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

Appendix II: Central U.S. Surface Mine Case Study

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The potential usefulness of reclaimed surface-mined land has received much attention recently. In an effort to develop a procedure for evaluating postmining land use potentials, specific mines in various regions of the U.S. were studied to determine the extent of current mined-land planning and to discover characteristics that are regional in nature. As part of this investigation, the Chinook Mine-West Field, located in western Indiana, has been studied. The Chinook Mine is presently operated by AMAX Coal Company and has been in continuous operation since 1928 under various ownership. The status of current reclamation and land use planning was reviewed. In addition, site planning principles were applied to the active mine area. This application included formation of a data base and development of postmining land use plan alternatives. Key factors affecting site potential realization for midwestern area mines have been identified along with suggestions for applying land use planning processes to mined-land planning.

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Foreword

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Chapter 1

INTRODUCTION

1.1 Report Objective

Demand to restore surface-mined lands to productive uses has increased. There are several possible explanations for this increased demand. These range from the increased economic value of the reclaimed land to the social pressure for postmining land use to be compatible with its surroundings. In a much larger sense, this demand is the result of the realization that surface mining is a temporary non-renewable use of the land and should be viewed as one component in a stream of multiple uses, some of which can be permanent and/or renewable uses. Although various state reclamation laws had addressed the issue of postmining land use, the concept that reclaimed land should be capable of supporting its premining use or some higher or better use was formalized in the Surface Mining Control and Reclamation Act of 1977. Specifically, the operator of a surface mine is required to state, in the permit application, what the proposed postmining use will be. In addition, the applicant must discuss, in writing, the utility and capacity of the reclaimed land to support a variety of alternative uses (P.L. 95-87, Sec. 508.A.3). This legislation does not represent a mandate for land use change. However, in the conduct of the required evaluation, a mine operator may discover that an alternative land use may be applicable or desirable for various reasons.

Evaluating the potential of reclaimed land to support alternative uses goes beyond the realm of typical premine planning. The objective of this research project is to identify the skills and techniques required to evaluate postmining land use plans and organize these components in such a way that mine planners will be aided in their work. Public planners will benefit from this work by gaining valuable insight into mine planning characteristics, particularly for land with surface-mineable resources. To accomplish this objective, various aspects of environmental site planning and comprehensive planning, which have mainly been of interest to public planners, must be incorporated into the premine planning process. Historically, the interaction and cooperation between premine planners and public planners have been more on an informal basis than on a formal, rational basis. To obtain maximum usefulness of reclaimed land, these relationships must be established in a more organized manner.

One of the problems that complicates the issue of surface-mined land potential evaluation is the wide range of surface mining, reclamation, and land use planning practices observed across the United States. In an effort to identify procedures that would have applicability in the various regions of the U.S., it is necessary to look at several of these regions individually. This report concerns itself with a specific surface mining operation in the central United States and is the second in a series of three investigations that deal with surface mining activities in the eastern, central, and western United States.

1.2 Scope of Work

A study of a central U.S. surface mine was conducted with particular emphasis on the postmining land use planning processes that were employed. This project is based upon the hypothesis that a study of reclamation and postmining land use practices can lead to valuable conclusions concerning the practicality of postmining land use planning and the effectiveness of current planning methods in achieving satisfactory utilization of reclaimed lands. The investigation centers around identifying the planning steps that were taken, why and how the various practices were applied, who was involved in the planning process, and what are the results of the planning efforts to the present time. The information gathered from this study will contribute to the development of a procedure for surface-mined land use potential evaluation.

The surface mine that was selected for this investigation is the Chinook Mine - West Expansion Field located in west central Indiana. It is operated by the AMAX Coal Company of Indianapolis, Indiana. There are several factors that influenced the selection of this site. First, the mine is rather large, typical of many area mines in the Interior Province, and is part of an ongoing operation which has existed for approximately 50 years. The mine is also located near a major population center (Terre Haute), a major transportation artery (I-70), and will likely be subject to increased land use demands in the future. Finally, the Company was both willing and cooperative to provide data and insight into land use considerations surrounding this mine and its other central U.S. operations.

The study included two visits to the mine and three visits to company headquarters for the purposes of observing the reclamation and postmining land use practices, interviewing engineers, planners, and environmental scientists involved in various phases of the mining operation, and collecting data on baseline conditions at the mine site. Because of the great number of factors involved in land use planning, the scope of this study is broad. Due to time limitations, primary data collection by the research team was impractical, and in most cases, not necessary. In addition to company sources, data was gathered from state and regional planning agencies and the Indiana Department of Natural Resources. The general areas addressed during data collection were environmental conditions (e.g., soils, geology, hydrology, and vegetation), engineering considerations, (e.g., cut plans and equipment selection), and socio-economic factors (e.g., population, employment, and present land use).

In Chapter 2, the REGIONAL SETTING including the physical, social, and cultural characteristics and their relationships to mining operations are discussed. The CASE STUDY DETAILS are presented in Chapter 3. These details include the history of the operation, engineering and planning practices, premining and postmining land use considerations, and the role of the regulatory authority in reclamation decisions. The role of COMPREHENSIVE PLANNING as conducted by the state and regional planners for the study area are addressed in Chapter 4. In Chapter 5 a LAND USE POTENTIAL EVALUATION is outlined employing the principles of environmental site planning. The results of the study are summarized in Chapter 6.

Chapter 2

REGIONAL SETTING

2.1 Physical Setting

The Chinook Mine of AMAX Coal Company is located in West Central Indiana, approximately six miles east of Terre Haute (Figure 2.1). The West Field lies on the line between Clay County (Posey Township) and Vigo County (Lost Creek Township). Although the area immediately adjacent to the mine is rural in nature, the mine is situated in the heart of the midwest industrial belt (Figure 2.2). It is approximately 160 miles east of St. Louis, 180 miles south of Chicago, 170 miles west of Cincinnati, and 170 miles north of Louisville. Interstate 70, a major east-west transportation artery, bisects the mine, with the West Field lying north of I-70 and the Southwest Field, the mine office, and the preparation plant lying south of I-70. Indianapolis, a major business and government center, is only 65 miles to the northeast of the mine. The mine is also situated within five miles of Brazil, the Clay County seat, and within two miles of the small communities of Staunton and Seelyville.

Most of Clay County and Vigo County, including the Chinook Mine area, are located in the Wabash Lowland of the Central Lowlands physiographic province (Figure 2.3). The Wabash Lowland is characterized by low relief with gently rolling uplands. On an average, the local relief varies approximately 70 feet per square mile (Hutchison, 1960). The surface expression in this area has been strongly influenced by glacial action and deposition (Wayne, 1956). The Pennsylvanian bedrock surface, prior to glaciation, had experienced considerable erosion due to the presence of many weak shale strata. The advance of the Kansan and Illinoian glaciers partially subdued the bedrock surface which was left covered by glacial drift as the glaciers retreated. Although the Wisconsin glacier did not advance quite as far south, the valleys in front of the glacier were filled with glacial till and outwash deposits as the glacier melted. The combination of direct glacial deposits, outwash deposits, and windblown glacial deposits provides a rather continuous blanket of unconsolidated material overlying bedrock. This layer varies in thickness from a few feet overlying bedrock high points to greater than one hundred feet in preglacial valleys.

The general area surrounding the case study site lies within the Wabash River drainage basin. The Wabash River and its major tributaries occupy broad valleys that are deeply filled with glacial and fluvial sediments (Powell, 1972). Due to the general lack of structural control, all streams in the area exhibit rather well-developed dendritic patterns (Hutchison, 1960).

A generalized geologic map of Indiana is shown in Figure 2.4. The Pennsylvanian rocks that underlie approximately 20 counties of western and southern Indiana form the eastern edge of the Eastern Interior Coal Basin. Structurally, these rocks dip to the southwest at less than one degree. Although several minor discontinuous coal seams can be found,

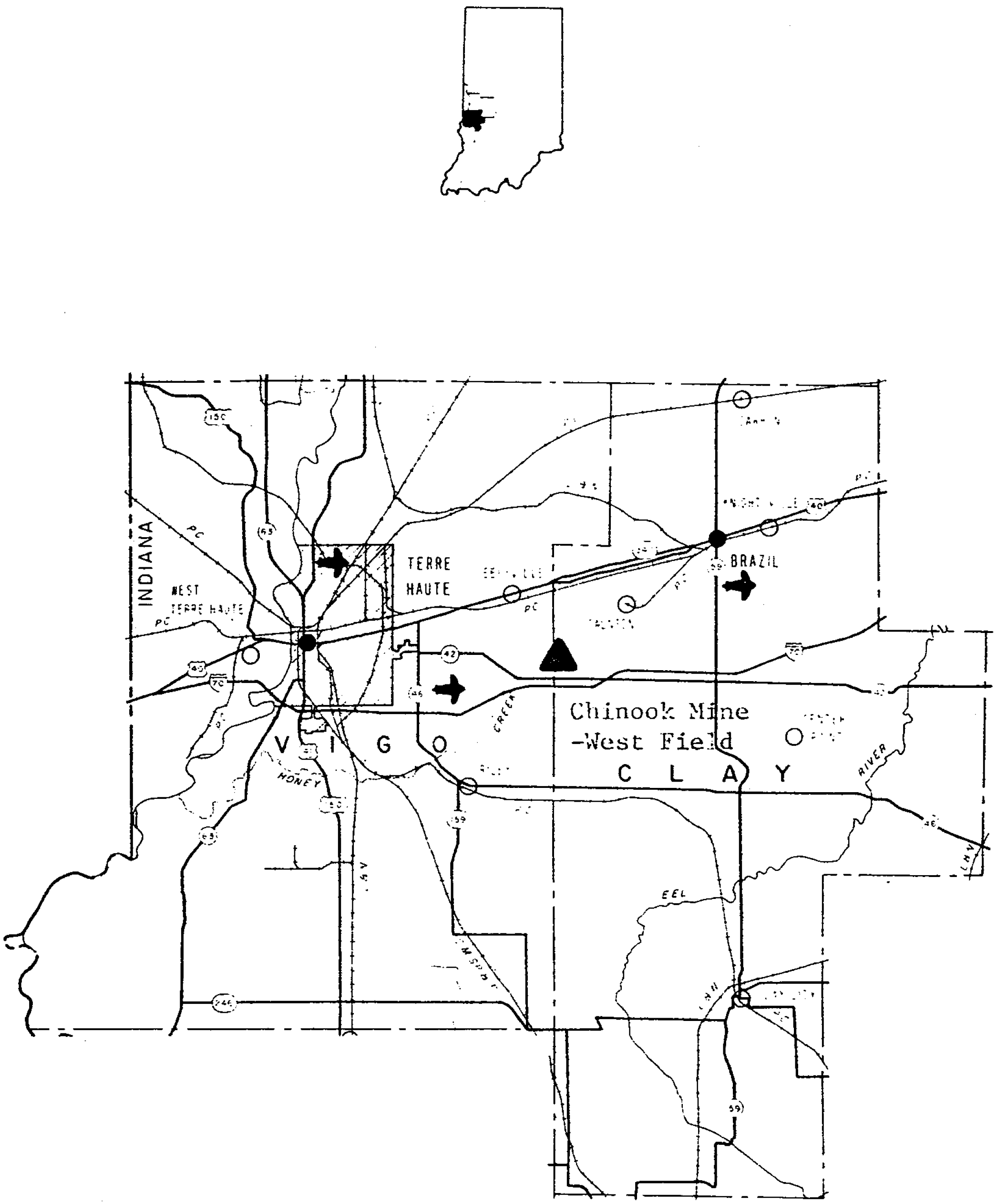


Figure 2.1 General location map for Chinook Mine - West Field.

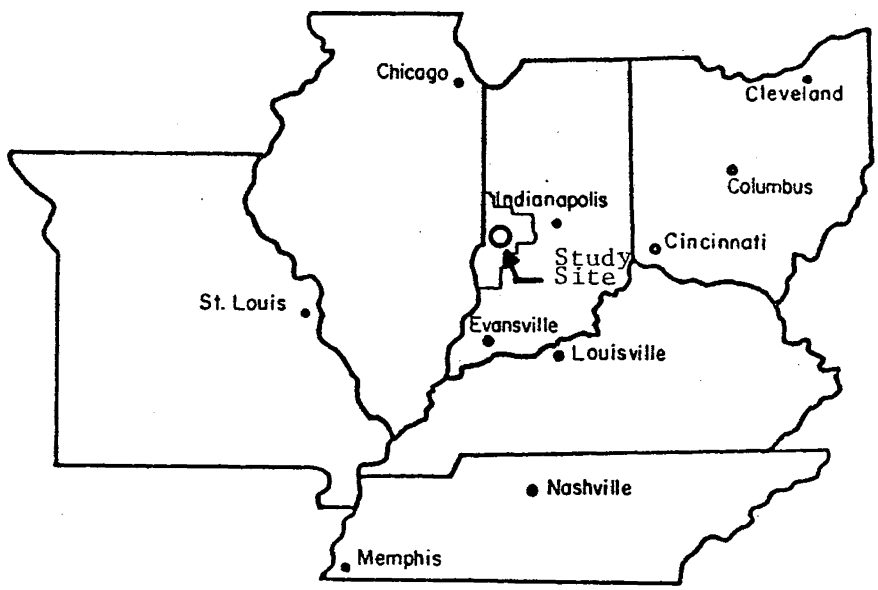


Figure 2.2 Relationship of study area to major industrial cities of the midwest.

SOURCE: WCIEDD, 1977a.

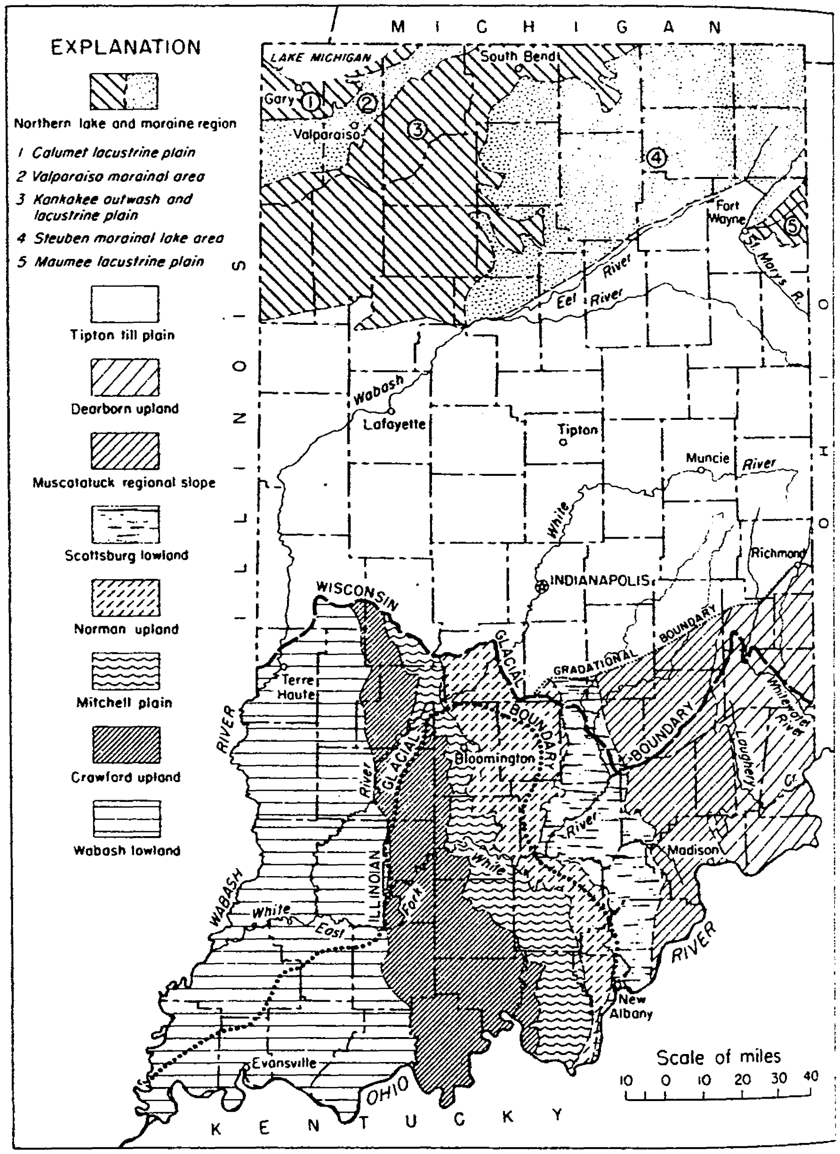


Figure 2.3 Regional physiographic map of Indiana.

SOURCE: Wayne, 1956.

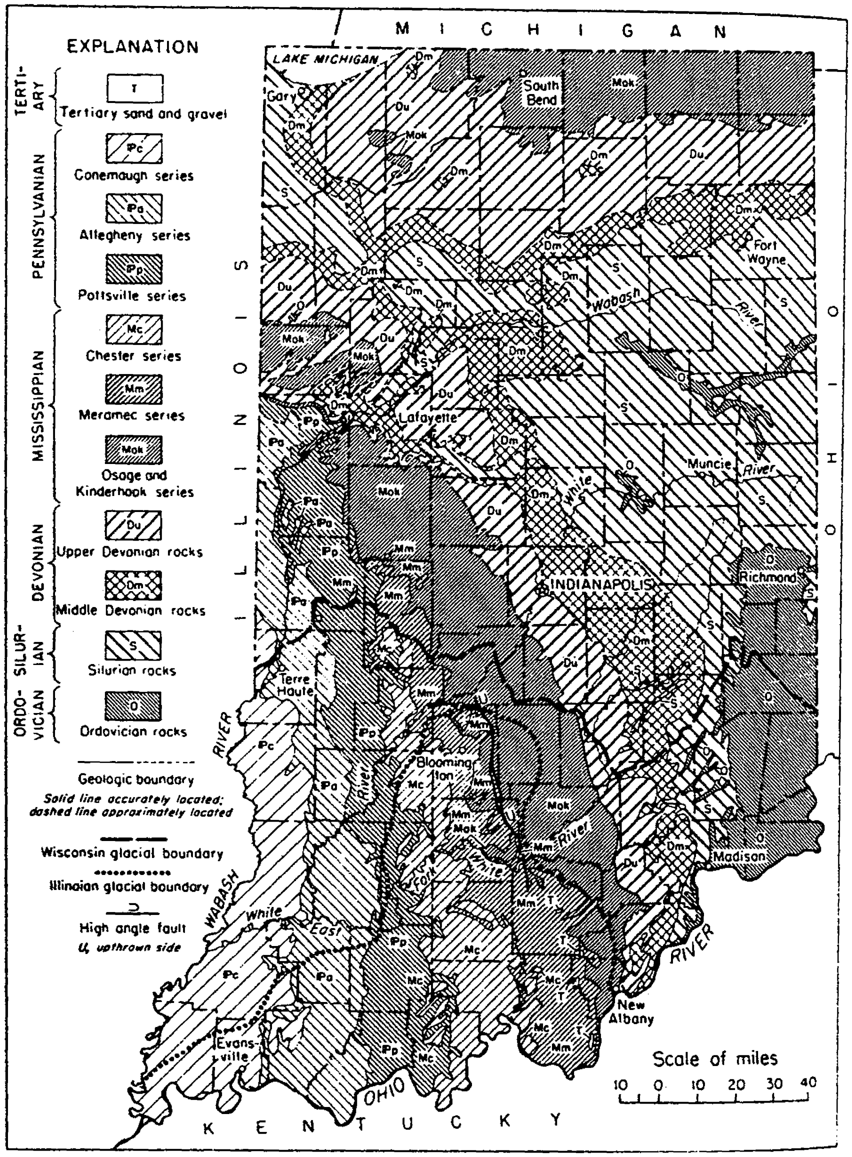


Figure 2.4 General geologic map of Indiana.

SOURCE: Wayne, 1956.

nearly all of the coal produced from surface mines in Indiana comes from nine seams and their associated riders. These nine seams are the Lower Block Coal, the Upper Block Coal, the Minshall Coal, the III Coal, the IIIa Coal, the IV Coal, the V Coal, the VI Coal, and the VII Coal. The typical analytical data for eight of these major seams are listed in Table 2.1. A generalized stratigraphic column of the Pennsylvanian section showing the relationship between the various coal measures is provided in Figure 2.5. The 20-county area of western and southern Indiana is located within the Eastern Interior Coal Basin (Figure 2.6). The outcrop areas of the III, V, VI, and VII Coal seams are shown in Figure 2.6. The case study area, also shown on this map, indicates that the Chinook Mine is situated near the outcrop of the III Coal.

In addition to the valuable coal resources, other mineral resources are found in the region. Limestone, sandstone, shale, clay, sand and gravel have all been extracted for road metal, bridge, and building-foundation construction, tile and face-brick material, and concrete aggregate, among other uses. Groundwater is another important resource that is relatively abundant, particularly, in buried glacial valleys (Hutchison, 1960).

2.2 Social and Cultural Setting

With a few local exceptions, this portion of Indiana has lagged behind the remainder of the state in population growth and economic development. The decennial population data for the two counties that surround the Chinook Mine are listed in Table 2.2. Over a period of 50 years, from 1930 to 1980, the population of Indiana has increased 69.53 percent. For that same period of time, the population of the two-county area increased only 9.50 percent. The city of Terre Haute is located in Vigo County accounting for the substantial difference in population between the two counties. The Vigo County fluctuations over the years can generally be attributed to the population changes in Terre Haute. In 1970, 71 percent of the Vigo County population was classified as urban. Most of the urban population resided in Terre Haute which had a population of 70,335 at that time. At the same time, only 34 percent of Clay County's population was classified as urban (WCIEDD, 1977a). It can be seen from the data in Table 2.2 that Vigo County experienced rather steady growth from 1940 through 1970, with slightly more rapid growth occurring in the 1940s and 1960s. Since 1970, there has been a general out-migration from the urban areas resulting in a decrease in Terre Haute's population and Vigo County's population. This pattern of migration from urban to rural areas, however, is one factor contributing to the largest population increase in 50 years for Clay County.

One of the principal reasons that the growth of this area has not kept pace with the remainder of the state is the slow transition that has occurred in going from an agrarian economy to an industrial economy (WCIEDD, 1977a). This fact is reflected in the relatively low per capita personal income and household effective buying income, shown in Table 2.3, when compared to state averages. Although this region has been one of high unemployment in the past, changes during the last decade have helped to reverse this trend. The West Central Indiana

Table 2.1

Selected Proximate Analyses of Indiana Coals
(as received basis; from channel samples of raw coals)

Coal name	Thickness (feet)	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Btu
VII Coal	2.4	12.6	35.4	39.8	12.2	2.03	10,900
VI Coal	6.3	13.4	35.5	41.2	9.9	2.61	11,050
V Coal	5.1	10.0	41.2	39.4	9.3	3.31	11,590
IV Coal	3.7	14.4	34.2	43.1	8.4	1.16	11,160
III Coal	5.4	11.3	39.8	37.7	11.2	3.05	11,080
Minshall	3.5	11.2	40.5	37.2	11.1	3.13	11,130
Upper Block	3.8	15.5	32.5	45.7	6.3	2.71	11,500
Lower Block	1.6	13.3	36.3	42.9	7.5	1.68	11,560

Source: Keystone Coal Industry Manual, 1980.

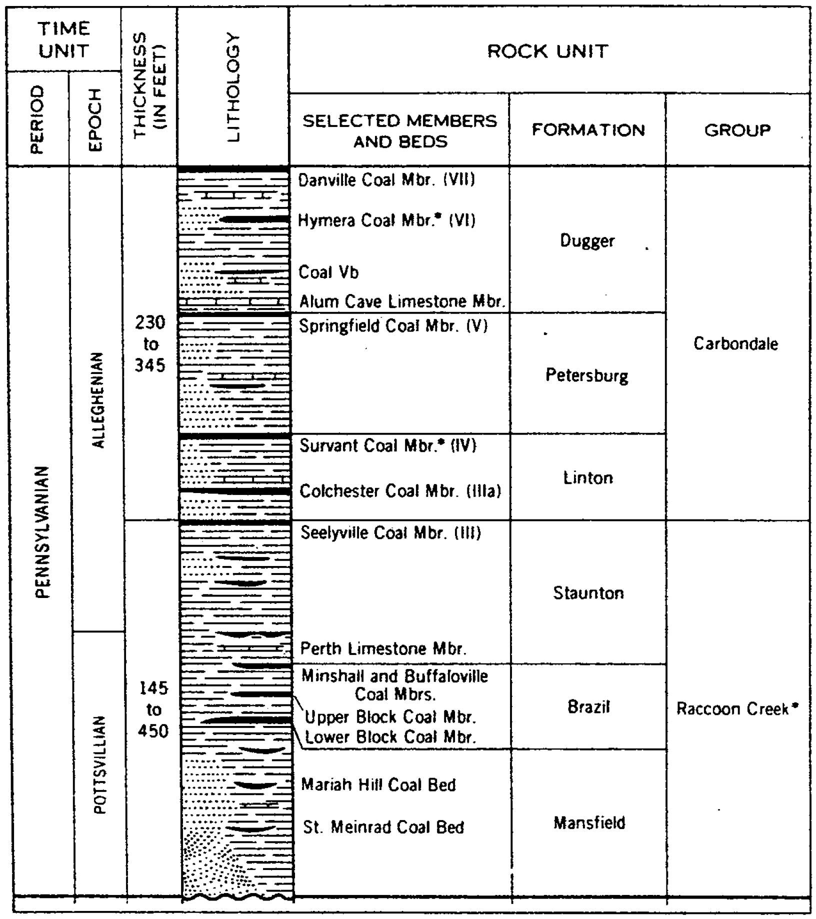


Figure 2.5 Generalized stratigraphic column illustrating the relationship between coal seams in the Indiana Pennsylvanian section.

SOURCE: Powell, 1972.

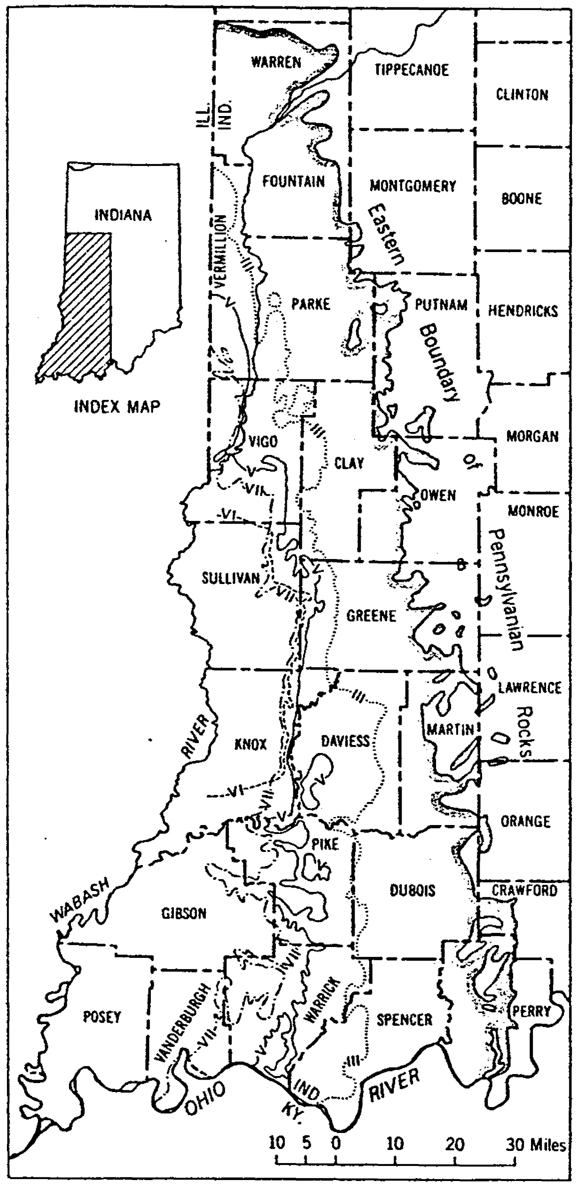


Figure 2.6 Map showing the coal producing region of Indiana and the outcrop area of the III, V, VI, and VII coals.

SOURCE: Powell, 1972.

Table 2.2

Regional Population Data

	Decennial Population						Percent Change					
	1930	1940	1950	1960	1970	1980	1930-40	1940-50	1950-60	1960-70	1970-80	1930-80
Clay County	26,479	25,365	23,918	24,207	23,933	24,862	-4.21	-5.70	+1.21	-1.13	+3.88	- 6.11
Vigo County	98,861	99,709	105,160	108,458	114,528	112,385	+0.86	+5.47	+3.14	+5.60	-1.87	+13.68
Two-County Region	125,340	125,074	129,078	132,665	138,461	137,247	-0.21	+3.20	+2.78	+4.37	-0.88	+ 9.50
Indiana	3,238,503	3,427,796	3,934,224	4,662,498	5,195,392	5,490,179	+5.85	+14.77	+18.51	+11.43	+5.67	+69.53

Table 2.3

Per Capita Personal Income and
Household Effective Buying Income

	Per Capita Personal Income			Household Effective Buying Income
	1969	1975	1976	1977
Clay County	$3,120	$5,132	$5,730	$13,584
Vigo County	$3,130	$5,284	$5,819	$13,281
Indiana	$3,611	$5,581	$6,230	$15,858

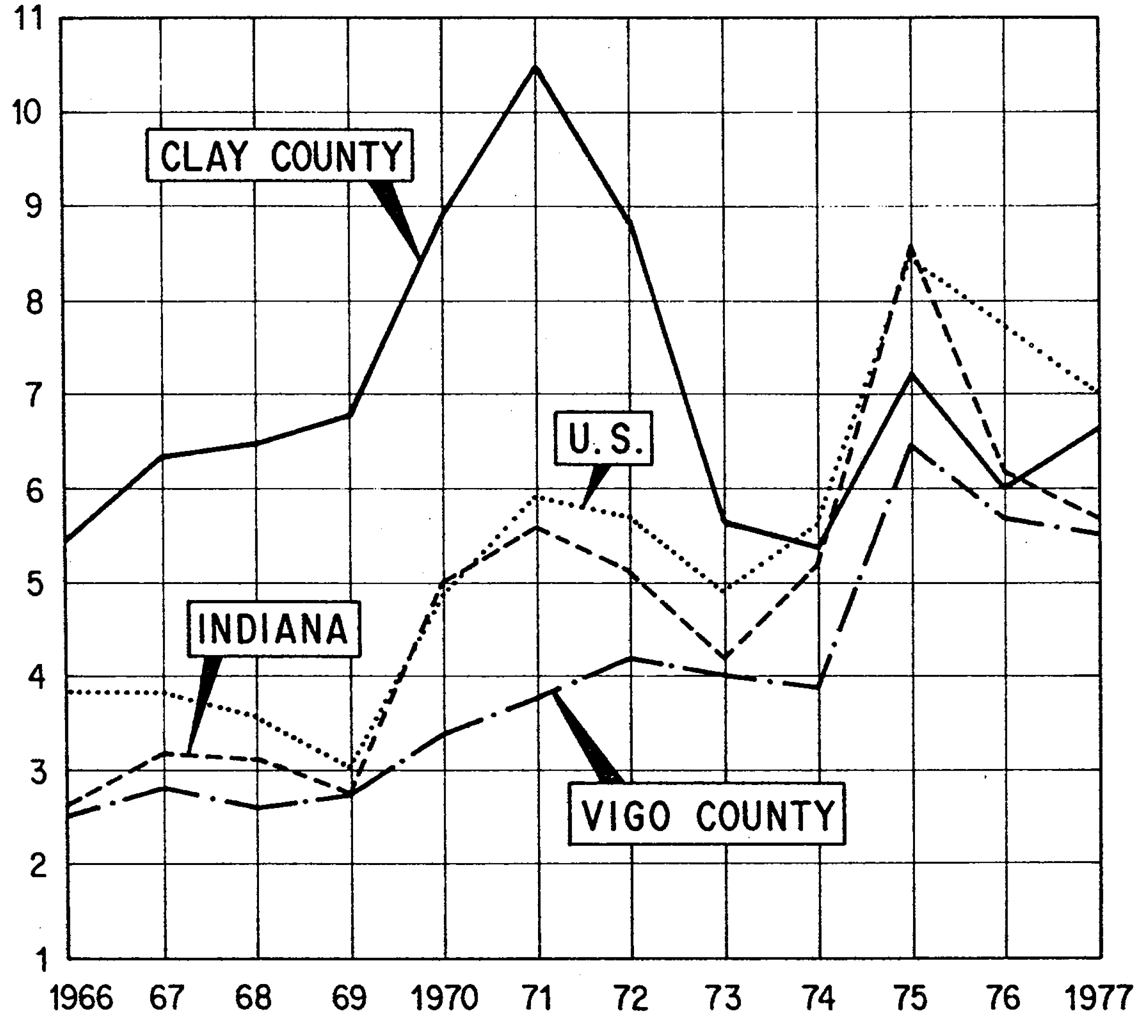
Source: Indiana State Planning Services Agency, 1979.

Economic Development District, Inc. (1977a) reports that one of these changes has been the success of Terre Haute in attracting new industries and in encouraging expansion of existing industries. A second factor has been a diversification of industry, particularly, in areas less likely to be affected by employment variation. The local unemployment pattern from 1966 to 1977 is compared with state and national averages in Figure 2.7. Vigo County has experienced relatively low unemployment during that period. However, the most drastic improvement was seen in Clay County which went from nearly four percent above the state average in 1971 to 1.4 percent below the state average in 1975. This pattern is typical of the rural counties surrounding Vigo County that have been impacted by improved economic conditions in the Terre Haute area.

A breakdown of employment by major industries is given in Table 2.4. Manufacturing industries employ the greatest percentage of workers in both counties. Some of the key products manufactured are chemicals and allied products, electrical machinery and supplies, primary metals, paper, packaged foods, fabricated metal, nonelectrical machinery equipment, printed materials, stone, clay, and glass (WCIEDD, 1977a). In both counties, professional services employment accounted for the largest increases from 1960 to 1970.

Direct employment in agriculture for the two-county area is relatively small and declining. This does not mean, however, that agriculture is not important to the local economy. One of the most important resources of this region is its high quality agricultural land. Being a basic industry, agriculture contributes to the employment in other sectors such as transportation, equipment manufacturing, chemical industries, and food processing. Another reason for the farm employment decline is a trend toward larger and more efficient farms. While the number of farms smaller than 500 acres has been decreasing and the number of farms in the 500 to 1000-acre range has remained nearly constant, the number of farms greater than 1000 acres has been increasing. Also, while the total number of acres in agricultural use declined, there was an increase in the total value of farm production, an increase in the number of farms producing more than $40,000 in agricultural products, and a sizable increase in the average value of farms (WCIEDD, 1977a).

The two-county area surrounding the case study site does not abound with public recreational facilities. However, there are several state-owned facilities within driving distance in adjacent counties. Three state parks, McCormick's Creek, Shakamak, and Turkey Run are located in the adjoining counties of Owen, Sullivan, and Parke, respectively. State parks provide opportunities for camping, fishing, boating, hiking, picnicking, and, in some cases, horseback riding. The state parks also generally have rental cabins or an inn for overnight guests. There are two state reservoirs in neighboring counties, Racoon Lake and Leiber State Recreational Area, that provide additional water-based recreational opportunities, particularly, motor boating and water skiing, which are not available at most state parks. One state-owned fish and wildlife area is located in Vigo County. Most of the recreational facilities located within Clay County and Vigo County are privately owned facilities, such as campgrounds, or county and municipal parks. The available acreages of various outdoor recreational uses are listed in Table 2.5.



	1966	67	68	69	1970	71	72	73	74	75	76	1977
Clay County	5.5	6.4	6.5	6.8	8.9	10.5	8.9	5.6	5.4	7.2	6.0	6.6
Vigo County	2.5	2.8	2.6	2.7	3.4	3.8	4.2	4.0	3.9	6.5	5.7	5.5
Indiana	2.6	3.2	3.1	2.7	5.0	5.6	5.1	4.2	5.2	8.6	6.1	5.7
United States	3.8	3.8	3.6	3.5	4.9	5.9	5.7	4.9	5.9	8.5	7.7	7.0

Figure 2.7. Unemployment rates from 1966 to 1977 for Clay County and Vigo County.

Source: WCIEDD, 1977a.
Indiana State Planning Services Agency, 1979.

Table 2.4

Major Industry of Employment by Workers by County of Residence.

	Clay County				Vigo County			
	1960		1970		1960		1970	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
A - Agriculture, Forestry & Fisheries	836	10	542	6	1156	3	811	2
B - Mining	354	4	254	3	602	2	149	.3
C - Construction	340	4	549	6.5	1863	5	2642	6
D - Manufacturing								
1. Durables	1948	24	1668	20	4191	11	5372	12
2. Non-durables	752	9	802	9	5852	15	5422	12
E - Transportation, Communications, Public Utilities	453	5.5	558	7	3702	10	3674	8
F - Wholesale & Retail Trade	1548	19	1627	19	8400	22	10,271	23
G - Finance, Insurance & Real Estate	146	2	245	3	1147	3	1505	3.5
H - Business & Repair Service	142	2	163	2	803	2	1064	2.5
I - Personal Services	371	4.5	389	4	2353	6	1808	4
J - Entertainment & Recreation	24	.3	33	.4	242	1	275	1
K - Professional Services	721	9	1277	15	4838	13	9505	21.5
L - Government	327	4	438	5	1690	4	1803	4
M - Industry not reported	264	3			1628	4		
TOTAL	8226	100%	8495	100%	38,467	100%	44,305	100%

Source: WCIEDD, 1977a.

Table 2.5

Outdoor Recreational Facilities in Acres, 1976

	Land (in acres)		Lake (in acres)		Stream (in acres)		Marsh (in acres)		Total	Acres Per
	Public	Private	Public	Private	Public	Private	Public	Private	Acres	Capita
Clay County	744	1,399	42	205	0	1	0	0	2,391	0.097
Vigo County	2,134	1,854	104	257	0	44	0	0	4,393	0.040
Indiana	708,033	133,979	21,971	9,920	1,812	574	12,956	1,985	891,230	0.168

Source: Indiana State Planning Services Agency, 1979.

A need has been identified in this area for improvements to the existing county and municipal parks and the acquisition of additional park land, particularly, in and around Terre Haute (WCIEDD, 1977a). The per capita acres of outdoor recreational facilities for Clay County and Vigo County, 0.097 and 0.040, respectively, are considerably lower than the state average of 0.168 acres per capita (Table 2.5). These figures reinforce the conclusion that additional public and private recreational facilities are needed.

The distribution of land among major land use classes is summarized in Table 2.6. These data demonstrate that while a large percentage of Vigo County's population is classified as urban (71 percent), agricultural land makes up nearly three quarters of the entire county. Although Clay County does not have a high percentage of urban population, the same pattern is evident with agricultural land and forests occupying approximately 90 percent of the total county area.

The general pattern of development for this area is illustrated in Figure 2.8. This figure shows that urban growth is centered around Terre Haute and a few larger towns. Some small outlying communities have grown to accommodate the flow of people from the urban centers. Development beyond these centers is linked to major transportation arteries, particularly U.S. 40, U.S. 150, and I-70 (WCIEDD, 1977a). The importance of these transportation links in locating industrial sites is apparent. One unique factor is the existence of large areas of surface-mined land. Much of the barren land listed in Table 2.6 is related to old surface mining operations. The acreage and condition of this land will be discussed in later sections of this report.

2.3 Mining Operations

The initial coal mining in Indiana was probably concentrated in the outcrops in the early 1800s. The Block coals of Clay County were first discovered in 1851 (Hutchison, 1960). The earliest surface operations were replaced by underground operations in the middle-to-late 1800s as the most accessible deposits were exhausted and heavy equipment was not available for massive overburden removal. In the late 1800s and the early 1900s, underground production was quite high in this area. Most of the coal was being mined from the Upper Block, Lower Block, Minshall, and III Coal seams. As surface mine equipment became available to handle greater overburden depths, a trend toward surface mining was established. The emerging role of surface mining in Indiana since World War I is illustrated in Figure 2.9. The last underground mine in Clay County ceased operations in the early 1950s.

According to 1974 statistics, there were 60 active surface mines in Indiana and only two active underground mines. Of the more than 25 million tons produced that year, less than 200,000 tons came from underground operations. Seven of the 60 active surface mines were located in Clay and Vigo counties, accounting for 1,136,000 tons of production (Indiana State Planning Services Agency, 1979). In 1978, the total coal production for Indiana was 23,938,000 tons. The Clay County and Vigo County contributions were 1,527,000 tons and 153,000 tons, respectively (Keystone Coal Manual, 1980).

Table 2.6

Distribution of Land Uses, 1976

Class	Clay County Acres	Clay County Percent of Area	Vigo County Acres	Vigo County Percent of Area
Urban and Built-Up	9,620	4.13	22,600	8.51
Agriculture	146,350	62.82	191,820	72.22
Forest	72,220	31.00	42,150	15.87
Water	770	0.33	3,060	1.15
Wetland	0	0	0	0
Barren	4,010	1.72	5,980	2.25
Other	0	0	0	0
Total Land	232,960	100.00	265,600	100.00

Source: Indiana State Planning Services Agency, 1979.

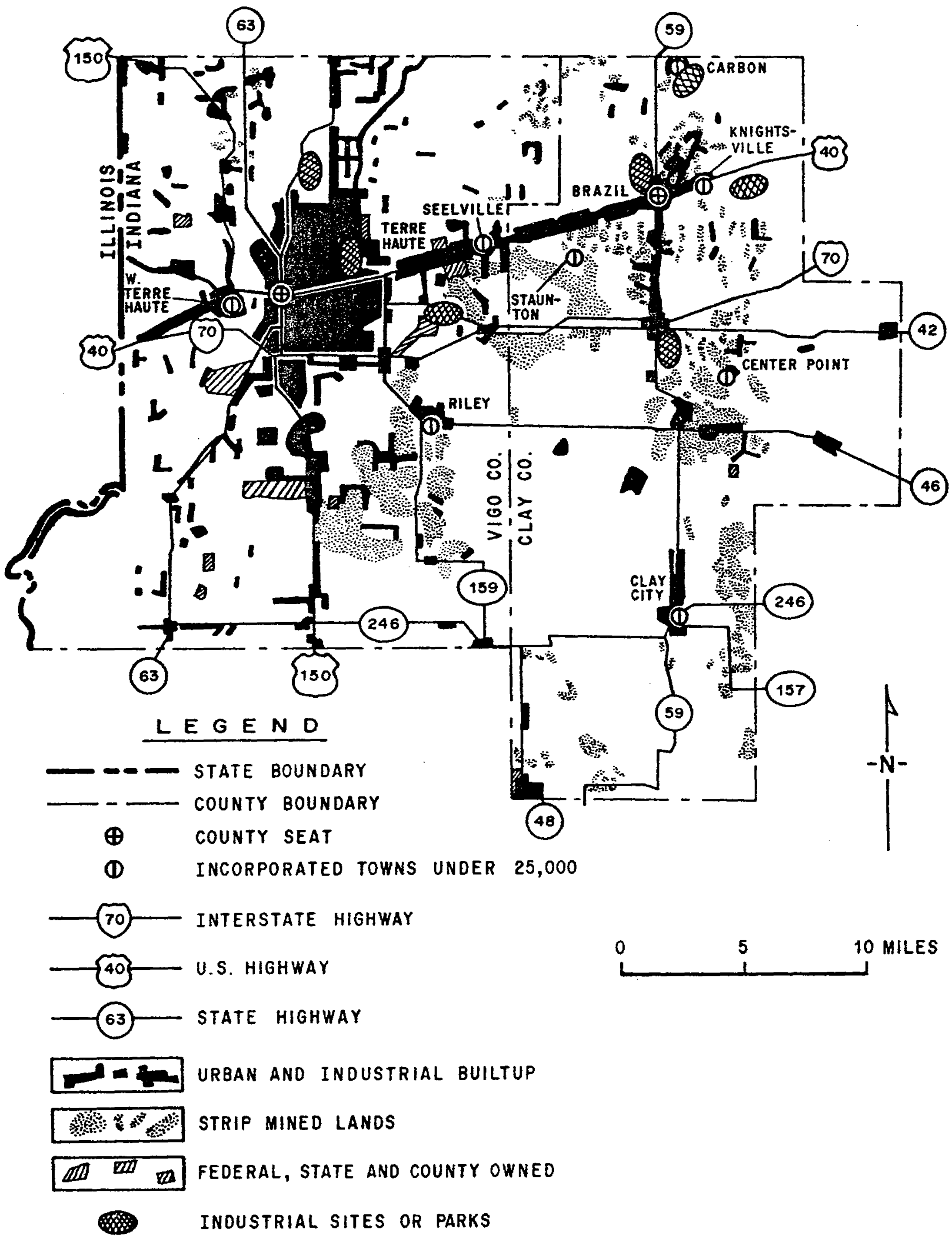


Figure 2.8 General land use and land ownership map.

SOURCE: WCIEDD, 1977a.

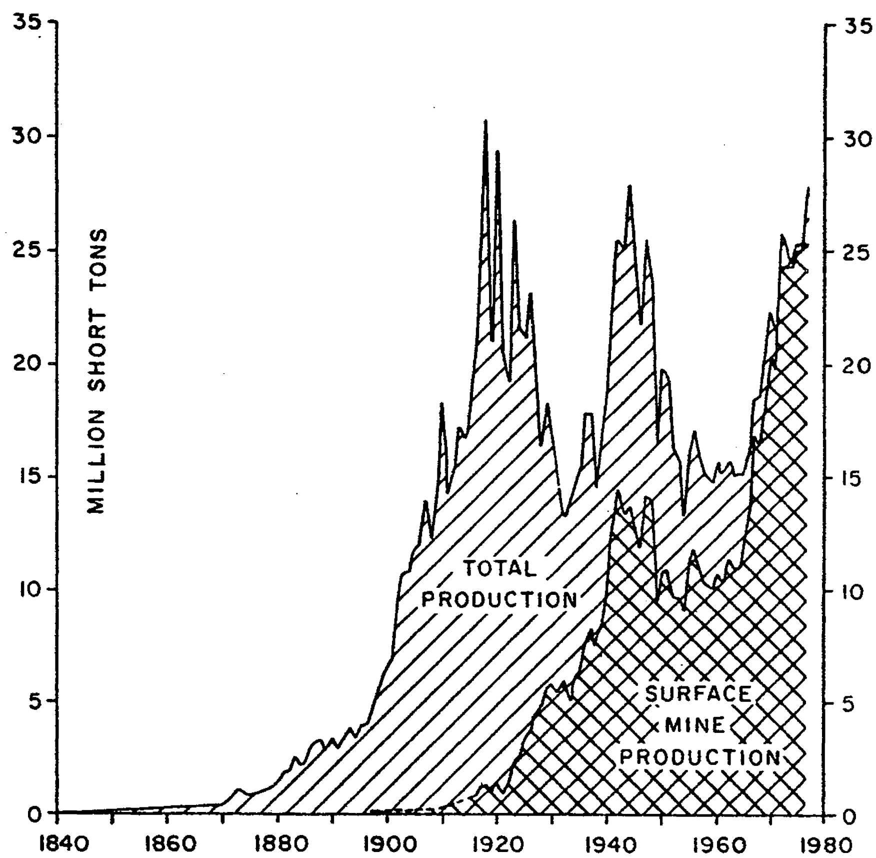


Figure 2.9 Graph showing the comparison of surface mine production to all coal production in Indiana.

SOURCE: Indiana Department of Natural Resources, 1980.

A summary of recoverable coal reserves of Indiana is shown in Table 2.7. Although Vigo County and Clay County rank fifth and ninth, respectively, in total recoverable reserves, Clay County's 323 million strippable tons ranks second only to Warrick County which has 324 million tons. In combination Clay and Vigo County contain 26 percent of Indiana's strippable recoverable reserves. While underground mining will likely make a resurgence in some southwestern counties such as Posey, Gibson, and Vanderburgh, surface mining will continue to dominate in Clay and Vigo counties for the foreseeable future.

Two general types of surface mining are practiced in Indiana. In the flat terrain of the glaciated region, area mining is used. In the more rugged terrain of southern Indiana, contour mining is practiced. Since the case study area is located in the northern glaciated part of the field, area mines are the only type of mines found in the region. Such mines typically encompass thousands of acres, have a fairly long life, and justify the large expenditures for machinery and equipment. Large area mines usually employ large stripping shovels or walking draglines with bucket capacities in the 100-to-200 cubic yard range. These machines are capable of removing over 100 feet of overburden. In addition to the overburden removal equipment, the mines employ several coal loading shovels, large capacity coal hauling trucks, several drills, scrapers, dozers, and an assortment of reclamation equipment. In 1974, the average annual production per surface mine for the entire state was nearly one half million tons and this value includes the production from those contour mines located in the southern part of the state as well.

About 200,000 acres of land surface have been disturbed for surface mining since the time surface mine operations began in Indiana (Table 2.8). This is slightly less than 0.8 percent of the area of the entire state. Clay County and Vigo County are among the counties with the greatest amount of disturbed land. Together, they had more than 29,000 acres disturbed by 1978 (Indiana State Planning Services Agency, 1979).

Indiana is noted for the early voluntary reclamation efforts conducted by several mining companies. In 1918 the Indiana Coal Producers Association was formed and began a program of reforesting spoil banks created by member firms. In 1941, Indiana became the second state in the nation to enact surface mine reclamation legislation. The initial act required only reforestation of spoil banks, but it did require a company to reforest one percent more land than it stripped each year. In 1967 new legislation was passed that, among other things, set maximum grade standards for three different types of postmining land use. The maximum allowable grade for forest or rangeland was 33 percent; the upper limit for pasture and hayland was 25 percent and land intended for row crops could be no steeper than eight percent. The act also set pH limits and standards for the amount of soil cover required over large boulders for the protection of farm machinery (Powell, 1972).

Not all surface-mined land in Indiana has been reclaimed. A breakdown of lands that remained derelict as of 1978 is shown in Table 2.9. The 976 acres of derelict land in Clay County represents only about five percent of the total acreage disturbed by surface mining.

Table 2.7

Recoverable Coal Reserves of Indiana

Summary by County
January 1, 1965

(in thousands of short tons)

County	Strippable	Nonstrippable	Total
Clay	323,296	252,366	575,662
Daviess	137,041	119,502	256,543
Dubois	4,803	3,981	8,784
Fountain and Warren	32,574	3,603	36,177
Gibson	------	2,236,927	2,236,927
Greene	213,757	228,298	442,055
Knox	142,285	2,241,486	2,383,771
Martin	82,771	11	82,782
Owen	50,791	-------	50,791
Parke	9,564	29,402	38,966
Perry	------	28,200	28,200
Pike	249,050	370,469	619,519
Posey	------	2,870,391	2,870,391
Spencer	53,097	------	53,097
Sullivan	313,964	3,490,574	3,804,538
Vanderburgh	------	1,083,454	1,083,454
Vermillion	44,712	295,407	340,119
Vigo	255,580	1,449,210	1,704,790
Warrick	324,014	517,404	841,418
Total Indiana	2,237,299	15,220,685	17,457,984

Source: Keystone Coal Industry Manual, 1980.

Table 2.8

Acreage Surface-Mined by County
for Selected Years

County	1941	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Total Acres of Land Mined
Adams	400	8	9	9	10						160	83	436
Clay	15,200	213	206	155	127	123	83	27	370	431	404	521	18,668
Daviess	1,713	7	11						78	120	217	120	2,591
Dubois										169	38	166	787
Fountain	652	1	2	6	8	5	6	5	15	5		25	855
Gibson	937					40	36	5	130	142	62	88	1,622
Greene	12,588	831	648	499	380	343	374	209	315	414	690	2,407	17,526
Knox	2,561				32		199	296	324	311	1,145	806	4,419
Owen	1,841	3	3				11		12	9	236	926	1,953
Parke	456		5	6	5	4	2		3				511
Perry	320				7				76	110			756
Pike	21,096	524	505	662	681	767	742	1,039	1,173	1,293	1,512	2,965	32,908
Spencer	1,587	14	19	19	41	98	154	12	266	521	9	53	4,966
Sullivan	10,624	642	511	837	859	939	760	541	667	702	336	1,280	20,279
Vermillion	2,560	5	151	208	306	448	245	179	284	341	302	511	5,876
Vigo	7,834			40	30	50	280	224	266	266	472	616	10,606
Warrick	24,964	1,152	1,544	1,656	1,441	1,386	1,703	1,894	2,277	1,932	2,237	9,461	51,647

Source: Indiana State Planning Services Agency, 1979.

Table 2.9

Derelict Surface-Mined Lands in Indiana, 1978.

County	Total Derelict Lands (acres)	Barren Spoil Overburden (acres)	Coal Refuse Sites (acres)	Slurry Ponds (acres)	Associated Water Ponds (acres)
Clay	976	697	34	70	175
Daviess	422	301	18	25	78
Dubois	10	5	5	0	0
Fountain	6	6	0	0	0
Gibson	39	120	0	39	198
Greene	1,339	857	187	119	176
Knox	722	111	556	4	51
Martin	67	53	0	0	14
Owen	14	14	0	0	0
Parke	89	71	2	0	16
Perry	9	3	6	0	0
Pike	3,803	3,113	186	129	375
Spencer	105	95	3	0	7
Sullivan	1,130	374	345	265	146
Vanderburgh	29	0	29	0	0
Vermillion	280	175	61	0	44
Vigo	678	93	170	365	50
Warrick	3,677	2,374	292	254	757

Source: Indiana State Planning Services Agency, 1979.

Likewise, the 678 acres of derelict land in Vigo County amount to slightly more than six percent of the total disturbed land. Therefore, in the two-county area, approximately 95 percent of all surface-mined lands have been reclaimed according to Indiana's reclamation laws.

A postmining land use trend was developed in Indiana over the last several years. In 1968, 98 percent of all reclaimed land was put back as forest or rangeland (Table 2.10). However, in 1978, only 16 percent of the reclaimed land was designated as forest and 79 percent was reclaimed for agricultural uses such as pastures, hayland, row crops, or other uses. Shown in Figure 2.10 is a photograph of a field reclaimed for row crops. This field has produced over 100 bushels of corn per year on spoil that was leveled and allowed to stand fallow for about five years. Included in the other uses would be minor amounts of reclaimed land that have been used for building sites. One of the reasons for this trend has been the recognition of the value of reclaimed land. In fact, it has been observed that the value of building sites situated near end cut lakes can far exceed the original value of the land for agricultural purposes (Powell, 1972). Several homes have been built near end cut lakes on surface-mined land in the vicinity of the study area (Figure 2.11). Some reclaimed land has been used for recreational purposes in this region. Both public and private lands are used for picnicking, camping, hiking, and fishing (Figure 2.12). Major portions of the Greene-Sullivan State Forest, located approximately 35 miles from the Chinook Mine, have been donated to the state by mining companies. Approximately 50 percent of the 5,488-acre state forest was mined at one time (Powell, 1972).

There are several reasons why surface-mined lands in the central U.S. are employed for a wider variety of uses than is common in other parts of the United States. A key factor is land ownership. Mining companies that conduct most of the operations in the central U.S. are large firms that are capable of buying, and often owning, the land they intend to mine. This allows greater flexibility in formulating a postmining land use plan and presents a greater incentive to the company to make efficient use of the land. Another factor that influences higher intensity use of reclaimed land in the central U.S. is the demand for building sites and recreational uses brought about by the major urban areas situated within the Interior Province. Of particular importance are building sites associated with end cut lakes and water-based recreational facilities. Finally, an environmental factor that influences postmining land use is the relative lack of acid drainage problems when compared to surface mines in the eastern United States. This fact allows for the construction of aesthetically and environmentally acceptable lakes on reclaimed land.

Table 2.10

Reclaimed Land in Indiana by Usage for Selected Years

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Forest	1,293	543	1,230	865	482	236	247	341	243	562	2,075
Range	2,041	3,002	2,624	2,318	2,879	2,740	1,813	2,067	2,056	937	0
Pasture/Hay	34	36	205	668	370	558	1,144	1,915	2,033	3,469	4,624
Row Crop/Other	34	36	41	79	475	1,063	1,569	1,867	2,050	3,173	5,642
Wildlife	-	-	-	-	-	-	-	-	-	-	597

Source: Indiana State Planning Services Agency, 1979.

Figure 2.10. Surface-mined field that has been reclaimed for row crops.

Figure 2.11. Houses built near an end cut lake on reclaimed surface-mined land.

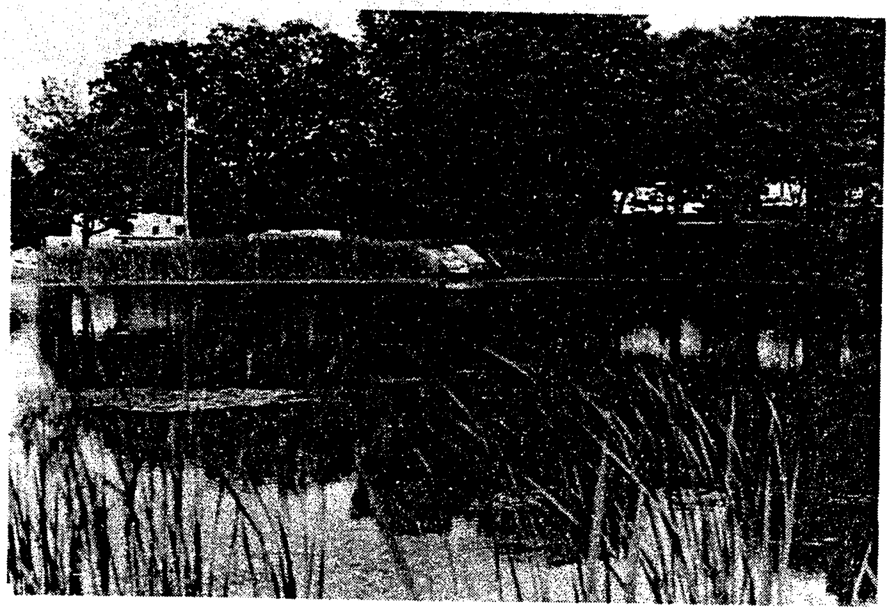


Figure 2.12. Private campground situated near an end cut lake.

Chapter 3

CASE STUDY DETAILS

3.1 Mining Company

AMAX Coal Company is a subsidiary of AMAX Inc., a major mining and natural resources firm. AMAX Inc. acquired Ayshire Collieries in 1969 and changed the name to AMAX Coal Company in 1972. The headquarters of AMAX Coal are located in Indianapolis, Indiana. Presently, AMAX Coal has mining operations in three states. It operates four surface mines in Indiana, three surface mines and one deep mine in Illinois, and two large open pit surface mines in Wyoming. AMAX's Belle Ayr mine, located in the Powder River Basin of Wyoming, has the distinction of being the largest producing coal mine in the United States.

In 1980, AMAX Coal was the third largest coal producer in the United States. The 1980 production for all ten mines is listed in Table 3.1. The total of 40,547,065 tons is a 17.3 percent increase over the 1979 annual production.

Meadowlark Farms, Inc., another subsidiary of AMAX Inc., performs land holding and land management services for AMAX Coal. Meadowlark Farms carries out all revegetation operations on AMAX Coal lands, operates four corporate farms, and conducts a cropshare-lease program on AMAX Coal lands with more than 200 independent farmers and ranchers. Meadowlark Farms' 1980 agricultural production is listed in Table 3.2.

3.2 Chinook Mine Background

The Chinook Mine first began production in 1928. Although the mine has changed ownership several times since then, it is the oldest continually operating mine in Indiana. Prior to acquisition by AMAX Inc., Chinook Mine was operated by Ayrshire Collieries. In 1980, 1,394,369 tons of coal were produced affecting 253 acres of land and requiring the removal of 30,099,437 cubic yards of overburden. The employment in the mine in 1980 was 228 persons.

The mine presently consists of two active fields, the West Field and the Southwest Field. The pits are situated approximately three miles apart, as shown in Figure 3.1. The case study concentrates on the West Field, located just north of Interstate 70. This field is being mined with the use of a Bucyrus-Erie 2570-W dragline. The majority of the coal is produced from the III Coal seam; however, the IV Coal and a sump vein below the III Coal are also taken where the thicknesses and area are adequate. A generalized stratigraphic column of the West Field is shown in Figure 3.2.

Coal from both pits is taken to a coal preparation plant for processing. The preparation plant has a raw coal capacity of 1200 tons per hour, and the coal load-out facility has a capacity of 960 tons per hour. The R.O.M. coal is crushed and stored in an 8,000-ton-capacity

Table 3.1

AMAX Coal Company Production
by Mine in 1980 (tons)

Indiana		
	Chinook	1,394,369
	Minnehaha	1,558,487
	Ayrshire	3,595,957
	Wright	1,367,460
Illinois		
	Sun Spot	1,265,034
	Leahy	2,713,357
	Delta	2,137,292
	Wabash (deep mine)	1,966,295
Wyoming		
	Bell Ayr	16,106,093
	Eagle Butte	8,442,721
TOTAL		40,547,065

Source: Keystone Coal Industry Manual, 1981

Table 3.2

MEADOWLARK FARMS
1980 Production by State

Wyoming:	Bushels of wheat	7584
	Head of beefalo	218
	Head of cattle (in 50-50 livestock share lease)	277
	Pounds of livestock marketed	26,685
Indiana:	Bushels of corn	656,258
	Bushels of soybeans	196,226
	Bushels of wheat	26,177
	Pounds of livestock marketed	309,502
Illinois:	Bushels of corn	571,798
	Bushels of soybeans	202,381
	Bushels of wheat	37,118
	Bushels of milo	18,700
	Pounds of popcorn	298,119
	Pounds of livestock marketed	651,350

Source: Meadowlark Farms Inc. brochure.

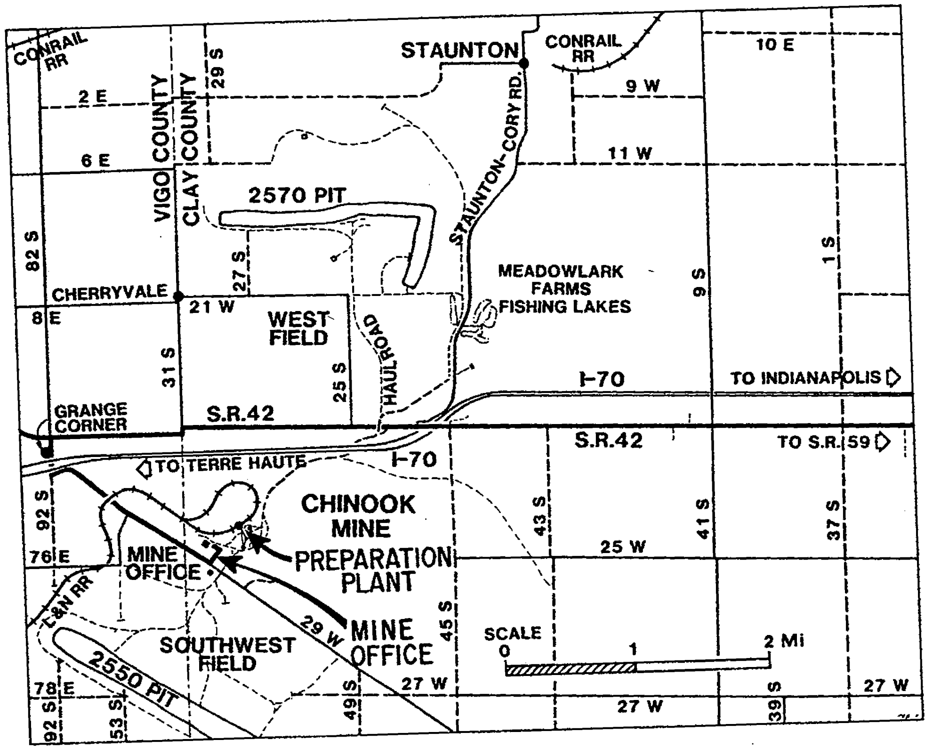


Figure 3.1 Map of Chinook Mine showing the general location of the West Field and the Southwest Field.

SOURCE: AMAX Coal Company brochure.

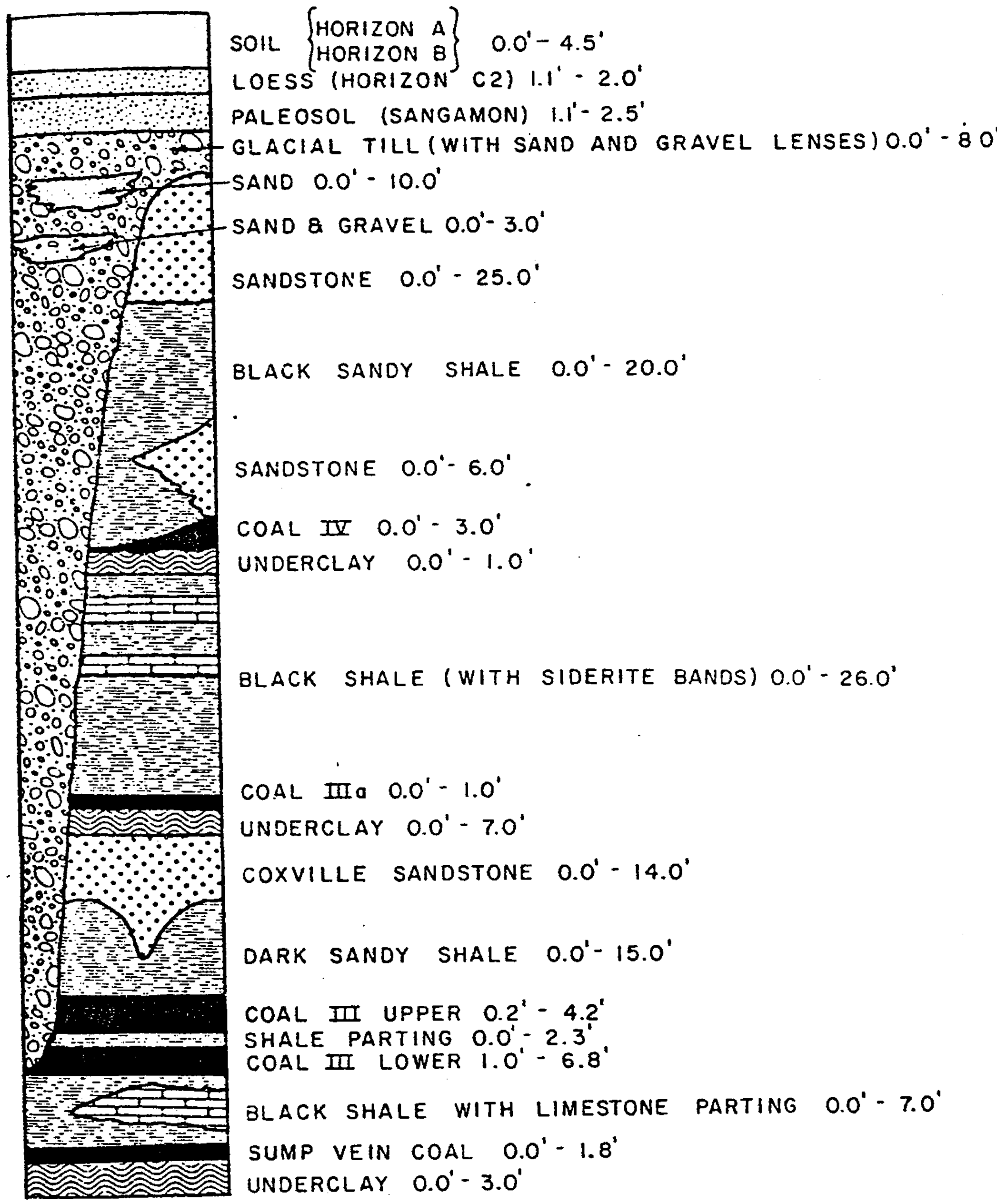


Figure 3.2 Generalized stratigraphic column of the West Field.

SOURCE: Chinook Mine - West Field 1981-82 permit application.

silo for supply to the plant. After processing, the clean coal is stored in a 15,000-ton-capacity silo until it is shipped.

One of the corporate farms operated by Meadowlark Farms is also located at the Chinook Mine. In addition to the revegetation operations, Meadowlark raises row crops and manages a herd of cattle on reclaimed land. A portion of the Meadowlark Farms facilities is shown in Figure 3.3. A herd of cattle grazing near a lake formed from an old incline in a reclaimed area is shown in Figure 3.4.

3.3 Environmental Planning and Engineering

The Environmental Engineering Department of AMAX Coal, located at the headquarters in Indianapolis, conducts all environmental engineering and planning activities for the eight AMAX Coal mines in Indiana and Illinois. This department consists of approximately 25 professionals in various engineering and scientific disciplines. The department is divided into three groups according to the services that they perform. These groups are Environmental Engineering, Environmental Services, and Environmental Studies and Planning.

The Environmental Design Group is mainly concerned with the control and handling of surface water before, during, and after mining operations. They are responsible for the design of water-related structures such as small dams and diversions. This responsibility includes both hydraulic, water treatment, and stability considerations. They also must formulate plans to meet air and noise standards and deal with special environmental situations that may arise such as the handling of toxic substances.

The Environmental Services Group provides input into the engineering design phase. They are responsible for such activities as monitoring groundwater, determining probable hydrologic consequences of mining, and characterizing soil and overburden. They assist in determining proper overburden handling techniques and selecting reclamation equipment.

The Environmental Studies and Planning Group was formed in the middle 1970s to conduct environmental baseline studies for new mine sites and expansion areas. The group's staff, consisting of environmental scientists and planners from several disciplines, conduct in-house baseline studies and coordinate the work of various outside consultants. The baseline data covers a broad spectrum including terrestrial ecology, aquatic biology, climate, air quality, archeology, socio-economic conditions, prime farmland, and land use. Although the environmental impact statement requirements of the 1970 National Environmental Policy Act do not apply to nonfederal projects, the Studies Group was set up to address many of the environmental issues covered by that act. With the background data requirements specified in the Surface Mining Control and Reclamation Act of 1977, the Studies Group has become an important component in the permit application procedure. The postmining land use planning function of this group will be discussed at greater length in the following chapter.

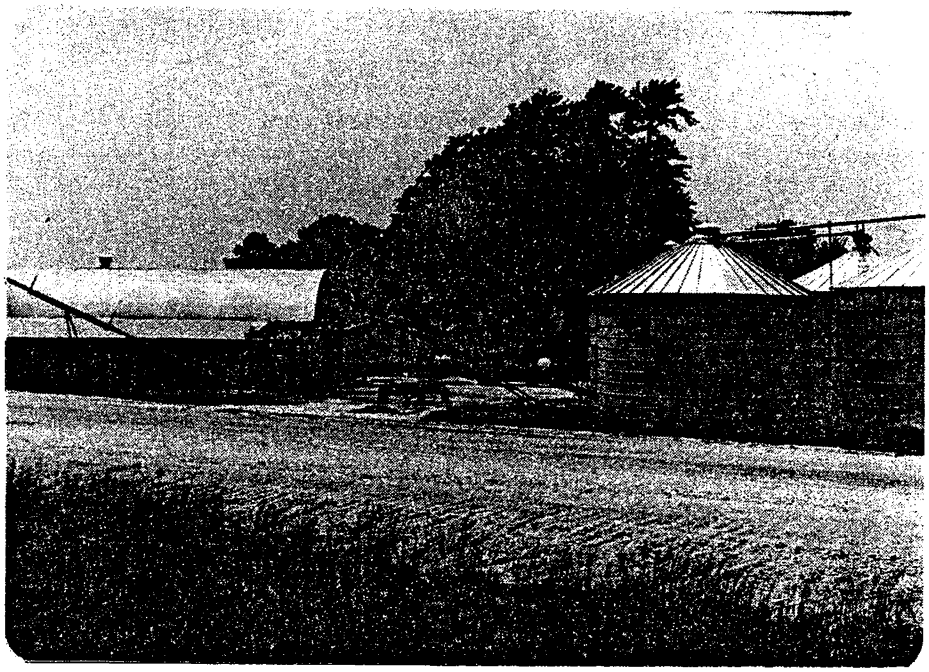


Figure 3.3. Photograph of Meadowlark Farms Chinook facilities.

Figure 3.4. Cattle grazing on reclaimed land managed by Meadowlark Farms at Chinook Mine.

The Studies Group works closely with the exploration group performing background studies that parallel the various exploration phases. When the exploration of a new area begins, the Studies Group will be notified and asked to prepare an environmental memorandum. This memorandum requires only a one- or two-day effort and is limited to a search of published literature. At the beginning of the exploratory drilling stage, the Studies Group prepares an environmental reconnaissance report that requires additional library research and contacts with key state agencies. As exploration proceeds, an environmental assessment report is prepared. This report is based upon two or three days of field inspection, analysis of several water and overburden samples, and preliminary input from the other groups within the Environmental Engineering Department. If a decision is made to go ahead with the project, an environmental baseline study may be conducted with or without assistance from outside consultants. Such a study would include baseline data collection for several environmental components and an inventory of local cultural and socio-economic conditions.

3.4 Surface Mining Permit and Reclamation Bond

The responsibility of obtaining the required surface mining permit lies with the Regulatory Affairs Section of the Engineering Department of AMAX Coal. The permitting process begins when the engineers in operations place a request with Regulatory Affairs. If it is an expansion or renewal request for an existing mine, Regulatory Affairs will review a checklist with the personnel at the mine. The three groups within the Environmental Engineering Department will then begin gathering the required information. Regulatory Affairs takes the information from all sources, coordinates and checks the material for legal sufficiency, and prepares a draft of the permit. The draft is circulated to Environmental Engineering and the mine office to insure technical accuracy. After this check has been performed, the permit application is sent to the state regulatory authority. In this case, the regulatory authority is the Indiana Department of Natural Resources (DNR) Division of Reclamation. Indiana requires that a $1000 permit fee and an average fee of $50 per acre be submitted with the application. After DNR reviews the permit application and conducts a site inspection, they may request additional information. Once DNR has approved the application, the Natural Resources Advisory Council makes an official recommendation to the Natural Resources Commission that the permit be issued. In the monthly meeting of the Natural Resources Commission, the recommendations of the Natural Resources Advisory Council are generally acted upon without further investigation. After this official action has been taken, the surface mining permit is issued to the company. A lead time of three or four months is usually allowed for permit approval. Before the permanent regulatory program under PL 95-87, Indiana had required annual submission of a permit application that covered the entire proposed mine. Although these frequent submissions represent considerable paperwork, the actual investigation required may not be extensive because the renewals only require an update of the previous application. Under the permanent regulatory program, five-year permits will be issued. The only county planning consideration required at the Chinook Mine is permission to temporarily close or mine within

100 feet of county roads. Since the state of Indiana has no requirements that county officials review or approve permit applications, and since neither Clay County nor Vigo County has applicable land use plans, only state approval is necessary for the permit application.

Upon request of DNR, the mining company is required to submit a reclamation bond before the permit will be issued. Indiana employs a scheduling scheme for determining the magnitude of the bond required per acre. For each condition that applies to the company or the specific mine in question, an incremental amount is added to the total bond. The elements found on Form R-102 "Bond Evaluation Factor Sheet" are listed in Table 3.3 along with the applicable rate per acre for each component. The purpose of this type of scheme is to allow companies with good compliance records to obtain a bond at a reasonable rate. At the same time, those companies with poor records have more applicable bond evaluation factors.

The Chinook Mine - West Field was first permitted in 1977. The 1981-82 renewal permit application covers 2,976 acres as shown in Figure 3.5. This is the entire area that was included in the original mining plan. The only applicable bonding evaluation factor that applies to the West Field is one pertaining to overburden geological formation. Since the overburden is composed of more than 30 percent consolidated material, the bond rate was set at $250 per acre.

3.5 Mining Engineering

A straight pit, running east-west, was the original mining plan for the West Field. Due to the uncertain location of abandoned underground workings in the northwest corner of the West Field, this plan was modified. The pit now has a dogleg that extends south along the eastern boundary of the property.

The average depth of overburden to be removed above the III Coal is about 85 feet. This results in a stripping ratio of approximately 15 to 1. The overburden is drilled using a Bucyrus-Erie 61-R drill. The initial blasting plan specified 15-inch diameter holes on a 45-by-39 foot grid. ANFO is used as the blasting agent and is detonated by a combination of cast primers and primacord. Approximately 1200 pounds of ANFO are used per hole. A Bucyrus-Erie 30-R drill is used to drill the parting between the III Coal and the sump vein. These holes, 5 5/8 inches in diameter, are drilled on a 12-by-15 foot pattern. Each hole is loaded with approximately 25 pounds of ANFO and detonated as previously described.

After the overburden has been fragmented, the material is removed by the Bucyrus-Erie 2570-W dragline. The dragline uses a direct side cast method with advance benching. Approximately 15 feet of material is removed by the chopdown method to produce the advance bench. A range diagram with typical pit dimensions is shown in Figure 3.6. Important dragline specifications are listed in Table 3.4. The range diagram shows the placement of the bench material on top of the initial spoil pile. Selective overburden handling is practiced to prevent complete

Table 3.3

Indiana Department of Natural Resources
Reclamation Bond Evaluation Factors

	Factor	Required Bond per Acre
1.	Previous Compliance: i.e., if the operator has violated any of the provision of IC 13-4-6, as amended.	$2,500
2.	Business Structure: i.e., if the operator has not been conducting a coal related business for more than three (3) years under the same name.	$ 750
3.	Previous Surface Mining Experience: i.e., if the operator has less than three (3) years surface mining experience under I.C. 13-4-6 as amended.	$2,000
4.	Depth of Overburden: i.e., if the average depth of the overburden is greater than fifity (50) feet.	$ 500
5A.	Surface Mining Method: i.e., if the operator uses exclusively dozers and/or frontend loaders for overburden removal.	$1,000
5B.	If the operator removes a coal seam that is twenty-four (24) inches or less. (Only if 5A applies).	$ 250
6.	Size of Proposed Operation: i.e., if the operator submits an application for twenty-five (25) acres or less.	$ 500
7.	Geological Formation: i.e., if the overburden is composed of more than thirty (30) percent consolidated materials such as: limestone, sandstone and shales or a combination thereof.	$ 250
8.	Attachable Real Property and Other Assets: i.e., if the operator does not have attachable real property or other assets within the State of Indiana.	$1,000
9.	If the operator does not plan to separate unconsolidated materials and replace those materials on the surface of the graded affected areas.	$ 250
10.	Other factors relative to the operator's ability to accomplish the intent of IC 13-4-6 as amended.	var.

Source: Indiana DNR Form R-102

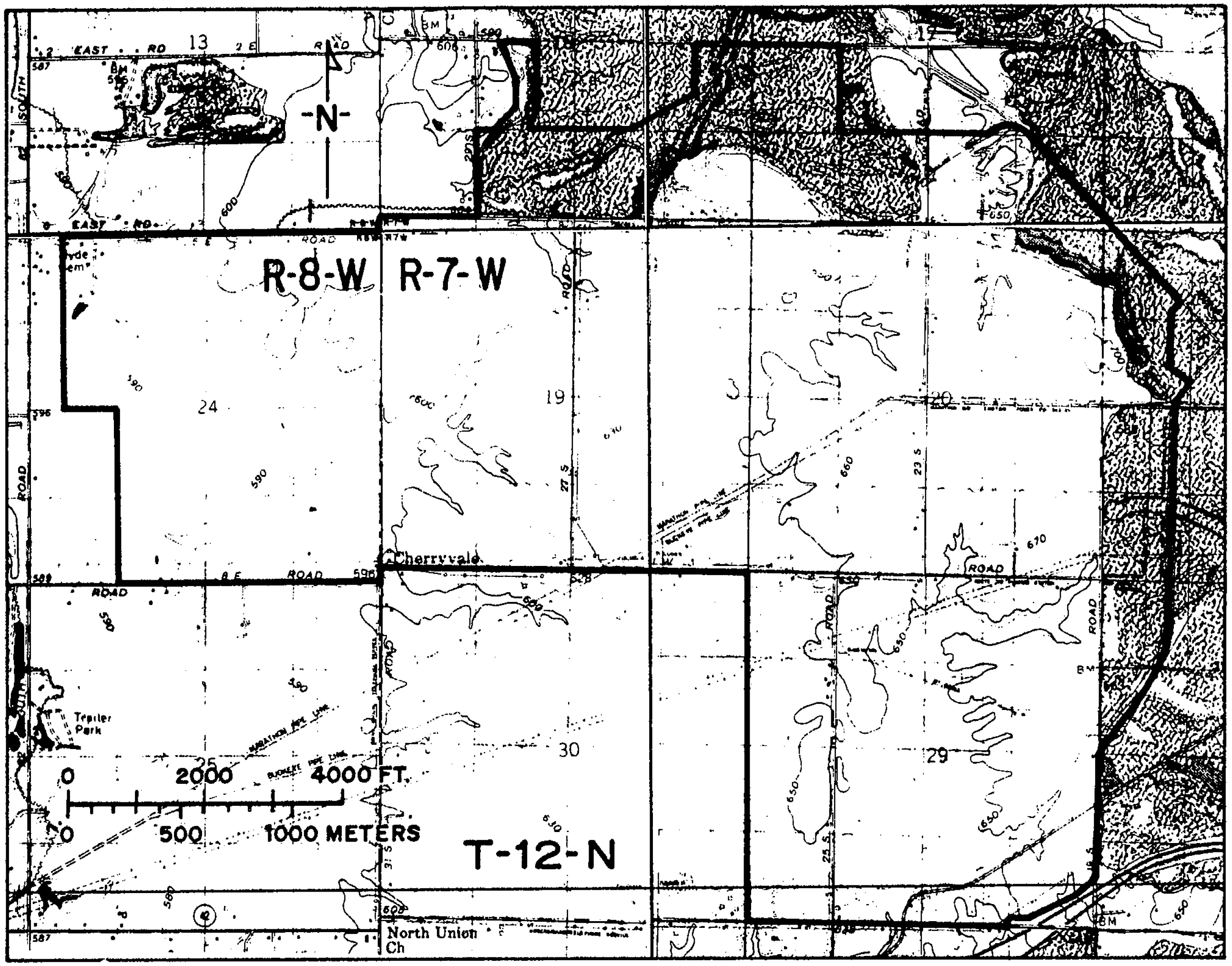


Figure 3.5 Chinook Mine - West Field 1981-82 permit area.

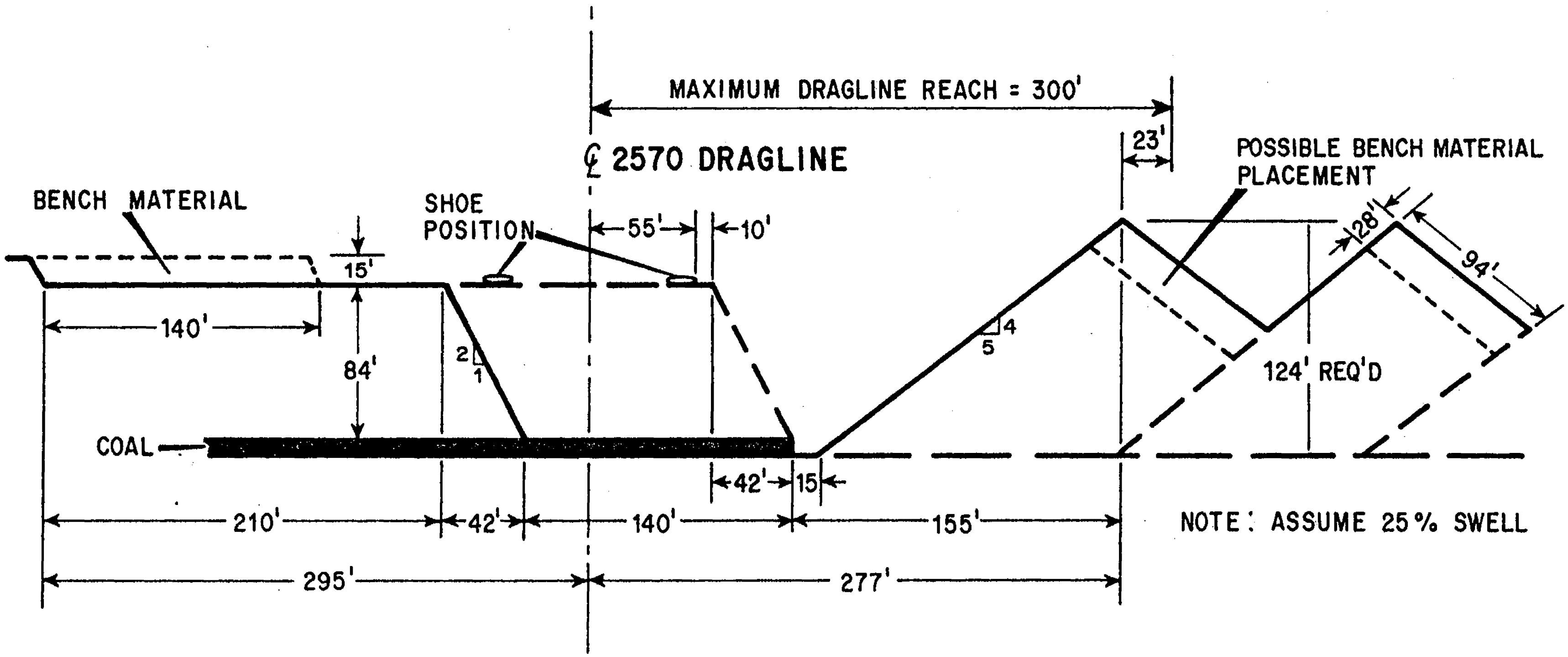


Figure 3.6 Range diagram for the West Field.

Table 3.4

Bucyrus-Erie 2750-W
Dragline Specifications

Boom length	335 feet
Working radius	310 feet
Weight (in millions lbs)	12.5
Horsepower	12,000 AC
Bucket capacity (in cu yds)	110
Maximum digging depth	160 feet
Tub diameter	80 feet
Walking speed	0.15 mph
Length of step	8.5 feet
Maximum suspended load	160 tons

Source: AMAX Coal Company brochure.

inversion of the overburden and thereby keep the spoil with potentially acid-producing components lower in the cast overburden. The advance bench created by the dragline is shown in Figure 3.7. A photograph of the cast overburden, Figure 3.8, shows the bench material on the spoil.

The bucket capacity of loading shovels used at Chinook range from 12 to 16 cubic yards (Figure 3.9). Between the West Field and the Southwest Field the Chinook Mine employs 13 coal haulage trucks. This fleet of bottom-dumps is made up of Euclids, Unit Rigs, and Darts which range in capacity from 100 to 120 tons. Some of the grading and reclamation equipment include two HD41B and four HD31B Fiat Allis dozers, seven D9 Caterpillar dozers, two D65P Kumatsu dozers, five 353 WABCO scrapers, eight TS-24 Terex scrapers, one 95WT Northwest dragline, one 9W dragline, two 16G Caterpillar scrapers, and one Terex water truck (Figure 3.10).

3.6 Reclamation Plan and Postmining Land Use

In Indiana, a reclamation plan must be submitted as part of the permit application. The general categories that must be addressed in the reclamation plan are:

- Area and mineral to be mined
- Method of operation
- Erosion and drainage control
- Grading work
- Refuse and debris
- Revegetation and soil amendments.

Some of these topics have been discussed, generally, in the preceding sections. In the following subsections, four specific components of the reclamation plan are addressed.

3.6.1 Topsoil Handling Plan

A detailed soil map of the West Field is shown in Figure 3.11. The name, percent slope, and agricultural capability unit for each of the soil mapping units are summarized in Table 3.5. An explanation of the Soil Conservation Service agricultural capability units is given in Appendix 1. According to the Soil Conservation Service's technical definition, practically all of the soils in the West Field are classified as prime farmland with the exception of those soils on steep slopes situated along natural drainageways.

Under PL 95-87, these soils would be subject to the special soil handling requirements specified in Part 823 of the permanent regulations. These requirements include soil removal to a depth of 48 inches plus separate removal and stockpiling of the A, B, and C soil horizons. The major portion of the West Field, however, satisfies the "grandfathering" criteria specified by DNR and, therefore, is exempted from the strict prime farmland standards. In conformance with Part 716.7(a)(2)(i-ii) of the initial regulatory program, the Division of Reclamation Director for DNR has specified, in an April 30, 1979, letter to all

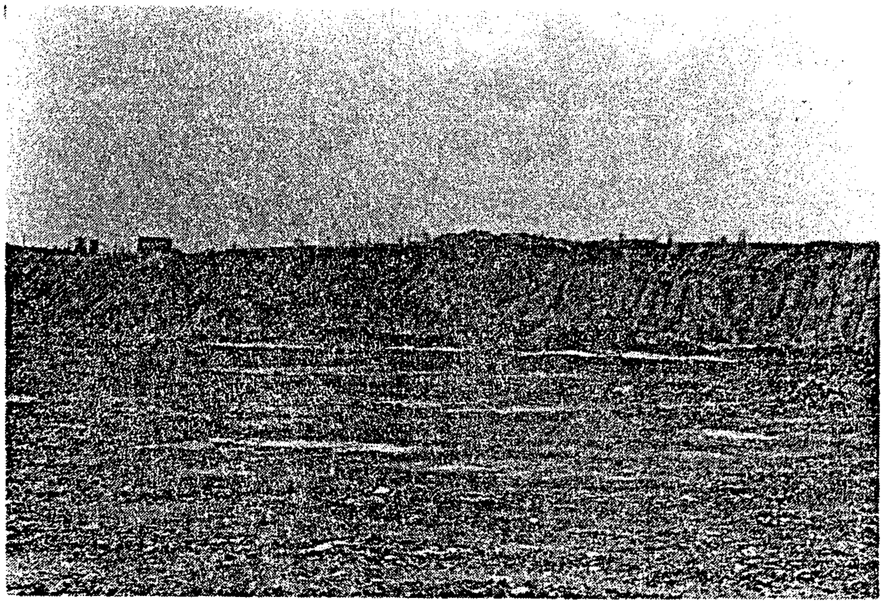


Figure 3. 7. Advance bench created by the dragline.

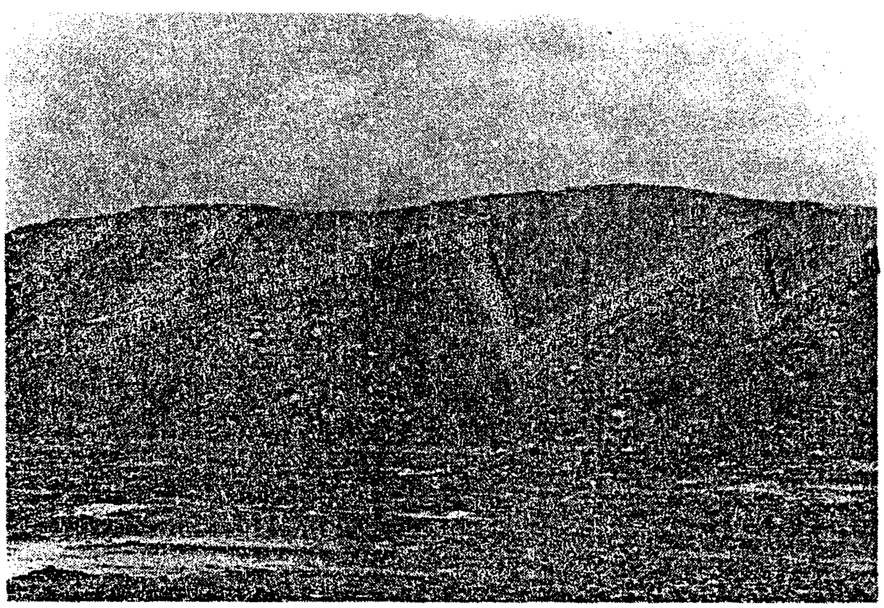


Figure 3.8. Cast overburden showing the placement of bench material at the top of the spoil pile.

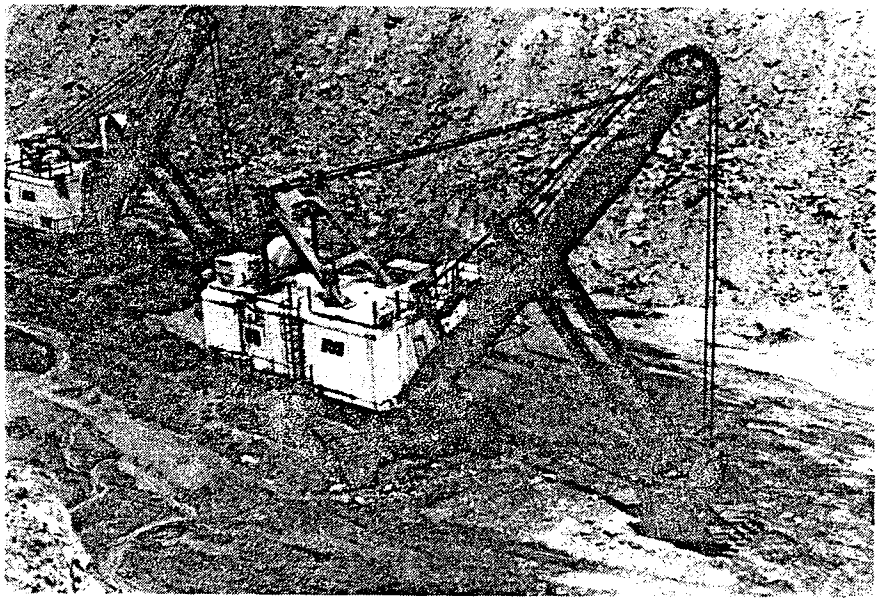


Figure 3.9. 151-M Marion coal loading shovel used in the West Field.

Figure 3.10. Grading and reclamation equipment in use.

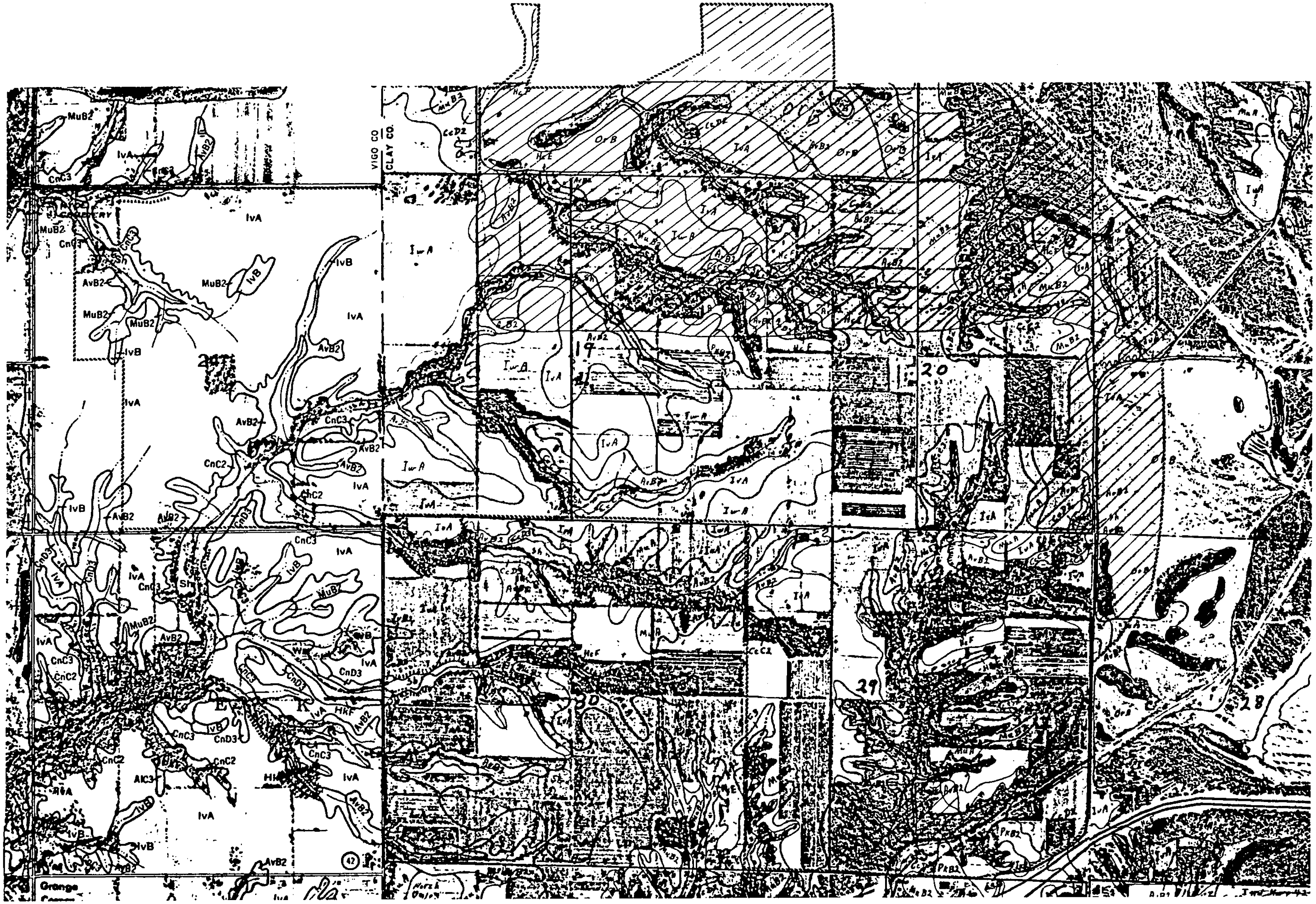


Figure 3.11. Soil map of Chinook Mine - West Field.

SOURCE: Chinook Mine - West Field 1981-1982 permit application.

Table 3.5

Identification of Soil Units

Mapping Units Clay	Vigo	Series Name	Slope %	Capability Unit
AlB	AlB2	Alford	2-6	IIe-3
AvB2	AvB2	Ava	2-6	IIe-7
CcC2	CnC2	Cincinnati	6-12	IIIe-7
CcC3	CnC3	Cincinnati	6-12	IVe-7
CcD2	CnD2	Cincinnati	12-18	
CcD3	CnD3	Cincinnati	12-18	VIe-1
CoA	Co	Cory	0-2	IIw-2
Ee	Ee	Eel	0-2	I-2
HcD	-	Hickory	12-18	
HcD2	-	Hickory	12-18	
HcD3	-	Hickory	12-18	
HcE	HkE	Hickory	18-25	VIe-1
HcF	HkF	Hiclory	25-40	VIIe-1
IvA	IvA	Iva	0-2	IIw-2
IvB2	IvB	Iva	2-4	IIw-2
IwA	-	Hoosierville	0-2	
MuA	MuA	Muren	0-2	I-1
MuB2	MuB2	Muren	2-6	IIe-3
PaD2	PaD2	Parke	12-18	IVe-1
PkB2	-	Parke	2-6	
-	Ra	Ragsdale	0-2	IIw-1
-	Re	Reesville	0-2	IIw-2
Sh	Sh	Shoals	0-2	IIw-7
Sn	-	Stendal	0-2	
Wa	Wa	Wakeland	0-2	IIw-7

Source: Chinook Mine-West Field 1981-82 permit application, SCS, Soil Survey of Vigo County, 1974.

Indiana surface mine operators, the criteria for obtaining this exemption. The letter states, "In the request (for a grandfather determination) the operator must show:

1) That a permit was in effect before August 3, 1977.
2) That the operator has mined continuously to that permit.
3) The prime farmland area for which the determination is sought; identifying past and existing permit boundaries and lands on which no permit is currently being held.
4) Proof that the area for which the determination is sought was owned or legally controlled for the purpose of surface mining for coal on or before August 2, 1977."

A grandfather determination has been requested and granted for all but about 80 acres of the West Field. Having obtained this exemption, the topsoil handling plan specifies removal, by scrapers, of eight to twelve inches of topsoil which will either be appropriately stockpiled or spread on areas approved for topsoil replacement. The stockpiling and temporary revegetation of topsoil are illustrated in Figure 3.12. It is estimated that a maximum of twelve inches of topsoil is present on upland soils and no more than ten inches on bottomland soils. There are two areas where there may be problems in complete topsoil removal. One is the steeply wooded areas along drainageways and the other is the poorly drained bottom areas where equipment operation is severely affected. In both these areas as much topsoil will be removed as is reasonably and safely possible. Upon reclamation, suitable alternative soil materials will be substituted for the topsoil that could not be salvaged.

3.6.2 Revegetation Plan

Revegetation practices and species selection vary according to the specified postmining land use. The majority of the West Field is designated to be returned to row crops and pasture. Upon replacement of the topsoil, soil samples are analyzed to determine the proper amounts of lime and fertilizer application. These amendments are applied by a conventional spreader and disked or harrowed into the soil. Two separate seeding procedures have been established which depend upon the season of the year. For spring planting, a cover crop is established using either 2 bushels per acre of spring oats in the early spring or 20 pounds per acre of rye grass or millet in the late spring. In addition to the cover crops, 12 pounds per acre of alfalfa, 6 pounds per acre of Alsike clover, and 20 pounds per acre of orchard grass are planted. For fall planting, winter wheat is sown at a rate of 1 1/2 bushels per acre for the cover crop. In addition to the winter wheat, 10 pounds per acre of orchard grass and 12 pounds per acre of alfalfa are planted. The area is then overseeded aerially with a mixture of legumes consisting of 12 pounds per acre of alfalfa and 6 pounds per acre of Alsike clover. In all cases, additional fertilizer topdressing is applied if plant and soil deficiencies are noticed.

For areas that are designated as forest land, a cover of annual ryegrass, orchard grass, and Korean lespedeza is used during spring planting. Wheat is included if seeding is done in the fall. Native

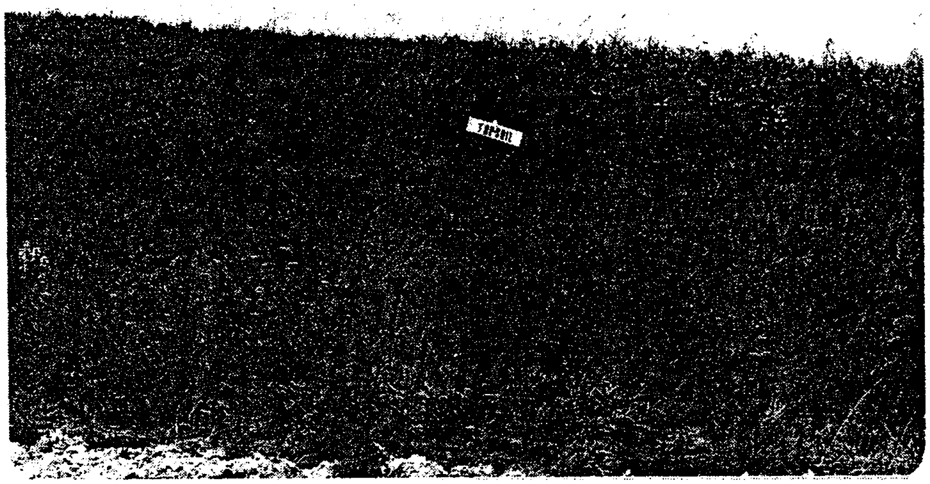


Figure 3.12. Stockpiled topsoil with temporary revegetation.

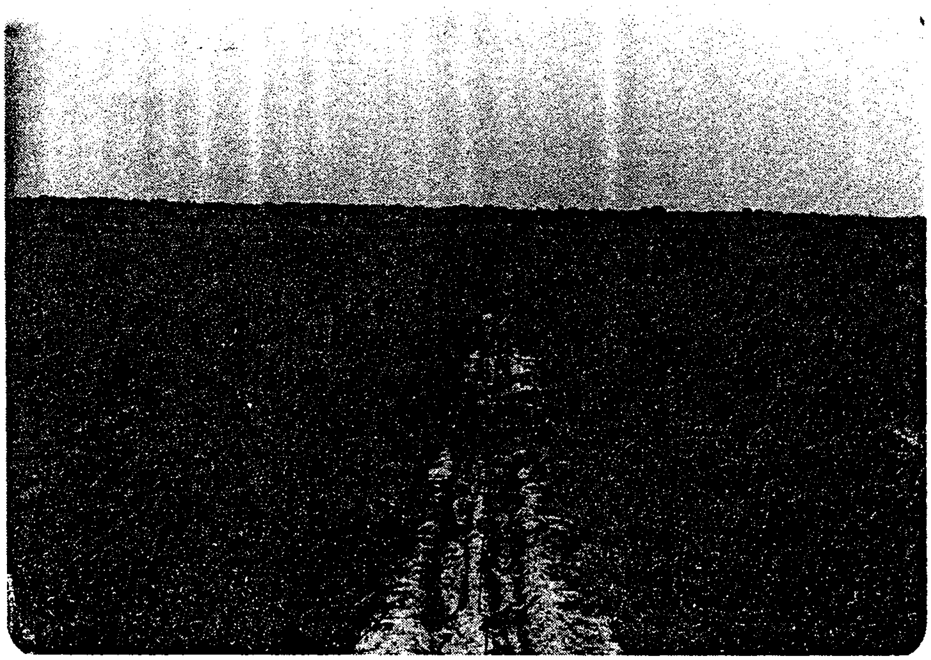


Figure 3.13. Plantation pattern used to revegetate forest land.

hardwood species normally planted are walnut, oak, hickory, poplar, and ash. Conifers are sometimes planted to add to the aesthetics of the area and to provide winter cover for wildlife. White pine and red cedar are commonly used for this purpose. Forested areas are generally planted at a density of 890 trees per acre. Both a 7-foot-by-7-foot plantation pattern and a variable pattern are used for tree planting. An example of recently planted seedlings is shown in Figure 3.13. Band spraying of a broad-spectrum herbicide has been used in this example to decrease the competition with other plants. A variable pattern is used in some cases for wildlife, recreation, or erosion control purposes.

Revegetation of wildlife areas also begins with a cover crop of annual ryegrass, orchard grass, and Korean lespedeza plus wheat if planted in the fall. The perimeter of the wildlife areas and selected sites within the area are planted with woody species such as black locust, autumn olive, and Virginia pine or other approved species. Natural succession is then allowed to occur, returning the land to a condition comparable to an "old field" habitat. Special wildlife management techniques are employed in some cases, such as the creation of small impoundments and hedgerows, to provide a more suitable wildlife habitat.

3.6.3 Drainage Plan

A well designed drainage plan is necessary to minimize the negative effects of mining on surface water quality. The major components of this plan are three sedimentation ponds and both natural and constructed drainageways. These components are illustrated in Figure 3.14.

A minor drainage divide separates the site into two watersheds. A small portion of the site drains to the northwest. Runoff from this area is captured by Sedimentation Pond 6A and is eventually directed into Sulphur Creek. The remainder of the site drains to the south and to the west. This runoff is collected in Sedimentation Ponds 7 and 8 before it is released into Honey Creek.

Sedimentation Pond 6A is a dug-out type impoundment that existed prior to the present mining operation and is to remain as a permanent impoundment. It was designed to handle the runoff from a 602-acre area for a 10-year 24-hour storm. It has a design capacity of 3,733,000 cubic feet and a surface area design pool stage of 914,760 square feet. Three ditches 6A-1, 6A-2, and 6A-3 have been proposed to channel runoff into Pond 6A along with the runoff from existing drainageways. They have been designed to carry the runoff from a 100-year 24-hour storm. The total drainage area and design discharge for these ditches are as follows:

	Drainage Area	Design Discharge
Ditch 6A-1	444.3 acres	599 cfs
Ditch 6A-2	12.6 acres	26.6 cfs
Ditch 6A-3	4.65 acres	9.8 cfs

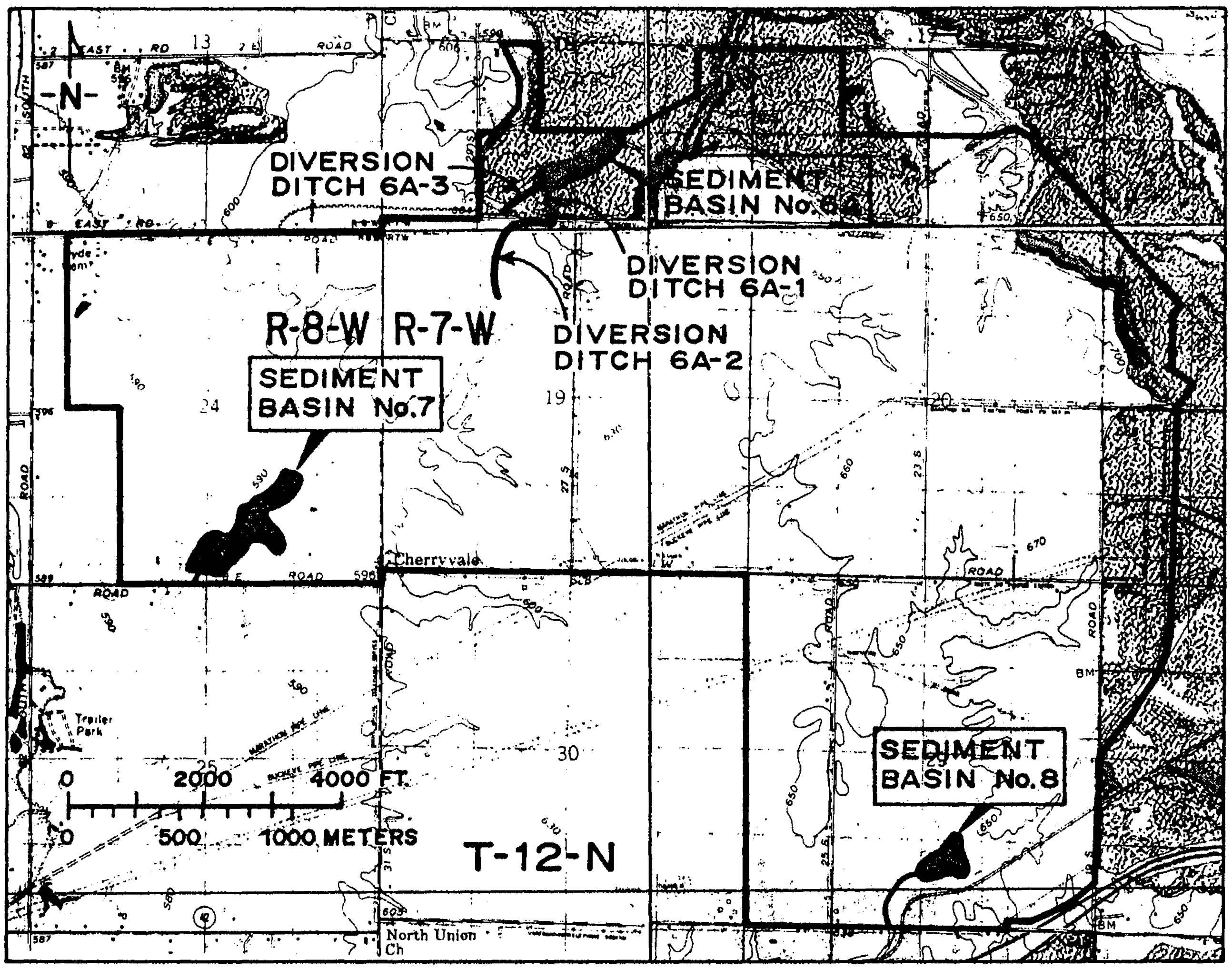


Figure 3.14. Drainage plan for the West Field.

Source: Chinook Mine - West Field 1981-82 permit application.

Sedimentation Ponds 7 and 8 have been designed for a 10-year 24-hour storm event. Sedimentation Pond 7 is a cross-valley dam type impoundment. It has been designed for a 1075-acre drainage area. The design capacity is 9,301,000 cubic feet and the surface area at design pool stage is 566,280 square feet. Pond 8 is a dug-out type impoundment that collects runoff from a 711-acre area. Its design capacity is 4,708,466 cubic feet and its surface area is 307,707 square feet at design pool stage.

3.6.4 Postmining Land Use Plan

The postmining land use plan has several objectives. The first objective is to balance, as nearly as possible, the acreage in various postmining uses with the respective premining acreage. The reclaimed acreages are not necessarily situated in the same location they occupied before mining. An effort is made to consolidate areas of a given use such as row crops, for easier management. With Meadowlark Farms presently owning approximately 62 percent of the 2976-acre permit area, redistribution and consolidation of certain land uses is both feasible and practical. A second objective of the plan is improvement of areas that are not presently being used or managed adequately. This includes the elimination of previously unreclaimed land and other mine-related disturbances. Another objective is reestablishment of the township grid system. Finally, the land use plan is intended to coordinate postmining uses with existing ownership and use patterns.

The four main postmining land use components are row crops, pasture, forest, and wildlife areas. A small amount of land will be used for surface water impoundments and public roads. The premining area and proposed postmining area by land use are listed in Table 3.6. These areas are mapped on Figures 3.15 and 3.16, respectively. The most abundant premining and postmining land use is row crops. Over half of the permit area was used for row crops prior to mining and the same amount of land will be returned to row crops. Due to the conversion of some previously unreclaimed land and land disturbed for other reasons, the amount of pasture and hayland will increase from 265 acres to 725 acres, forest land will increase from 397 acres to 471 acres, and 145 acres of new wildlife habitat will be established. The amount of land occupied by surface water impoundments will remain unchanged at 29 acres and will be used in conjunction with cattle grazing and wildlife enhancement.

Except for the box cut and end cut spoil, the entire surface will be returned to the approximate original contour. In these special areas, the spoils will be graded to a maximum 3:1 slope and established as wildlife habitat through proper revegetation.

Table 3.6

Distribution of Premining and Postmining
Land Use for the West Field

Land Use	Premining Acres	Postmining Acres
Row Crop	1581	1581
Steep Slope Row Crop	27	-
Pasture/Hay	265	725
Forest	397	471
Water	29	29
Wildlife	-	145
Previously Mined & Unreclaimed	102	-
Mine Related Disturbance	146	-
Prev. Mined & Reclaimed to Pasture	376	-
Haul Road	27	-
Public Road	25	25
Utility	1	-
TOTAL	2976	2976

Source: Chinook Mine - West Field 1981-82 permit application.

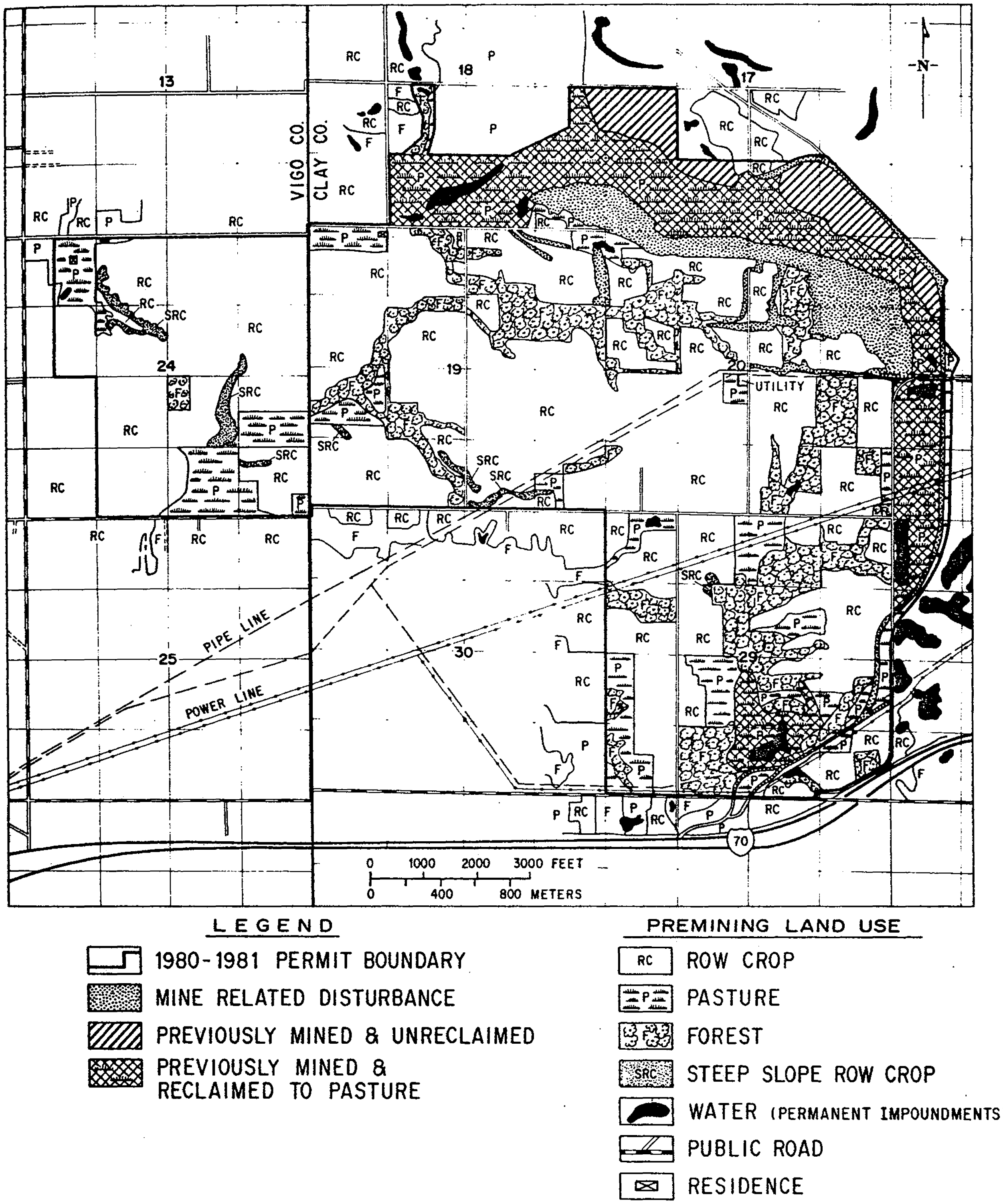


Figure 3.15. Premining land use plan.

Source: Chinook Mine - West Field 1981-82 permit application.

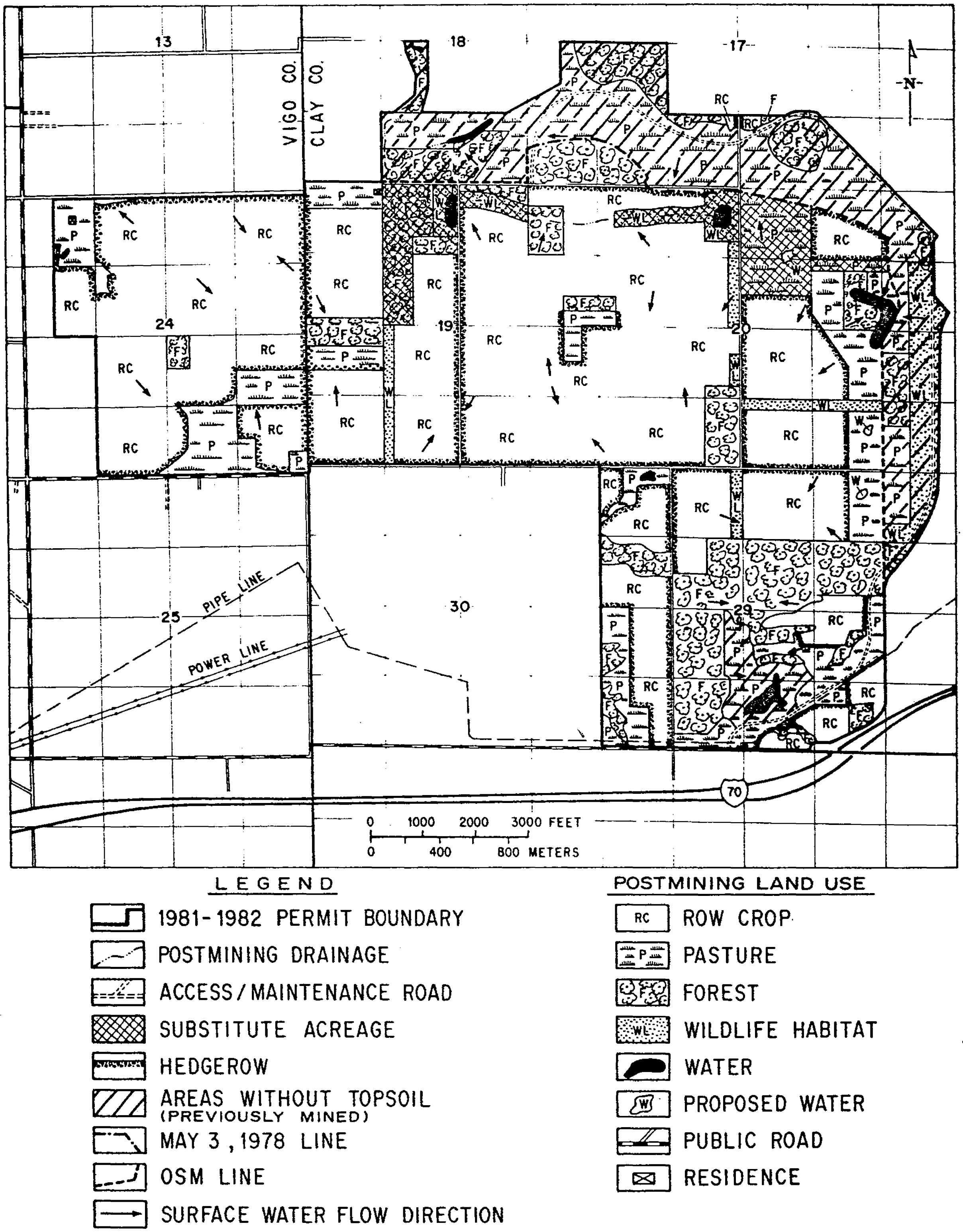


Figure 3.16. Proposed postmining land use plan.

Source: Chinook Mine - West Field 1981-82 permit application.

Chapter 4

LAND USE PLANNING

4.1 Overview

Land use planning is a nonspecific term that can be applied to two distinct levels of planning. Macro-scale land use planning, also known as comprehensive planning, is directed toward guiding growth, development, and land use for an entire region through the formulation of a comprehensive plan. Micro-scale planning, generally referred to as site planning, is concerned with developing a site for specific purposes such as mining. The objective is to develop a site plan which is in concert with the overall comprehensive plan for the area. Macro-scale planning is generally conducted at the county or multi-county level by public planners. It can be conducted on a state or Federal level in some instances. Although surface mine planners are not engaged in this process, they are affected by the results. Site planning is generally a function of the private sector, particularly land developers and, to a lesser extent, mine planners as well.

The processes used for both types of land use planning are essentially the same but the level of effort may vary significantly. Ideally, comprehensive planning should precede site planning and provide input to the site planning process. It is not uncommon, however, for site planning to be conducted in an area which has no comprehensive plan. This places the burden on the site planner to consider the regional objectives and determine how much effort should be directed toward evaluating these objectives. The land use planning process illustrated in Figure 4.1 is essentially the regional planning model given by Chapin (1979) with some modifications. Some of the steps that are central to the regional planning process may become less significant or routine at the site-specific level. For example, once a mining company has defined the scope of its reclamation and land use planning program, this scope will not change drastically for each successive operation. References will be made in the following chapter to the various planning process stages illustrated in Figure 4.1.

4.2 Regional Planning

The Public Works and Economic Development Act of 1965 was the basis for establishing many regional planning agencies throughout the United States. In 1968 such an agency was formed in the western central region of Indiana that includes the Chinook Mine. This agency was designated the West Central Indiana Economic Development District, Inc. (WCIEDD). Initially, the agency served a five-county area including Clay, Parke, Sullivan, Vermillion, and Vigo. Around the time that WCIEDD was formed, the State of Indiana established 18 planning and development regions throughout the state. Region 7 was formed to include the five counties of the WCIEDD plus adjacent Putnam County. Therefore, in 1972 the WCIEDD was expanded to include Putnam County and thus be conterminous with Indiana Region 7 (WCIEDD, 1977a).

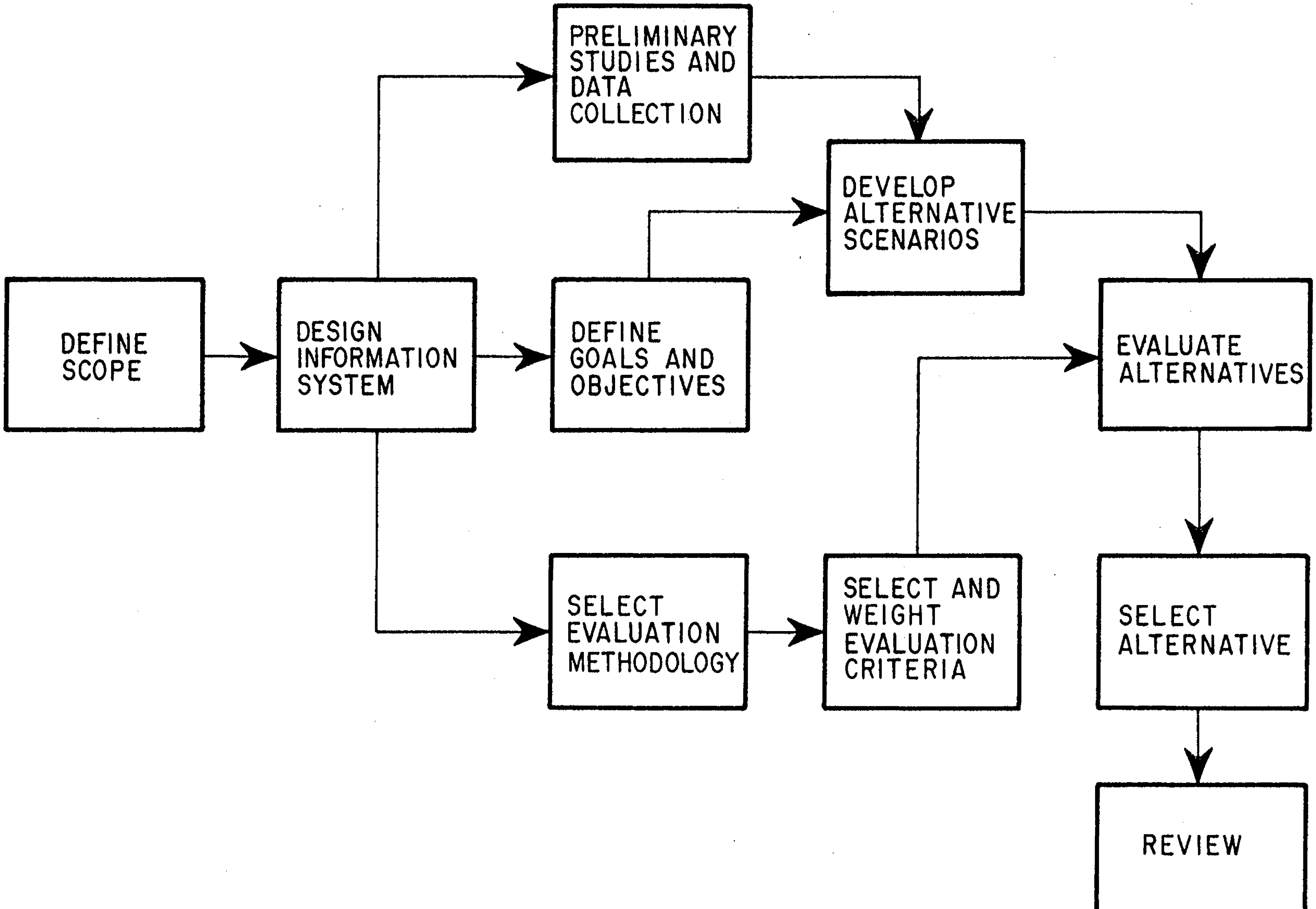


Figure 4.1. Land use planning process.

The WCIEDD has five basic areas of planning responsibility as indicated on the organization chart, Figure 4.2. These five planning responsibilities are: Economic Development Administration Development Planning, EPA Section 208 Program, Transportation Planning, HUD "701" Planning, and Aged and Aging Programs. The major function of the agency in each of these areas is the review of Federal grant applications. The WCIEDD has prepared an Overall Economic Development Plan, 1976-1980 (WCIEDD, 1977a) which considered various development strategies for the region and postulated a work program designed to implement those strategies. This document serves as a valuable source of background information on the region.

A District Land Use Element (WCIEDD, 1977b) was prepared by the WCIEDD in 1977 with funds from a HUD "701" Comprehensive Planning Grant and contributions from the member counties. Since the WCIEDD has no authority to enact any land use control measures, such as zoning ordinances, the document serves mainly as a recommendation to the member counties. If the county governing bodies chose to do so, they could implement all or portions of the land use plan. None of the six counties have elected to do that. Presently, the land use plan is used only as resource material when the WCIEDD is called upon to review a federal grant application.

As part of the background study performed in the formulation of the land use element, the WCIEDD attempted to define a series of regional goals and objectives. These general goals and objectives include the following (WCIEDD, 1977b):

General Goals

1. To encourage sound economic development of which will obtain maximum utilization of the natural resources of the District.

   a. Soil
   b. Water
      1) Ground Water
      2) Surface Water
   c. Coal
   d. Clay
   e. Sand and Gravel
   f. Forest
   g. Oil
   h. Limestone

2. To encourage growth in employment by providing a desirable environment for industrial and commercial enterprises in accord with the advantages present in the District.

3. To protect the tax base in the District by inducing a development pattern which enhances property values on adjacent land parcels and does not permit development which will detract from the value of present development.

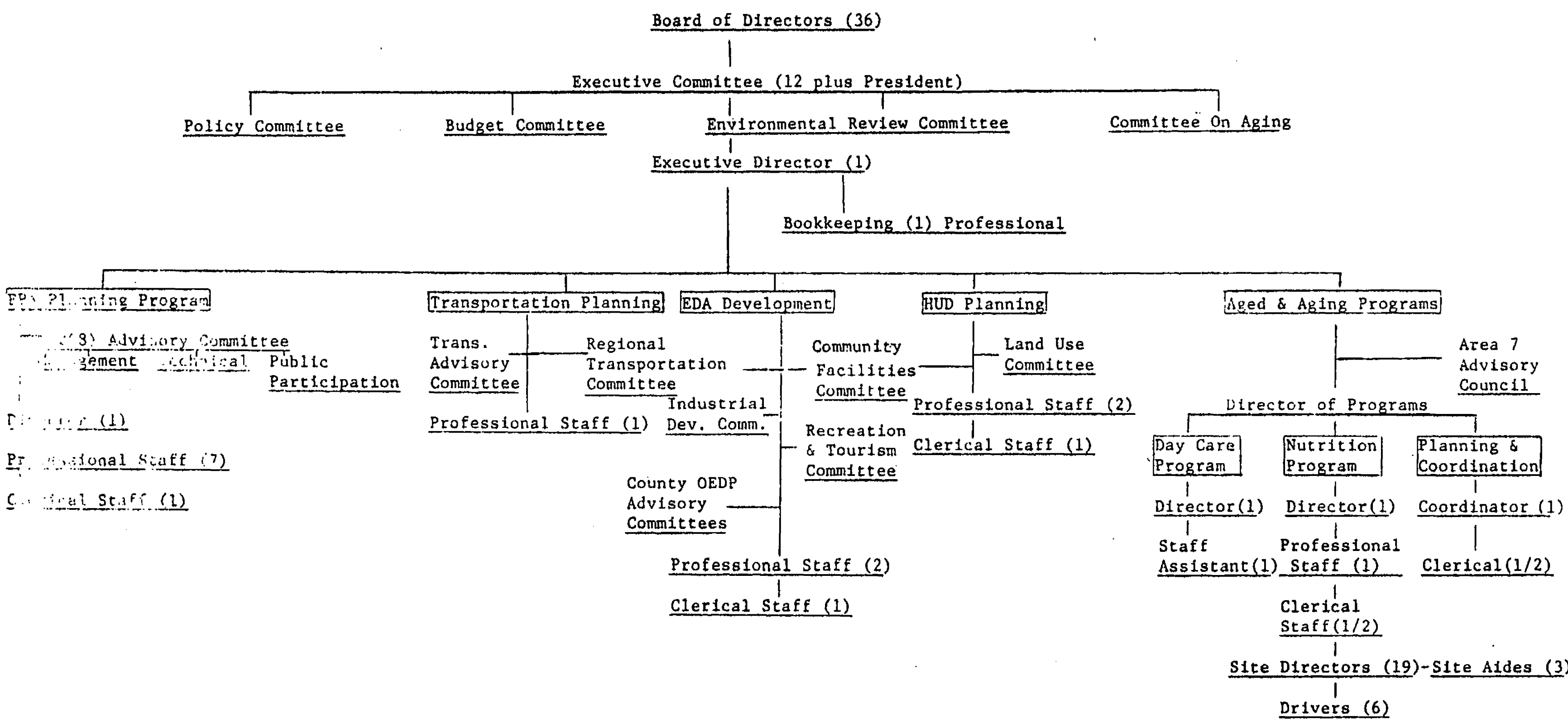


Figure 4.2. Organization chart for the West Central Indiana Economic Development District, Inc.

Source: WCIEDD, 1977a.

4. To provide a positive environment for the construction and maintenance of commercial, industrial and residential areas in the District.

5. To promote orderly growth in such a way that it does not adversely affect the quality of the physical, aesthetic, or social environments.

6. To promote the protection of prime agricultural land, aquifer recharge areas, water resource areas, preservation of rural areas not compatible for urban development, and preservation of historic and natural areas.

7. Support local communities (governmental bodies) in their efforts to maintain proper growth and development - whether that growth is economic, rural, industrial, residential, etc.

8. To provide for the conservation of energy via land use strategies designed to reduce energy consumption in a manner compatible with environmental protection and future re-use of lands.

9. Encourages local governments to evaluate existing plans and goals relative to land use to see how effective or useful they are.

10. Encourage cooperation between local area and consistency in land use issues and goals.

11. To provide a usable tool to evaluate policies related to land use through the A-95 process.

12. Assist local governments (when requested to do so) in providing improved planning, development and management of supportive services and facilities related to land use, or that have an impact on land use policy.

13. Support efforts of local governments to coordinate the delivery of services.

<u>Objectives</u>

1. Support of residential housing needs in relationship to geographical suitability and employment.

2. Maintenance of quality in public facilities, utilities, recreation needs, transportation needs, and other services required to support proper land use needs.

3. Maintain proper growth and development - whether that growth is economic, rural, industrial, residential, etc.

4. Evaluation and coordination of various land use plans.

5. Flood plain protection.

6. Conservation of prime agricultural land.

7. Protection of aquifer recharge areas.

8. Former mined lands reclamation and usage.

9. Protection of water resource areas.

10. Preservation of rural areas.

11. Protection of historic or nature sites.

12. Designation and use of environmental corridors.

13. Support of land, water conservation and environmental quality.

Each of the preceding objectives are followed by three to five policy proposals in the text of the Land Use Element. These policy proposals are reproduced in Appendix 2.

In addition to the economic development planning conducted at the regional level within the state, Indiana and the other coal-producing states have had to consider further land use policies as a result of the Surface Mining Control and Reclamation Act of 1977. Although PL 95-87 was not intended to be a land use bill, it does require that certain land use considerations become part of the state's policy before primacy will be awarded. The most notable example is Section 522 of the Act that requires the state to implement a petition process for designating certain areas unsuitable for surface coal mining. In Section 515, which addresses environmental protection performance standards, states are directed to require certain justifications from the mine operator before granting a surface mining permit where the proposed postmining land use differs from the previous use and the approximate original contour is not restored. Subsection 515 (c)(3)(B) requires the operator to submit a plan for the proposed postmining land use and provide assurances that the use will be -

(i) compatible with adjacent land uses;
(ii) obtainable according to data regarding expected need and market;
(iii) assured of investment in necessary public facilities;
(iv) supported by commitments from public agencies where appropriate;
(v) practicable with respect to private financial capability for completion of the proposed use;
(vi) planned pursuant to a schedule attached to the reclamation plan so as to integrate the mining operation and reclamation with the postmining land use; and
(vii) designed by a registered engineer in conformance with professional standards established to assure the stability, drainage, and configuration necessary for the intended use of the site.

The director of the Division of Reclamation has prepared a letter to all Indiana surface coal mine operators outlining DNR's policy in reviewing requests for postmining land use changes. That letter can be found in Appendix 3 of this report.

4.3 Local Planning

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

Discussions with members of the planning staff indicated a willingness to cooperate with mining interests, particularly to protect mineral resources from urban sprawl. In fact, subsequent to the visit by the project investigator, a representative of the Area Planning Department contacted AMAX Coal Company to solicit input for the comprehensive plan under development.

At the present time, Clay County has no planning commission, no zoning ordinances, and no subdivision ordinance. Apparently, a county planning commission did exist at some prior time since a water and sewer facilities plan was prepared in 1968, but this commission is no longer functioning.

The control exercised by local planning bodies varies in the areas surrounding other AMAX Coal Company operations. For example, a conditional use permit is required for the operation of Sun Spot Mine located in Fulton County, Illinois. A conditional use permit allows the county to enforce additional reclamation standards if so desired. Illinois regulations require that the reclamation plan be submitted to the counties for review. In Fulton County, the Zoning Board requires a hearing before the Land Use Committee which then makes a recommendation to the County Planning Commission. This recommendation is in turn taken up by the County Board whose final approval is required for issuance of the conditional use permit.

4.4 Company Site Planning

The postmining land use plans, submitted as part of AMAX Coal permit applications, are prepared primarily by the Environmental Studies and Planning Group of the Environmental Engineering Department. Background data collection for the land use plans includes input data provided by Operations, Mining Engineering, Meadowlark Farms, and the other groups within the Environmental Engineering Department. The procedure for land use planning and management is illustrated in Figure 4.3.

In the formulation of postmining land use plans, one of the most important factors is the postmining topography. Postmining topography is approximated by applying mine plan data, appropriate swell factors, and box cut and end cut locations to the premining topography. Another key factor is the location and thickness of high capability soils.

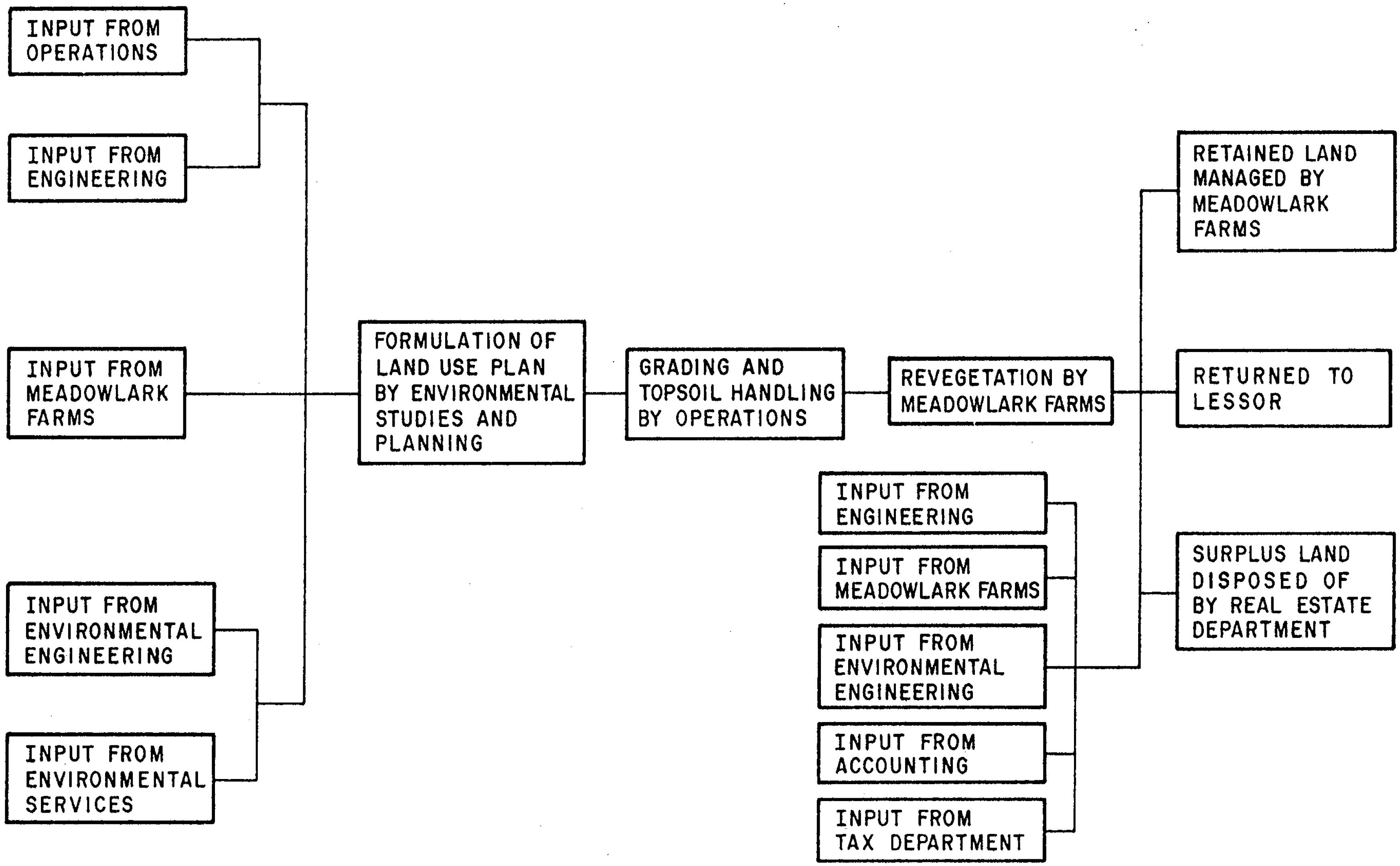


Figure 4.3. Schematic drawing of land use planning and land management procedures of AMAX Coal Company.

This factor is particularly important in determining the location of agricultural lands. Location of property boundaries and public right-of-ways and limitations on certain equipment are also taken into consideration. For example, the grade limitation on mechanical tree planters may influence the location of forest land or the type of planting pattern that is employed. Premining land use, however, may play the most important role in determining the postmining land use plan.

As stated in an earlier section, AMAX Coal Company planners endeavor to balance, as nearly as possible, the premining and postmining areas devoted to various land uses. Although the distribution of land among various uses may not change significantly, planning skills are required in designing a site plan that spatially orients the land uses in an efficient and aesthetically pleasing manner. Five primary post-mining land use designations are used:

- row crops
- pasture/hay
- forest
- wildlife habitat
- water

Some additional land may be designated for public roads, etc. The planners may recognize a potential for higher intensity uses such as residential development or industrial uses, however, these are not proposed as part of the required postmining land use plan. Instead, the land is returned to one of the five primary uses until the bond has been released.

After all reclamation work has been completed by Operations at the mine and by Meadowlark Farms, leased land is returned to the original owner. The company retains the right of access until the final bond release. Land that has been purchased by Meadowlark Farms is generally retained for at least a few years. If possible, this land will be used by Meadowlark Farms for agricultural production. After a period of time, if it is determined that the land is not needed for any future mining operations and is in fact a surplus, it may be considered for disposal. Disposal of surplus land is initiated by the Land Planning and Development Section, Real Estate Department. Before any land is sold or donated, input is solicited from Meadowlark Farms, the Engineering Department, the Environmental Engineering staff, the Tax Department, and the Accounting Department. After all of the necessary internal approvals have been obtained, the land is appraised and offered for sale. A typical sale notice that would be distributed to prospective buyers is included in Appendix 4. Another common method of land disposal is through trading reclaimed land for additional mineable lands. Due to the relatively high value of reclaimed land at the Chinook Mine, this method is frequently employed so that properties needed for continuing the mining operation can be obtained.

Chapter 5

LAND USE POTENTIAL EVALUATION

5.1 Scope Definition

This aspect of the case study employs the land use planning process, previously outlined in Figure 4.1, in the development and systematic evaluation of three alternate postmining land use plans for the Chinook Mine - West Field. The purpose is to satisfy one of the reclamation plan criteria in PL 95-87 Section 508 (a)(3) which requires,

> "... a discussion of the utility and capacity of the reclaimed land to support a variety of alternative uses and the relationship of such uses to existing land use policies and plans, ..."

The main objective of this exercise is to develop a postmining land use plan that is environmentally and aesthetically sound and enhances property value. The objective will be met through inventorying the local environmental and social conditions, formulating alternative site plans, and evaluating the alternatives in light of the regional planning framework and the economic, environmental, and social feasibility of the plans themselves.

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

5.2 Information System

Design of the information system is a major task for the regional planner. At the site planning level, the complexity of the task depends on the specific operation. It can be as simple as opening a file or as extensive as developing a computerized land data system to store and manipulate planning information. For the purpose of the case study, a conventional filing system is used.

AMAX Coal Company presently employs a computerized data handling system for the storage and retrieval of all geological data at its several mines. The data includes strata information, approximate depths, thicknesses, special environmental or mining related data, core descriptions, and geophysical logs. The data are stored using a coordinate system. Advantages of a computerized data base are enormous. With the use of computer graphics, much of the manual map production can be eliminated. Other advantages include fast access to the most recent data, a centralized location for all the data, elimination of much duplication, and fast duplication of data and maps if required. AMAX Coal also uses its computer capability in reclamation planning. Using several programs developed by AMAX personnel, the postmining topography is predicted as a function of the premining topography and mining parameters. This capability is especially useful when it is necessary to reestablish natural drainages. A recent publication by Eframian (1981) presents a general overview of the computer applications that AMAX Coal has made in the areas of planning and operations. Postmining land use plans are presently developed and evaluated without computer assistance. Due to the important role played by postmining topography, however, computer applications here could be very useful.

5.3 Preliminary Studies and Data Collection

Primary data collection of environmental baseline information and local socio-economic conditions was beyond the scope of this case study. For data to be truly baseline information, it must be obtained before the proposed action is taken. Since mining of the West Field began in 1977, it was impossible for the investigators to collect premining primary data. A substantial amount of secondary information was available, however, from the permit application, company files, and reports by public agencies. The data collection phase consisted mainly of three visits to the company offices, two visits to the mine site, interviews with representatives of the public planning agencies and the regulatory authority, and a library search of pertinent public documents. Interviews with AMAX Coal Company personnel and access to in-house reports, which included a detailed environmental assessment of the West Field expansion project were especially helpful in this stage of the investigation. Some background data has already been presented in Chapter 3. In this section, references will be made to that information. The majority of data presented in this section will be more site-specific in nature.

Mine planners rarely conduct primary data collection of socio-economic data. This information is generally obtained from public agencies. For the case study, data was obtained from the Bureau of the Census, the Indiana State Planning Services Agency, and the West Central Indiana Economic Development District. The data obtained from such agencies may not always be in the form that is most useful to the mine planner. Therefore, manipulation of the data, and development, identification, and extrapolation of trends must often be performed by the mine planner to use the information for postmining land use decisions.

5.3.1 Geographic Characteristics

The location of the West Field relative to the surrounding cities and towns has been discussed previously. The size and shape of the site are also important factors in planning the postmining land use. In this case, the shape and, to a certain degree, the size have been influenced by the range and township grid system that is found in the central and western United States. When this land was originally surveyed, it was divided into square townships that were six miles long on each side. The townships were further divided into sections that were one square mile each. The range designations are given as the number of the township either east or west of a certain principal meridian. The township designations are measured north or south of a baseline. The range and township grid system designations for the West Field are illustrated in Figure 5.1. The study area consists mainly of Sections 19, 20, 29, and 30 to T-12-N, R-7-W which are contiguous with the six primary sections named above. The 2,976 acres that are presently permitted do not include Section 30 of T-12-N, R-7-W or Section 25 and part of Section 24 of T-12-N, R-8-W. If these are included, the total study area will be 4,369 acres. As illustrated in Figure 5.1, the study area is basically a three-section by two-section rectangular area with some irregularities due to mine-related disturbances such as box cut spoils.

Accessibility to the site is another consideration in determining postmining land use. The network of roads that provide access to the West Field from the surrounding highways and communities is shown in Figure 5.2. The site is bounded by county or state roads on all four sides. One county road, Road 8 East (Vigo County) and Road 21 West (Clay County), is shown traversing the site from east to west. Several north-south roads are shown, however, only those on the east and west ends of the field continue south of Interstate 70. Nearly all of the county roads that traverse the site are presently or will in the future be temporarily closed due to the mining operations. Company access and haul roads are also shown on Figure 5.2. Interstate 70, a major east-west artery, passes within a few feet of the permit area. The nearest junctions on the interstate, however, are approximately four miles on either side of the site. Access to the eastern boundary from Interstate 70 is via State Routes 59 and 42. The actual driving distance is 4.5 miles. Approaching the site from the west, the actual driving distance from Interstate 70 is 6.4 miles via State Routes 46 and 42. Several of the north-south county roads provide access to U.S. Route 40 which is less that two miles from the northern boundary of the West Field. State Route 42 must be considered the major artery into the site. It not only provides access to Interstate 70, but it also gives access to Hulman Field, the local municipal airport, and serves as a major thoroughfare through the city of Terre Haute.

5.3.2 Topography

The premining topography is shown in Figure 5.1. The West Field is nearly flat except for some relief along the sides of incised drainages. The highest point on the site prior to mining was located in the northeast corner and was approximately 680 feet above sea level. The lowest point was around 570 feet above sea level and is found where Honey Brook leaves the southwest corner of the site.

Postmining topography is one of the primary factors in postmining land use planning. A possible postmining topographic configuration is shown in Figure 5.3. Several steps were taken in generating this land surface. First, the locations of box cut spoils and the probable locations of end cut lakes were established. Then the entire field was swelled using a premining topographic map and a contour map of the III Coal seam to determine overburden thickness at numerous points. A 20 percent swell factor was employed. Contour lines were reconstructed and

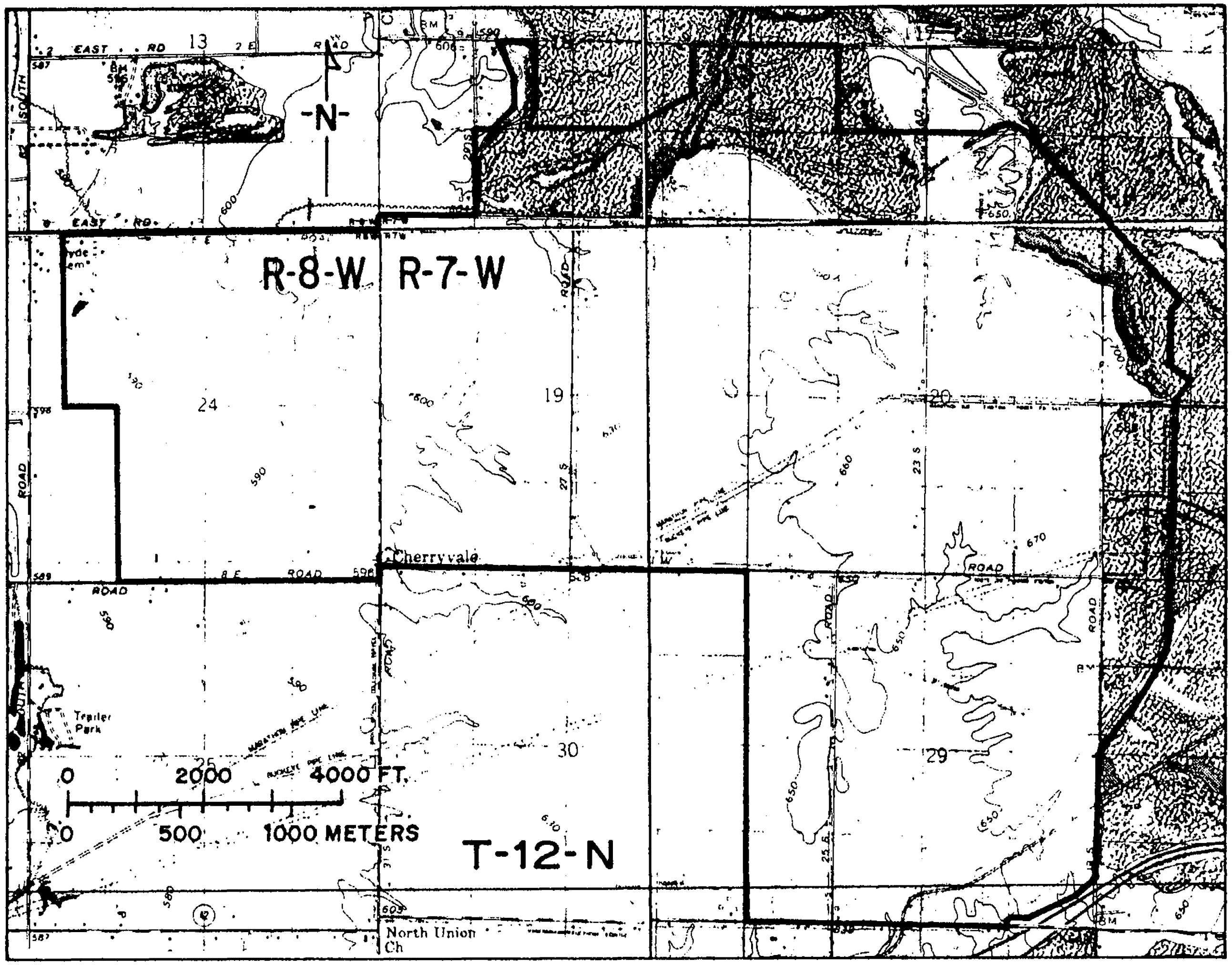


Figure 5.1. Premining topographic map with range and township designations for the West Field.

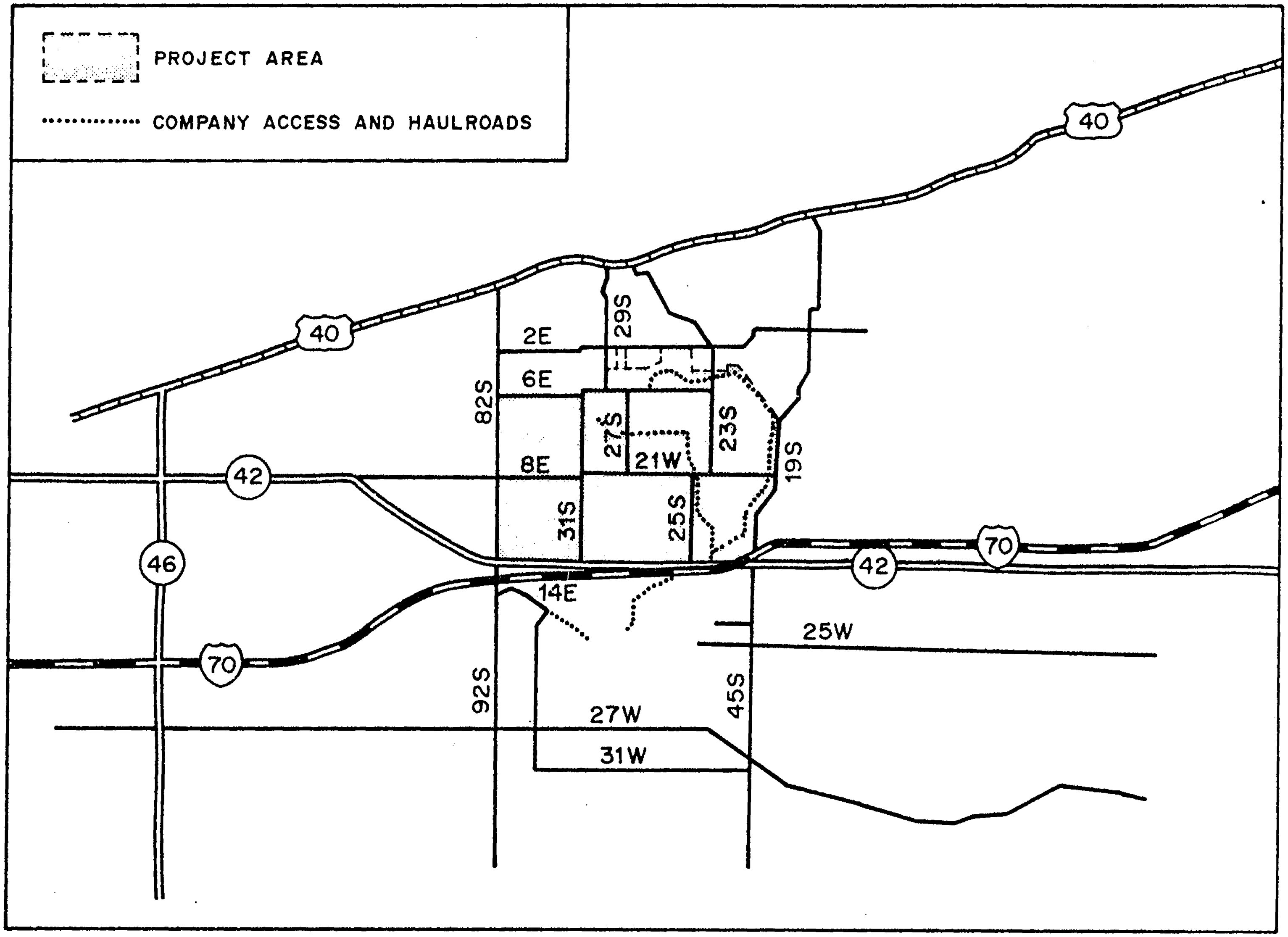


Figure 5.2. Access map of the West Field.

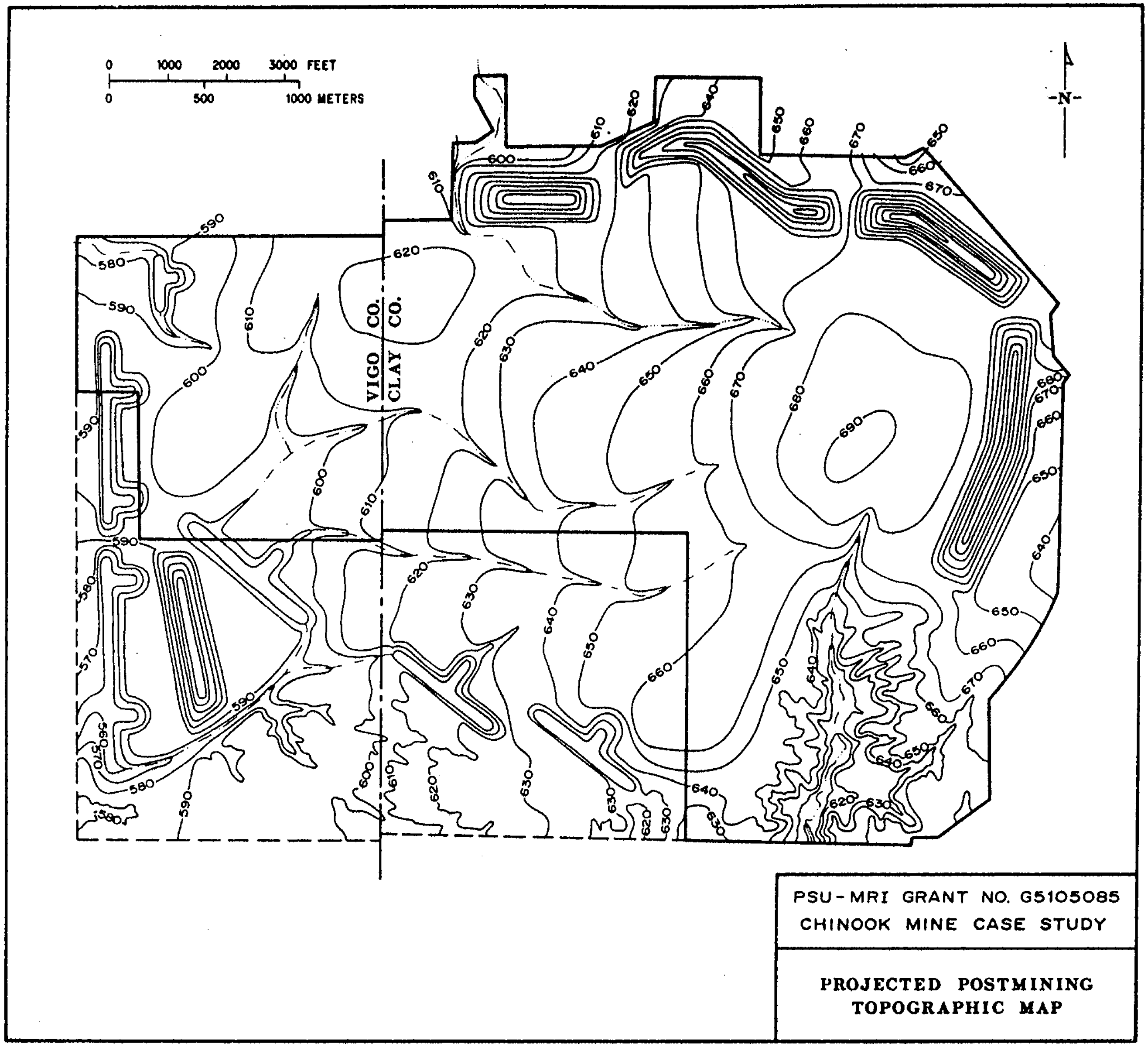


Figure 5.3. Projected postmining topographic map for Chinook Mine - West Field.

modified slightly to recreate a drainage pattern that is very similar to the premining pattern. The site retains the same topographic characteristics after mining with a few exceptions. The entire surface has been elevated slightly due to overburden swell. A more significant deviation is the existence of box cut spoils along portions of the northern and eastern boundary. Although these spoil piles appear steep on the post-mining topographic map, they will be contoured and reduced to a maximum slope of three to one.

5.3.3 Overburden Characteristics

A generalized stratigraphic column for the West Field was presented previously in Figure 3.2. The unconsolidated overburden consists of soils, loess, glacial till, and outwash deposits. The upper 10 to 15 feet is generally brown or yellowish brown. Below that level, the material is dark grey, more calcareous, and partially consolidated.

The bedrock overburden is made up mainly of dark gray to black shales and gray sandstones. A brown oxidized sandstone is sometimes found above the IV Coal. Overburden analyses have shown the consolidated overburden to have high total sulfur values. Much of this material has the potential for acid production. This is particularly true for the interval from the IIIa roof shale down to the sump vein. Sulfur concentrations in this interval were found to range from 0.6 percent to 10.28 percent. The acid neutralization potential is deficient for this material and would require in excess of 50 tons of lime per 1000 tons of material. Tests also showed high concentrations of cadmium in the IIIa roof shale and the interburden between the III Coal and the sump vein. The average cadmium concentration in the IIIa roof shale was 26.0 parts per million and the average for the interburden was 10.0 parts per million. The sulfur and cadmium concentrations appear to be correlated.

As discussed in Section 3.5 - Mining Engineering, selective overburden handling techniques are being employed to keep the material with high sulfur and cadmium concentrations low in the cast overburden. The black roof shale of the IIIa Coal is used as a marker bed in segregating the spoil. It was also illustrated in Section 3.5 that the advance bench material was being used as cap material on the spoil piles. This bench material consists mainly of unconsolidated glacial deposits. By burying the potential acid producing material deeply in the cast overburden, the possibility of exposure at the surface due to settlement and erosion is eliminated. Also, the amount of groundwater percolating down through this material is reduced. Finally, care is also exercised in the selection of haul road material so that potential acid producing material is not used.

5.3.4 Hydrology

The overall surface water drainage pattern of the West Field was described in Section 3.6.3 - Drainage Plan. There are no reliable discharge measurements for the streams that flow across the site. Water quality samples have been taken at the four locations shown on Figure 5.4. Sampling point #1 is significant since approximately 12 percent

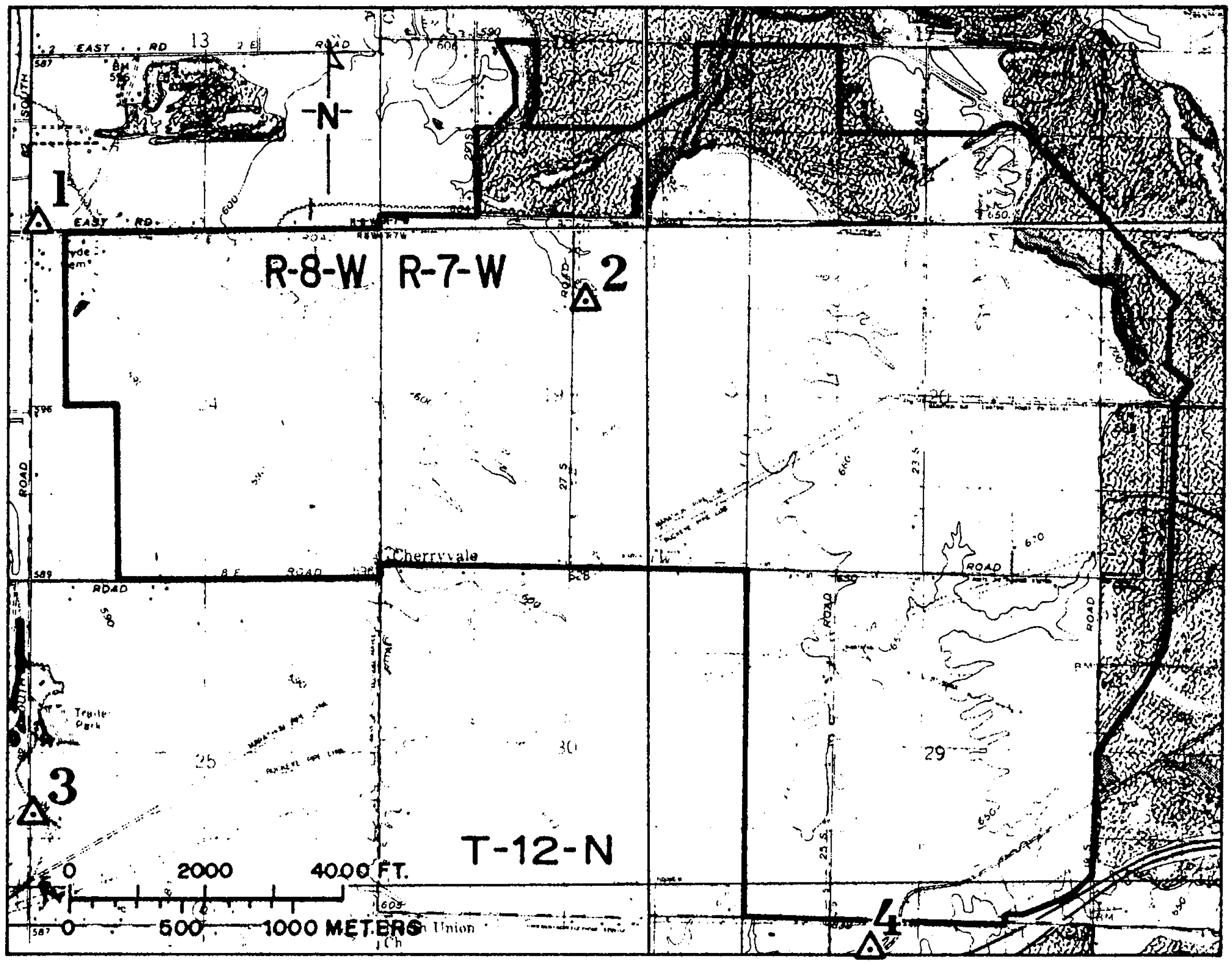


Figure 5.4. Surface water quality sampling locations.

of its drainage area has been mined in the past. Analyses indicated good water quality at this point with an average laboratory pH of 6.75 and an average suspended solids concentration of 16 milligrams per liter (mg/1). It was found that the maximum conductivity, total dissolved solids, sulfate, and acidity values occurred about five days after a storm event indicating some leaching through slightly acidic surface material. All samples were within Indiana State Pollution Control standards. The water quality at point #2 was similar to that at #1. Again, all samples were within Indiana standards. The average concentration of suspended solids was slightly higher at 30.25 mg/1. This increase can most likely be attributed to somewhat steeper slopes. The drainage area above point #3 is unmined and nearly all used as agricultural land. Analyses indicated that the water quality was good. Laboratory pH values averaged 6.20. On three occasions, however, relatively high concentrations of suspended solids were observed. The maximum value was 63 mg/1. It is believed that these higher background levels are due to erosion of cultivated fields. The drainage area above point #4 was being actively mined when the samples were taken. No problem with acid formation was observed. Laboratory pH values averaged 6.94. In fact, nearly all parameters measured were similar to those collected from unmined areas with the exception of conductivity, total dissolved solids, and suspended solids. The average concentration of suspended solids was 171.91 mg/1.

In the past, groundwater has supplied all farm and domestic demands in the mine area. Numerous private wells exist in the West Field and adjacent properties. The town of Staunton has a public well located approximately one mile from the northeast corner of the site. This well was drilled to a depth of 268 feet. Most wells in the area tap the sand and gravel aquifer. Domestic wells in the sand and gravel produce 25 gallons per minute on the average. One locally significant sandstone aquifer exists immediately above the III Coal. This aquifer supplies water to farms, small industries, and communities west of the site. Generally, water bearing units are numerous in this area. However, they are also thin and discontinuous. They are separated by equally numerous impermeable layers of clay, silt, and shale resulting in perched water table and semiconfined aquifer conditions. It has been observed that previously mined areas have increased groundwater storage capacity. An increase in bicarbonate and a decrease in hardness has been observed in groundwater at greater depths. Although the groundwater is hard and has iron concentrations that are slightly in excess of recommended Federal drinking water standards, it is abundant and there are no real problems affecting its use. By following the overburden handling scheme previously discussed, significant deterioration of groundwater quality will be prevented.

5.3.5 Soils

The agricultural capability of the soils is an important factor in determining the postmining land use. A soils map of the West Field was presented previously in Figure 3.12. Over half of the site is covered with Iva silt loam. This soil has a capability unit classification of II w-2. The II w-2 classification means that this soil unit has only moderate limitations and is suited to all crops commonly grown in the area. The moderate limitation is due to the somewhat poorly drained condition of the soil. This limitation can be overcome by a suitable drainage system. Under proper management, the Iva silt loam produces approximately 115 bushels of corn per acre and 45 bushels of wheat per acre. Minor soil units at the site are generally associated with drainageways. The productivity characteristics for the major soil units present in the West Field are listed in Table 5.1.

The use of Soil Conservation Service soil interpretations for land use planning is not practical since the soil properties will be completely changed by the mining operation. Premining agricultural productivity is an indication, however, of the expected yields on reclaimed lands. Since the major soil limitations are associated with slopes along drainages, these limitations will be taken into account during the land use planning process by considering the postmining topography.

5.3.6 Climate

The mean monthly climatological data for the period from 1896 to 1973 is shown in Table 5.2. The average temperature for that period was 54 degrees Fahrenheit. The highest and lowest mean temperatures are in July and January, respectively. The average growing season is 207 days or from April 5 through October 29. The average annual precipitation for the same period was 39.7 inches. The precipitation is fairly well distributed throughout the entire year. The averages for May and June are slightly higher than for the other months. This fact can partially be attributed to the frequent occurrence of high intensity summer thunderstorms. Potential evapotranspiration is highest in the late summer months of July and August. In fact, during those months the potential evapotranspiration exceeds the average precipitation resulting in a water deficit. The average annual snowfall for this area is 18.2 inches. There is no prevailing wind direction, however, southerly, southwesterly, and northwesterly winds are most common.

Microclimatic studies at the site have shown marked differences between various locations. The stations included undisturbed land and reclaimed land that varied in age from less than a year to 30 years. The main purpose of a microclimatic investigation is to determine the stress placed upon vegetation by differences in climatic factors. As would be expected, the newly reclaimed sites had the greatest stress on vegetation because they exhibited the largest temperature deviations, reached saturation long before older sites, and lost their soil moisture much quicker. Variations in windspeed were observed for the stations at five feet above the ground surface. These differences were not related to the age of reclamation but to the surrounding topography.

5.3.7 Vegetation

Background studies by company biologists have identified four basic types of plant communities. These types include cultivated fields, fallow fields, old fields, and woodlands. Cultivated fields consist mainly of corn, soybeans, and grain sorghum. A limited number of non-cultivated species such as giant foxtail and crabgrass are also present.

Table 5.1

Productivity of Major Soil Units Present in the West Field

Soil Series	Darkened Surface Horizon Thickness (inches)	SCS Capability Class	SCS Predicted Yields Corn (bu/A)	Wheat (bu/A)	Hay (t/A)
Iva	6-10	IIw-2	115	45	4.5
Ava	4-8	IIe-7	90	40	4.0
Muren	6-10	IIe-3	120	50	5.0
Cincinnati	4-8	IIIe-7	90	25	4.0
Hickory	0-5	VIIe-1	NS*	NS	3.0
Cincinnati	0-6	VIe-1	NS	NS	3.5
Shoals	8-12	IIw-7	105	30	4.0
Wakeland	8-12	IIw-7	115	50	5.0
Eel	8-12	I-2	115	45	4.5

*NS - Not suitable for crops because of slope limitation.

Source: SCS Soil Survey of Vigo County, Indiana.

Table 5.2

Mean Monthly Climatological Data for 1896 to 1973

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Monthly Values													
Mean	30	32	42	54	64	73	77	75	69	57	44	33	54
Maximum Mean	41	42	55	62	72	80	85	82	75	68	53	43	58
Minimum Mean	15	23	29	46	57	67	71	68	60	48	38	20	51
Precipitation													
Mean	2.8	2.3	3.7	3.8	4.2	4.2	3.5	3.1	3.5	2.6	3.0	2.9	39.7
Maximum Mean	10.6	6.1	11.0	10.6	11.9	12.2	12.6	10.0	11.4	8.9	7.6	10.5	63.3
Minimum Mean	0.4	0.2	0.1	0.8	0.4	0.0	0.5	0.5	0.3	0.2	0.1	0.6	28.0
Snowfall													
Mean	5.1	4.4	3.2	0.3	-	-	-	-	-	0.4	1.1	3.7	18.2
Record Max	23.5	17.5	25.5	3.6	Trace	-	-	-	-	0.8	7.7	13.3	39.9

The fallow field designation is limited to fields that have been cultivated in the past one or two years. These fields generally demonstrate well developed plant communities that cover nearly 100 percent of the ground with stands up to 1.5 meters high. Nearly all of the fallow field species are herbaceous and most commonly include giant foxtail, annual bluegrass, and two rush species. Other species present are ragweed, smartweed, yellow and green foxtail, buckhorn and broad-leafed plantain, Johnson grass, and several Panicums. Some previously cultivated species such as red clover and timothy are also found. The plant diversity of the fallow fields demonstrates the ability of wild species to initiate succession once land is no longer cultivated and herbicides are no longer applied.

Old fields are those that were last cultivated three to ten years ago and are presently reverting to natural vegetation through plant succession. The most important herbaceous species are tall goldenrod, several species of Aster, agrimony, black medic, yarrow, and boneset. Old fields demonstrate a high diversity of plant species. Some woody species less than two meters tall are also found in old fields, particularly wild blackberry, multiflora rose, woodbine, poison-ivy, grape, and trumpet vine. The only seedlings observed were sassafras. Some red clover, timothy, and corn persist from previous cultivation.

Woodlands demonstrate greater variability because they range from the very late old field stage to mature forests. No virgin timber remains on the site. The herbaceous species include several woodland grasses, sedges, clearweed, and common blue violet. Bramble, such as wild blackberry, and vines, such as poison-ivy, woodbine, and Japanese honeysuckle, are mixed in with the herbaceous layer. The most common tree shrubs are spicebrush, hazelnut, elderberry, and blackhaw. The major tree species found are ashes, elms, pin oak, soft maple, and sycamore. These species are characteristic of poorly drained soil. The older woodland plant communities have higher concentrations of oaks, hickories, sugar maple, American beech, and basswood. The canopy layers extend to a maximum of approximately 115 feet.

5.3.8 Wildlife

The wildlife species in the West Field can be described according to the habitats provided by the plant communities listed in the previous section. In cultivated fields, house mice and deermice are common along with several species of birds such as grackles, starlings, doves, house sparrows, and red-wing blackbirds. Insects present include beetles, leafhoppers, flies, and springtails.

Fallow fields are inhabited by house mice, deermice, meadow voles, and prairie voles. There is no great difference between the birds present in cultivated fields and fallow fields. True bugs are the most dominant insects found in fallow fields followed by leafhoppers, aphids, springtails, and beetles.

Old fields provide excellent habitat for low-nesting birds, small game mammals, and deer. Meadow voles and prairie voles are the most common small mammals. Less abundant are the least shrew and

Table 5.3

Population Statistics for Posey Township and Lost Creek Township

	Decennial Population						Percent Change				
	1930	1940	1950	1960	1970	1980	1930-40	1940-50	1950-60	1960-70	1970-80
Posey Township	2,545	2,359	2,451	2,811	3,311	3,459	-7.31	+3.90	+14.69	+17.79	+4.47
Lost Creek Township	2,799	2,728	3,383	4,475	6,434	7,753	-2.54	+24.01	+38.28	+43.78	+20.50

Source: Bureau of the Census, U.S. Department of Commerce, 1980 Census of Population and Housing.

southeastern shrew. More species of birds are found in oldfields than in either of the first two habitats. In addition to the birds named previously, song sparrows, indigo buntings, and robins are common. Fowler Toads are basically the only amphibians present. Ground-inhabiting insects are mainly springtails, spiders, and ants. Other insects include leafhoppers, true bugs, and beetles. Invertebrates such as sowbugs and snails are also present.

Woodlands provide habitat for small mammals including white-footed mice, short-tail shrews, and chipmunks. The fox squirrel is the most common game species. The most common birds are starlings, grackles, robins, cardinals, indigo buntings, and bluejays. Amphibians and reptiles include Fowler Toads, bullfrogs, red-back salamanders, and box turtles. Sowbugs and other moisture-dependent invertebrates such as earthworms, snails, crayfish, and millipedes are present. The most abundant insects are leafhoppers, flies, ants, and beetles.

5.3.9 Demographic Characteristics

The analysis of population trends is central to determining the demand for various land uses. Previous discussions in Chapter 3 considered the population on the entire region. Population data at the township level is presented in Table 5.3. The West Field is located in both Posey Township, Clay County and Lost Creek Township, Vigo County. The township populations are analyzed separately since county data may not accurately represent the area immediately surrounding the mine. Although Clay County has experienced population decline in three of the last five census periods, Posey Township has been growing steadily since 1940. Except for the 1980 census, Vigo County has shown moderate growth over the last 50 years. County population figures do not reflect, however, the migration that has occurred from Terre Haute to the surrounding suburban townships. During the last four census periods Lost Creek Township has had population increases of 24.0, 32.3, 44.8, and 20.5 percent, respectively.

A straight-line projection method was used to make initial estimates of both the township and county population at ten-year intervals through the year 2020. A scaling technique was then used to adjust the initial township estimates. This technique proportioned the differences between county projections produced from the straight-line calculations and those determined independently by the State Planning Services Agency. Each township's proportion of the difference was either added or subtracted from the initial township estimate. The population projections for Posey Township and Lost Creek Township are listed below in Table 5.4.

Table 5.4

Population Projections for Posey Township and Lost Creek Township

Year	Posey Township	Lost Creek Township
1990	3,633	8,690
2000	3,810	9,548
2010	4,047	10,571
2020	4,233	11,542

The number of housing units and the occupancy rates are given in Table 5.5 for the years 1960, 1970, and 1980. Occupancy rates were projected in a manner similar to the population projections as the first step in determining future housing demand for the two townships. The trend in declining occupancy rates was extrapolated at the current rate through the year 2000. An assumption was made that the occupancy rates would level off or hold constant from 2000 to the year 2020. This assumption makes the housing demand estimate more conservative than if the occupancy rates continued to decline through 2020. Based upon the projected populations, estimated occupancy rates, and a ten percent replacement of housing units existing in 1980, it is estimated that 3,139 new housing units will be required in the two-township area by the year 2020. The calculation of the estimated housing demand is summarized in Table 5.6. An important fact to be considered in post-mining land use planning is the demand for residential building sites that are situated near end cut lakes. From 1968 through 1977, 13.7 percent of the homes constructed in Posey Township and 9.0 percent of the homes constructed in Lost Creek Township were built on previously mined lands.

Population projections can also be used to determine the amount of land that will be required for other uses. For example, Dechiara and Koppelman (1968) have suggested the use of population-based standards (Table 5.7) to estimate the amount of land needed for recreational activities. The estimated population increase for Posey and Lost Creek Townships is 4,563 from 1980 to 2020. This increase alone could justify construction of one 40- to 50-acre park providing playgrounds, athletic fields, tennis courts, picnicking, and other outdoor facilities. In addition, the entire two-county region is presently deficient in outdoor recreational facilities as shown in Table 2.5. Also associated with population increases are additional land demands for schools, services, utilities, commercial, and other community development related activities.

5.3.10 Land Use

A premining land use map and a breakdown of the premining land uses and of the West Field were provided in Figure 3.16 and Table 3.6, respectively. In developing postmining land use plans it is important to consider their relationship to surrounding land uses, as well as premining uses on the site. Properties that are adjacent to the West Field are similar in use to the premining condition of the site itself. The majority of the surrounding land is agricultural with farmsteads scattered throughout. Some of the adjacent land has been surface mined and reforested. There is an outdoor recreational club located just north of the permit boundary that is situated on an old end cut lake and reforested land. Some single-family homes have been built along State Route 42 which forms the southern boundary of the site. There presently is no industrial land adjacent to the site; however, there is an industrial park approximately two miles west of the mine. Although the surrounding land is used mainly for agricultural production and would be classified as rural in nature, it exhibits considerable diversity and the impacts of the site's proximity to Terre Haute and other nearby towns.

Table 5.5

Housing Units and Occupancy Rates for
Posey Township and Lost Creek Township

	1960	1970	1980	Percent Change 1960-70	Percent Change 1970-80
Housing Units					
Posey Township	940	1,171	1,355	+24.57	+15.71
Lost Creek Township	1,330	1,998	2,686	+50.23	+34.43
Occupancy Rates					
Posey Township	2.99	2.83	2.55	-5.35	-9.89
Lost Creek Township	3.36	3.22	2.89	-4.17	-10.25

Source: Bureau of the Census, U.S. Department of Commerce, 1980 Census of Population and Housing.

Table 5.6

Estimation of Housing Demand

Township	1980 Households	2020 Population	2020 Occupancy Rate	2020 Households	Additional Housing Demand	10% of 1980 Homes Replaced	Total Increase in Homes Required by 2020
Lost Creek	2,686	11,542	2.42	4769	2083	269	2352
Posey	1,355	4,233	2.11	2006	651	136	787
Total							3139

Table 5.7

Standards for Recreational Activities

Type of recreational activity	Space requirements for activity per population	Ideal size of space required for activity	Recreational area wherein activity may be located
Active Recreation			
1. Children's play area (with equipment)	0.5 acre/1000 pop.	1 acre	Playgrounds-neighborhood parks, community parks, school playgrounds
2. Field play areas for young children	1.5 acres/1000 pop.	3 acres	Playgrounds-neighborhood parks, community parks
3. Older children-adult field sports activities	1.5 acres/1000 pop.	15 acres	Playfield-community park, district park
4. Tennis-outdoor basketball, other court sports	1.0 acres/5000 pop.	2 acres	Playfield-community park
5. Swimming	1 outdoor pool/ 25,000	Competition size plus wading pool 2 acres	Playfield-community park
6. Major boating activities	100 acres/50,000	100 acres & over	District park, regional park or reservation
7. Hiking, camping, horseback riding, nature study	10 acres/1000 pop.	500-1000 acres	Large district park, regional park
8. Golfing	1-18 hole course per 50,000 pop.	120 acres	Community park, district park
Passive recreation			
1. Picnicking	4 acres/1000 pop.	varies	All parks
2. Passive water sports - fishing, rowing, canoeing	1 lake or lagoon per 25,000 pop.	20 acre water area	Community parks, special regional reservations
3. Zoos, arboretums, botanical gardens	1 acre/1000 pop.	100 acres	Large district park or special facility
Other			
1. Parking at recreational areas	1 acre/1000 pop.	varies	Playfields, community, district & regional parks
2. Indoor recreation centers	1 acre/10,000 pop.	1-2 acres	Community parks
3. Outdoor theaters, band shells	1 acre/25,000 pop.	5 acres	District parks

Source: Dechiara and Koppelman, 1968.

5.3.11 Archeological and Historical Characteristics

Lithic debris found in the West Field indicates that North American Indians used this area for hunting, gathering, and temporary encampments over a long period of time. Although the entire region was inhabited by Indians, they chose to locate their villages in the river valleys. Consequently, archeologists believe that the area around the mine was used only as peripheral gathering or hunting grounds by communities that existed to the west along the Wabash River. A fair amount of lithic debris was found at the site such as projectile points, tools, and some grinding implements. However, these finds are typical of large areas in the central U.S. and may not hold any unique archeological value.

There are no historically significant buildings or landmarks in the West Field that would have any impact on postmining land use decisions.

5.3.12 Noise

A baseline noise study was conducted at the West Field in 1974 and 1975. This study indicated that the major portion of the site had background noise levels that approached or slightly exceeded the recommended levels set by EPA for residential areas and farm residences. However, the observed levels pose no barrier to most land uses. Increased noise levels would likely result in occasional complaints. One portion of the site has background conditions that are classified as very noisy according to EPA recommended standards. This area is located along the southern boundary of the West Field, adjacent to State Route 42. The major source of background noise is highway traffic on Interstate 70 which basically parallels State Route 42 at a distance of 1,000 feet to the south. The area affected is a relatively narrow strip of land and does not represent a major land use constraint for the site in general.

5.4 Define Local Goals and Objectives

The definition of local goals and objectives is basically a function of the public planners. This is an area where the mine planners should interact with local and regional planners to insure that the proposed postmining land use plan is compatible with the overall plan of the area. In addition to satisfying local goals and objectives, the mining company may wish to establish other goals for itself such as improving the value of the land.

A rather extensive listing of goals and objectives for the region that includes the Chinook Mine was presented in Section 4.2. These goals and objectives are part of the District Land Use Element prepared by the WCIEDD (1977b). There is no legal requirement that these must be considered in the postmining land use planning process since the land use element was never adopted by any local governing bodies. However, this list is assuredly the most comprehensive compilation of goals and objectives for this region and, as such, should be reviewed before land use plans are developed. Some of the specific objectives that have the greatest impact on the case study site are discussed below.

One of the primary regional objectives is the support of residential housing needs in relationship to geographical suitability and employment. It is hoped that maximum utilization of the existing infrastructure will be obtained by directing future residential development into areas that are easily accessible to employment centers, shopping areas, and other services. Regional planners wish to discourage residential development in areas that would have an adverse impact on natural, historic, or prime agricultural areas. Although the site is not served by public sewer and water, the existing transportation network provides excellent access to the employment centers and shopping areas situated in the Terre Haute area. Of particular importance is the proximity to a newly developed industrial park that is located approximately two miles west of the site along State Route 42. The West Field appears to be in the path of an already-existing development trend that is proceeding eastward from Terre Haute.

Another regional objective identified by the WCIEDD planners is the conservation of prime agricultural land. They hope to discourage development on prime agricultural land by recommending that utilities, services, and transportation facilities be concentrated around existing cities and towns. Since a large portion of the West Field is considered prime agricultural land and will be suitable for agricultural production after reclamation, this objective should be considered in developing land use plans. Due to natural conditions existing before mining and some mining-related conditions, however, not all of the site will be suited to agricultural use.

One of the stated regional objectives is the reclamation and usage of former mined lands. This objective refers mainly to land that was mined before current reclamation standards were in force. The public planners are recommending that these lands be devoted to rural density, recreational, or open space uses. They specifically mentioned attempting to gain public access to these areas for outdoor recreational purposes. Under current reclamation standards, the West Field will not be limited to open space uses because of any physical constraints on the site. Some of the surrounding land does fall into this category of limited usefulness. Therefore, the compatability of any proposed land uses with these surrounding areas should be considered.

Protection of water resources is another important regional objective. Although there are no major streams on the site, there will most likely be several impoundments left after mining is completed. Any postmining land use must be designed so that the water quality of the minor natural streams and man-made impoundments will be protected. This factor is particularly important when residential or industrial uses are being considered. One of the recommendations made by the WCIEDD is the creation of environmental corridors along water courses to prevent deterioration of the water quality.

Planners have also identified a desire to preserve rural areas in the region. One of the methods they offer for accomplishing this objective is through establishing buffers between urban/suburban uses and rural uses. They also discourage the provision of utilities to rural areas. This objective is extremely important to the West Field since it is presently rural in nature but is near the edge of advancing suburban development. With the potential for development at the site, the concept of buffers between community development and rural uses should be considered.

5.5 Select Evaluation Methodologies

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

Performing a traditional discounted cash flow internal rate of return analysis for this case study would be difficult but not impossible. One of the problems would be in determining which costs to include in the analysis. Reclamation is not an option, it is a requirement. Therefore, if the entire cost of reclaiming a parcel of land to a particular use is included in the analysis, the costs may far exceed the cash flows generated by that land use. An internal rate of return calculation would require some knowledge about how the land will be managed after reclamation. That means it would be necessary to know whether the company plans to sell the land or retain it and put it into agricultural production. This information is not available at the present time. Another obstacle to such an analysis is the need for proprietary information such as the property taxes and corporate income taxes the company would pay on the property along with the methods of financing any improvements or equipment that would be necessitated by a particular land use. The economic approach that will be used is simpler than an internal rate of return calculation and is valid regardless of who owns or manages the land after reclamation. The recommended approach is to simply estimate the land value based upon a unit price for each component land use. This approach employs the assumption that if land designated for a specific use has a certain value in the open market, it will have at least that value to the company.

The environmental impacts of the viable alternate postmining land use plans will be evaluated using an environmental impact matrix which attempts to estimate the magnitude and importance of the proposed actions on the environmental components of the site. A quantitative approach to social impact analysis is beyond the scope of this case study. Although methods do exist for estimating the changes in social parameters, their accuracy and usefulness are questionable. The social impact of the alternatives will be discussed and evaluated qualitatively.

5.6 Select and Weight Evaluation Criteria

The economic evaluation criterion that will be used for recommending a particular alternative is the maximization of economically efficient land values. Economic efficiency implies that any additional cost in preparing the land for a specific use would be compensated by an increase in land value. Additional costs are defined as those costs that are in excess of those incurred in returning the land to its original use. In some cases additional costs could be negative, implying a cost savings. The inclusion of economic efficiency in the criterion simply means that a higher value land use would not be selected over a lower value use if the costs required to achieve the higher value use exceeded the increase of value over the premining use.

It is also important to realize that there is no inherent correlation between land use and land value. The market determines this relationship. As an illustration, one can say that commercial land is more valuable than residential land but this is only true in an area where there is real competition between these land uses. The unit prices for land of various land use types are based upon the assumption that competition exists at the study site between these uses. Only those alternatives that are considered feasible from a regional socioeconomic standpoint will be evaluated. The unit prices that will be used are a combination of company estimates and estimates by the project investigators.

The environmental impact evaluation will consider the following list of factors which are taken from Leopold's (1971) list of existing characteristics and conditions of the environment:

- land form
- surface water occurrence
- surface water quality
- groundwater occurrence
- groundwater quality
- erosion
- deposition
- compaction and settling
- slope stability
- trees
- crops
- birds
- land animals
- fish
- insects
- wildlife barriers
- wildlife corridors

It will be determined whether each of the alternative land use plans impact any of these existing factors. If it is determined that the prospective land use plan will have an impact on any of the above factors, a subjective estimate will be made of the magnitude and importance of the impact. Quantitative estimates will be based on a scale of one to ten. After all of the alternatives are evaluated, they will be ranked in order of their environmental impacts.

The qualitative social impact will include consideration of the aesthetic qualities of the alternatives, their compatibility with surrounding land uses, and the degree to which they satisfy regional planning objectives. The demands placed upon existing public utilities, services, and the transportation network will also be reviewed.

For the purpose of decision-making, the economic evaluation and environmental evaluation will be given relatively equal importance in recommending a postmining land use plan. The social impact evaluation will serve two basic purposes. First, it will help in resolving a conflict between the first two evaluation methods. Secondly, it will act as a safety valve by alerting the planners to any previously unforeseen social problem that would result from a particular land use plan.

5.7 Development of Alternative Scenarios

After the evaluation methodologies and criteria have been selected, several site plans can be proposed for the reclaimed area. Only viable scenarios should be evaluated. Plans which are obviously unacceptable for economic, environmental, or social reasons need not be subjected to the evaluation process. Since the postmining land use plan will most likely combine several land uses, the number of alternatives that can be generated is limitless. The alternative scenarios should be kept to a manageable number. In practice, by the time the mine planner begins formulating alternate land use plans it should be fairly obvious that certain land uses are unacceptable and certain others are potentially acceptable. The tendency to produce one desired alternative and then generate several less satisfactory plans for comparison should be avoided. Each land use plan should be developed using all of the available information and applying sound site planning principles so that the set of land use plans comprise a viable set.

Three alternative postmining land use plans have been developed for the West Field. The regulatory delays that may be encountered with a proposed change in land use are not a consideration. The main purpose of this study is to investigate postmining land use potential. Disregarding the delays caused by regulation removes a major constraint that mine planners are forced to deal with. From the preliminary studies and data collection stage it becomes obvious that a large portion of the site should be returned to agricultural productivity. A review of physical characteristics, socioeconomic conditions, and regional objectives all lead to this conclusion. Preliminary studies also indicated, however, the potential for other land uses as well. The three plans differ in the amounts of land that would be returned to agricultural uses and in uses that would be made of lands with marginal agricultural potential or lands that are particularly suited to other types of use.

There are, however, similarities between all three plans. One important characteristic of all three land use plans is the reestablishment of the basic range and township grid pattern. This is an area where site planners are not in total agreement but it is the viewpoint of the investigators that the site plan should be in harmony with its surroundings and a site plan that ignores the overall grid pattern would be out of context. As will be demonstrated in the alternatives, application of this concept does not require strict adherence to previous road and boundary locations but rather it implies the acceptance of a grid-like pattern in designing various land use schemes. The pattern can be expressed using different means including traffic circulation, planting of forests and hedges, establishing cultivated fields, and creating wildlife areas.

5.7.1 Alternative A - Agricultural Use

Alternative A, illustrated in Figure 5.5, is very similar to the premining land use condition in the West Field. The primary land use changes are an increase in water area due to the end cut lakes and the creation of wildlife areas on the box cut spoils. These changes result in a slight decrease in agricultural land; however, this decrease is mitigated by the reclamation of some previously unreclaimed land and enhancement of the agricultural management capability through the consolidation of row crop and pasture areas. The total area and percentage of total area in each land use class are listed in Table 5.8.

This plan endeavors to return nearly all of the suitable land to agricultural production. Areas that are in the 0 to 6 percent slope range would be used for row crops. Areas that may have size or shape limitations or those areas with slopes in the 6 to 18 percent slope range would be used mainly as pasture. The end cut lakes would either be surrounded by pasture or forest areas. Adjacent to pasture, they would be accessible to the livestock and adjacent to forest, they would provide cover for various types of wildlife. Much of the area adjacent to reconstructed drainageways would also be forested. Forestation of these areas would enhance wildlife movement and serve as a buffer between high-runoff cultivated areas and the streams. The box cut spoil areas would be designated as wildlife areas. The major distinctions between wildlife areas and other forest areas would be the steepness of slope and the type of planting used. Wildlife areas may reach a maximum slope of three to one and would generally be hand-planted in a random pattern. The type of vegetation used would be more diverse than other forested areas so as to provide a more suitable habitat for wildlife. The designated forest areas may be planted mechanically in a plantation pattern after the initial ground cover is established and may use species that are selected specifically for their commercial value as lumber or pulpwood. Some additional narrow strips of forest would be established and designated as wildlife areas. The main purpose of these strips would be to provide corridors for wildlife movement between other forested areas. The vegetation would include native shrubs and woody species. An additional function of these forested strips would be to help establish the grid pattern of the site. They are designed so that they will not interfere with farm management or limit the usefulness of large farm equipment.

Along with topography, soil characteristics are of prime importance for agricultural land uses. The largest portion of the area that would be returned to row crops was covered by Iva silt loam before mining. The reclaimed area will likely have a productivity potential that is

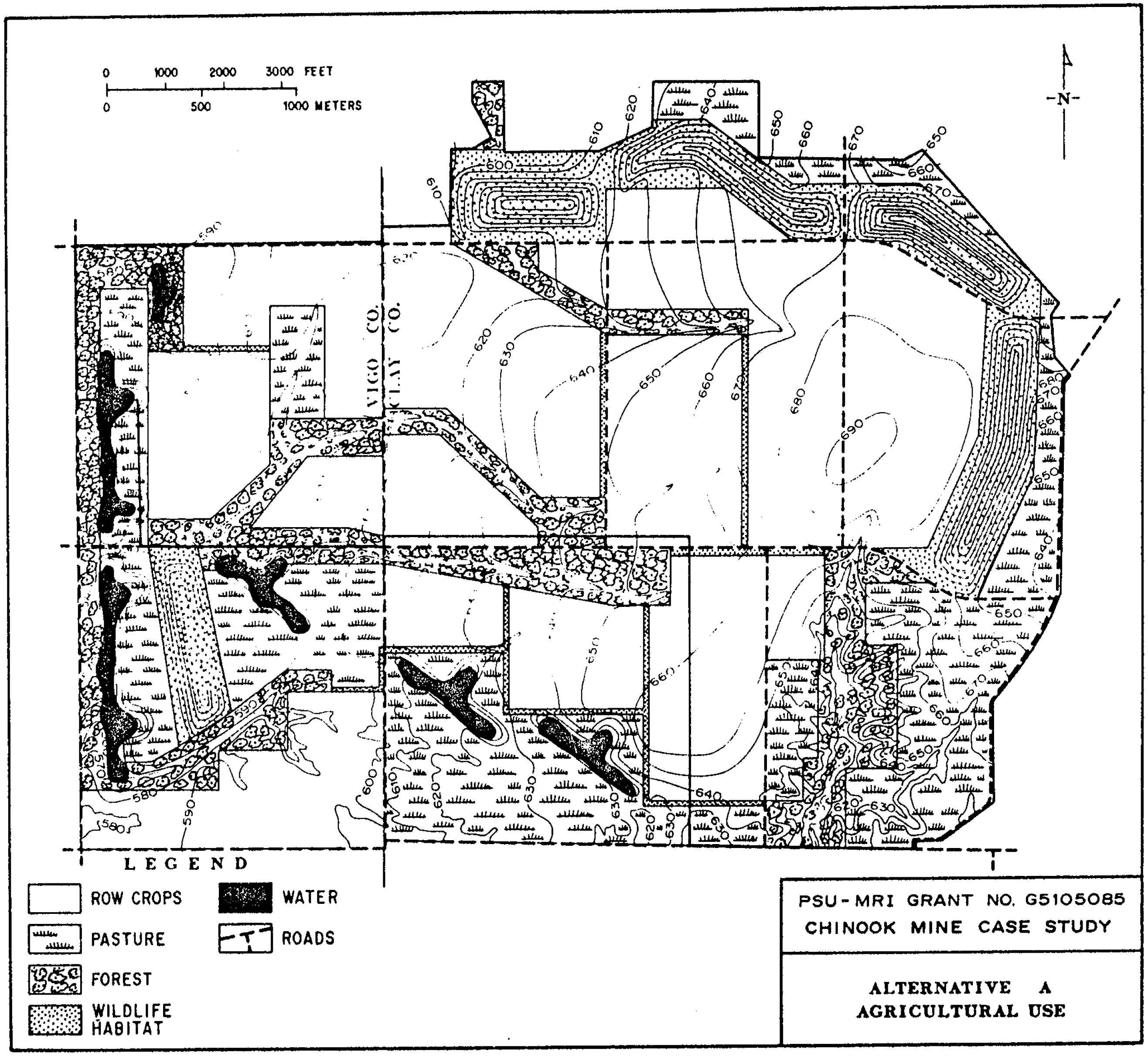


Figure 5.5. Postmining Land Use Alternative A - Agricultural Use.

Table 5.8

Area and Percent of Area for
Land Use Classes in Alternative A

Land Use	Acres	Percent of Total Area
Row Crops	2,079.6	47.6
Pasture	996.1	22.8
Forest	611.7	14.0
Wildlife Habitat	524.3	12.0
Water	96.1	2.2
Roads	61.2	1.4
Total	4,369.0	100.0

comparable to the Iva silt loam. Although SCS soil taxonomy units cannot be applied directly to disturbed soil, it is assumed that the reclaimed row crop areas will have limitations similar to soils with Class II agricultural capability. A yield of approximately 115 bushels of corn per acre can be anticipated. Initially, cultivated fields may require special care in management due to the susceptibility of recently reclaimed fields to climatic stresses. The impact of the disturbance will rapidly decrease with time. These expectations are substantiated by past experience at the site. One mined area that did not receive topsoil or root medium but was allowed to lie fallow for a few years is presently producing in excess of 100 bushels of corn per acre. One limitation of the Iva silt loam is its relatively poor drainage characteristics. For this reason, special care should be taken in topsoil replacement so that compaction will be minimized.

Due to the similarities between Alternative A and the premining land use configuration, it is assumed that the plan would require no changes in the existing infrastructure. Public roads would be reestablished as indicated in Figure 5.5 and would conform primarily to the premining grid pattern. This network of roads would be satisfactory to handle the normal flow of traffic including the movement of agricultural products to the markets.

5.7.2 Alternative B - Low Density Residential Development

Alternative B is oriented toward meeting the demand for home building sites that are situated near end cut lakes. This plan provides for the development of approximately 400 half-acre building sites which would be located either adjacent to or near the impoundments that would remain after mining is completed. A total of 400 new housing units would account for nearly 13 percent of the overall two-township demand through the year 2020. The residential development would be concentrated in the southwest portion of the site. The remainder of the site would be reclaimed to agricultural land, forest, and wildlife habitat identical to the pattern described in Alternative A. Only about 17 percent of the total surface area is impacted by the residential development plans.

The objective of this plan is to make the best use of the available water front areas. This plan would allow for the connection of final cut lakes whenever feasible to enhance their attractiveness. The two large lakes along the western boundary of the property would be connected providing a lake that is over 1.3 miles long. This would necessitate the construction of a bridge for Road 8 East which crosses the lake at this point. Also the two lakes in Section 30 would be connected. The shoreline along all of the lake would be contoured during reclamation to give them a more natural appearance. To protect water quality and to provide all residents with equal access to the water, a band of common open space would be established between the shoreline and the residential properties.

The building sites would primarily be developed upon land that was designated as pasture in Alternative A. The maximum slope would be 12 percent, though the average slope will be much lower than that. The

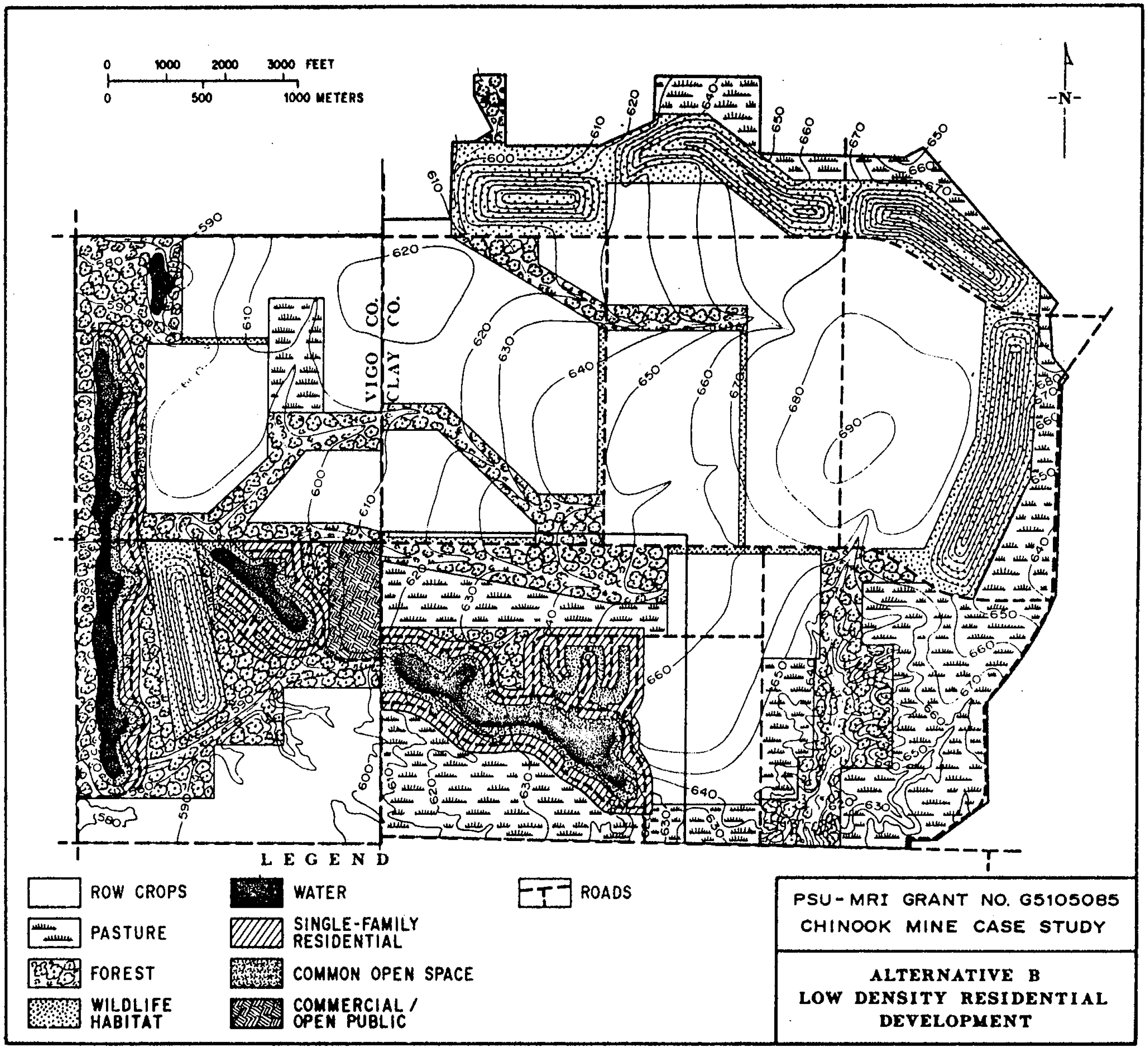


Figure 5.6. Postmining Land Use Alternative B - Low Density Residential Development.

forested areas would be expanded slightly, as indicated in Figure 5.6, to provide an adequate buffer between the primarily residential area and the primarily agricultural area.

The circulation plan is a very important aspect of this alternative. In addition to the county roads that would be reestablished in Alternative A, approximately 7.1 miles of streets and roads would be necessitated by this plan. In accordance with the overall grid pattern, the primary access road to the residential areas would follow the same north-south and east-west pattern. The residential streets themselves are affected by the configurations of the lakes and cannot follow the grid system. With this network of streets and roads, other building sites could be developed quite easily. However, they would need to be increasingly further away from the lakes. Allowing for a street frontage of 150 feet, Alternative B still only provides approximately 150 sites with direct access to the water. The remaining 250 sites would have access to the lake by way of the common open space.

A 40-acre commercial/public area near the intersection of Roads 8 East and 31 South (Cherryvale on original topographic map) is shown in Figure 5.6. This area could be used for commercial establishments such a convenience store, a service station, a restaurant, or whatever other service is demanded. Possible public uses might include a playground, a fire station, a small park, or an elementary school if the population increase was sufficient to justify the investment.

The land use plan outlined in Alternative B would require some changes in the existing infrastructure. Other than the streets that would be needed within the residential development, there would be relatively few changes required in the transportation network. The most significant changes would likely be the upgrading of a few intersections around the perimeter of the site to handle the additional traffic. These improvements would include no more than widening the intersections so that turning lanes could be established. The site is very well located with regard to major access roads, particularly those leading to Terre Haute and the industrial park located east of Terre Haute.

The provision of sewer service to the residential area requires special consideration. Although capacity in the regional system is not a problem, the nearest possible connection point is two miles to the west of the site. Due to the size of the lots and their proximity to surface water, on-lot disposal would not be practical. An alternative to extending the sewer line to include the residential development would be the construction of a small treatment plant to serve only the area in question. The costs of both approaches would require additional investigation. Water supply does not present the same problem. Public wells could readily be developed to serve the entire residential area.

5.7.3 Alternative C - Residential Development with Integrated Open Space and Recreational Uses

This final alternative is similar to Alternative A and Alternative B in that the major portion of the site would be returned to agricultural uses. Unlike the development plan described in Alternative B which provided only single family housing units on half-acre lots, this plan includes cluster homes and multi-family units which are integrated into an open space plan that provides outdoor recreational opportunities as well. Alternative C is illustrated in Figure 5.7. The major differences between Alternative B and Alternative C are the greater diversity that is incorporated into Alternative C and the higher density residential uses. Other aspects that remain unchanged are the reestablishment of the overall grid pattern, provision of buffers between developed areas and agricultural areas, and the improvement of lake attractiveness by connecting some water bodies and contouring the shoreline.

Alternative C would basically develop the same areas for residential use as those previously described in Alternative B. The major exception would be the shoreline along the southern half of the western-most lake. This area would become part of the recreational development. Two types of residential densities are indicated on the site plan. Approximately 100 acres would be provided for single family dwellings. Using half-acre lot sizes, this would provide lots for 200 units. An additional 93 acres would be set aside for multi-family dwelling units. This could include a combination of garden-type apartments, individually-owned townhouses, and duplexes. It is estimated that 400 units could easily be accommodated in this area bringing the total to 600 housing units for the entire plan. This figure represents about 19 percent of the new housing demand for Posey Township and Lost Creek Township through the year 2020. Although Alternative C provides 200 more housing units than would be provided in Alternative B, it would not require any additional area due to the different type of development. This plan would also incorporate open space between the shoreline and the residential properties. Besides protecting the water quality, this concept would actually enhance the value of certain residential sites by making the lake accessible to residents that otherwise would have no access to the water.

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

A somewhat larger commercial area is shown on the map for Alternative C than was indicated in Alternative B. In addition to a larger resident population due to 50 percent more housing units, nonresidents may be attracted into the area to use either the park or the golf course. This would result in a higher demand for commercial services such as grocery stores, restaurants, automotive service stations, and possibly a speciality store such as a tackle shop. The Commercial/Other Public classification shown on the site plan has been divided into 57 percent commercial and 43 percent other public for analytical purposes.

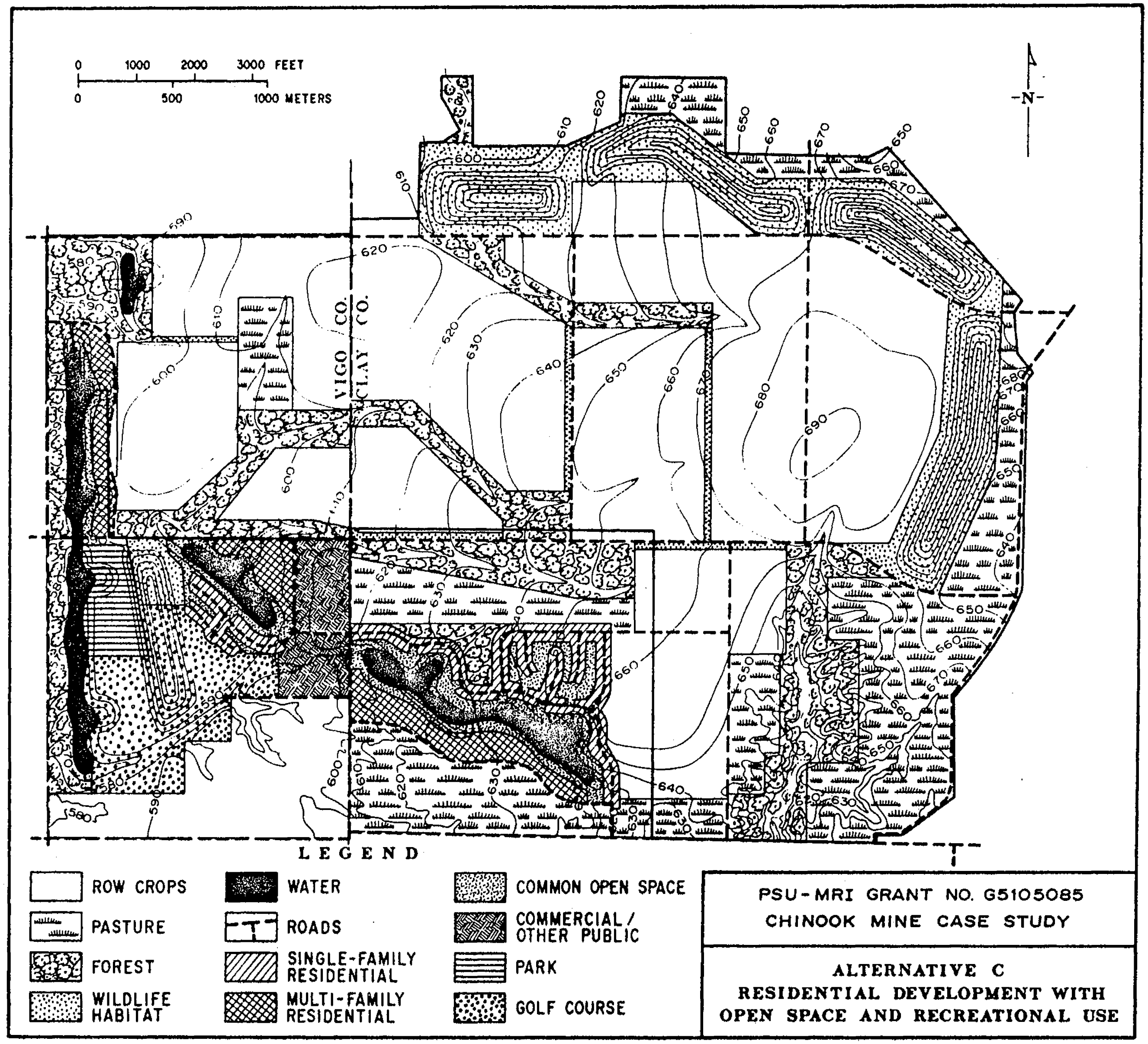


Figure 5.7. Postmining Land Use Alternative C - Residential Development with Open Space and Recreational Use.

This alternative would also place a slightly greater demand on utilities and other public facilities. The intersection improvements discussed in the last section should be adequate to meet the traffic volumes at all but one or two intersections. Traffic signals would possibly be required at these intersections. The remainder of the highway network would be unaffected. The waste water problem identified in the previous section would be the major physical obstacle to development. The higher density of residential units, however, would give greater justification for extending the existing regional sewer lines rather than constructing a separate treatment facility.

5.8 Evaluation of the Alternatives

Each of the postmining land use plan alternatives have been evaluated from an economic, environmental, and social impact perspective. Quantitative estimates have been made of the economic and environmental impacts. The social implications of each plan have been addressed qualitatively.

5.8.1 Economic Evaluation

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

The costs to the mining company would not vary considerably between the three alternatives. Each alternative represents a cost savings over strict adherence to approximate original contour standards. These savings would be realized by maintaining the final cuts as lakes and only partially reducing the height of the box cut spoils. A small amount of additional earthwork would be required in Alternatives B and C to contour the shoreline and construct two channels as connections between end cut lakes. Preliminary grading for roads and development sites would be done for Alternatives B and C during reclamation. This would not represent movement of additional material since the material would otherwise have to be graded. It would, however, require stricter engineering control of the final grades. There would be no cost savings in topsoil handling because development areas would have to be topsoiled and temporarily revegetated until construction began.

A comparison of the total estimated land value resulting from each alternative land use plan is given in Table 5.9. The unit price for the different land uses were arrived at through several means. The Real Estate Handbook (Seldin, 1980) estimates the value of cultivated land in this region at approximately $725 per acre in 1975. This figure corresponds very closely to the figure used by AMAX Coal appraisers at that

Table 5.9

Land Value Estimation for Land Use Alternatives

	Number of Acres	Unit Price of Land ($/Ac.)	Land Value ($)
Alternative A			
Row Crops	2079.6	1859	3,865,976
Pasture	996.1	1280	1,275,008
Forest	611.7	640	391,488
Wildlife Habitat	524.3	512	268,442
Water	96.1	-	
Roads	61.2	-	
Total	4369.0		5,800,914
Alternative B			
Row Crops	1907.9	1859	3,546,786
Pasture	713.8	1280	913,664
Forest	689.7	640	441,408
Wildlife Habitat	499.8	512	255,898
Single Family Residential	193.1	2048	395,469
Commercial	20.0	2560	51,200
Common Open Space	124.2	-	
Roads	104.4	-	
Other Public	20.0	-	
Water	96.1	-	
Total	4369.0		5,604,425
Alternative C			
Row Crops	1888.3	1859	3,510,350
Pasture	697.1	1280	892,288
Forest	566.2	640	362,368
Wildlife Habitat	456.2	512	233,574
Single Family Residential	101.2	2048	207,258
Multi-Family Residential	93.2	2560	238,592
Commercial	39.3	2560	100,608
Private Recreational	158.0	2560	404,480
Common Open Space	102.1	-	
Park	42.2	-	
Roads	99.1	-	
Other Public	30.0	-	
Water	96.1	-	
Total	4369.0		5,944,518

time. The handbook also reported that the value of agricultural land increased at a rate of approximately 26 percent per year from 1975 through 1979. Therefore all 1975 values were increased by 156 percent to arrive at 1981 estimates. The 1975 value of pasture land was taken at $500 per acre, forest and wildlife habitat at $250 per acre and $200 per acre, respectively, single-family residential land at $800 per acre, and commercial land at $1000 per acre. Wildlife habitat is assumed to be slightly lower in value than ordinary forest land since it is unlikely to have any timber value and is generally situated on steeper slopes. The value of multifamily residential land was assumed to be the same as the value of commercial land. The value of recreational land can vary considerably according to the use which is made of it and whether or not the developer will realize some cash flow benefits from its use. For this reason, private recreational land was evaluated the same as commercial land. Public recreational land, however, was lumped with roads, common open space, and water areas. No land value was assigned to these public uses since the initial landowner or developer will receive no direct return from these areas. However, they do have a positive impact on the surrounding land values. For example, streets that are built as part of a residential development are generally dedicated to the local municipality.

This analysis indicates that for each alternative, the largest percentage of the total land value is derived from the land's usefulness in agricultural production. It can also be seen that there is very little difference between all three alternatives in total land value. The residential land and public streets in Alternative B are taken primarily from pasture land and, to a lesser extent, row crop land in Alternative A. The slight increase in value from the single-family residential use is more than offset by the land that is essentially lost to additional streets and roads.

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

5.8.2 Environmental Evaluation

The results of the environmental evaluation are summarized in the environmental impact assessment matrix given in Table 5.10. This technique follows the format of the Leopold Matrix (Leopold, 1971) where a slash is entered in each cell for which an impact is anticipated. The number above the slash is an estimate of the magnitude of the impact and the other number is an estimate of its importance. All values range between 1.0 and 10.0 and unsigned values are taken to mean negative impacts.

The first environmental characteristic considered in the matrix is that of land form. Divergence from the original land form will not be

Table 5.10

Environmental Impact Assessment Matrix
for Land Use Alternatives

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

an extremely important factor in any of the alternatives. The largest change will be in the wildlife areas created on box cut spoils. Since each alternative includes box cut spoil areas and final cut lakes, these factors are of no use in distinguishing between alternatives. Also, with proper grading and planting the negative impact of these areas will not be great. Alternatives B and C represent a somewhat greater divergence from the original landform due to the grading that would be required for residential uses. However, since the initial topography is generally flat to slightly rolling, these developed areas will represent a minimal change in land form.

The next several factors on the environmental assessment matrix can all be categorized as water impacts. In general, the impacts on surface water quantity will be small and unimportant. Because of increased permeability resulting from the mining operation, the amount of groundwater recharge should increase slightly. Increased recharge has the accompanying effect of reducing peak flows on the surface. Alternative A would receive the largest positive benefit while this effect would be partially offset in Alternatives B and C by the increased amount of impermeable surface area that would be created. The quality of surface water is relatively important, particularly, for Alternatives B and C because the bodies of water would be adjacent to residential areas. It is not anticipated that any of the plans would have a significant negative impact on water quality since it was assumed earlier that public sewers would be required for residential development. The largest problem would occur during the construction phase of Alternative B or C when large areas could be exposed to erosion resulting in sediment deposition in stream channels and lakes. This negative impact would be temporary in nature and mitigable through proper site development procedures.

The geotechnical properties of the site are of importance mainly to Alternatives B and C. The amount of compaction and settling that would occur on reclaimed land is unknown, but because of the potential for structural damage to the proposed buildings, the importance of the impact must be assigned a fairly high value. The importance is even greater for Alternative C which would include the larger multifamily dwelling units. Slope stability is not an important consideration at this site since the maximum slope areas will be used only as wildlife habitat.

The impact on vegetation would be quite similar for each alternative. The mining operation, itself, has the greatest impact on vegetation. However, each land use alternative would follow a similar revegetation plan that would restore a natural vegetative cover. Approximately the same amount and diversity of trees would be provided by each alternative. One problem that is difficult to overcome in reforestation is the uniformity of age and size. Only by transplanting larger seedlings can this situation be improved. Wildlife areas would require transplanting of some more mature seedlings to increase the attractiveness to birds and other animals. Alternative A would provide slightly more row crop area than would be provided by the other two alternatives. Although the total difference in cultivated land is small, the importance of row crops to the entire area must be considered.

The final collection of environmental factors deal with the impact of the alternatives upon wildlife. All of the wildlife components have been assigned relatively high importance values. It is expected that Alternative A will have very little influence on most wildlife such as birds, land animals, and insects. Since the proposed uses are quite similar to the premining uses, it is assumed that the wildlife would return after the mine-related disturbance has ceased. Alternatives B and C would have slightly greater impacts on these factors due to the introduction of more humans into the area and more barriers to wildlife movement. Each alternative does attempt to mitigate this problem through the creation of wildlife corridors. There is no significant difference between the extent and quality of wildlife corridors that would be provided by the three plans. An important wildlife consideration is the positive impact that the final cut lakes would have on fish population in the area. These lakes would be suitable to both native fish and stocked game fish. This impact is more important to Alternative C which places a high priority on the outdoor recreational potential of the site.

In reviewing the total environmental impact of the three land use plans, it can be concluded that Alternative A has the least impact since it differs the least from the premining uses. Although the impacts of Alternative B and Alternative C vary slightly on certain points, the overall impacts of the two plans are essentially identical. It should also be noted that while Alternatives B and C do represent larger negative environmental impacts than Alternative A, these impacts are in no way disproportionate from any other development project and can be mitigated, in many instances, through proper design and construction methods.

5.8.3 Social Impact Evaluation

Alternative A would cause the least social impact for the same reason that it would cause the least environmental impact. That reason is the great similarity between this land use plan and the premining land uses. Aesthetically, Alternative A would be quite satisfactory because it would be in agreement with the surrounding land uses. It would have no impact on utilities, public services, or the transportation network. This alternative is in complete harmony with the regional objective to preserve prime agricultural lands. It would also make use of some previously mined land. No consideration is given in this alternative to meeting residential housing needs or providing outdoor recreational facilities. Basically, it can be concluded that Alternative A would cause no negative social impact nor would it provide any additional social benefits.

Alternative B would have more drastic social implications, both positive and negative. On the positive side, it would help in meeting the regional objective of satisfying residential housing needs in relation to geographic suitability and employment. Given the local population trends, the accessibility to Terre Haute, and the demonstrated demand for housing in the suburban townships, it appears that the area is geographically suitable for residential development. Although none of the surrounding properties are heavily developed for residential use, this type of use is not incompatible with the surroundings. Aesthetically, a properly designed residential community is often much more satisfactory than haphazard development that is likely to occur without any planning. Although Alternative B would not retain quite as much cultivated land as Alternative A, most of the residential development would occur on land that is better suited to grazing than to cultivation. Therefore, this alternative basically satisfies the objective of conserving prime agricultural lands. Alternative B also endeavors to preserve the rural areas by establishing a wooded buffer between residential and agricultural areas. The major negative social impact of this alternative is the strain which may be placed on existing utilities, public services, and transportation networks. These issues were addressed in a previous section along with measures to mitigate their impact.

Alternative C would result in many of the same social impacts already listed for Alternative B. The magnitude of the impacts would be increased slightly, however. Since this alternative would provide more housing units, it would have a greater impact on meeting the need for geographically suitable housing. It also would help alleviate the recognized shortage of rental housing. This alternative addresses a social need that has not been considered directly in either of the other two alternatives. The premining studies phase of the investigation has shown a deficiency in outdoor recreational facilities. Alternative C would provide a variety of recreational opportunities. Aesthetically, the same principle applies to this alternative as to the last. Although the proposed land uses are different from those of the adjacent properties, proper planning and design can result in an appealing landscape. Alternative C is essentially the same as Alternative B in preserving prime agricultural land and in providing buffers between developed areas and rural areas. As Alternative B would have some negative impact on utilities, public facilities, and highways, Alternative C would have a slightly larger negative impact. It appears that the magnitude and importance of the positive social impacts generated by Alternative C would outweigh any negative impacts.

5.9 Selected Alternative

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

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

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

5.10 Review

The final phase of the site planning process would be a review of the selected land use plan by other interested individuals within the company. In addition to this immediate review, a final review of the evaluation process should be conducted as completion of the mining operation approaches to ensure that the proposed land use plan is still workable and consistent with local objectives.

Chapter 6

CONCLUSIONS

The main objective of this case study was to investigate the post-mining land use potential of AMAX Coal Company's Chinook Mine - West Field. One of the keys to meeting this objective was to understand the process used by AMAX planners in developing postmining land use plans.

An important aspect of the reclamation and land use planning activities in AMAX Coal Company is Meadowlark Farms, Inc., the land management subsidiary of AMAX, Inc. Discussions with various planners, engineers, and real estate specialists within the AMAX structure have yielded insight into the land use planning process. Summarizing AMAX's approach, the responsibility for developing post-mining land use plans rests basically with the Environmental Studies Group which is located within the Environmental Engineering Department. This group receives input from operations and Meadowlark Farms, gets technical assistance from the Special Services Group, and coordinates its planning activities with the Regulatory Affairs Department which is ultimately responsible for obtaining approval of reclamation and postmining land use plans.

Interaction with the Environmental Studies Group has shed light on the techniques that are presently used to develop postmining land use plans. From a technical standpoint, the most important consideration is fitting the proposed land use to the postmining topography. Equally important are the conservation and utilization of high capability agricultural soils. Public right-of-ways and private ownership are also important. Much of the land in the West Field either belongs to Meadowlark Farms or is intended to be purchased in the future. Present postmining land use plans specify a combination of row crops, pasture, forest, wildlife habitat, and water.

One of the secondary objectives of the study has been to investigate ways of increasing the interaction between mine planners and public planners. There are two tiers of public planning that are active in the mine area. The first tier is the county level, and the Area Planning Department for Vigo County is the responsible agency. Vigo County presently does not have a comprehensive plan, however, such a plan is in the formulation stage. As a result of this study and the visits by the investigators, the planning commission has contacted AMAX Coal Company to request input into their planning process. A portion of the mine is also in Clay County which has no planning commission.

The other tier of public planning affecting the mine area is conducted by the West Central Indiana Economic Development District. This organization serves a six-county area including Vigo and Clay counties. Although the major concern of these planners is economic development, they have had a regional land use element prepared (WCIEDD, 1977b) which has never been implemented by any of the local governing bodies.

With regard to public planning in the area, part of the objective of this research has already been accomplished by fostering interaction between the Vigo County Planning Department and planners within AMAX. It has been apparent that local and regional planners are generally interested in cooperating with the mining industry in their area but do not know how to proceed. For example, the Vigo County planners indicated a desire to protect possible mineral development areas from conflicting land uses but really did not know how to go about it.

The land use planning process illustrated in Figure 4.1 was applied to the Chinook Mine - West Expansion Field. This project included defining the scope of the planning process, discussing the required information systems, conducting preliminary studies and data collection, defining local goals, selecting evaluation methodologies, selecting and weighing evaluation criteria, development of alternative scenarios, evaluation of alternatives, and final selection.

The scope that was adopted includes formulation and evaluation of three alternate postmining land use plans while considering such characteristics as mining practices, land values, aesthetics, and environmental, geographic, demographic, and social conditions. Although primary environmental data collection was beyond the project scope, researching of company files, permit applications, and public documents yielded a considerable amount of background data. Environmental data included topography, climatology, soils, overburden characteristics, vegetation, wildlife, surface water hydrology, and groundwater hydrology. The demographic, geographic, economic, historical, archeological, aesthetic, background noise, and land use characteristics of the site were also inventoried. Local goals and objectives were extracted from the land use element prepared by the West Central Indiana Economic Development District (1977b). Of particular importance to the mine site are those objectives relating to residential growth, recreational use of mined land, wildlife protection, and preservation of agricultural land.

Three alternate land use scenarios were considered. These scenarios were:

Alternative A - Agricultural Use
Alternative B - Low Density Residential Development
Alternative C - Residential Development with Integrated Open Space and Recreational Uses

The evaluation procedure considered projected housing demands, transportation requirements, land values, environmental constraints, and social acceptability. Application of this procedure indicated that Alternative C has the highest land use potential. The procedure did not consider regulatory or ownership constraints. Also, it is quite likely that much of the site will be returned to agricultural production, at least for the near future.

Most of AMAX's and Meadowlark Farms' pioneering work has involved agricultural lands. The Chinook Mine is in a rather unique location where the premining use of the land is almost exclusively agricultural, but there has been rapid growth immediately to the west of the site due to the influence of Terre Haute. Studies have indicated a high future demand for additional housing in this area. It has also been established that homes built near final cut lakes have higher value than those not located near a body of water. For these reasons it is believed that some residential development could be considered for portions of the reclaimed mine site, particularly those areas with greatest accessibility. From a regulatory standpoint, however, this would constitute a change in land use and require significant justification and possibly third-party commitments. The best way of handling this dilemma appears to be matching the acres of postmining land uses, as nearly as possible, to the premining uses and at the same time preserving the potential for high intensity use in the future. To accomplish this objective, the company must seek permission to construct end cut lakes. Or else, certain valuable land resources will be lost. Another challenge in this process is to properly locate those areas that will remain in agricultural production so that they are in harmony with those acres that will eventually be developed for residential or commercial uses.

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APPENDIX 1

SCS Agricultural Capability Units

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife (None in Vigo County).

Class VI soils have very severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or to esthetic purposes (None in Vigo County).

APPENDIX 2

Regional Objectives and Policy Statement for West Central Indiana Economic Development District

Objective: <u>Support of Residential Housing Needs in Relationship to Geographical Suitability and Employment</u>

Policy:

1. Use of the District Housing Element to help facilitate distribution of housing needs in the District.

2. Encourage residential development in areas not affected by flooding; in areas which will not be adversely affected (i.e., natural areas, historic areas, prime agricultural areas).

3. Encourage, through planning with local officials, residential development in and around areas which have adequate support facilities, and employment centers.

4. Discourage residential development in areas void of transportation, medical, shopping and other vital facilities.

Objective: <u>Maintenance of Quality in Public Facilities, Utilities, Recreation Needs, Transportation Needs, and other Services required to Support Proper Land Use Needs.</u>

Policy:

1. Assist local governments (upon their request) in their efforts to upgrade support facilities in target areas (i.e., via Community Development Block Grants, Economic Development, outdoor recreation development), and to extend selected public services to unserved areas (including suburban and rural areas).

2. Use the Identification of Public facilities and services listed in the Overall Economic Development Work Program (1976-1980) as a tool to further the needs of local communities; to upgrade and maintain quality in public support services.

3. Encourage the strengthening of the efficiency of local communities delivery of service.

4. Encourage proper development of public facilities in such a way that they will not adversely infringe on various uses of land (i.e., public facilities, transportation facilities should be away from prime agricultural land or flood prone areas).

Objective: Maintain Proper Growth and Development - Whether that Growth is Economic, Rural, Industrial, Residential, etc.

Policy:

1. Provide assistance to localities in planning for economic development-industrial development.

- Technical assistance is given in this area by the WCIEDD staff via industrial site surveys (see map of industrial sites), assistance with Public Works projects, etc.

- Technical assistance is offered in relation to distribution of key facilities (related to above point).

2. Provide assistance in planning for residential and rural development (i.e., via Housing Element).

3. Encourage balanced growth in the above areas which will best suit each area of the District in relationship to land uses.

Objective: Evaluation and Coordination of Various Land Use Plans.

Policy:

1. Encourage local governments to evaluate their existing plans and goals relative to land use to see how effective or useful they are.

2. Use of A-95 Review to measure the effective implementa-

tion of the Land Use policies of the District and coordination with State, local and federal policies.

Objective: Flood Plain Protection.

Policy:

1. Develop flood plain ordinances.

2. Designate flood plains as open space areas.

3. Discourage development (i.e. residential, industrial) on flood prone areas.

4. Discourage the development of flood prone areas by federally sponsored projects using the A-95 review and environmental impact statement authority of the District.

Objective: Conservation of Prime Agricultural Land

Policy:

1. Develop rural zoning ordinances.

2. Apply impact zoning techniques to number one and to existing zoning ordinances.

3. Discourage development by concentrating utilities, services, and transportation facilities in or near towns and cities.

4. Develop a subdivision ordinance having a comprehensive section on conservation practices and regulations.

5. Investigate tax assessment and tax deferral methods of retaining prime agricultural lands.

Objective: Protection of Aquifer Recharge Areas.

Policy:

1. Encourage Planned Unit developments with these areas.

2. Encourage as a prerequisite to development, the provision of adequate sanitary services. (Subdivision and zoning

ordinance).

3. Until adequate utilities can be provided, discourage development in these areas by providing services, utilities, and traffic facilities away from such areas.

4. Apply impact zoning techniques within existing or new zoning ordinances.

Objective: Former Mined Lands Reclamation and Usage.

Policy:

1. Develop zoning and subdivision ordinances having as primary elements impact zoning procedures and conservation requirements.

2. Encourage rural density, recreational, or open space use of these areas by providing utilities, services, and transportation facilities elsewhere.

3. Request assistance from the State Board of Health and the Environmental Protection Agency in forming a program of acid mine drainage control and reclamation.

4. Use A-95 review and environmental impact statements to direct government sponsored projects away from these areas if the proposed use is incompatible to the area's physical composition.

5. Gain public use of these areas for recreation purposes using direct acquisition, conservation easements, installment purchase, or by gift.

Objective: Protection of Water Resource Areas.

Policy:

1. Develop conservation procedures to protect watershed, reservoirs, and water frontage areas from physical damage.

2. Develop ordinances emphasizing environmental quality would be advisable.

3. Establish and request the advice of a Conservation Commission to insure the proposed development becomes compatible with the environment.

4. Discourage the use of on-site sewage disposal systems in areas unsuitable for such systems. (Subdivision and zoning ordinance).

5. Develop trails environmental corridors, or linear parkways along the region's primary water routes using acquisition, donation, or easement techniques.

Objective: <u>Preservation of Rural Areas</u>

Policy:

1. Develop rural zoning ordinance.

2. Adopt subdivision ordinances possessing comprehensive conservation elements.

3. Discourage the provision of those utilities and services designed to stimulate urban and suburban development in rural areas.

4. Develop open space areas as separators or buffers between urban/suburban land uses and rural activities.

5. Whenever possible, form an open space area between urban, suburban, and rural land uses, using, if necessary, acquisition, taxing, or easement techniques.

Objective: <u>Protection of Historic or Nature Sites</u>

Policy:

1. Develop historical zoning elements within existing or newly adopted zoning ordinances.

2. Administer subdivision ordinances in a manner that

protects natural and scenic areas.

3. Utilize taxing methods, easement procedures, or acquisition to insure the preservation of these areas.

4. Designate historical sites throughout the District that are of major significance.

5. Use A-95 Review to protect historic/natural areas.

Objective: Designation and Use of Environmental Corridors.

Policy:

1. Encourage development of ordinances to protect designated corridors.

2. Develop such corridors to serve various functions, thereby alleviating development pressures.

3. Utilize flood plain and conservation zoning measures to protect the corridors environmental quality.

4. Acquire public use of the corridor by acquisition, taxing, gift, or easement procedures.

Objective: Support of Land, Water Conservation and Environmental Quality.

Policy:

1. To assist local governments and their agencies in:
   - Preserving the quality of ground water supply sources.
   - Encouraging private and public sector agencies in seeking protection of air and water quality (via higher standards for water and air anti-pollution techniques.)
   - Encouraging industrial development which will minimize air and water pollution.
   - Preserving productive soils (The WCIEDD staff and the S.C.S. have identified suitable and productive soils), especially for agricultural production.

2. Use of A-95 Review to comment to Federal agencies on projects which may impact Land, water and environmental conservation.

APPENDIX 3

Indiana Division of Reclamation Letter Concerning Postmining Land Use Changes

STATE of INDIANA

INDIANAPOLIS, 46204

DEPARTMENT OF NATURAL RESOURCES

JAMES M. RIDENOUR
DIRECTOR

TO: All Indiana Surface Coal Mine Operators - Others

FROM: Division of Reclamation, Stephen B. Stafford, Director

DATE: April 13, 1981

SUBJECT: Post-mining land use changes

This letter is intended to provide guidance for operators seeking alternative post-mining land uses. All surface mine operators are reminded that 30 CFR 715.13(d), Interim Rules and Regulations, describes the criteria for approving alternative post-mining land uses. The following information shall be used in preparing requests for land use changes and should be submitted with permit applications.

Any operator whose permit or amended permit will have an effective date on or after July 1, 1981 shall comply with the following requirements for post-mining land use changes.

Section 715.13(d)

All land use changes must be accompanied by written comments from the landowner addressing the land use proposal(s) or documentation that the landowner has been notified by certified letter, affording him an opportunity to comment to the Division of Reclamation on the proposed land use change within thirty (30) days of receipt of that letter.

Section 715.13(d)(1)

The proposed land use must be compatible with adjacent land uses, and where applicable, with existing local, Indiana or Federal land use policies and plans. According to the State Planning Services Agency, below is a list of those counties and municipalities in southwestern Indiana which, at the present time, have adopted comprehensive land use plans:

Counties	Municipalities	
Knox	Attica (Warren)	Jasper (Dubois)
Parke	Boonville (Warrick)	Loogootee (Martin)
Perry	Brazil (Clay)	Newburgh (Warrick)
Spencer	Chandler (Warrick)	Princeton (Gibson)
Vermillion	Ferdinand (Dubois)	Rockport (Spencer
Vigo	Gentryville (Spencer)	Santa Claus (Spencer)
Warren	Grandview (Spencer)	Sullivan (Sullivan)
Warrick	Harmony (Clay)	Tell City (Perry)
	Huntingburg (Dubois)	Washington (Daviess)

This may not be a complete list and operators are reminded of their obligation to comply with all other existing laws, rules, regulations or ordinances established by Federal, Indiana, county and local authorities.

Before requesting a post-mining land use change, operators are advised to contact the appropriate land use planning agency with statutory authority to determine if the proposed use will require special zoning or other approval from the local agency.

The Division of Reclamation will require a written statement of the views of the appropriate land use planning agency regarding the following post-mining land uses:

> heavy industry, light industry and commercial services, public services, and residential.

Land use changes to water impoundments may, with some local agencies, require special zoning or other approval and operators are advised to check with the applicable agency to determine if an approval will be needed.

Where a local, Indiana or Federal land management agency has jurisdiction over the area proposed to be mined, the operator must obtain any required approval by that agency for the alternate land use.

Section 715.13(d)(2)

The land use change request must be accompanied by specific plans which show the feasibility of the proposed land use related to needs, projected land use trends and markets, and should also include a schedule showing how the proposed use will be developed and achieved within a reasonable time and be sustained.

Section 715.13(d)(3)(4)

When a proposed alternate post-mining land use is to be developed by parties other than the operator, plans for financing attainment and maintenance of the post-mining land use and letters of commitment must accompany the request. This provision does not apply to row crop, pasture and hay, forest or wildlife land use changes where the property owner would apply standard farming practices.

Section 715.13(d)(5)

The land use change request must be accompanied by specific plans designed under the general supervision of a registered professional engineer, or other appropriate professional, who will ensure that the plans conform to applicable standards for adequate land stability, drainage, and vegetative cover.

For post-mining uses of water impoundments, plans must also include applicable information meeting the requirements of Sections 715.14(e) and 715.17(k) of the Federal Interim Regulations.

Section 715.13(d)(6)

The proposed use must not present actual or probable hazard to public health or safety nor pose actual or probable threat of water flow diminution or pollution.

Section 715.13(d)(7)

The proposed use must not involve unreasonable delays in reclamation.

Section 715.13(d)(8)

When a post-mining land use change is proposed on properties owned or managed by Indiana or Federal fish and wildlife management agencies, measures to prevent or mitigate adverse effects on fish and wildlife must be submitted with the request for the land use change with a written approval by the appropriate Indiana or Federal agency.

Section 715.13(d)(9)

When a pre-mining land use of fish and wildlife habitat, forest, or pasture is proposed to be changed to a post-mining cropland use and where the cropland would require continuous maintenance, the request must be submitted with a firm written commitment by the party responsible for the crop management after bond release that the proposed use will be practical and reasonable and that sufficient crop management will be maintained for the cropland use.

The request must be accompanied by plans which demonstrate the topsoil quality and depth will be sufficient to support the proposed use.

Sincerely,

Stephen B. Stafford
Director
Division of Reclamation

SBS:bjm

APPENDIX 4

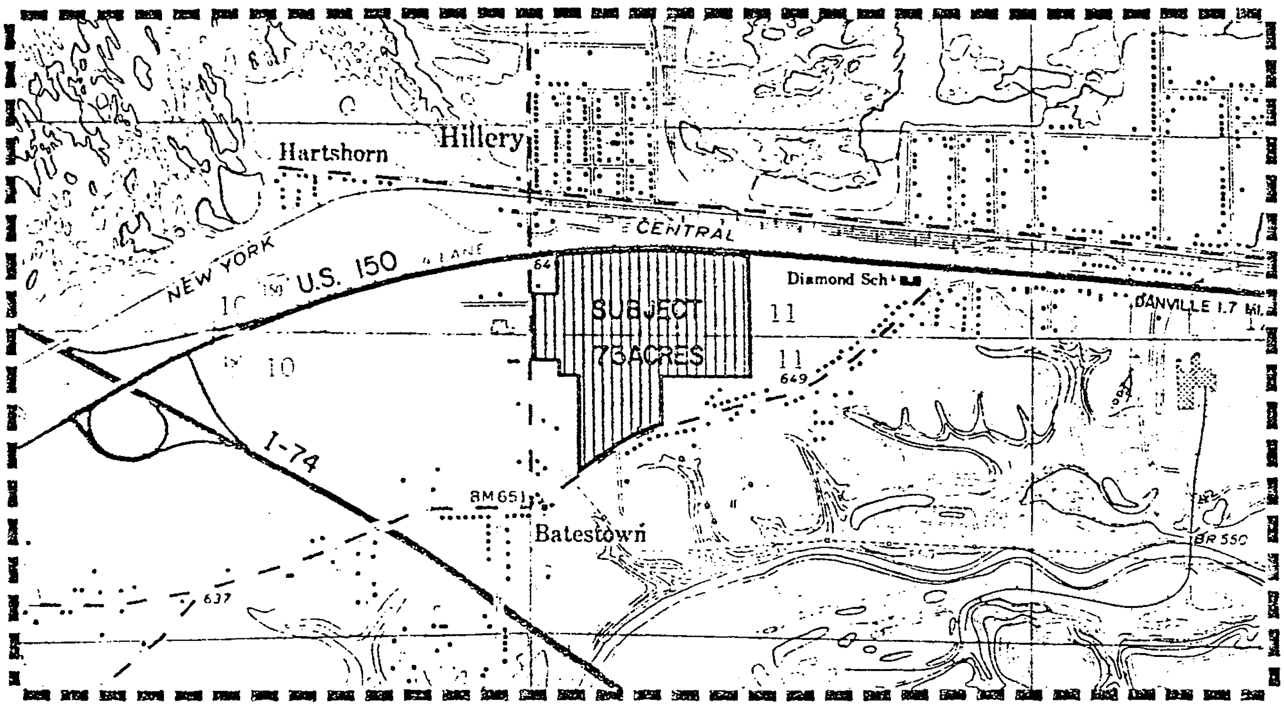
AMAX Coal Company Notice of Property for Sale

FOR SALE

73 ± ACRES

PRIME INDUSTRIAL OR COMMERCIAL SITE

DANVILLE, ILLINOIS



ACREAGE HAS BEEN CLASSIFIED AS A POTENTIAL HIGH INTENSITY DEVELOPMENT AREA. SOURCE: BLOUNT, NEWELL, AND DANVILLE TWPS., VERMILLION COUNTY, ILLINOIS; ENVIRONMENT OPTIMIZATION AND LAND USE MANAGEMENT PLAN.

BROKER PARTICIPATION WELCOMED

LOCATION

PROPERTY LOCATED ON THE SOUTH SIDE OF U.S. 150, ONE-HALF MILE EAST OF THE I-74/U.S. 150 INTERCHANGE, 1.5 MILES DIRECTLY WEST OF DANVILLE, ILLINOIS.

SITE

73± ACRES SITUATED WITHIN A TRIANGLE FORMED BY U.S. 150 TO THE NORTH, HILLARY ROAD TO THE WEST, AND BATESTOWN ROAD TO THE SOUTH. APPROXIMATELY 2,000 FEET OF ROAD FRONTAGE IS ON HEAVILY TRAVELED U.S. 150 WITH ADDITIONAL FRONTAGE ON HILLERY ROAD (550 FEET) AND BATESTOWN ROAD (1,000 FEET). THE I-74/U.S. 150 INTERCHANGE IS LOCATED 1/2 MILE WEST OF THE PROPERTY.

ZONING

NO ZONING ORDINANCES

PRESENT LAND USE

AGRICULTURE - ALL ACREAGE IN ROW CROP PRODUCTION

UTILITIES

GAS - ILLINOIS POWER
ELECTRIC - ILLINOIS POWER
WATER - INTERSTATE WATER COMPANY
SEWAGE - SEPTIC

RAILROAD

CON-RAIL-LOCATED ON NORTH SIDE OF U.S. 150

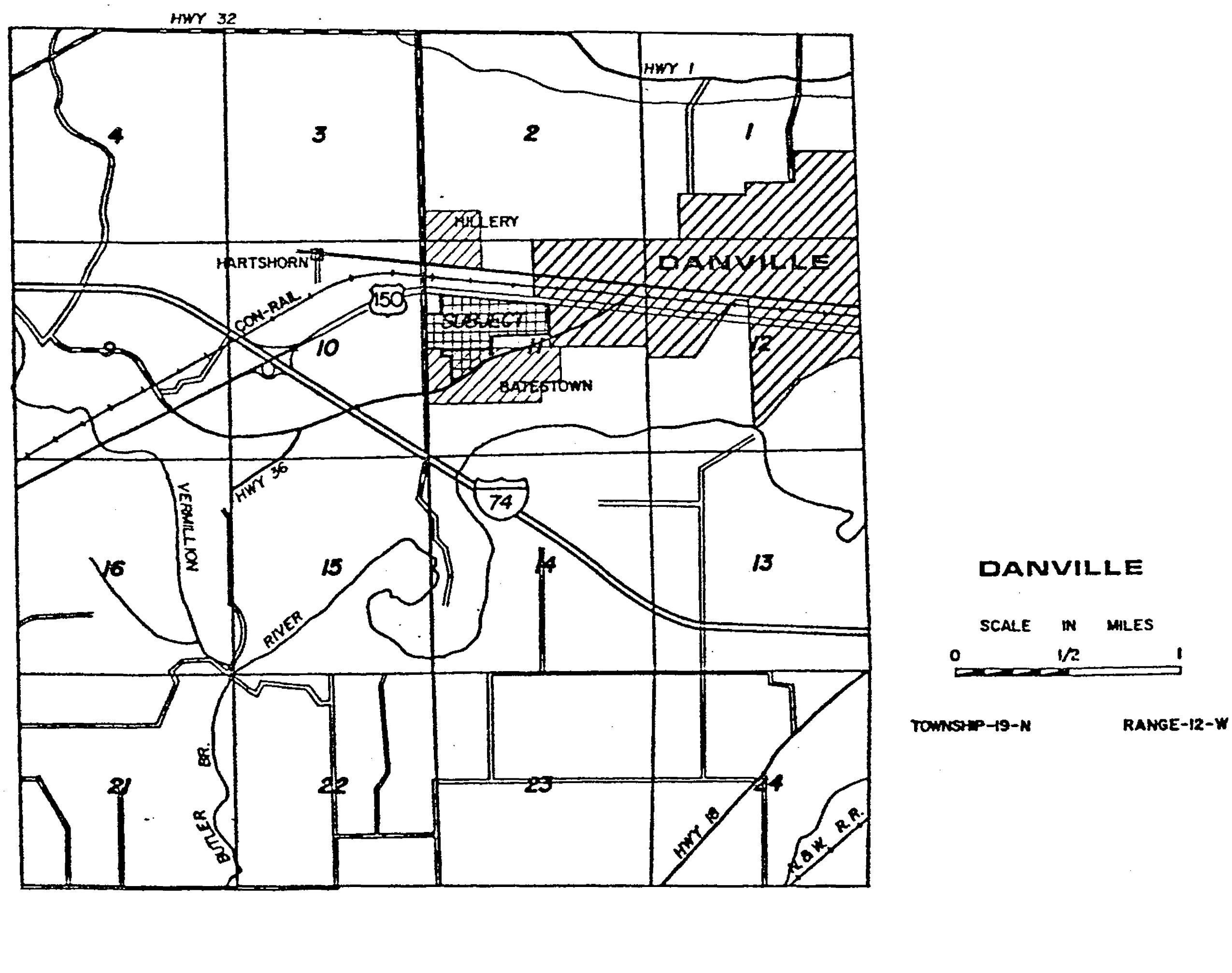
All Sales Subject To AMAX INC. Approval

PRICE

$ 425,000

ALL OFFERS SHOULD BE SUBMITTED ON AMAX COAL COMPANY'S STANDARD OFFER - TO - PURCHASE REAL ESTATE FORM. THE FORM AND FURTHER INFORMATION MAY BE OBTAINED FROM :

DON McCOLLUM
AMAX COAL COMPANY
105 South MERIDIAN STREET
INDIANAPOLIS, INDIANA 46225
TELEPHONE: (317) 266 2798



MEETING PLACE, JUNCTION POINT

Danville is a crossroad of Mid-America, with ties to Chicago 125 miles to the north and ultimately the St Lawrence Seaway. O'Hare Airport, world's largest connection point, is minutes away by commuter flights of Allegheny Airlines. [illegible]-south and east-west highways meet here. Danville is close to the industrial heart of the nation and only a few miles from the population center of the nation.