shipped directly to the utility for use.

Market Characteristics

Between 1960 and 1980 coal consumption in Michigan grew twenty percent, rising from twenty-five to thirty million tons per year (Webber and Ehlke, p. 8, 1982). In 1980 nearly three-quarters of the thirty million tons of coal consumed in Michigan were used to generate electricity; a substantial amount of the remaining coal was used in the production of coke. Residential and commercial uses of coal in recent years have been negligible (Ibid, p. 59).

In 1981 coal supplied 26 percent of Michigan's energy needs. Sources of petroleum (37 percent), natural gas (31 percent), nuclear power (5.5 percent) and hydroelectric power and imported electricity (0.5 percent) contributed remaining requirements (Webber and Ehlke, p. 19, 1982).

By 1982 dependence on imported sources of fuel in Michigan was expected to reach 90 percent of the state's energy requirements; the dollar value of these imports was estimated to be 8.9 billion dollars (Webber and Ehlke, p. 6, 1982). With no mines currently operating in the state, all coal used in Michigan is imported (see Table 2-2). The more than thirty-one million tons of coal imported to the state in 1980 had a delivery price between \$60 and \$80 per ton compared with a price of \$40 or more at the mine site (Roethele and Parrish, p. 35, 37, 1982). By 1985 state coal requirements are expected to exceed 44 million tons per year (The President's Commission on Coal, p. 35, 1980).

-

L

-

E

D

N

M

M

S

P

C

T

-

E

TABLE 2-2. 1980 Sources of Michigan Bituminous
and Lignite Coal Imports

Location	Amount (1,000 tons)	% of Total
E. Kentucky	16,294	52.2
Ohio	2,572	8.2
Northern W. Va.	4,023	12.9
Montana	4,049	13.0
W. Kentucky	459	1.5
Southern W. Va.	1,515	4.9
Pennsylvania	1,477	4.7
Other	818	2.6
Total	31,206	100.0

Source: Webber and Ehlke, Michigan Energy Data Book, Michigan
Energy Administration, p. 65, 1982 .

Although coal is imported to meet state energy needs of the 1980's this fact does not necessarily imply that it would be inherently better for Michigan to produce coal within its borders for sale to state consumers. The principle of comparative advantage states that,

"a region specializes in the production of that commodity for which it has a comparative production advantage. The relative advantage is the result of different factor endowments among regions. A region will export those commodities which can be produced with relatively abundant factors of production, and it will import those commodities which are produced by a relatively scarce factor" (Siebert, p. 91, 1969).

Factor endowments include natural advantages such as a well-endowed resource base and favorable climatic conditions and such factors as favorable location and transportation costs. Barlowe (1978) states that "comparative advantage is measured by the economic ability of an area to compete with other areas in the production of particular goods and services" (p. 271). Additionally, comparative advantage is a function of the alternative uses of a particular site. Coincidentally, the Michigan coal resource is located near the major population and industrial areas of the state making transportation costs relatively low, thereby giving state producers a significant advantage.

Historically, coal mined in Michigan has been sold either to local citizens for residential heating or nearby utilities for electrical generation (U.S. Bureau of Mines, p. 377, 1976 and Arnold, p. 101, 1954). Based on this experience, it seems reasonable to assume that coal mined

in the future will also be sold to nearby consumers who want to take advantage of the lower delivered price of Michigan coal. However, this will depend on a large number of factors, including the availability and price of alternative sources of energy, air quality standards, and the price of Michigan coal.

Reclamation

Seitz et al. (1981) define reclamation as the "return of the land to a form and level of productivity that will sustain the prior or future planned use or uses in an ecologically stable state, a state that will not contribute substantially to environmental deterioration and that is compatible with surrounding aesthetic values" (p. 153). Previously, reclamation procedures have been aimed at the return of the land to some productive use, not necessarily to the level of productivity which existed before mining (Ibid, p. 173).

The success of any reclamation procedure varies with the physical characteristics of the land, the climate of the region, and the water and nutritional requirements of the proposed end use of the site.¹ The determination of end use dictates the amount of grading to be done and the type of vegetation required; both of which represent the major costs of a surface mine reclamation project as well as the major source of cost variation (Carter et al., p. 111-73, 1974).

The length of time required to reestablish soil productivity levels varies from site to site. Huff et al. (1982) report that recovery time

¹See Seitz et al. (1981) for a discussion of the success of reclamation procedures (pp. 173-178).

may range from five to one hundred years. However, surface mines in Ohio and Pennsylvania have taken farmland out of production for as few as two years (Seitz et al., p. 173, 1981).

Reclamation in Michigan will be regulated by the performance standards developed by the DNR. These standards will be based on the following requirements specified in Michigan P.A. 303:

1. Restoration to the original contour.
2. Disturbed land areas must be restored such that they are able to support pre-mining levels of usage.
3. Topsoil not used immediately must be segregated into a pile separated from other spoils.
4. The operator must assume responsibility for revegetation for a period of five years.

Agricultural land requires the following special standards:

1. Soil horizons A and B must be segregated and piled separately unless it can be shown that other available materials can produce a more productive topsoil.
2. Replacement and regrading of root zone is required.
3. Land must be returned within a reasonable time period to levels of yield higher than or equal to non-mined agricultural land in the surrounding area.

The enforcement and effectiveness of reclamation procedures promulgated by the DNR will have a significant effect on the magnitude of the impacts surface coal mining has on Michigan residents.

Michigan Agriculture

In order to analyze the impacts of the surface coal mining of Michigan agricultural lands, it is necessary to understand the role of

agriculture in the Michigan economy. An examination of data relating the physical, economic and institutional characteristics of Michigan agriculture will provide a foundation on which to evaluate the consequences of actions which affect this industry.

Role of Agriculture in the Michigan Economy

Agriculture is an important component in the economy of the state of Michigan. In 1982, as the state's second largest industry based on total value, agriculture in Michigan produced more than fifty commercial food crops with a cash value of more than three billion dollars.¹ As an employer and producer of goods and services, agriculture also provides stability for the Michigan economy. Unlike the automobile and tourism industries, agricultural income is not closely correlated with the general economy; in times of economic recession, agriculture lends support to the state economy (Wright and Ferris, p. 1, 1981). Estimates show that between 35 and 40 percent of Michigan citizens receive some portion of their income from agricultural industry (Michigan Department of Commerce, p. 1, 1980). It is important to note that farming comprises a relatively small portion of the total agricultural industry in Michigan. Farming, manufacturing, distribution, and provision of farm inputs combine to form the total farm and food system. A disruption in any single area is felt throughout the system making it reasonable to assume that the surface mining of Michigan farms will affect the entire state agricultural system to some extent.

¹Unless otherwise noted, facts appearing in this section are taken from "Michigan Agricultural Statistics, August 1982," Michigan Department of Agriculture, Ag. Reporting Service.

Michigan agriculture is considered a growth industry, increasing at a real rate of just over two percent annually (Wright and Ferris, p. 1, 1981). Although imports presently account for more than one-half of the food consumed in Michigan, increasing fuel costs could give Michigan farmers an advantage over more distant producers; the close proximity of farmers to markets in Michigan may yield significant transportation cost savings which allow Michigan farmers to deliver their products at a lower price than more distant producers. While this may result in a lower level of food imports and food prices, it does not necessarily follow that any degree of self-sufficiency should be a goal for Michigan agriculture.

Michigan agriculture plays an important role in the national economy as well. Michigan farmers lead the nation in the production of five crops - blueberries, tart cherries, cucumbers (processing), dry beans and navy beans - and rank fifth or higher in the production of fifteen others. (See Table 2-3). In addition, Michigan ranked fifteenth among all states in agricultural exports in 1981 with shipments totaling \$943.6 million. Growing demand for agricultural exports in the United States is likely to lead to further increases in these figures; the National Interregional-Agricultural Projection Study (NIRAP) cites corn, wheat and soybean export markets as having the greatest potential for expansion between 1985 and 2000 (Wright and Ferris, p. 25, 1981). Because all three crops are grown in Michigan it is likely state producers will increase production of these commodities to take advantage of expanding export markets.

Table 2-3. Michigan's Rank in the Nation's
Agriculture, 1981

COMMODITY	Rank Among States	Production 1,000	% U.S. Production
Crops			
Blueberries	1	52,000 lbs.	44.9
Tart Cherries	1	88,000 lbs.	65.4
Cucumbers, Processing	1	100.8 Tons	17.5
Dry Beans	1	7,198 Cwt.	22.6
Navy Beans	1	4,070 Cwt.	75.3
Bedding Plants	2	6,428 Flats	15.2
Prunes & Plums	2	16 Tons	23.5
Apples	3	640,000 lbs.	8.4
Asparagus	3	171 Cwt.	10.0
Celery	3	1,440 Cwt.	7.9
Red Clover Seed	3	1,520 lbs.	8.9
Tomatoes, Processing	3	118.3 Tons	2.1
Snap Beans Processing	4	36.2 Tons	5.4
Sweet Cherries	4	46,000 lbs.	15.0
Strawberries	4	176 Cwt.	2.4
Carrots	5	1,316 Cwt.	6.3
Floriculture	5	54,464 Dol.	5.4
Grapes	5	53 Tons	1.2
Pears	5	9 Tons	1.0
Sugarbeets	5	2,030 Tons	7.4
Cauliflower	6	62 Cwt.	1.3
Cantaloups	6	184 Cwt.	1.4
Maple Syrup	6	91 Gal.	6.5
Oats	6	21,080 Bu.	4.1
Spearmint	6	118 lbs.	5.5
Green Peppers	7	135 Cwt.	2.3
Onions	7	2,446 Cwt.	6.9
Corn for Silage	8	4,160 Tons	3.6
Corn for Grain	8	273,600 Bu.	3.3
Corn, Sweet, Fresh Market	8	702 Cwt.	5.1
Peaches	8	35,000 lbs.	2.2
Popcorn	8	24,150 lbs.	3.1
Rye	8	532 Bu.	2.9
Cucumbers, Fresh Market	9	238 Cwt.	3.9
Lettuce	9	258 Cwt.	.4
Alfalfa Hay	10	3,300 Tons	3.9
Snap Beans, Fresh Market	10	83 Cwt.	2.8
Tomatoes, Fresh Market	10	391 Cwt.	1.5
Cabbage, Fresh Market	11	464 Cwt.	2.3
Potatoes	11	8,503 Cwt.	2.5
Winter Wheat	17	41,500 Bu.	2.0
Soybeans	18	29,100 Bu.	1.4
Livestock Products			
Non-Fat Dry Milk	5	75,769 lbs.	5.8
Creamed Cottage Cheese	6	38,308 lbs.	5.0
Milk Production	6	5,103 1,000lbs.	3.8
Butter	6	43,790 lbs.	3.6
Ice Cream	10	32,046 Gal.	3.9
Hink	10	129 Pelts	3.7
Honey	11	4,900 lbs.	2.6

Source: "Michigan Agricultural Statistics, August,
1982," MDA.

Description of Michigan Agriculture

In 1984, there are 65,000 farms¹ averaging 17 acres in size and covering 11.5 million acres in Michigan. Although a change in the Michigan Department of Agriculture's (MDA) definition of a "farm" in 1977 makes citing exact numbers difficult, the overall trend has been toward fewer farms. This rate of decline has, however, slowed in recent years (Wright and Ferris, p. 6, 1981). From 1959 to 1978 the percentage of farms of less than fifty acres rose from 24 percent to 29.6 percent, farms of 50-179 acres fell from 52.7 percent to 41.3 percent, farms of 180-499 acres rose slightly from 21.6 to 22.7 percent, and farms of 500 to 1,000 acres and over rose from 1.7 to 6.4 percent (Ibid, p. 6, 1981). In 1984, 5.7 million acres of the agricultural cropland in Michigan has been designated as prime farmland (Huff, et al., p. 74, 1982).

Ninety percent of all farms in Michigan were family-owned in 1978. The remaining ten percent were divided between partnerships (9 percent) and corporation-owned farms (1 percent). Full owners accounted for 63 percent of all farmoperators in 1978, with 30 percent being part-owners and the remaining 7 percent tenants (Wright and Ferris, p. 8, 1981). The average value of an acre of farm real estate in Michigan in 1982 was \$1,192, down 3 percent from 1981. Property taxes levied against farms accounted for 5 percent of state property tax levy; in 1977 farm property taxes in Michigan were levied at 1.6 percent of current market

¹The Michigan Department of Agriculture defines a farm as a "place with annual sales of agricultural products of \$1,000.00 or more."

value compared with an average of 0.7 percent nationwide (Ibid., pp. 1, 26).

Milk, corn and cattle are the most valuable commodities produced in Michigan; together this group accounts for over one billion dollars in cash receipts annually. Ranked next in value are soybeans, dry beans, wheat, fruit and vegetables and hogs. (See Table 2-4). Leading production, by county, is listed for the four most valuable commodities in Table 2-5. Note the [*] symbol which designates those counties which also hold a significant percentage of the state's coal deposits.

Between 1979 and 1980 production expenses on Michigan farms rose 17 percent to a record 26 billion dollars. These expenses are broken down into two categories, operating expenses and total annual expenses (Huff et al., p. 84, 1981). Operating expenses comprised 48 percent of total production expenses while total annual expenses (depreciation and consumption of farm capital and taxes and interest) account for 34 percent. The remaining expenses fall into a miscellaneous category.

In 1980, Michigan farmers paid 212 million dollars for feed, 256.6 million dollars on fertilizer and lime, 396 million dollars on repairs and equipment, and 557.1 million dollars on depreciation and consumption of farm capital. The largest increases in expenditures from 1979 to 1980 included interest on farm mortgage debt, hired labor (31 percent higher), fertilizer, repairs, and equipment operation costs (see Table 2-6).

Due primarily to these sharply rising production costs, net farm income in Michigan declined in 1980 for the first time in four years (12 percent decrease). Net farm income in Michigan averaged \$7,190

TABLE 2-4. Cash Receipts from Marketings, Michigan

Product	1980	1979
1,000 Dollars		
Livestock & Products Total	1,118,819	1,003,837
Dairy	647,602	571,725
Cattle & Calves	237,075	208,564
Hogs	135,148	124,490
Eggs	57,760	61,376
Sheep & Lambs	5,438	4,114
All Chickens	4,786	5,438
Wool	703	682
Other	30,307	27,448
Crops Total	1,574,749	1,357,686
Field Crops:		
Corn	477,773	318,552
Dry Edible Beans	155,957	111,234
Soybeans	208,684	194,586
Sugarbeets	73,599	60,295
Wheat	120,212	102,468
Potatoes	50,127	67,729
Hay	21,369	23,267
Oats	19,258	16,635
Mint	1,498	1,475
Red Clover Seed	580	745
Rye	864	984
Barley	1,330	1,315
Vegetables	130,364	136,813
Other	23,543	13,341
Fruit:		
Apples	73,386	75,314
Blueberries	14,104	16,164
Cherries	40,181	59,194
Grapes	12,443	12,810
Peaches	7,622	6,732
Strawberries	8,358	10,041
Pears	2,405	2,606
Plums & Prunes	2,575	2,873
Other	1,030	971
Other Products:		
Forest & Maple	17,720	16,475
Greenhouse, Nursery	109,767	105,067
All Commodities	2,693,568	2,361,523
Government Payments	10,666	15,593
Total	2,704,234	2,377,116

Source: "Michigan Agriculture Statistics, August, 1982," MDA.

County

Huron
Sanil
Alleg
Ottaw
Kent
Ionia
Clint
*Jack
Lapee
Isabe

County

Huron
*Tusco
Lenawe
Sanil
Branch
St. Jo
Hills
Gratic
*Jack
Calhou

Michi

TABLE 2-5. 1981 Michigan Counties Leading
in Agricultural Production

Cattle and Calves		Dairy	
County	#	County	milk production (1,000 lbs)
Huron	78,800	Sanilac	427,200
Sanilac	75,000	Huron	257,500
Allegan	49,000	Allegan	196,800
Ottawa	41,000	Clinton	190,500
Kent	40,700	Ottawa	185,000
Ionia	39,800	Kent	180,000
Clinton	39,300	Ionia	171,000
*Jackson	37,700	Lapeer	146,000
Lapeer	35,500	Hillsdale	140,800
Isabella	35,000	*Ingham	135,800

Corn		Soybeans	
County	Bushels (million)	County	Bushels (million)
Huron	14.2	*Saginaw	3.8
*Tuscola	13.1	Lenawee	2.9
Lenawee	12.9	Monroe	2.4
Sanilac	11.8	*Shiawasee	2.0
Branch	11.6	Gratiot	1.6
St. Joseph	11.2	Clinton	1.3
Hillsdale	9.5	St. Joseph	1.1
Gratiot	9.1	St. Clair	1.08
*Jackson	8.8	*Genesee	1.03
Calhoun	8.7	Branch	1.02

Source: "Michigan Agricultural Statistics, August, 1982,"
Michigan Department of Agriculture.

TABLE 2-6. Farm Production Expenses, Michigan

Item	1980	1979
Million Dollars		
Current Farm Operating Expenses:		
Feed	212.0	186.6
Livestock	66.9	54.0
Seed	107.0	93.0
Fertilizer & Lime	256.6	210.7
Repair & Equipment Operation	396.0	335.6
Hired Labor	215.2	163.8
Miscellaneous	452.4	401.3
Total Current Expenses	1,705.9	1,445.0
Depreciation & Consumption of Farm Capital	557.1	480.7
Taxes on Farm Property	161.9	148.7
Interest on Farm Mortgage Debt	170.5	141.7
Net Rent to Non-Farm Landlords	16.4	9.5
Total Production Expenses	2,611.9	2,225.4

Source: "Michigan Agriculture Statistics, August 1982" MDA.

compared with a nationwide average of \$8,180. Gross income rose 14 percent to a record 3.1 billion dollars (see Tables 2-7 and 2-8).

Michigan farms depend primarily on family workers as a source of labor. In 1981, 77,000 persons worked on Michigan farms; of this number 57,000 were family workers. Wage rates averaging \$4.25 per hour represented one of the highest rates in the nation. Throughout Michigan agriculture and agribusiness employ 200,000 persons year around, approximately 5 percent of the total state workforce. Additional summer-only employment totals 40,000 workers (Wright and Ferris, p. 1, 1981).

Institutional Framework

Numerous institutional measures control land use in Michigan. Taken together, these measures establish the rights and duties of participants and provide a framework within which land use allocation functions in the state (Barlowe, p. 562, 1978). Institutional measures may be public or private and range from fee simple ownership to government regulations and incentive-oriented methods to influence the choice of land use. It is within this framework that choices of land use between surface mining and farming will take place. A brief discussion of these measures is presented below (see Barlowe [1978] for a more extensive discussion). The chapter concludes with a discussion of an incentive-oriented method relevant to this study, the Michigan Farmland and Open Space Preservation Act.

Private Institutional Framework: A basic private institutional measure controlling land allocation is fee-simple ownership. As defined by Barlowe (1978), a fee simple owner has the "right to possess, use and within reason to exploit, abuse and even destroy his land resource."

TABLE 2-7. Gross and Net Income, Michigan

Item	1980	1979
Million Dollars		
Realized Gross Farm Income		
Cash receipts from farm marketings	2,693.6	2,361.5
Government payments	10.7	15.6
Non money income	339.9	296.8
Other farm income	42.3	40.6
Total gross farm income	3,086.5	2,714.6
Farm production expenses	2,611.9	2,225.4
Realized net farm income	474.6	489.2
Total net farm income	515.4	587.6
Net change in farm inventories	40.9	98.4

Source: "Michigan Agriculture Statistics, August, 1982," MDA.

TABLE 2-8. Income Per Farm, Michigan

Year	Michigan		United States	
	Realized Gross Income	Total Net Income	Realized Gross Income	Total Net Income
1980	\$46,764	\$7,810	\$62,818	\$9,002
1979	\$41,130	\$7,412	\$60,318	\$11,256

Source: "Michigan Agriculture Statistics, August, 1982," MDA.

Additionally, a fee simple owner has the right to give away, lease, sell, mortgage, subdivide and grant easements to his/her property. And, although it is important to note that a fee simple owner may exercise these rights to the exclusion of all other persons, s/he is limited by the overall interests and continued benevolence of society (Barlowe, p. 398, 1978).

Private property interests in land resources may be controlled by a variety of institutional measures. For the purposes of this study, it is important only to be familiar with fee simple ownership and the fact that interests in a particular piece of property may be severed. For example, ownership of surface and subsurface rights may be divided between two individuals.

The separation of surface and subsurface rights may be a source of conflict for Michigan farmers who own only the surface rights to the land that they farm. The Michigan Farm Bureau is concerned that farmers may incorrectly assume that they own the rights to the minerals beneath their soil (Kirvan, p. 13, 1982). In recent years a large number of oil and gas leases have been signed in Michigan that included the term "other minerals," which may or may not include coal. In addition, an oil/gas leasee may have the right to resell the subsurface rights to a coal company without the surface owner's consent. Because farming and surface mining are mutually exclusive land uses, it is likely that conflicts resulting from the separation of surface and subsurface rights will require resolution in the state court system. Historically, subsurface mineral rights owners have prevailed over surface rights owners in the United States (Barlowe, p. 431, 1978).

Public Institutional Framework: Beyond private institutional measures, state and local governments retain powers that direct land allocation. The police power is a residual power granted to the states allowing the sovereign the right to act to advance, preserve, and protect the public health, safety, and welfare. One of the most important exercises of the police power is zoning. Use of zoning by state and local governments controls the direction of land use by designating particular areas as falling under regulations which establish boundaries on the uses of land, height and size of buildings and population density (Barlowe, p. 572, 1978).

Incentive-oriented measures such as tax breaks, pollution certificates and incentive programs implemented through the passage of state-wide legislation also control land use. Many states have developed incentive-oriented programs in an attempt to preserve agricultural land (Cochran et al., p. iv, 1977). The incentive program established by P.A. 116, the Michigan Farmland and Open Space Preservation Act, is of particular importance to this study. A number of state policy makers have voiced concern over the conflict which may develop between the P.A. 116 program and future surface mining operations. The purpose of the section which follows is to examine the history and operation of the P.A. 116 program and to explore the policy questions which may arise if an acre currently enrolled in the program is leased or sold for surface mining.

The Michigan Farmland and Open Space Preservation Act: Enacted in May of 1974, the Michigan Farmland and Open Space Preservation Act was developed to provide a mechanism for the protection of state farmland from non-farm uses. Under the act, a development rights agreement

between the state and the property owner is constructed to maintain active farming of the land in a substantially undeveloped condition for a period of not less than ten years. Property tax relief is the incentive offered to a landowner who is willing to enter into a development rights agreement.

As of 1983, 3.5 million acres were enrolled in the P.A. 116 program (Harvey, 1984). Table 2-9 shows the number of acres that were entered into a development rights agreement in counties with coal deposits as of 1983. Assuming that some amount of strippable coal underlies these acres, it seems likely that conflicts will arise between surface mining and farming uses. And, although a land owner who wants to lease his land for surface mining can apply to terminate the P.A. 116 development rights agreement, the state land use agency or local governing body does not automatically grant terminations. In evaluating these applications the following factors are considered (Hepp, p. 3, 1981):

1. Whether or not the agreement imposes continued economic in-
viability through the prevention of necessary improvements to
the land.
2. If surrounding conditions impose physical obstacles to agri-
cultural operations or prohibit essential agricultural practices.
3. If significant natural physical changes in the land exist
which are generally irreversible and permanently effect the
land.
4. The opportunity to sell the land is not considered adequate
reason to terminate the agreement.

If the agreement is terminated, a lien is placed against the land for the total amount of the tax credit received. In addition, the lien

TABLE 2-9. Acres Enrolled in P.A. 116
Program, by County, 1983

County	Total Acres
Bay	81,779
Clare	17,255
Clinton	121,243
Eaton	58,954
Genesee	35,716
Gladwin	15,758
Gratiot	184,734
Ingham	163,835
Ionia	75,336
Isabella	46,203
Jackson	66,733
Mecosta	18,766
Montcalm	59,388
Osceola	13,031
Saginaw	163,524
Shiawasee	87,833
Tuscola	183,572

Source: Compiled by: Lynn R. Harvey, Extension Specialist
State and Local Government, Data Source: Office of Land Use,
Michigan DNR.

provides that an interest rate of 6 percent per annum compounded will be added to the credit from the time it was received until it is paid.

Therefore, if the surface and subsurface rights are held jointly by a property owner, and the governing body agrees to terminate the development rights agreement, surface coal mining can proceed at the landowner's consent. However, the outcome is much less certain if the surface and subsurface rights have been severed and a mineral lease is held by the subsurface owner while the surface owner is entered into a P.A. 116 development rights agreement. Historically, the subsurface mineral rights owner has been granted rights and easements to the overlying surface land in the United States (Barlowe, p. 431, 1978).

To summarize, the purpose of this section has been to briefly outline the institutional framework within which the process of land allocation operates in the state of Michigan. It is within this framework that land will move from farming to surface coal mining uses. Additionally, the program developed to preserve farmland in Michigan, P.A. 116, was discussed to evaluate the potential for conflict which exists between this program and future surface mining operations. Through the P.A. 116 program, the state of Michigan and participating landowners have expressed a commitment to continue farming activities on specific acres of land. Because it is possible that the rights of owners of the subsurface minerals may supercede the surface owner's rights, it is important to evaluate the impact of surface coal mining in Michigan on the continued effectiveness of the P.A. 116 program. Uncertainty regarding the location of future surface mining operations and the ownership of subsurface mineral rights makes predicting actual performance difficult.

It

sc

wh

co

to

in

mi

It

fr

ma

is

th

ba

th

fa

vi

af

st

of

mir

ing

ity

What does seem certain is that conflicts will occur and have to be resolved through the court system.

Summary

The purpose of this chapter has been to establish the setting in which surface coal mines will operate in the state of Michigan. Because only limited mining has occurred in recent years, it is important to develop an understanding of the resources and institutions that are involved in the allocation of land between farming and surface coal mining. Presently, locating information on Michigan coal is difficult. It is, therefore, a major role of this study to consolidate information from various sources and make it available to state and local decision-makers.

The impact of surface coal mining on the state's agricultural base is a concern to state and local decision-makers and citizens living in the area of future surface mine operations. Because the Michigan coal basin lies in a region of the state presently dominated by agriculture, there exists a potential for conflict between surface coal mining and farming. This conflict involves disruption of farming activities, environmental damages and impacts on local economic activities. Therefore, after a thorough examination of the coal resources located within the state's boundaries, the chapter continued with an analysis of the role of agriculture in the Michigan economy.

Available information indicates that the extent of surface coal mining in Michigan will be limited. When compared to other coal-producing states, Michigan's coal resource is meager. Furthermore, the quality and sporadic occurrence of the coal beds will restrict the size and

1000

vey

mine

tors

ing

of

the

sec

be

are

and

100

number of surface mining operations. Officials of the Geological Survey Division of the Michigan DNR predict that between ten and twelve mines will operate in Michigan, producing approximately 2.5 million tons of coal per year. It is believed that each mine will operate from eight to ten years and cover between three to five hundred acres of land. Given the information currently available, it seems unlikely that surface coal mining will seriously affect Michigan's agricultural sector on a state-wide level. Rather, the most serious impacts will be experienced at the county or local level. After establishing an analytical framework within which the allocation of land between farming and surface mining can be considered, this study turns to an analysis of local impacts that can result from surface coal mining.

CHAPTER 3

ECONOMICS OF A STOCK RESOURCE AND PUBLIC CHOICE ECONOMICS

Introduction

As a discipline, economics contributes a conceptual framework within which choices among alternative courses of action may be examined. By structuring choices into a framework that provides a rational and operational set of rules, a determination can be made of whether the benefits from an action exceed the cost (Brooks, p. 17, 1966). Economics can make a contribution to the understanding of a choice by providing a unique perspective. Libby (1981) states that "an economic perspective involves the organization of complex information in ways that facilitate decisions based on indicators of the consequences involved." By applying an economic perspective to the choice presented in this paper - that is, the allocation of land between agricultural uses and surface coal mining - the decision will be more clearly defined. The purpose of this chapter, therefore, is to develop a conceptual framework within which resource allocation decisions can be structured and better understood. These concepts are used in Chapter 4 to develop an economic perspective on the allocation of land between farming and surface coal mining in Michigan.

Chapter 3 begins to build a conceptual framework by considering the economics of a stock resource. Included under this subject area are the concepts of efficiency, resource allocation over time,

uncertainty, intergenerational equity and resource scarcity. This framework is then extended by utilizing concepts from the field of public choice economics to evaluate the legislative policy enacted by the passage of P.A. 303, the Michigan Surface and Underground Mine Reclamation Act.

The Economics of a Stock Resource

According to Randall (1981), "natural resource and environmental economics is, for the most part, concerned with the problems that arise when markets in natural resources and environmental amenities perform poorly, and with identifying and evaluating possible solutions to those problems." Although a "perfect" solution may not exist, resource economics can, at the very least, point to the existing alternatives. As such, there is a need to establish the criteria by which to judge performance in the economy and to evaluate alternative choices (Randall, p. 99, 156, 1981). The criterion most often used in economic analysis is that of efficiency. Within this rather broad category are a number of subdivisions that are explored in the following pages: Pareto-efficiency, maximum social well-being, maximum value of social product, Pareto-safety, and potential Pareto-improvement. Each criterion is evaluated based on its ability to judge efficiency and the amount of economic injury which results from an action. Following an examination of these criteria a discussion of the factors which may lead to inefficiency in a market, the so-called "market failures," is presented.

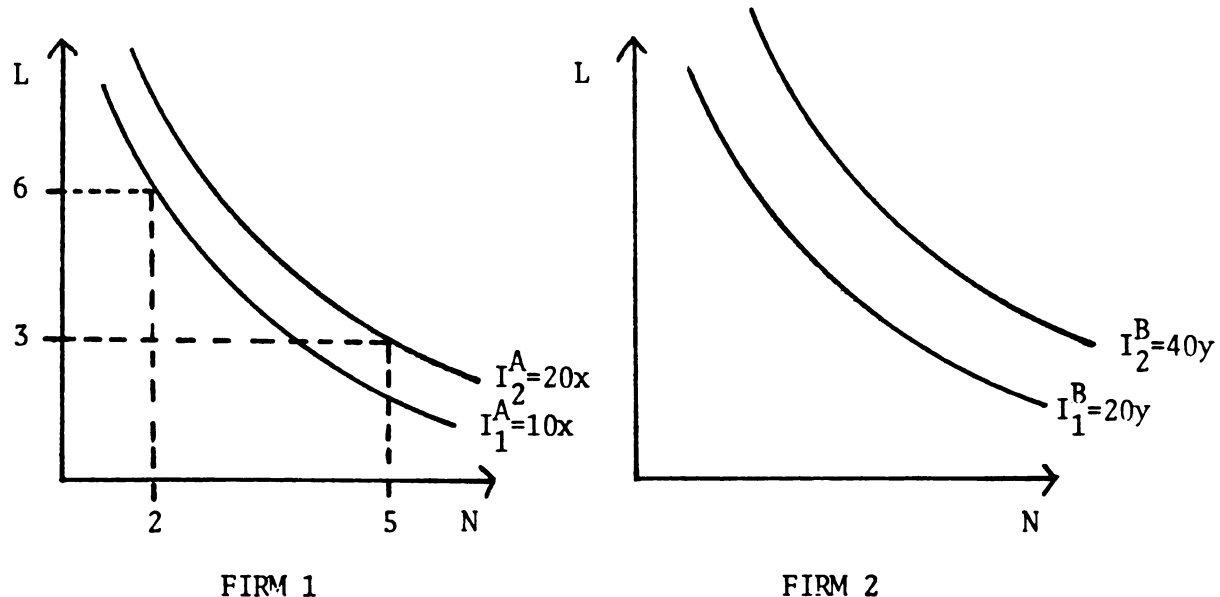
Efficiency

Pareto-Efficiency

In considering Pareto-efficiency, it is useful to first separate the functions of the economy into two major areas: production and consumption.

Production involves the use of inputs, for example, land [L] and labor [N], to produce outputs. To keep the analysis simple assume an economy in which only two goods are produced, X and Y. In addition, assume an industry composed of only two firms, 1 and 2. Firm 1 produces good X while Firm 2 produces good Y.

For each firm, a curve called an isoquant may be drawn. An isoquant represents the various combinations of inputs L and N which are needed to produce a given output level:



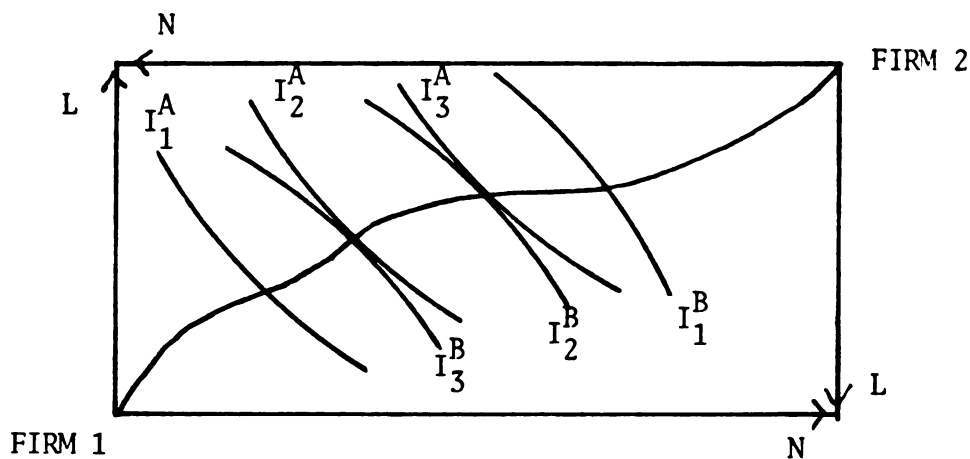
For each firm, an isoquant map can be drawn to illustrate combinations of inputs which lead to various levels of output. For example, assuming perfectly divisible inputs, the isoquant labeled 10X in Firm 1's isoquant map, shows the infinite number of input combinations which can

produce 10 units of good X. Specifically, ten units of good X may be produced by using 3 units of L and 5 units of N or by using 6 units of L and 2 units of N.

The slope of an isoquant is called the marginal rate of technical substitution (MRTS). The MRTS is the number of units of input L which can be given up in exchange for one more unit of N and still maintain a given level of production.

Production efficiency results when inputs are allocated such that production of good X cannot be increased without reducing the production of good Y. This is referred to as the Pareto-criterion. The use of an Edgeworth-Bowley Box diagram will help to illustrate this concept.

An Edgeworth-Bowley Box diagram is formed by connecting the axis of the isoquant maps of Firm 1 and 2 so that they form a square or a "box." This is accomplished by rotating one of the axis 180 degrees:



An Edgeworth-Bowley Box diagram has the following properties: (1) its dimensions are determined by the availability of the resource used as inputs; that is, the width is determined by the availability of N and the height by the availability of L; and (2) each point inside the box is a uniquely defined input combination and output mix.

Efficient allocations of L and N are defined at the tangencies between the isoquants of Firm 1 and 2. At these points the following is true:

$$[MRTS (L,N)] \text{ firm 1} = [MRTS (L,N)] \text{ firm 2}$$

Therefore, the Pareto-criterion holds at these points as well: no re-allocation of inputs can occur such that more of both goods can be produced. The locus of these efficient points is called the efficiency locus.

In the long run, a cost-minimizing firm facing a competitive market for inputs will choose input combinations such that the firm's $[MRTS (L,N)]$ equals the ratio of input prices $[P(L)/P(N)]$. Because all firms face identical input prices, a perfectly competitive economy will operate at the point of efficient input allocation:

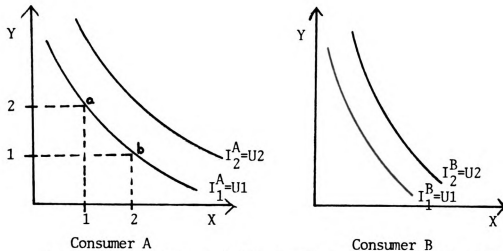
$$[MRTS (L,N)] \text{ firm 1} = [P(L)/P(N)] = [MRTS (L,N)] \text{ firm 2}$$

By plotting the efficiency locus on a two dimensional graph with axis labeled good X and good Y, the production possibility curve is formed. Every point on this curve represents an efficient production mix of good X and good Y. The shaded area inside the curve is the area of technological feasibility but inefficient output. The slope of the production possibility curve is called the rate of product transformation (RPT). RPT is equal to the amount of good Y that must be forfeited in order to produce one more unit of X.

Efficiency in consumption can be described similarly. Consider an economy with two consumers, A and B, and two goods, X and Y. What is the efficient allocation of goods among these consumers?

To begin, indifference curves can be constructed for each consumer. Each indifference curve is a locus of bundles of goods for which a

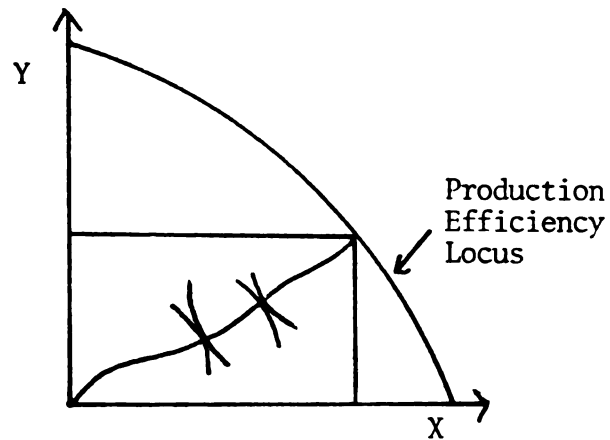
consumer's utility remains constant; that is, s/he is indifferent between the bundles. Utility is an ordinal measure of well-being; it is assumed that consumers can rank bundles in the order of increasing or decreasing utility.



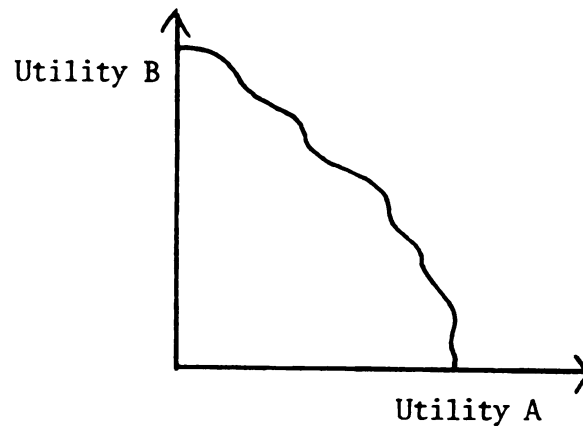
Consumer A derives a utility level of U_1 from bundle 'a' $[1X, 2Y]$ and bundle 'b' $[2X, 1Y]$. The slope of each indifference curve is called the marginal rate of substitution (MRS). In effect, it is the amount of good Y consumer A is willing to give up to receive one more unit of good X and maintain a given level of utility.

Again, using an Edgeworth-Bowley Box diagram, efficiency in consumption can be described as the point of tangency between consumer A and consumer B's indifference curves. At these points, the Pareto-criterion holds: consumer A cannot be made better-off (i.e., cannot increase utility level) without simultaneously making B worse-off. The locus of these efficient points is called the contract curve.

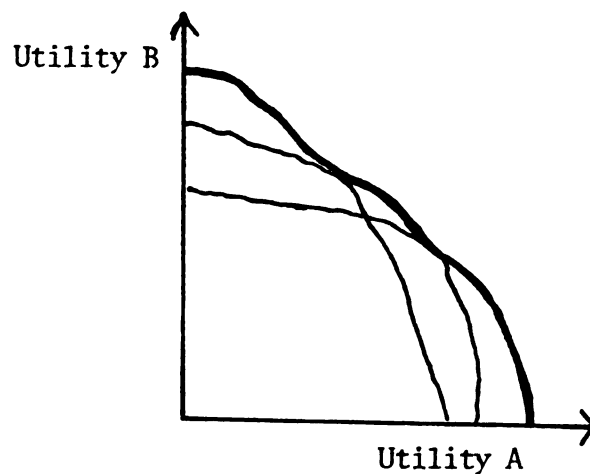
For a particular point on the production possibility curve which represents a particular product mix, a contract curve can be specified:



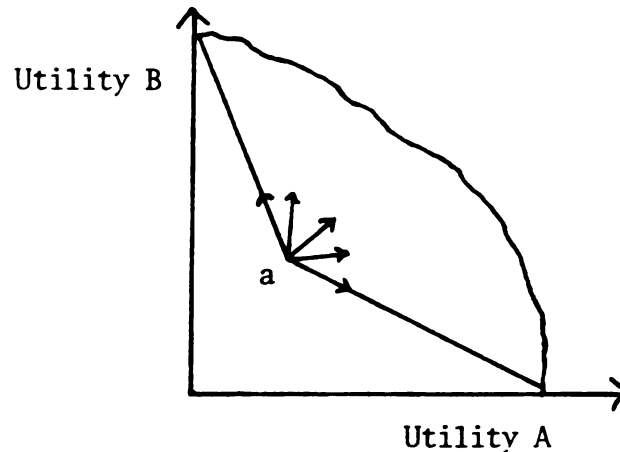
By extending this analysis, a grand utility frontier is derived. For any product mix located on the production possibility curve, a utilities possibility curve is derived by mapping the contract curve onto utility space:



By plotting the utilities possibility curve for each product mix and tracing the outermost boundary formed by the graphing, the grand utility frontier is found:



At each point on the grand utility frontier, it is impossible to re-allocate resources and make one person better off without simultaneously making another worse off. Stated another way: all points on the grand utility frontier are Pareto-optimum - that is, each has a unique and efficient resource allocation, product mix, commodity distribution and set of price ratios such that no reallocation exists that can increase one individual's utility without decreasing another's. Therefore, if located at a point below the curve (see figure below) a move toward the curve in any direction is considered a Pareto-safe move: all movements from a point toward the grand utility frontier are moves toward efficiency:



Any point on the grand utility frontier is Pareto-optimum; at these positions all opportunities for voluntary trade have been exhausted.

To summarize, there are three necessary conditions for Pareto-efficiency:

$$[1] \quad [MRTS(L,N)]_X = [MRTS(L,N)]_Y = [P(L)]/[P(N)]$$

$$[2] \quad [MRS(X,Y)]_A = [MRS(X,Y)]_B = [P(X)]/[P(Y)]$$

$$[3] \quad [MRPT(X,Y)]_1 = [MRPT(X,Y)]_2 = [P(X)]/[P(Y)]$$

Summary Condition:

$$[MRS(X,Y)]_A = \dots = [MRPT(X,Y)]_A = [P(X)]/[P(Y)]$$

The only sufficient condition is that the isoquants be convex in shape.

Maximum Social Well-Being

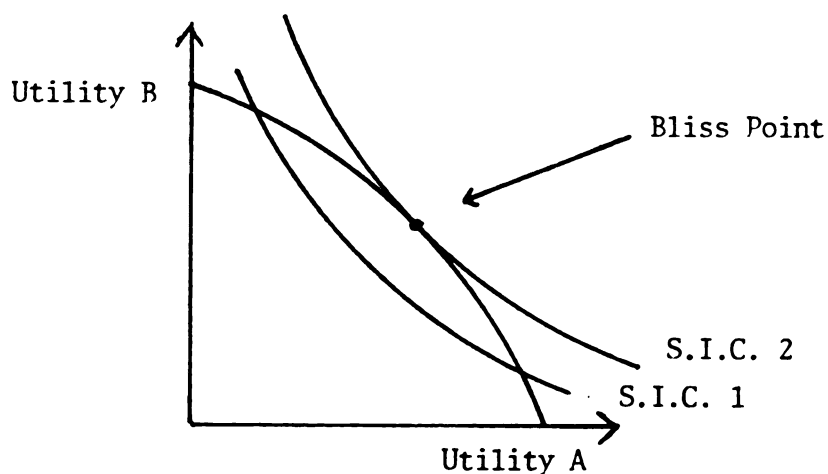
By assuming that a social welfare function exists, another criterion of efficiency can be developed. The existence of a social welfare function assumes that society can reach a consensus over how income should be distributed and that this function can express such a consensus. The validity of this assumption has been questioned and refuted by a number of economists¹ but it is nevertheless the underlying basis of the maximum social well-being criterion.

A social welfare function may be defined as:

$$W[S] = f(U_1, U_2)$$

By finding a point of tangency between the social indifference curves (similar to individual consumer indifference curves) and the grand utility frontier the point of maximum social well-being is found. The point of maximum social well-being is referred to as the "bliss point" and is located where the grand utility frontier is tangent to the highest social indifference curve. Under this criterion, a movement from 'a' toward the grand utility frontier is a movement toward efficiency. Note that such moves may leave consumer 1 with a lower level of utility than s/he started with. The criterion of maximum social well-being does not account for economic injury suffered by some members of the society because it ignores distributional results.

¹Most notably, Kenneth Arrow (1967).



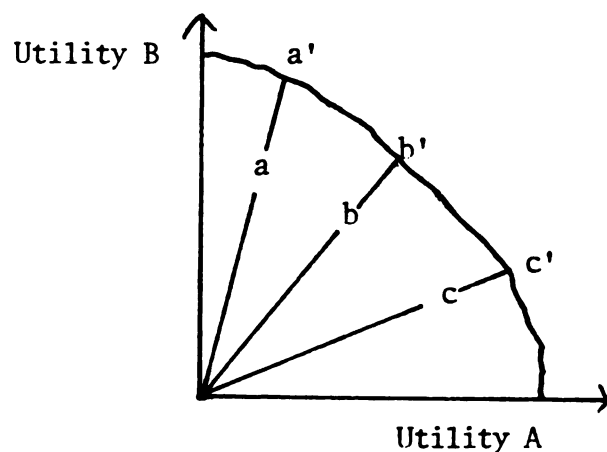
The necessary conditions for maximum social well-being are:

1. Parety-efficiency; and
2. a point of tangency between the grand utility frontier and a social indifference curve.

The sufficient condition is that a unique, true tangency between the grand utility function and a social indifference curve exist.

Constant Proportional Shares

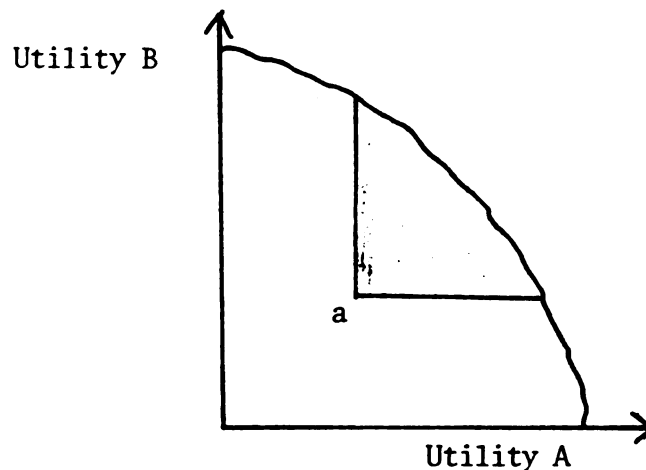
Unlike the two preceding examples, the criterion of constant proportional shares does address the issue of distribution. By allowing only those moves which preserve original income proportions (a to a', b to b', etc.), the status quo is maintained:



In essence, the constant proportional shares criterion defines an improvement as a move which increases the income of one consumer while increasing all other consumers' incomes by the same proportion. In this way, no economic injury can occur.

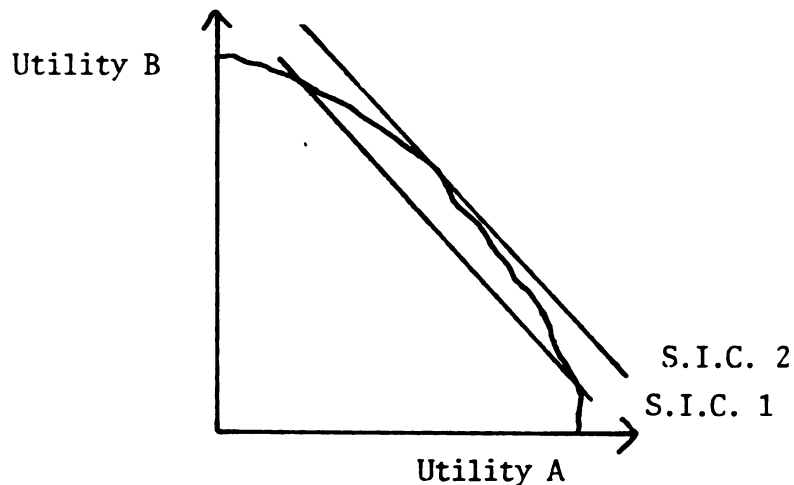
Parety-Safety

A more restricted form of the Pareto-efficiency criterion, the Pareto-safety criterion, permits no real economic injury. It is defined as a move that would improve the utility of at least one person while making no one else worse off. Movements from point 'a' toward the shaded area are considered moves toward efficiency. Note that relative redistributions of income between persons are permitted.



Maximum Value of Social Product

The maximum value of social product criterion is a special case of the maximum social well-being criterion. In this case, the slope of the social indifference curves is equal to negative one, signifying that every one dollar of income is weighted equally regardless of the recipient. Those policies which result in a larger value of social product are preferred.



Under the maximum value of social product criterion, economic injury is permitted as long as the gains outweigh the losses. Essentially, this criterion is identical to the benefit/cost criterion.

Potential Pareto Improvement

This criterion, proposed independently by Kaldor (1939) and Hicks (1939), states that a policy should be accepted if those who gain as a result of the policy could fully compensate those who lose. Note that this "compensation principle" does not require that the losers be compensated, only that they could be. However, the resulting program would be optimal only if the compensation is actually carried out. The criterion is satisfied when the sum of the changes in individual welfare is greater than zero (Freeman, p. 55, 1979). Under this criterion, a unit of benefit is weighted equally regardless of to whom it accrues.

The application of efficiency criteria to the choice of land use between farming and surface coal mining illuminates important aspects of the market allocation process. Efficiency criteria are used to judge performance in the economy and to evaluate alternative courses of action. The criteria presented in this section are used to understand more clearly the efficiency and distributive consequences of actions

relating to surface coal mining on Michigan farmland. These concepts are used throughout the remainder of the study to illustrate the land allocation process and evaluate the role of the regulatory structure implemented by the Michigan Surface and Underground Mine Reclamation Act (P.A. 303).

Sources of Inefficiency

An externality is defined as an "inefficiency which arise(s) when some of the benefits or costs of an action are external to the decision maker's calculus" (Randall, p. 157, 1981). As is pointed out by Schmid (1978), under a definition as general as this one nearly every action may involve an externality. To make the concept of an externality more useful, Randall (1981) distinguishes between a "relevant externality" and a "Pareto-relevant externality." A relevant externality exists whenever the affected party is not indifferent to the effects resulting from an action; i.e., s/he wants more or less of the externality to be produced. A Pareto-relevant externality exists whenever it is possible to change the activity in such a way as to make the affected party better-off without making the acting party worse-off. Pareto-relevant externalities may produce either costs or benefits for the affected party and can only exist when the economy is not operating at a point of efficiency. An external economy exists whenever it is possible to increase the level of an activity and increase the utility of one person without decreasing the utility of another while an external diseconomy exists when the level of an activity can be decreased to increase the utility of one person without decreasing the utility of another.

cie

goc

to

(a

co

lo

mo

o

W

S

W

S

W

S

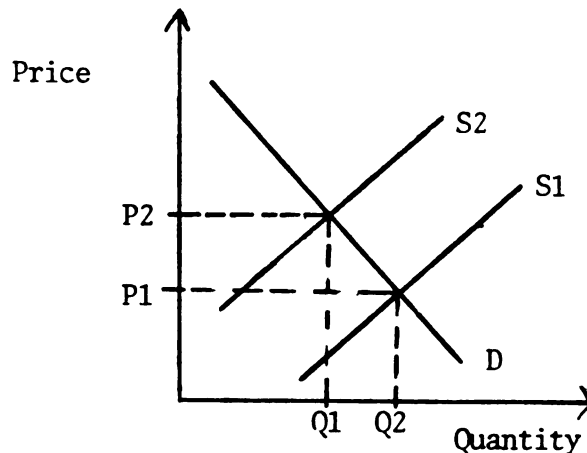
W

S

W

S

The existence of Pareto-relevant externalities causes inefficiencies which are manifested in both the pricing and level of output of a good. A Pareto-relevant diseconomy causes the price of the good to be too low and the quantity produced too high; the cost of the externality (air pollution, for example) is not a part of the producer's cost accounts and, therefore, the supply curve which the producer see is too low (S_1). Taking account of the externality causes the supply curve to move up and to the left (S_2) resulting in a higher price and lower level of output.



To eliminate the inefficiencies imposed by the presence of externalities, the producer must be induced to account for them. Stated another way, the externalities must be "internalized." This may be accomplished through either the implementation of a system of regulations or use of an incentive-oriented method such as taxing policies or pollution certificates. Both solutions, regulations and incentive-oriented methods, attack the root cause of externalities: an attenuation of property rights. In essence, an externality occurs because there are no clearly defined property rights to the good in question. Air pollution, for example, occurs because no one "owns" the right to clean air

and polluters can, therefore, dirty the air without fear of reprisal or cost to their firm.

Barriers to the Internalization of Externalities

Basically, there are three barriers to the internalization of a relevant externality: joint-impact, high exclusion cost, and super economies of scale. These barriers involve either characteristics inherent in the nature of the good itself or the production of the good.

An attenuation of property rights results in goods having high exclusion costs which prevent producers from extracting revenues. These goods, through either characteristics inherent in the good itself or by law or institution, are available to all consumers whether or not they contribute to the production costs of the good. Even those consumers who would otherwise contribute are tempted to become "free riders" and not contribute since the good will be provided regardless of their actions. Typically, high exclusion cost goods are underproduced.

A good is considered a "joint-impact" good if, after production, it is available to all consumers without rivalry: consumer 'a' can use the good without diminishing the amount available to consumer 'b' (Schmid, p. 70, 1978). Over some range of output, the marginal cost of an additional user of a joint-impact good is equal to zero. Joint-impact goods cause market inefficiencies because there is no mechanism whereby producers can extract revenues to cover total production costs. Frequently, joint-impact goods are referred to as "public goods," although this is misleading because it implies that these goods are or should be publicly provided.

A particular joint-impact good may exhibit either high or low exclusion costs: scenery has a high exclusion cost because anyone driving or walking by can enjoy the view while cable t.v. that requires a subscription fee to unscramble the signal has low exclusion costs. Goods with high exclusion costs are also called non-exclusive because it is very costly to exclude individuals whether or not they contribute to the cost of provision. For example, when surface mine reclamation regulations are enforced, everyone living in the area benefits from a cleaner environment. While reaping the majority of the benefits of the economic activity, the mine operator also bears the majority of the costs involved in reclamation procedures.

Continuously declining long run average costs lead to another barrier to the internalization of externalities. This is the case of monopoly production: due to declining costs the lowest cost per unit of the good is achieved by having only one firm produce the good. Monopoly production leads to higher prices per unit of good and a lower level of consumer welfare.

The nature of the surface coal mining process causes use of an acre of land to display joint-impact and high exclusion cost characteristics. The concepts presented in this section are applied to surface coal mining on Michigan farmland in the public choice economics discussion appearing at the end of this chapter.

Optimal Allocation of a Stock Resource Over Time

The question to be explored in this section is: "what is the optimal allocation of a stock resource over time?" Concern over the rate of resource extraction have been voiced frequently in the 1970's:

opposing sides claim that present rates of extraction are either too fast or too slow (See Robinson [1975], Surrey and Page [1975] and Common [1975]). By taking account of the properties peculiar to stock resources, this section will identify the important conclusions which can be drawn about the optimal allocation of a stock resource over time. The concepts presented in this section are applied to the extraction of Michigan coal in Chapter 4.

The first comprehensive work in this field was completed by Gray (1914). Following this, Hotelling (1931) published his classic article describing optimal extraction paths for a stock resource under various conditions. Works by Scott (1967), Gordon (1967), Cummings and Burt (1969), and Solow (1974) further modified and expanded upon this foundation.

Exhaustible Natural Resources

As discussed in Chapter 1, an exhaustible resource is a resource that cannot be reproduced and for which the total physical supply is fixed. Additions to the stock occur only over geologic time periods or through discoveries or the development of new technologies. In essence, this implies that the extraction and consumption of a unit of an exhaustible resource involves an opportunity cost: the value of the resource in its next highest alternative use (Fisher, p. 13, 1981). The importance of this concept is made clear in the discussion which follows.

It is important to recognize that, in an economic sense, "exhaustion" does not refer to the complete depletion of physical supply. Rather, it refers to a gradual rise in the cost of exploitation which

leads to higher resource prices (Herfindahl and Kneese, p. 115, 1974). The resource itself is not necessarily limited but the quantity available at a relatively low cost is limited (Fisher, p. 24, 1981). Exhaustion occurs when price rises to such a level that quantity demanded falls to zero. To illustrate this point, consider the following: it is unrealistic to assume that the United States will someday "run out" of domestic sources of oil. Before the last drop is pumped, the price of oil will have risen prohibitively high and consumers will replace oil with other energy resources called "backstops" (see Nordhaus, 1973). A backstop sets an upper limit on the price of a resource. Solar energy, for example, is a backstop capable of providing for some uses the same services of oil and coal, albeit at a higher price, without risking exhaustion within any meaningful time period (Fisher, p. 18, 1981).

Optimal Allocation Over Time

As given by Fisher (1981), the first condition of the optimal depletion of a stock resource is that:

$$\text{price} = \text{marginal production cost} + \text{opportunity cost}$$

The properties of stock resources result in the addition of opportunity cost to this condition and imply that less of the resource will be extracted today than would have been if the resource were reproducible. Net price is found by subtracting extraction cost from the market price:

$$\text{Net price} = \text{market price} - \text{marginal extraction cost}$$

In the literature, net price is also referred to as royalty, rent, and user cost. For the purposes of this paper, the term "net price" will be used.

An exhaustible resource deposit in the ground represents a capital asset to its owner and derives its market value from its potential extraction and sale (Solow, p. 2, 1974). Left in the ground, resource deposits can only earn a current rate of return by appreciating in value, and, in equilibrium, the value of the resource deposit must be growing at a rate equal to the rate of interest. The value of a resource deposit is also found by taking the present value of future sales minus extraction costs:

$$PV = (P_0 - C_0) + \frac{(P_1 - C_1)}{(1 + r)} + \frac{(P_2 - C_2)}{(1 + r)^2} + \dots + \frac{(P_t - C_t)}{(1 + r)^t}$$

where:

P = price of resource

C = unit of cost of extraction

$(1 + r)$ = discount factor

t = time period in which extraction occurs

$(P - C)$ = the unit royalty in time period "t"

The resource owner must expect the net price of the resource deposit to be increasing at a rate equal to the rate of interest as well:

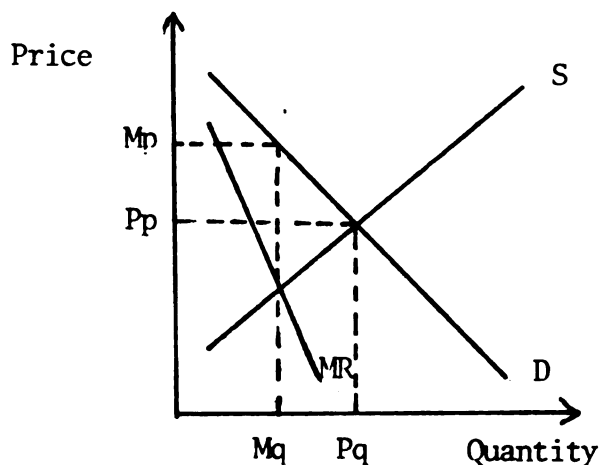
$$(P - MC) = (P_0 - MC)(1 + r)$$

(For a more complete discussion of investment criteria, see Chapter 4).

Under the conditions of a monopolistic market, marginal revenue minus marginal cost must be growing at a rate equal to the rate of interest:

$$(MR - MC) = (MR_0 - MC_0)(1 + r)$$

It is interesting to note that the monopolist must be considered to be the "conservationist's friend" because of the rate at which s/he extracts a resource deposit (Solow, p. 1974). Because the monopolist sees the marginal revenue curve rather than the demand curve in setting price and quantity, it underproduces relative to a perfect competitor:



The monopolist produces quantity $[M_q]$ at price $[M_p]$ while the perfect competitor produces $[P_q]$ at price $[P_p]$.

The fundamental principle of the economics of a stock resource can be stated as follows (Solow, p. 3, 1974):

If net price is increasing like compound interest, owners of operating mines will be indifferent at the margin between extracting and holding at every instant of time...If net price were to rise too slowly, production would be pushed nearer in time, and the resource would be exhausted quickly, precisely because no one would wish to hold resources in the ground and earn less than the going rate of return. If the net price were to rise too fast... owners would delay production while they enjoyed supernormal capital gains.

While net price is the price producers receive, the market price paid by consumers is equal to the net price plus costs of extraction. Falling extraction costs may result in higher net prices while market prices either remain constant or fall. When market price increases relative to extraction costs, production tends to increase as new

producers are motivated to enter the market. Just the opposite is true when market prices fall relative to extraction cost: producers leave the market. In essence, the asset and extraction markets provide offsetting influences on the income generated by the ownership of a stock resource deposit.

Uncertainty

As noted in Chapter 2, there are a number of uncertainties involved in the surface coal mining of Michigan agricultural land: future effective demand for Michigan coal, quality and quantity of the coal resource, the probable success of reclamation procedures on prime farmland, and the validity of the need to preserve agricultural lands. In this section the effect of these uncertainties on decisions to operate surface coal mines in Michigan is discussed.

For the most part, surface coal mine operations are investments which involve relatively long time periods. As stated by Fisher (1981), "the difficulty is that resource owners must form expectations about future prices and then act on these expectations in making decisions about how much of the resource to use at any time." Demand uncertainty evolves because the taste and preferences of consumers in distant time periods may differ considerably from present generations and may depend upon factors which are presently unknown or unmeasurable. Additionally, uncertainty regarding technological innovation will affect future levels of effective demand; developments that make solar energy provision cheap and efficient and new mining methods capable of extracting coal at a lower price are likely to alter effective demand for coal.

Generally, uncertainty is accounted for in economic models through the use of a higher rate of discount, yielding higher rates of depletion.

Response to uncertainties is affected by whether the investor is risk-averse, risk-neutral or risk-loving. In the face of uncertain stock levels a risk-averse investor will slow extraction to push the day when the stock will near exhaustion further out into the future.

One type of uncertainty arises because some decisions and actions are potentially irreversible. Modern reclamation procedures are capable of returning some farmland to levels of productivity equal to or higher than pre-mining levels, but some doubt exists over the capability of mine operators to restore prime rowcrop farmland. If this is indeed impossible given the current state of scientific knowledge, a decision to surface mine removes this land from the opportunity set of rowcrop farmland forever. In essence, the decision to mine can only be reversed at infinite costs to society.

An event is considered a "risk" if the outcome is uncertain but the probabilities are known or can be estimated. One method proposed to deal effectively with the problem of risk in an investment decision is the use of expected values. The expected value (E.V.) of a risky event can be calculated using the following formula:

$$E(X) = P_1X_1 + P_2X_2 + \dots + P_nX_n$$

where:

P_n = probability of event n

X_n = value of the n th event

A probability is a numerical value between 0 and 1 that measures the uncertainty that a particular event will occur (Lapin, p. 99, 1980). Probabilities are based on a large number of observations and when multiplied by the value of the event yield a weighted average of the outcome - the expected value. A policy maker relying on the expected value

criterion will choose the alternative with the greatest expected value, subject to the provision that the variance not be too large (Solberg, p. 446, 1982).

Coping with uncertain parameters (those for which the probabilities are unknown) is inherently more difficult than risk. One approach, the Safe Minimum Standard, has been developed by Bishop (1978) to deal with endangered species extinction and, it is possible that its use could be extended to other areas as well.

Intergenerational Equity

Although the use of the present value criterion illustrated in the section on the optimal allocation of a stock resource over time yields an efficient solution for the resource owner, there is no guarantee that this solution will also allocate resources "equitably" between generations. It is important to note the role of r , the market rate of interest, in the present value criterion; a change in this value can alter the choice of alternatives. It has been suggested by a number of economists that the use of r leads to rates of depletion that are too rapid from societal viewpoint.

The central argument for a social discount rate lower than the market rate, developed by Marglin (1963), is based on the assumption that present generations derive a benefit from knowing that future generations will prosper. Given that this assumption is true, all individuals of the present generation are better off saving and investing more than they would have if they had no concern for the welfare of future generations. Hence, the social rate of discount is lower than the current market rate, r , that is used to evaluate individual investment opportunities.

Resource Scarcity and Resources as Constraints on Growth

Concerns over the possible impacts of natural resource scarcity on economic growth have prompted research efforts for the last twenty years. Beginning with the Barnett and Morse (1963) study which showed scarcity fears to be overdrawn, researchers have been studying economic and physical measures of scarcity to determine whether resources were truly becoming more scarce and what implications scarcity might have on economic growth.

Resource scarcity can be estimated using either physical or economic measurements. For exhaustible natural resources the most commonly used measure is reserves: the known amount of the stock that can be profitably extracted given current prices and technology (Fisher, p. 94, 1981). Reserve measurements tend to be misleading because they are strongly affected by new discoveries and changes in input and resource prices and therefore do not account for all of the resource base that is potentially recoverable. For example, a statement such as "the coal reserves of the United States will meet energy requirements for the next 200 years" is necessarily based on present values of consumption, price, known supply, and extractive technology; all of which may change significantly and alter the estimate.

Another measurement of resource scarcity is crustal abundance. This measurement accounts for all of the "material which exists in minute concentrations in the average rock in the earth's crust" (Fisher, p. 98, 1981). In essence, this measurement represents the opposite extreme of the reserve measurement - everything is counted and a rate of recovery of 100% is assumed.

Both measurements - reserves and crustal abundance - attempt to predict physical scarcity: the occurrence of a state in which there is not enough of the resource to satisfy consumption requirements and need (Manthy, p. 2, 1977). Use of these measurements has led forest resource managers, for example, to institute programs designed to increase reserve inventories. However, these programs have not been successful in reducing economic scarcity.

Economic scarcity of a particular resource is identified by increasing real prices over time and is measured by analyzing changes in resource costs, price and net price. Increasing or decreasing price over time may result from changes in supply factors, demand factors, and changes in the existing institutional framework. Studies analyzing cost patterns have indicated falling real costs over time for extractive resources; it has been hypothesized that this decrease is a reflection of the technological improvements of the same time period. Whether or not these improvements will continue in the future is unclear, but Fisher (1981) points out that there may be some validity to the argument that extractive industries have neared their peak technologically and rising costs will occur in the future.

The use of resource price as a measure of resource scarcity reflects expected future costs of exploration, discovery and extraction (Brown and Field, p. 219, 1979). However, changing technology may distort the price pattern. Brown and Field (1979) report that improved methods for capturing passenger pigeons held the price paid for the bird nearly steady even when it became clear that the species was near extinction. Previous studies of extractive resources have indicated falling prices over time. More recently, however, research indicates

price levels that have leveled off and, in some cases, are beginning to rise slowly indicating an overall U-shaped pattern for extractive resource prices (Fisher, p. 107, 1981).

The theoretical economic concepts presented in this chapter are directly applicable to a landowner or community's decision-making process. Use of these concepts acts to structure the choice of land use between farming and surface coal mining. In Chapter 4 these concepts are used to develop a framework for analyzing land conversions from farming to surface mining in Michigan.

Public Choice Economics

Introduction

The Michigan Surface and Underground Mine Reclamation Act (P.A. 303) relies upon regulatory performance standards to ensure levels of environmental protection and the provision of abandoned mine reclamation. In effect, the passage of P.A. 303 restructures and redistributes the property rights of any surface mine operator seeking to function in the state of Michigan, thereby altering substantive performance in the economy. This section is an attempt to hypothesize the effects of this change within a framework which relates situation, structure and performance. To accomplish this analysis, it will be instructive to contrast the intended performance of P.A. 303 with the actual performance of other regulatory systems implemented to control similar goods.¹

As stated earlier, the state legislature was clear about the intent of the law. Its purpose was to retrieve exclusive control over

¹Unless otherwise noted, the public choice concepts presented in this section are from Schmid (1978).

state-owned resources (previously vested in the federal government pursuant to P.L. 95-87), regulate the mining of coal and land reclamation, and control the adverse environmental effects of surface mining. More generally, state officials expressed a desire to structure a framework within which surface mine operators would be attracted to the state and contribute to the economic recovery of Michigan. In addition, officials declared an interest in protecting state agricultural land from the potentially irreversible impacts of surface coal mining (Michigan Senate Analysis Section, p. 1, 1982).

Nature of Good

When examining the performance effects of a legislative statute, court ruling or proposed administrative policy, it is important to have a clear understanding of the nature of the good that the policy seeks to affect or change. The Michigan statute is directed toward land reclamation and the resulting environmental quality, but the nature of the good (land covering coal deposits) and the interdependent rights relating to it are complex.

An acre of land that covers a coal deposit is a type of incompatible-use good: an acre of land may have two or more physical uses or users that are incompatible. Put simply, land cannot be surface mined and farmed simultaneously. Use of an acre of land by "A" diminishes the amount available to "B". Factor ownership controls the rights to access of an incompatible-use good and the right to participate in resource use decisions. When looking at the public choice of factor ownership of an incompatible-use good the major question to be answered is, "who gets to own and use the good?" In other words, "whose interests count and

whose do not?" Factor ownership strongly influences the distribution of income and the opportunity for one party to create costs for another. Use of a regulatory system moves rights from surface mine operators to third parties who benefit from improved environmental quality and suggests a choice in favor of the interest of third parties.

A significant, inherent characteristic of this particular incompatible-use good is that it also has low exclusion costs; land owners in the United States are protected through a complex system of property law and learned habits which regard land ownership as an institution granting exclusive use rights to an individual. Generally, use rights exchange has been limited to bargained transactions between private parties.

However, due to the nature of surface mining, use of an acre of land displays characteristics of a joint-impact good. The environmental quality which results from a surface mine operation is a high exclusion cost, joint-impact good for which avoidance is, to a large extent, non-optional. Anyone who lives near a surface mine must either live with the damages, or move away. Damages can include the disruption of aquifers, water pollution, and serious aesthetic destruction. For the purposes of this analysis, these damages will be combined under the term "environmental impacts." The success of P.A. 303 in controlling environmental impacts is of particular importance to the state's goal of protecting agricultural land. By extension, attainment of a lower level of negative environmental impacts should mean more land that is capable of being reclaimed for agricultural uses.

The high exclusion cost of environmental impacts further enhances the ability of one party to affect another. If reclamation regulations

are effectively enforced, everyone in the region benefits from a healthy, more pleasing environment. If not, everyone loses. This situation leads to a temptation for individuals to become free-riders and not contribute to the provision of the good. Alternatively, the enforcement of regulations may lead to the existence of unwilling-riders who would prefer to see tax dollars spent on a purpose other than surface-mined land reclamation.

Governmental regulations create a public right to expect certain minimal standards of surface-mined land reclamation. When interests conflict, the issue confronting the state is the location of the right to use the natural environment for either waste disposal or pleasure. Use of a regulatory system allocates these rights in a particular manner. What follows is an examination of the structure of rights and performance in Michigan under the regulatory system enacted by the passage of P.A. 303. This discussion should lead to a better understanding of the potential performance of the Michigan statute.

Structure and Performance of a Regulatory System

The structure of property rights orders the interdependencies which exist in a given situation. The role of property rights is to determine the opportunity set of one firm (person) to affect another by determining the relationship which exists between them. Put more succinctly, when tastes conflict, property rights specify whose interests count.

Historically, environmental impacts have been controlled in the United States by a complex system of design and/or performance standards. To date, analysis shows these regulations to be only marginally successful and extremely costly (Rosenbaum, pp. 51-54, 1978). If this is

indeed the case, one might ask why decision makers are so persistent in their use of regulations to control environmental impacts. Unfortunately, the answer to this isn't altogether clear. The discussion which follows is based, in part, on prior analysis of the effectiveness of existing regulatory systems in achieving desired performance.

As noted earlier, the issue of surface coal mining in Michigan has developed into a case of coal v. farmland. The uncertainties which permeate this situation make finding solutions acceptable to all parties difficult. To summarize, these uncertainties include the future effective demand for Michigan coal, the quantity and quality of Michigan coal reserves, and the debated necessity to protect Michigan agricultural land from transition to another type of land use. Under the circumstances, present prices do not necessarily reflect future value. To correct this divergence, Michigan citizens (or, rather, their elected officials) created P.A. 303 as a mechanism by which they could hold an option to future supplies of agricultural land and environmental quality. In effect, P.A. 303 is designed to ensure these options.

Prior to the implementation of a system of regulations, surface mine operators enjoy an effective right which extends beyond the limits of his/her property. Because a conflict of interest exists between mine operators and third parties, the exercise of this right involves a production process which results in negative impacts to third parties. These impacts may be either pecuniary or technological in nature. Pecuniary externalities exist whenever the "good remains intact, but its value in exchange is affected" (Schmid, p. 171, 1978). For example, proximity to an unreclaimed surface mine may lower property values of adjacent lands. A technological externality is an impact which

physically affects another firm (person), such as lower soil productivity which results from acid run-off. The effect of regulation is not to make these externalities go away, but rather to change their form. What was once a cost to third parties and a source of income for mine operators is now a cost to operators and an expanded opportunity set for third parties.

The use of a regulatory system orders property rights in a particular manner. Enforcement of a performance standard precludes consideration of individual circumstances which might cause compliance to be particularly difficult or costly for an operator. Each operator must meet the same standards regardless of the individual firm's marginal cost of compliance. Although uniform standards may ensure the maintenance of state-wide levels of environmental quality, it does not deal well with considerations of equity. In the past, performance controlled by regulations has led operators to reduce environmental impacts by the minimum amount and no more. If standards are raised, the set of effective property rights held by each operator is reduced while those held by third parties increases. At this point, marginal firms face the choice of leaving the industry and losing immobile assets or risking the penalties for non-compliance.

Performance standards (unlike design standards) allow considerable freedom for the operator to decide how best to comply with the law. However, enforcement is difficult and detailed information is required by the regulating agency. In addition, performance standards sometimes lead operators to fear they are committing to open-ended objectives which may be difficult or impossible to attain at a given location. Because the difficulty and expense of a reclamation operation is

directly related to topography, climatic conditions, and geological features, enforcement of regulatory standards affect the geographical location of surface mines as well. Faced with stiff penalties for non-compliance an operator may, for example, choose to mine a relatively flat area of land rather than a rolling area in order to reduce the high costs of reclamation. Again, this has implications for the state's goal of protecting agricultural land: it is generally true that prime farmland is relatively flat and this makes these locations ideal for surface mining. The law which is intended to protect this farmland is, at the same time, encouraging miners to operate at these locations.

Regulatory systems transfer important rights into the opportunity sets of individuals who derive the most benefit from high levels of environmental quality while granting nontransferable use rights to mine operators. Although each standard is backed by scientific analysis, regulations are really nothing more than administrative judgements. As such, they are frequently contested and debated. P.A. 303 grants individuals who feel they are being adversely affected by a surface mining operation the right to appeal the administrative process that grants miners operating permits. In addition, if they are willing to bear the contractual costs, citizens may file civil suit against mine operators. The state government bears the cost of obtaining injunctions against operators not complying with the regulations.

Summary

The purpose of Chapter 3 has been to develop a conceptual basis for understanding the allocation of land between farming and surface coal mining. While this chapter has been concerned primarily with

theoretical concepts, it raises numerous considerations which are directly applicable to a landowner's or community's decision-making process. After considering some of the conclusions which can be drawn from this chapter, these concepts are used in Chapter 4 to develop a framework for analyzing the land conversions from farming to surface coal mining in Michigan.

The private market allocation of land between farming and surface coal mining can be analyzed on the basis of economic efficiency. Given an absence of externalities, standard microeconomic theory states that private market decisions will result in an economically efficient allocation of resources if certain theoretical assumptions hold (Huff et al., p. 242, 1982). In the chapters which follow, the conversion of land in Michigan from farmland to surface coal mining will be analyzed on the basis of efficiency. Furthermore, the sources of inefficiency and barriers to the internalization of externalities inherent in the surface coal mining process are discussed.

An economically rational decision-maker will choose to extract a stock resource at the rate which maximizes his/her returns. Michigan farmers who are given the opportunity to sell or lease their land to surface coal mine operators must choose between the returns from farming and returns from surface coal mining. The conceptual framework for determining the optimal allocation of a stock resource over time can be applied to both individual landowner and community resource allocation decisions. The discussion presented in this chapter is extended in the analysis which follows in order to develop an economic perspective on the choice between farming and surface coal mining uses.

The uncertainties which exist regarding surface coal mining in Michigan complicate the decision-making process. As noted earlier, there is a need to recognize these factors when choosing between alternative resource allocations. The validity of the method which accounts for uncertainty by adding a risk premium to the discount rate is discussed in Chapter 4. Additionally, concepts from the discussions of intergenerational equity and resource scarcity applicable to the allocation of land between farming and surface coal mining in Michigan are utilized in the following analysis.

By applying concepts from the field of public choice economics, it was possible to hypothesize the effectiveness of the regulatory system implemented to control surface mining in Michigan. The major contribution of this section was to contrast the intended performance of P.A. 303 with the actual performance of other regulatory systems designed to control similar goods. To summarize, regulatory systems transfer rights from surface mine operators to third parties who benefit from the enforcement of regulatory standards. Historically, the use of regulatory standard to control environmental quality has been only marginally successful and extremely costly (Rosenbaum, pp. 51-54, 1978). The actual performance of P.A. 303 relies heavily upon the ability of the state's Department of Natural Resources to effectively implement and enforce mining and reclamation regulations. Until a system of regulations (called administrative rules in Michigan) is developed, it is difficult to predict the impact of P.A. 303 on surface coal mine operations in Michigan.

CHAPTER 4

ANALYSIS OF THE ALLOCATION OF LAND BETWEEN AGRICULTURE AND SURFACE COAL MINING IN MICHIGAN

Introduction

As stated in Chapter 3, the discipline of economics can, by structuring information into a rational and operational framework, contribute valuable insight to the choice among alternative courses of action. Throughout Chapter 3 the theoretical concepts of the economics of a stock resource were explored. In the analysis which follows, the theoretical framework of Chapter 3 will be applied to the situational variables outlined in Chapter 2 in order to gain a better understanding of the choice confronting a Michigan landowner who has the opportunity to sell or lease his/her land for surface coal mining. In Chapter 5 this framework is extended to identify and estimate the effects of the private land allocation process on a local community.

In an idealized economy with perfectly functioning markets, choices made by individuals would reflect their own preferences and opportunity sets as well as the relative prices of the goods and services developed through market interaction (Seitz et al., p. 70, 1981). Changes in land use are assumed to move land to those uses that command the highest market prices and generate the highest net returns to factors of production. Unless significant external costs are present, unregulated private decisions result in economically efficient resource allocations if certain theoretical assumptions are valid (Huff et al., p. 242, 1982).

These assumptions include perfect information, resource mobility and the existence of a set of non-attenuated property rights. However, as pointed out in Chapter 3, conditions may exist in resource markets that prevent the market from operating efficiently: (1) property rights may be attenuated causing goods to exhibit joint-impact characteristics and non-exclusiveness; (2) information shortages can lead to risk and uncertainty regarding the stream of income produced by an investment over time; and (3) intra- and intertemporal problems may cause a divergence between private/social and present/future generation optimum resource allocation. All of these conditions prevent the market from allocating resources efficiently unless the economic actors are compelled to consider more than individual preferences and opportunity sets. Furthermore, these conditions result in market-determined prices that do not necessarily reflect the true value of the good. This chapter develops an analytical framework for understanding the allocation of land between agricultural and surface coal mining uses.

To begin Chapter 4, an analysis of the investment decision faced by a Michigan landowner is undertaken. The concepts of discounting, choice of discount rate and the investment criterion of net present value are discussed. These concepts are used to examine the unregulated, private market allocation of land between agricultural and surface coal mining uses.

Investment Decisions

Many investment decisions involve commitments of land, labor and capital for extended periods of time. Under these circumstances, an investor chooses between different streams of costs and returns that

accrue over time. Consider the case of the Michigan farmer who has the opportunity to sell or lease his/her land to a surface coal mine operator. In essence, the farmer must choose between two alternative streams of costs and benefits: either the farmer will sell or lease the land and accept surface mining bonus and royalty payments and forego receipts from farming or s/he will continue farming and forego returns from surface coal mining. This choice will be based on the returns that the farmer expects to receive from each alternative and the economically rational farmer will choose the alternative from which s/he expects to gain the most. However, this decision is complicated by the fact that investment returns do not occur at only one point in time. Rather, costs and benefits are incurred over a period of time. Economists recommend "discounting" these streams of benefits and costs in order to calculate the net present value of the investment. Discounting provides a method for comparing returns from alternative investment opportunities whose costs and benefits accrue in different time periods. Use of an investment criterion determines choice between alternative investments.

Discounting Returns Over Time

The process of discounting reduces a stream of costs and benefits to a single value, called the net present value (NPV), by using the method of compound interest (Stokey and Zeckhauser, p. 160, 1978). The present value formula is used to calculate the NPV of a sum of money (or some other unit of measurement) that will be received at some future point in time:

$$NPV = \frac{R_t}{(1 + r)^t}$$

where:

R_t = (benefits - costs) at time t

r = discount rate

$(1 + r)$ = discount factor

For example, assuming a rate of discount equal to 10 percent, the NPV of \$100 to be received one year from today is:

$$NPV = \frac{100}{(1 + .10)^1} = 90.91$$

From this calculation, \$100 received today is worth more than \$100 received one year from now (worth \$90.91). This divergence occurs because \$100 that is received today can be invested and earn the market rate of interest while waiting until next year to receive the \$100 means forfeiting the interest payments (Nicholson, p. 429, 1978). Additionally, it has been suggested that many consumers practice myopic consumption patterns and that this practice leads to a high rate of time preference which leads consumers to prefer consumption today over consumption tomorrow (this is discussed more extensively in the following section). In summary, the present value of an amount of money is the amount which if invested in the present would equal the amount received in the future (Solberg, p. 403, 1982).

Many investments involve a stream of costs and benefits which occur at various points in time. An extended version of the net present value formula deals with investments of this type:

$$NPV = R_0 + \frac{R_1}{(1 + r)^1} + \frac{R_2}{(1 + r)^2} + \dots + \frac{R_n}{(1 + r)^n}$$

Additionally, the discounting procedure can be extended to account for initial capital investments (K_0) and salvage values (K) that accrue at the end of the investment period:

$$NPV = \sum_{t=0}^n \frac{R_n}{(1+r)^n} - K_0 + \frac{K}{(1+r)^n}$$

Net Present Value Criterion (NPV)

The net present value criterion (NPV) is a commonly suggested investment criterion. In its most general form, the NPV criterion states that the decision maker will choose the investment alternative that maximizes the NPV of the return:

$$NPV = \sum_{t=0}^n \frac{B_t - C_t}{(1+r)^t}$$

In other words, the criterion states that the decision maker will choose to avoid any project for which the sum of the discounted value of the return (benefits - costs) to the investment is less than zero. It is important to note that a change in the discount rate, r , may alter the project choice. In addition, under the net present value criterion use of a high discount rate tends to favor projects with a stream of returns characterized by early benefits and late costs. Use of the criterion assumes that returns from the project are reinvested at the discount rate.

Choice of Discount Rate

In the previous discussion, a discount rate was used that closely resembled an interest rate. Although a discount rate is not the same as an interest rate, they are closely related. Interest rates are determined in capital markets and are used in compounding formulas to

determine future values of a given amount of money. A discount rate, on the other hand, is a rate chosen by a decision maker and analyst to arrive at the present value of a stream of returns accruing at future points in time. Although discount rates are not simply arbitrarily chosen numbers, some practical difficulties are involved in deciding which discount rate should be used to evaluate a given investment decision.

If a single, observable market rate of interest existed at which all individuals could lend and borrow, all individuals would share the same marginal rate of time preference (MRTP) (this concept will be discussed in more detail in the following section). Under these conditions, the market rate of interest correctly reflects the opportunity cost of the resources invested in a project and is, therefore, an appropriate choice for the discount rate. Unfortunately, no single market rate of interest exists and because an individual's marginal rate of time preference is dependent upon such factors as level of impatience, expected future earnings and past income flows, there are many reasons for believing that all persons in a society do not share the same MRTP. Therefore, the choice of the discount rate becomes a matter of policy choice made by the decision maker in consultation with the analyst.

Even after the practical difficulties of choosing a discount rate are overcome and a rate is specified, there is still the question of how risk should be accounted for in an investment decision. As pointed out in Chapter 3, the future is inherently uncertain. Costs and benefits that accrue in future time periods are, therefore, uncertain and introduce a degree of risk into the investment decision.

Frequently, it has been suggested that a risk "premium" be added to the discount rate in order to compensate for uncertainty. However, as pointed out by Stokey and Zeckhauser (1977), "raising the discount rate in effect changes the tradeoff rate between payoffs in different time periods, yet there is no inherent reason why uncertainties about the amount of future payoffs should affect the way we are willing to tradeoff one year's payoff against the following year's." In essence, various costs and benefits have different uncertainties which cannot be accounted for by changing the discount rate. Stokey and Zeckhauser (1977) recommend that the correct analytical approach for treatment of risk is to choose a rate of discount that is essentially risk-free and treat the problem of risk separately and explicitly.

Economics of the Allocation of Land Between Agricultural and Surface Coal Mining Uses

The purpose of this section is to utilize the concept of discounting to develop an analytical framework for understanding the economics of the allocation of land between agricultural and surface coal mining uses. Because the state of Michigan is endowed with a significant agricultural base and a reserve of strippable coal deposits, much of which lies beneath agricultural land, there is the potential for constant conflict between these mutually exclusive land uses. Although reclamation procedures have been developed to return most agricultural land to a productive capacity equal to or greater than pre-mining levels, a great deal of controversy exists over the use of land for surface mining operations.

Standard microeconomic theory states that in the absence of significant externalities, the private market allocates land in a way that

is economically efficient. However, surface mining operations impose significant externalities on nearby landowners and the communities in which they are located. State and federal regulations have been passed in an effort to control the impact of these externalities by regulating various aspects of the conversion of land from agricultural to surface mining uses (Huff et al., p. 241, 1982). Additionally, it is important to note that farming operations also inflict negative externalities on third parties which are not accounted for in the market allocation process. These externalities include soil erosion and noise and air pollution.

To examine the unregulated market allocation process in the absence of externalities, the concepts of discounting and net present value can be used. Consider an acre of currently productive farmland in Michigan that has some amount of coal beneath it. As suggested by Page (1977), it is instructive to first view the consumer and producer sides of this allocation process separately in order to understand the whole.

The rate at which an individual consumer is willing to trade off a unit of consumption today for a unit of consumption tomorrow is referred to as his/her marginal rate of time preference (MRTP). The MRTP exists because consumption in one time period is viewed by consumers as different from consumption in a different time period (Sudgen and Williams, p. 13, 1978). The marginal rate of time preference held by a consumer may be inferred by examining his/her behavior with regard to the borrowing or saving of money: if consumer A is indifferent between spending \$100.00 today and saving that same \$100.00 in a bank account that pays $5 \frac{1}{4}$ percent interest per day, s/he is revealing

that

othe

1977

con

a

va

w

t

t

h

.

r

.

.

.

.

h

s

that \$105.25 received tomorrow is worth the same as \$100.00 today. In other words, s/he holds a MRTTP equal to 5 1/4 percent (Page, p. 148, 1977).

Assuming that a consumer's well-being is a function of his/her consumption at a point in time (C_t):

$$\text{well-being} = f(C_t)$$

a consumer will choose a consumption path that maximizes the present value of the utility stream:

$$\frac{f(C_t)}{(1 + r)}$$

where:

r = consumer's marginal rate of time preference

Likewise, a producer will choose an investment path that maximizes the net present value of the stream of returns. Consider, for example, the Michigan farmer who has to choose between selling an acre of his/her land for surface coal mining and continuing to farm that same acre. The two alternative investments are mutually exclusive, farming and mining cannot occur simultaneously. Which investment should the farmer choose?

To begin, assume an infinite time period and that the acre of land in question can be farmed each year forever. Additionally, assume that the net income accruing to this acre is \$200.00 per year. If the appropriate rate of discount for this farmland is 10 percent, the net present value of this acre in farming is \$2,000:

$$NPV = \frac{a}{r} = \frac{200}{.10} = 2,000$$

where:

NPV = net present value

a = permanent annual return

r = discount rate

Now, assume that the coal lying beneath this acre of farmland has value of \$5,000 at current market prices, that the cost to extract this coal is \$2,500, and that all of the coal can be mined in one year. The coal operator must estimate the net present value of the future stream of benefits and costs when deciding whether or not to undertake mining. Under these conditions, for example, the coal mine operator would value this acre of land at \$2,500 and, even if coal production permanently removes this acre from farming, it will be economically efficient to mine this acre of land. Indeed, private bargaining between the coal producer and farmer will lead to this solution; the farmer will accept at least \$2,000 for the acre and the coal producer is willing to pay as much as \$2,500, making a trade beneficial to both parties.

Huff et al. (1982) identify three points regarding the discounting procedure and the allocation of land between surface coal mining and agriculture: (1) The purchase price of the farmland compensates the farmer (and society, assuming no externalities) for the foregone net cash flow from crop production over the entire life of the farmland. The discounting procedure makes the differential timing of net cash flows from the two investments irrelevant (i.e., farming yields a steady stream forever, while coal mining yields early returns and then zero returns). (2) The discounting process illuminates the role of various determinants of cash flow to both farming and mining; a change

in the magnitude of one of these determinants may affect the allocation process. For example, when estimating the net present value of future income streams, the coal operator must account for changes in the price of coal, etc. In the preceding example, a drop in the price of coal after the introduction of a substitute energy fuel might reduce the value of the acre for coal production below \$2,000. In this case, the land would remain in farming. (3) The effect of governmental regulations on the conversion of land from farming to surface coal mining can also be better understood as a result of the discounting process; reclamation requirements increase the cost of coal mining, thereby decreasing returns per acre and the overall value of the acre for surface mining.

To summarize, standard microeconomic theory states that, in the absence of externalities, unregulated private decisions of farmers and coal miners will result in an economically efficient allocation of land between farming and surface mining. However, as was noted earlier, surface mining does impose significant external costs on third parties who are not directly involved in the transaction, thereby rendering the private market solution socially inefficient. These external costs include aesthetic destruction, increased usage and damage to local road systems, soil erosion control problems, and water pollution. In a similar manner, reclamation practices provide external benefits to third parties in the form of aesthetic improvement, restored land productivity, etc. In essence, governmental regulations are enforced to control the conversion of farmland to surface mining and thereby control the magnitude and incidence of external costs of mining and external benefits of reclamation. Huff et al. (1982) make an important point by

noting that, "(i)t is contrary to economic theory to argue for regulations to restrict conversion and/or to encourage land reclamation in order solely to preserve the future crop-producing potential of the disturbed land." Rather, the correct argument is that increased land prices that result from reclamation regulations provide accurate incentives for private, self-interested landowners to make socially efficient land allocation decisions (Huff et al., p. 252, 1982).

Summary

The purpose of this chapter has been to develop an analytical framework for examining the allocation of land between agricultural and surface coal mining uses. Many of the theoretical concepts presented in Chapter 3 were applied to the landowner decision-making process in order to develop an economic perspective of the determinants of land conversion. After summarizing the conclusions which can be drawn from this discussion, Chapter 5 utilizes this framework to present a method by which local policy makers in Michigan can identify and estimate the magnitude of economic impacts resulting from the conversion of land from farming to surface coal mining.

Changes in land use are assumed to move land to those uses that command the highest market prices and generate the highest net return to factors of production. Through the use of the discounting procedure and appropriate investment criteria, choice among alternative investments can be determined. In the absence of significant externalities, unregulated private decisions are assumed to result in resource allocations which are economically efficient.

However, surface coal mining does impose significant external costs on third parties, thereby rendering the private market solution inefficient for society by allocating more land to mining than would occur if all costs were accounted for. Governmental regulations are enforced to control the magnitude and incidence of these external costs by controlling the conversion of land from agriculture to surface coal mining. The regulations are designed to provide accurate incentives for private, self-interested individuals to make land use decisions that are socially efficient.

CHAPTER 5

LOCAL IMPACTS OF SURFACE COAL MINING AND PROCEDURE FOR ECONOMIC IMPACT ASSESSMENT

Introduction

Through the private market mechanism, resources are assumed to move from lower to higher valued uses. As explained by Barlowe (1978), "(1)and resources tend to move to those operators who bid the most for their control and to those uses that offer the highest return for their utilization" (p. 193). However, as discussed in Chapter 4, the presence of externalities may cause unregulated private decisions regarding the conversion of land from farming to surface mining to lead to socially inefficient resource allocations. Local policy makers must be prepared to deal with changes in land use initiated in the private sector which may impose significant externalities on the community and may have substantial impacts on the local economy by altering income accruing to local businessmen, tax revenues, and employment levels (Scott, p. 1, 1978).

At the state level, impacts resulting from changes in land use can be aggregated and analyzed to determine statewide impact. However, analysis at the local level is much more difficult. Historical residential patterns, purchasing habits, and local tax policies all play a part in determining the degree to which a change in land use will affect the local economy (Huff et al., p. 22, 1982). Variability between areas makes it possible for a change in land use which is beneficial

for particular regions or the state as a whole to have a devastating impact on the community in which the conversion occurs. This situation led Huff et al. (1982), in their study of the future economic tradeoffs between coal and agriculture in Illinois, to conclude that "(t)hese local impacts, because of the disparity between social costs and revenues (benefits), are perhaps of greatest concern in projecting the future significance of coal mining in Illinois" (p. 28). It seems that this statement can be applied equally well to the state of Michigan. Although the uncertain nature of future surface mining operations in the state makes any predictions questionable, it does seem safe to assume that the limited extent of mining will force the majority of benefits and costs on local communities, rather than the state as a whole. Because of the highly emotional nature of public debate regarding surface coal mining, it is especially imperative that local policy makers have a rational, operational framework within which they can assess the impact of these changes on the local economy, environment, and road system.

The purpose of this chapter, therefore, is to present a framework within which local policy makers can estimate the economic effects of land conversions from agriculture to surface coal mining. The chapter begins with a discussion of the distribution of benefits and costs of surface mining within a community, followed by a brief summary of the potential impacts of surface mining on the local environment and transportation infrastructure. Although actual modeling of environmental and transportation infrastructure impacts is beyond the scope of this study, a discussion of the general types of impacts which the community might expect from surface mining is presented to supplement the discussion of

economic impacts. The chapter concludes with a discussion of the economic impacts of surface mining and the presentation of a framework within which these effects may be determined. Developed at the University of Illinois, this framework provides a mechanism for comparing the local economic impacts of farming and surface mining by calculating the returns to each land use. The purpose of this framework is to provide a method for organizing information and developing estimates of the benefits and costs to the local community from a change in land use (Scott, p. 2, 1978). It should be kept in mind that environmental and transportation infrastructure impacts are not included in this framework; rather, these must be dealt with separately and explicitly by the local decision makers.

Distribution of Impacts

The conversion of an acre of land from agricultural to surface coal mining does not affect all of the parties involved in the transaction equally. The current economic climate which has sparked renewed interest in Michigan coal has caused acres presently engaged in farming activities to become increasingly valuable for coal production. In some cases, land may generate higher returns from surface coal mining than from farming. However, it is important to note that the benefits and costs of this conversion will not be distributed to all affected parties equally.

When a farmer sells or leases an acre of land to a surface coal operator, s/he experiences economic gain in the form of bonus and royalty payments or the sale price of the land which compensates him/her for foregoing the returns to farming. Likewise, the coal operator

derives benefits from extracting and marketing the coal. At the same time, however, it is likely that neighboring farms and communities experience some losses as a result of this mining. These losses may range from aesthetic destruction to contamination of local water supplies by acid drainage from the mine site. Therefore, while private parties directly involved in the transaction gain, third parties bear some of the costs of the transaction. And, although losses may be small and may even be offset by the overall gains to society, state and local government officials may be induced to act to offset these losses. In fact, it is possible that a public choice in favor of minimizing these losses may dictate a level of mining below socially-optimal levels. Frequently, policy decisions are made without regard to efficiency standards; rather, these choices depend on the relative bargaining power of participants who are seeking to shift burdens from themselves to other parties.

Identification of Impacts

Throughout this analysis, numerous references have been made to the negative impacts (externalities) which may result from surface coal mining. In addition, it is important to note that agricultural land uses cause external effects as well. Land allocation decisions are based on the net effects of alternative land uses. The purpose of this section is to briefly summarize the potential impacts of surface mining on the surrounding environment, transportation infrastructure and local economy. As stated earlier, it is important for local policy makers to be aware of these impacts and be prepared to deal with them by developing appropriate policy. Following this discussion, a

framework for estimating the economic effects of the conversion of land from agricultural uses to surface mining is presented.

Environmental Impacts

The effects of surface coal mining operations on the environment have been extensively studied and well-documented. Analysis of the environmental impacts of surface mining centers on the changes which occur in the environment as a result of a mining operation. The complex nature of an ecosystem makes the modeling of these impacts difficult. The effect of surface coal mining on the local environment in Michigan will depend heavily on the enforcement of regulations developed by the Department of Natural Resources to implement P.A. 303; these regulations will dictate the extent to which coal operators must act to prevent environmental damages.

Table 5-1 below summarizes the major environmental impacts of a surface coal mine operation. From this chart, it can be seen that a mining operation has the potential to affect every sector of the environment: land and soil, water, air, wildlife and local aesthetics. Because the extent of these impacts is a function of local characteristics such as geology, location of water table, and soil type, etc., it is impossible to draw specific conclusions regarding impacts. Rather, local citizens and policy makers should become familiar with the potential effects and act within the regulatory framework to offset these to the extent possible. For example, local governments may participate in the regulatory process by encouraging public meetings to discuss future surface mining operations and reclamation procedures.

TABLE 5-1. Potential Environmental Effects of
a Surface Coal Mine Operation

Surface Mining Unit Operations	Land and Soil	Water	Air	Wild Life	Other
	Soil Erosion Overburden Swelling Toxic Strata Soil Inversion Soil Stability Landslides Spoil Piles Oil Spills Coal Spills	Aquifer Effects Runoff Alteration Sediments Toxic Substances Groundwater Contamination Industrial Effluents Sludge	Exhaust Emissions: Dust Noise Other (Welding, etc.) Blasting Fumes	Habitat Altered Species Diversity Aquatic Life Animal Essentials Accident/Deaths Soil Organisms Vegetation Potential Wildlife Disturbed	Aesthetic Dangerous Material
1. Exploration	x	x	x x x	x	
2. Area Dewatering Diversion, Etc.	x	x x x x		x x x x x x	
3. Drilling		x x	x x x	x	
4. Blasting	x x x	x x	x x x	x x x	x x
5. Stripping (Over- burden Removal)	x x x x x		x x x x	x x	x
6. Haulage	x x x	x	x x x	x x x x	
7. Top Soil or Other Soil Storage	x x x	x x	x	x x x x	x
8. Maintenance	x		x x x x		x x
9. Beneficiation		x x x x x	x x		x

Source: Fung (1981).

Transportation Infrastructure

After mining, coal must be transported from the mine site to the location where it will be used. Historically, transportation costs have comprised a large percentage of the delivered price of coal (Capehart, p. 71, 1980). Within Michigan, there are two methods of transportation available to the coal operator: railroad and truck.

Although railroad is the principal method of transportation in the United States (74.2 percent in 1977), it is more likely that the majority of Michigan coal will be transported by truck. The financial condition of the railway system combined with the flexibility offered by truck transportation will make it a logical choice for many coal operators. For hauls of less than fifty miles, which are likely in Michigan considering the quality, quantity, and location of the state coal resource, truck transportation has been found to be the most economical and feasible method of coal transportation (Capehart, p. 85, 1980).

With regard to transportation infrastructure, local policy makers need to address the question of how coal transportation is going to affect the local road system. A report by the Congressional Research Service (1977) estimates that one 55,000 pound truck inflicts the same amount of damage to a road system as 2,500 cars, indicating that increased truck traffic resulting from surface coal mining will have a negative impact on the local road system. In addition to the physical damage to the road itself, truck transportation causes increased dust and noise levels in areas adjacent to the road system.

Because a great deal of the Michigan rural road system was developed in the early 1900's, its ability to meet present and future demands is questionable. It has been estimated that by 1986 one-third of

Michigan's 116,473 miles of paved roads will need resurfacing while 12,382 miles will require complete rebuilding (Tucker and Thompson, p. 1, 1979). Currently, 36 percent of all rural roads in Michigan are rated as poor or very poor by federal standards (Thompson, p. 1, 1978). Increasing population pressures will increase the demands on the road system in the future. For example, by the year 2000, Thompson (1979) reports that an increase in grain transportation by truck of 50 percent should be expected.

In Michigan, the county road commission is responsible for maintaining the rural road system within a county. Funding for this purpose comes from a variety of federal, state and local sources. Recent budget cuts and tight fiscal policy have made the maintenance of these roads even more difficult leading Tucker and Thompson (1979) to conclude that "(w)ith rapidly rising costs due to inflation and increasing use of county rural roads, it is difficult to maintain and construct the type of rural road system needed to meet current and projected transportation needs." The use of rural roads for coal transportation will place additional strain on a system whose capacity to meet current demand is highly questionable. Although damage to the road system will result from transporting coal by truck, the burden of repairing the roads lies ultimately with the taxpayer. Although this apparent inequity has not yet been addressed by state and local officials, it will require a public choice to determine who will pay to repair road damages caused by coal trucks.

Economic Impacts

A change in land use from farming to surface coal mining will cause changes in the local economy. These changes may include alteration of

income accruing to local businesses, local tax base, and employment structure. When evaluating the effects of a change in land use on the local economy, policy makers should be concerned with identifying the net effects that result from a land conversion.

Income Changes and The Multiplier Effect: Central to the discussion of economic impact assessment is the concept of a multiplier. The income effects which result from a change in land use may be divided into two categories: primary (direct) and secondary. Primary effects are those benefits (costs) which are a direct result of the change in land use. Secondary effects are only indirectly a result of the land conversion. Following derivation of direct effects, a multiplier is used to arrive at the estimated total effect of a change in land use.

Multipliers measure the degree of interdependence within regional economies and their use is justified because most communities are economically interdependent (Gartner and Holecek, p. 2, 1982). The concept of a multiplier is relatively straightforward and can be most easily explained through the use of an example: A farmer purchases seed at a cost of \$20.00 from a local store. The store must pay the(ir) supplier, hired labor, management cost, operational costs and other miscellaneous bills. Likewise, the recipients of these payments will spend money according to their own consumption/savings function (Ibid). The end result is that the original \$20.00 payment is recycled through the economy many times, resulting in a multiplier effect. The total amount of income that is generated from the original payment is a function of the characteristics of the local economy. The larger the communities' economic base (i.e., the more self-sufficient it is),

the greater the share of the original payment that will remain within the local economy (Ibid).

The amount of money that stays in the local economy is also dependent upon the sector of the economy in which the original payment was made. For example, the money from a farmer's purchase of gasoline is more likely to flow out of the local economy than a purchase of labor of equal value.

Tax Impacts: The use of land for an economic activity generates tax revenue for state, county and local governments. A change in land use may alter the tax base of a local community, thereby increasing or decreasing local governmental revenue. Because the potential for change exists, it is important that local government officials be prepared to deal with land conversions initiated in the private sector which may significantly affect local revenue sources. Unfortunately, the uncertain future of surface coal mining in Michigan prevents any estimation of the extent or importance of these effects on local communities at this time. Because the extent of tax revenue impacts are so closely correlated to individual community characteristics, it is not possible to state anything more than a few general observations.

One of the most important factors for a community facing the beginning of surface mining to recognize is the impact of residential patterns on the purchases of goods and services and the resulting sales tax revenues. The size and diversity of the local economic base will strongly influence the impact of changing land use. Huff et al. (1982) report that smaller communities located near mining operations do not receive additional business activity, rather these purchases are made in larger business centers. Communities with populations of 5,000 -

10,000 experience business growth from surface mining that is very similar to that resulting from an agricultural base (Huff et al., p. 333, 1982).

In addition to altering sales tax revenues, a change in land use may affect property tax revenues. Because many local governments rely heavily on property taxes as a source of revenue, a significant decrease in these funds may severely hamper the provision of local services. The limited and discontinuous nature of Michigan coal makes it unlikely that any one community will experience dramatic changes in property tax receipts. Nevertheless, it is important for local government officials to be aware that some changes may occur and be prepared to compensate for these changes. Additionally, officials should be aware of increased demands on local revenues that may result from surface coal mine operations. For example, the presence of an operation may result in the need for a larger share of local funds to be allocated for local road repair.

When analyzing the impact of a change in land use on tax revenues, consideration must be given to the proposed use and method of property tax assessment of an area after reclamation. An understanding of what the reclaimed use of the land will be and how it will be assessed for tax purposes will aid local governmental officials in developing long range community plans. Again, the variability between areas makes anything more than general observations impossible.

Employment: A final impact to be discussed is the effect of surface coal mining operations on employment levels in coal producing areas. On a national level, increased coal production following the 1973 oil embargo caused significant population and employment growth

only in those counties where increases in coal production were massive (Myers, p. iv, 1983). Within these counties employment growth rates were greater than population growth rates, suggesting increased labor force participation by local residents (Ibid). Similarly, employment growth in related service industries, such as transportation and retail trade, increased in those areas experiencing major increases in coal production.

On a statewide basis, it is relatively easy to assess the importance of new employment opportunities to the state economy. (It is important to differentiate between "new" employment opportunities and those that are simply shifted from other areas of the state as the latter represents no gain in state employment opportunities.) Increasing employment opportunities are generally beneficial to the state economy. On a local level, however, the economic importance of new mining employment is less certain (Huff et al., p. 315, 1982). Once again the site characteristics of the community and the existing population patterns play a large role in determining local impacts.

It is difficult to predict the employment impacts of surface mining on local communities in Michigan. A number of scenarios seem possible. The high state unemployment rate indicates that there are workers available to fill mining jobs. If previously unemployed workers are hired, the state as a whole will benefit from an increase in employment opportunities. However, it is also possible that workers will simply be transferred from other jobs into the mining industry. For example, the most recent surface mine in Michigan employed gravel workers and did not represent any new employment. In addition, it is possible that new employment opportunities may not benefit the local economy in which

a mine operates; workers may be residents of nearby communities. In this situation, studies show that only a small percentage of the miner's income flows through the local economy.

Procedure for Local Economic Impact Assessment

Many techniques exist for calculating the impact of a change in land use on a local economy. (See Burchell and Listokin [1978] for an overview of the available techniques.) Undoubtedly, new surface mine operations in Michigan will affect local economies, and, for the reasons mentioned in the previous section, there is a significant role for economic impact assessments to play in local community planning. Local policy makers need to determine the amount of time and resources that can be efficiently allocated to studying these effects. The analysis presented in this paper suggests that surface mining operations in Michigan will be of limited extent and will probably be scattered throughout the southeastern lower peninsula. Therefore, it seems that allocating large amounts of time and money to study these effects will be an inefficient use of a community's resources. Rather, local decision makers in Michigan require a method for assessing changes in land use from agriculture to surface mining that can be accomplished with a minimum amount of time and money.

By using a framework developed in the Department of Agricultural Economics at the University of Illinois, local governmental officials in Michigan can objectively estimate the economic consequences of a change in land use, or proposed change, within a local community (Scott et al., p. 1, 1978). Although the framework is of limited scope, it does provide officials with a method for estimating the costs and

returns of a change in land use and organizing information with relative ease. The framework presented below was designed primarily for use at the county level, however, with appropriate modifications its use can be extended to more local regions.

The procedure used to estimate economic impact is straightforward: costs and returns are calculated for present agricultural and proposed surface mine land uses and the resulting returns are compared to determine the benefits accruing to the local community from each land use. The analysis deals with both private and public sectors effects of land conversion. Private sector effects include direct and indirect benefits, while public sector effects involve revenues received and expenses incurred as a result of land use. As stressed in the preceding section, any discussion of public sector effects is difficult because of the large variations which exist among communities. Therefore, this analysis centers on private sector effects.

Overall, the purpose of this section is to present the framework through an example utilizing data from the coal region of Michigan. To begin the analysis, costs and returns will be estimated for two types of Michigan farms: Saginaw Valley cash crop farms and average Michigan cash grain farms. Both types are further broken down into two size classifications: fewer than 400 acres and 400 to 800 acre farms. Following this, a procedure suitable for calculating the returns to surface mining is discussed. At the onset of this research it was hoped that these returns could be calculated for comparison to agricultural returns. Such a comparison would have made it possible to estimate the impact of a change in land use from farming to surface mining for a particular region of the Michigan coal basin. Unfortunately, an

inaccessible data base makes these calculations impossible. Presently, only the coal companies that are interested in mining Michigan coal and the state Department of Natural Resources have access to the information necessary to carry out these calculations (for example, estimated mining and reclamation costs, specific mine locations, etc.). The intent of this section is to explain the underlying conceptual framework of the procedure and outline the steps by which it is carried out. It is hoped that data needed to utilize this procedure will eventually be compiled and made available to local policy makers. In the interim, this impact assessment procedure can provide a method for organizing information and, if nothing else, aid local policy makers in formulating the right questions to ask state regulating officials and prospective coal operators and illuminate the areas in which further research is needed.

Estimating Costs and Returns to Michigan Agriculture, by Farm Type and Farm Size

This section discusses the data and methodology required to assess the benefits accruing to a local economy from an acre of land engaged in agricultural uses. For the purpose of this study, data from two types and sizes of Michigan farms will be analyzed. The procedure is easily adapted to other farming activities; local policy makers should select data that best represent their area so that the estimated economic effects are closely related to their community (Scott et al., p. 2, 1978).

Data used in this study were taken from the 1982 Telefarm Business Analysis Summaries compiled in the Department of Agricultural Economics at Michigan State University. The Telefarm system is a management

education program that compiles and analyzes farm financial and production reports from farm families. Local policy makers may also find data at county extension offices and the state department of agriculture or may attempt to gather information directly from local farmers and surface mine operators.

The benefits of an acre of farmland are defined in terms of direct and indirect returns. In this analysis, the data used to calculate these benefits are the most recent estimates available for costs and returns per acre. (It should be noted that 1982 was a bad year financially for Michigan agriculture. These figures are used exclusively for the purpose of illustration.) However, if available, it might be more desirable for the analyst to average these estimates over a number of years to arrive at the best representation of an area's agricultural costs and returns. This is especially true of return data, which tend to fluctuate more on a year-to-year basis than cost data.

Table 5-2 summarizes the data used to estimate costs and returns to farmland on a per acre basis. The cost data include expenditures per acre made by a farmer, both within and outside of the local business community. Return data show gross income per acre for each farm type and size. Net returns to management are found by subtracting total costs from total returns.

As noted earlier in this chapter, when a farmer sells or leases an acre of land for surface mining, s/he experiences economic gain in the form of bonus and royalty payments or the sale price of the land in exchange for foregoing the returns to farming. Additionally, neighboring farms, local businessmen who sell farms supplies and products and others in the community may be affected by land conversions. Therefore, the

TABLE 5-2. Estimated Costs and Returns Per Acre of Farmland,
by Acreage and Farm Type (\$/acre), 1982

	Saginaw Valley Cash Crop Farm		Average Michigan Cash Grain Farm	
	[<400]	[400-800]	[<400]	[400-800]
COSTS				
Power and Equipment	\$ 85.54	97.32	\$ 70.04	70.89
Buildings & Improvs.	11.70	16.88	15.16	10.57
Soil Fertilization	76.24	68.38	58.29	56.15
Seed and Plants	12.91	22.53	6.70	11.61
Livestock Expenses	.28	.01	.48	.41
Labor	51.51	40.74	32.14	27.97
Land Charge	17.01	21.58	8.67	21.70
Taxes	28.37	24.61	25.47	9.99
Insurance and Miscell	13.24	10.96	13.61	8.97
Interest	120.26	123.57	102.12	69.12
Total Costs	\$417.06	\$426.58	332.68	287.38
RETURNS				
Crops	\$244.00	268.00	185.00	212.00
Livestock	1.00	-	-1.00	1.00
Custom	8.00	3.00	5.00	3.00
Government	1.60	7.00	7.00	9.00
Other Income	20.00	16.00	11.00	5.00
Total returns	\$274.00	\$294.00	207.00	230.00
NET RETURNS (management)	\$-143.02	\$-132.58	\$-125.68	\$-57.38

Data Sources:

Brown, L.H., and M.P. Kelsey, Business Analysis Summary for Saginaw Valley Cash Crop Farms: 1982 Telefarm Data, Agricultural Economics Report No. 435, East Lansing: Michigan State University, Department of Agricultural Economics, 1983.

Brown, L.H., and M.P. Kelsey, Business Analysis Summary for Cash Grain Farms: 1982 Telefarm Data, Agricultural Economics Report No. 434, East Lansing: Michigan State University, Department of Agricultural Economics, 1983.

benefits accruing to a local community from an acre of land include the direct returns to the farm operator as well as the secondary income associated with the business expenditures a farmer makes in the local community (Scott, p. 2, 1978).

Multipliers are used to estimate the secondary benefits associated with the use of an acre of land. Determining the correct multiplier to use in an analysis can be a costly and difficult procedure (Gartner and Holecek, p. 2, 1978). The Illinois framework suggests using average multiplier values that reflect the relationship between the size of the county labor force and the relative complexity of the economy: the larger, more varied the labor force, the more complex the economy and the higher the multiplier used. These values are summarized in Table 5-3.

The cost estimates in Table 5-2, compiled from information provided in the 1982 Telfarm reports, include both local and non-local farm operator expenditures. However, non-local expenditures do not contribute to the local economy and must be deducted when determining impacts. Similarly, adjustments must be made for state and federal taxes and sales taxes which decrease the amount of income accruing to the local economy. In Table 5-4 the allocation of expenditures in and out of the local economy estimated by Scott et al. (1978) is presented. In addition, appropriate expenditures are reduced for state and federal taxes as well as sales taxes. An example of these adjustments is shown for a Saginaw Valley cash crop farm of 400-800 acres.

In Table 5-5 this procedure is carried out for private costs and returns for all farm types and sizes. By selecting an appropriate multiplier the private sector benefits accruing to a local community from

TABLE 5-3. Average Multiplier Value and Ranges,
by Size Class, for County Employment^a

County Employment Size Class	Average Multiplier	Probable Range
1,000-2,999	1.7	1.5 - 1.9
3,000-4,999	1.8	1.5 - 2.0
5,000-9,999	1.9	1.6 - 2.1
10,000-19,999	2.0	1.8 - 2.2
20,000-49,999	2.2	2.0 - 2.4
50,000 - +	2.2	2.0 - 2.5

Source: Scott et al., 1978.

^aBased on data for 375 Appalachian Counties, there is a probability of 70 percent that an individual county multiplier will be included in these ranges.

TABLE 5-4. Allocation of Costs In and Out of Local Economy, in General and Saginaw Valley Cash Crop Farm (400 - 800 acres)

	General		Saginaw Valley Farm	
	In	Out	In	Out
	percent		(\$)	
PRIVATE SECTOR COSTS				
Power and Equipment	30	70	29.20	68.12
Building & Improv	60	40	10.13	6.75
Soil Fertilization	20	80	13.68	54.70
Seed and Crop	60	40	13.52	9.01
Livestock Expense	70	30	--	--
Labor	100	0	40.74*	--
Land Charge	80	20	17.26	4.31
Insurance and Miscell	50	50	7.34	3.62
Interest	67	33	82.79*	40.78*
Management	67	33	-88.83	-43.75
Private sector subtotal			122.52	134.32
PUBLIC SECTOR COSTS				
Real Estate Taxes	100	0	24.61	
Sales Taxes	20	80	1.64	6.56
Federal Income Taxes		100^		29.58
Michigan State Income Taxes		100^		7.56
Public sector subtotal			26.25	43.70

*These items reduced when added into private sector subtotal by 4.6% State Income Tax and 18% Federal Income Tax (assuming this is an appropriate average tax rates).

^Although various Federal and State Taxes return to local governments, they vary substantially and are a small portion of total public expenditures in local area.

TABLE 5-5. Estimated Costs and Returns to the Local Economy,
per Acre by Farm Type and Size

	Saginaw Valley Cash		Average Michigan	
	Crop Farm		Cash Grain Farm	
	[<400]	[400 - 800]	[<400]	[400 - 800]
COSTS				
Power and Equipment	25.66	29.20	21.01	21.27
Building and Improv	7.02	10.13	9.10	6.34
Soil Fertilization	15.25	13.68	11.66	11.23
Seed and Crop	7.75	13.52	4.02	6.96
Livestock Expenses	.20	--	.34	.29
Labor	51.51*	40.74*	32.14*	27.97*
Land Charge	13.60	17.26	6.94	17.36
Taxes	28.36	24.61	25.63	9.99
Insurance and Miscell	6.62*	7.34*	6.80*	4.48*
Interest	80.57*	82.79*	68.42*	46.31*
MANAGEMENT	-95.82	-88.83	-75.41	-38.44
PRIVATE SECTOR SUBTOTAL	110.87	122.52	82.92	95.35

*These items reduced before added into private sector subtotal by the Federal (18%) and State (4.6%) taxes, assuming these are appropriate average figures.

an acre of farmland can be estimated. Below, this calculation is carried out for a Saginaw Valley cash crop farm assuming a multiplier of 2.2. Using this procedure, the total estimated private sector benefits from an acre of Saginaw Valley cash crop farmland is equal to \$269.54.

Direct, private sector subtotal.....	\$122.52
*Indirect, \$122.52 x 1.2.....	\$147.02
TOTAL BENEFITS/ACRE.....	\$269.54

*Assumes a total multiplier of both direct and indirect effects.

The procedure described above estimates the annual benefits accruing to a local community from an acre of farmland. However, when an acre of agricultural land is converted to surface mining, the value of this land in agriculture is lost for a number of years. Because the benefits from farming represent a flow of returns over time, the present value of these returns should be calculated for comparison to the present value of the returns from surface mining (see Chapter 4 for a discussion of discounting).

Table 5-6 presents the discounted estimated agricultural benefits per acre accruing to the local community. (These estimates are compared to the returns from an acre of surface mined land in the section that follows.) As discussed in Chapter 4, determining the proper discount rate to use in an analysis is often a difficult task. Scott et al. (1978) recommend that county officials select a rate of discount that reflects their own judgements about the future. Because of the uncertain time period during which surface mining will occur and the

TABLE 5-6. Discounted Estimated Agricultural Benefits per Acre to Local Economy, by Farm Type and Size, for Infinite Period (\$) ^a

	Saginaw Valley Cash Crop Farm		Average Michigan Cash Grain Farm	
	[<400]	[400 - 800]	[<400]	[400 - 800]
5 percent discount rate				
Direct	2217.40	2450.40	1658.40	1907.00
Indirect	2660.88	2940.40	1990.00	2288.40
Total	\$ 4878.28	\$ 5390.80	\$ 3648.40	\$ 4195.40
7-1/2 percent discount rate				
Direct	1478.27	1633.60	1105.60	1271.33
Indirect	1773.87	1960.27	1326.67	1525.60
Total	\$ 3252.14	\$ 3593.87	\$ 2432.27	\$ 2796.93
10 percent discount rate				
Direct	1108.70	1225.20	829.20	953.50
Indirect	1330.40	1470.20	995.00	1144.20
Total	\$ 2439.10	\$ 2695.40	\$ 1824.20	\$ 2097.70

^aPresent value = annual value/discount rate, for infinite time period.

difficulties involved in choosing a discount rate, Table 5-6 shows present value calculations for an infinite time period and three different discount rates, 5%, 7 1/2% and 10%.¹

As noted earlier, it is difficult to estimate the public sector economic impacts of a change in land use. Varying revenue sources, quality and quantity of publicly provided services preclude any general statements (Scott et al., p. 8, 1978). In addition, it is difficult to allocate government services to a particular type of land use or individual acre of land (Ibid). The framework described above does estimate sales, state and federal income tax receipts per acre. The major contribution of this method is that it provides a means for organizing information and comparing tax revenues arising from various land uses.

Estimating Costs and Returns to Surface Coal Mining in Michigan

The procedure used to estimate the benefits accruing to a local community from surface coal mining is analytically similar to that used for agricultural uses. Benefits include direct and indirect increases in personal income, plus any inputs purchased in the local business economy (Scott et al., p. 25, 1978). In addition, the benefits associated with the use of the land after reclamation must be included. Costs include the direct and indirect discounted agricultural benefits foregone during the mining operation.

¹Present value = annual value/discount rate, for infinite number of years.

As noted earlier, the empirical data needed to calculate benefits from surface mining in Michigan are not available. Instead, this section briefly outlines the procedure that can be used by local officials to determine benefits when data become available. Because of the difficulties that are involved in estimating public sector benefits, the procedure which follows emphasizes returns to the private sector.

The worksheet developed by Scott et al. (1978) for determining benefits to the private sector from surface mining is presented in Table 5-7. (Throughout the following discussion numbers appearing in parentheses refer to the corresponding worksheet line. For example, (I-A-1) refers to the direct benefits from a mining activity.) Basically, direct and indirect costs are added (II-A, II-B) and then subtracted from the sum of the benefits associated with the mining activity (I-A) and the postmining agricultural benefits (I-B). The resulting surplus or deficit is the private sector benefits accruing to the local economy from an acre of surface mined land (III). The following discussion briefly outlines this procedure.

To determine the benefits from the mining activity, data are obtained on the annual costs of mine production per ton of coal and then converted to annual costs per acre ($\text{costs/ton of coal} \times \text{tons of coal/acre} = \text{costs/acre}$). Table 5-8 provides a worksheet for calculating the direct and fixed costs of a mining operation. These costs are then adjusted for leakages in and out of the local economy. Similarly, adjustments must be made for state and federal taxes and sales taxes which decrease the amount of income accruing to the local economy. Estimates of expenditure allocation developed by Scott et al. (1978) are presented in Table 5-9. Local officials using this framework should be

TABLE 5-7. Worksheet for Estimating Returns to the Local Economy From an Acre of Surface Coal Mining in Michigan

I. BENEFITS

A. Mining activity

[1] Direct

a. Personal income per acre -----

b. Mining inputs purchased locally per acre -----

[2] Indirect

a. Personal income x county multiplier -----

Total benefits per ton -----

Benefits per acre -----

B. Postmining agricultural benefits

[1] Direct

a. Estimated discounted agricultural returns/acre -----

[2] Indirect

a. Direct benefits x county multiplier -----

Total, postmining -----

II. COSTS

A. Direct

[1] Estimated discounted agricultural returns per
acre for appropriate type of farm and size,
during mining operation. -----

B. Indirect

[1] Direct cost x county multiplier -----

Total costs/acre -----

III. SURPLUS OR DEFICIT/ACRE (I - II) -----

Source: Scott et al. (1978).

TABLE 5-8. Worksheet for Calculating Annual
Mine Production Costs/Acre

	Total Annual Costs	Cost/ton	Cost/acre
1. Direct Costs			
A. Production Costs (labor and supervision)			
B. Maintenance (labor and supervision)			
C. Operating Supplies			
Electrical			
Equipment parts			
Explosives			
Drill Bits			
Fuel and Lubrication			
Tires			
Reclamation and Miscell			
D. Utilities			
E. Haulage road construction			
F. Payroll overhead			
G. Royalty			
H. Union welfare			
I. Strip License and reclamation fee			
2. Fixed Costs			
A. Taxes and Insurance			
B. Depreciation			
C. Deferred Expenses			
TOTAL PRODUCTION COSTS			

Source: Scott et al. (1978).

TABLE 5-9. Worksheet for Estimating Expenditure
Allocation In and Out of Local Economy

	Inside	Outside	Per acre
	percent		(\$)
DIRECT COSTS			
Production Costs	70	30	
Maintenance Costs	70	30	
Operating Supplies	20	80	
Utilities	100	0	
Haulage and Road Construct	100	0	
Payroll overhead	70	30	
Royalty	100	0	
Union Welfare	70	30	
Strip mine reclamation			
fee and license	80	20	
Indirect costs			
(including reclamation)	70	30	
FIXED COSTS			
Taxes and Insurance	30	70	
Depreciation	0	100	
Deferred Expenses	30	70	
Private Sector Subtotal			
Public Sector Subtotal			
Gross Revenue			
State Taxes			
Sales taxes			
Services rendered			

Source: Scott et al. (1978).

cautious about assumptions regarding this distribution of costs; changes in these assumptions can significantly affect results.

Expenditures occurring within the local economy are then used to estimate direct and indirect benefits accruing to the community from a surface mine operation (I-A): direct benefits are found by adding together personal income per acre of coal mined (production plus maintenance costs) and the amount of mining inputs purchased in the local economy. Indirect benefits are determined by multiplying personal income and a county multiplier. Direct and indirect benefits are summed to determine the benefits per acre accruing to a local economy from a surface mining activity (I-A).

Estimation of benefits from postmining agricultural uses is difficult. Scott et al. (1978) note that factors influencing the extent of benefits from reclaimed land include the structure of the organizations that operate postmining activities and the type of farming enterprise that operates on the land. Even with no loss in productivity after mining, variations in returns from different land uses may cause a change from the premining land use to result in a lower level of benefits to the local economy. Nevertheless, by making assumptions regarding: (1) the appropriate rate of discount; (2) the number of years after mining that returns from agriculture will begin; and (3) the probable use of reclaimed land, users of this framework can calculate postmining agricultural benefits (I-B). This is accomplished by using the procedure developed in the previous section for estimating the returns to Michigan agriculture.

The costs accruing to a local economy from a surface coal mining operation include the direct and indirect benefits from agriculture

foregone during the mining operation. These benefits were calculated in the previous section. By subtracting the total costs per acre (II) from the total benefits per acre (I), the returns accruing to the local economy from an acre of surface mining can be estimated (III). By comparing returns from surface mining (III) to returns from continuous farming (calculated in previous section), local decision makers can anticipate and estimate the local economic impact of changes in land use from farming to surface coal mining. For example, utilizing the data presented in this chapter, it is possible to say that the net present value of mining an acre of Saginaw Valley cash crop farmland for one year must be at least equal to \$269.54 in order to be considered an economically rational improvement over agriculture. However, it is also important to point out that non-monetary factors exist which may influence a landowner's decision of whether to sell or lease his/her land for surface coal mining. It may be true that a landowner prefers an agricultural way of life and will not sell his/her land to a coal operator even though the sale price exceeds the net present value of the acre in farming. The opportunity cost figure may be considered a threshold for rational conversion to mining. Use of the procedure presented in this section will lead to estimates of acreage converted from farming to surface coal mining which local policy makers can use to estimate the magnitude and incidence of local economic impacts.

Summary

The purpose of this chapter has been to outline a procedure by which local policy makers can estimate and compare the returns to the local economy from agriculture and surface coal mining land uses.

Assuming that the limited extent of surface mining operations in Michigan will force the majority of impacts on local communities, policy makers require a framework within which these impacts can be identified and assessed. Although the framework presented in this chapter was somewhat limited in scope, it does provide a mechanism for organizing information and developing estimates of the benefits and costs accruing to the local community from a change in land use.

A change in land use from farming to surface coal mining does not affect all of the parties involved in the transaction equally. Although the framework presented in this chapter was not designed to predict distributive consequences, some general distributive effects can be hypothesized (Scott et al., p. 31, 1978): (1) Local businesses associated with agriculture are likely to experience some decline in business as a result of the land conversion. (2) Machinery dealers may be able to alter their sales line to sell surface mining equipment. Additionally, repair services for surface mining equipment might develop in the local economy. (3) During land reclamation, local seed and fertilizer businesses might profit. (4) Changes in retail and service industries will most likely depend on whether or not there is an increase or decrease in local employment as a result of the land conversion. In Michigan, the limited extent of surface mining operations make it unlikely that significant employment changes will occur in a single community. In addition to these effects, local citizens may be forced to bear some of the costs of surface mining. These costs may include aesthetic damages, increased dust and noise levels, and various environmental damages.

Environmental and transportation infrastructure impacts were briefly outlined. The major contribution of this discussion was to identify possible impacts from surface coal mining and point out the need for local decision-makers to be aware of these impacts when developing policy.

Local economic impacts resulting from the conversion of land from farming to surface coal mining may include changes in income accruing to local businesses, local tax base, and employment structure. Historical residential patterns, purchasing habits and local tax policies all play a part in determining the degree to which a change in land use will affect the local economy (Huff et al., p. 22, 1982). Therefore, local officials in Michigan need to determine probable impacts given the characteristics of their communities. The framework presented in this chapter provides a mechanism for such an analysis. By utilizing data from local agricultural enterprises and surface coal mine operations, policy makers can estimate and compare the returns to the local economy from each land use. This information can be used to evaluate the economic consequences of changes in land use and to develop policy to deal with these changes.

CHAPTER 6

SUMMARY AND CONCLUSIONS

The purpose of this chapter is to summarize the findings of this research, draw conclusions and develop suggestions for future research in this area.

Summary

The state of Michigan presently faces the renewal of surface coal mining within its borders. Although the size and number of these future operations is likely to be limited, mining will impose impacts on state residents and communities located near mining sites. The intent of this research is to analyze the effects of surface coal mining in Michigan within an economic framework. The role of economics in the decision-making process has been discussed throughout this paper. In short, economics facilitates the decision-making process by providing a conceptual framework within which choices among alternative courses of action may be structured and guidelines for decision-making may be developed. As stated by Bishop (1979), the job of economists is to "help society to properly conceptualize the problem - that is, to ask the right questions."

The choice of land use between farming and surface coal mining cannot be conceptualized without an understanding of the components of the problem being studied. In Chapter 2, the background for the analysis is established through an examination of the resources and

institutions that will be involved when Michigan farmland is converted to surface coal mining uses. One goal of this study has been to consolidate the limited information that is available on surface coal mining in Michigan. By doing this, and establishing the role of agriculture in the Michigan economy, an understanding of the impact surface coal mining will have on the state's agricultural resources was developed. Available data indicate that the extent of surface coal mining in Michigan will be limited. It is, therefore, unlikely that mining operations will seriously affect Michigan's important agricultural sector on a statewide basis. Rather, the most serious impacts will be experienced at the local level. The remainder of the study concentrates on the development of an economic framework that may be used to understand and estimate the impact of surface coal mining in Michigan agricultural lands.

Chapter 3 develops a conceptual basis for understanding the allocation of land between farming and surface coal mining. Although this chapter is primarily concerned with theoretical concepts, it raises numerous considerations that are directly applicable to a landowner's or community's decision-making process. For example, the conceptual framework for determining the optimal allocation of a stock resource over time can be directly applied to a landowner's decision of whether or not to lease his land for surface coal mining. The conceptual framework presented in Chapter 3 is utilized throughout the remainder of the study to develop an economic perspective on the allocation of land between farming and surface coal mining in Michigan.

Concepts from the field of public choice economics are utilized to hypothesize the performance of legislation designed to control

surface mining in Michigan. In the absence of significant externalities, it is assumed that private market decisions allocate land to those uses that command the highest market prices and generate the highest returns to factors of production. Surface coal mining, however, does impose significant external costs on third parties, thereby rendering the private market solution "inefficient." Governmental regulations seek to control the magnitude and incidence of these external costs by providing incentives for private, self-interested individuals to make land use decisions that are socially efficient. The Michigan Surface and Underground Mine Reclamation Act (P.A. 303) relies upon regulatory standards to ensure levels of environmental protection and the provision of abandoned mine reclamation. In doing so, P.A. 303 transfers rights from surface mine operators to third parties who benefit from the enforcement of regulatory standards. Historically, the use of regulatory standards to control environmental quality has been costly and only marginally successful. The effectiveness of the system of regulations being developed to control surface coal mining and reclamation operations in Michigan will depend heavily on the ability of the DNR to implement and enforce these rules.

Many of the theoretical concepts presented in Chapter 3 are directly applicable to the landowner and community decision-making process. In Chapter 4 an analysis of the investment decision faced by a Michigan landowner is undertaken through a discussion of discounting, choice of discount rate, and the investment criterion of net present value. These concepts are then used to examine the unregulated private market allocation of land between farming and surface coal mining.

The principal purpose of Chapter 5 is to present a method for estimating local economic impacts from surface coal mining using the concepts presented in Chapter 3 and the analytical framework of Chapter 4. The major role of this method is to provide a mechanism for organizing information and to aid local policy makers in formulating the right questions to ask state regulating officials and prospective surface coal operators about the local impacts of mining. In addition to presenting this framework, Chapter 5 examines the distributive consequences and general nature of the local physical and economic impacts of a surface coal mine operations.

Conclusions

The state of Michigan is endowed with both productive agricultural land and a reserve of bituminous coal deposits. Because coal underlies agricultural land considered to be a key factor for the future growth and stability of the state's economy, some state officials and residents feel that agricultural land should be protected from use by surface coal mine operations. Yet, the renewal of mining has the potential to benefit Michigan by attracting new industry into the state, providing new employment opportunities, and decreasing dependence on imported sources of energy. Both viewpoints have merit: the renewal of surface mining in Michigan will, at least temporarily, remove acres from farming while at the same time lowering state coal imports, developing new employment opportunities, and attracting small surface coal operators from neighboring states. The issue of surface coal mining vs. farming is, therefore, a public choice issue. The choice involves weighing the benefits and costs from each alternative land use and choosing that use

which yields the greatest net social discounted benefits to the state of Michigan. By enacting P.A. 303, the Michigan legislature has chosen to allow surface coal mines to operate within the state borders under relatively strict guidelines which provide considerable protection for agricultural land.

By utilizing an economic framework, this paper has developed one perspective for viewing the alternative and mutually exclusive land uses of farming and surface coal mining in Michigan. Although current information on surface coal mining in this state is limited due to the previous lack of interest in extracting the coal resource, this perspective leads to some conclusions concerning the benefits and costs of surface coal mining on Michigan agricultural lands. The unique characteristics of the Michigan coal resource preclude the use of a comparable region technique to identify and estimate impacts from surface coal mining operations. Other Midwestern states hold significantly greater coal resources and produce larger quantities of coal than is anticipated will occur in Michigan. Furthermore, the lack of available data, uncertainty regarding future decisions of coal operators, and the discretionary nature of the state's implementation and enforcement of its regulatory program result in these conclusions being somewhat general in nature. Nevertheless, they contribute important insight into the manner in which surface coal mining operations may affect the state of Michigan. For the purposes of this discussion, these conclusions are broken down into three broad categories: general conclusions, agricultural impact conclusions, and local impact conclusions. Following this, factors which the author views as valid implications for

the development and implementation of surface coal mining policy in Michigan will be presented.

General Conclusions

The purpose of this section is to present general conclusions on the impact of surface coal mining in Michigan. The poor reputation of surface coal mining, combined with the lack of current information and relatively long period of time since coal mines have operated in Michigan accentuate the need for state officials and residents to develop an understanding of the manner in which surface coal mining will affect the state of Michigan.

The market process of land allocation is assumed to move land to those uses that generate the highest returns to factors of production and command the highest market prices. Data collected throughout this analysis suggest that the coal resources of Michigan are neither of sufficient quantity nor quality to generate high levels of returns or prices except in a relatively few number of cases.

Given the information presented in this analysis, it is possible to develop an understanding of the manner in which surface coal mining will operate in the state of Michigan. The location of the coal basin will concentrate mining operations in the eastern section of the lower peninsula within the counties of Midland, Bay, Saginaw, Tuscola, Shiawassee, Genesee, Ingham and Jackson. Presently, the Michigan Department of Natural Resources estimates that ten to twelve mines, each covering three to five hundred acres, will operate in this region and produce a total annual output of approximately 2.5 million tons of coal. Unless this scenario is significantly altered by changes in the economic

conditions which have sparked renewed interest in mining Michigan coal, it is unlikely that these operations will significantly alter state coal imports, employment opportunities or the general economy for the following reasons:

(1) Assuming that coal production levels reach those estimated by the DNR, Michigan coal will supply less than 8 percent of total state coal demand. Even if a larger percentage of state energy requirements could be supplied by Michigan coal, this fact does not necessarily imply that it would be inherently better to develop local coal resources rather than import coal from other states. The theory of comparative advantage states that a region should specialize in the production of that commodity for which it has a comparative production advantage. From information that is available, it appears that the only strong advantage Michigan has for producing coal is the location of the coal basin with respect to state energy markets. In many other ways, there are disadvantages to developing the state coal resource. For example, it is likely that the high sulphur content of Michigan coal will require variances in federal and state air pollution control laws prior to burning whereas low sulphur imported coal does not. Therefore, it is important to be cautious when citing a reduction in state energy imports as a net benefit resulting from mining the coal resources of Michigan.

(2) Because interest in extracting Michigan coal is being expressed by small, out-of-state coal operators, it is possible that the state as a whole will benefit to some degree from new employment opportunities generated by coal mining. However, at the present time, it appears that the overall impact on state employment will be minimal. In fact,

it is possible that mining operations will simply transfer workers from other employment sectors and not produce any new employment opportunities for state residents. Additionally, mine operators may find it to their advantage to simply relocate trained workers from nearby states to fill skilled positions. While the state as a whole will benefit from the development of new employment opportunities, the effect on communities located near mining sites is not as clear. If mine employees reside and purchase goods and services within the community, the local economy will benefit from the onset of surface mining operations. If, however, mine employees travel from nearby communities to work it is unlikely that the local economy will experience employment gains from new mining operations.

Agricultural Impact Conclusions

The impact of surface coal mining operations on state agricultural lands is a major concern of state officials and residents. This concern includes the effect of mining operations on local agribusinesses, the impact of land leasing and sale arrangements on the effectiveness of the P.A. 116 program, and the ability of reclamation procedures to return mined land to levels of productivity equal to or greater than pre-mining levels. One conclusion of this study is that state agricultural lands will not be significantly affected by surface coal mining operations. This conclusion stems from the following observations:

(1) Assuming that the DNR's estimates of mine numbers and sizes are correct and that all of surface mined land is presently in agricultural uses, less than one percent of Michigan cropland will be surface mined for coal. This fact, combined with the guidelines established in

P.A. 303 for the protection of agricultural lands, make it highly unlikely that the state's important agricultural sector will be significantly affected on a state-wide basis.

(2) The effect of surface coal mining on the state's Farmland and Open Spaces Preservation Act (P.A. 116) is also likely to be minimal. If every acre of surface mined land was previously enrolled in the P.A. 116 program, only a small percentage of the total enrollment will be affected. This remains true whether or not all lands enrolled in P.A. 116 are included in the comparison or only lands enrolled in counties where surface mining will likely occur. Of this percentage, those cases in which the landowner holds title to both the surface and underground rights will be subject to a screening process through which the state has the right to refuse to allow the landowner to break the development rights agreement by leasing or selling the land to be surface mined. And, while it is possible that disputes will arise in cases where there are different surface and subsurface rights owners, these disputes are likely to be small in number and will require resolution through the state's court system.

(3) The ability of state of the art reclamation procedures to effectively return farmland to pre-mining levels of productivity is a function of individual site characteristics. Without additional scientific study, it is difficult to assess the likelihood of success for farmland reclamation procedures in Michigan. P.A. 303 has set rigorous guidelines for the reclamation of farmland which operators must prove they can meet prior to the start of mining operations. If the law is enforced as it is written, state agricultural lands should be well-protected from the damages surface coal mining operations inflict, perhaps

at the expense of limiting the size and number of surface coal mining operations in Michigan.

Local Impact Conclusions

The limited quantity and quality of the Michigan coal resource have led to the conclusions that surface coal mining will neither significantly affect the state as a whole nor the important agricultural sector of the state economy. Rather, impacts will be felt most strongly by communities located near mining sites who will be forced to bear a considerable portion of the external costs of mining operations. Because the extent of these impacts is a function of individual community characteristics, it was not possible in this study to estimate specific local impacts of mining operations in Michigan. Rather, the study concentrated on identifying the general nature of surface coal mining impacts, distributive consequences of land conversions from farming to mining, and the presentation of a method suitable for estimating the local economic impacts of the conversion of land from farming to surface coal mining in Michigan. The following are the conclusions which can be drawn about the local impacts of surface coal mining in Michigan:

(1) The benefits and costs of a change in land use from farming to surface coal mining are not equally distributed among all parties affected by the conversion. Although mine operators and landowners benefit from land conversions to surface mining, others in the community may suffer costs. When farmland is used for surface mining, local businesses directly associated with agriculture are likely to decline. In addition, nearby residents may be forced to bear the environmental costs of surface coal mining. Furthermore, coal transportation causes

damages to local road systems which are repaired through the use of state and local tax dollars.

(2) Community leaders and residents can anticipate economic, environmental and transportation infrastructure impacts from nearby surface coal mining operations. The magnitude and incidence of these impacts will depend heavily on historical residential patterns and purchasing habits, local tax policies, and the number and size of mining operations in their community.

(3) Local economic impacts resulting from the conversion of land from farming to surface coal mining may include changes in income accruing to local businesses, local tax base, and employment structure. By utilizing data from local agricultural enterprises and surface coal mining operations, policy makers can estimate and compare the returns to the local economy from each land use. Presently, hypothesized cost and return data from future coal mining operations in Michigan are unavailable. Therefore, the assessment procedure presented in Chapter 5 was unable to develop specific comparisons of the returns to surface coal mining and farming for a particular region of the Michigan coal basin. Because such comparisons can serve as useful tools for local policy makers in Michigan, it is the opinion of this author that developing and supplying the necessary cost and return data from hypothetical mining operations in Michigan to the communities affected by mining operations would be a valuable function of the state regulating agency. Equipped with this information, local officials and citizens could estimate the economic implications of changes in land use from farming to surface coal mining within their community relatively easily and cheaply.

Policy Implications

The foregoing conclusions are derived from the analysis presented in this study. Based on a review of available information, the author feels that the following are valid implications for future policy decisions regarding surface coal mining in Michigan. For the purposes of discussion, these policy implications are divided into three categories: participation in the regulatory process by local officials and citizens, the role of the DNR as the state regulating agency, the development of P.A. 303 administrative rules.

Participation in the Regulatory Process by Local Officials and Citizens: The position taken here is that local policy makers and citizens should be encouraged to participate in the regulatory process. The reasoning behind this position is the following: (1) Surface coal mining is a highly emotional issue capable of generating conflict and tension within a local community. Because this study suggests that mining impacts will be highly localized and relatively minor, participation by local officials and residents should act to alleviate the conflict and tension that the onset of surface coal mining operations may induce. (2) Because mining impacts are highly correlated to historical residential patterns, purchasing habits and local tax policies, participation by residents and officials may contribute an important perspective to the regulatory process. (3) By encouraging participation by local officials and citizens, it is more likely that the regulatory system can be adjusted to the individual needs of particular communities. Given the highly localized nature of mining impacts, it appears that such a structure will be more effective than broad policy initiatives developed for the entire coal basin.

The Role of the DNR as the State Regulatory Agency: The role of the DNR in regulating surface coal mining in Michigan is outlined in P.A. 303. However, throughout the research that was conducted to complete this study, it was difficult to assess the manner in which the Geological Survey Division (GSD) of the DNR perceives its role in the regulatory process. The following are the author's observations regarding what the role of the DNR is and should be: (1) The position taken here is that the overall role of the DNR should be to protect the long-term interests of state residents by allowing those mining operations which produce net benefits to the state and local communities in which mining occurs. (2) In carrying out this role, the DNR should act as a source of information for local residents and decision makers of communities that will be affected by surface coal mining operations. (3) Increased participation by other divisions of the DNR and state and local governments may facilitate the regulatory process. Although the GSD is qualified to provide the technical assistance required to develop mining and reclamation performance standards, it is not clear that they are equipped to develop policy that controls the impacts of mining operations on local economies, environments, and road systems.

The Development of the P.A. 303 Administrative Rules: The Michigan Surface and Underground Mine Reclamation Act (P.A. 303) was developed to provide incentives for private, self-interested individuals to make land use decisions that are socially efficient and give the state of Michigan exclusive control over the coal resources that lay within its borders. Nineteen months after the passage of P.A. 303, the administrative rules needed to implement the act have not yet been completed by the DNR. Until these rules are completed and approved by the federal

Office of Surface Mining, there exists a question regarding who will control surface coal mining operations in Michigan. Because mining operators are in the process of buying and leasing land for future mining operations, it is imperative that the administrative rules be completed and approved as quickly as possible to ensure attainment of the state's goal of controlling surface coal mining in Michigan.

Future Research Suggestions

The conclusions and policy implications drawn from this analysis suggest the need for further research into particular areas. These research suggestions are briefly outlined below:

(1) Additional research could be conducted to determine the magnitude of surface coal mining impacts on local communities in Michigan. This research may be accomplished through a case study and may include study of land reclamation procedures, impacts of coal transportation on specific rural road systems, and environmental impacts.

(2) Further study of the institutional design through which the regulatory system functions may suggest areas in need of reform or modification. With regard to surface coal mining in Michigan, such an analysis might attempt to develop specific suggestions by which the regulatory system could be tailored to the individual needs of communities located near mining sites.

(3) The method of property tax assessment on surface mined lands will determine the extent to which local property tax revenues are affected by land conversions. Research into this area might predict the method of assessment to be used and the resulting impact on the tax base of a local community.

(4) Projections of demand for Michigan coal under varying economic conditions could be developed utilizing data on alternative energy sources and consumption patterns. A scenario analysis of this type would be useful for developing policy relating to surface coal mining in Michigan. In addition, these projections would alert local policy makers to the likelihood of coal development in their community.

(5) Michigan landowners would benefit from research into the availability of information on coal leasing arrangements. This research could direct landowners toward publications which address the questions of what to look for in a coal lease, factors to consider prior to signing a coal lease and people to contact for more information on the legal aspects of coal leasing arrangements.

APPENDIX A

**MICHIGAN SURFACE AND UNDERGROUND MINE
RECLAMATION ACT, MICHIGAN P.A. 303**

Act No. 303
Public Acts of 1982
Approved by Governor
OCT 12 1982

**STATE OF MICHIGAN
81ST LEGISLATURE
REGULAR SESSION OF 1982**

Introduced by Senators Faust, Corbin, Geo. Hart, Sederburg, Ross, Arthurhultz, Monsma, Irwin, DiNello and J. Hart

ENROLLED SENATE BILL No. 819

AN ACT to regulate the mining of coal; to provide for the reclamation of land subjected to coal mining; to control the adverse environmental effects of coal mining; to provide for the establishment and imposition of fees; to provide for the creation of a fund; to prescribe the powers and duties of certain state agencies; and to provide remedies, fines, and criminal penalties.

The People of the State of Michigan enact:

ARTICLE 1. GENERAL PROVISIONS

Sec. 101. This act shall be known and may be cited as the "Michigan surface and underground mine reclamation act".

Sec. 102. Pursuant to the authority granted in section 503 of the surface mining control and reclamation act of 1977, 30 U.S.C. 1253, that allows a state to assume and retain exclusive jurisdiction over the regulation of surface coal mining and reclamation operations within that state by obtaining approval of a state program that has the capability of implementing and enforcing the provisions and purposes of the surface mining control and reclamation act of 1977, Public Law 95-87, this state wishes to assume exclusive jurisdiction over the regulation of surface coal mining and reclamation operations in this state. It is the purpose of this act to provide a state plan to implement and enforce the purposes provided in section 102 of the surface mining control and reclamation act of 1977, 30 U.S.C. 1202.

Sec. 103. For the purposes of this act, the words and phrases defined in sections 104 and 105 have the meanings ascribed to them in those sections.

Sec. 104. (1) "Agricultural land" includes any of the following as defined by the inventory advisory committee created by the Michigan resource inventory act, Act No. 204 of the Public Acts of 1979, being sections 321.201 to 321.213 of the Michigan Compiled Laws.

(a) Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, and fiber crops, and is also available for these uses including cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water. Prime farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmland has an adequate and dependable water supply from precipitation or

irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. Prime farmland is permeable to water and air. Prime farmland is not excessively erodible or not saturated with water for a long period of time, and it either does not flood frequently or is protected from flooding.

(b) Unique farmland is land other than prime farmland that is used for the production of specific high value food and fiber crops. Unique farmland has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields or both high quality and high yields of a specific crop when treated and managed according to acceptable farming methods. Areas which can be classified as unique farmland include organic soils producing vegetables and specialty crops; high lying and relatively frost free fruit sites; and areas of high water table acid soils especially suited to highbush blueberry culture as well as the small areas in the Upper Peninsula copper country which are producing strawberries.

(c) Other farmland is land in addition to prime farmland and unique farmland that has a combination of soils, location and management characteristics which is or can produce in or for a region food, feed, forage, and fiber crops and is land on which agriculture represents the greatest current economic return from the land. Other farmland includes beef cow-calf operations which occur on generally fine textured, somewhat poorly drained soils well suited to forage production and grazing. Cropland areas that by their location are especially suited for the production of disease free seed crops or which offer special opportunities for integrated best management programs could also be considered other farmland. The determination of whether agricultural land is prime farmland, unique farmland, or other farmland shall be made by the inventory advisory committee created by the Michigan resource inventory act, Act No. 204 of the Public Acts of 1979, with the concurrence of the department of agriculture and the United States department of agriculture.

(2) "Applicant" means a person applying for a permit from the department to conduct surface coal mining activities or underground coal mining activities pursuant to this act.

(3) "Approximate original contour" means that surface configuration achieved by backfilling and grading of the mined area so that the reclaimed area, including any terracing or access roads, closely resembles the general surface configuration of the land prior to mining and blends into and complements the drainage pattern of the surrounding terrain, with all highwalls and spoil piles eliminated.

(4) "Coal" means all forms of coal including lignite. Coal does not include clay, stone, sand, gravel, metalliferous and nonmetalliferous ores, and any other solid material or substance of commercial value excavated in solid form from natural deposits on or in the earth, exclusive of coal, and those minerals that occur naturally in liquid or gaseous form.

(5) "Coal exploration operation" means the substantial disturbance of the surface or subsurface for the purpose of or related to determining the location, quantity, or quality of a coal deposit.

(6) "Department" means the department of natural resources or an authorized representative of the department of natural resources.

(7) "Eligible land and water" means all land that was mined for coal or was affected by that mining, wastebanks, coal processing, or other coal mining processing, and abandoned or left in an inadequate reclamation status under the standards provided in articles 3 and 4 prior to August 3, 1977, and for which there is no continuing reclamation responsibility under state or federal law.

(8) "Historic resource" means a district, site, building, structure, or object of historical, architectural, archeological, or cultural significance which meets any of the following requirements:

(a) Designated as a national historic landmark pursuant to the historic sites, buildings, and antiquities act, 16 U.S.C. 461 to 467.

(b) Listed on the national register of historic places pursuant to the national historic preservation act, 16 U.S.C. 470 to 470w-6; or the state register of historic sites pursuant to Act No. 10 of the Public Acts of 1955, being sections 399.151 to 399.152 of the Michigan Compiled Laws.

(c) Recognized under a locally established historic district created pursuant to Act No. 169 of the Public Acts of 1970, being sections 399.201 to 399.212 of the Michigan Compiled Laws.

(d) Eligible for listing, designation, or recognition under subdivisions (a) to (c).

(9) "Imminent danger to the health and safety of the public" means the existence of any condition or practice, or any violation of a permit or other requirement of this act in a surface coal mining and reclamation operation, which condition, practice, or violation could reasonably be expected to cause substantial physical harm to persons outside the permit area before the condition, practice, or violation can be abated. A reasonable expectation of death or serious injury before abatement exists if a reasonable person, subjected to the same conditions or practices giving rise to the peril, would not expose himself or herself to the danger during the time necessary for abatement.

(10) "Local unit of government" means a county, city, township, or village; a board, commission, or authority of a county, city, township, or village; or a soil conservation district.

(11) "Operator" means a person engaged in coal mining who removes or intends to remove more than 250 tons of coal from the earth by coal mining within 12 consecutive calendar months in any 1 location.

Sec. 105. (1) "Permit" means a permit, issued by the department, to conduct surface coal mining and reclamation operations.

(2) "Permit area" means the area of land indicated on the approved map submitted by the operator with the operator's application, which area of land shall be covered by the operator's bond required by section 502 and shall be readily identifiable by appropriate markers on the site.

(3) "Permittee" means a person holding a permit to conduct surface coal mining and reclamation operations or underground mining activities pursuant to this act.

(4) "Person" means an individual, partnership, corporation, business, governmental agency, or other legal entity.

(5) "Reclamation plan" means a plan submitted by an applicant which provides a plan for reclamation of the proposed surface coal mining operations pursuant to section 305.

(6) "Soil conservation district" means a soil conservation district established and operating pursuant to Act No. 297 of the Public Acts of 1937, being sections 282.1 to 282.16 of the Michigan Compiled Laws.

(7) "Surface coal mining and reclamation operations" means surface mining operations and all activities necessary and incident to the reclamation of those operations conducted in this state after August 3, 1977.

(8) "Surface coal mining operations" means:

(a) Activities conducted in this state on the surface of any land in connection with a surface coal mine or subject to the requirements of section 601 incident to an underground coal mine. These activities include excavation for the purpose of obtaining coal including such common methods as contour, strip, auger, mountaintop removal, box cut, open pit, and area and any other areas impacted by the surface coal mining operation mining, the use of explosives and blasting, and in situ distillation or retorting, leaching or other chemical or physical processing, and the cleaning, concentrating, or other processing or preparation, loading of coal at or near the mine site.

(b) The areas on which such activities occur or where such activities disturb the natural land surface, including adjacent land the use of which is incidental to those activities; all land affected by the construction of new roads or the improvement or use of existing roads to gain access to the site of those activities and for haulage; and excavations, workings, impoundments, dams, ventilation shafts, entryways, refuse banks, dumps, stockpiles, overburden piles, spoil banks, culm banks, tailings, holes or depressions, repair areas, storage areas, processing areas, shipping areas, and other areas on which are sited structures, facilities; or other property or materials on the surface, resulting from or incident to those activities.

(9) "Unwarranted failure to comply" means the failure of a permittee to prevent the occurrence of any violation of his or her permit or any requirement of this act due to indifference, lack of diligence, lack of reasonable care, or the failure to abate any violation of his or her permit or this act due to indifference, lack of diligence, or lack of reasonable care.

Sec. 106. The department has exclusive jurisdiction over all surface coal mining and reclamation operations in this state. This act shall not be construed as preempting a zoning ordinance enacted by a local unit of government or impairing a land use plan adopted pursuant to a law of this state by a local unit of government.

Sec. 107. To implement this act, the department has the following powers:

(a) To promulgate and enforce rules pertaining to surface coal mining and reclamation operations consistent with the general intent and purposes of this act.

(b) To issue permits pursuant to this act.

(c) To conduct hearings pursuant to this act and the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.201 to 24.315 of the Michigan Compiled Laws.

(d) To issue orders requiring an operator to take actions that are necessary to comply with this act and with rules promulgated pursuant to this act.

(e) To issue orders modifying previous orders.

(f) To issue a final order revoking the permit of an operator who has failed to comply with an order of the department requiring the operator to take action required by this act or rules promulgated pursuant to this act.

(g) To order the immediate cessation of an ongoing surface mining operation or part of an ongoing surface mining operation if the department finds that the operation or part of the operation creates an imminent danger to the health or safety of the public, or is causing or can reasonably be expected to cause significant imminent harm to land, air, or water resources, and to take other action or make changes in a permit that are reasonably necessary to avoid or alleviate these conditions.

(h) To enter on and inspect a surface mining operation that is subject to this act to assure compliance with this act.

(i) To conduct, encourage, request, and participate in studies, surveys, investigations, research, experiments, training, and demonstrations by contract, grant, or otherwise.

(j) To prepare and require permittees to prepare reports.

(k) To accept, receive, and administer grants pursuant to section 407(e) of the surface mining control and reclamation act of 1977, 30 U.S.C. 1237; accept, receive, and administer grants, gifts, loans, or other funds made available from any other source for the purposes of this act.

(l) To take those steps necessary to ensure that the state may participate to the fullest extent practicable in the abandoned land program provided in title IV of the surface mining control and reclamation act of 1977, 30 U.S.C. 1231 to 1243.

(m) To take those actions necessary to establish exclusive jurisdiction over surface coal mining and reclamation in this state under the provisions of this act and the surface mining control and reclamation act of 1977, Public Law 95-87, 91 Stat. 445, including, in the event the federal administrative agency disapproves this state's program as submitted, making recommendations for remedial legislation to clarify, alter, or amend the program to meet the terms of the surface mining control and reclamation act of 1977, Public Law 95-87, 91 Stat. 445.

(n) To enter into contracts with other state agencies that have pertinent expertise to obtain the professional and technical services necessary to carry out the provisions of this act.

(o) To establish a process, in order to avoid duplication, for coordinating the review and issuance of permits for surface coal mining and reclamation operations with any other federal or state permit process applicable to the proposed operations.

(p) To enter into cooperative agreements with the secretary of the United States department of the interior for the regulation of surface coal mining operations on federal land in accordance with the surface mining control and reclamation act of 1977, Public Law 95-87, 91 Stat. 445.

(q) To perform any other duties and acts required by and provided for in this act.

Sec. 108. (1) The department shall promulgate rules pertaining to surface coal mining and reclamation operations that are required by this act.

(2) The promulgation of rules and the issuance of permits provided for in this act shall be pursuant to the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.201 to 24.315 of the Michigan Compiled Laws.

(3) A rule promulgated or a permit issued by the department may differ in its terms and provisions as to particular permit conditions, types of coal being extracted, particular areas of the state, or any other conditions that appear relevant and necessary if the action taken is consistent with attainment of the general intent and purposes of this act.

Sec. 109. Except when confidentiality is provided in this act, information submitted to the department, other state agency, or local unit of government pursuant to this act shall be a public record as provided in the freedom of information act, Act No. 442 of the Public Acts of 1976, being sections 15.231 to 15.246 of the Michigan Compiled Laws. Information which pertains only to the analysis of the chemical and physical properties of coal, excepting information regarding such mineral or elemental content which is potentially toxic in the environment, or information which pertains to the exact location of archeological sites shall be kept confidential and shall not be a public record. The department shall promulgate rules establishing a procedure to determine whether information which pertains only to the analysis of the chemical and physical properties of the coal shall be kept confidential.

ARTICLE 2. ABANDONED MINE RECLAMATION

Sec. 201. The department is authorized to take all action necessary to ensure participation to the fullest extent practicable in the abandoned mines reclamation fund established by title IV of the surface mining control and reclamation act of 1977, 30 U.S.C. 1231 to 1243, and to function as the state's agency for that participation relative to coal mining. Pursuant to this act and title IV of the surface mining control and reclamation act of 1977, 30 U.S.C. 1231 to 1243, the department shall establish procedures for the

designation of the land and water eligible for reclamation or abatement expenditures; for the submission of reclamation plans, annual projects, and applications to the appropriate authorities pursuant to the terms of this act and title IV of the surface mining control and reclamation act of 1977, 30 U.S.C. 1231 to 1243; and for the administration of all money received for abandoned mine reclamation or related purposes.

Sec. 202. (1) The state abandoned mine reclamation fund is created in the state treasury and shall be administered by the department. The state treasurer shall direct the investment of money in the fund. The interest and earnings of the fund shall be used exclusively for the purposes specified in subsection (4).

(2) The following money shall be deposited in the fund:

(a) All funds from the application fees imposed under article 3, the inspection and reclamation fees imposed under article 9, and the civil fines imposed under article 8.

(b) All funds made available to the department for the purposes specified in subsection (4) pursuant to title IV of the surface mining control and reclamation act of 1977, 30 U.S.C. 1231 to 1243.

(c) All funds which may be donated to the department for the purposes specified in subsection (4) by an individual, association, corporation, charitable organization, or private foundation or trust.

(3) Any money remaining in the fund at the end of a fiscal year shall be carried over in the fund to the next and succeeding fiscal years and shall only be used for the purposes specified in subsection 4. Pursuant to section 10 of Act No. 98 of the Public Acts of 1919, being section 21.10 of the Michigan Compiled Laws, money in the fund shall not be credited to or revert to the general fund.

(4) Expenditure of money from the state abandoned mine reclamation fund shall be made as follows:

(a) Money that is deposited in the fund under subsection (2)(b) shall reflect the following priorities in the order stated:

(i) The protection of public health, safety, general welfare, and property from extreme danger of adverse effects of coal mining practices.

(ii) The protection of public health, safety, and general welfare from adverse effects of coal mining practices.

(iii) The restoration of land and water resources and the environment previously degraded by adverse effects of coal mining practices including measures for the conservation and development of soil; water, excluding channelization; woodland, fish, and wildlife; recreation resources; and agricultural productivity.

(iv) Research and demonstration projects relating to the development of surface mining reclamation and water quality control program methods and techniques.

(v) The protection, repair, replacement, construction, or enhancement of public facilities such as utilities, roads, recreation, and conservation facilities adversely affected by coal mining practices.

(vi) The development of publicly owned land adversely affected by coal mining practices including land acquired as provided in this title for recreation and historic purposes, conservation, and reclamation purposes and open space benefits.

(b) Money that is deposited in the fund under subsection (2)(a) or (c) for any of the expenditures authorized in subdivision (a) and for any other purpose of this act including the cost of administering this act.

Sec. 203. (1) The department may, in the manner provided in this section, enter on private property for the purposes of conducting an investigation, inspection, study, or exploratory work to determine the existence of adverse effects of past coal mining practices and to determine the feasibility of restoration, reclamation, abatement, control, or prevention of those adverse effects.

(2) The department may enter on property as provided in subsection (3) if all of the following conditions exist:

(a) The land or water resources on the property have been adversely affected by past coal mining practices.

(b) The adverse effects to land or water resources on the property are at a stage where, in the public interest, action should be taken to restore, reclaim, abate, control, or prevent the adverse effects of past coal mining practices.

(c) The department gives notice by certified mail, return receipt requested, to the record owner or owners of the property requesting permission to enter on the property.

(d) The owners of the land or water resources where entry must be made to restore, reclaim, abate, control, or prevent the adverse effects of past coal mining practices are not known, or readily identifiable; or the owners of the property will not give permission, after receiving notice under subdivision (c), for the

state or local unit of government to enter on the property to restore, reclaim, abate, control, or prevent the adverse effects of past coal mining practices.

(3) After giving notice by certified mail, return receipt requested, to the record owner or owners of the property; posting notice on the property; and advertising for 4 consecutive weeks in a newspaper of general circulation in the county in which the property is located, the department may enter on property adversely affected by the past coal mining practices and any other property necessary to have access to the property to take those actions necessary or expedient to restore, reclaim, abate, control, or prevent the adverse effects. The money expended to restore, reclaim, abate, control, or prevent the adverse effects and the benefits accruing to the property entered on shall be chargeable against the land and shall mitigate or offset any claim in an action brought by the owner of any interest in the property for damages by virtue of the entry. This subsection is not intended to create new rights of action or eliminate existing immunities.

(4) The department may acquire land by purchase, donation, or condemnation that is adversely affected by past coal mining practices if the department determines that acquisition of the land is in the public interest, is necessary to successful reclamation, and any of the following apply:

(a) The acquired land, after restoration, reclamation, abatement, control, or prevention of the adverse effects of past coal mining practices, will serve recreation and historic purposes, conservation and reclamation purposes, or provide open space benefits; and

(b) Permanent facilities such as a treatment plant or a relocated stream channel will be constructed on the land for the restoration, reclamation, abatement, control, or prevention of the adverse effects of past coal mining practices; or

(c) Acquisition of coal refuse disposal sites and all coal refuse on the acquired land will serve the purposes of this section or is desirable to meet emergency situations and prevent recurrences of the adverse effects of past coal mining practices.

The price paid for land acquired pursuant to this section shall reflect the market value of the land taking into consideration its current use and its condition as adversely affected by past coal mining practices.

(5) If land acquired pursuant to this section is considered suitable for agricultural, industrial, commercial, residential, or recreational development, the state may sell or transfer the land pursuant to rules promulgated by the department and procedures provided by law to ensure that the land is put to proper use consistent with the land use plans of local units of government. If a grant accepted pursuant to section 107(k) is involved in the acquisition of the land to be sold, the land may be sold only when authorized by the secretary of the United States department of the interior. The department shall hold a public hearing in compliance with the open meetings act, Act No. 287 of the Public Acts of 1976, being sections 15.261 to 15.275 of the Michigan Compiled Laws, in the county or counties of the state in which land acquired pursuant to this section is located. The hearings shall afford local citizens and local units of government an opportunity to participate in the decision concerning the use or disposition of the land after restoration, reclamation, abatement, control, or prevention of the adverse effects of past coal mining practices.

Sec. 204. (1) Within 6 months after the completion of a project to restore, reclaim, abate, control, or prevent the adverse effects of past mining practices on privately owned property, the department shall itemize the money expended to complete the project and shall file an account of the money expended with the clerk of the county in which the property is located, together with a notarized appraisal by an independent appraiser of the value of the land before the restoration, reclamation, abatement, control, or prevention, of the adverse effects of past mining practices if the money so expended will result in a significant increase in property value. The filing of his pendens with a copy of the statement of account and the appraisal shall constitute a lien on the land second in priority only to a lien for delinquent property taxes placed on the property pursuant to section 40 of the general property tax act, Act No. 206 of the Public Acts of 1993, being section 211.40 of the Michigan Compiled Laws. The lien shall not exceed the amount of the increase in the market value of the land as a result of the restoration, reclamation, abatement, control, or prevention of the adverse effects of past mining practices. A lien shall not be filed against the property of a person who was a record owner of the surface rights in the property prior to May 2, 1977, and who did not consent to, participate in, or exercise control over the mining operation that necessitated the restoration, reclamation, abatement, control, or prevention of the adverse effects of past mining practices.

(2) An affected landowner may petition the department within 60 days of the filing of the lien for a hearing concerning the amount of the lien. That hearing and any appeal shall be conducted under chapter 4 of the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.271 to 24.287 of the Michigan Compiled Laws.

Sec. 205. (1) The department is authorized to spend money from the state abandoned mine reclamation fund created by section 202 for the emergency restoration, reclamation, abatement, control, or prevention of adverse effects of coal mining practices on eligible land, if the department finds that all the following conditions exist:

(a) An emergency exists constituting a danger to the public health, safety, or general welfare.

(b) No other person, state agency, or local unit of government has commenced actions or operations on the eligible land to restore, reclaim, abate, control, or prevent the adverse effects of past coal mining practices.

(2) The department may enter on any land where the emergency exists and any other land necessary to have access to the land where the emergency exists to take those actions necessary or expedient to restore, reclaim, abate, control, or prevent the adverse effects of coal mining practices and to do all things necessary or expedient to protect the public health, safety, or general welfare, if the department has obtained a warrant authorizing that entry. Entry pursuant to this subsection is an exercise of the police power and not an act of condemnation or trespass. If the owner of any interest in the property brings an action for damages because of an entry made pursuant to this subsection, the money expended to restore, reclaim, abate, control, or prevent the adverse effects and the benefits accruing to the property entered on shall be chargeable against the land and shall mitigate or offset any claim in that action. This subsection is not intended to create new rights of action or eliminate existing immunities.

ARTICLE 3. PERMITS

Sec. 301. (1) A person shall not conduct a surface coal mining operation in this state without a permit for that operation issued by the department pursuant to this act.

(2) Not later than 2 months following approval by the federal government of this state's program under the terms of the surface mining control and reclamation act of 1977, Public Law 95-87, 91 Stat. 445, regardless of litigation contesting that approval or implementation, all operators of surface coal mines engaged in surface coal mining operations before the effective date of this act shall file an application for a permit with the department. The application shall cover all land to be mined.

(3) In the event of disapproval of this state's program by the federal government and prior to promulgation of a federal program or a federal land program for this state, permits shall not be issued by the department, but the existing surface coal mining operations may continue. Permits that lapse during the period may continue in full force and effect until promulgation of a federal program or a federal land program.

Sec. 302. (1) Permits issued pursuant to this act shall be for a term not to exceed 3 years, except that if the applicant demonstrates that a specified longer term is reasonably needed to allow the applicant to obtain necessary financing for equipment and to open the operation, and if the application is full and complete for the specified longer term, the department may grant a permit for that longer term. A successor in interest to a permittee who applies for a new permit within 30 days of succeeding to that interest and who is able to obtain the same bond coverage pursuant to article 5 as the original permittee may continue the surface coal mining and reclamation plan of the original permittee until the successor's application is granted or denied.

(2) A permit shall terminate if the permittee has not commenced the surface coal mining operation covered by the permit within 2 years after commencement of the period for which the permit is issued. However, upon application by the permittee the department may grant reasonable extensions of time, not to exceed 6 months each, to commence a surface coal mining operation if the permittee demonstrates either of the following:

(a) The extension is necessary because the commencement of the operation has been enjoined by a court of competent jurisdiction.

(b) The extension is necessary because of conditions beyond the control and without the fault or negligence of the permittee.

In the case of a coal lease issued under the mineral lands leasing act, chapter 85, 41 Stat. 437, the department shall not grant extensions of time that extend beyond the period allowed for diligent development under section 7 of the mineral lands leasing act, 30 U.S.C. 207.

Sec. 303 (1) The permit application shall be submitted to the department and shall contain all of the following

(a) The names and addresses of the following persons.

(i) The applicant.

(ii) All legal owners of record of the property, surface or mineral, to be mined.

(iii) The holders of record of any leasehold interest in the property to be mined.

(iv) The purchasers of record under a land contract of the property to be mined.

- (v) The operator if the operator is a person other than the applicant.
- (vf) If the applicant is a partnership, corporation, association, or other business entity, the following where applicable: the names and addresses of every officer, partner, director, or person performing a function similar to a director, of the applicant; the name and address of any person owning, of record 10% or more of any class of voting stock of the applicant; and a list of all names under which the applicant, partner, or principal shareholder previously operated a surface mining operation within the United States within the 5-year period preceding the date of submission of the application.
- (b) The names and addresses of the owners of record of all surface and subsurface areas adjacent to the permit area.
- (c) A statement of any current or previous surface coal mining permits held by the applicant including permit identification, and any pending application.
- (d) Information concerning ownership and management of the applicant or operator required by the department by rule.
- (e) A statement of whether the applicant or any subsidiary, affiliate, or other person controlled by or under common control with the applicant has ever held a federal, state, or local mining permit which in the 5-year period prior to the date of submission of the application has been suspended or revoked or whether that person has had a mining bond or similar security deposited in lieu of bond forfeited and, if so, a brief explanation of the facts involved.
- (f) A copy of an advertisement to be published in a newspaper of general circulation in the locality of the proposed site for 4 consecutive weeks, that indicates the ownership and a description of the location and boundaries of the proposed site sufficiently so that the proposed operation may be readily located, and a statement that the application is available for public inspection at the office of the county clerk of each county in which the proposed permit area is located.
- (g) A description of the type and method of coal mining operation that exists or is proposed, the engineering techniques proposed or used, and the equipment used or proposed to be used in the mining operation.
- (h) The anticipated or actual starting and termination dates of each phase of the mining operation and number of acres of land to be affected by each phase of the mining operation.
- (i) An accurate map or plan, to scale determined by the department by rule, filed by the applicant with the department clearly showing the land to be affected as of the date of the application, the area of land within the permit area on which the applicant has the legal right to enter and commence surface mining operations, and those documents on which the applicant bases his or her legal right to enter and commence surface mining operations on the area affected, and whether that right is the subject of pending court litigation.
- (j) Identification of the watershed and location of the surface streams, tributaries, groundwaters, and county and intercounty drains into which surface, pit drainage, or other waters from the mining operation will be discharged.
- (k) A determination of the probable hydrologic consequences of the mining and reclamation operation, if any, both on and off the mine site, with respect to the hydrologic regime; quantity and quality of water in surface and groundwater systems, including the dissolved and suspended solids under seasonal flow conditions; and the collection of sufficient data for the mine site and surrounding areas so that an assessment can be made by the department of the probable cumulative impacts of all anticipated mining in the area on the hydrology of the area and particularly on water availability. However, the determination of hydrologic consequences shall not be required until existing hydrologic information regarding the general area prior to mining is made available from the appropriate federal or state agency, except that the permit shall not be approved until the information is available and is incorporated into the permit application.
- (l) The climatological factors that are peculiar to the locality of the land to be affected, including the average seasonal precipitation, average direction and velocity of prevailing winds, and seasonal temperature ranges.
- (m) A statement of the result of test borings or core samplings from the proposed permit area, including logs of the drill holes; the thickness of the coal seam found, and an analysis of the chemical properties of the coal; the sulfur content of any coal seam; a chemical analysis of any potentially acid or toxic-forming sections of the overburden; and a chemical analysis of the stratum lying immediately underneath the coal to be mined. The provisions of this subdivision may be waived by the department with respect to any particular application by a written determination by the department that the information is unnecessary.
- (n) A soil survey made or obtained according to standards established by the department of agriculture in order to confirm the exact location of agricultural land, if any, within the proposed permit area. The soil survey shall include the exact location of agricultural land enrolled under the farmland and open space

preservation act, Act No. 116 of the Public Acts of 1974, being sections 554.701 to 554.719 of the Michigan Compiled Laws.

(o) Accurate maps to scale determined by the department by rule clearly showing both of the following:

(i) The land to be affected as of the date of application.

(ii) All types of information set forth on topographical maps of the United States geological survey of a scale of 1:24,000 or 1:25,000 or larger, including all man-made features and significant known archeological sites existing on the date of application.

The map or plan shall, among other things specified by the department, show all boundaries of the land to be affected, the boundary lines and names of present owners of record of all surface areas adjacent to the permit area, and the location of all buildings within 1,000 feet of the permit area.

(p) Cross section maps or plans of the land to be affected to a scale determined by the department by rule, including the actual area to be mined, prepared by or under the direction of and certified by a qualified registered professional engineer, or professional geologist with assistance from experts in related fields such as land surveying and landscape architecture, showing pertinent elevation and location of test borings or core samplings and depicting the following information: the nature and depth of the various strata of overburden; the location of subsurface water, if encountered, and its quality; the nature and thickness of any coal or rider seam above the coal seam to be mined; the nature of the stratum immediately beneath the coal seam to be mined; all mineral crop lines and the strike and dip of the coal to be mined, within the area of land to be affected; existing or previous surface mining limits; the location and extent of any underground mines, including mine openings to the surface; the location of aquifers, the estimated elevation of the water table; the location of spoil, waste, or refuse areas and topsoil preservation areas; the location of all impoundments for waste or erosion control; any settling or water treatment facility; constructed or natural drainways and the location of any discharges to any surface body of water on the area of land to be affected or adjacent thereto; profiles at appropriate cross sections of the anticipated final surface configuration that will be achieved pursuant to the operator's proposed reclamation plan; and other information required by the department by rule that is consistent with the purposes of this act.

(q) A reclamation plan that meets the requirements of this act and the requirements of the zoning ordinances enacted by a local unit of government.

(r) A determination of the impact on historic preservation concerns including all of the following:

(i) A statement of available information on whether the proposed permit area is within an area designated unsuitable for surface mining activities due to the potential effect of mining on historic resources, or whether the area is under study for a designation of unsuitability in an administrative proceeding.

(ii) A description of the historic resources located within the proposed permit area and adjacent areas. The description shall be based on available information, including data in the possession of state and local archeological, historical, and cultural preservation agencies.

(iii) A map showing the boundaries of each historic resource within the permit area and adjacent areas.

(iv) An evaluation of the potential adverse affect that the proposed surface mining operation will have on historic resources within the proposed permit area and adjacent areas.

(v) A statement indicating whether there are feasible and prudent alternatives to the potential adverse affects on historic resources.

(vi) A statement of the measures proposed to prevent, minimize, or mitigate potential adverse affects upon historic resources located within the proposed permit area, including a proposal for recording or salvaging the resources in the event that adverse affects cannot be avoided.

The determination required by this subdivision shall include the name, address, and employment position of each person that the applicant consulted in collecting information on historic resources.

(s) An agricultural impact statement which includes all the following:

(i) The location and boundaries of the proposed mining operation

(ii) The number of acres to be affected by the proposed mining operation

(iii) The nature and type of agricultural operations to be affected by the proposed mining operation

(iv) The nature and extent of the effect of the proposed mining operation on the agricultural operations, including the number and types of buildings and other facilities which will be affected by the mining operation.

(v) The anticipated future effect of the proposed mining operation on adjacent agricultural land which will not be immediately affected by the proposed mining operation.

(vi) The anticipated amount of time, in years and months, during which the area affected by the proposed mining operation will be unsuitable for normal agricultural production.

(vii) The anticipated amount of time, in years and months, required to restore the area affected by the proposed mining operation to the level of productivity before it was affected by the mining operation.

(viii) The impact of the proposed mining operation on agriculture generally.

(i) Other data and maps as the department may require by rule that are consistent with the purposes of this act.

(2) An applicant for a surface mining and reclamation permit shall submit to the department as part of its application a certificate issued by an insurance company authorized to do business in this state certifying that the applicant has a public liability insurance policy in force for the surface mining and reclamation operations for which the permit is sought. The policy shall provide for personal injury and property damage protection consistent with the standards established in section 501 in an amount adequate to compensate any persons damaged as a result of surface coal mining and reclamation operations, including the use of explosives, and entitled to compensation under the applicable provisions of state law. The policy shall be maintained in full force and effect during the terms of the permit or any renewal, including the length of all reclamation operations.

Sec. 304. (1) A permit issued pursuant to this act shall carry with it the right of successive renewal on expiration with respect to areas within the boundaries of the existing permit. The permittee may apply for renewal and except as provided in subsection (2) the renewal shall be issued.

(2) Renewal shall not be issued if, after a hearing conducted pursuant to section 310, it is established and the department makes written findings that any of the following conditions exist:

(a) The terms and conditions of the existing permit are not being satisfactorily met by the permittee.

(b) The present surface coal mining and reclamation operation is not in compliance with the environmental protection standards of this act and the approved state plan or federal program pursuant to the surface coal mining and reclamation act of 1977, Public Law 95-87.

(c) The renewal requested substantially jeopardizes the operator's continuing responsibility for reclamation established under this act on existing permit areas.

(d) The operator has not provided evidence that the performance bond in effect for the operation or any additional bond the department might require pursuant to section 502 will continue in full force and effect for the renewal requested in the application.

(e) Additional revised or updated information required by the department by rule has not been provided by the permittee.

(3) Before the renewal of a permit the department shall provide notice to the appropriate persons, local units of government, and interested parties.

(4) If an application for renewal of an existing permit includes a proposal to extend the mining operation beyond the boundaries authorized in the existing permit, the portion of the application that addresses new land areas shall be subject to the full standards applicable to a new application under this act.

(5) A permit renewal shall be for a term not to exceed the period of the existing permit established by this act. Application for permit renewal shall be made at least 120 days before the expiration of the existing permit.

Sec. 305. The reclamation plan required to be submitted pursuant to this act as part of a permit application shall include details necessary to demonstrate that reclamation required by this act can be accomplished, and shall include all of the following:

(a) Identification of land subject to the surface coal mining operation over the estimated life of that operation and the size, sequence, and timing of any subareas for which it is anticipated that individual permits for surface coal mining will be sought.

(b) The condition of the land to be covered by the permit prior to any surface coal mining, including:

(i) The uses existing at the time of the application, and if the land has a history of previous mining, the uses that preceded any mining.

(ii) The capability of the land, prior to any surface coal mining, to support a variety of uses giving consideration to soil and foundation characteristics, topography, and vegetative cover and, if applicable, a soil survey prepared pursuant to section 303(1)(n).

(iii) The productivity of the land prior to mining, based on the average yield of food, fiber, forage, or wood products consistent with productivity of similar lands in this state under best management practices.

(c) The use 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 those uses to applicable land use policies and plans. However, if the use made of the land before mining is agricultural and the use proposed to be made of the land following reclamation is other than that agricultural use, a copy of the permit application shall be transmitted to the Michigan environmental review board created by Executive Order No. 1974-4 for study and recommendation and the permit shall not be approved by the department without the approval of the legislative body of each local unit of government in which land to be reclaimed is located.

(d) A detailed description of how the proposed postmining land use is to be achieved and the necessary support activities that may be needed to achieve that use.

(e) The engineering techniques proposed to be used in mining and reclamation and a description of the major equipment to be used. A plan for the control of surface water drainage and of water accumulation; a plan, where appropriate, for backfilling, soil stabilization and compacting, grading, and appropriate revegetation; and a plan for soil reconstruction, replacement, and stabilization, pursuant to the performance standards in section 401(2)(g) for food, forage, and forest land identified in that section, and an estimate of the cost per acre of the reclamation, including a statement as to how the permittee plans to comply with each of the requirements set out in that section.

(f) The actions to be taken to maximize the utilization and conservation of the solid fuel resource being recovered so that mining and any activities related to mining of the land in the future can be minimized.

(g) An estimated timetable for the accomplishment of each major step in the reclamation plan.

(h) The actions to be taken to making the surface mining and reclamation operations consistent with surface owner plans and applicable land use plans and programs of local units of government.

(i) The actions to be taken to comply with applicable air and water quality laws of this state or the United States, rules and regulations of this state or the United States, or local ordinances; and applicable health and safety standards.

(j) The action to be taken to develop the reclamation plan in a manner consistent with local physical, environmental, and climatological conditions.

(k) The results of test borings that the applicant has made at the proposed permit area or other equivalent information and data in a form satisfactory to the department, including the location of subsurface water, and an analysis of those chemical properties of the coal and overburden that can be expected to have an adverse effect on the environment.

(l) An itemized list of land, interests in land, or options on those interests held by the applicant or pending bids on interests in land by the applicant, which land is adjacent to the proposed permit area.

(m) A detailed description of the actions to be taken during the mining and reclamation process to assure the protection of:

(i) The quality of surface and groundwater systems, both on site and off site, from adverse effects of the mining and reclamation process and the rights of present users to that water.

(ii) The quantity of surface and groundwater systems, both on site and off site, from adverse effects of the mining and reclamation process or to provide alternative sources of water where the protection of quantity cannot be assured.

Sec. 306. Each applicant for a surface coal mining and reclamation permit shall submit to the department as a part of its application a blasting plan which shall outline the procedures and standards by which the operator will meet the requirements of section 401(2)(o).

Sec. 307. (1) An applicant for a surface coal mining and reclamation permit shall file a copy of the application with the county clerk of each county in which the mining is proposed to occur and with the township clerk of each township in which the mining is proposed to occur, except for that information in the application pertaining to the coal seam.

(2) Except when confidentiality is provided for in this act, a record, report, inspection materials, or other information obtained by the department shall be available to the public with the county clerk of each county in which the mining is proposed to occur. The department shall transmit a record, report, inspection material, or other information to each county clerk within 10 days after it is received by the department.

Sec. 308. An application for a surface coal mining and reclamation permit shall be accompanied by an initial application fee. The initial application fee shall be \$100.00.

Sec. 309. If the department finds that the probable total annual production at all locations of a surface coal mining operator will not exceed 100,000 tons, the determination of probable hydrologic consequences

and statement of the results of test borings or core samplings required by section 303 shall, on the written request of the operator, be performed by a qualified governmental agency or private consultant designated by the department, and the cost of the preparation of the determination and statement shall be assumed by the department.

Sec. 310. (1) When an application for a surface coal mining and reclamation permit, or renewal of an existing permit is submitted, the applicant's advertisement of ownership, location, and boundaries of the land to be affected shall be placed in a local newspaper of general circulation in the locality of the proposed surface coal mining operation for 4 consecutive weeks. The department shall notify local units of government in the vicinity of the proposed mining and reclamation area of the operator's intention to conduct a surface mining operation indicating the application's number and the county courthouse or township office in which a copy of the proposed surface coal mining and reclamation plan may be inspected. A local unit of government may submit written comments within a period established by the department on the mining applications with respect to the effect of the operation proposed by the applicant on the environment that is within their area of responsibility. The comments shall immediately be transmitted to the applicant by the department and shall be made available to the public at the same location as the mining application.

(2) In addition to the notice required in subsection (1), the department shall notify the department of state of the operator's intention to conduct a surface mining operation and shall provide the department of state with a copy of the permit application. Based on the information required pursuant to section 303(1)(r), the department of state shall determine whether or not the proposed surface mining operation will adversely affect an historic resource. The department of state may file written objection to the proposed surface mining operation pursuant to subsection (3).

(3) A person having an interest that is or may be adversely affected by the operation proposed in the application and any federal or state government agency or any local unit of government is entitled to file written objections to the proposed initial or revised application for a permit for surface coal mining and reclamation operation with the department not later than 30 days after the last publication of the notice required by subsection (1). Those objections shall immediately be transmitted to the applicant by the department and shall be made available to the public.

(4) Within 45 days after the last publication of the notice provided in subsection (1), the applicant or any person with an interest which is or may be adversely affected may request a hearing on the application. The hearing shall be held within 30 days after the expiration of the time allowed for submitting the request.

(5) An action taken by the department with respect to a permit application shall be conducted pursuant to chapters 4 and 5 of the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.271 to 24.292 of the Michigan Compiled Laws.

Sec. 311. (1) On the basis of a complete application for a surface coal mining and reclamation permit or a revision or renewal of a permit, the department shall grant, require modification of, or deny the application for a permit within 120 days after the application is submitted to the department, except that an application submitted pursuant to section 301(2) shall be granted, modified, or denied within 120 days after the approval of this state's program. The department shall notify the applicant in writing of its decision regarding granting, modifying, or denying the application for a permit. The applicant for a permit or revision of a permit shall have the burden of establishing that his or her application is in compliance with all the requirements of this act. Within 3 days after the granting of a permit, but before the permit is issued, the department shall notify the county clerk in each county in which the land to be affected is located that a permit has been issued and shall describe the location of the land.

(2) An application for a permit or revision of a permit shall not be approved unless the department finds, in writing, that all the following requirements have been met:

(a) The application is accurate and complete and that it complies with all the requirements of this act.

(b) The applicant has demonstrated that reclamation as required by this act can be accomplished under the reclamation plan contained in the application.

(c) An assessment of the probable cumulative impact of all anticipated surface coal mining inside and outside the permit area on the hydrologic balance, including quantitative and qualitative analyses, has been made by the department, and the proposed operation has been designed to prevent material damage to the hydrologic balance inside and outside the permit area.

(d) The area proposed to be mined is not included within an area designated unsuitable for surface coal mining pursuant to this act nor is it within an area under study for this designation in an administrative proceeding commenced pursuant to this act, unless in the area as to which an administrative proceeding has commenced, the applicant demonstrates that, prior to January 1, 1977, the applicant has made substantial

legal and financial commitments in relation to the operation for which the applicant is applying for a permit.

(e) If the ownership of the coal has been severed from the private surface estate, the applicant has submitted to the department either the written consent of the surface owner to the extraction of coal by surface mining methods or a conveyance that expressly grants or reserves the right to extract the coal by surface mining methods. However, if the conveyance does not expressly grant the right to extract coal by surface mining methods, the surface-subsurface legal relationship shall be determined in accordance with state law, except that nothing in this act shall be construed to authorize the department to adjudicate property rights disputes.

(f) If the department of state determines that the proposed surface mining operation will adversely affect an historic resource, the application is approved jointly by the department, by the federal, state, or local agency with jurisdiction over the historic resource, and by the department of state.

(3) The applicant shall file, with the application, a schedule listing all notices of violations of this act or other law of this state and any law, rule, or regulation of the United States, or of any department or agency in the United States pertaining to air or water environmental protection incurred by the applicant in connection with a surface coal mining operation during the 3-year period prior to the date of application. The schedule shall include the final resolution of notice of the violation. If the schedule or other information available to the department indicates that a surface coal mining operation owned or controlled by the applicant is currently in violation of this act or other laws referred to in this subsection, the permit shall not be issued until the applicant submits affidavits that the violation has been corrected or is in the process of being corrected to the satisfaction of the department or the agency that has jurisdiction over the violation or that the notice of violation is being contested by the applicant. A permit shall not be issued to an applicant after a finding by the department, after opportunity for hearing, that the applicant, or the operator specified in the application, controls or has controlled mining operations with a demonstrated pattern of violations of this act of such nature and duration with such resulting pollution, impairment, or destruction to the environment as to indicate an intent not to comply with this act.

(4) If the area proposed to be mined contains agricultural land, the department shall consult with the director of the department of agriculture and the secretary of the United States department of agriculture and shall not grant a permit to mine on agricultural land unless the department finds in writing that the operator has the technological capability to restore the mined area and any other areas impacted by the surface coal mining operation within a reasonable time to equivalent or higher levels of yield as nonmined agricultural land in the surrounding area under equivalent levels of management, and also finds that the applicant can meet the soil reconstruction standards of this act.

Sec. 312. (1) During the term of a permit, the permittee may submit an application for a revision of the permit, including a revised reclamation plan, to the department. An application for a revision of a permit shall not be approved unless the department finds that reclamation as required by this act can be accomplished under the revised reclamation plan. The revision shall be approved or disapproved within 90 days after it is submitted to the department. The department shall establish standards for a determination of the scale or extent of a revision request for which all permit application information requirements and procedures shall apply.

(2) A transfer, assignment, or sale of the rights granted under a permit issued pursuant to this act shall not be made without the written approval of the department.

(3) The department shall, within a time limit prescribed by rule, review outstanding permits. The department may require revision or modification of the permit provisions during the terms of the permit based on a change in technology or a change in circumstances.

(4) All action taken by the department under this section regarding the granting, modification, denial, or revision of a permit shall be conducted pursuant to chapters 4 and 5 of the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.271 to 24.292 of the Michigan Compiled Laws.

Sec. 313. This article shall not be construed as exempting a permittee from obtaining any other permit, license, or permission to engage in any activity regulated by this act that is required by any other law of this state or any rule promulgated pursuant to a law of this state, or a zoning ordinance enacted by a local unit of government.

ARTICLE 4. ENVIRONMENTAL PERFORMANCE STANDARDS

Sec. 401. (1) A permit issued under this act to conduct surface coal mining operations shall require that the operations meet the performance standards provided in subsection (2).

(2) Except as otherwise provided in this act, all surface coal mining and reclamation operations shall require the operator to do all of the following:

(a) To conduct surface coal mining operations in a manner that maximizes the utilization and conservation of the solid fuel resource being recovered to prevent re-affecting the land in the future through subsequent surface coal mining.

(b) To restore the land affected to a condition capable of supporting the uses which it was capable of supporting prior to any mining, or higher or better uses if priority is given to restoration of agricultural land to agricultural uses, so long as that use does not present an actual or probable hazard to public health or safety or pose an actual or probable threat of water diminution or pollution, and the declared proposed land use in the permit application following reclamation is not inconsistent with applicable land use policies and plans, involves unreasonable delay in implementation, or in violation of a law of this state or the United States or a local ordinance.

(c) To backfill; to compact, where advisable to ensure stability or to prevent leaching of toxic materials; and to grade in order to restore the approximate original contour of the land with all highwalls, spoil piles, and depressions eliminated, unless small depressions are needed in order to retain moisture to assist revegetation or as otherwise authorized pursuant to this act. However, for surface coal mining that is carried out at the same location over a substantial period of time where the operation transects the coal deposit and the thickness of the coal deposits is large relative to the volume of the overburden and where the operator demonstrates that the overburden and other spoil and waste materials at a particular point in the permit area or otherwise available from the entire permit area is insufficient, giving due consideration to volumetric expansion to restore the approximate original contour, the operator, at a minimum, shall backfill, grade, and compact using all available overburden and other spoil and waste materials to attain the lowest practicable grade but not more than the angle of repose, to provide adequate drainage and to cover all acid-forming and other toxic materials, in order to achieve an ecologically sound land use compatible with the surrounding region. Further, that in surface coal mining, where the volume of overburden is large relative to the thickness of the coal deposit and where the operator demonstrates that due to volumetric expansion the amount of overburden and other spoil and waste materials removed in the course of the mining operation is more than sufficient to restore the approximate original contour, the operator shall, after restoring the approximate contour, backfill, grade, and compact the excess overburden and other spoil and waste materials to attain the lowest grade but not more than the angle of repose, and to cover all acid-forming and other toxic materials, in order to achieve an ecologically sound land use compatible with the surrounding region. In all cases the overburden or spoil shall be shaped and graded to prevent slides, erosion, and water pollution and revegetated in accordance with a plan for revegetation developed in cooperation with each soil conservation district affected by the surface coal mining operation and the requirements of this act.

(d) To stabilize and protect all surface areas, including spoil piles, affected by the surface coal mining and reclamation operation and to effectively control erosion and attendant air and water pollution.

(e) To remove the topsoil from the land in a separate layer and replace it on the backfill area. Except that if the topsoil is not utilized immediately, to segregate it in a separate pile from other spoil and when the topsoil is not replaced on a backfill area within a time short enough to avoid deterioration of the topsoil, maintain a successful cover by quick growing plant or other means so that the topsoil is preserved from wind and water erosion, remains free of any contamination by other acid or toxic materials, and is in a usable condition for sustaining vegetation when restored during reclamation. However, if topsoil is of insufficient quantity or of poor quality for sustaining vegetation requirements imposed in this article and article 3, or if other strata can be shown to be more suitable for vegetation requirements imposed in this article and article 3, then the operator shall remove, segregate, and preserve in a like manner the other strata that are best able to support vegetation.

(f) To restore the topsoil or the available subsoil which is best able to support vegetation.

(g) If agricultural land is to be mined and reclaimed, the specifications for soil removal, storage, replacement, and reconstruction shall be established by the department of agriculture in consultation with the secretary of the United States department of agriculture and the operator shall, as a minimum, be required to do all of the following:

(i) Segregate the A horizon of the natural soil, except where it can be shown that other available soil materials will create a final soil having a greater productive capacity. If the A horizon of the natural soil is not utilized immediately, it shall be stockpiled separately from other spoil, and provided protection from wind and water erosion or contamination by other acid or toxic materials.

(ii) Segregate the B horizon of the natural soil, or underlying C horizons or other strata, or a combination of those horizons or other strata that are shown to be both texturally and chemically suitable for plant growth and that can be shown to be equally or more favorable for plant growth than the B horizon, in sufficient quantities to create in the regraded final soil a root zone of comparable depth and

quality to that which existed in the natural soil. If the B and C horizons of the natural soil are not utilized immediately, they shall be stockpiled separately from other spoil, and provided protection from wind and water erosion or contamination by other acid or toxic material.

(#) Replace and regrade the root zone material described in subparagraph (#) with proper compaction and uniform depth over the regraded spoil material.

(#) To redistribute and grade in a uniform manner the surface soil horizon described in subdivision (g)(i).

(h) To create, if authorized in the approved mining and reclamation plan and permit, permanent impoundments of water on mining sites as part of reclamation activities but only when it adequately demonstrates all of the following:

(i) The size of the impoundment is adequate for its intended purposes.

(ii) The impoundment dam construction will be designed to achieve necessary stability with an adequate margin of safety compatible with that of structures constructed under the watershed protection and flood prevention act, 16 U.S.C. 1006.

(iii) The quality of impounded water will be suitable on a permanent basis for its intended use and discharges from the impoundment will not degrade the water quality below water quality standards established pursuant to applicable federal and state law in the receiving stream.

(iv) The level of water will be stable.

(v) Final grading will provide safety and access for proposed water users.

(vi) The water impoundments will not result in the diminution of the quality or quantity of water utilized by adjacent or surrounding landowners for agricultural, industrial, recreational, or domestic uses.

(vii) The impoundment is consistent with the laws of this state or the United States; rules and regulations of this state or the United States; or local ordinance.

(i) To conduct an augering operation associated with surface mining in a manner to maximize recoverability of coal reserves remaining after the operation and reclamation are complete, and seal all auger holes with an impervious and noncombustible material in order to prevent drainage, except where the department determines that the resulting impoundment of water in the auger holes may create a hazard to the environment or the public health or safety. The department may prohibit augering under standards established by rule if necessary to maximize the utilization, recoverability, or conservation of solid fuel resources or to protect against adverse water quality impacts.

(j) To minimize disturbances to the prevailing hydrologic balance at the mine site and in associated off site areas and to the quality and quantity of water in surface and groundwater systems both during and after surface coal mining operations and during reclamation by:

(i) Avoiding acid or other toxic mine drainage by preventing or removing water from contact with toxic-producing deposits; treating drainage to reduce toxic content that adversely affects downstream water on being released to water courses; or casing, sealing, or otherwise managing bore holes, shafts, and wells and keeping acid or other toxic drainage from entering surface water and groundwater.

(ii) Conducting surface coal mining operations to prevent, to the extent possible using technology currently available, additional contributions of suspended solids to streamflow or runoff outside the permit area, except that contributions shall not be in excess of requirements set by applicable state or federal law.

(iii) Constructing any siltation structures pursuant to subparagraph (h) prior to commencement of surface coal mining operations. A siltation structure shall be certified by a qualified registered engineer and shall be constructed as designed and approved in the reclamation plan.

(iv) Cleaning out and removing temporary or large settling ponds or other siltation structures from drainways after disturbed areas are revegetated and stabilized and depositing the silt and debris at a site in a manner approved by the department.

(v) Restoring recharge capacity of the mined area to approximate premining conditions.

(vi) Avoiding channel deepening or enlargement in operations requiring the discharge of water from mines.

(vii) Other actions as the department may prescribe.

(k) To stabilize all waste piles in designated areas with respect to surface disposal of mine wastes, tailings, coal processing wastes, and other wastes in areas other than the mine working or excavation through construction in compacted layers including the use of incombustible and impervious materials, if necessary, and to assure that the final contour of the waste pile will be compatible with natural surroundings and that the site can and will be stabilized and revegetated according to this act.

(l) To refrain from surface coal mining within 500 feet of an active or abandoned underground mine in

order to prevent breakthroughs and to protect the health and safety of miners and other persons. However, the department shall allow an operator to mine near, through, or partially through an abandoned underground mine or closer than 500 feet of an active underground mine if the nature, timing, and sequencing of specific surface mine activities with specific underground mine activities are jointly approved by the federal and state agencies and local units of government concerned with surface mine regulation and the health and safety of underground miners, and the operations will result in improved resource recovery, abatement of water pollution, or elimination of hazards to the health and safety of the public.

(m) To design, locate, construct, operate, maintain, enlarge, modify, and remove or abandon, in accordance with the standards and criteria developed pursuant to rules promulgated by the department, all existing and new coal mine waste piles, consisting of mine wastes, tailings, coal processing wastes, or other liquid and solid wastes, and used either temporarily or permanently as a dam or embankment.

(n) To ensure that all debris, acid-forming materials, toxic materials, or materials constituting a fire hazard are treated, buried, compacted, or otherwise disposed of to prevent contamination of surface water or groundwater and that contingency plans are developed to prevent sustained combustion of those materials.

(o) To ensure that explosives are used only in accordance with existing state and federal law and the rules promulgated by the department. Rules promulgated by the department shall require the permittee to do all of the following:

(i) Publish the schedule of the planned blasting in a newspaper of general circulation in the vicinity, mailing a copy of the proposed blasting schedule to every resident living within 1/2 mile of the proposed blasting site, and providing daily notice in the vicinity prior to any blasting.

(ii) Maintain for a period of at least 3 years and make available for public inspection on request during normal business hours, a log detailing the location of the blasts, the pattern and depth of the drill holes, the amount of explosives used per hole, and the order and length of delay in the blasts.

(iii) Limit the type of explosives and detonating equipment and the size, timing, and frequency of blasts based upon the physical conditions of the site to prevent injury to persons, damage to public and private property outside the permit area, adverse impacts on any underground mine, and change in the course, channel, or availability of ground or surface water outside the permit area.

(iv) Have all blasting operations conducted pursuant to this act conducted by trained and competent individuals certified by the department.

(v) Require the applicant or permittee to conduct a preblasting survey of a structure or dwelling upon the request of a resident or owner of a structure or dwelling within 1/2 mile of the permit area and to submit the survey to the department and a copy of the survey to the resident or owner making the request. The area covered by the survey shall be determined by the department and the survey shall include provisions and shall be conducted pursuant to standards established by rules promulgated by the department.

(p) To ensure that all reclamation efforts proceed in an environmentally sound manner and as contemporaneously as practicable with the surface coal mining operations. However, if the applicant proposes to combine surface mining operations with underground mining operations to assure maximum practical recovery of the coal resources, the department may grant a variance for specific areas within the reclamation plan from the requirement that reclamation efforts proceed as contemporaneously as practicable to permit underground mining operations prior to reclamation if all the following conditions are met:

(i) The department finds in writing that:

(A) The applicant has presented, as part of the permit application, specific, feasible plans for the proposed underground mining operations.

(B) The proposed underground mining operations are necessary or desirable to assure maximum practical recovery of the coal resource and will avoid multiple disturbance of the surface.

(C) The plan for the underground mining operations conforms to requirements for underground mining in the jurisdiction and that permits necessary for the underground mining operations have been issued by the appropriate authority.

(D) The areas proposed for the variance have been shown by the applicant to be necessary for implementing the proposed underground mining operations.

(E) No significant adverse environmental damage, either on site or off site, will result from the delay in completion of reclamation as required by this act.

(F) Provisions for the off site storage of spoil will comply with subdivision (v).

(ii) The department has promulgated specific rules to govern the granting of the variances in accordance with the provisions of this subsection.

- (#) The variance granted will be reviewed annually by the department.
- (iv) The liability under the bond filed by the applicant with the department pursuant to section 502(2) is for the duration of the underground mining operations and until the requirements of sections 401(2) and 501 have been fully complied with.
- (q) To ensure that the construction, maintenance, and postmining conditions of access roads into and across the site of operations will control or prevent erosion, siltation, pollution of water, damage to fish or wildlife or their habitat, or public or private property.
- (r) To refrain from the construction of roads or other access ways up a stream bed or drainage channel or in such proximity to the channel as to significantly alter or degrade the normal flow of water.
- (s) To establish on regraded areas and all other land affected, in cooperation with each soil conservation district affected by the surface coal mining operation, a diverse, effective, and permanent vegetative cover of the same seasonal variety native to the area of land to be affected and capable of self-regeneration and plant succession at least equal in the extent of cover to the natural vegetation of the area. However, introduced species may be used in the revegetation process where desirable and necessary to achieve the approved postmining land use plan.
- (t) To assume the responsibility for successful revegetation as required by subdivision (s) for a period of 5 years after the last year of augmented seeding, fertilizing, irrigation, or other work in order to assure compliance with subdivision (s). However, in those areas or regions of the state where the annual average precipitation is 26 inches or less, the operator's assumption of responsibility and liability will extend for a period of 10 years after the last year of augmented seeding, fertilizing, irrigation, or other work. If the department approves long-term intensive agricultural postmining land use, the applicable 5- or 10-year period of responsibility for revegetation shall commence at the date of initial planting for the long-term intensive agricultural postmining land use, except that if the department issues a written finding approving a long-term intensive agricultural postmining land use as part of the mining and reclamation plan, the department may grant exception to the provisions of subdivision (s).
- (u) To protect off site areas from slides or damage occurring during the surface coal mining and reclamation operations, and not deposit spoil material or locate any part of the operations or waste accumulations outside the permit area.
- (v) To place all excess spoil material resulting from coal surface mining and reclamation activities in such a manner that:
 - (i) Spoil is transported and placed in a controlled manner in position for concurrent compaction and in such a way to assure mass stability and to prevent mass movement.
 - (ii) The areas of disposal are within the bonded permit areas and all organic matter is removed immediately prior to spoil placement.
 - (iii) Appropriate surface and internal drainage systems and diversion ditches are used to prevent spoil erosion and movement.
 - (iv) The disposal area does not contain springs, natural watercourses, or wet weather seeps unless lateral drains are constructed from the wet areas to the main underdrains in such a manner that filtration of the water into the spoil pile will be prevented.
 - (v) If placed on a slope, the spoil is placed on the most moderate slope and is placed, where possible, on or above a natural terrace, bench, or berm, if the placement provides additional stability and prevents mass movement.
 - (vi) If the toe of the spoil rests on a downslope, a rock toe buttress of sufficient size to prevent mass movement is constructed.
 - (vii) The final configuration is compatible with the natural drainage pattern and surroundings and suitable for intended uses.
 - (viii) Design of the spoil disposal area is certified by a qualified registered professional engineer in conformance with professional standards.
 - (ix) All other provisions of this act are met.
- (w) To meet other criteria necessary to achieve reclamation in accordance with the purposes of this act, taking into consideration the physical, climatological, and other characteristics of the site.
- (x) To the extent possible, using the best technology currently available, minimize disturbance and adverse impacts of the operation on fish, wildlife, and related environmental values and, where practicable, to achieve enhancement of those resources.
- (y) To provide for an undisturbed natural barrier to be retained in place as a barrier to slides and erosion beginning at the elevation of the lowest coal seam to be mined and extending from the outslope for the distance the department determines necessary.

ARTICLE 5. BONDING

Sec. 501. (1) An applicant for a permit shall submit to the department, as part of each permit application, a certificate that the applicant has a public liability insurance policy in force for the surface coal mining and reclamation operation for which the permit is sought. The policy shall be maintained in full force and effect during the terms of the permit or any renewal, including all reclamation operations.

(2) The department shall promulgate rules establishing standards for adequate public liability insurance coverage consistent with section 303(2).

Sec. 502. (1) After a surface coal mining and reclamation permit application has been approved, but before the permit is issued, the applicant shall file with the department, on a form prescribed and furnished by the department, a bond for performance payable to the state of Michigan and conditioned on faithful performance of all requirements of this act and the permit. The bond shall cover that area of land within the permit area on which the applicant will initiate and conduct surface coal mining and reclamation operations within the initial term of the permit. Before succeeding increments of surface coal mining and reclamation operations are initiated and conducted within the permit area the permittee shall provide an additional bond or bonds to cover those increments. The amount of the bond required for each bonded area shall reflect the reclamation requirements of the approved permit and the probable difficulty of the reclamation giving consideration to such factors as topography, geology of the site, hydrology, and revegetation potential; and shall be determined by the department. The amount of the bond shall be sufficient to assure the completion of the reclamation plan if the reclamation had to be performed by the department in the event of forfeiture and the bond for the entire area under 1 permit shall not be less than \$10,000.00.

(2) Liability under the bond shall be for the duration of the surface coal mining and reclamation operation and for a period coincident with applicant's responsibility for revegetation. Except as provided in subsection (3), the bond shall be executed by the applicant and a corporate surety licensed to do business in this state.

(3) The applicant may elect to deposit cash or the following types of assets as security for the performance of the applicant's obligation under the bond:

(a) Obligations or securities of, or fully guaranteed as to principal and interest by, the United States or any of the agencies of the United States, or for which the full faith and credit of the United States is pledged to provide for the payment of principal and interest.

(b) Obligations of a state of the United States, or an agency or authority of a state for which the full faith and credit of the state is pledged to provide payment of principal and interest.

(c) Obligations of this state or an agency or authority of this state for which specific revenues are pledged to provide payment of principal and interest.

(d) Negotiable certificates of deposit of a state or national bank.

The cash deposit or market value of the assets shall be equal to or greater than the amount of the bond required for the bonded area.

(4) The department may accept the bond of the applicant without separate surety if the applicant demonstrates to the satisfaction of the department the existence of a suitable agent to receive service of process, and a history of financial solvency, and continuous operation sufficient for authorization to bond such amount.

(5) The amount of the bond or deposit required and the terms of each acceptance of the applicant's bond shall be adjusted by the department from time to time as affected land acreages are increased or decreased or where the cost of future reclamation changes.

(6) The department shall promulgate rules establishing standards for adequate bond coverage consistent with this section.

Sec. 503. (1) The permittee may file a request with the department for the release of all or part of a performance bond or deposit. Within 30 days after submission of an application for bond or deposit release to the department, the permittee shall submit a copy of the notice to be published by the department for 4 consecutive weeks in a newspaper of general circulation in the locality of the surface coal mining operation. The notice shall be considered part of the bond release application and shall contain a notification of the precise location of the land affected, the number of acres, the permit and the date approved, the amount of the bond filed and the portion sought to be released, the type and appropriate dates of reclamation work performed, and a description of the results achieved as they relate to the permittee's reclamation plan. In addition, as part of any bond release application, the applicant shall submit copies of letters which the applicant has sent to adjacent property owners and local units of government notifying them of the application to seek release from the bond.

(2) Within 30 days after the applicant complies with subsection (1), the department shall conduct an inspection and evaluation of the reclamation work involved. The evaluation shall consider, among other things, the degree of difficulty to complete any remaining reclamation, whether pollution of surface and subsurface water is occurring, the probability of continuance of future occurrence of the pollution, and the estimated cost of abating the pollution. The department shall notify the permittee, in writing, of its decision to release or not to release all or part of the performance bond or deposit based on the criteria in subsection (3) within 60 days from the filing of the request, if no public hearing is held, and if there has been a public hearing, within 30 days after the hearing.

(3) The department may release the bond or deposit in whole or in part if the reclamation covered by the bond or deposit or portion of the reclamation has been accomplished as required by this act according to the following schedule:

(a) If the permittee completes the backfilling, regrading, and drainage control of a bonded area in accordance with the reclamation plan, the release of 60% of the bond or collateral for the applicable permit area.

(b) If revegetation has been established on the regraded mined lands in accordance with the reclamation plan, the department may release an additional portion of the bond or deposit. In determining the amount of the bond or deposit to be released after successful revegetation has been established, the department shall retain the amount of the bond or deposit that is sufficient for a third party to establish revegetation and for the period specified for permittee responsibility in section 401(2)(t). No part of the bond or deposit shall be released under this subdivision if the land to which the release would be applicable is contributing suspended solids to streamflow or runoff outside the permit area in excess of the requirements of section 401(2)(j) or until soil productivity for agricultural land has returned to equivalent levels of yield as nonmined land of the same soil type in the surrounding area under equivalent management practices as determined from the soil survey performed pursuant to section 303(1)(n). If a silt dam is to be retained as a permanent impoundment pursuant to section 401(2)(h), the portion of bond may be released under this subdivision if provisions for sound future maintenance have been made with the department.

(c) If the permittee has successfully completed all surface coal mining and reclamation activities, the release of the remaining portion of the bond, but not before the expiration of the period specified for permittee responsibility in section 401(2)(t). However, at least 25% of the bond or deposit shall be retained by the department until all reclamation requirements of this act are fully met.

(4) If the department disapproves the application for release of the bond or deposit or a portion of the bond or deposit, it shall notify the permittee, in writing, stating the reasons for disapproval and recommending corrective actions necessary to secure the release and allowing opportunity for a public hearing.

(5) When an application for total or partial bond or deposit release is filed with the department, the department shall notify the county clerk of each county in which the surface coal mining operation is located by certified mail within 10 days after the application for the release of all or a portion of the bond or deposit is filed.

(6) A person with a legal interest or other interest that might be adversely affected by release of the bond or deposit or a federal or state agency or local unit of government shall be entitled to file written objections to the proposed release from bond or deposit with the department within 30 days after the last publication of the notice provided in subsection (1). If written objections are filed, the department shall conduct a public hearing on the objections and inform all the interested parties of the time and place of the hearing and hold the hearing in the locality of the surface coal mining operation within 30 days. Notice of the date, time, and location of the public hearings shall be published by the department in a newspaper of general circulation in the locality for 2 consecutive weeks.

Sec. 504. (1) Coal exploration operations that significantly disturb the natural land surface shall be conducted in accordance with rules promulgated by the department. The rules shall include, at a minimum, the requirement that prior to conducting the exploration a person must file with the department notice of intent to explore. The notice of the intent to explore shall include a description of the exploration area; the period of proposed exploration; provisions for reclamation in accordance with the performance standards in section 401 of all lands disturbed in exploration, including excavations, roads, and drill holes; and the removal of necessary facilities and equipment.

(2) A person who conducts any coal exploration operations that substantially disturb the natural land surface in violation of this section or the rules promulgated pursuant to this section shall be subject to the penalties provided in section 801.

(3) An operator shall not remove more than 250 tons of coal pursuant to an exploration permit without the specific written approval of the department.

ARTICLE 6. UNDERGROUND MINING

Sec. 601. The department shall promulgate rules applicable to the surface effects of underground mining that are consistent with the requirements of the surface mining control and reclamation act of 1977, Public Law 95-87, 91 Stat. 445, and regulations adopted pursuant to that act by the secretary of interior of the United States relative to coal mining.

Sec. 602. (1) A permit issued pursuant to this act relating to underground coal mining shall require the operator to do all of the following:

(a) Adopt measures consistent with technology currently available in order to prevent subsidence causing material damage to the extent technologically and economically feasible; maximize mine stability; and maintain the value and reasonably foreseeable use of such surface lands, except in those instances where the mining technology used requires planned subsidence in a predictable and controlled manner. This subsection shall not be construed to prohibit the standard method of room and pillar mining.

(b) Seal all portals, entryways, drifts, shafts, or other openings between the surface and underground mine working when no longer needed for the conduct of the mining operations.

(c) Fill or seal exploratory holes no longer necessary for mining, maximizing to the extent technologically and economically feasible return of mine and processing waste, tailings, and any other waste incident to the mining operation, to the mine workings or excavations.

(d) With respect to surface disposal of mine wastes, tailings, coal processing wastes, and other wastes in areas other than the mine workings or excavations, stabilize all waste piles created by the permittee from current operations through construction in compacted layers including the use of incombustible and impervious materials if necessary; assure that the leachate will not degrade below water quality standards established pursuant to applicable federal and state law surface or groundwaters; and assure that the final contour of the waste accumulation will be compatible with natural surroundings and that the site is stabilized and revegetated according to the provisions of this section.

(e) Design, locate, construct, operate, maintain, enlarge, modify, and remove, or abandon all existing and new coal mine waste piles consisting of mine wastes, tailings, coal processing wastes, or other liquid and solid wastes and used either temporarily or permanently as dams or embankments.

(f) Establish on regraded areas and all other lands affected, a diverse and permanent vegetative cover capable of self-regeneration and plant succession and at least equal in extent of cover to the natural vegetation of the area.

(g) Protect off site areas from damages which may result from underground mining operations.

(h) Eliminate fire hazards and eliminate conditions which constitute a hazard to health and safety of the public.

(i) Minimize the disturbances of the prevailing hydrologic balance at the mine site and in associated off site areas and to the quantity of water in surface groundwater systems both during and after coal mining operations and during reclamation by meeting both of the following requirements:

(i) Avoiding acid or other toxic mine drainage by such measures as:

(A) Preventing or removing water from contact with toxic producing deposits.

(B) Treating drainage to reduce toxic content which adversely affects downstream water upon being released to watercourses.

(C) Casing, sealing, or otherwise managing boreholes, shafts, and wells to keep acid or other toxic drainage from entering surface and groundwaters.

(ii) Conducting surface coal mining operations so as to prevent, to the extent possible using technology currently available, additional contributions of suspended solids to streamflow or runoff outside the permit area, but in no event shall such contributions be in excess of requirements set by applicable state or federal law; and avoiding channel deepening or enlargement in operations requiring the discharge of water from mines.

(j) With respect to other surface impacts not specified in this subsection, including the construction of new roads or the improvement or use of existing roads to gain access to the site of such activities and for haulage, repair areas, storage areas, processing areas, shipping areas, and other areas upon which are sited structures, facilities, or other property or materials on the surface, resulting from or incident to such activities, operate in accordance with the standards established under section 401 for those effects which result from surface coal mining operations, except that the department shall make modifications in the requirements imposed by this subparagraph as are necessary to accommodate the distinct difference between surface and underground coal mining.

(k) To the extent possible using technology currently available, minimize disturbances and adverse impacts of the operation on fish, wildlife, and related environmental values, and achieve enhancement of those resources where practicable.

(l) Locate openings for all new drift mines working acid-producing or iron-producing coal seams in such a manner as to prevent a gravity discharge of water from the mine.

(2) To protect the stability of the land, the department shall suspend underground coal mining under urbanized areas, cities, towns, and communities and adjacent to industrial or commercial buildings, major impoundments, or permanent streams if the department finds imminent danger to inhabitants of the urbanized areas, cities, towns, and communities.

(3) Articles 3, 4, 5, 7, and 8 shall be applicable to surface operations and surface impacts incident to an underground coal mine with such modifications to the permit application requirements, permit approval or denial procedures, and bond requirements as are necessary to accommodate the distinct difference between surface and underground coal mining. The department shall promulgate rules to make those modifications.

ARTICLE 7. INSPECTIONS AND MONITORING

Sec. 701. (1) The department shall conduct inspections and require monitoring and reporting of surface coal mining and reclamation operations, and shall take all actions necessary to administer, enforce, and evaluate the administration of this act and to meet the state program requirements of the surface mining control and reclamation act of 1977, Public Law 95-87, 91 Stat. 445, and for those purposes, the department or an authorized representative of the department shall, without advance notice and on presentation of appropriate credentials, have a right of entry to any surface coal mining and reclamation operation or any premises in which any records required to be maintained are located, and may at reasonable times, without delay, have access to and copy any records and inspect any monitoring equipment and method of operation required under this act or the rules promulgated pursuant to this act.

(2) Each inspector, on detection of each alleged violation of any requirement of this act, shall give written notice to the operator of the violation and shall report the violation, in writing, to the department. The notice of violation shall include a warning that the violation may result in a fine or penalty under article 8.

(3) If a surface coal mining and reclamation operation removes or disturbs strata that serves as an aquifer which significantly ensures the hydrologic balance of water use either on or off the mining site, the department shall specify:

(a) Monitoring sites to record the quantity and quality of surface drainage above and below the mine site as well as in the potential zone of influence.

(b) Monitoring sites to record level, amount, and samples of groundwater and aquifers which are affected or potentially affected by the mining and also directly below the lowermost, deepest coal seam to be mined.

(c) Records of well logs and boreholes data to be maintained.

(d) Monitoring sites to record precipitation.

(4) The department shall promulgate rules that provide for informing the operator of an alleged violation detected by an inspector and for making public all inspection and monitoring reports and other records and reports required to be kept pursuant to this act and the rules promulgated pursuant to this act.

(5) Inspections by the department shall comply with all the following requirements:

(a) Occur on an irregular basis averaging not less than 1 partial inspection per month and 1 complete inspection per calendar quarter for the surface coal mining and reclamation operation covered by each permit.

(b) Occur without prior notice to the permittee or agents or employees of the permittee except for necessary on-site meetings with the permittee.

(c) Include the filing of inspection reports adequate to enforce the requirements of and to carry out the terms and purposes of this act.

Sec. 702. Each permittee shall conspicuously maintain at the entrances or visible areas of access to the surface coal mining and reclamation operations a clearly visible sign which sets forth the name, business address, and phone number of the permittee and the permit number of the surface coal mining and reclamation operations.

Sec. 703. Copies of any records, reports, inspection materials, or information obtained under this article by the department shall be made available to the public with the county clerk of each county in the area of mining within 10 days after they are received by the department so that they are conveniently available to residents in the areas of mining.

ARTICLE 8. FINES AND PENALTIES

Sec. 801. (1) The department may impose a civil fine against a permittee or other person who violates a permit condition or a provision of this act. If the department issues a cease and desist order with respect to a violation, a civil fine must be assessed. A civil fine shall not exceed \$5,000.00 for each violation, except that each day a violation continues may be deemed a separate violation. In determining the amount of the civil fine, the department shall consider the permittee's history of previous violations at the particular surface coal mining operation; the seriousness of the violation, including any pollution, impairment, or destruction to the environment and any hazard to the health or safety of the public; whether the permittee or person was indifferent, or lacked diligence or reasonable care; and the demonstrated good faith of the permittee or person charged in attempting to achieve compliance after notification of the violation.

(2) A civil fine shall be assessed only after the person charged with a violation described under subsection (1) has been given an opportunity for a public hearing. A hearing conducted under this section shall be conducted pursuant to the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.201 to 24.315 of the Michigan Compiled Laws.

(3) The department shall inform the permittee and any other person charged within 30 days after the issuance of a notice or order charging that a violation of the act has occurred of the proposed amount of the civil fine. The person charged with the penalty shall then have 30 days to pay the proposed fine in full or, if the person wishes to contest either the amount of the fine or the fact of the violation, forward the proposed amount to the department for placement in an escrow account. If, through administrative or judicial review of the proposed fine, it is determined that no violation occurred or that the amount of the fine should be reduced, the department shall, within 30 days, remit the appropriate amount to the person with interest at 12% per year. Failure to forward the money to the department within 30 days after the issuance of the notice or order shall result in a waiver of all legal rights to contest the violation or the amount of the fine.

(4) A civil fine imposed under this act may be recovered in a civil action brought by the attorney general at the request of the department.

(5) A person who wilfully and knowingly violates a condition of a permit issued pursuant to this act or fails or refuses to comply with an order issued under this act, or an order incorporated in a final decision issued by the department under this act, except an order incorporated in a decision issued under subsection (2) or section 805, shall be punished by a fine of not more than \$10,000.00, or by imprisonment for not more than 1 year, or both.

(6) A permittee or person who fails to correct a violation for which a notice or order has been issued under subsection (1) within the period permitted for its correction, which period shall not end until the entry of a final order by the department, in the case of any review proceedings initiated by the permittee in which the department orders the suspension of the abatement requirements of the notice or order after determining that the permittee will suffer irreparable loss or damage from the application of those requirements, or until the entry of an order of the court, in the case of any review proceedings initiated by the permittee in which the court orders the suspension of an abatement requirement of the citation, shall be assessed a civil fine of not less than \$750.00 for each day during which the failure or violation continues.

(7) If a corporate permittee or person violates a condition of a permit issued pursuant to a state program under section 311 or fails or refuses to comply with any order issued under section 803, or any order incorporated in a final decision issued by the department under this act, except an order incorporated in a decision issued under subsection (2), then a director, officer, or agent of the corporation who wilfully and knowingly authorized, ordered, or carried out the violation, failure, or refusal shall be subject to the same civil fines and imprisonment that may be imposed on a person under subsections (1) and (5).

(8) A person who knowingly makes a false statement, representation, or certification, or who knowingly fails to make a statement, representation, or certification in an application, record, report, or other document filed or required to be maintained pursuant to a state program or this act or any order of decision issued by the department under this act, shall be punished by a fine of not more than \$10,000.00, or by imprisonment for not more than 1 year, or both.

Sec. 802. (1) Except as provided in subsections (2) and (3), a person having an interest that is or may be adversely affected by an operation not in compliance with a permit or this act may commence a civil action in circuit court or federal district court, whichever has jurisdiction, on his or her own behalf to compel compliance against:

(a) The department or other state agency where there is alleged a failure of the department or other state agency to perform any act or duty under this act that is not discretionary with the department or other state regulatory authority.

(b) Any governmental instrumentality or agency of the United States that is alleged to be in violation of the provisions of this act or of any rule, order, or permit issued pursuant to this act or any other person who is alleged to be in violation of any rule, order, or permit issued pursuant to this act.

(2) An action shall not be commenced under subsection (1)(a) until 20 days after the person intending to bring the action has given notice in writing of the intent to commence a civil action to the department or other state regulatory authority in the manner as the department shall by rule prescribe, except that the action may be brought immediately after the notification if the violation or order complained of constitutes an imminent threat to the health or safety of the plaintiff or would immediately affect a legal interest of the plaintiff.

(3) An action shall not be commenced under subsection (1)(b) until 20 days after the person intending to bring the action has given notice in writing of the violation to the department and to any alleged violator; however, if this state has commenced and is diligently prosecuting a civil action in a court of this state or the United States to require compliance with the provisions of this act, or any rule, order, or permit issued pursuant to this act, an action shall not be commenced pursuant to subsection (1)(b). In a civil action brought under this section, the department or federal regulatory agency, if not a party, may intervene as a matter of right.

(4) The circuit court, in an action brought pursuant to this section, may award costs of litigation, including attorney and expert witness fees to a party. The court may, if a temporary restraining order or preliminary injunction is sought, require the filing of a bond or equivalent security.

(5) This section shall not be construed to restrict any right that a person or class of persons has under any statute or common law to seek enforcement of the provisions of this act and the rules promulgated under this act, or to seek any other relief, including relief against the department.

Sec. 803. (1) If the department determines, on the basis of an inspection, that a condition exists or practices exist or that a person or permittee is in violation of a requirement of this act or a permit condition required by this act and that this condition, practice, or violation also creates an imminent danger to the health or safety of the public or is causing or can reasonably be expected to cause pollution, impairment, or destruction to land, air, or water resources, the department shall immediately order a cessation of surface coal mining operations or the portion of surface coal mining operations relevant to the condition, practice, or violation. The cessation order shall remain in effect until the department determines that the condition, practice, or violation has been abated, or until modified, vacated, or terminated by the department pursuant to subsection (8). If the department finds that the ordered cessation of surface coal mining and reclamation operations, or any portion of those operations, will not completely abate the imminent danger to health or safety of the public or the pollution, impairment, or destruction to land, air, or water resources, the department shall, in addition to the cessation order, impose affirmative obligations on the operator requiring the operator to take those actions the department considers necessary to abate the imminent danger or the pollution, impairment, or destruction.

(2) If the department determines, on the basis of an inspection, that a permittee is in violation of a requirement of this act or a permit condition required by this act, but the violation does not create an imminent danger to the health or safety of the public or is not causing or reasonably expected to cause pollution, impairment, or destruction to land, air, or water resources the department shall issue a notice to the permittee setting a reasonable time not to exceed 90 days for the abatement of the violation. If, on expiration of the period of time as originally set or subsequently extended for good cause shown, and on written finding of the department, the department finds that the violation has not been abated, it shall immediately order a cessation of surface coal mining operations or the portion of surface coal mining operations relevant to the violation. The cessation order shall remain in effect until the department determines that the violation has been abated or until modified, vacated, or terminated by the department under subsection (9). In the order of cessation issued by the department under this subsection, the department shall specify the steps necessary to abate the violation in the most expeditious manner possible, and shall include the necessary measures in the order.

(3) A permittee issued notice or order by the department pursuant to subsections (1) and (2) or any person having an interest which is or may be adversely affected by the notice or order or by any modification, vacation, or termination of the notice or order, may apply to the department for review of the notice or order within 30 days of issuance of the notice or order or within 30 days of its modification, vacation, or termination. On receipt of the application, the department shall conduct an investigation. The investigation shall provide an opportunity for a public hearing, at the request of the applicant or the person having an interest which is or may be adversely affected, to enable the applicant or the person to present

information relating to the issuance and continuance of the notice or order or the modification, vacation, or termination of the notice or order. The filing of an application for review under this subsection shall not operate as a stay of any order or notice. A hearing conducted under this subsection shall be conducted pursuant to chapter 4 of the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.271 to 24.287 of the Michigan Compiled Laws.

(4) On receiving the report of the investigation, the department shall make findings of fact and shall issue a written decision incorporating in the decision an order vacating, affirming, modifying, or terminating the notice or order or the modification, vacation, or termination of the notice or order complained of and incorporate its findings therein. Where the application for review concerns an order for cessation of surface coal mining and reclamation operations issued pursuant to subsection (1) or (2), the department shall issue the written decision within 30 days of the receipt of the application for review unless temporary relief has been granted by the department under subsection (5).

(5) Pending completion of the investigation and hearing required by this section, the applicant may file with the department a written request that the department grant temporary relief from any notice or order issued under this section, together with a detailed statement giving reasons for granting the relief. The department shall issue an order or decision granting or denying the relief, except that if the applicant requests relief from an order for cessation of coal mining and reclamation operations issued under subsection (3) or (4), the order or decision on the request shall be issued within 5 days of its receipt. The department may grant the relief, under conditions it may prescribe, if all of the following requirements are met:

(a) A hearing has been held in the locality of the permit area on the request for temporary relief in which interested parties were given an opportunity to be heard.

(b) The applicant shows that there is a substantial likelihood that the findings of the department will be favorable to the applicant.

(c) The relief will not adversely affect the health or safety of the public or cause significant, imminent environmental harm to land, air, or water resources.

(6) Following the issuance of an order to show cause as to why a permit should not be suspended or revoked under this section, the department shall hold a public hearing after giving written notice of the time, place, and date of the hearing. The hearing shall be conducted pursuant to chapters 4 and 5 of the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.171 to 24.292 of the Michigan Compiled Laws. If the department revokes the permit, the permittee shall immediately cease surface coal mining operations on the permit area and shall complete reclamation within a period specified by the department, or the department shall declare as forfeited the performance bonds for the operation.

(7) If an order is issued under this section, or as a result of any administrative proceeding under this act, at the request of any person, a sum equal to the aggregate amount of all costs and expenses, including attorney fees, as determined by the department to have been reasonably incurred by the person for or in connection with his participation in the proceedings, may be assessed against either party as the department considers proper, or as the court, for costs and attorneys' fees resulting from judicial review, considers proper.

(8) If the department has reason to believe, on the basis of an inspection, that a pattern of violations of any requirements of this act or any permit conditions required by this act exists or has existed, and if the department or its authorized representative also finds that these violations are caused by the unwarranted failure of the permittee to comply with requirements of this act or any permit conditions, or that the violations are wilfully caused by the permittee, the department shall issue an order to the permittee to show cause as to why the permit should not be suspended or revoked. The order shall set a time and place for a public hearing, to be conducted pursuant to chapters 4 and 5 of the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, and the department shall inform all interested parties of the hearing. If the permittee fails to show cause why the permit should not be suspended or revoked, the department shall promptly suspend or revoke the permit.

(9) Notices and orders issued pursuant to this section shall set forth with reasonable specificity the nature of the violation and the remedial action required, the period of time established for abatement, and a reasonable description of the portion of the surface coal mining and reclamation operation to which the notice or order applies. Each notice or order issued under this section shall be given promptly to the permittee or an agent of the permittee by the department. A notice or order issued pursuant to this section may be modified, vacated, or terminated by the department. A notice or order issued pursuant to this section that requires cessation of mining by the operator shall expire within 30 days of actual notice to the operator unless a public hearing is held at the site or within a reasonable proximity to the site so that any viewings of the site can be conducted during the course of the public hearing.

(10) The department may request the attorney general to institute a civil action for relief, including a permanent or temporary injunction, restraining order, or other appropriate order, if the permittee does any of the following:

- (a) Violates or fails or refuses to comply with an order or decision issued by the department under this act.
 - (b) Interferes with, hinders, or delays the department or its authorized representative in carrying out the provisions of this section.
 - (c) Refuses to admit to the mine an authorized representative of the department, if the authorized representative presented the documents required by this act for proper entry.
 - (d) Refuses to permit inspection of the mine by an authorized representative of the department, if the authorized representative presented the documents required by this act for proper entry.
 - (e) Refuses to furnish information or a report requested by the department under the department's rules.
 - (f) Refuses to permit access to and copying of records the department determines reasonably necessary to carry out this act.
- (11) All notices or orders required by this article shall be sent by certified mail, return receipt requested.

Sec. 804. An employee of the department performing any function or duty under this act shall not have a direct or indirect financial interest in an underground or surface coal mining operation. A person who knowingly violates the provisions of this subsection shall, on conviction, be punished by a fine of not more than \$2,500.00, or by imprisonment of not more than 1 year, or both.

Sec. 805. Except as permitted by a law of this state or the United States, a person shall not wilfully resist, prevent, impede, or interfere with the department or any of its agents in the performance of duties pursuant to this act. A person who violates this section shall be punished by a fine of not more than \$5,000.00 or by imprisonment for not more than 1 year, or both.

ARTICLE 9. INSPECTION AND RECLAMATION FEE

Sec. 901. (1) For the purposes of inspections and monitoring, and the administration and enforcement of this act, an operator is assessed an inspection and reclamation fee of not more than 25 cents per ton of coal mined, as determined by the department. The department shall establish, by rule, criteria for determining the amount of the inspection and reclamation fee. In making the determination of the amount of the inspection and reclamation fee, the department shall take into account funds made available to the department pursuant to the surface mining control and reclamation act of 1977, Public Law 95-87, and funds from any other source for the purposes specified in this subsection. The total inspection and reclamation fees assessed annually shall not exceed the total amount appropriated to the department for the purposes specified in this subsection.

(2) An operator shall file quarterly reports with the department on a calendar year basis. The report shall include all of the following:

- (a) The location of the mining operation and the areas mined during the quarter.
 - (b) A description of the progress of restoration and reclamation activities of the operator for the preceding quarter.
 - (c) The number of tons of coal mined during the quarter.
- (3) Based on the information reported pursuant to subsection (2)(c), the department shall send the operator written notice of the amount of the fee due for the quarter. The operator shall pay the fee to the department within 30 days after receipt of the notice.
- (4) The department shall deposit the inspection and reclamation fee in the state abandoned mine reclamation fund created by section 202.

Sec. 902 (1) Failure to submit a quarterly report shall constitute grounds for revocation of a permit. An action taken by the department under this subsection shall be conducted pursuant to chapters 4 and 5 of the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.271 to 24.292 of the Michigan Compiled Laws.

(2) A penalty equal to 12% of the amount due, or \$1,000.00, whichever is greater, shall be assessed against the operator for a fee not properly or promptly paid pursuant to section 901. An unpaid fee and penalty shall constitute a debt and become the basis of a civil action against the operator to compel the payment of the debt.

(3) The inspection and reclamation fee and quarterly reports required by this article shall be confidential and shall not be subject to the disclosure requirements of the freedom of information act, Act No. 442 of the Public Acts of 1976, being sections 15.231 to 15.246 of the Michigan Compiled Laws, except that disclosure may be made with the written consent of the operator filing the fee and report or pursuant to a court order.

Sec. 903. Any person, corporate officer, agent, or director, on behalf of an operator, who knowingly makes any false statement, representation, or certification, or knowingly fails to make any statement, representation or certification regarding a report required in this article shall be punished by a fine of not more than \$10,000.00, or by imprisonment for not more than 1 year, or both.

ARTICLE 10. MISCELLANEOUS PROVISIONS

Sec. 1001. (1) The department shall promulgate rules establishing a process for designating areas unsuitable for surface coal mining. The rules shall include all of the following:

- (a) Surface coal mining land review.
- (b) Development of a data base and an inventory system which will permit proper evaluation of the capacity of different land areas of the state to support and permit reclamation of surface coal mining operations.
- (c) Development, by rule, of a method for implementing land use planning decisions concerning surface coal mining operations.
- (d) Development, by rule, of proper notice provisions and opportunity for public participation, including a public hearing, prior to making any designation or redesignation pursuant to this section.
- (e) Procedures for determining whether an area proposed for surface coal mining contains historic resources. These rules shall be developed with the concurrence of the department of state.
- (2) On a petition submitted pursuant to subsection (3), the department shall designate an area as unsuitable for all or certain types of surface coal mining operations if the department determines that reclamation pursuant to the requirements of this act is not technologically and economically feasible. A surface area may be designated unsuitable for certain types of surface coal mining operations if those operations cause any of the following:
 - (a) Incompatibility with existing state or local land use plans or programs.
 - (b) Affect fragile land or historic resources resulting in significant damage to important historic, cultural, scientific, and esthetic values and natural systems.
 - (c) Affect renewable resource land, including aquifers and aquifer recharge areas, resulting in a substantial loss or reduction of long-range productivity of water supply or of food or fiber products.
 - (d) Affect natural hazard land, including areas subject to frequent flooding and areas of unstable geology, substantially endangering life and property.
 - (e) Affect agricultural land by diminishing the productivity of the land after reclamation to less than the productivity before the site was mined.
 - (f) Adversely affect an agricultural operation, including planting, harvesting, transportation, processing, or other activity included in the agricultural impact statement required by section 303(1)(s).

Determinations of the unsuitability of land for surface coal mining shall be integrated with present and future land use planning and regulation processes at the federal, state, and local levels. The requirements of this section shall not apply to land on which surface coal mining operations were being conducted on August 3, 1977, or under a permit issued pursuant to this act, or where substantial legal and financial commitments in the operation or proposed operation were in existence prior to January 4, 1977.

(3) A person having an interest that is or may be adversely affected shall have the right to petition the department to have an area designated as unsuitable for surface coal mining operations or to have that designation terminated. The petition shall contain allegations of facts with supporting evidence. Within 30 days after receipt of the petition the department shall hold a public hearing in the locality of the affected area. After a person having an interest that is or may be adversely affected has filed a petition and before the hearing, any person may intervene by filing allegations of facts with supporting evidence that would tend to establish the allegations. Within 60 days after the hearing, the department shall issue and furnish to the petitioner and any other party to the hearing a written decision with reasons for the decision. In the event that all the parties stipulate agreement prior to the requested hearing and withdraw their request, the hearing need not be held.

(4) Before designating land areas as unsuitable for surface coal mining operations, the department shall prepare a detailed statement on the potential coal resources of the area, the demand for coal resources, and the impact of the designation on the environment, the economy, and the supply of coal.

(5) After the effective date of this act and subject to valid existing rights, surface coal mining operations, except those that existed on August 3, 1977, shall not be permitted that do any of the following:

(a) Adversely affect a publicly owned park or historic resource unless approved jointly by the department and the federal, state, or local agency with jurisdiction over the park or historic resource and by the department of state.

(b) Are within 100 feet of the outside right of way line of a public road, except where mine access roads or haulage roads join the right of way lines and except that the department may permit these roads to be relocated or the area affected to lie within 100 feet of the public road, if, after public notice and opportunity for public hearing in the locality, a written finding is made that the interests of the public and the landowners affected by the relocation will be protected.

(c) Are within 300 feet of an occupied dwelling, unless waived by the owner of the dwelling, or within 300 feet of any public building, school, church, community, or institutional building, public park, or within 300 feet of a cemetery.

(6) The department shall designate areas protected by the wilderness and natural areas act of 1972, Act No. 241 of the Public Acts of 1972, being sections 322.751 to 322.763 of the Michigan Compiled Laws, as unsuitable for surface coal mining.

Sec. 1002. An agency, unit, or instrumentality of federal, state, or local government, including any publicly owned utility or publicly owned corporation of federal, state, or local government, that proposes to engage in surface coal mining operations that are subject to the requirements of this act shall comply with all provisions of this act.

Sec. 1003. The provisions of this act shall not apply to any of the following activities:

(a) The extraction of coal as an incidental part of federal, state, or local government financed highway or other construction under rules established by the department.

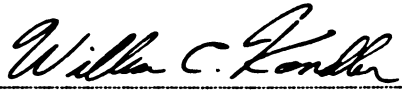
(b) The extraction of coal incidental to the extraction of other minerals where the amount of coal does not exceed 50 tons or $16\frac{2}{3}\%$ of the total tonnage of other minerals removed annually for purposes of commercial use or sale, whichever is less.

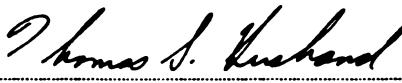
Sec. 1004. To encourage advances in mining and reclamation practices and to allow postmining land use for industrial, commercial, residential, or public use, including recreational facilities, the department may, with approval by the secretary of the United States department of the interior, authorize departures in individual cases and on an experimental basis from the environmental protection performance standards of this act. These departures may be authorized if the experimental practices are potentially at least as environmentally protective, during and after mining operations, as those required by this act; the mining operations approved for particular land use or other purposes are not larger or more numerous than necessary to determine the effectiveness and economic feasibility of the experimental practices; and the experimental practices do not reduce the protection afforded public health and safety below that provided by this act.

Sec. 1005. (1) This act shall not be construed as affecting the right of any person to enforce or protect, under applicable law, his or her interest in water or any other natural resource affected by a surface coal mining operation.

(2) The operator of a surface coal mining operation shall replace the water supply of an owner of an interest in real property who obtains all or part of his or her supply of water for domestic, agricultural, industrial, or other legitimate use from an underground or surface source where the supply has been affected by contamination, diminution, or interruption proximately resulting from the surface coal mine operation.

This act is ordered to take immediate effect.


Secretary of the Senate.


Clerk of the House of Representatives.

Approved

.....
Governor.

APPENDIX B

**MAP - MICHIGAN COAL BASIN
(See back cover pocket)**

BIBLIOGRAPHY

BIBLIOGRAPHY

- Anderson, Fredrick R., et al. Environmental Improvement Through Economic Incentives. Baltimore: Johns Hopkins University Press, 1977.
- Arnold, Chester A. "Michigan Coal Basin," Our Rock Riches. Lansing: Michigan Geological Survey, pp. 101-104, 1964.
- Arrow, Kenneth. "Public and Private Values," Human Values and Economic Policy, A Symposium. S. Hook, ed., New York: New York University Press, 1967.
- Barlowe, Raleigh, Land Resource Economics, The Economics of Real Estate. 3rd Edition. New Jersey: Prentice-Hall, Inc., 1978.
- Barnett, Harold J. and Chandler Morse. Scarcity and Growth: The Economics of Natural Resource Scarcity. Baltimore: Johns Hopkins University Press, 1963.
- Bishop, Richard C. "Endangered Species and Uncertainty: The Economics of a Safe Minimum Standard." American Journal of Agricultural Economics, Feb. 1978, pp. 10-18.
- _____. "Endangered Species, Irreversibility and Uncertainty: A Reply." American Journal of Agricultural Economics, pp. 376-379, May, 1979.
- Brewczak, Nancy L., "Scraping Up Michigan's Coal." State News, East Lansing, Michigan, 15 Oct. 1982, p. 5.
- Brooks, David B. "Strip Mine Reclamation and Economic Analysis." Natural Resources Journal, vol. 6, no. 1, pp. 13-44, January, 1966.
- Brown, Gardner M. and Barry Field. "The Adequacy of Measures for Signaling the Scarcity of Natural Resources," Scarcity and Growth Reconsidered. V. Kerry Smith, ed., Baltimore: Johns Hopkins University Press, 1979.
- Brown, L. H., and M. P. Kelsey. Business Analysis Summary for Cash Grain Farms, 1982 Telefarm Data. Agricultural Economics Report, no. 434, East Lansing: Michigan State University Department of Agricultural Economics, 1983.
- _____. Business Analysis Summary for Saginaw Valley Cash Crop Farms, 1982 Telefarm Data. Agricultural Economics Report, no. 435, East Lansing: Michigan State University Department of Agricultural Economics, 1983.

Bur

Cap

Ca

Co

C

C

C

C

C

G

- Burchell, R. W. and D. Listokin. The Fiscal Impact Handbook. New Jersey: The Center for Urban Policy Research, 1978.
- Capehart, Barry L., et al. "Coal Transportation," Coal Burning Issues, A.E.S. Green, ed., Gainesville: University Presses of Florida, 1980.
- Carter, Ralph P., et al. Surface Mined Land in the Midwest: A Regional Perspective for Reclamation Planning. Argonne National Laboratory, 1974.
- Cochran, Mark, et al. An Evaluation of P.A. 116: Michigan's Farmland and Open Space Preservation Program. East Lansing, Michigan State University: Center for Rural Manpower and Public Affairs, no. 42, 1977.
- Cohee, George V. Coal Resources of Michigan. U.S. Geological Survey Circular, no. 77, Washington: U.S. Government Printing Office, 1950.
- Common, Michael. "Comment on the Papers by Robinson, and Surrey and Page," The Economics of Natural Resource Depletion. D. W. Pearce and J. Rose, eds., New York: John Wiley and Sons, pp. 74-80, 1975.
- Congressional Research Service. National Energy Transportation, Vol. 1, Systems and Movements. Washington: U.S. Government Printing Office, 1977.
- Cook, Earl. "Limits to the Exploitation of Non-Renewable Resources." Science, vol. 191, pp. 677-682, 20 Feb. 1976.
- Cummings, Ronald G. and Oscar R. Burt. "The Economics of Production from Natural Resources: Note." The American Economic Review, vol. LIX, no. 5, pp. 985-990, December, 1969.
- Dorr, John A. and Donald F. Eschman. Geology of Michigan. Ann Arbor: University of Michigan Press, 1970.
- Fisher, Anthony C. Resource and Environmental Economics. Cambridge: Cambridge University Press, 1981.
- Freeman, A. Myrick. The Benefits of Environmental Improvement: Theory and Practice. Baltimore: Johns Hopkins University Press, 1979.
- Fung, R., ed. Surface Coal Mining Technology: Engineering and Environmental Aspects. New Jersey: Noyes Data Corporation, 1981.
- Gartner, William C. and Donald F. Holecek. The Economic Impact of a Short-Term Tourism Industry Exposition (1980 Greater Michigan Boat and Fishing Show). Agricultural Experiment Station Research Report, no. 436, East Lansing: Michigan State University, 1982.
- Gordon, R. L. "A Reinterpretation of the Pure Theory of Exhaustion." Journal of Political Economy, vol. 75, no. 3, pp. 274-86, June, 1967.

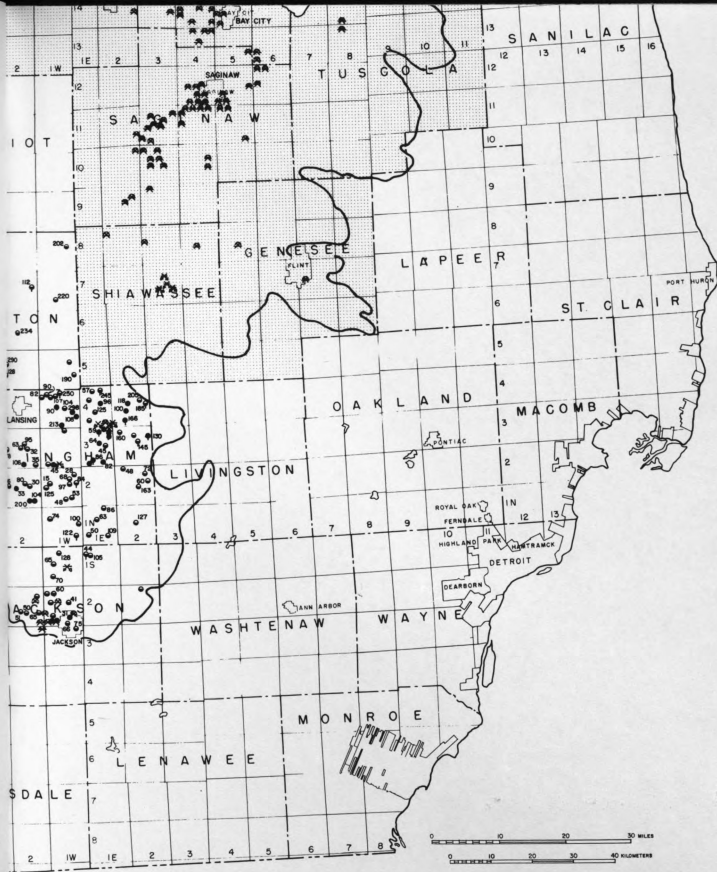
- Gray, L. C. "Rent Under the Assumption of Exhaustibility." Quarterly Journal of Economics, vol. 28, pp. 466-489, 1914.
- Harvey, Lynn. Table: Farmland and Open Space Preservation Act, P.A. 116, Acres Enrolled. Data Source: Office of Land Use, Michigan Department of Natural Resources, May, 1984. (Unpublished.)
- Hepp, Ralph E. Public Act 116: Farmland and Open Space Preservation Act. Extension Bulletin E-792A, East Lansing: Michigan State University Cooperative Extension Service, 1981.
- Herfindahl, Orris C. and Allen V. Kneese. Economic Theory of Natural Resources. Columbus: Charles E. Merrill Publishing Company, 1974.
- Hicks, John R. "The Foundations of Welfare Economics." Economic Journal, vol. 49, pp. 696-712, 1939.
- Hotelling, H. "The Economics of Exhaustible Resources." Journal of Political Economy, vol. 39, no. 2, pp. 137-175, April 1931.
- Huff, Linda L., et al. Assessment of Future Economic Tradeoffs Between Coal Mining and Agriculture. Illinois Department of Energy and Natural Resources, Project no. 80-214, 1982.
- Johnson, Wilton and James Paone. Land Utilization and Reclamation in the Mining Industry, 1930-1980. Bureau of Mines Information Circular, no. 8862, 1982.
- Kaldor, Nicholas. "Welfare Propositions of Economics and Interpersonal Comparisons of Utility." Economic Journal, vol. 49, pp. 549-52.
- Kalliokoski, J. and E. J. Welch, Magnitude and Quality of Michigan Coal Reserves. U.S. Bureau of Mines Open File Report, no. 102-76, 1977.
- Kirvan, Cathy J. "Land and Energy: A Fragile Balance." Rural Living, vol. 61, no. 10, pp. 13-14, Oct. 1982.
- Kneese, A. V. and C. L. Schultze. Pollution, Prices and Public Policy. Washington: Brookings Institution, 1975.
- Lapin, Lawrence. Statistics, Meaning and Method, 2nd Edition. New York: Harcourt Brace Jovanovich, Inc., 1980.
- Libby, Lawrence W. The Role of the University Social Scientist in Development and Implementation of Environmental Policy at the National Level. Paper presented at International Conference on Rural Development at Backaskog, Sweden, June 23-30, 1981. (Unpublished Staff Paper no. 81-39, Department of Agricultural Economics, Michigan State University.)
- Manchester, Alden C. The Farm and Food System: Major Characteristics and Trends, East Lansing: Michigan State University Cooperative Extension.

- Manthy, Robert S. "Scarcity, Renewability, and Forest Policy." Journal of Forestry, vol. 75, no. 4, April, 1977.
- Marglin, S. A. "The Social Rate of Discount and the Optimal Rate of Investment." Quarterly Journal of Economics, vol. 77, no. 1, pp. 95-112, February, 1963.
- McDonald, M. G. and J. R. Stark. Ground Water of Coal Deposits: Bay County, Michigan. U.S. Geological Survey Open File Report, no. 80-591, 1980.
- Michigan Department of Agriculture. Michigan Agriculture Statistics, August 1982. Michigan Agricultural Reporting Service, 1983.
- Michigan Department of Agriculture. Michigan Food Facts. Lansing, MI.: Office of Communication, 1982.
- Michigan Department of Commerce. Analysis of Senate Bill 819. Lansing, MI., 1982.
- Michigan Farmland and Open Space Preservation Act, Michigan Public Act 116 of 1974.
- Michigan Senate Analysis Section. Regulate Coal Mining. May 26, 1982.
- Michigan Surface and Underground Mine Reclamation Act, Michigan Public Act 303 of 1982.
- Michigan Public Act 92 of 1970, July 20, 1970.
- Moncrief, Lewis W., et al. Participation in Land Use Control Programs as a Function of Land Ownership Objectives and Environmental Orientation. Agricultural Experiment Station, Research Report, East Lansing: Michigan State University, 1981.
- Myers, Paul R. Regional Population and Employment Adjustments to Rising Coal Production. Rural Development Research Report, no. 37, U.S. Department of Agriculture, Washington: U.S. Government Printing Office, Nov. 1983.
- Nicholson, Walter. Intermediate Microeconomics and Its Applications. 2nd ed. Hinsdale, Illinois: The Dryden Press, 1979.
- Nordhaus, William D. "Resources as a Constraint on Growth." American Economic Review, vol. 64, no. 2, May 1974.
- _____. "The Allocation of Energy Resources." Brookings Papers on Economic Activity, vol. 3, pp. 529-70, 1973.
- Page, Talbot. Conservation and Economic Efficiency: An Approach to Materials Policy. Baltimore: Johns Hopkins University Press, 1977.

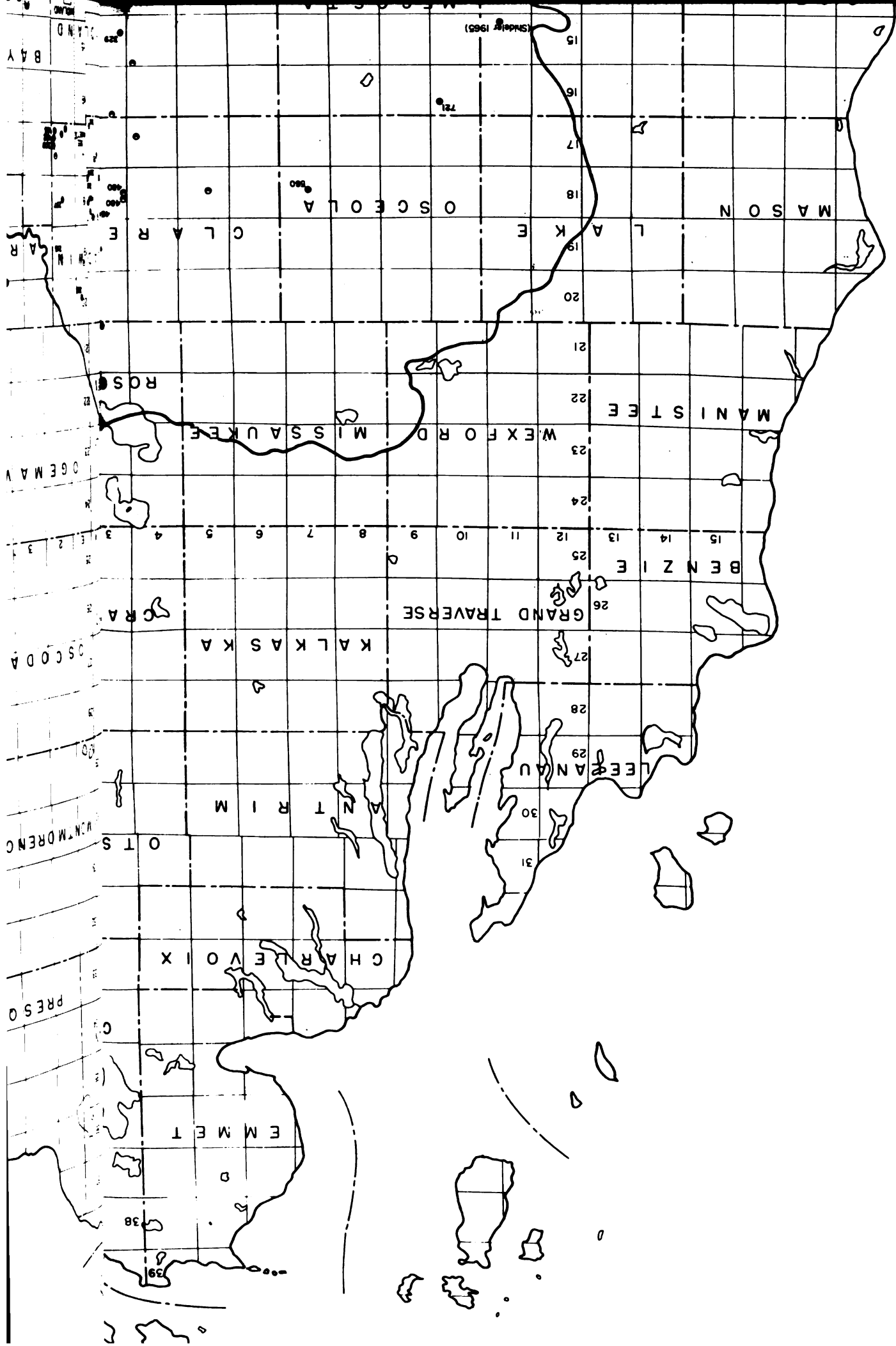
- Perry, Harry. "Coal in the United States: A Status Report." Science, vol. 222, no. 4622, pp. 377-384, 28 Oct. 1983.
- Randall, Alan. Resource Economics: An Economic Approach to Natural Resource and Environmental Policy. New York: John Wiley and Sons, 1981.
- Rhoads, Steven E. "Economists and Policy Analysis." Public Administrative Review, pp. 112-119, March-April, 1978.
- Robinson, Colin. "The Depletion of Energy Resources," The Economics of Natural Resource Depletion. D. W. Pearce and J. Rose, eds., New York: John Wiley and Sons, pp. 21-55, 1975.
- Roethelie, Jon, and Jim Parrish. "Michigan's Hidden Resource: Coal." Michigan Natural Resources, pp. 30-37, Sept.-Oct., 1982.
- Rosenbaum, Walter A. Coal and Crisis: The Political Dilemmas of Energy Management. New York: Praeger Publishers, 1978.
- Schmid, A. Allan. Property, Power and Public Choice: An Inquiry Into Law and Economics. New York: Praeger Publishers, 1978.
- _____. The Political Economy of Public Investment. Unpublished manuscript for public project analysis course taught at Michigan State University, East Lansing, Spring 1980.
- Schurr, Sam H., et al. Energy in America's Future: The Choices Before Us. Baltimore: John Hopkins University Press, 1979.
- Scott, A. D. "The Theory of the Mine Under Conditions of Certainty." Extractive Resources and Taxation, Mason Gaffney, ed., Madison: University of Wisconsin Press, 1967.
- Scott, John T., et al. Estimating the Economic Effects of Changes in Land Use: A Guide. Agricultural Economics Research Report, no. 156, Champaign/Urbana: University of Illinois Agricultural Experiment Station, Nov. 1978.
- Seitz, Wesley, et al. Surface Mining: Soil, Coal and Society. The Committee on Soil as a Resource in Relation to Surface Mining for Coal, Natural Research Council, Washington, D.C.: National Academy Press, 1981.
- Siebert, Horst. Regional Economic Growth: Theory and Policy. Scranton, Pennsylvania: International Textbook Company, 1969.
- Silverman, Arnold J. "Environmental Effects: Assessment of Energy Technology." Proceedings of the Fort Union Coal Field Symposium vol. I-IV, April 25-26, 1975. Sponsored by Montana Academy of Sciences, Billings: Hagen Printing Company, 1975.
- Singer, S. Fred. "Soil and Coal: A Cost-Benefit Inquiry." Science, vol. 198, no. 4314, p. 255, 21 Oct., 1977.

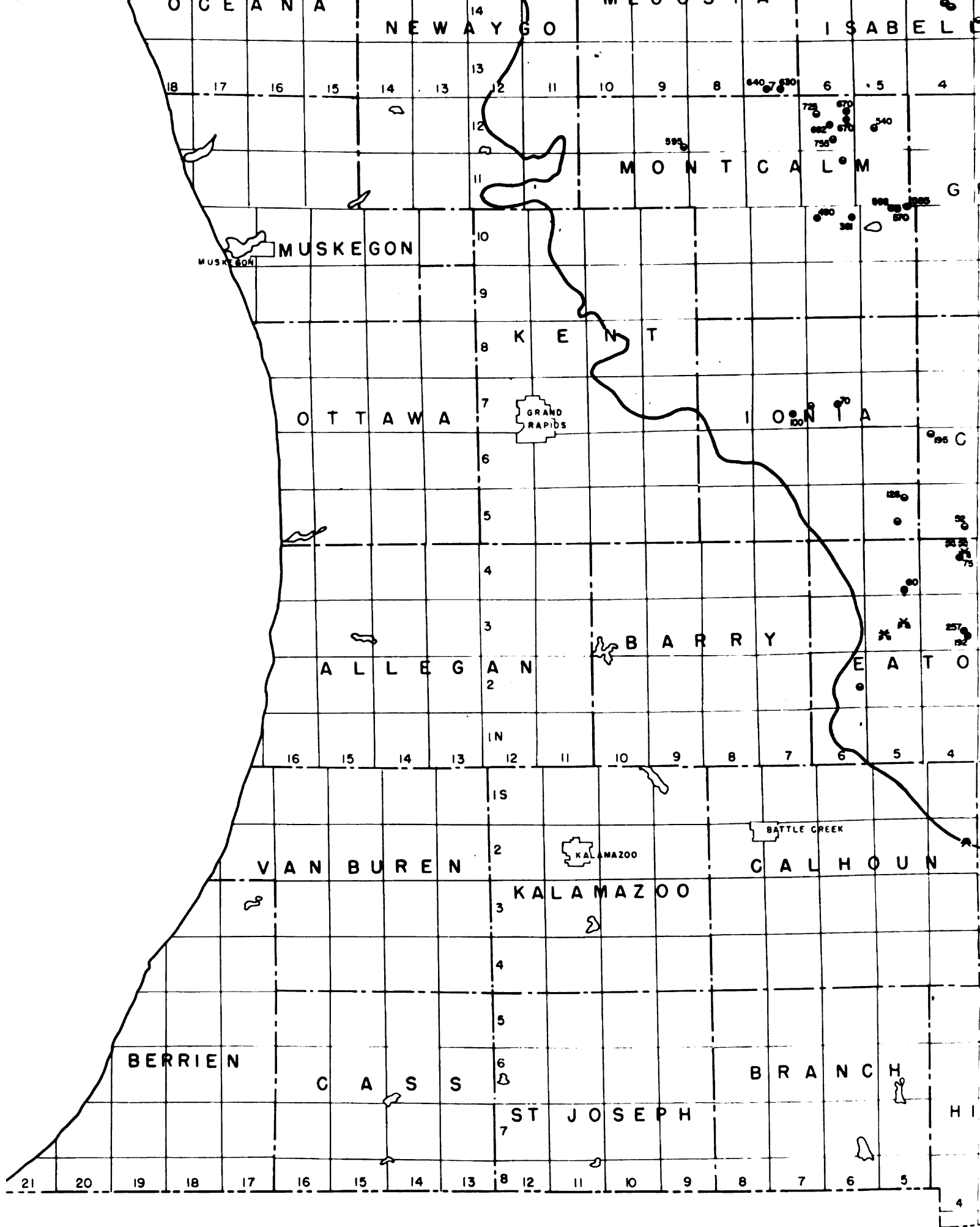
- Solberg, Eric. Intermediate Microeconomics. Plano, Texas: Business Publications, Inc., 1982.
- Solow, Robert M. "The Economics of Resources or the Resources of Economics." American Economics Review, vol. 64, pp. 1-14, May 1974.
- Stokey, Edith and Richard Zeckhauser. A Primer for Policy Analysis. New York: W. W. Norton and Company, 1978.
- Sugden, William and Alan Williams. The Principles of Practical Cost-Benefit Analysis. Oxford: Oxford University Press, 1978.
- Surface Mine Control and Reclamation Act of 1977, Public Law 95-87 of 1977.
- Surrey, A. J. and William Page. "Some Issues in the Current Debate about Energy and Natural Resources," The Economics of Natural Resource Depletion. D. W. Pearce and J. Rose, eds., New York: John Wiley and Sons, pp. 56-73, 1975.
- The President's Commission on Coal. Coal Data Book. Washington: U.S. Government Printing Office, 1980.
- Thompson, Stanley R. Transportation Needs for Michigan Grain in 1985 and 2000. Michigan Farm Economics, no. 426, East Lansing: Michigan State University, Cooperative Extension Service, July 1978.
- Tourbier, J. Toby and Richard Westmacott. A Handbook for Small Surface Coal Mine Operators. U.S. Department of the Interior, Office of Surface Mining, Water Resources Center: University of Delaware, 1980.
- Tucker, Jay Dean, and Stanley R. Thompson. Rural Roads in Michigan. Michigan Farm Economics, no. 433, East Lansing: Michigan State University, Cooperative Extension Service, March 1979.
- U.S. Bureau of Mines, Staff. Strippable Reserves of Bituminous Coal and Lignite. Bureau of Mines Information Circular, no. 8531, 1971.
- U.S. Bureau of Mines, Staff. "The Mineral Industry of Michigan." Minerals Yearbook, Vol. II, Area Reports: Domestic, Washington: U.S. Government Printing Office, 1977.
- U.S. Department of Energy. Demonstrated Reserve Base of Coal in the U.S. on January 1, 1979. Washington: U.S. Government Printing Office, May 1981.
- U.S. Department of Housing and Urban Development. State Land Use Activity. Prepared by The Institute of Planners, 1976.
- Webber, Robert E., and Sharon Ehlke. Michigan Energy Data Book. Michigan Department of Commerce, 1981.

Wright, Karl T., and John N. Ferris. Michigan Agriculture: Going Into the Eighties. East Lansing: Michigan Cooperative Extension Service, 1981.









LEGEND

COAL DEPOSITS

MORE THAN 14 in. OF COAL REPORTED :

LESS THAN 14 in. OF COAL REPORTED or
UNCERTAIN INFORMATION :

NO COAL REPORTED :

COAL MINES

ABANDONED SHAFT MINE :
ABANDONED STRIP MINE :
OPERATING STRIP MINE : (One, 1975)

201 NUMBER ADJACENT TO DRILL HOLE
= DEPTH TO TOP OF THICKEST COAL

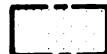
● ONE BED
◆ SEVERAL BEDS

○ ONE BED
○ SEVERAL BEDS

○ BARREN DRILL HOLE



BOUNDARY OF MICHIGAN COAL BASIN



COUNTIES WITH COAL MAPS ON SCALE: 1" =

for MIDLAND COUNTY see MAP 4A

BAY " " 5A

SAGINAW " " 6A

TUSCOLA " " 7A

SHIAWASSEE " " 8A

GENESEE " " 9A

