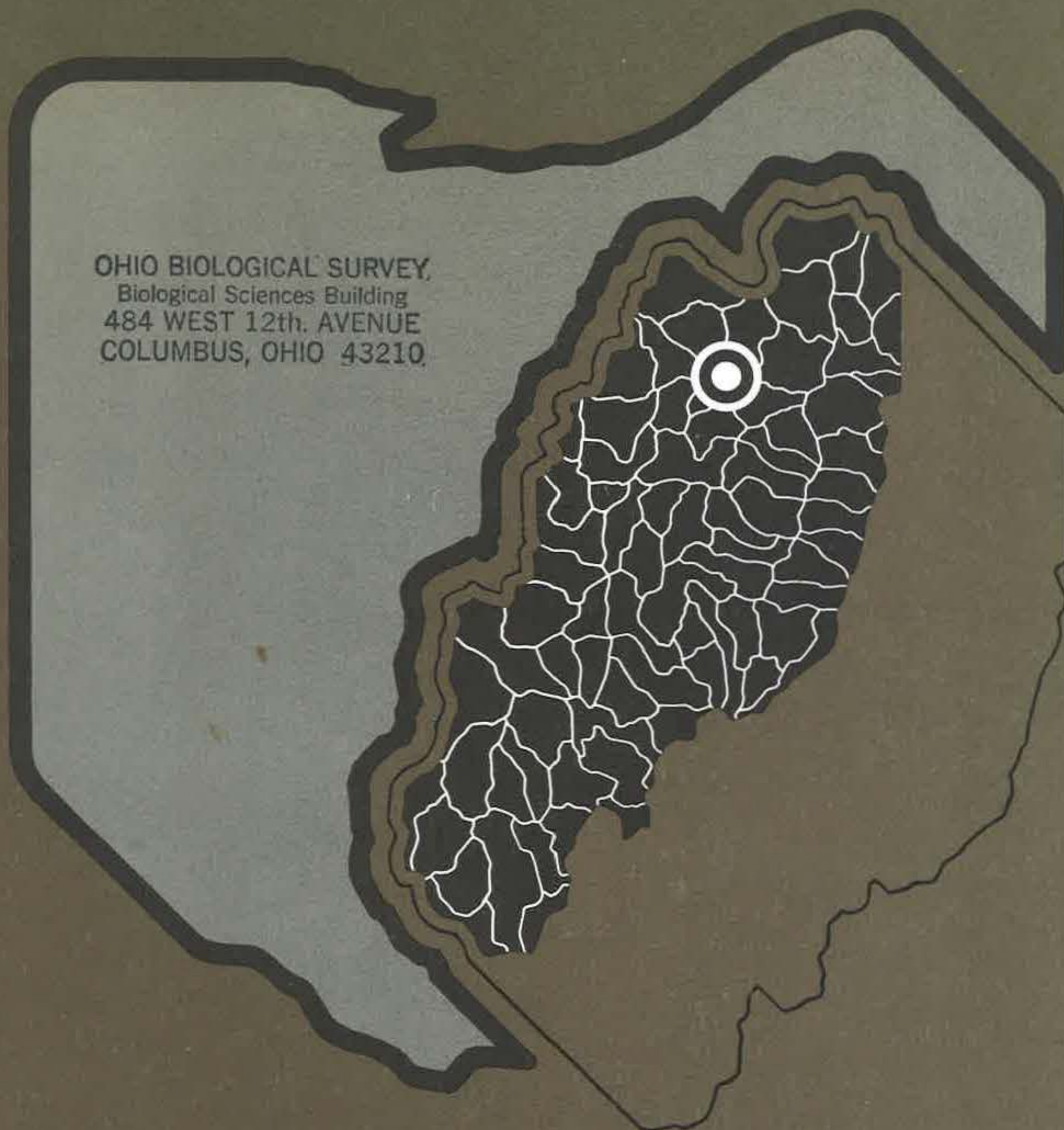

OHIO BIOLOGICAL SURVEY
Biological Sciences Building
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COLUMBUS, OHIO 43210

LAND REBORN

Board on Unreclaimed Strip
Mined Lands & Department
of Natural Resources
State of Ohio

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BUSML

January 1, 1974

The Honorable John J. Gilligan
Governor, State of Ohio

The Honorable A. G. Lancione
Speaker of the Ohio House of Representatives

The Honorable Theodore M. Gray
President Pro Tempore of the Ohio Senate

Gentlemen:

The Board on Unreclaimed Strip Mined Land is pleased to submit this report entitled *Land Reborn.*

The Board on Unreclaimed Strip Mined Lands was established under the provisions of Section 1513 of the Revised Code, the Ohio Strip Mine Law. The Board was directed to "gather information, study and make recommendations concerning the number of acres, location, ownership, condition, environmental damage resulting from the condition, cost of acquiring and reclaiming to the standards in Section 1513.16 of the Revised Code, and possible future uses and value of eroded lands within the state, including land affected by strip mining for which no cash is held in the strip mining reclamation fund."

The report contains the Board's findings and recommendations which are based on an intensive six month study conducted by a team of eight consultants. The recommendations contained in the report, if followed, will lead to the reclamation of lands whose present condition is an abuse of the States' resources and a major burden on the people of Southeastern Ohio. Implementing the recommendations will materially contribute to the goal of improving the quality of life in the region.

Respectfully submitted,

Robert Secrest, Chairman
Board on Unreclaimed Strip Mined Land

Harry L. Armstrong
William A. Behnke
Arthur R. Bowers
Raymond L. Lowrie
Robert H. Mortensen
James P. Schafer
Sam Speck
Terry A. Wakeman

Board on Unreclaimed Strip Mined Lands
State of Ohio

LAND REBORN

A study of unreclaimed coal strip mined land in Ohio January 1, 1974 prepared by the Board on Unreclaimed Strip Mined Lands with the assistance of the Ohio Department of Natural Resources & consultants:

Arthur Young & Company
Battelle Memorial Institute
Environmental Control Corporation
Hayward, Cooper, Straub,
Walinski, Cramer & Co.
Ohio State University, Division of
Landscape Architecture
Photogrammetric Services, Inc.
Robert G. Burton, M.A.I.
Skelly and Loy

recommendations

The Board on Unreclaimed Strip Mined Lands recommends that:

I. The State should set a goal to reclaim all of Ohio's unreclaimed strip mined lands and underground mines by the year 2000.

II. Since the citizens of Ohio have benefited from the production of inexpensive coal for many years, much to the detriment of the environment, it is therefore appropriate to assess the cost of subsequent reclamation against the general public.

III. Full use should be made of the State's mineral severance tax for reclamation activities. The following programs should be funded by the severance tax:

1. Establishment of a financial incentive program for strip mine operators to restrip and reclaim previously mined land that is not now profitable to mine. This will encourage mine operators to reclaim abandoned mine areas much more economically than the normal State bidding process.
2. Establishment of a tax incentive program to encourage landowners to perform their own reclamation where economically possible.
3. Development of guidelines to assist private individuals and other groups to perform reclamation on private lands.
4. Implementation of reclamation on privately owned lands by using landowner consent agreements whenever possible, rather than through land acquisition, by eminent domain, or other means, except where public use requirements are overwhelming.
5. Providing state matching money for federal funding opportunities.
6. Providing for reclamation planning on a watershed or sub-watershed basis, as exemplified in the "Implementation Planning and Strategy Model" section of this report. (See Recommendation V.)

Protection should be provided to prohibit financial windfalls for private owners and to assure that the benefits of State financed reclamation work are not nullified by subsequent land use. (See the "Legal Considerations" section of this report.)

IV. All potential sources of funding for each project should be investigated in detail during the conduct of the watershed projects in accordance with the guidelines established in the "Potential Funding" section of this report.

V. The State should immediately initiate three of the detailed watershed studies described in the "Implementation Planning and Strategy Model" section of this report. The three watersheds to be studied should be selected from the high priority list and the three studies accomplished concurrently. The Department of Natural Resources should expand on the procedures listed in the "Implementation Planning and Strategy Model" in order to develop detailed criteria appropriate to each watershed. This will assure that each watershed project is in the most appropriate manner within the general outlines indicated while maintaining the established goals, budget and time frame. In accomplishing these studies:

1. Either the State of Ohio, Department of Natural Resources or a private system management and planning consultant should act as overall coordinator of the projects.
2. Local citizens and planning groups should be encouraged to participate in the formulation of specific study goals and objectives within each sub-watershed.

VI. The State should immediately establish a program directed toward preparing geology and soil surveys in those counties containing high priority watersheds to ensure the essential information is available when programs described in the "Implementation Planning and Strategy Model" section are initiated.

VII. The State of Ohio should place the highest priority on obtaining federal funds for the three "quick-start" reclamation projects for which applications have been prepared.

VIII. The State of Ohio should continue to strive for positive benefits from this program in a variety of areas including: mine drainage pollution abatement, socio-economic development and comprehensive environmental land use planning by integrating with other State planning and development programs where possible.

executive summary

The 109th General Assembly passed, and Governor John J. Gilligan signed, the nation's most comprehensive strip mine reclamation law, which became effective on April 10, 1972. As part of that law, a Board on Unreclaimed Strip Mined Lands was created to guide restoration of lands and waters affected by strip mining prior to 1972, which today are sources of pollution.

That Board is composed of the following members:

Senator Harry L. Armstrong	Raymond L. Lowrie
Senator Robert Secrest	James P. Schafer
Representative Arthur R. Bowers	Terry A. Wakeman
Representative Sam Speck	Robert H. Mortensen
	William A. Behnke

The Board was charged with the responsibility of gathering information, studying and making recommendations concerning the number of acres, location, ownership, condition, environmental damage resulting from the condition, cost of acquiring and reclaiming to the standards in Section 1513.16 of the Revised Code, and possible future uses and value of eroded lands within the State, including land affected by strip mining for which no cash is held in the Strip Mining Reclamation Fund (forfeited performance bonds).

Action by the Board

The Board immediately initiated work on this task. Acting through the Department of Natural Resources, the Board assembled a team of professionals in the needed project disciplines, and started them on the different project tasks concurrently, so that this report could be submitted to Governor Gilligan and the General Assembly for their approval on January 1, 1974.

The Board's Objectives

The objectives established for the project included basic data development (physical and biological, land use, and socio-economic characteristics), determination of potential land uses, estimation of land values, development of reclamation costs, determination of legal tools available to the State and private interests in reclaiming land, and development of public grant/private financing opportunities.

The specific goal of the project is to establish a comprehensive on-going long range mine reclamation program that is economically achievable. This was accomplished and is part of this Report.

How It Was Done

The multidisciplined team of consultant firms and State experts proceeded with the tasks in a number of ways. High level aerial photography was made to identify the mined lands. More than 3,000 aerial photographs were taken to produce 253 photomaps outlining the mined lands. Field crews were sent out to check on a statistical basis the defined mined lands and to take water quality samples.

A detailed mine drainage pollution survey was made. Attorneys researched the legal aspects of reclamation work being done in Ohio and adjacent states. Social and economic considerations were investigated and reported in detail. The entire 11,000 square mile area of the coal field was divided into 79 watersheds for ease of handling the amount of data being accumulated and to provide sensible working units within this large total area.

Appraisers gathered information on current land values before and after reclamation. Public land ownership was defined. Factors such as development demand, economic need, visual quality, and public visibility were incorporated. Cost estimates were made for all of the required reclamation work.

Potential sources of funding were explored, implementation procedures developed, and a series of recommended priorities were established to permit execution of the recommended program on the most beneficial/economical basis.

The Project's Output

The results of this project, or its output, are summarized briefly:

1. Inventory of Surface Mined Lands
   a. 253 aerial photograph mylars which overlay and are on the same scale as the USGS 7½ minute quadrangle maps (1:24,000). 253 photomap overlays showing the mined lands.
   b. Boundaries are shown and acreages computed for all surface mined lands.
   c. Active surface mines are plotted and labeled.
   d. Boundaries and acreages for refuse piles are given.
   e. Surface mined lands are categorized by type and amount of reclamation required.
   f. The coal field was divided into 79 watersheds and surface mine reclamation costs (by categories) are developed for each watershed.

2. Index Maps
   a. The map base is at a scale of 1:250,000.
   b. These maps summarize and clearly depict:
      Sample station locations (water quality stations)
      Watershed boundaries (the 79 working watersheds) and numbers
      Extent of surface mining
      Extent of water pollution
      The location and name of each 7½ minute topographic quadrangle
   c. These maps are color keyed and artistically presented for use as wall display maps.
3. Water Pollution Inventory
   a. Water quality data on all streams (mine drainage parameters).
   b. Pollution amounts attributable to mining activities and amounts of stream degradation.
   c. Origin of pollution defined – relative amounts of underground mine versus strip mine pollution loads for each watershed.
   d. Underground mine pollution abatement cost by watershed.
4. Long Range Reclamation Plan
   a. Watershed priority ranking based upon the following parameters: water pollution, economic need, development demand, public lands, public visibility, visual quality, and density of strip mined lands.
   b. Implementation procedure (detailed) encompassing: recommended order of implementation, manner of performing studies and engineering design, recommended legal procedures, and possible funding avenues.
5. Additional Uses of This Information
   a. The maps can be used to keep track of future mining.
   b. The maps can be used to guide future permit issuing decisions.
   c. The maps can be a base map for future planning activities.
   d. The water quality data are managed so that future water quality can be added for use as a mine water quality data collection system.
   e. The location of strip mine lands and other data will be useful to other State and local functions: planning; geology; soils; agriculture; forestry.
6. A Detailed Report on the Social-Economic Conditions Existing in All Thirty Counties Where Mining Has Been Done
7. A Detailed Report from the Team of Attorneys on Legal Aspects
8. A Detailed Report from the Appraisers on Current Land Values
9. A Detailed Management Report
10. This Report, which summarizes all of the above information

The Board's Findings

More than 370,000 acres of strip mined land area will require some form of reclamation. Of this total, 24,000 acres are active and will be reclaimed by the miners; 166,000 acres require occasional spot treatment; the remaining 180,000 acres require major reclamation effort. This effort will cost 290 million dollars.

Abandoned coal mines discharge over 1,000,000 pounds of acid each day to the State's streams. Sixty percent of this pollution comes from abandoned deep mines and will cost 440 million dollars to eliminate.

A summary tabulation of the high priority watersheds showing the location of each and the reclamation costs follows:

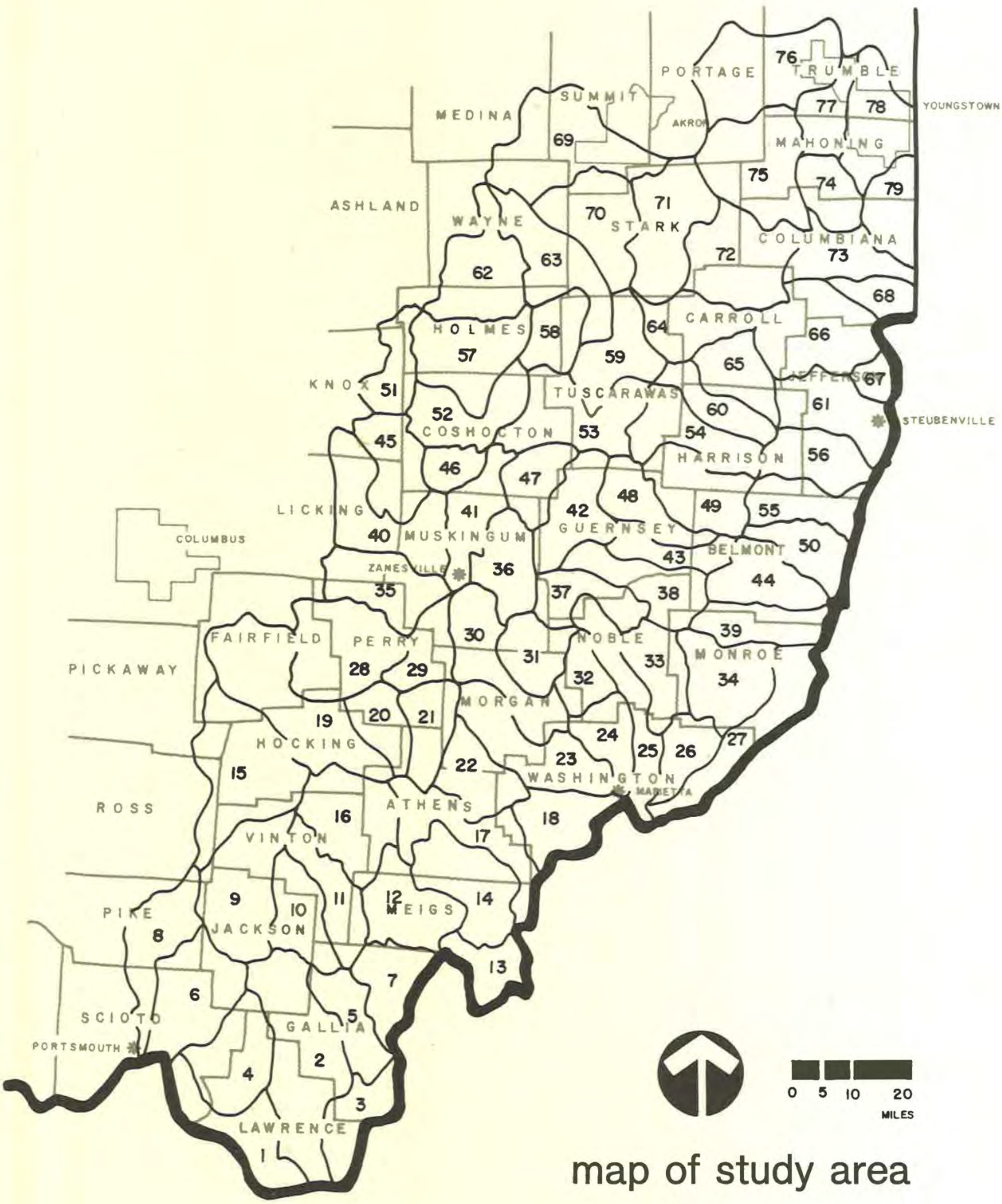
Cost Summary High Priority Watersheds

Watershed Number	Area (sq. mi.)	Stream Name	Counties	Reclamation Cost (in thousands)[1] Strip Mine	Underground Mine	Total	Cost Effectiveness ($ per lb/day acid)[2] Strip Mine	Underground Mine	Overall
1	150	Ice Creek and Ohio River Tributaries	Lawrence	$ 1,500	$ 200	$ 1,700	$ 5,290	$ 625	$ 2,960
4	186	Pine Creek	Lawrence, Scioto	4,100	550	4,650	13,930	625	3,950
7	139	Ohio River Tributaries	Gallia, Meigs	16,900	2,000	18,900	15,870	625	4,440
10	151	Little Raccoon Creek	Gallia, Jackson, Vinton	6,800	34,100	40,900	120	625	380
11	154	Raccoon Creek and Elk Fork Raccoon Creek	Gallia, Meigs, Vinton	3,100	9,900	13,000	200	625	410
12	157	Leading Creek	Meigs	16,800	4,600	21,400	6,900	625	2,200
16	230	Raccoon Creek Headwaters	Athens, Hocking, Meigs, Vinton	5,100	10,100	15,200	310	625	470
20	116	Monday Creek	Athens, Hocking, Perry	4,400	69,300	73,700	120	625	500
25	157	West Fork of Duck Creek	Noble, Washington	9,400	1,200	10,600	1,620	625	1,380
28	235	Rush Creek	Fairfield, Hocking, Perry	6,700	14,000	20,700	300	625	460
29	106	Moxahala Creek	Morgan, Muskingum, Perry	21,300	106,700	128,000	370	625	560
30	179	Muskingum River Tributaries	Morgan	8,100	9,400	17,500	1,630	625	880
33	135	East and Middle Forks of Duck Creek	Noble, Washington	7,400	0	7,400	250	625	250
41	132	Muskingum River Tributaries	Coshocton, Muskingum	5,200	2,800	8,000	3,370	625	1,310
47	124	Lower Wills Creek	Coshocton, Muskingum	2,900	4,200	7,100	1,270	625	790
49	210	Upper Stillwater Creek	Belmont, Guernsey, Harrison	21,400	0	21,400	—	—	—
52	160	Lower Walhonding River	Coshocton	5,200	0	5,200	—	—	—
53	245	Tuscarawas River Tributaries	Coshocton, Tuscarawas	2,300	5,000	7,300	860	625	680
54	160	Stillwater Creek	Harrison, Tuscarawas	1,200	0	1,200	—	—	—
55	137	Wheeling Creek	Belmont, Harrison	6,300	25,600	31,900	460	625	590
56	147	Short Creek and Ohio River Tributaries	Jefferson, Harrison	10,800	0	10,800	—	—	—
59	143	Stone Creek and Tuscarawas River Tributaries	Tuscarawas	6,200	7,300	13,500	530	625	580
61	164	Cross Creek	Harrison, Jefferson	1,150	0	1,150	—	—	—
64	139	Conotton Creek	Carroll, Tuscarawas	2,600	3,000	5,600	530	625	580
66	241	Yellow Creek	Carroll, Columbiana, Jefferson	4,900	7,400	12,300	1,240	625	780

[1] The underground mine column reflects only acid drainage abatement costs.

[2] For strip mines: Total reclamation cost divided by total lb/day acid.
For underground mines: Total acid abatement cost divided by total lb/day acid.

Overall: Total reclamation cost plus total acid abatement cost divided by total lb/day acid from both strip and underground mines.



map of study area

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introduction

The 109th General Assembly passed, and Governor John J. Gilligan signed, the nation's most comprehensive strip mine reclamation law, which became effective on April 10, 1972. The new law requires extensive preplanning of mining and subsequent reclamation, and compliance with mining rules and regulations to insure restoration of areas affected by strip mining.

At the same time, the General Assembly provided for orderly identification and restoration of abandoned mined lands. The Board on Unreclaimed Strip Mined Lands was created with the responsibility to "gather information, and make recommendations concerning the number of acres, location, ownership, condition, environmental damages resulting from the condition, cost of acquiring and reclaiming to the standards in Section 1513.16 of the Revised Code (Ohio Strip Mine Law), and possible future uses and value of eroded lands within the state, including land affected by strip mining for which no cash is held in the Strip Mining Reclamation Fund." The identification of the State's unreclaimed mined lands and definition of the opportunities that exist for their future users has been accomplished. A multidisciplined approach was undertaken utilizing a number of different private firms and coordinated by the Department of Natural Resources. The team assembled by the Board on Unreclaimed Strip Mined Lands included these firms:

- Battelle Memorial Institute's Columbus Laboratories presented information on social and economic factors in the coal areas.
- Robert G. Burton, Marion, made land appraisals and produced a report on land values.
- Environment Control Corporation, Painesville, assisted Skelly and Loy with acquisition of physical data.
- Hayward Cooper Straub Walinski and Cramer, Toledo, researched and reported on legal aspects.
- Ohio State University, Division of Landscape Architecture, developed the Priority Selection Model, prepared the Implementation Planning and Strategy Model, and coordinated preparation of the report and graphics.
- Photogrammetric Services, Inc., Columbus, accomplished aerial photography and definition of the mined lands.
- Skelly and Loy, Columbus, gathered and analyzed all physical data, computed costs, and wrote the report.
- Arthur Young & Company of Toledo provided general project management and consultation.

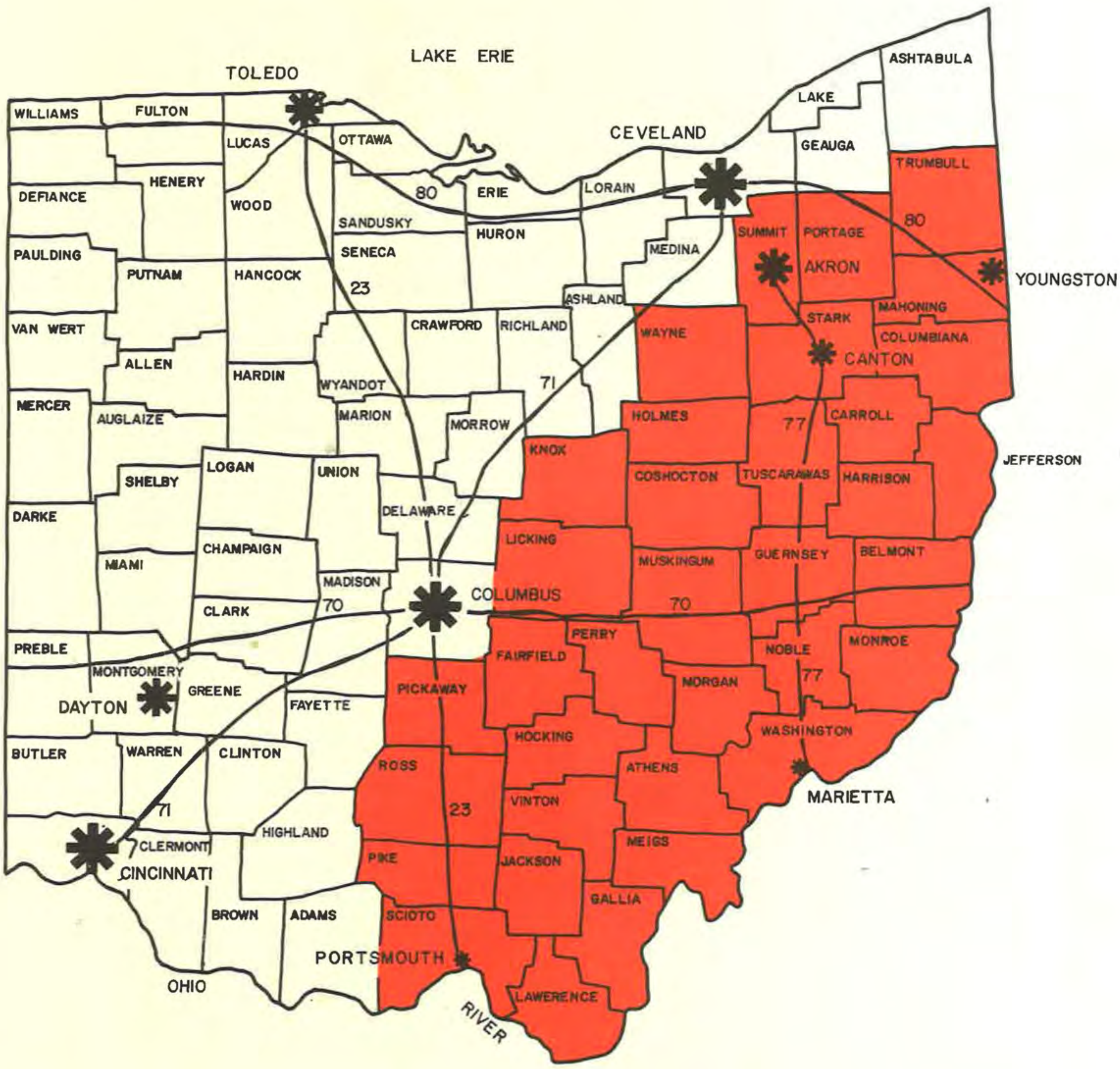
The objective of the project was to develop a long-range comprehensive reclamation plan for the State which can be conducted with a minimum of expense in response to the specific needs of the people of the State. This is the essence of this report.

Thirty counties in southeastern Ohio have been mined for coal since the early 1800's. Techniques for strip mining coal were developed nearly a century ago, and this extraction method has steadily gained importance. Strip mining involves removal of the land surface above the coal to permit extraction of the underlying coal. Today strip mining accounts for more than 70% of the State's total coal production.

Much of the land disturbed by strip mining, prior to 1948, was not reclaimed after mining. While most of the State's strip mining was done after enactment of the State's first strip mining law in 1948, reclamation requirements were not adequate by today's standards. The utility of the land was sometimes completely destroyed by strip mining with improper reclamation. The abandoned mined lands could no longer be put to any productive use such as farming, grazing, or timbering. Abandoned strip and underground coal mines pollute surface streams and ground water by introducing excessive amounts of acid, iron, sulfate, aluminum, manganese and hardness. The unsightly strip mined areas and the acid streams produce an area which will not lend itself to development and also render an area unsuitable for recreational activities, thereby depressing the local economy.

Today, both environmentalists and industry recognize a need to eliminate the previous abuses of natural resources associated with improper strip mining and reclamation.

The predicted expansion of strip mining in the State due to the energy shortage will undoubtedly raise outcries from many people concerned with environmental destruction. The public will have to be convinced of the ability of the strip mining industry and the State to return mined lands to satisfactory condition. This concern could be alleviated by implementation of a plan to reclaim strip mines which are reminders of poor mining practices. The reclamation program could also benefit from the predicted upsurge of strip mining in the State, because the revenues produced by the severance tax will increase. This would only be true if these revenues were used for reclamation, of course.



location map

the coal field

coal mining history

Coal was first mined in the State in the early 1800's for use as a source of household heat. Much of the coal was extracted from small underground mines. Scattered strip mining consisted of removing the coal outcrop by picks and shovels or using horse-drawn wooden scrapers to remove thin rock and soil layers covering shallowly buried coal seams. Although railroads had been built in the 1840's they were not used to transport coal until the early 1850's. This development expanded the market for coal from the areas along rivers and canals to the entire State, and enabled the Ohio coal industry to satisfy a steadily increasing demand for a fuel that would burn longer and hotter than wood.

The coal industry rapidly expanded operations to meet increasing demands during the Industrial Revolution. Northern and eastern investors converged on the coal field to acquire title to the land, or the rights to the "black gold" that it contained. By obtaining title to only the minerals in the land and the right to use the land as necessary to mine those minerals, speculators took advantage of many unsuspecting landowners. Coal companies would pay a landowner as little as fifty cents per acre for all of these mineral rights and mining privileges. The land surface, which was seldom purchased by the mining interests, was frequently ravaged during the mining operations and left unreclaimed.

Increased demand for coal and the advent of the steam powered coal shovel in 1914 enabled strip mining to evolve into a viable industry. Surface mining was favored over deep mining where applicable because it required fewer men, was safer, more efficient, more economical, and therefore more profitable. Strip miners simply surface mined all of the coal around the margins of the deep mined hills. Little or no reclamation work was done in these old strip mines, and they frequently caused severe environmental damages. The strip mines occasionally cut into flooded portions of abandoned deep mines, allowing impounded acid waters to discharge into surface streams, creating a permanent acid mine drainage problem.

The United States' involvement in World War I enormously increased production of coal. In 1918, Ohio produced nearly 48 million tons of coal, a figure not surpassed until 1968. This period of prosperity for the coal industry continued until 1927 when the shadow of depression began to cover the land.

The coal industry was forced to again expand operations to support the World War II effort in the late 1930's. The biggest technological advances were made during this period in the improvement of strip mining equipment and methods. Larger equipment enabled more coal to be stripped more efficiently. Strip mining proved to be more economical and more efficient than deep mining in many areas.

Prior to 1948 there had been no regulations requiring reclamation; therefore, most strip mined land was left in a totally unreclaimed state and severe environmental degradation resulted. The first strip mine law in the State was established in 1948 in an attempt to curb this environmental damage. This law required strip mine operators to post a reclamation bond before they could obtain a permit to strip mine coal in the State. If the operator did not satisfactorily restore the mined lands to comply with existing standards, this bond money was forfeited. Reclamation requirements were generally inadequate for restoration of desirable environmental conditions to the strip mined areas. Many operators found it more profitable to abandon mined lands and forfeit their bonds than to perform the required reclamation. The 1972 Strip Mine Law established strict reclamation requirements and increased the dollar amount of required performance bonds to more nearly equal the actual costs of reclamation. In addition, forfeiture of bond under the 1972 law can prevent a strip mine operator from receiving future mining permits. Bond forfeiture is no longer more desirable than performing the required reclamation work, and strip mine reclamation is now adequate.

Today Ohio is the home of some of the world's largest surface mining equipment. The dipper capacities of the largest shovels exceed 135 cubic yards and the bucket capacity of the largest dragline is 220 cubic yards. With these technological improvements, strip mining has emerged as the predominant method of extracting coal in Ohio. The State of Ohio Division of Mines reported in 1972 that 90% of the active coal operations in Ohio were surface mines, which accounted for approximately 68% of the 50.6 million tons of coal mined in the State. These production figures placed Ohio second in the nation in surface mined coal production, both in the total tonnage produced and in the percentage of total coal production produced by surface mining methods. Approximately 84% of Ohio's surface mined coal in 1971 was produced in the following counties: Belmont, Coshocton, Harrison, Jackson, Jefferson, Muskingum, Noble, Perry and Tuscarawas.

Unreclaimed Strip Mined Land.

socio-economic characteristics

With the exception of eleven counties, the thirty-six county mined lands study area falls within Ohio Appalachia, a region generally characterized by low per capita income, high unemployment, and net out-migration of population. After a period of intense resource exploitation during the late nineteenth century, Appalachia now finds itself isolated from the mainstream of American life. The region is highly rural in an era when major urban centers are the focus of economic growth in the nation as a whole.

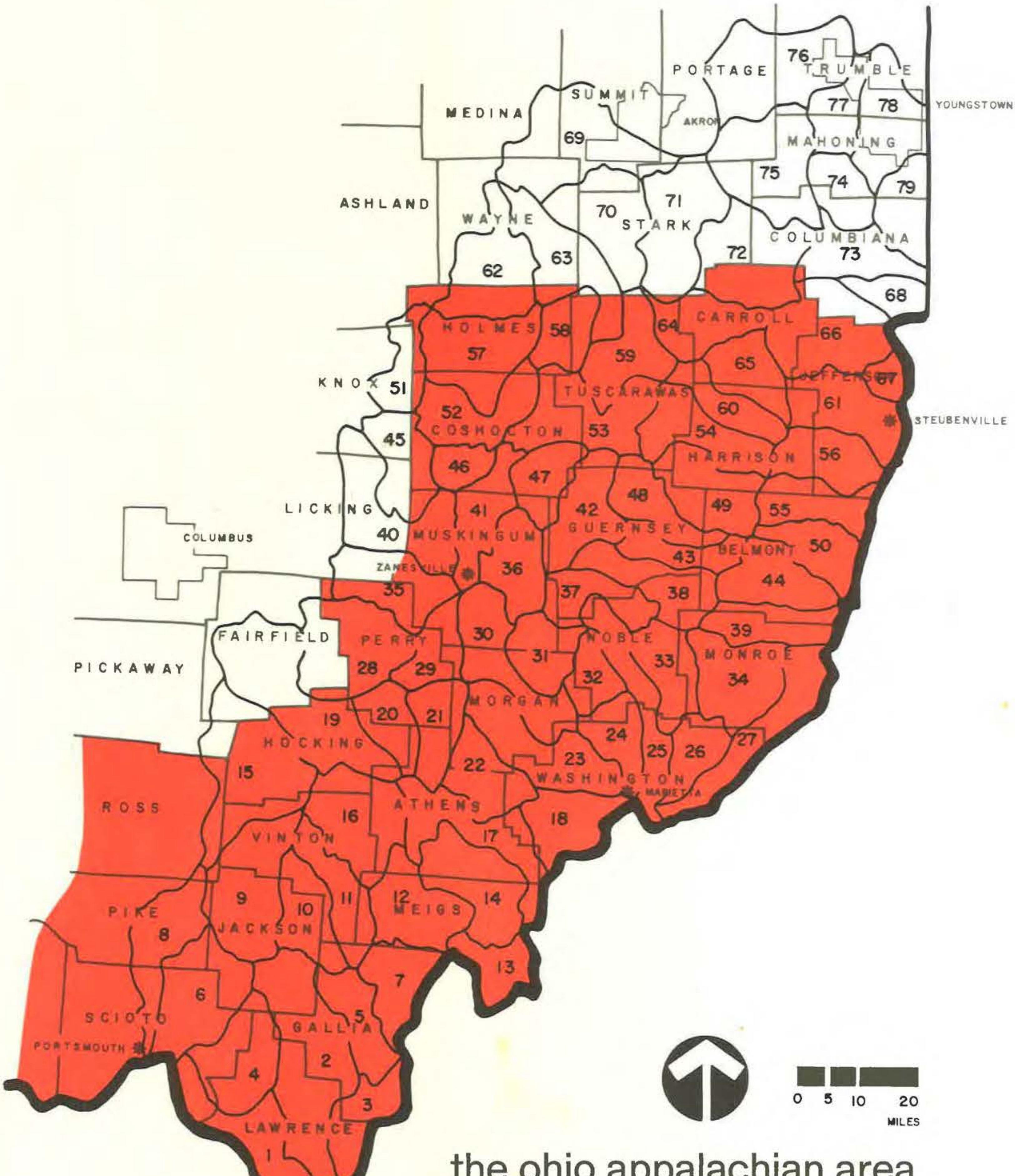
There are several important historical, economic, and political factors that have given rise to the socio-economic conditions that exist in the mined lands study area. Generally, a distinction can be made between the northern counties that fall within the State's major urban-industrial complex and the southern counties where rural land uses dominate.

Early east-west lines of transportation and commerce historically bypassed large portions of Appalachia, further reinforcing its isolation from the rest of the country.

Appalachia did not receive major national attention until after the Civil War when interest was focused upon the region's vast hardwood forests and large deposits of bituminous coal. Coal became an important source of energy in the late nineteenth century when the annual production of coal in Appalachian states jumped dramatically, and many mining towns were established. The mining companies exerted great influence upon some towns in the form of company-owned houses, stores, and the monopoly of job opportunities. With the heavy specialization in primary production, these small urban centers were virtually at the mercy of the coal mining industry. Adequate support facilities for diverse types of secondary activity were never developed, and consequently, these towns are at present incapable of attracting and supporting significant economic growth.

During the 1920's when the United States experienced a decline in coal production, chronic unemployment and wages far below the national average resulted.

Even today, a large portion of the mined lands study area is isolated from the major economic and social trends in contemporary America.



the ohio appalachian area

Population

In 1970 the thirty principal counties in the mined lands study area had a population of 2,680,711. The population was highly concentrated in the northern counties. Portage, Stark, Summit, Trumbull, and Wayne Counties contained 1,587,452 persons, 59.2 percent of the total for the entire region. The densely populated counties tended to be highly urban, and generally experienced significant increases in population from 1960 to 1970. Growth rates vary from a 60.2 percent projected increase in Portage County to a 22.4 percent decrease in Scioto County. The largest population increases are projected for a northeast to southwest belt including Trumbull, Portage, Summit, Stark, Wayne, and Holmes Counties. These counties are highly urban and lie within one of Ohio's major industrial regions. With the exception of Meigs and Monroe, the counties bordering the Ohio River are expected to experience overall decreases or very slight increases in population. This is largely a function of their rural character and their inability to compete for new industrial activity. Population data and projections are presented in the following table.

Land Use

The major productive uses of land in the thirty-six county study area are for forest, mining, and agricultural purposes. There is, however, a significant difference between the urban-industrial North and the rural South. Mahoning, Trumbull, Stark, Summit, and Portage Counties contain large tracts of urban land surrounded by less dense residential land. In most of the remaining counties only a small portion of the land has been classified as urban.

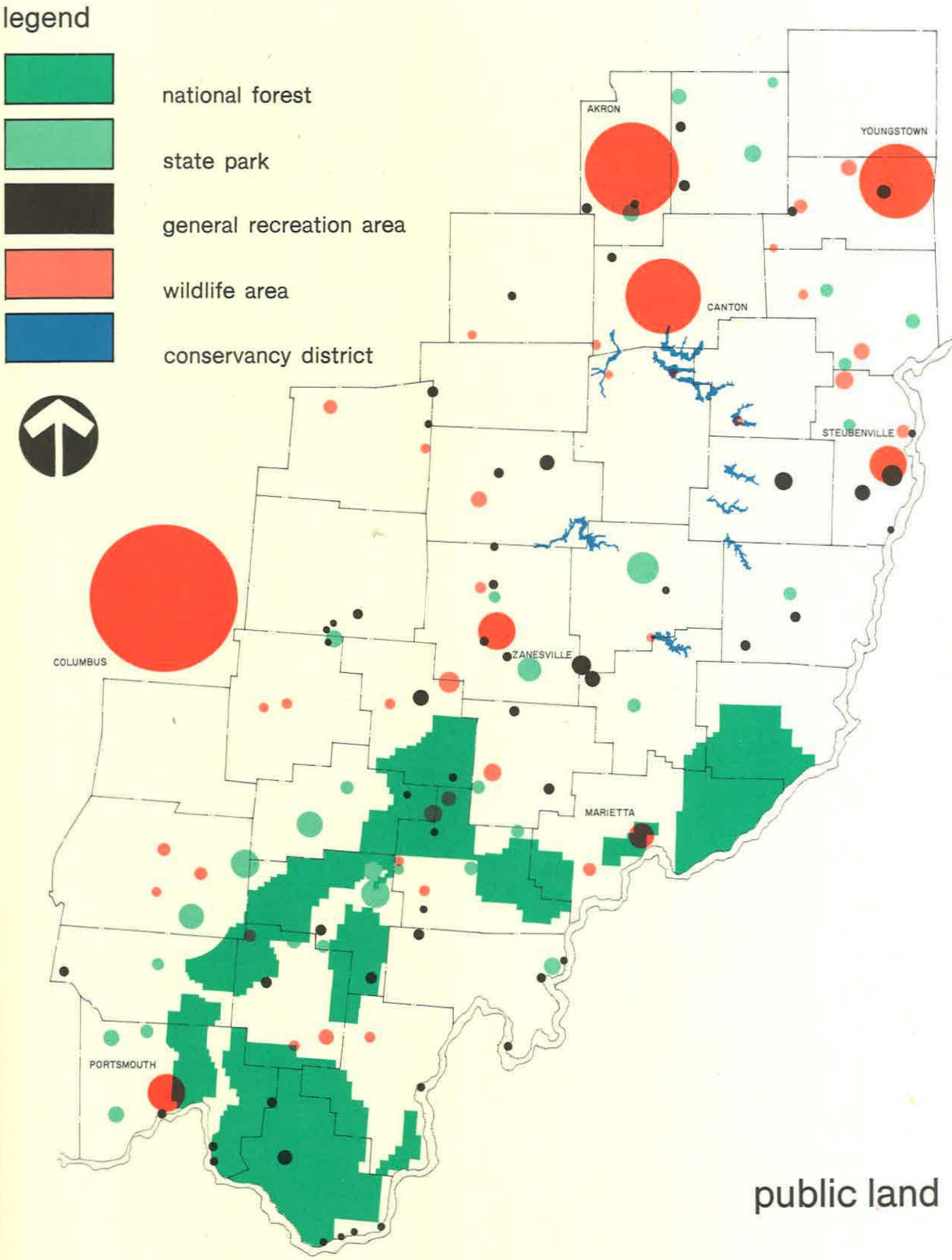
In the southern portion of the study area, large tracts of land are devoted to recreational uses such as federal and state forests, parks, and historical areas. Roughly three quarters of Lawrence and Vinton Counties are park and forest land, while Scioto, Perry, Hocking, Athens, and Guernsey Counties also contain large portions of recreational land.

Large tracts of land used for mining purposes are characteristic of the east-central portion of the State. A significant proportion of the total land in some of these counties is devoted to mining. This is the case in Noble, Morgan, Belmont, Jefferson, and Harrison Counties.

summary population data

County	Population 1960	Population 1970	Annual Increase 1960-70 (Percent)	Projected Population 2000	Population Change 1970-2000 (Percent)	Average Population Annual Change 1970-2000 (Percent)
Athens	46,998	54,889	1.6	57,400	4.6	.1
Belmont	83,864	80,917	—.4	77,897	—3.7	—.1
Carroll	20,857	21,579	.3	20,048	—7.1	—.2
Columbiana	107,004	108,310	.1	97,852	—9.7	—.3
Coshocton	32,224	33,486	.4	32,224	—3.0	—.1
Gallia	26,120	25,239	—.3	24,589	—2.6	—.1
Guernsey	38,579	37,665	—.2	44,877	19.1	.6
Harrison	17,995	17,013	—.6	16,715	—1.8	—.1
Hocking	20,168	20,322	.1	23,788	17.1	.5
Holmes	21,591	23,024	.6	29,801	29.4	.9
Jackson	29,372	27,174	—.7	31,916	17.5	.5
Jefferson	99,201	96,193	—.3	98,044	1.9	.1
Lawrence	55,438	56,868	.3	56,410	—.8	0
Mahoning	300,480	303,424	.1	297,040	—2.1	—.1
Meigs	22,159	19,799	—1.1	24,470	24.0	.7
Monroe	15,268	15,739	.3	18,894	20.0	.6
Morgan	12,747	12,375	—.3	14,341	15.9	.5
Muskingum	79,159	77,826	—.1	77,891	.1	0
Noble	10,982	10,428	—.5	11,694	12.1	.4
Perry	27,864	27,434	—.1	30,329	10.6	.3
Pike	19,380	19,114	—.1	22,545	18.0	.6
Portage	91,798	125,868	3.2	201,641	60.2	1.6
Scioto	84,216	76,951	—.9	59,993	—22.0	—.8
Stark	340,345	372,210	.8	512,028	37.6	1.1
Summit	513,569	553,371	.7	683,433	23.5	.7
Trumbull	208,526	232,579	1.1	252,363	8.5	.3
Tuscarawas	76,789	77,211	.1	78,580	1.8	.1
Vinton	10,274	9,420	—.8	11,040	17.2	.5
Washington	51,689	57,160	.1	55,029	—3.7	—.1
Wayne	75,497	87,123	1.4	121,470	39.4	—1.1

Note: The methodology used to derive these projections was developed by Battelle's Columbus, Laboratories with the assistance of the Ohio Department of Economic and Community Development. Because the emphasis of the Department was on projections at the region or district level, some data inputs are not county-specific (such as migration rates and industry growth coefficients). Therefore, care should be taken when using results for individual counties.


legend
national forest
state park
general recreation area
wildlife area
conservancy district
AKRON
YOUNGSTOWN
CANTON
STEUBENVILLE
COLUMBUS
ZANESVILLE
MARIETTA
PORTSMOUTH

public land

A sensitive indicator of economic conditions in the region is the percentage of families below the census-defined level of poverty. This value varies significantly from the North, where from 5 to 10 percent of the population of a watershed lives in poverty, to the southern watersheds where 10 to 25 percent of the population lives below the poverty standards.

Because of the large geographic coverage of the study, a considerable range of housing situations exists. The two most important aspects of housing are the condition of the existing housing stock and the demand for housing. In general, the Appalachian counties are characterized by high owner-occupied housing (72 percent) rather than rental housing (28 percent), and display a vacancy rate somewhat higher than the State average (8.6 percent vs. 6.2 percent). The median value of owner-occupied housing units in the Ohio Appalachian counties is only about 60 percent of the median value for the entire state. In the northern part of the study area, housing conditions are generally more favorable, the possible exception being the pockets of substandard housing associated with decaying central cities in large metropolitan areas. Where suburbanization has occurred, owner-occupied housing values are high and tend to offset the conditions found in central cities.

The second aspect of housing is demand. During the period from 1950-1970, the Appalachian counties experienced relatively low levels of residential construction activity, primarily because of a decrease in the rate of household formation during the period. In addition, if the high out-migration rate for young adults aged 15-30 continues, there is little likelihood that a significant increase in the demand for housing will occur. If, however, programs are initiated that raise income levels in Appalachian counties, there could be a reduced out-migration of young persons and a commensurate increase in family formation and housing demand. In the northern part of the study area, especially in the urbanized counties, absolute increases in population are expected to be large, and the demand for housing will continue to be high. Most new housing will be in the suburban fringe areas.

Labor Force and Employment

Labor force participation rates for males 16 years and older in the study area range from a low of 56.7 percent in Athens County to 81.1 percent in Trumbull County. In general, the male labor force participation rate increases with higher income. This is also true in the case of female labor force participation where values range from 43.1 percent in Wayne County to 22.6 percent in Monroe County. The proportion of the total labor force involved in service-oriented activities in the low income, rural counties is small. Since these service activities are major employers of women, there are fewer job opportunities for women in the southern rural counties.

The work force of the southern counties is more highly concentrated in primary activities such as agriculture, mining, and forestry than is the labor force of the northern counties. In the North, a higher proportion of the work force is engaged in tertiary activities such as retail trade, banking, insurance, real estate, and wholesaling.

Manufacturing was the largest single source of employment in all of the counties in 1970. Its relative importance in terms of each county's total population did, however, vary from low values in Athens, Gallia, Harrison, and Meigs Counties to high values in Mahoning, Carroll, and Trumbull Counties where manufacturing accounted for around 50 percent of the total employment. In 1970 the metals industry was the major source of manufacturing activity in the mined lands region. In almost every county, more persons were employed in the metals industry than in any other type of manufacturing activity. The furniture, lumber, and wood products industry was a major employer of persons in Athens, Gallia, Holmes, and Morgan Counties. Machinery and the production of other durables also employed a significant number of people in several of the other counties.

Transportation

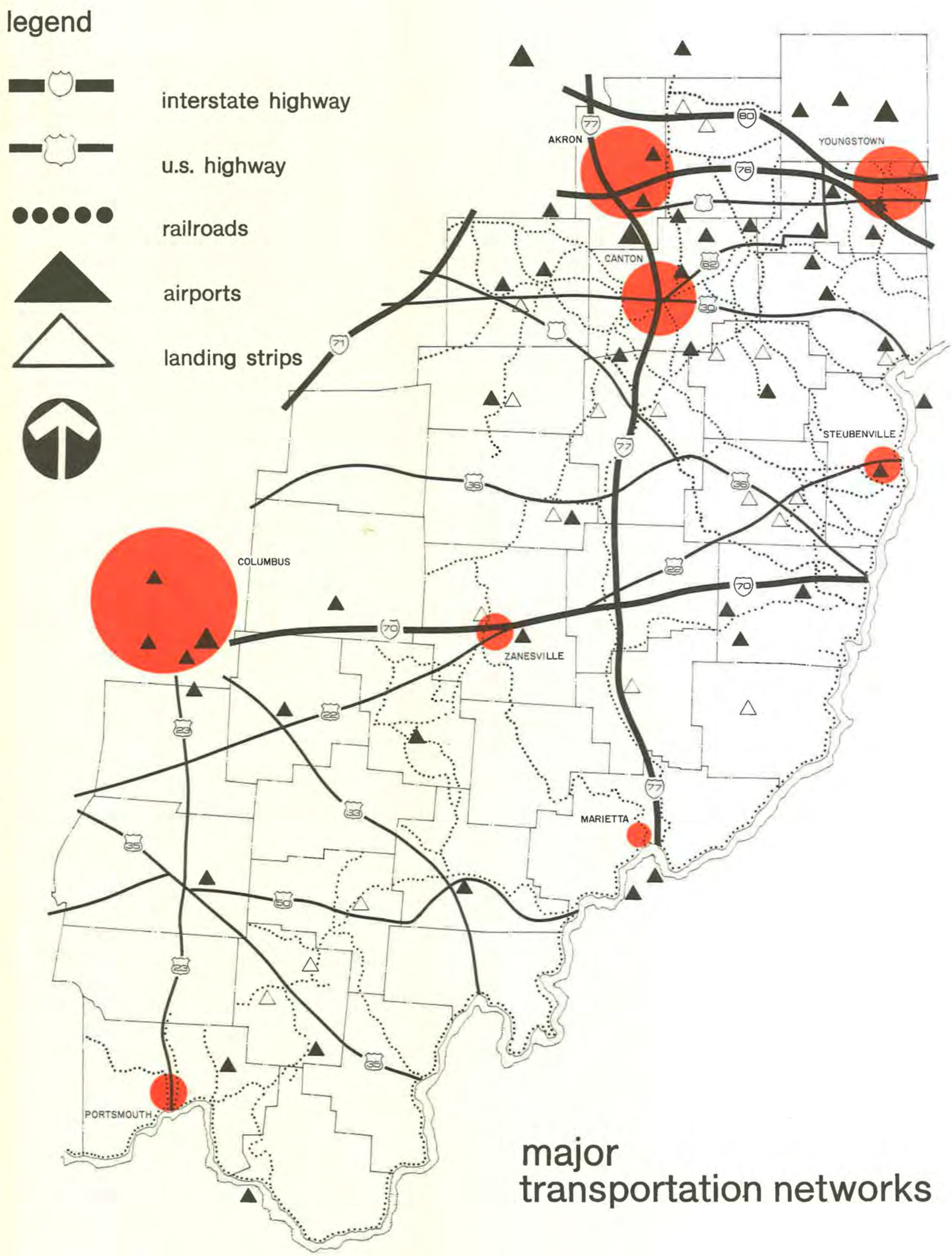
The national transportation system has historically bypassed Appalachia. Until recently, areas in Appalachia, very poorly connected with the rest of the nation, possessed only limited access to the rest of the region. The Appalachian Regional Commission has placed high priority on construction of facilities intending to induce the growth of private investment in the region. As a result, many miles of highways have been built through remote areas in the past decade. Local access roads to specific facilities such as recreational and industrial sites have also been constructed.

The increased accessibility of an Appalachian town was intended to place the town in a more favorable competitive position relative to surrounding urban areas. With increased accessibility to the outside world, the Appalachian town theoretically increased its market area. However, planners involved in the construction of the Appalachian Highway System failed to consider an alternative outcome. The surrounding urban areas such as Columbus and Cincinnati have expanded their markets and the dreams of attracting industrial activity to Appalachia by improving the transportation system have all but vanished.

The northern counties outside of Appalachia Ohio are well connected by the system of interstate highways and four lane divided highways. Generally, accessibility decreases in the southern section of the region where there are no interstate highways and the state and federal highways are less extensive. This is to be expected considering the sparse population and lack of major urban centers in the southern counties.

One benefit of increasing the accessibility to Appalachian counties from large metropolitan areas is the increased potential for recreational activities. As the availability of leisure time increases, many urban residents will use the state and private facilities now being built. Increased expenditures by tourists will allow further development in the areas suitable for recreation. The possibility exists for tourism to become a minor industry in this area. Once the recreational facilities are developed, many persons could be drawn to the lakes and camping facilities.

In order to accurately summarize socio-economic conditions, it is convenient to divide the study area into two regions, the northern seven counties and the remaining counties. The northern counties are generally characterized by a high level of urbanization, intense industrial activity, high incomes, low unemployment, and an overall favorable picture in terms of attracting industrial and commercial activity. These counties experienced rapid growth in population from 1960 to 1970 and are projected to continue such growth at a somewhat slower pace. The southern counties do not fare as well in terms of their potential for economic growth. They are characterized by low incomes, high unemployment, and greater inaccessibility to national resources and markets. The major potential for this area lies in its utilization for recreational purposes. The diverse landscape and the vast tracts of recreational land make the area a potential source for parks, wildlife preserves, camping, hunting, and fishing.



major transportation networks

physical characteristics

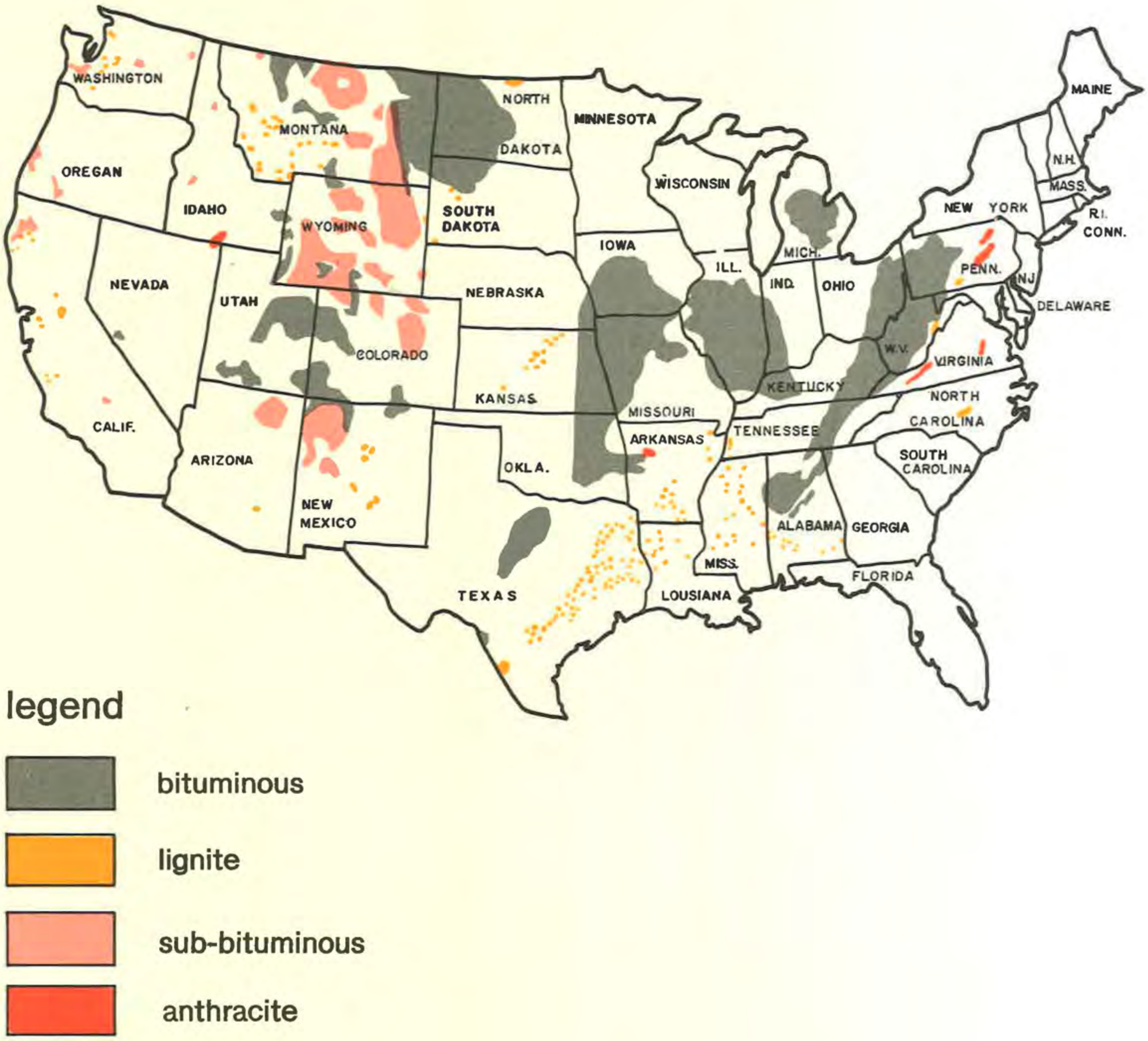
The State's coal field lies on the northwestern edge of a large geologic structure called the Main Bituminous Coal Basin. This basin extends from North-central Pennsylvania through Eastern Ohio, West Virginia and Western Maryland, and southward into Alabama. Coal bearing deposits underlie roughly the eastern third, or 11,000 square miles, of the State. The coal field occurs in a northeast-southwest oriented, 180 mile long band along the Ohio River, which averages 60 miles in width. Coal mined lands are found within four major river basins: the Scioto, Muskingum, Beaver and Hocking Rivers. All of the coal mined lands are within the Ohio River Basin. This vast study area included all or portions of the thirty-six eastern counties listed below.

Athens	Jefferson	Pickaway
Belmont	Knox	Pike
Carroll	Lawrence	Portage
Columbiana	Licking	Ross
Coshocton	Mahoning	Scioto
Fairfield	Medina	Stark
Gallia	Meigs	Summit
Guernsey	Monroe	Trumbull
Harrison	Morgan	Tuscarawas
Hocking	Muskingum	Vinton
Holmes	Noble	Washington
Jackson	Perry	Wayne

Climatic conditions are variable within the coal field. The annual average temperature varies from a low of 49°F in the northern portion to a high of 56°F in extreme Southeastern Ohio. The average annual precipitation is also variable and ranges from a high of 42 inches per year in the southeast to 34 inches per year in the northeast.

Surface landforms in the coal field are the product of a long and complex history. Stream erosion produced steep slopes and narrow ridges throughout the southern portion. Landforms in the northern half of the coal field have been influenced by erosion and by the periods during which large portions of North America were covered by glaciers. These glaciers covered approximately the northern one-third of the coal field. As the glaciers melted, large amounts of rock and soil materials they had picked up were deposited on the land surface, with thin deposits on the former hilltops and very thick deposits in the previously formed valleys. Deposition of this glacial material tended to subdue the previous surface features, producing a much more gently rolling land surface.

Rocks and coals in Southeastern Ohio were formed by sea and swamp deposits of sediment and organic material. The center of this deposition basin lies along a northeast-southwest axis centered about northern West Virginia. The rocks within the coal field slope gradually to the southeast, toward the center of the basin.

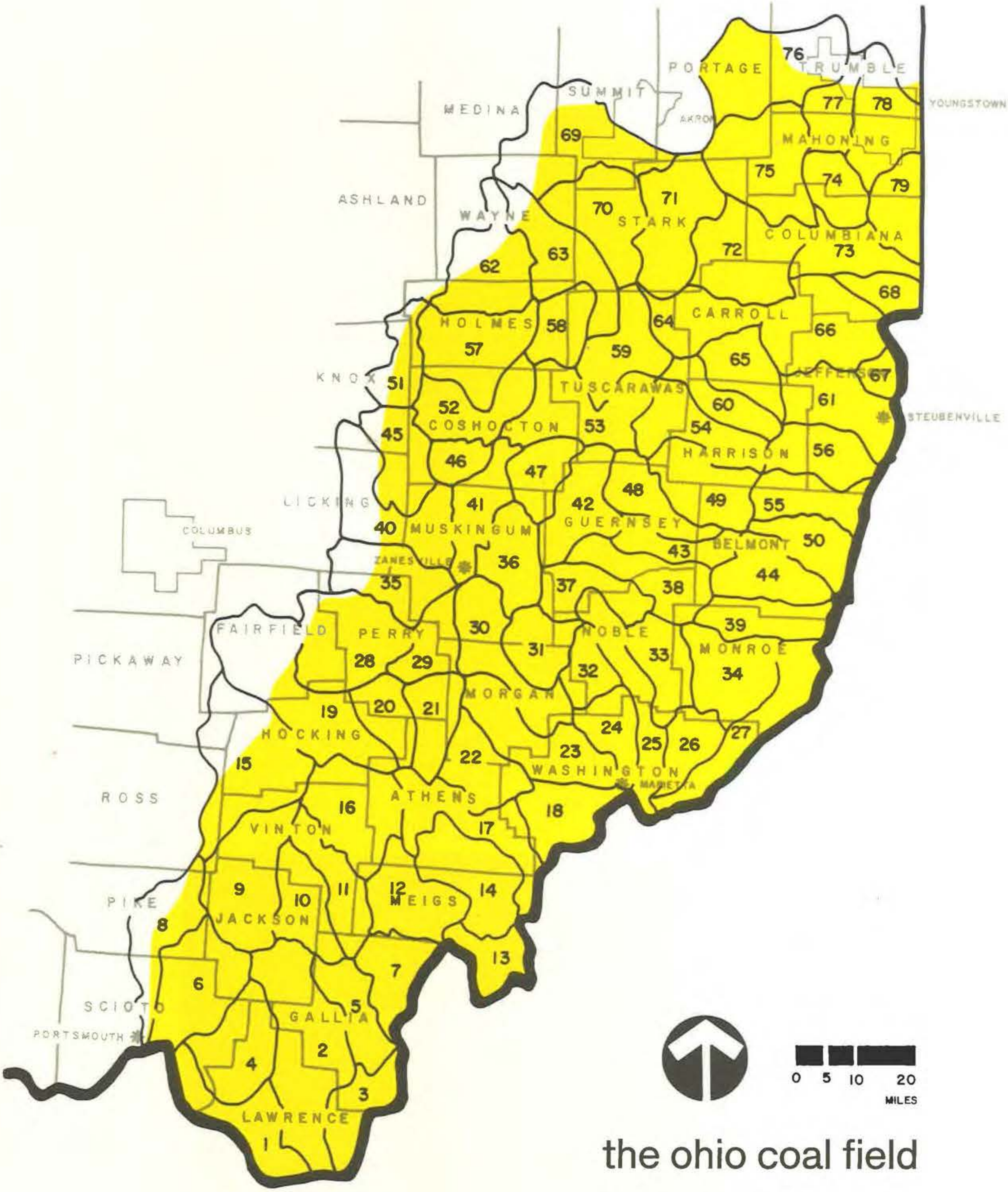


coal fields of continental united states

As a result of the southeastward slope, the rocks which are near the land surface in the western portion of the coal field are deeply buried beneath the land surface in the southeast near the Ohio River.

The coal field includes over fifty separate layers of bituminous coal which vary greatly in geographic extent, quantity, quality, and depth. Although most of these coal seams have been locally mined, most of the coal production has been from thirteen of the fifty seams. Coal is derived from compaction of vegetation and other organic materials that accumulated in swamps along the shoreline of an ancient inland sea. The repetitive formation of these many coal layers and the rocks between them was the result of repetitive geological and environmental conditions when the ancient sea existed. The sequence of events involved was: 1) initial formation of the swamp, 2) a general lowering of the land surface with subsequent flooding of the swamp, 3) accumulation of sediments on top of the flooded swamp, forming the rocks overlying the coals, and 4) establishment of a new swamp on the accumulated sediments, thus beginning a new cycle. These same general conditions also produced variations in thickness, geographic extent, quality, and chemical nature of the coal layers. As a result, specific coal layers in different localities have been much more important economically than others, and have been very heavily mined.

Local variations of conditions within the basin also resulted in the occurrence of iron and sulfur with the coal-forming organic materials. As the coal formed from the vegetation, the sulfur and iron were precipitated as the mineral pyrite. Pyrite, combined with air and moisture, forms the acid mine drainage pollution that is today common throughout the coal field.



the ohio coal field

reclamation and pollution

formation of pollution

A basic explanation of mining practices is helpful to understand the environmental disruption resulting from improper mining of coal. "Contour strip mining," the most common method of coal extraction in the State, is practiced where coal deposits occur in rolling or hilly country. This method involves removal of the hillside where coal is closest to the land surface. Rock material on the hillside overlying the seam is removed to expose the underlying coal. This process continues to greater depths into the hill until it becomes uneconomical to remove further overburden. Contour stripping then follows the surface exposure of the coal around the hillside, generally resulting in a long, sinuous band of strip mined land around an entire hill. This type of mining creates a bench, or shelf, on the hill which is bordered on the inside by a highwall ranging from 20 feet to more than 100 feet in height. The outer (downslope) side of the shelf is composed of the excavated overburden, or spoil.

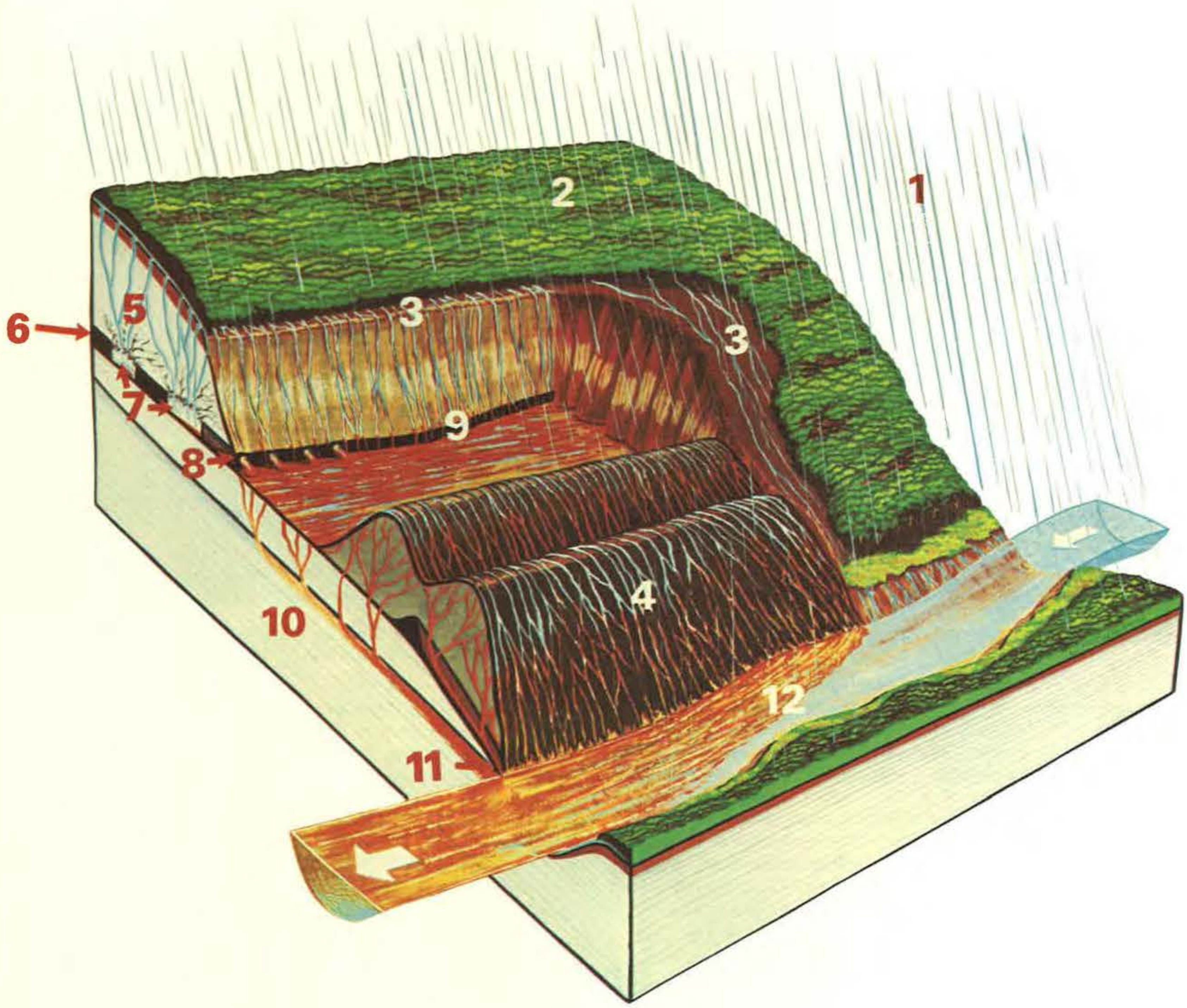
Prior to recent passage of strict strip mining regulations, much of this spoil material was allowed to remain on the natural slope below the bench. This creates a spoil pile below the strip mine which is much steeper than the natural landslope. These unconsolidated spoil banks erode and cause landslides.

Coal is also strip mined in relatively flat-lying land, using the "area mining" technique. Area strip mining affects large blocks of land, rather than the sinuous bands of contour strip mining.

Large quantities of coal are also extracted from underground mines. Underground mines tunnel into the coal in areas where the rock material above the coal is too thick to be economically strip mined.

The most common and most serious physical damage attributable to abandoned coal mining operations is pollution of streams and rivers with acid mine drainage. Surface and ground water is often degraded by addition of acidity, hardness, iron, sulfates, aluminum, and dissolved and suspended solids. Coal and adjacent rocks contain various sulfur compounds including the mineral pyrite, which is an iron disulfide. When exposed to atmosphere by mining activities, the reactive portion of the pyrite oxidizes in the presence of air and moisture to form sulfuric acid and ferrous sulfate (iron sulfate). These water soluble compounds eventually are flushed from the mines into the surface or ground water system. The iron will oxidize and an unsightly red or yellow precipitate results, often referred to as "yellowboy." Factors that

Polluted Water in an Abandoned Strip Mine Pit.



Legend

Blue—Uncontaminated Water
Orange—Contaminated Water

Key

1—Precipitation
2—Undisturbed land
3—Uncontaminated surface runoff
4—Spoil-bank runoff
5—Subsurface infiltration
6—Coal bed
7—Deep mine
8—Auger holes
9—Stripping excavation
10—Ground water
11—Seepage
12—Stream

source and flow of water on unreclaimed mine site

An Example of the Corrosive Nature of Mine Drainage.

Unreclaimed Land Showing Exposed Toxic (Dark Colored) Materials.

determine the extent of pollution formation include: availability of air, water, and reactive pyritic material; length of time those reactants have been in contact; physical and hydrologic conditions of the mined area; and the type of mining employed (underground versus surface).

Recent studies have revealed that only about one quarter of the acid mine drainage polluting the streams originates in strip mines. Rainwater and surface runoff, unless diverted or properly drained, frequently accumulates in the pits of unreclaimed strip mines between highwalls and spoil banks. If the spoil and bench material is acidic, the water usually is polluted. Some of this water eventually seeps through the permeable spoil material to the surface on the downslope side of the spoil bank as acid mine drainage.

Ponded water may overflow the lowest point in the impoundment during periods of heavy rain, causing extensive erosion and stream pollution. Pyrite oxidation can also occur on the exposed surface of strip mine spoil and coal refuse piles. Surface water runoff during periods of precipitation dissolves these pollutants and washes them into streams.

Physical and chemical characteristics of the spoil also have major effects on the revegetation of strip mined lands. Without adequate treatment, toxic, rocky, and dark colored spoils may render a strip mine surface temporarily or permanently sterile. The toxic materials may be sufficiently leached away over a period of time to permit vegetative growth, provided erosion does not expose unleached materials. Steepness of spoil slopes frequently has a detrimental effect on revegetation because of severe erosion and slope instability.

Volume of sediments eroded from strip mine surfaces can be as much as 1000 times greater than sediment loadings from similar undisturbed land. These sediments often choke receiving streams, reducing channel size and water-carrying capacity and increasing flood potential. Sediments also disrupt the natural ecosystem of these streams by smothering bottom life and destroying vital segments of the aquatic foodchain.

Three quarters of the acid mine drainage produced in Appalachia originate in underground mines. Underground mining exposes pyrite to the atmosphere and oxidation occurs. Oxidation products are then flushed from the mines after rains to form acid mine drainage.

benefits of strip mine reclamation

There are many benefits to be derived from reclamation of strip mined lands. Elimination of pollution is a primary benefit. The most visual benefit is the purely aesthetic landscape improvement. Aesthetic improvements directly influence realization of other less tangible benefits such as increased property value, revenue from property tax evaluations, tourism and recreational usage. While reclamation sometimes increases the sale price of strip mined land by $25 to $50 per acre, in many cases the surrounding property values show similar increases due to the aesthetic improvement of the area.

Reclamation of strip mined land can enhance propagation of wildlife species by revegetating with the proper grasses and game food. Reclamation can provide increased nature enjoyment and hunting potentials. This again benefits not only the reclamation site, but also adjacent areas.

The southern study area's primary asset is its tourism and recreational potential. During the summer months, tourist activities thrive, with interest centered around the enjoyment of nature. The presence of unreclaimed strip mined land, with ravaged landscapes and denuded spoil banks, curtails such activities.

Dollar benefit values ascribed to areas affected by strip mine reclamation, while difficult to assess, are substantial. Although the actual tax base increase realized from a reclaimed strip mine site may be small, land values of adjacent undisturbed areas go up, helping to increase the total tax base.

The corrosive nature of mine drainage pollution requires increased maintenance of structures in contact with acid water. State, municipal, industrial groups, and private citizens are forced to absorb the costs of repairing damages to bridges, dams, docks, conveyance systems, structures, and plumbing which cannot tolerate acid water. Toxicity and hardness of mine drainage restricts its use for irrigational and stock watering purposes. High hardness levels prevent its use in boilers and hot water systems. Acid mine drainage pollution seriously affects almost all beneficial water uses. As a result, municipalities are often required to seek new sources of water supply, and industry is discouraged from moving into polluted areas. Quite often the polluted water can be used after treatment, but the required costly treatment expenses increase costs of municipal water service, and are ultimately passed on to the consumer.

Recreational potential of entire areas is significantly decreased by presence of streams degraded by mine drainage pollution. Polluted streams are generally aesthetically displeasing, and aquatic life is either destroyed or suppressed. Serious economic losses are incurred by loss of tourist trade, fishing, boating, camping, swimming, and other water-based recreational activities. It is difficult to attract tourist trade and other nature-oriented recreational activities to an area where mine drainage has rendered a stream sterile, and iron sludge deposits cover stream beds.

Financial losses from property devaluation along streams polluted by mine drainage is monumental. A $25 per acre decrease in waterfront property in the Raccoon Creek Watershed alone would result in a startling combined property loss. Assuming a similar loss for each acre of waterfront property on the streams polluted by mine drainage, property losses would stagger the imagination. Combined with tax losses resulting from reduced property values, it is apparent that the property owner and taxing authority are suffering significant financial losses from mine drainage pollution.

Reclaimed Strip Mined Land. When the Equipment is Removed, the Operator's Bond Will Be Refunded Under Provisions of the 1972 Law.

potential uses of strip mined land

Unreclaimed strip mined land removes large areas from otherwise productive use. Properly reclaimed mined lands can be utilized for many purposes, including agriculture, recreation, forestry, housing and industrial development.

The highest land use potential for much of the unreclaimed strip mined lands within the study area is agricultural. Areas with low potential for other uses will probably revert to agricultural use. This land use can absorb large acreages, has a lower cost of reclamation than most other uses, and requires the least management. Agricultural land uses identified as having the most potential include commercial woodlots and forests, pastures, and orchards.

Reforestation of the unreclaimed strip mined areas has the highest potential for absorbing the largest number of acres. This land use provides long-term benefits, requires little management between the time the land is planted and the trees reach economic maturity, has a relatively low cost of reclamation, and substantially enhances the potential for future recreation related activities.

Reclaiming lands for pasture or grasses provides a faster return than reforestation. Problems inherent in reclaiming lands in the study area for pasture usage include: more intensive management is required, the physical relief of the lands makes them more suited to grazing than hay production; fewer cattle can be grazed on reclaimed strip mined lands than other competitive lands; the study area is a grain deficit area and grains would probably have to be imported to winter livestock; and this land use contributes little to the enhancement of potential future recreation activities.

The entire study area has a high potential for non-urban related recreational land uses. Examples of non-urban related land uses for recreation include wilderness areas for camping, hiking, hunting, fishing, horseback riding, state parks, and wildlife refuge areas. Non-urban recreation land uses require scenic surroundings and are thus a long-term reclamation effort. This type of land use should be especially adaptable to future uses of reforested lands.

Land uses for recreation include parks, golf courses, hiking trails and bike paths, amusement and theme parks, and tourist related activities. A good example of reclamation efforts directed toward recreation is Friendship Park in Jefferson County. This park is a 1,100-acre development that includes a county fairgrounds with multipurpose recreational buildings, an 85-acre lake, a county airport, golf course, ski slope and lodge, camping areas, wildlife refuge, picnic areas, and hiking trails. The project is funded by the county, the Appalachian Regional Commission, and the Bureau of Outdoor Recreation. The potential for recreation is closely linked to population concentration and therefore may be limited to the northern counties of the study area. This type of land use requires a high capital outlay for development and can only absorb relatively small acreage parcels of land.

Water impoundments for recreation may also be included in reclamation efforts. Water impoundments will substantially enhance the potential for water related recreational activities such as fishing, swimming and boating.

Municipal land uses identified as exhibiting potential for reclamation efforts include sanitary landfill, sewage treatment, corrections institutions, and county or municipal airports. Several counties throughout the study area have investigated the feasibility of utilizing unreclaimed strip mined lands for sanitary landfills. County airports have been constructed on strip mined lands in nine of the thirty-six counties within the study area, yet the potential for county airport development is very limited because the construction phase of the State County Airport Program has been completed. Smithfield, Ohio, is utilizing benefits from a sewage treatment plant constructed on strip mined land to serve Friendship Park in Jefferson County.

Limited potential exists for residential, commercial, and industrial land uses of unreclaimed strip mines. In instances where access, water and sewer availability, and load bearing capabilities meet industry requirements, the use of strip mined lands may be viable. The highest potential for commercial or industrial uses is in close proximity to the major metropolitan areas within the study region and in strip mined areas in proximity to interstate and other major highway access. Some use has been made of strip mined areas for radio and television towers and light manufacturing.

current and proposed reclamation projects

Several reclamation projects are currently being carried out by the Department of Natural Resources. The Division of Reclamation reclaims strip mined lands by using forfeited performance bonds. As previously discussed, these bonds are frequently insufficient to accomplish the necessary reclamation work, severely hampering the Division's efforts.

The Division of Research is directing an underground mine sealing demonstration project in the Lake Hope Watershed in Vinton County. This project involves abatement of acid mine drainage discharging from one of two underground mine complexes and seriously degrading the lake. The project has been funded by the United States Environmental Protection Agency to demonstrate utilization of mine sealing techniques to abate polluted water from underground mines.

The Division of Research is also involved in a strip mine spoil stabilization demonstration project near the West Shade River in Meigs County. Strip mining operations here have exposed extensive areas of loosely bonded sandstone. Rapid weathering and erosion wash massive amounts of sand into adjacent valleys, filling stream beds and covering fertile farm land. Erosion also exposes pyritic materials to oxidation, resulting in production of acid mine drainage. The study will demonstrate feasibility of utilizing a soil bonding agent to remedy this condition.

An earth resource management demonstration study, also directed by the Division of Research, is planned for Harrison County. This study will (1) assess the state-of-the-art of waste material recycling together with mined land reclamation (with particular emphasis on the beneficial utilization of waste materials), (2) develop an information, acquisition, and dissemination system on mined land reclamation and waste recycling technology, and (3) develop a management system for implementation of the recommended program. Results of this concept development program will be a series of technically and economically feasible methods for recycling and reclamation which will be applicable nationwide.

The Division of Forests and Preserves is currently reclaiming a large tract of land in Perry County. Reclamation work in this Perry Reclamation Area has been limited by available funds, equipment, and personnel. The Division estimates that 100 acres will be reclaimed by July, 1974.

It is evident that while the Department of Natural Resources is currently administering several reclamation projects, the work accomplished to date affects a very minor portion of the unreclaimed mined land.

In addition to the reclamation projects currently underway, Federal funding applications are being prepared for three "quick-start" reclamation projects within the study area. These tentative projects, developed during this study, have been selected because of their anticipated high degree of success and the favorable benefits to be realized. The following site descriptions relate pertinent physical conditions present at each site, as well as the reclamation techniques to be utilized.

McMahon Creek Abatement Area

McMahon Creek and some of its tributaries are severely affected by acid and mineral pollution draining from old coal refuse piles, and abandoned strip and underground mines. A study by what is now the U.S. Environmental Protection Agency entitled "Extent of Coal Mine Drainage Pollution, McMahon Creek Watershed, Ohio" found that 40 percent of the volume of acid waters and 71 percent of the total acid load came from seven coal refuse piles, and that a 75 percent reduction in acid loading would result in acceptable water quality in McMahon Creek. Approximately 600 acres of the watershed have been disturbed by strip mining, while an additional 430 acres have been affected by coal refuse piles. These areas discharge approximately 6,800 pounds per day of acid into the McMahon Creek Watershed.

The overall objective of this proposed reclamation project is to reduce acid and mineral pollution emanating from these unreclaimed sites. This will be accomplished by utilizing waste products such as power plant fly ash, sewage sludge, or dredgings from the Ohio River.

Huff Run Abatement Area

The fifteen square mile Huff Run Watershed is located fifteen miles south of Canton in Carroll and Tuscarawas Counties. Approximately 15 percent of the watershed, or 1,480 acres, has been strip mined and is presently unreclaimed. These unreclaimed surface mines, and some underground mines in this area, discharge approximately 6,250 pounds per day of mineral acidity to Huff Run. The strip mines are also the source of large amounts of eroded sediment which chokes Huff Run and its tributaries. Successful implementation of surface mine reclamation techniques here should substantially reduce the amounts of acid mine drainage and sediments entering Huff Run.

Proposed reclamation in the Huff Run Watershed will take advantage of its proximity to the metropolitan Akron-Canton area, utilizing low-cost urban waste products to augment vegetative survival on strip mine surfaces. Potential strip mine neutralization and fertilization additives which can be obtained locally are softener sludge from the Canton water treatment facility, sludge from the New Philadelphia sewage treatment plant, and bark and wood chip mulches from local commercial firms.

Brush Creek Abatement Area

The Brush Creek abatement area surrounds a major tributary to Brush Creek at Cannelsville, just south of Zanesville, in watershed 30. The five-square-mile area contributes one-fifth of Brush Creek's flow and mine drainage. Brush Creek is unpolluted upstream from the abatement area, but receives large acid, iron and sulfate loads from the Cannelsville tributary and several other streams. The abatement area's mine drainage discharges from abandoned underground mines, unreclaimed strip mines, and a large refuse pile. The refuse pile is also eroding into adjacent stream channels, and is burning in several areas, presenting additional safety and air pollution hazards.

Proposed reclamation in this abatement area will put the immediate emphasis on the refuse pile and the strip mines. Reclamation and revegetation will be augmented where possible by flyash obtained from the electric generating station at Philo, Ohio, which is only thirteen miles from the abatement area. Such reclamation work could greatly decrease the quantity of mine drainage produced, thereby improving water quality within and downstream from the abatement area.

the study and its results

objectives

A primary objective of this study is to establish a long range plan for reclamation of unreclaimed strip mined lands. Due to obviously limited funding avenues, it is usually desirable to limit early reclamation work to watershed areas where overall benefits will be maximized. This requires establishment of watersheds and the placement of these watershed units into a priority ranking system. Parameters affecting potential benefits which could be derived from reclamation are examined. These characteristics are discussed in detail in the following sections of this report. The following "Priority Selection Model" summarizes the data utilized to determine final watershed priorities.

Two objectives of the "Priority Selection Model" are:

1) To present in graphic and tabular form, summarized data from the various portions of the study as related to unreclaimed strip mines.
2) To develop and present the overall priority ranking of individual watersheds. The method of combining parameters determined distribution and pattern of areas with severe problems, high expectations for pollution abatement success, and high socio-economic returns.

Relevant data for each of the parameters examined in the "Priority Selection Model" are ranked according to the importance of that particular factor in each watershed. The ranking involved four categories: "High" if the factor was highly important; "Medium" if moderately important; "Low" if relatively unimportant; and "None" if the factor did not apply or was not calculated for the watershed in question. A "None" rating generally applied to watersheds in which there are no unreclaimed strip mines, and thus no need to consider reclamation at all. The parameters considered in the "Priority Selection Model" included:

Density of Unreclaimed Strip Mines — Percentage of total land in a watershed occupied by unreclaimed strip mined lands.

Development Demand — Relative demand for roads, construction, recreation and airports.

Economic Need — Need for economic stimulation within a given watershed as determined from percentage of families below poverty level.

Public Land Ownership — Percentage of unreclaimed strip mines that is publicly owned.

Public Visibility — Proximity of unreclaimed strip mines to towns and roads.

Visual Quality — Diversity of numerous desirable landscape elements within a watershed.

Mine Drainage Pollution — Severity of mine drainage pollution, in terms of pollution loads and downstream pollution effects.

strip mined lands survey

Inventory of strip mined lands throughout the coal field was accomplished by use of high altitude aerial photographs taken specifically for this study. The photographs were prepared at the same scale as the United States Geological Survey's 7.5 Minute Topographic Quadrangle Maps, approximately 1 inch equals 2000 feet, to provide comparison of the maps with the photographs. The photography also insured that the mined land survey would contain information on recent strip mines. Fixed wing aircraft and aerial photo stereo identification were used to identify and outline strip mined lands and to define existing physical conditions at each site.

Mined land definition included determining: strip mine boundaries, exposed highwalls and ponds, degree of regrading, general slope of the adjacent land surface, and amount of vegetative cover present. Based upon these variables, strip mines were classified according to existing conditions and relative amount of reclamation work required to upgrade them to acceptable standards. The parameters listed above formed a matrix from which a six category ranking system was established to distinguish the degree of reclamation required. Four of these classes define areas in which reclamation work is required, while a fifth defines areas generally reclaimed, but where minor efforts are required. The sixth class is for coal refuse piles. The matrix developed for this classification follows:

Map Classification of Strip Mined Land

1. Active
2. Completely Reclaimed
3. Minimal Reclamation Effort Required
4. Moderate Reclamation Effort Required
5. Extensive Reclamation Effort Required
6. Coal Refuse Piles

Field Classification of Strip Mined Land

A. Ungraded
B. Partially Regraded
C. Completely Regraded
D. Unvegetated (less than 40% cover)
E. Partially Revegetated (40-80% cover)
F. Completely Revegetated (greater than 80% cover)
G. Level Slope (less than 10°)
H. Moderate Slope (10°-20°)
I. Steep Slope (greater than 20°)

Matrix Used for Classification Cross Index

Field	Map	Field	Map	Field	Map
ADG	4	BDG	3	CDG	3
ADH	5	BDH	4	CDH	3
ADI	5	BDI	5	CDI	3
AEG	4	BEG	3	CEG	3
AEH	5	BEH	4	CEH	3
AEI	5	BEI	4	CEI	3
AFG	3	BFG	3	CFG	2
AFH	3	BFH	3	CFH	2
AFI	4	BFI	3	CFI	2

Reclamation costs were established on a per acre basis for each of these classes according to amount of work estimated to be required in each class. These costs were based on a comprehensive reclamation cost analysis study performed for the Appalachian Regional Commission, and from earlier reclamation projects accomplished in Ohio and surrounding states.

The report produced by the Appalachian Regional Commission entitled "Analysis of Pollution Control Costs" includes unit costs for all presently available means of reclamation and mine drainage pollution abatement. Data compiled by an extensive research project, evaluating many completed projects.

It should be noted that the strip mine acreages computed by this study are slightly different from those published in the Department of Natural Resources "Coal Strip Mining Statistical Report by Counties." This is principally due to the fact that an area to be **reclaimed** may be slightly greater than an area defined as **stripped.** Other factors include use of the area behind the highwall for moving equipment, or an area included within a strip mine boundary that was not stripped but needs some revegetation, or slight differences due to the small scale of the maps and photos on which this planning study was performed. This difference is not significant from a planning standpoint.

Per acre costs ranged from a relatively low reclamation figure to a moderately high figure where extensive reclamation is required. All acreages and costs were accumulated for each of 79 watersheds to form a basis for comparison and priority ranking. Established reclamation costs, total acreages in each classification, and total reclamation costs for each of the six classes are presented below.

Class 1 – Active strip mining operations for which reclamation is required by law.

Total Acreage	24,000 acres
% of Total Strip Mined Area*	6.5%
Total Reclamation Cost	—

Class 2 – Strip mines which in general have been satisfactorily reclaimed, occasional minor reclamation will be required.

Total Acreage	166,000 acres
% of Total Strip Mined Area	45.0%
Total Reclamation Cost @ $250/Acre	$41,000,000

Class 3 – These strip mined areas are classified as unreclaimed, but require only a small amount of reclamation effort to achieve satisfactory reclamation. A reclamation cost of $700 per acre was applied to all Class 3 lands. This value would sufficiently cover minimal surface recontouring and revegetation, the most common requirements of this class.

Total Acreage	57,000 acres
% of Total Strip Mined Area	15.5%
Total Reclamation Cost @ $700/Acre	$40,000,000

Class 4 – Strip mines in which a moderate level of effort is required to achieve satisfactory reclamation. Such areas have generally had little or no reclamation work performed but do not require extensive expenditures to achieve satisfactory reclamation. A reclamation cost of $1500 per acre was applied to lands in this class.

Total Acreage	98,000 acres
% of Total Strip Mined Area	26.5%
Total Reclamation Cost @ $1500/Acre	$147,000,000

Class 5 – Totally unreclaimed strip mines requiring an extensive effort to achieve acceptable reclamation. Such mines show little or no regrading and revegetation work and are generally located in hilly terrain. A reclamation cost of $2500 per acre was applied to lands in this class. This cost reflects both the extensive work required and the increased difficulties of performing such work in steep terrain.

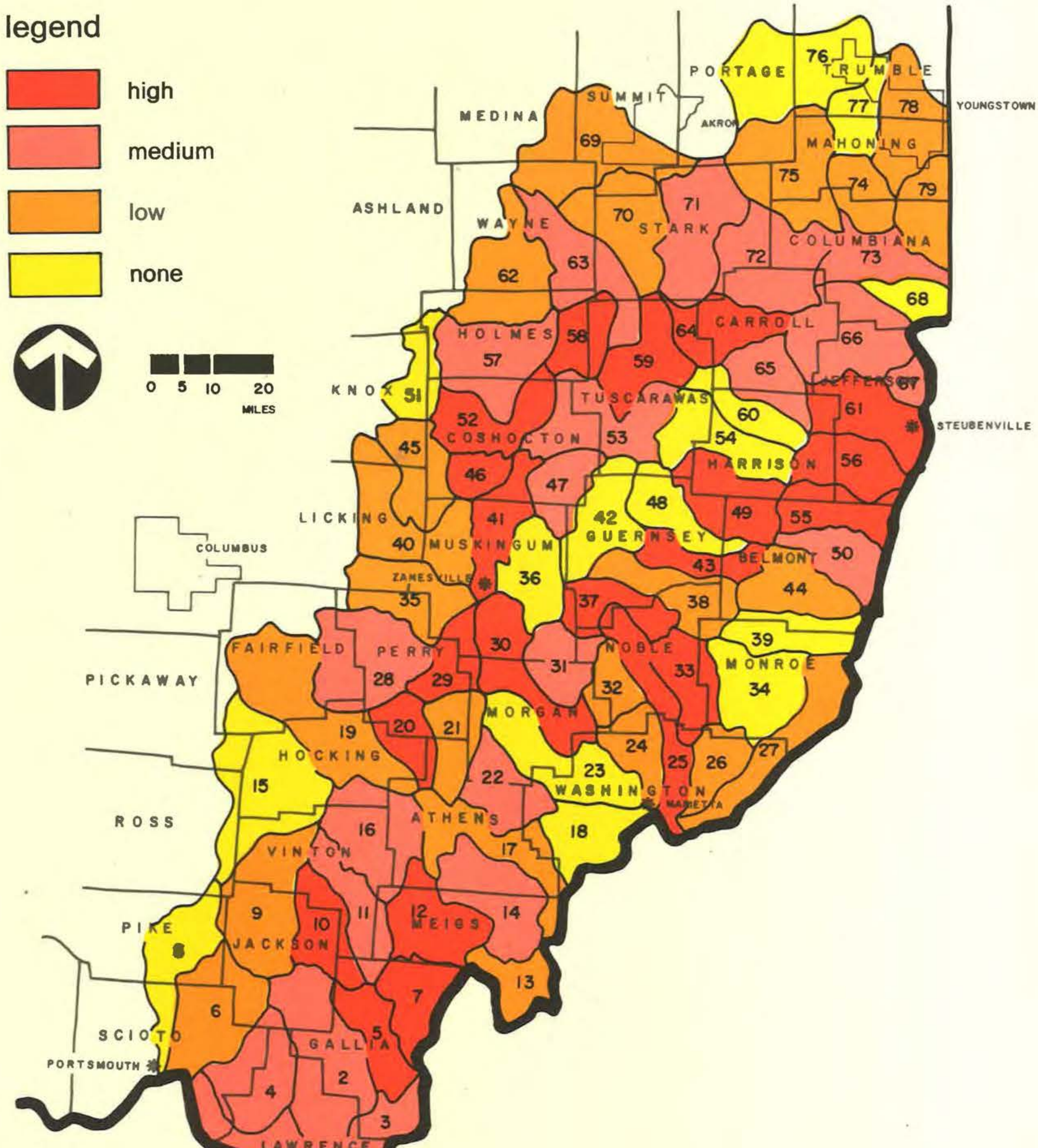
Total Acreage	23,000 acres
% of Total Strip Mined Land	6.2%
Total Reclamation Cost @ $2500/Acre	$58,700,000

Class 6 – This separate class was established for coal refuse piles. Coal refuse consists of waste material extracted from underground mines in the process of mining or processing the coal. This material is difficult to reclaim, prohibiting natural vegetative growth even after many years of exposure and can be severely detrimental to the local environment. Refuse requires special handling during reclamation, and the resultant reclamation cost is fairly high, at $3000 per acre.

Total Acreage	1,200 acres
% of Total Strip Mined Land	0.3%
Total Reclamation Cost @ $3000/Acre	$3,600,000

The total estimated cost for upgrading all unreclaimed coal strip mined lands is $290,000,000.

The following map shows the watershed ranking by order of density of unreclaimed strip mined land. Unreclaimed strip mined lands represent greater than 3% of the total land area in the "High" category, 0.85% to 3% in the "Medium" category and less than 0.85% in the "Low" category. There are no unreclaimed strip mined lands in the "None" category. These percentages were derived by dividing the area of strip mined land in each watershed by the total watershed area. The categories were established by judgment at these percentages to yield a fairly even distribution of watersheds in the three classes containing strip mined land.



strip mine density

mine drainage pollution survey

All of the environmental damages attributed to abandoned coal mining operations were examined in this study, but major emphasis was placed on a survey of the extent of pollution by mine drainage, since the effects of this pollution are the most damaging and far-reaching. It was also evident that, in many portions of the economically depressed Ohio coal field, reclamation of abandoned mined lands could only be justified by resultant mine drainage pollution abatement and subsequent water quality improvements. A broad scale stream and water quality survey of the Ohio coal field was conducted to isolate all major sources of mine drainage pollution.

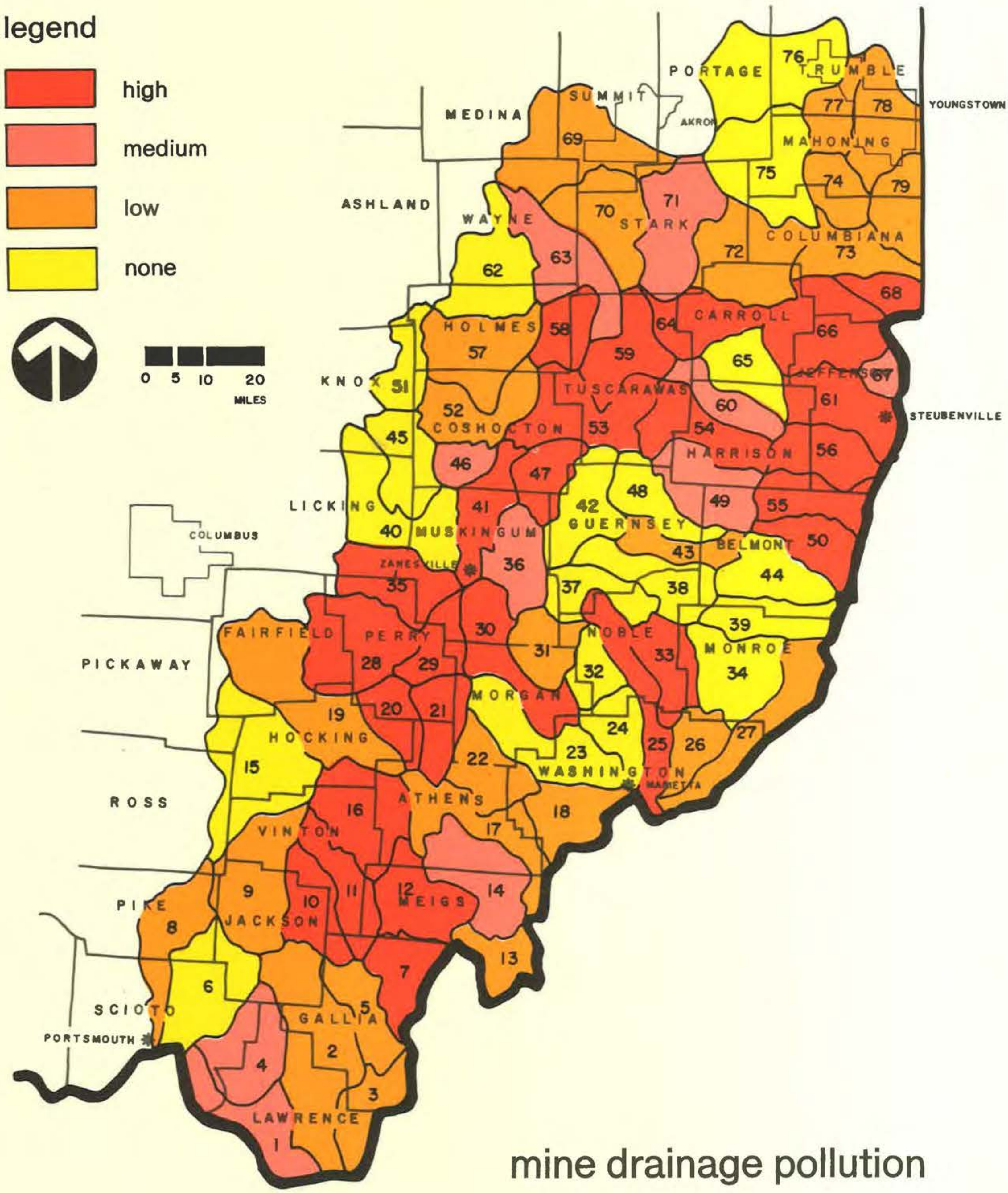
The first step in the development of a water quality survey program was separation of the coal field into working units. Since water quality was to be a principal factor in establishment and justification of reclamation priorities, the study area was divided into seventy-nine units based upon watershed boundaries. These watersheds varied in size from 45 to 370 square miles, and averaged 175 square miles. Where previous water quality survey data indicated acid mine drainage production, sizes of the watersheds were reduced to enable a more detailed water quality survey. Water samples and flow measurements were taken at approximately 1300 locations within the seventy-nine watersheds. These samples were analyzed for basic mine drainage indicators: acidity; alkalinity; pH; sulfates; and iron. Pertinent information regarding discoloration, siltation, and aquatic life was also recorded.

Standards for establishing acceptable water quality were based on the effects of mine drainage pollutants on aquatic life. Water quality was deemed acceptable in all streams in which alkalinity exceeded acidity, iron concentrations were less than 3 parts per million and sulfate concentrations were less than 500 parts per million. Mine drainage pollutant levels in excess of these concentrations may adversely affect aquatic life. Watersheds which conformed to these water quality criteria were placed in the "None" mine drainage pollution category.

Watersheds which showed no evidence of acid drainage and only slightly high levels of iron or sulfate pollution were classified in the "Low" category. Iron and sulfate concentrations varied widely in these watersheds, but pollution loadings were generally low with insignificant stream affects.

Watersheds in which water samples revealed deleterious levels of iron, sulfates, or acid were classified in the "Medium" category. This included watersheds in which acid loads were less than 4900 pounds per day with acidity concentrations generally less than 100 parts per million. Other watersheds in this category contained no acidity but showed iron concentrations in excess of 10 parts per million or sulfate concentrations in excess of 600 parts per million.

Watersheds in the "High" mine drainage pollution category were defined as those in which extremely high levels of iron, sulfates, or acid degrade water quality. Acid loads, where present, ranged from 4300 pounds per day to over 225,000 pounds per day with acidity concentrations generally exceeding 100 parts per million. Several additional watersheds were severely degraded primarily by high concentrations of iron or sulfate, generally exceeding 25 parts per million and 1000 parts per million, respectively. These watersheds were also classified in the "High" mine drainage pollution category.



mine drainage pollution

The data gathered in the stream sampling program allowed computation of quantities of each mine drainage pollutant observed in each affected stream. These quantities (loadings) are expressed as pounds of pollutant carried past a specific sampling location in one day. Data obtained in the sampling program revealed that the coal fields are discharging more than one million pounds of acid and more than 400,000 pounds of iron every day into the streams.

The amount of mine drainage pollution attributed to abandoned underground mines was computed by comparison of the extent of abandoned surface and underground mining operations. The Appalachian Regional Commission, in its report entitled "Acid Mine Drainage in Appalachia," reported that over 70% of the mine drainage pollution in the Appalachian coal fields was discharged from abandoned underground mines. Information on the extent and location of underground mines was obtained from the Ohio Department of Natural Resources, Division of Geological Survey. The extent (area) of abandoned underground mines was directly proportioned to the amount of unreclaimed strip mined land (area) in each watershed to determine the percentage of acid mine drainage attributable to each source. The most prevalent percentage figures computed were approximately the same as those cited by the Appalachian Regional Commission: Most acid producing watersheds derive 25 to 50% of their mine drainage pollutants from unreclaimed strip mines, and the remaining 50 to 75% discharges from abandoned underground mines. Such computations were only made for acid producing watersheds, because a reliable method of distinguishing between strip and underground mine production of other mine drainage pollutants (such as iron and sulfates) has not been established.

Underground mine acid abatement costs were computed by applying reclamation costs to each pound per day of acid originating in underground mines. Three different cost factors were utilized to compute the underground mine abatement costs. These factors were based on anticipated degree of difficulty of abating the acid, as determined by previous experiences in abating acid mine drainage of underground mine origin. The three cost factors utilized in this computation are:

1) A low abatement cost of $250 per pound was applied to the first 50% of each watershed's underground mine acid. This represents the portion of an area's acid that can generally be abated with relatively simple, inexpensive techniques.

2) A mid-range abatement cost of $500 per pound was applied to the next 25% of underground mine acid load. This higher cost results from the greater complexity of the abatement techniques required to eliminate this portion of the acid mine drainage.

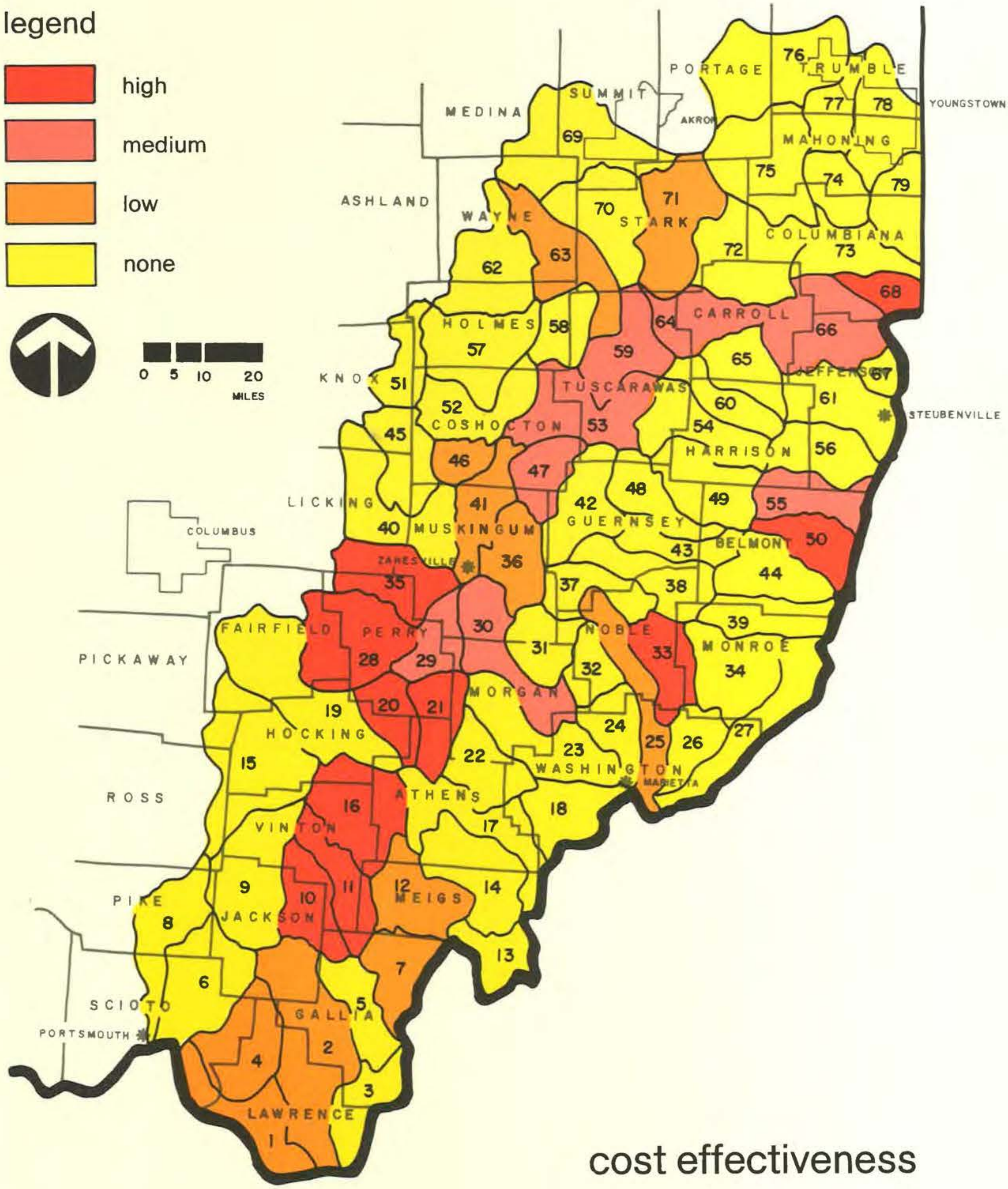
3) An abatement cost of $1500 per pound was applied to the last 25% of the acid. This portion of the acid is extremely difficult to abate because the technology does not exist or because the existing potential abatement techniques are not financially feasible. This cost was applied to the remaining acid on the assumption that existing abatement techniques will be utilized where feasible, and treatment techniques will be employed where present technology appears inadequate.

These cost values were applied to the derived underground mine acid loads, and the total underground mine abatement costs were computed for each area. The total estimated cost for underground mine acid pollution abatement is $440,000,000.

Underground mine pollution abatement costs were combined with the strip mine reclamation costs for each watershed. Overall cost effectiveness figures, indicating dollars required to abate one pound of acid, were computed for each watershed by dividing total abatement cost by measured acid load.

The watersheds were then ranked into four categories based on computed effectiveness. The "Low" category includes all watersheds with a cost effectiveness greater than $1000 per pound of acid abated, "Medium" from $500 to $1000, and "High" is less than $500 per pound abated. Since cost effectiveness was computed only in areas exhibiting acid pollution, the "None" category included all watersheds where a cost effectiveness was not computed.

This cost effectiveness factor was not used in establishing final priority rankings. It is presented here merely for information purposes. When the next phases of the total program are implemented, it may be desirable to use these data to see where the "biggest bang for the buck" can be obtained.



cost effectiveness

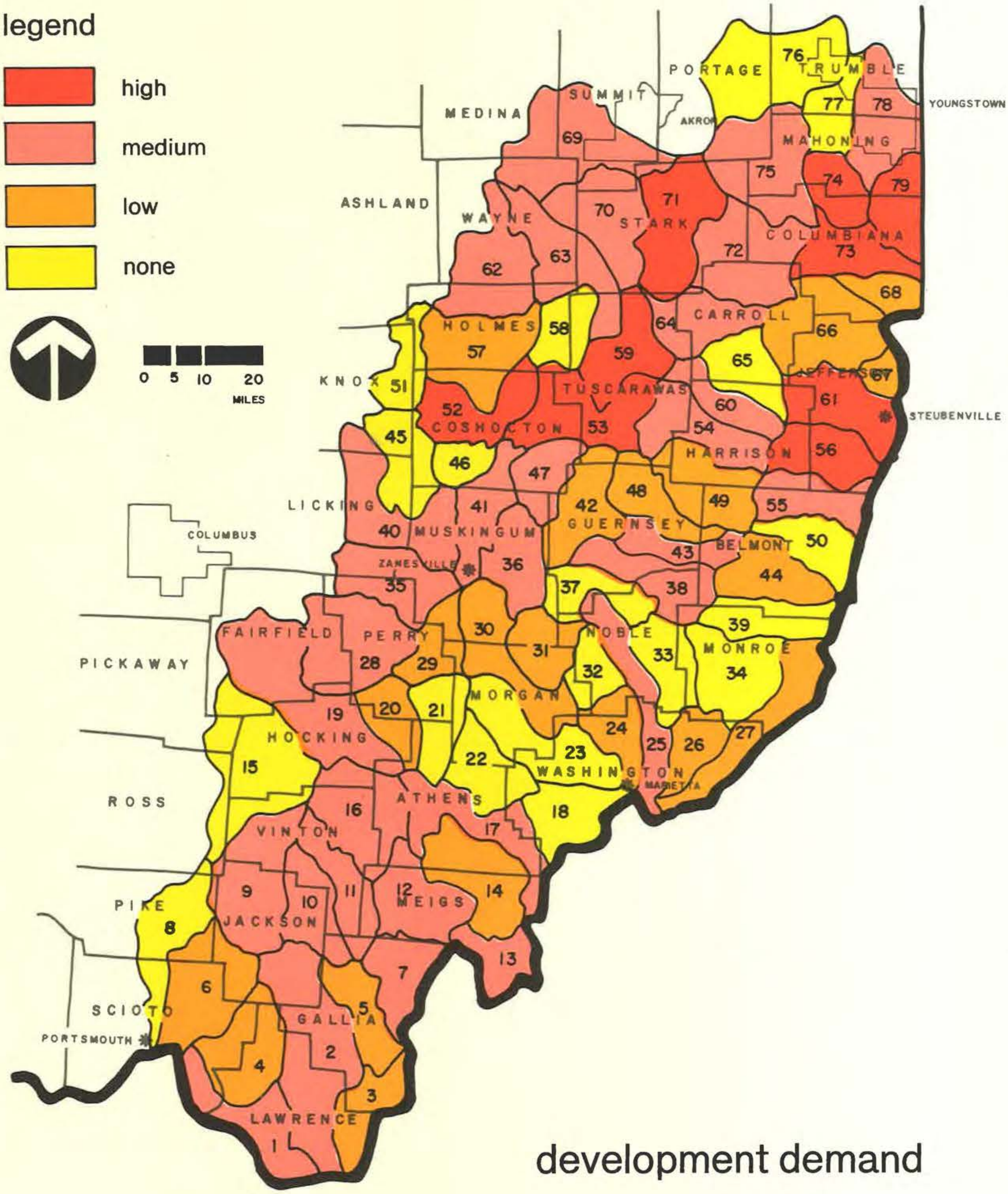
socio-economic considerations

Principal goals of the economic investigation were determination of demand and economic need for reclamation of lands in each of the 79 watersheds and assessment of priorities. Weights for economic need were based on the percentage of families in each watershed below poverty levels. The results of this weighting procedure were included in the overall priority evaluation. Factors such as proximity to major highways, urban areas, resource areas for recreation, and airports were included in a weighting system for the demand variable.

Development Demand

The demand variable is comprised of a number of separate elements deemed important in estimating demand for reclamation. These include access, presence of an urban area, recreation resources, and proximity to airports. Access in this study is defined in terms of there being an interstate highway or a U.S. highway either within the watershed or in such close proximity that it serves the needs of the watershed. The urban area element is determined by presence or absence of an urban area with a population of at least 5,000 persons. If an urban area exists just outside a watershed, that watershed was evaluated as if it had an urban area within its boundaries. Recreation resources have been designated by the Department of Natural Resources in its Outdoor Recreation Plan. These areas are listed as having the highest potential for development as recreation areas. Those working watersheds containing a recreation resource will likely benefit from reclamation efforts, especially if the unreclaimed mined land is within the area designated for future recreation use. The last element, airports, is an extremely important factor in reclamation of mined lands of Ohio. Under the Ohio County Airport Program initiated in 1965, ten county airports have been constructed on strip mined lands. Benefits to communities near the airports have been substantial. In many cases, the presence of the airport has stimulated other activities within the immediate area, such as industrial, commercial, recreational, and community service development. Thus, those watersheds with airports are deemed to have a high demand for further reclamation.

The procedure for evaluating and weighing these four factors is straightforward. First, a series of overlay maps was prepared, showing such features as the road network, urban areas, recreation resources, airports, and watershed boundaries. Each of these variables was then evaluated as to their proximity to mined lands and the extent of those mined areas. Scores were then assigned to each watershed module based on the presence or absence of each of the four developmental demand variables. Major emphasis was placed on the presence of urban areas and access in the watersheds, while lesser emphasis was placed on recreation resources and presence of airports. Scores were weighted and totaled for each of the 79 watersheds. These watersheds were ranked into three categories: "High"; "Medium"; and "Low" according to degree of development demand as shown on the following map. The "None" category is reserved for watersheds that have no unreclaimed strip mined lands.



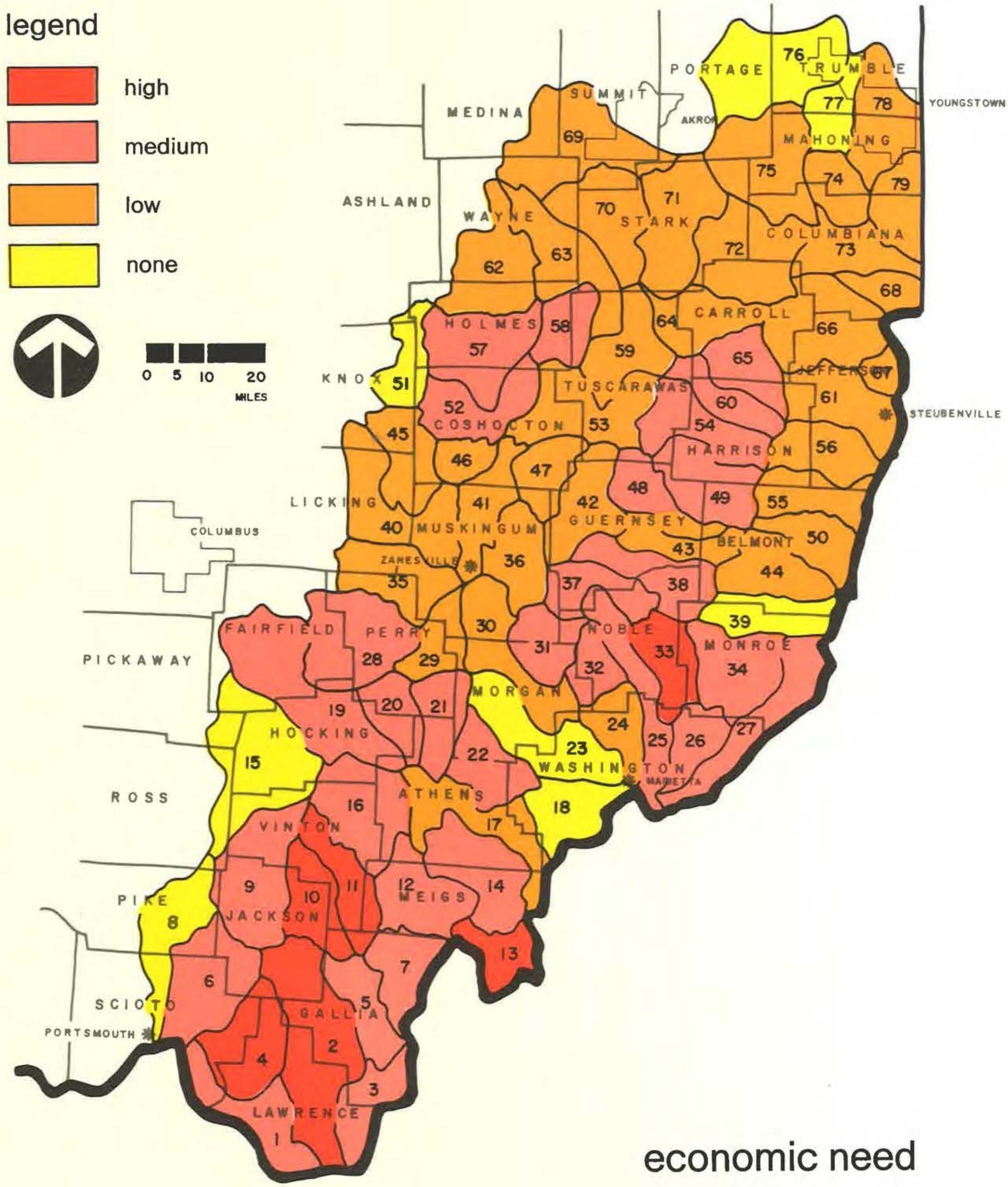
development demand

Economic Need

The previously mentioned development demand variable identifies those watersheds that would have the highest probability of development using economic arguments only. That is, those watersheds that score high on each of the four elements have more development potential than do watersheds with lower scores. For this study, however, it was deemed desirable to consider not only development demand, but economic need as well, even though there appears to be some interdependence between the two variables. This implies that there would be those areas that, although they did not rank high on the development demand variable, should deserve consideration as priority areas. For example, if there are watersheds in Appalachian Counties in which the standard of living is very low, and if through reclamation of mined lands the standard of living would be raised to some higher level, then reclamation might be encouraged.

The index selected for measuring economic need in this study, percentage of families below poverty level, reflects the incidence of poverty in each watershed. The Bureau of the Census, U.S. Department of Commerce was the source of information. Poverty thresholds were defined by the census according to head of household, age, number of children, and whether or not the family lived on a farm. Since the data utilized are at the township level, it was necessary to convert the census information to coincide with the established watershed boundaries. The percentage of families below poverty level ranged from 3% to 28% for the entire area.

The watersheds were ranked into three categories according to percentage of families below poverty level. The "Low" category includes all watersheds in which that percentage is less than 11%, "Medium" from 12% to 19%, and "High" is greater than 19%. The "None" category is used for watersheds without any unreclaimed strip mined lands.



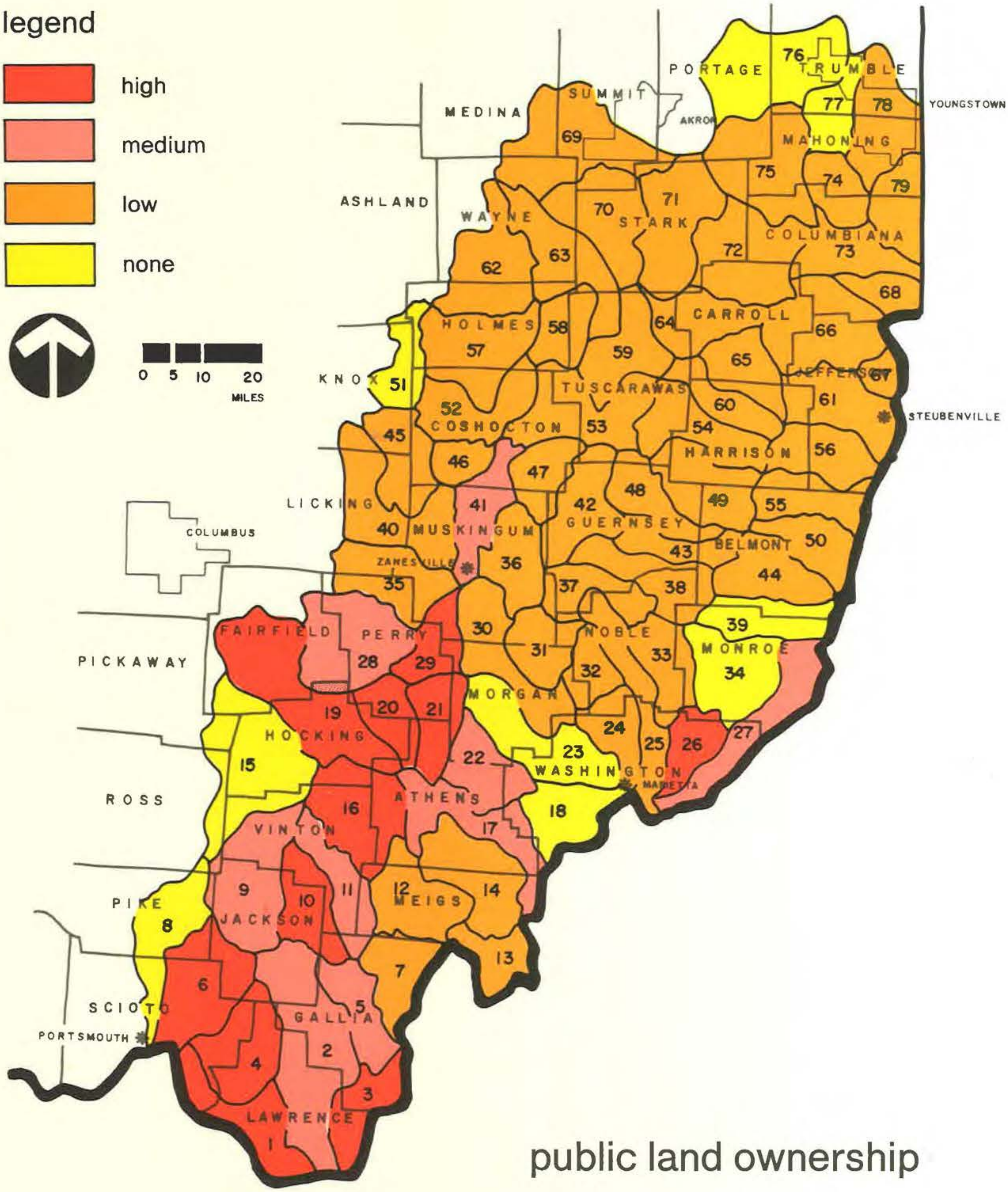
economic need

public land ownership

Public ownership of unreclaimed strip mined lands simplifies reclamation work in several ways. Access costs and problems are eliminated, and the question of benefiting private landowners with public funds does not arise. Land use and recreation benefits are generally higher for reclamation on public land versus private. Reclamation results in upgrading of present public holdings, but reclamation on private lands also benefits nearby public holdings by upgrading area aesthetics and enhancing wildlife populations.

The following map ranks watersheds into three categories according to the percentage of unreclaimed strip mined land that is publicly owned. The "Low" category has less than 33% public ownership of unreclaimed strip mines, "Medium" between 33% and 67%, and "High" is greater than 67% public ownership. The "None" category is used for watersheds without any unreclaimed strip mined lands.

The information used to establish public versus private lands was taken from U.S. Geological Survey Topographic Maps, County Maps, and other available sources. Courthouse recorded deeds were not used due to the extreme difficulty and time consuming nature of an assignment of this magnitude. This amount of detail will be needed in subsequent phases of the implementation program.

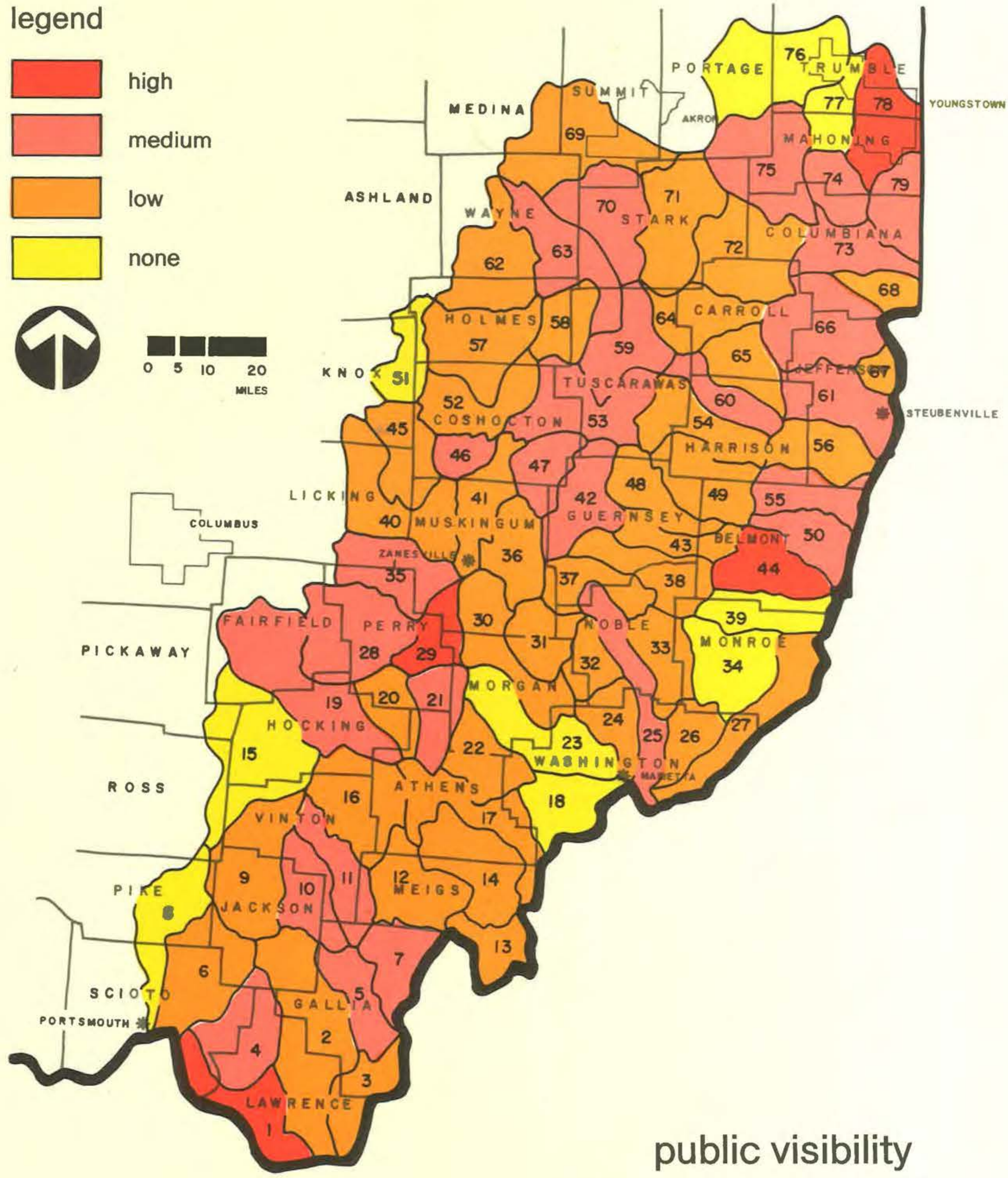


public land ownership

public visibility

Presence of large areas of unreclaimed land adjacent to major highways or towns is immediately noticeable by large numbers of people. This leads to a distinctly unfavorable overall impression of an area which can severely affect a local economy.

To include public visibility into watershed priority rankings, the relative degree of public visibility of the unreclaimed strip mined land was categorized as high, medium, low, or none for each watershed. Rankings were established after examining maps showing unreclaimed lands, highways, and towns. A "High" public visibility ranking was assigned to watersheds in which unreclaimed mined lands were located near major federal highways or large towns. Watersheds in which unreclaimed lands were located near smaller towns or state roads generally traveled only by local residents were given a "Medium" ranking, and watersheds where the lands were not easily visible by many people were ranked "Low". Watersheds in the "None" ranking had no unreclaimed strip mined lands.



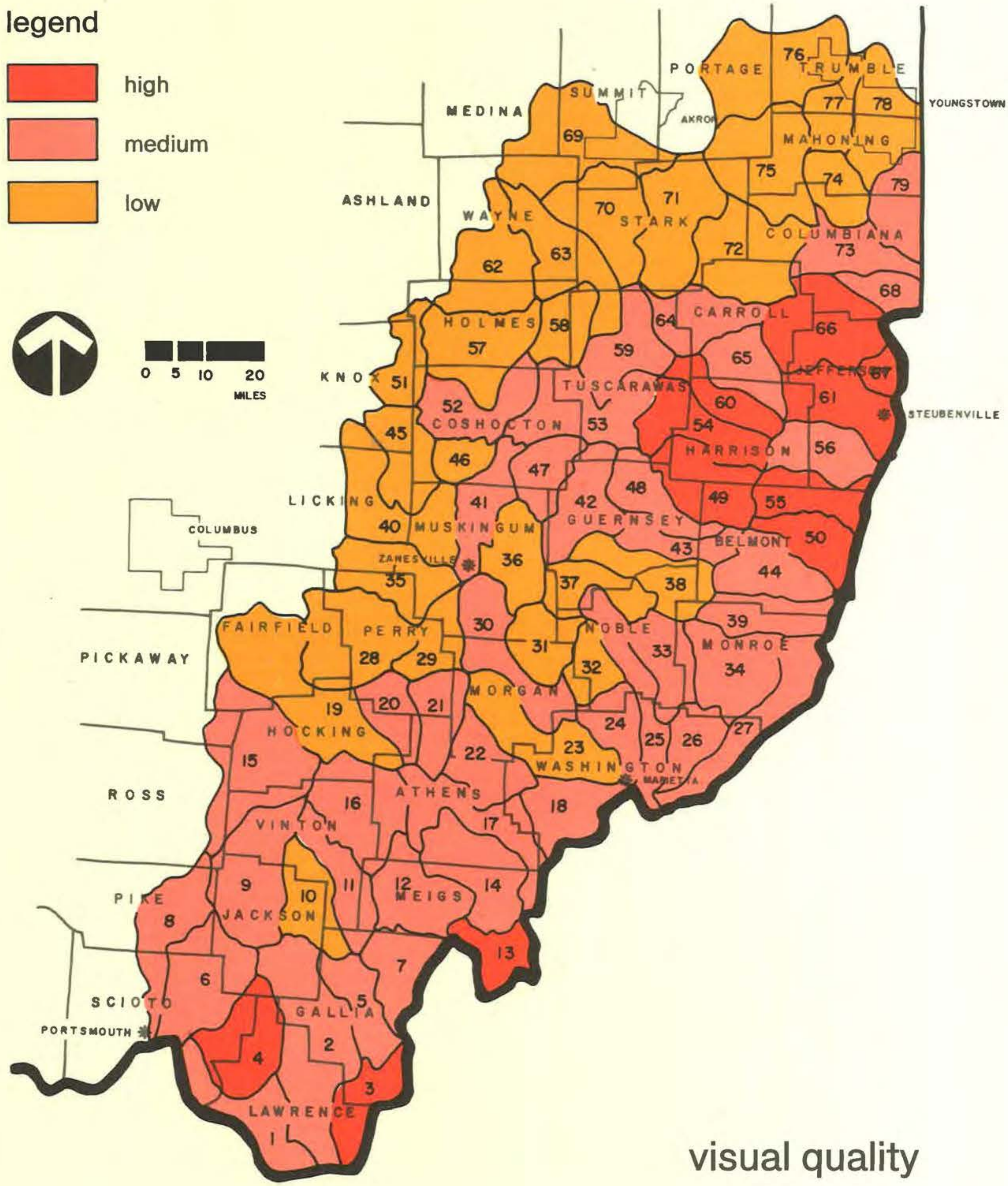
public visibility

visual quality survey

The visual quality analysis of the study area was based on the premise that needed reclamation should be given higher priority in areas of high visual quality. Visual quality was equated with landscape diversity as interpreted from United States Geological Survey Topographic Maps and land use maps. Landscape diversity is the amount of variety and interest generated by the distribution and combination of such landscape components as: landform, landscape pattern, water, vegetation, and existing land use. A more diverse landscape generally has a higher visual quality than a more homogeneous landscape. This method of visual quality analysis has been successfully employed in many recent environmental analysis studies.

The study area was divided into cells of 25 square kilometers each on both the topographic and land use maps. These cells were rated as to distribution and combination of land form and landscape pattern. The outline of the 79 watersheds was adapted to the cellular grid system, and diversity of each watershed was obtained by averaging ratings of all the cells within that watershed. The watersheds were then arithmetically divided into categories of "High," "Medium," and "Low" visual quality as depicted on the following map.

1. "Study of Visual and Cultural Environment; North Atlantic Regional Water Resources Study" by E. H. Zube; Research Planning and Design Associates, Inc., Amherst, Mass. 1970.
2. "Visual Analysis; Environmental Analysis of Central Ohio," by Koichi Kobayashi, Division of Landscape Architecture, School of Architecture, Ohio State University, for the Ohio Biological Survey and the U.S. Department of the Army Corps of Engineers, Huntington District. 1973.



visual quality

current land values

The purpose of the appraisal study was to estimate fair market value of unreclaimed strip mined lands in Eastern and Southern Ohio, to estimate fair market value of certain reclaimed mined lands, and to make an estimate as to the highest and most profitable use of the lands after they are reclaimed.

It is apparent that certain factors, both economic and environmental, as well as physical factors, make a very positive contribution to the overall value. These include proximity to population centers and transportation networks, favorable topography and physical site characteristics, and availability of access and utilities. Size of the sale tracts did not make any great impact upon the sale price, because sales were discovered that ranged from two to several hundred acres. The presence or absence of suitable quality water supplies, such as lakes and streams, was also studied. In almost every case the presence of such water was found to be an extremely desirable factor and was very important in most of the sales studied.

In order to determine the fair market value of land in the study area, an analysis of recent comparable sales of both reclaimed and unreclaimed strip mined lands was conducted. Many recent sales were investigated and seventeen parcel exchanges in six counties were felt to represent average conditions. County officials and strip mine operators were also contacted to develop property value data.

Sales analyzed involved both reclaimed and unreclaimed land. The appraiser determined that the difference in sale price between reclaimed and unreclaimed lands was influenced to a large extent by topography, and by other factors such as location, and the ratio of land available for residential purposes. Higher sale prices encountered generally involved adjoining landowners who were assembling land which had been offered to them on a first-choice basis. They paid prices somewhat higher than the normal purchaser or absentee buyer would tend to pay. Therefore the appraiser has discounted abnormally high-priced sales that reflect locational or special purpose factors. The range of $150 to $250 per acre is an average reclaimed land value that is considered to be representative of the entire study area. For simplification, the appraiser developed two broad categories of land values.

Category 1: Unreclaimed mined land with limited higher usefulness, primarily forest, agricultural and recreational lands with some potential for residential development. This category is primarily rural in character. Land values range from $100 to $150 per acre.

Category 2: Reclaimed mined land with a potential for high agricultural use and a strong possibility for residential and/or recreational use. The value range applicable to lands in this category is from $150 to $250 per acre. Here again, the value range depends primarily upon the various physical site and locational factors previously discussed.

The small fraction of land surrounding the larger urban areas is not included in these categories. This land is available for commercial purposes and is not believed representative of the study area. The values in this category range from $500 to $2,000 per acre, with a sprinkling of sales exceeding $2,000.

legal considerations

A legal review was conducted as part of this study to determine existing, proposed and possible parties, and mechanisms for reclaiming abandoned strip mined lands. Private landowners, strip mine operators, local governments and the State were all considered as potential parties to assume the burden of reclamation.

Private individuals or corporations presently holding title to unreclaimed mined lands could be assigned the responsibility of reclaiming their lands. One of the oldest established means of controlling land use involved lawsuits against private owners whose lands had an adverse affect upon neighboring lands or persons. Two basic principles come into conflict here: 1) every person is entitled to use his property for any purpose he desires, 2) everyone is bound to use his property in such a manner as not to injure the property rights of his neighbor. Court decisions have not shown any definite trend favoring one of these principles over the other, and have shown a reluctance to find any liability in the landowner for nuisances committed by his tenant during the term of use.

There are certain statutory provisions which could be useful in dealing with the unreclaimed strip mined land problem. City boards of health and general health districts have very broad powers to require private landowners to abate nuisances, and have the power to enter upon private land and abate the nuisances, assessing the costs of abatement as liens against the land. Criminal penalties have also been enacted in many areas as punishment for the pollution of rivers, streams or other waters of the State by discharges from mining operations. State and federal water pollution control acts could also be applied.

There are several legislative schemes for either compelling or inducing private landowners to upgrade their property by reclaiming abandoned strip mines or by neutralizing any detrimental environmental impacts. One possible solution is the enactment of an "environmental code" which would require the landowner to maintain certain environmental standards upon his property. Similar applicable legislative schemes have been incorporated in some municipal housing codes. In addition, landowners could possibly be induced to reclaim their land by offering them tax exemptions or premiums for certain kinds of land treatment. A myriad of practical as well as constitutional problems stand in the way of each of these potential avenues of reclamation. The foremost problem is the lack of an economic incentive. Reclamation is quite expensive, and, most landowners lack the financial ability to perform the work. In addition, reclamation usually results in little increase in land value. Most of the mining was performed in what was at that time a legal manner, usually by parties other than the landowners. The landowners themselves did not receive any additional profits by leaving their lands unreclaimed. The general public actually benefited from the lack of reclamation through lower coal prices which did not reflect the cost of reclamation. Therefore, it seems appropriate to assess the cost of subsequent reclamation against the general public.

Active strip mine operators are also potential candidates for accomplishing the work of reclaiming abandoned strip mined lands. While there are no existing laws that could compel these operators to reclaim lands owned by others which were stripped and abandoned years earlier, the operators are currently providing severance tax funds that are available for the reclamation of abandoned mined lands.

The interaction between the State and the coal mining industry could provide the incentive for active strip mine operators to reclaim abandoned strip mined lands. One recommendation that would greatly benefit the Department of Natural Resources' abandoned surface mine reclamation program is the establishment of a financial incentive on the order of $100 to $300 per acre, payable to any surface mine operator who reclaims abandoned, unreclaimed strip mines during the course of new mining activities. Since many of these abandoned areas could presently be remined on a low or zero profit basis, the incentive could increase the profit margin to the point where remining would be financially attractive. Such a measure, in combination with the State's existing, effective reclamation laws, would enable the Department to reclaim many acres of abandoned stripping at nominal cost.

Potential sources of funds for such an incentive are the State mineral severance tax and forfeited performance bonds. The mineral severance tax is assessed on some minerals extracted in the State including coal, gas, and oil. The Division of Reclamation of the Department of Natural Resources has the legal right to utilize a portion of this money to reclaim lands affected by strip mining on which there is no legal obligation requiring the strip mine operator to perform such work. The State could efficiently and effectively administer such an incentive system, since it controls both the severance tax funds and the issuance of strip mining permits. The second alternative, utilization of reclamation performance bond forfeitures, could be implemented in areas for which the State presently holds such forfeited money. State law dictates that all forfeited bond money collected since 1948 must be used to reclaim the area for which the bond was issued. While the older bonds are frequently insufficient to finance the required reclamation, that money could be utilized as an incentive to encourage reactivation of abandoned areas. These restripped areas would then be subject to reclamation under the 1972 Strip Mine Law.

There are two principal ways in which the State can approach the problem of abandoned strip mine reclamation. First, the State can restrict reclamation to lands which it already owns or acquires specifically for the purpose of reclamation. This approach assures that reclamation work performed by the State will not increase the property values of privately owned lands. However, information compiled for this study revealed that the value of surface mined lands is only increased by an average $25 to $50 per acre through reclamation work. The market value of the reclaimed lands generally averages from $150 to $250 per acre. Using this reclamation approach, the State would purchase the land and invest from $700 to $2,500 per acre in reclamation, only to increase its appraised value by $25 to $50 per acre. This small increase in land value hardly justifies the expenditures required in land acquisition costs, much less the expenditure in reclamation now or in the foreseeable future.

Secondly, past experience in several states has shown that the reclamation of abandoned strip mined lands can be most efficiently achieved if the State initiates the work without purchasing the land. This would require the consent of the landowner in the form of a property easement or right-of-way permitting the reclamation work to be completed. State severance tax funds could be used to upgrade these privately owned lands, but the actual financial benefits derived by the landowners would be minimal, since reclamation only increases the market value of the land by $25 to $50 per acre. The resultant environmental improvements and the efficient use of State severance tax funds would justify the minimal benefits accrued by the landowners. The possibility of private financial windfall profits could be eliminated through assessment of property liens for the actual amount of increased property value resulting from reclamation. Where a landowner refuses to grant an easement for reclamation on his property, one of the previously described "nuisance" laws could be applied. Should the landowner fail to abate the "nuisance" the State could then legally perform the reclamation. Most landowners would be hesitant to invest money in the reclamation of their lands, and would ultimately allow the State to perform that work. Such situations would occur infrequently, but this approach would provide the State with some means of by-passing uncooperative landowners who could indefinitely delay much needed abatement projects. The Department of Natural Resources presently has the statutory powers and authority to reclaim abandoned strip mined land (if a polluter) for private landowners by means of eminent domain, if necessary. Abatement or reclamation work initiated through these means could rapidly and efficiently upgrade the environmental quality of Ohio coal field lands.

It is recommended that the burden of the reclamation of abandoned strip mine lands be accepted by the State and that several reclamation mechanisms be employed. The severance tax and bond forfeiture funds should be applied directly to reclamation on private and public property utilizing consent liens on private property. The State should refrain from outright land purchase unless public institutions such as state parks or public buildings are to be created on the reclaimed land. Private incentive programs that will ease the expenditure burden should also be initiated. Such programs could include the establishment of financial incentives for active miners to re-affect previously strip mined lands, the application of tax incentives or cash payments for private reclamation and development and the encouragement of favorable land use zoning for mined lands. It is emphasized these incentives are for the purpose of reclaiming strip mined land more economically than could be accomplished otherwise, and that proper safeguards should be inaugurated to prevent financial windfalls to the private sector. Adequate safeguards should also be established to assure that the benefits of State-financed reclamation work on private lands are not nullified by the subsequent use to which the owner puts that land.

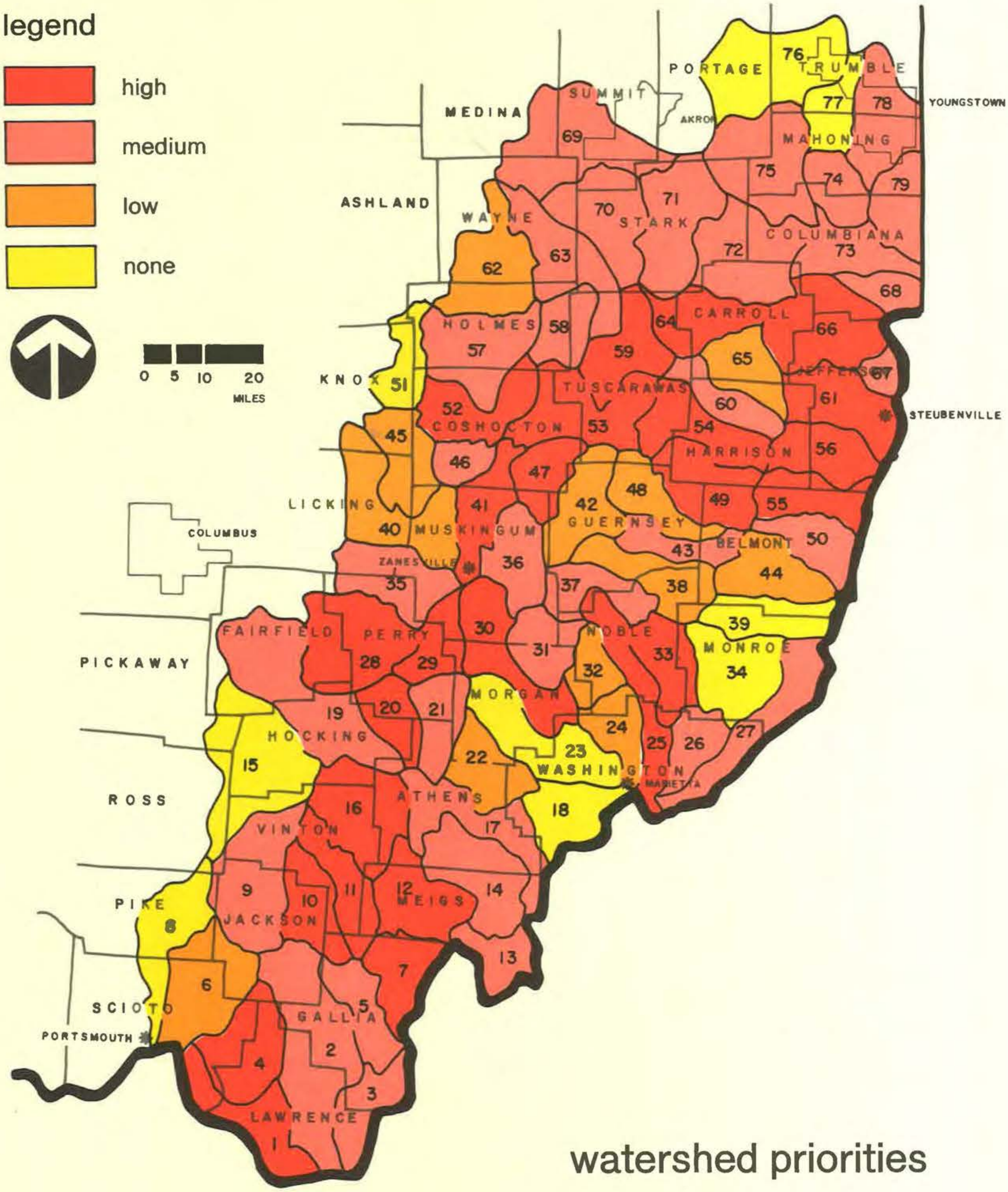
priorities and costs

A summary chart has been prepared to compare relative priority values among watersheds in each of the categories. Initially each "High" or favorable rating is given a value of three (3), "Medium" ratings a value of two (2), "Low" or unfavorable ratings a value of one (1) and a zero (0) rating where the particular characteristic is not evident or not calculated. The watershed characteristics are then assigned coefficients to adjust the relative importance of each characteristic in the final priority determination. The following coefficients are used:

DATA CHARACTERISTIC	COEFFICIENT
Mine Drainage Pollution	9
Development Demand	9
Density of Unreclaimed Strip Mines	7
Economic Need	6
Public Visibility	4
Visual Quality	3
Public Land Ownership	1

The watershed priority value for each data characteristic is determined by multiplying the data characteristic coefficient by the data characteristic rating. For example, if Development Demand (coefficient = 9) had a "High" rating (value = 3), the resultant watershed priority value would be 27.

Values are totaled for each watershed. Watershed scores are compared and divided into four groups to establish overall priority ranking of watersheds for the land reclamation program. A "High" priority ranking indicates watersheds where immediate reclamation feasibility studies are desirable. "Medium" priority watersheds are those in which reclamation work is desirable, but should be initiated only after considering all of the "High" priority watersheds. "Low" priority watersheds are those where some reclamation work is required, but is not critical and should not be initiated until the higher ranked watersheds have been considered. Watersheds in which there are no unreclaimed strip mined lands are placed in the "None" category.



watershed priorities

WATERSHED NUMBER	ECONOMIC NEED Rank × Coef[6]	= Subtotal	DEVELOPMENT DEMAND Rank × Coef[9]	= Subtotal	MINE DRAINAGE POLLUTION Rank × Coef[9]	= Subtotal	STRIP MINE Rank × Coef[7]
1	2	12	2	18	2	18	2
2	3	18	2	18	1	9	2
3	2	12	1	9	1	9	2
4	3	18	1	9	2	18	2
5	2	12	1	9	1	9	3
6	2	12	1	9	0	0	1
7	2	12	2	18	3	27	3
8	0	0	0	0	1	9	0
9	2	12	2	18	1	9	1
10	3	18	2	18	3	27	3
11	3	18	2	18	3	27	2
12	2	12	2	18	3	27	3
13	3	18	2	18	1	9	1
14	2	12	1	9	2	18	2
15	0	0	0	0	0	0	0
16	2	12	2	18	3	27	2
17	1	6	2	18	1	9	1
18	0	0	0	0	1	9	0
19	2	12	2	18	1	9	1
20	2	12	1	9	3	27	3
21	2	12	0	0	3	27	1
22	2	12	0	0	1	9	2
23	0	0	0	0	0	0	0
24	1	6	1	9	0	0	1
25	2	12	2	18	3	27	3
26	2	12	1	9	1	9	1
27	2	12	1	9	1	9	1
28	2	12	2	18	3	27	2
29	1	6	1	9	3	27	3
30	1	6	1	9	3	27	3
31	2	12	1	9	1	9	2
32	2	12	0	0	0	0	1
33	3	18	0	0	3	27	3
34	2	12	0	0	0	0	0
35	1	6	2	18	3	27	1
36	1	6	2	18	2	18	1
37	2	12	0	0	3	27	3
38	2	12	2	18	0	0	1
39	0	0	0	0	0	0	0
40	1	6	2	18	0	0	1

DENSITY	VISUAL QUALITY		PUBLIC LAND OWNERSHIP		PUBLIC VISIBILITY		PRIORITY SUMMARY	
Subtotal	Rank × Coef[3]	= Subtotal	Rank × Coef[1]	= Subtotal	Rank × Coef[4]	= Subtotal	Total	Rank
14	2	6	3	3	3	12	83	3
14	2	6	2	2	1	4	71	2
14	3	9	3	3	1	4	60	2
14	3	9	3	3	2	8	79	3
21	2	6	2	2	2	8	67	2
7	2	6	3	3	1	4	41	1
21	2	6	1	1	2	8	93	3
0	2	6	0	0	0	0	15	
7	2	6	2	2	1	4	58	2
21	1	3	3	3	2	8	98	3
14	2	6	2	2	2	8	93	3
21	2	6	1	1	1	4	89	3
7	3	9	1	1	1	4	66	2
14	2	6	1	1	1	4	64	2
0	2	6	0	0	0	0	6	
14	2	6	3	3	1	4	84	3
7	2	6	2	2	1	4	52	2
0	2	6	0	0	0	0	15	
7	1	3	3	3	2	8	60	2
21	2	6	3	3	1	4	82	3
7	2	6	3	3	2	8	63	2
14	2	6	2	2	1	4	47	1
0	1	3	0	0	0	0	23	
7	2	6	1	1	1	4	33	1
21	2	6	1	1	2	8	93	3
7	2	6	3	3	1	4	50	2
7	2	6	2	2	1	4	49	2
14	1	3	2	2	2	8	84	3
21	1	3	3	3	3	12	81	3
21	2	6	1	1	1	4	74	3
14	1	3	1	1	1	4	52	2
7	1	3	1	1	1	4	27	1
21	2	6	1	1	1	4	77	3
0	2	6	0	0	0	0	18	
7	1	3	1	1	2	8	70	2
7	1	3	1	1	1	4	57	2
21	1	3	1	1	1	4	68	2
7	1	3	1	1	1	4	45	1
0	2	6	0	0	0	0	6	
7	1	3	1	1	1	4	39	1

WATERSHED NUMBER	ECONOMIC NEED Rank × Coef[6]	= Subtotal	DEVELOPMENT DEMAND Rank × Coef[9]	= Subtotal	MINE DRAINAGE POLLUTION Rank × Coef[9]	= Subtotal	STRIP MINE Rank × Coef[7]
41	1	6	2	18	3	27	3
42	1	6	1	9	0	0	1
43	1	6	2	18	1	9	3
44	1	6	1	9	0	0	1
45	1	6	0	0	0	0	1
46	1	6	0	0	2	18	3
47	1	6	2	18	3	27	2
48	2	12	1	9	0	0	1
49	2	12	1	9	2	18	3
50	1	6	0	0	3	27	2
51	0	0	0	0	0	0	0
52	2	12	3	27	2	18	3
53	1	6	3	27	3	27	2
54	2	12	2	18	3	27	1
55	1	6	2	18	3	27	3
56	1	6	3	27	3	27	3
57	2	12	1	9	1	9	2
58	2	12	0	0	3	27	3
59	1	6	3	27	3	27	3
60	2	12	2	18	2	18	1
61	1	6	3	27	3	27	3
62	1	6	2	18	0	0	1
63	1	6	2	18	2	18	2
64	1	6	2	18	3	27	3
65	2	12	0	0	0	0	2
66	1	6	1	9	3	27	2
67	1	6	1	9	2	18	2
68	1	6	1	9	3	27	1
69	1	6	2	18	1	9	1
70	1	6	2	18	1	9	1
71	1	6	3	27	2	18	2
72	1	6	2	18	1	9	2
73	1	6	3	27	1	9	2
74	1	6	3	27	1	9	1
75	1	6	2	18	0	0	1
76	0	0	0	0	0	0	0
77	0	0	0	0	1	9	0
78	1	6	2	18	1	9	1
79	1	6	3	27	0	0	1

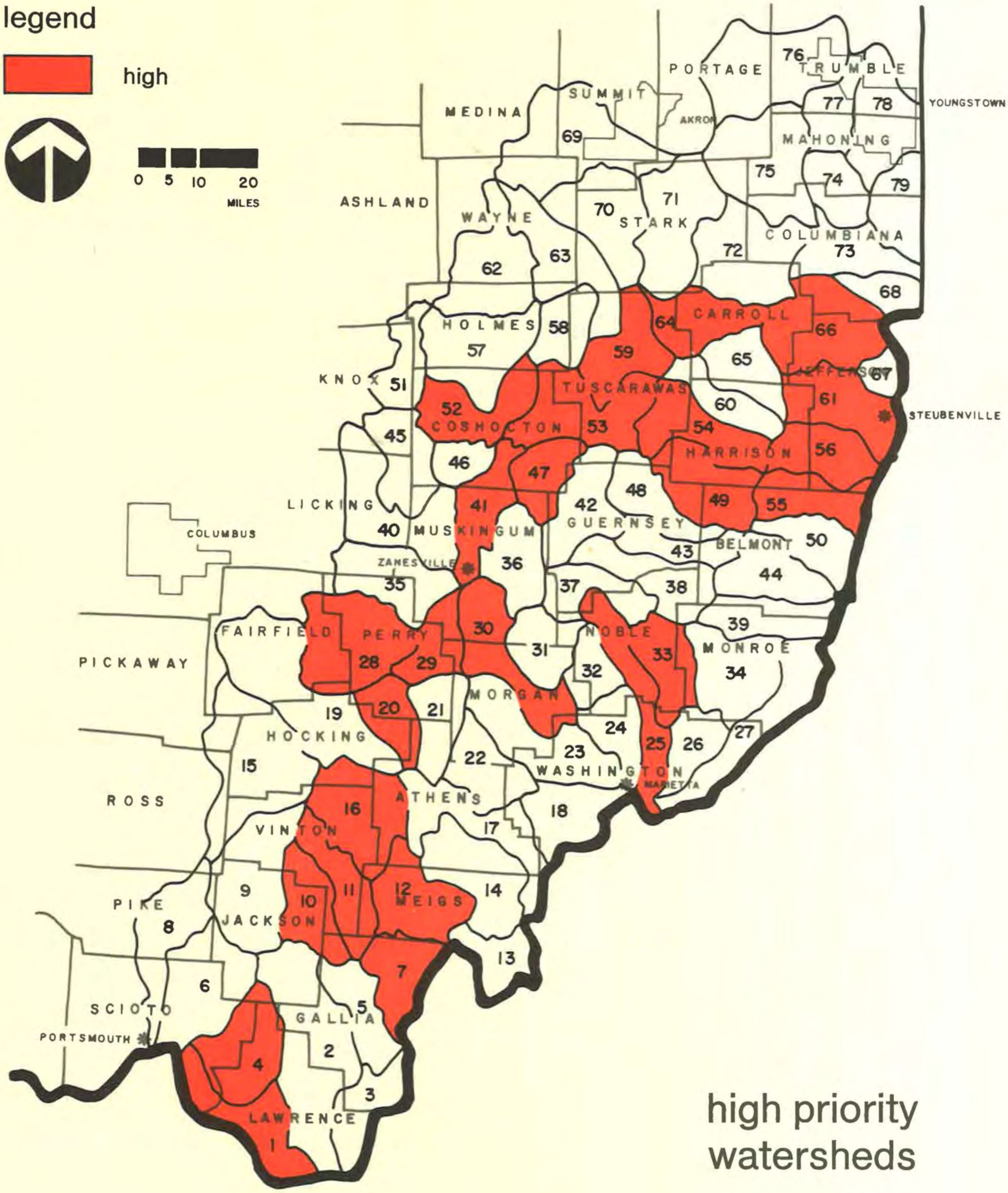
DENSITY	VISUAL QUALITY		PUBLIC LAND OWNERSHIP		PUBLIC VISIBILITY		PRIORITY SUMMARY	
Subtotal	Rank × Coef[3]	= Subtotal	Rank × Coef[1]	= Subtotal	Rank × Coef[4]	= Subtotal	Total	Rank
21	2	6	2	2	1	4	84	3
7	2	6	1	1	2	8	37	1
21	2	6	1	1	1	4	65	2
7	2	6	1	1	3	12	41	1
7	1	3	1	1	1	4	21	1
21	1	3	1	1	2	8	57	2
14	2	6	1	1	2	8	80	3
7	2	6	1	1	1	4	39	1
21	3	9	1	1	1	4	74	3
14	3	9	1	1	2	8	65	2
0	1	3	0	0	0	0	3	
21	2	6	1	1	1	4	89	3
14	2	6	1	1	2	8	89	3
7	3	9	1	1	1	4	78	3
21	3	9	1	1	2	8	90	3
21	2	6	1	1	1	4	92	3
14	1	3	1	1	1	4	52	2
21	1	3	1	1	1	4	68	2
21	2	6	1	1	2	8	96	3
7	3	9	1	1	2	8	73	2
21	3	9	1	1	2	8	99	3
7	1	3	1	1	1	4	39	1
14	1	3	1	1	2	8	68	2
21	2	6	1	1	1	4	83	3
14	2	6	1	1	1	4	37	1
14	3	9	1	1	2	8	74	3
14	3	9	1	1	1	4	61	2
7	2	6	1	1	1	4	60	2
7	1	3	1	1	1	4	48	2
7	1	3	1	1	2	8	52	2
14	1	3	1	1	1	4	73	2
14	1	3	1	1	1	4	55	2
14	2	6	1	1	2	8	71	2
7	1	3	1	1	2	8	61	2
7	1	3	1	1	2	8	43	2
0	1	3	0	0	0	0	3	
0	1	3	0	0	0	0	12	
7	1	3	1	1	3	12	56	2
7	2	6	1	1	2	8	55	2

Cost Summary — High Priority Watersheds

Watershed Number	Area (sq. mi.)	Stream Name	Counties	Reclamation Cost (in thousands)[1] Strip Mine	Underground Mine	Total	Cost Effectiveness ($ per lb/day acid)[2] Strip Mine	Underground Mine	Overall
1	150	Ice Creek and Ohio River Tributaries	Lawrence	$ 1,500	$ 200	$ 1,700	$ 5,290	$ 625	$ 2,960
4	186	Pine Creek	Lawrence, Scioto	4,100	550	4,650	13,930	625	3,950
7	139	Ohio River Tributaries	Gallia, Meigs	16,900	2,000	18,900	15,870	625	4,440
10	151	Little Raccoon Creek	Gallia, Jackson, Vinton	6,800	34,100	40,900	120	625	380
11	154	Raccoon Creek and Elk Fork Raccoon Creek	Gallia, Meigs, Vinton	3,100	9,900	13,000	200	625	410
12	157	Leading Creek	Meigs	16,800	4,600	21,400	6,900	625	2,200
16	230	Raccoon Creek Headwaters	Athens, Hocking, Meigs, Vinton	5,100	10,100	15,200	310	625	470
20	116	Monday Creek	Athens, Hocking, Perry	4,400	69,300	73,700	120	625	500
25	157	West Fork of Duck Creek	Noble, Washington	9,400	1,200	10,600	1,620	625	1,380
28	235	Rush Creek	Fairfield, Hocking, Perry	6,700	14,000	20,700	300	625	460
29	106	Moxahala Creek	Morgan, Muskingum, Perry	21,300	106,700	128,000	370	625	560
30	179	Muskingum River Tributaries	Morgan	8,100	9,400	17,500	1,630	625	880
33	135	East and Middle Forks of Duck Creek	Noble, Washington	7,400	0	7,400	250	625	250
41	132	Muskingum River Tributaries	Coshocton, Muskingum	5,200	2,800	8,000	3,370	625	1,310
47	124	Lower Wills Creek	Coshocton, Muskingum	2,900	4,200	7,100	1,270	625	790
49	210	Upper Stillwater Creek	Belmont, Guernsey, Harrison	21,400	0	21,400	—	—	—
52	160	Lower Walhonding River	Coshocton	5,200	0	5,200	—	—	—
53	245	Tuscarawas River Tributaries	Coshocton, Tuscarawas	2,300	5,000	7,300	860	625	680
54	160	Stillwater Creek	Harrison, Tuscarawas	1,200	0	1,200	—	—	—
55	137	Wheeling Creek	Belmont, Harrison	6,300	25,600	31,900	460	625	590
56	147	Short Creek and Ohio River Tributaries	Jefferson, Harrison	10,800	0	10,800	—	—	—
59	143	Stone Creek and Tuscarawas River Tributaries	Tuscarawas	6,200	7,300	13,500	530	625	580
61	164	Cross Creek	Harrison, Jefferson	1,150	0	1,150	—	—	—
64	139	Conotton Creek	Carroll, Tuscarawas	2,600	3,000	5,600	530	625	580
66	241	Yellow Creek	Carroll, Columbiana, Jefferson	4,900	7,400	12,300	1,240	625	780

[1] The underground mine column reflects only acid drainage abatement costs.

[2] For strip mines: Total reclamation cost divided by total lb/day acid.
For underground mines: Total acid abatement cost divided by total lb/day acid.
Overall: Total reclamation cost plus total acid abatement cost divided by total lb/day acid from both strip and underground mines.



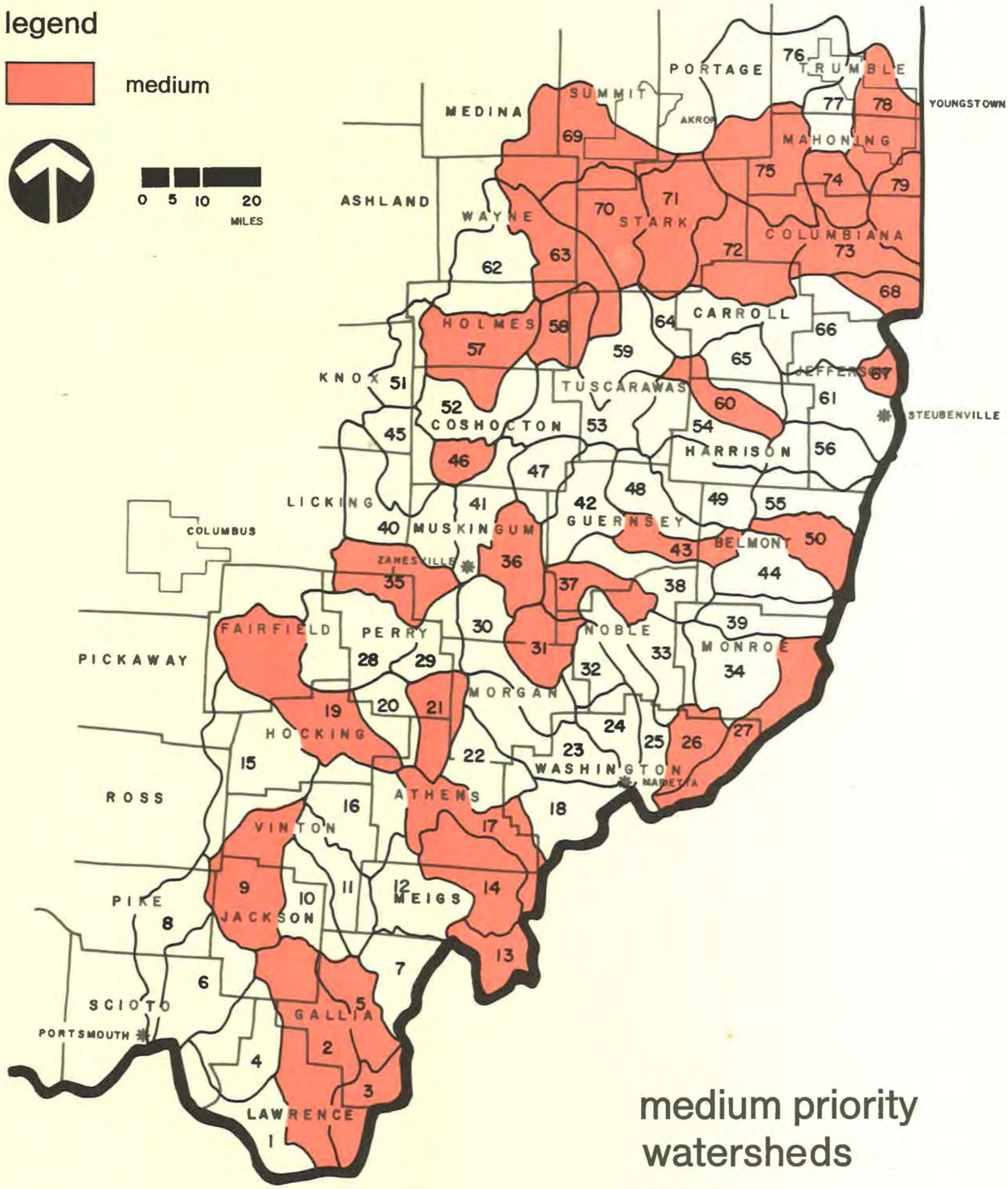
high priority watersheds

Cost Summary

medium priority watersheds

Watershed Number	Area (sq. mi.)	Stream Name	Counties	Reclamation Cost (in thousands)[1] Strip Mine	Underground Mine	Total	Cost Effectiveness ($ per lb/day acid)[2] Strip Mine	Underground Mine	Overall
2	369	Symmes Creek	Gallia, Jackson, Lawrence	$ 4,900	$ 100	$ 5,000	$26,500	$ 625	$18,590
3	141	Indian Guyan Creek and Ohio River Tributaries	Jackson, Lawrence	1,100	0	1,100	—	—	—
5	129	Lower Racoon Creek	Gallia	3,200	0	3,200	—	—	—
9	252	Little Salt Creek and Middle Fork Salt Creek	Jackson, Vinton	700	0	700	—	—	—
13	114	Ohio River Tributaries	Meigs	30	0	30	—	—	—
14	216	Shade River	Athens, Meigs	6,300	0	6,300	—	—	—
17	220	Lower Hocking River	Athens, Meigs	1,800	0	1,800	—	—	—
19	352	Upper Hocking River	Meigs	2,700	0	2,700	—	—	—
21	136	Sunday Creek	Athens, Morgan, Perry	940	15,200	16,140	120	625	500
26	115	Lower Little Muskingum River	Washington	17	0	17	—	—	—
27	142	Ohio River Tributaries	Monroe, Washington	46	0	46	—	—	—
31	145	Meigs Creek	Morgan, Muskingum, Noble	5,200	0	5,200	—	—	—
35	202	Jonathan Creek	Licking, Morgan, Muskingum, Perry	8,100	59,700	67,800	253	—	533
36	146	Salt Creek	Muskingum	775	300	1,075	5,200	625	1,770
37	123	Buffalo Fork of Wills Creek	Guernsey, Muskingum, Noble	6,800	0	6,800	—	—	—
43	77	Leatherwood Creek	Guernsey	3,100	0	3,100	—	—	—
46	63	Mill Fork of Wakatomika Creek	Coshocton	10,500	300	10,800	6,920	625	5,190
50	132	McMahon Creek	Belmont	1,500	44,000	45,500	70	625	490
57	223	Lower Killbuck Creek	Coshocton, Holmes	2,800	0	2,800	—	—	—
58	139	Sugar Creek	Holmes, Tuscarawas	4,900	0	4,900	—	—	—
60	116	Little Stillwater Creek	Harrison, Tuscarawas	1,600	0	1,600	—	—	—
63	205	Sugar Creek	Holmes, Stark, Wayne	3,700	500	4,200	4,680	625	2,650
67	67	Ohio River Tributaries	Jefferson	2,000	0	2,000	—	—	—
68	46	Little Yellow Creek and Ohio River Tributaries	Columbiana	140	1,800	1,940 6	140 —	625 —	500 —
69	308	Upper Tuscarawas River	Medina, Summit, Wayne	6	0				
70	230	Central Tuscarawas River	Stark, Summit, Wayne	170	0	170	—	—	—
71	250	Lower Sandy Creek	Stark	4,400	700	5,100	3,870	625	2,250
72	256	Upper Sandy Creek	Carroll, Columbiana, Stark	1,400	0	1,400	—	—	—
73	167	West Fork of Little Beaver Creek	Columbiana	3,400	0	3,400	—	—	—
74	144	Middle Fork of Little Beaver	Columbiana, Mahoning	1,700	0	1,700	—	—	—
75	278	Upper Mahoning River	Columbiana, Portage, Stark	900	0	900	—	—	—
78	219	Lower Mahoning River	Mahoning, Trumbull	1,500	0	1,500	—	—	—
79	214	North Fork of Little Beaver Creek Tributaries	Columbiana, Mahoning	1,600	0	1,600	—	—	—

[1] The underground mine column reflects only acid drainage abatement costs.
[2] For strip mines: Total reclamation cost divided by total lb/day acid.
For underground mines: Total acid abatement cost divided by total lb/day acid.
Overall: Total reclamation cost plus total acid abatement cost divided by total lb/day from both strip and underground mines.



medium priority watersheds

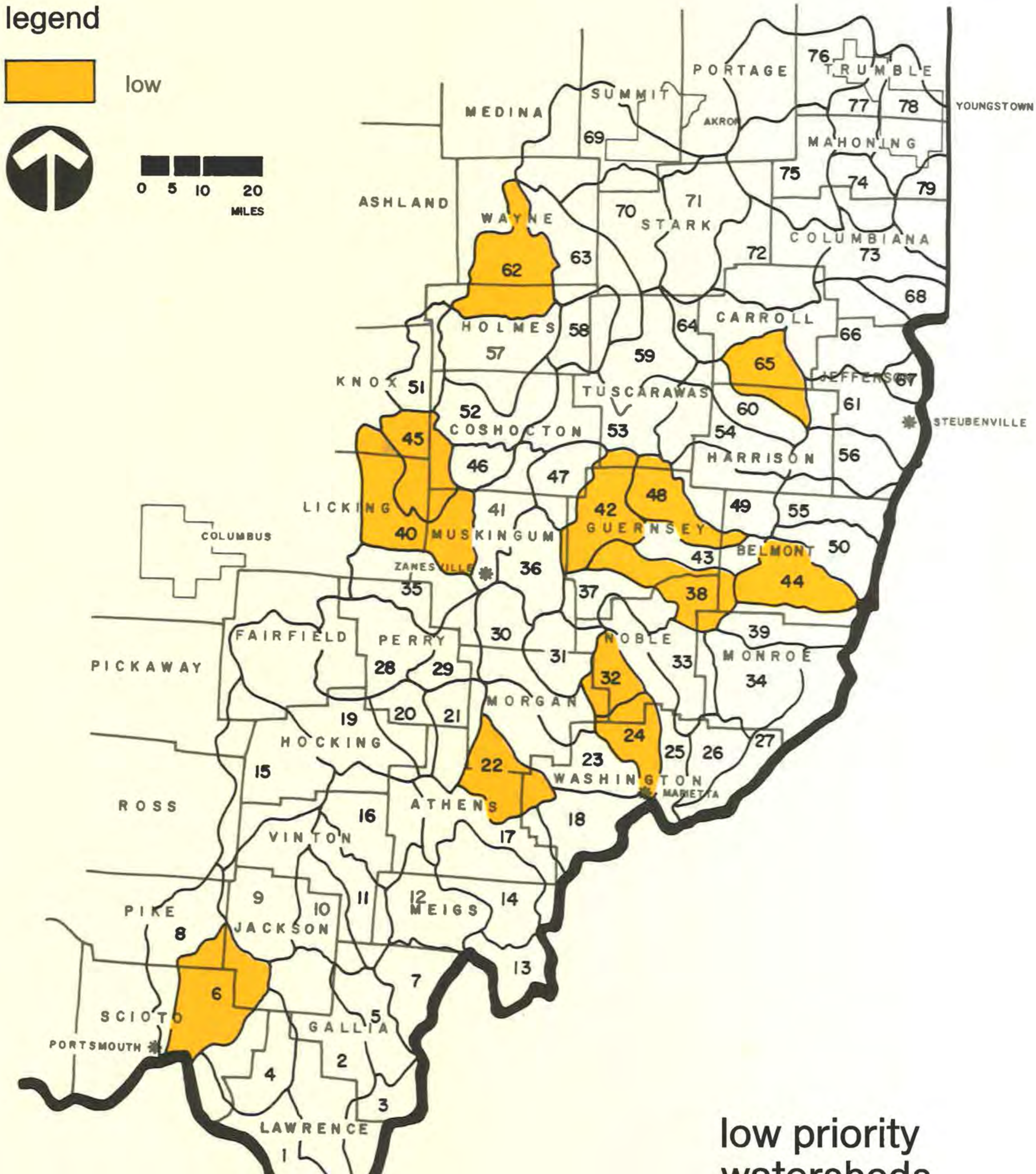
Cost Summary

low priority watersheds

Watershed Number	Area (sq. mi.)	Stream Names	Counties	Strip Mine	Underground Mine	Total[1,2]
6	249	Little Scioto River	Jackson, Pike, Scioto	$ 250	0	$ 250
22	145	Federal Creek	Athens, Morgan	3,200	0	3,200
24	106	Lower Muskingum River	Morgan, Noble, Washington	250	0	250
32	85	Olive Green Creek	Morgan, Noble	350	0	350
38	191	Upper Wills Creek	Guernsey, Monroe, Noble	700	0	700
40	255	Lower Licking River	Licking, Muskingum	300	0	300
42	187	Central Wills Creek	Guernsey, Muskingum	450	0	450
44	183	Captina Creek	Belmont	500	0	500
45	168	Wakatomika Creek	Coshocton, Knox, Licking, Muskingum	11	0	11
48	159	Salt Fork of Wills Creek	Guernsey	1,200	0	1,200
62	248	Central Killbuck Creek	Holmes, Wayne	140	0	140
65	150	Upper Conotton Creek	Carroll, Harrison	2,500	0	2,500

[1] The underground mine column reflects only acid drainage abatement costs.

[2] Cost effectiveness is not computed here because, by definition, low priority watersheds do not contain acid drainage.



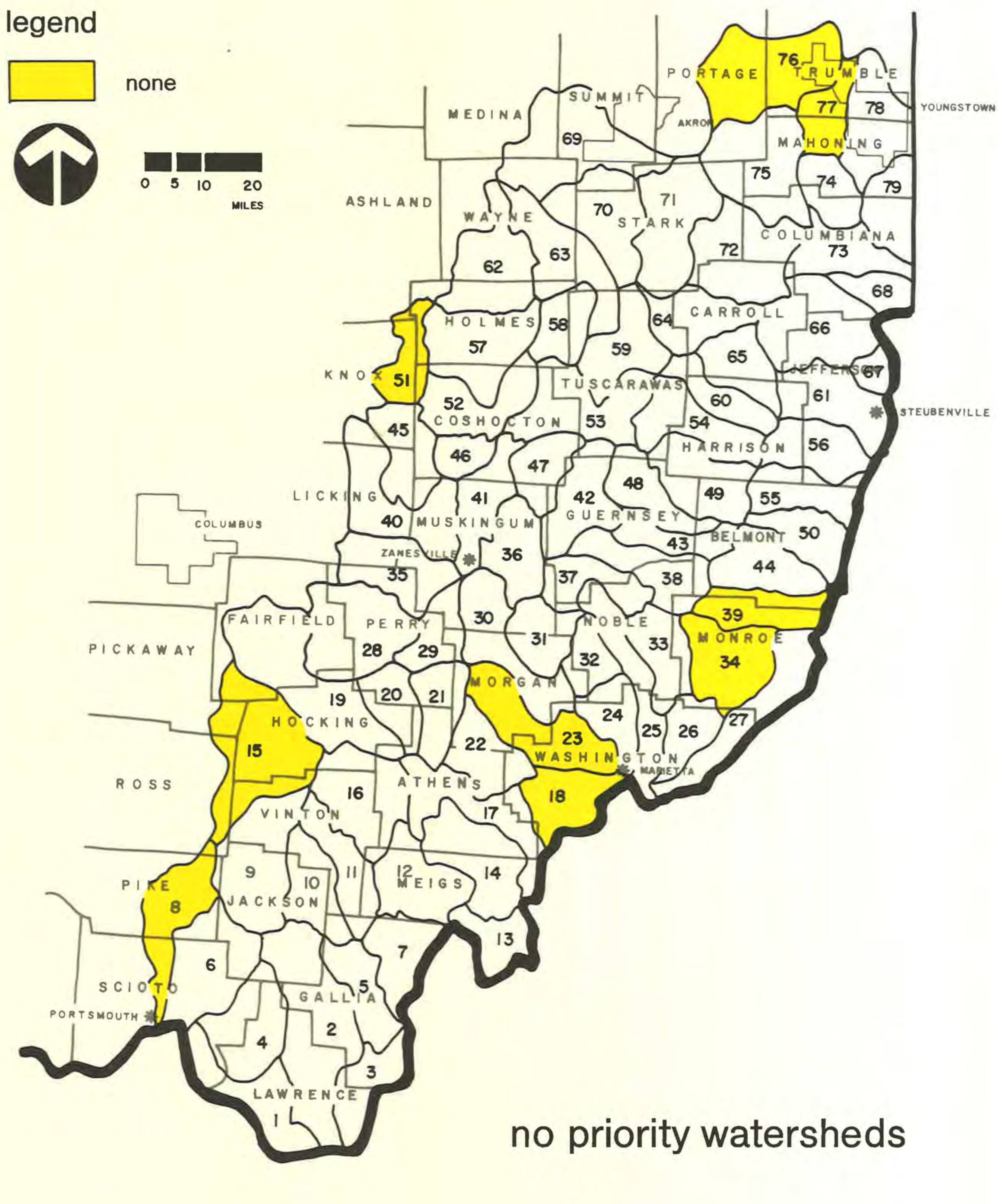
low priority watersheds

Cost Summary

no unreclaimed strip mines

Watershed Number	Area (sq. mi.)	Stream Names	Counties	Reclamation Cost (in thousands)[2] Strip Mine	Underground Mine	Total
8	181	Beaver Creek and Scioto River Tributaries	Pike, Scioto	0	0	0
15	309	Salt Creek	Hocking, Ross, Vinton	1[1]	0	1
18	144	Little Hocking River and Ohio River Tributaries	Athens, Washington	0	0	0
23	236	Wolf Creek	Morgan, Washington	0	0	0
34	194	Upper Little Muskingum River	Monroe	0	0	0
39	133	Sunfish Creek	Monroe	0	0	0
51	106	Lower Mohican River	Coshocton, Holmes, Knox	0	0	0
76	297	Central Mohican River	Mahoning, Portage, Trumbull	0	0	0
77	91	Meander Creek	Mahoning, Trumbull	20[1]	0	20

[1] These costs apply to spot treatment on fairly well reclaimed strip mines.
[2] Cost effectiveness is not computed here because, by definition, low priority watersheds do not contain acid drainage.



no priority watersheds

potential funding

Appalachian Regional Commission

The Appalachian Regional Commission can provide financial assistance for up to 75 percent of the costs of restoring abandoned mine areas damaged by subsidence, fire, or surface mining and which have potential for economic growth. Two million dollars were budgeted for this purpose in 1974. The Commission has uncommitted an amount of approximately $8.9 million from 1973, however, their present thinking is to utilize these funds in the Tropical Storm Agnes disaster area.

The Commission expects applications from the States of Ohio, West Virginia, Maryland, and Pennsylvania for mine drainage pollution abatement work. Commission approval of specific projects is contingent upon each state having a sound mine reclamation plan and assurances that it will be implemented and enforced. Ohio, of course, certainly meets that qualification now.

Under existing legislation the Appalachian Regional Commission is the only agency of government which can give grants to the states for action programs in acid mine drainage pollution abatement work. The U.S. Environmental Protection Agency has funds available for demonstration projects in this area.

U. S. Environmental Protection Agency

The EPA program for acid mine water control demonstration projects is intended to demonstrate control of mine drainage, preferably at the source. It is not a general program for action related to mine reclamation. However, EPA has taken a realistic approach to interpretation of the law, and is willing to fund projects that would demonstrate feasibility of a technique that has already been demonstrated in another part of the country.

Public Law 92-500, the 1972 amendment to the Federal Water Pollution Control Act, provides for $30 million for these demonstration projects.

The President signed HR 8619 into law (PL 93-137) on October 24, 1973 which appropriates $516 million to EPA for fiscal 1974. Of this total, $161.7 million was earmarked for research and development programs.

U. S. Department of the Interior

On October 4, 1973, the President signed into law HR 8917 (PL 93-120) which appropriates $2.4 billion to the Interior Department and related agencies during fiscal 1974. A total of $66 million would be available to the states within the Bureau of Outdoor Recreation's Land and Water Conservation Fund. The Forest Service is appropriated $257.5 million for forest land management. Opportunities should exist for securing some of these funds for various types of mine reclamation projects.

It is extremely important that Ohio immediately start several of the watershed studies recommended in the implementation section of this report. Unless **specific** projects are located and well defined as part of the recommended detailed feasibility studies, these funding opportunities will be lost.

Other Federal Funding Possibilities

It is evident the federal government will soon enact legislation that will provide financial assistance to the states for an **action** program for abandoned mine reclamation and abatement of pollution from abandoned mines. This extensive interest is shown by:

1. The Senate passed S.425 on October 9, 1973 by an 82 to 8 vote. This bill would authorize $100 million **initially** for an Abandoned Mine Reclamation Fund, with additional annual appropriations.

2. A surface mining bill (H.R. 11500) was approved by the House Interior Subcommittees on the Environment and Mines and Mining after five months of mark-up sessions. This bill was referred to the House Interior Committee on November 12, with an amendment that would establish a $2.50 per ton reclamation fee which would be used to rehabilitate abandoned surface mines.

3. Senator Jackson's Land Use Policy and Planning Assistance Act (S.268) passed the Senate June 21, 1973, and provides $100 million **annually** for eight years for grants to the states. This will provide some financial opportunity for reclamation planning as part of the detailed watershed feasibility studies recommended as the next step in this program.

4. The House's Land Use Planning Act (H.R. 10294) also includes appropriation authority for $100 million annually for the next eight years for grants to the states. It is important to note that this project as undertaken by the Board of Unreclaimed Strip Mined Lands should satisfy the mined lands inventory that will be required before the states will be eligible for grants. There is a high probability that one of these two bills will become law during 1974.

5. Other federal agencies that must be investigated for financial assistance when specific projects are defined, include: the Department of Housing and Urban Development; the Economic Development Administration of the Department of Commerce; the Farmers Home Administration and the Soil Conservation Service of the Department of Agriculture; and the Departments of Transportation and Health, Education, and Welfare; the Water Resources Council; and the Small Business Administration.

6. Although not a source of federal funding, private industry must not be overlooked as a source of reclamation funds. When detailed watershed feasibility studies are performed, attention should be focused on the potential future land use as related to its development by the private sector. It is not reasonable to expend tax dollars for reclamation of abandoned mined lands in those areas where private industry may pay the bill if it needs the land for development or some other purpose.

State Funding

Use of the existing mineral severance tax for these purposes is explained in detail in the section of this report titled "Legal Considerations." Many other possibilities for State funding should be introduced, including:

1. A bond issue program such as Pennsylvania's "Land and Water Conservation and Reclamation Fund."
2. An increase in the severance tax levy. This option might be combined with a bond issue to guarantee payments.
3. Using the State's general capital improvement program.
4. Using funds from the State's general appropriation budget.

Conclusions

After reviewing the above mentioned avenues for existing and possible future federal funding, it becomes obvious that much financial assistance is now or will become available in the near future. Those states that have done their planning on a sound basis will be able to secure large portions of the available monies. It then becomes imperative that the State proceed immediately to implement the recommendations in this report.

An estimate of the cash flow that is or will be available during the next 3½ years can be projected this way:

Income

Estimated income from State severance tax	=	$10,500,000
Appalachian Regional Commission could provide	=	3,500,000
U. S. EPA Demonstration Projects	=	1,750,000
Department of Interior (Reclamation)	=	10,000,000
Department of Interior (Land Use)	=	5,000,000
Other Federal Agencies	=	2,000,000
Potential Income		$32,750,000

Expenditure

If three high priority watersheds were started now, the estimated costs within the 3½ year period are:

Phase		
1. Preliminary Feasibility Studies @ $70,000	=	$ 210,000
2. Detailed Feasibility Studies @ $110,000	=	330,000
3. Engineering Design @ $600,000	=	1,800,000
4. Construction @ $10,000,000	=	30,000,000
5. Monitoring Results @ $135,000	=	405,000
Potential Costs		$32,745,000

It should be realized these costs are only estimates at this time, and cannot be projected more accurately until specific watershed studies are underway. It does show that sufficient funding will be, or can be, made available to permit the State to initiate three or four watershed studies now.

implementation procedures

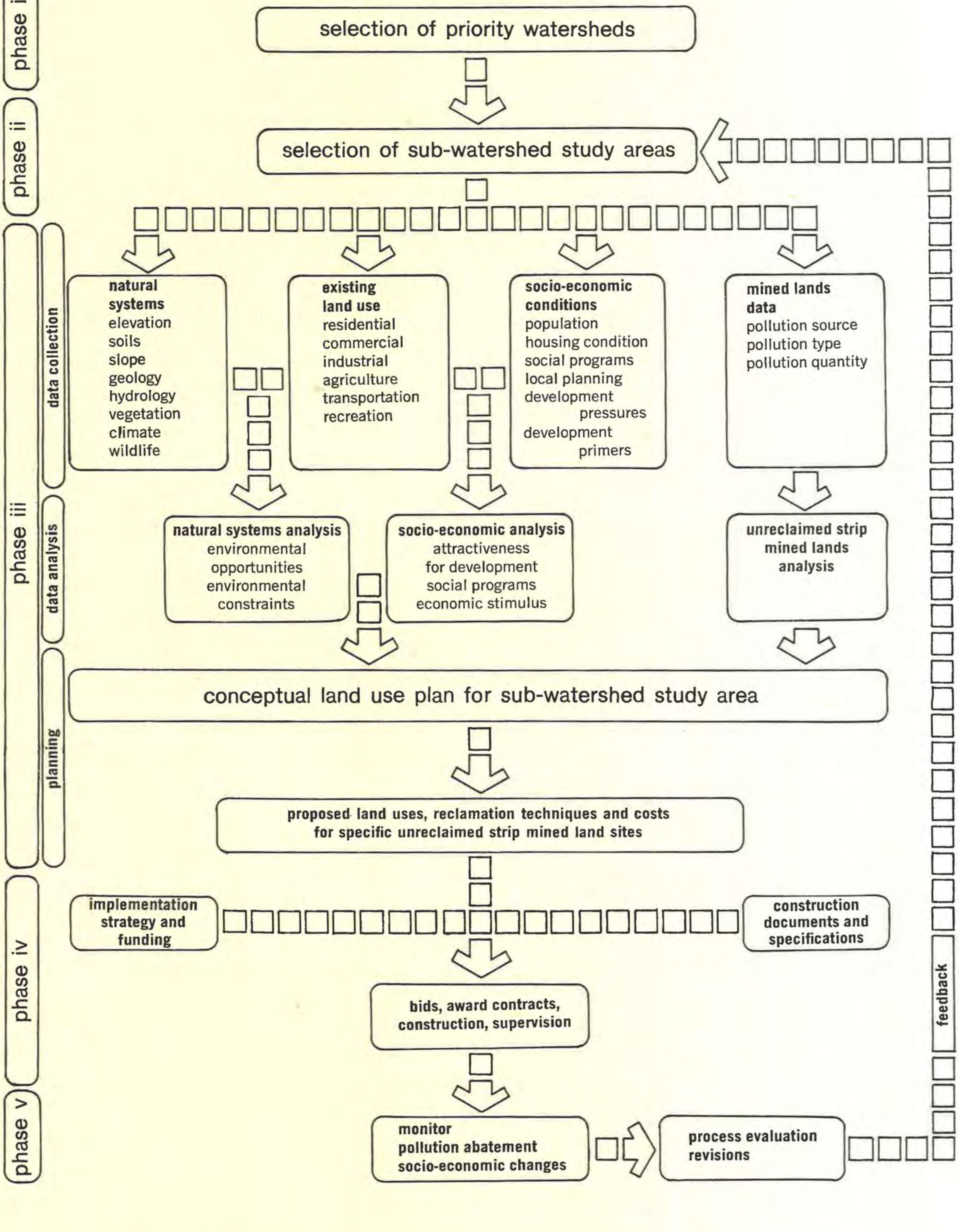
Introduction

This study represents the first of five major steps in the development of an effective long-term abandoned strip mined land reclamation program. The initial study has gathered and analyzed data in detail for the entire study area. Data analyses include: socio-economic factors; the extent, location and condition of abandoned strip-mined lands; and general environmental conditions. This study concludes that twenty-five specific watersheds should be assigned the highest priority for immediate detailed planning and implementation of mine reclamation and abatement work. This section of the report proposes a method of transition from broad planning to detailed planning, implementation and monitoring of constructive results.

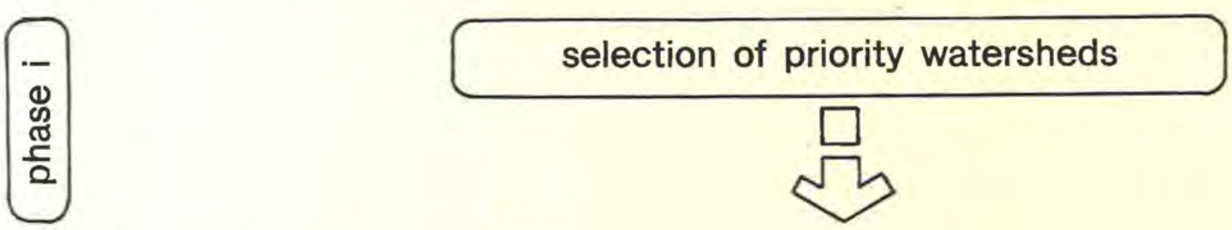
For illustrative purposes, the section will use watershed number seventy-one as an example of the proposed implementation model. Although this was not determined to be a "high priority" watershed, it was chosen for demonstration because of the breadth and detail of available data. Most of this data will need to be generated for effective planning of the high priority watersheds. Certain relevant data and interpretations were not available for this watershed as will be noted and explained.

The following chart "Unreclaimed Strip Mined Land Study — Planning and Implementation Strategy Model" outlines the remaining four major steps in a comprehensive program for abandoned strip mined land reclamation. This chart outlines a proposed method of objective study and implementation procedures for immediate action in at least three of the high priority watersheds. The chart and the subsequent detailed maps and explanations illustrate the methods for positive results through sensitive land use planning, abandoned strip mine reclamation, and socio-economic development within the study areas.

unreclaimed strip mined lands study implementation planning and strategy model

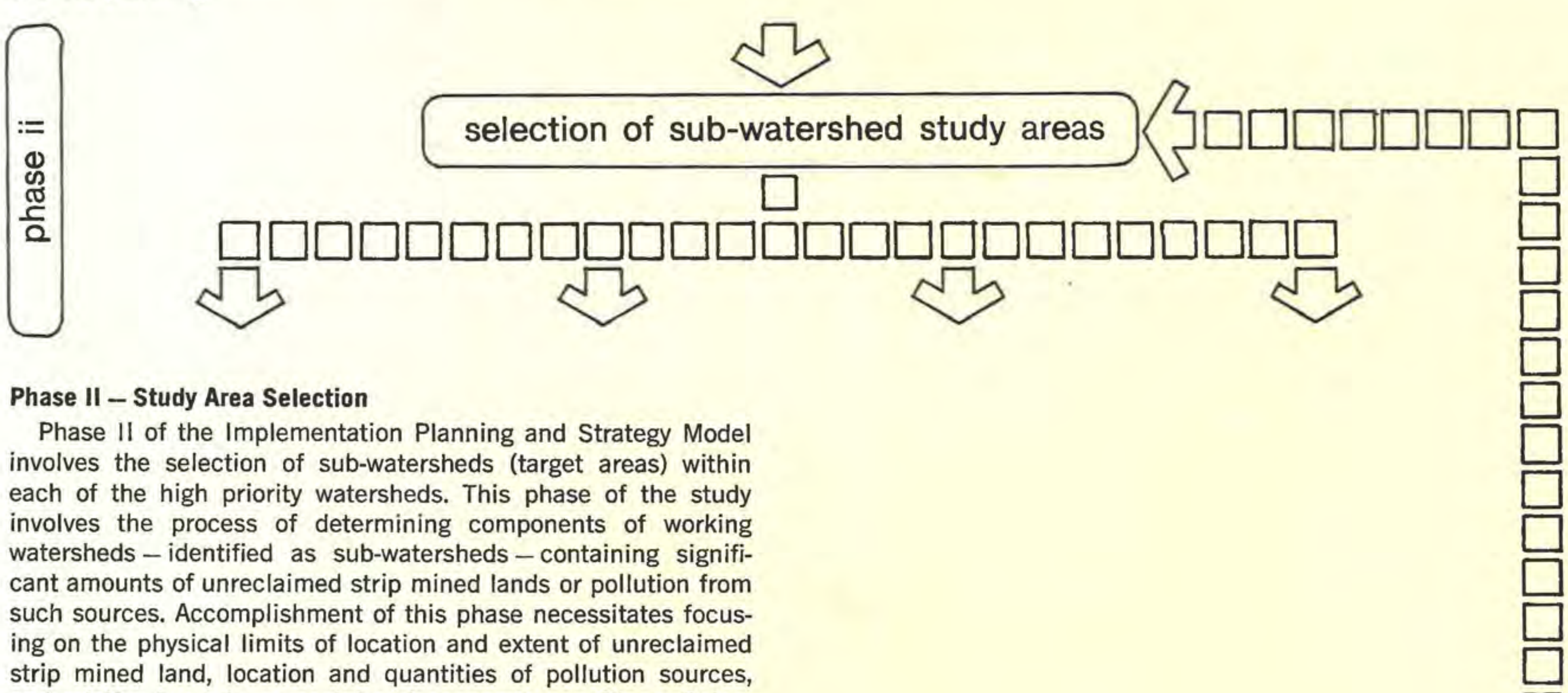


This proposed study method will require management of a diverse multi-disciplinary team. It is recommended that either the State of Ohio, Department of Natural Resources, Division of Planning or a private System Management and Planning Consultant act as overall coordinator of the study portions of the implementation phase. The Board on Unreclaimed Strip Mined Lands should continue to act in an advisory capacity and make critical decisions as to objectives and policy. It is further recommended that within selected study and implementation areas local citizenry and planning groups be encouraged to participate in the formulation of specific study goals and objectives as well as to serve as data resource groups. The widest range of study participants will serve to fill the widest range of needs.



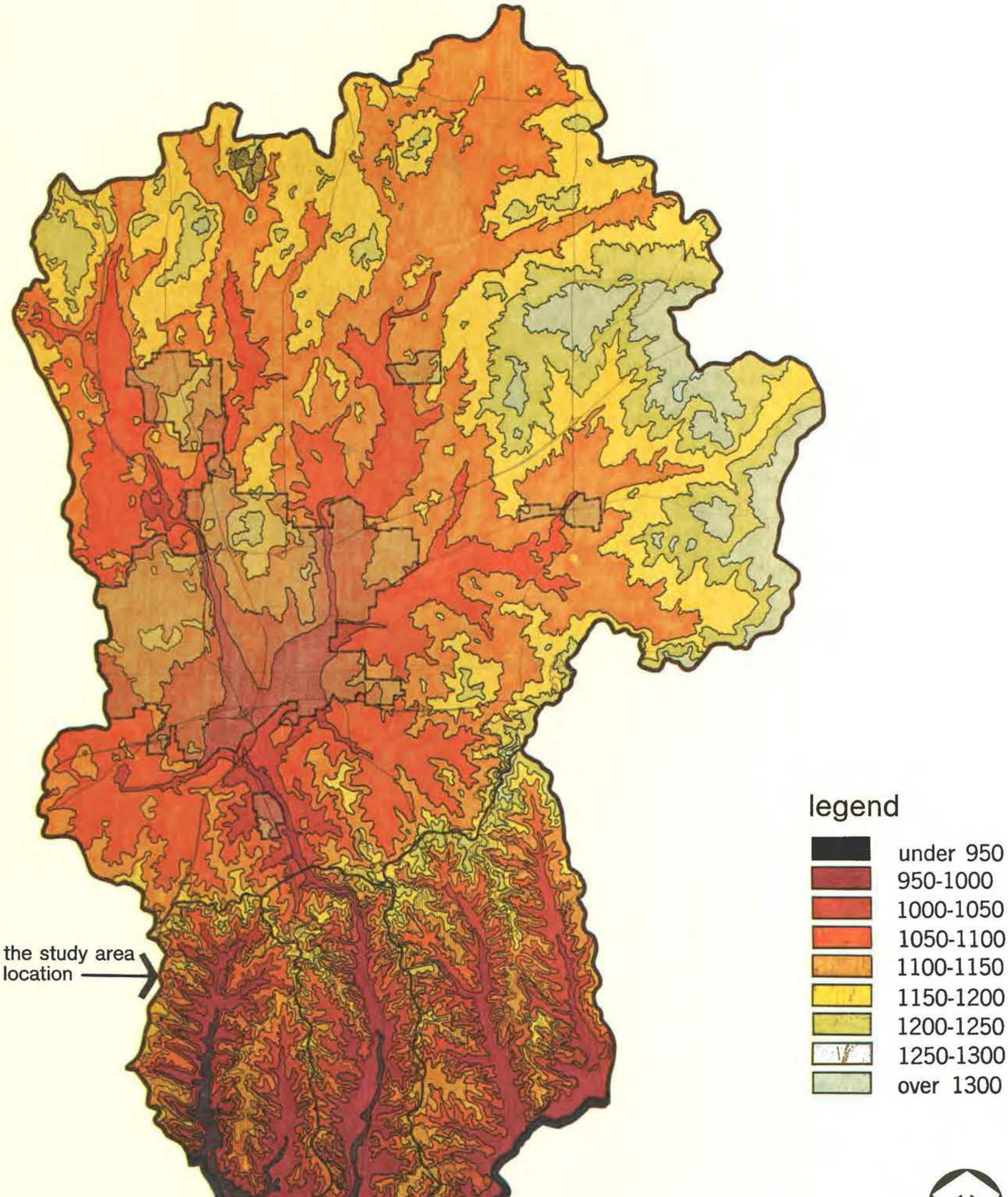
Phase I — Priority Selection

As previously noted this report represents the first of five phases of a comprehensive program for reclamation of unreclaimed strip mined lands. This report recommends that the State of Ohio initiate immediate action in three of the high priority watersheds. This report further recommends that the State of Ohio continue to strive for positive benefits from this program in a variety of areas including: mine drainage pollution abatement, socio-economic development, and comprehensive environmental land use planning.

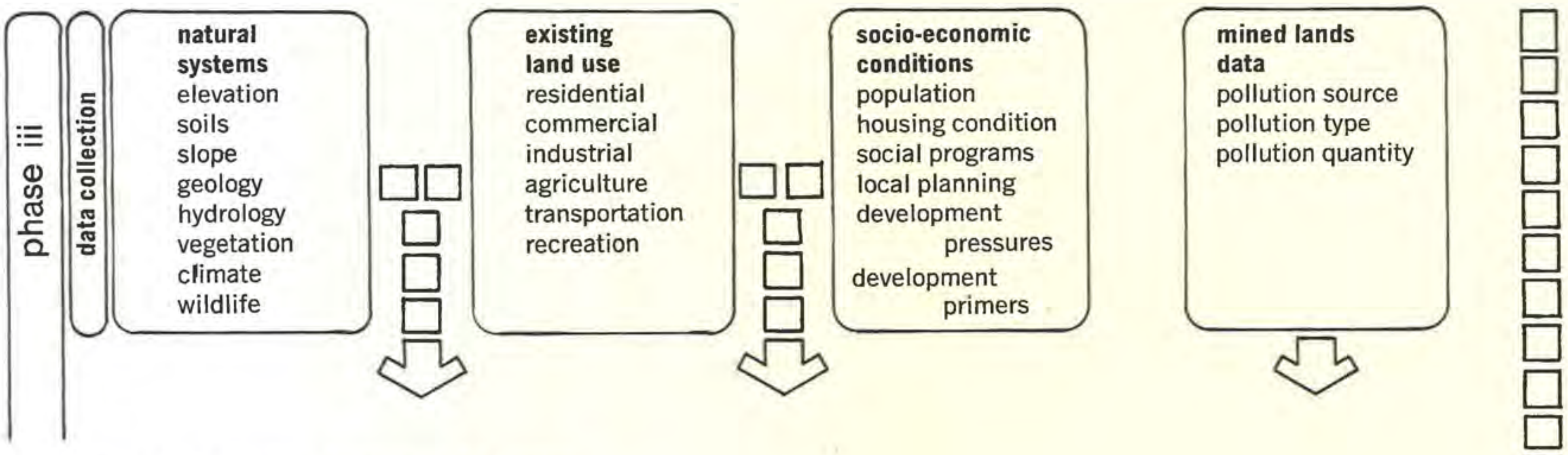


Phase II — Study Area Selection

Phase II of the Implementation Planning and Strategy Model involves the selection of sub-watersheds (target areas) within each of the high priority watersheds. This phase of the study involves the process of determining components of working watersheds — identified as sub-watersheds — containing significant amounts of unreclaimed strip mined lands or pollution from such sources. Accomplishment of this phase necessitates focusing on the physical limits of location and extent of unreclaimed strip mined land, location and quantities of pollution sources, and relative impacts on social and economic conditions. Selection of sub-watersheds will be reached by consensus of the study team and the Board on Unreclaimed Strip Mined Lands, working within the objectives of the program. A large scale stream sampling program to locate and quantify each pollution source within the watershed should be initiated at the same time. The map on page 61 illustrates such a sub-watershed selection technique within watershed seventy-one. The selected detailed study area contains a concentration of unreclaimed strip mine lands and its physical character compares closely to the majority of watersheds within the study area. The fifty foot contour interval is rendered to illustrate the topographic relief and water drainage pattern of the entire watershed.



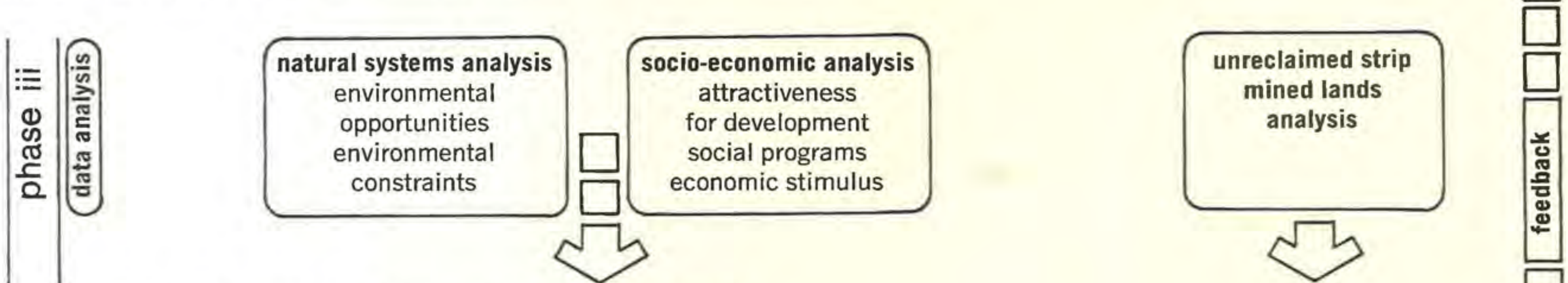
elevational relief
watershed number 71



Phase III — Data Collection, Analysis and Planning

Phase III of the Implementation Planning and Strategy Model requires a multidisciplinary approach at the sub-watershed level in three related areas: data collection; data analysis; and planning. The four major components of the Phase III data collection step are: (1) A detailed package of natural systems data, including soil, geology, topography, hydrology, vegetation, wildlife, and climate. (2) A detailed summary of socio-economic conditions, including population distribution, housing conditions, location of highways, railroads, commercial and industrial establishments. (3) A detailed existing land use plan. (4) A detailed compilation of the pollution sources, types and quantities of the unreclaimed strip mined lands.

The illustrations on page 63 through 81 represent such data collection. In most cases these are quick approximations and are not intended to be all-inclusive or in-depth data.



The three major steps in Phase III data analysis are: (1) Formulating an environmentally based land use plan, identifying areas with development potential and areas in need of conservation for protection of fragile natural systems; (2) Formulating a development attractiveness plan, showing area of expected development pressure by type; (3) Investigating individual mine sites by quantitatively and qualitatively describing mined lands.

The three data analysis maps on pages 83, 85, and 87 are subjective at this point due to the lack of some relevant data or interpretations. However, these maps will serve as illustrations of the three steps in data analysis.

Phase III planning combines the results of the natural systems plan with the development attractiveness plan, to determine a land use plan which is environmentally, socially and economically sound and then investigates the proximity of the unreclaimed strip mined land to assigned land use areas.

Elevational Relief

Elevation mapping, as a natural system data set, is used as a key indicator for the identification of landforms, slopes, and drainage patterns. The fifty foot contour interval rendering clearly describes the three dimensional form (topographic relief) of the sub-watershed study area. By combining elevation with vegetation, analysis may be done to determine microclimate, ecologic association, and visual site types or regions.

legend

under 950	1100-1150
950-1000	1150-1200
1000-1050	1200-1250
1050-1100	

0 ¼ ½ 1
MILES

elevational relief

Soils

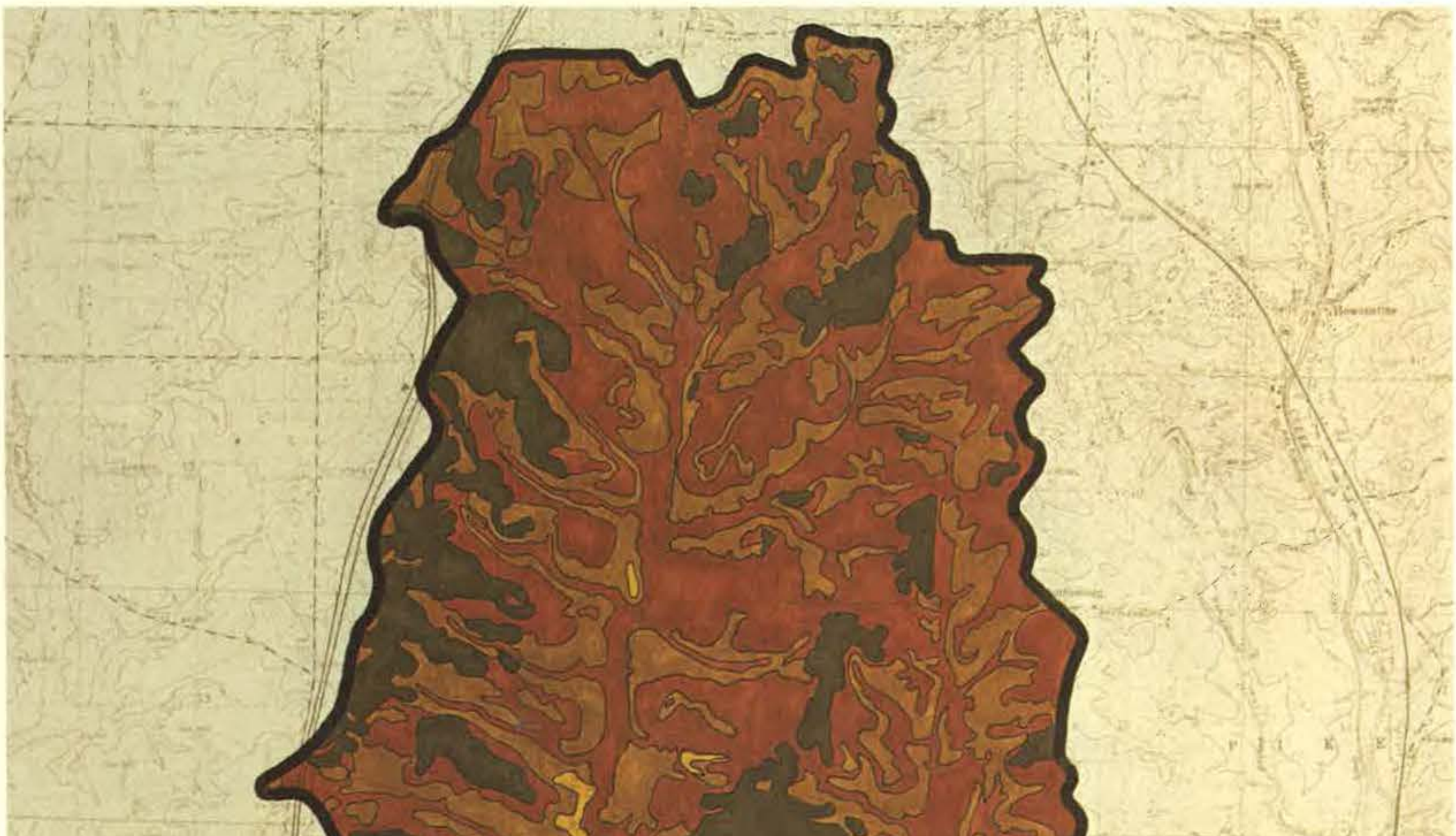
The soil types indicated on this data map are simplification of the Soil Survey for Stark County, Ohio by the U.S.D.A. Soil Conservation Service. Soils data can be interpreted for the feasibility of most projected land uses in terms of construction cost, engineering limitations and impacts on fragile natural systems. The two maps, "Limitations for Home Sites" and "Limitations for Cultivated Crops" are examples of such data interpretations which can be made from soil surveys prepared by the Soil Conservation Service.

legend

- gravel and silt/clay mixtures
- sand and silt/clay mixtures
- silts and clays: low plasticity
- silts and clays: high plasticity
- strip mine spoil-non acid
- strip mine spoil-acid clay

0 ¼ ½ 1
MILES

soils



legend

- severe
- moderate
- slight
- strip mines

0 ¼ ½ 1
MILES

soil interpretation— limitations for home sites

legend

- severe
- moderate
- slight
- strip mines

0 ¼ ½ 1
MILES

soil interpretation— limitations for cultivated crops

Slope

Slope data is an extremely useful natural system data set when preparing development engineering constraints. The three lowest slope categories (0-2%, 2-6%, 6-12%) would be considered well within the desirable range of developable slopes. Slopes in the mid-range (12-18%) would be considered generally developable at very low densities. Slopes in the high ranges (18-25%, 18-35%) would be considered undevelopable without major grading operations. These two highest ranges generally appear in abandoned strip mined lands areas and would within the framework of the strip mined land reclamation study come under consideration for appropriate regrading.

legend

- 0-2%
- 2-6%
- 6-12%
- 12-18%
- 18-25%
- over 25%

0 ¼ ½ 1
MILES

slope

Geology

The geology map is a combination of geology and glacial maps of Stark County, Ohio as prepared by the State of Ohio, Department of Natural Resources, Division of Geologic Survey. Geologic data can yield useful interpretations of geologic formations subject to land slides and other development limitations as well as offering support and base data in determining hydrologic conditions and sensitive areas.

legend

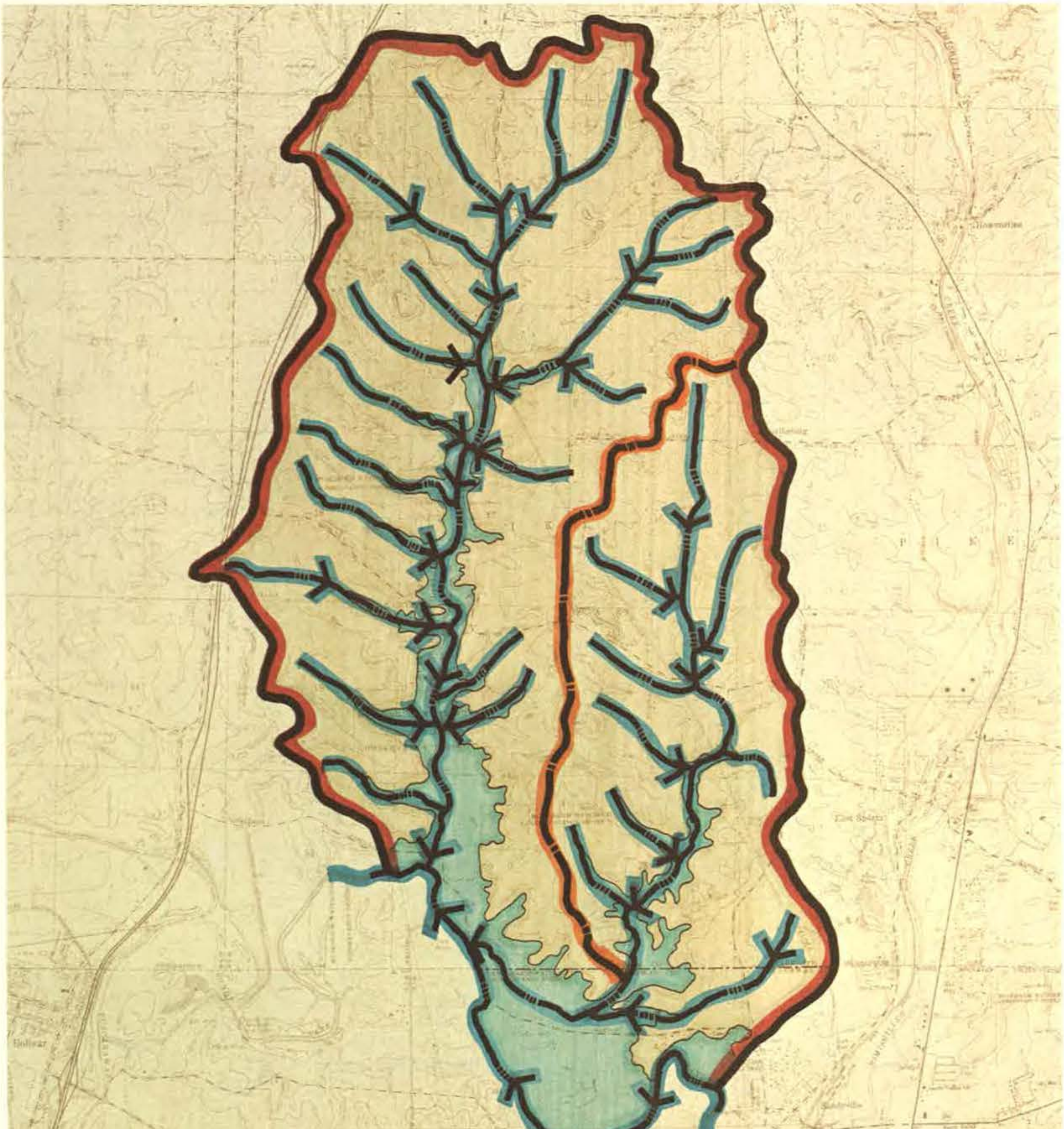
- conemaugh group
- allegheny group
- pottsville group
- flood plains & kettleholes
- valley train
- alluvial terraces
- glacial boundary
- outcrop of middle kittanning (no. 6) coal bed

0 ¼ ½ 1
MILES

geology

Hydrology

Water quality and quantity are two of the basic components necessary for assessing the health and viability of the natural environment. Thus, it is extremely important to investigate and develop a detailed understanding of the operation of the study area's hydrologic conditions. Hydrology, in regards to the watershed's projected water budget, should also be considered one of the key components used for determining land use potentials in a study area.



legend

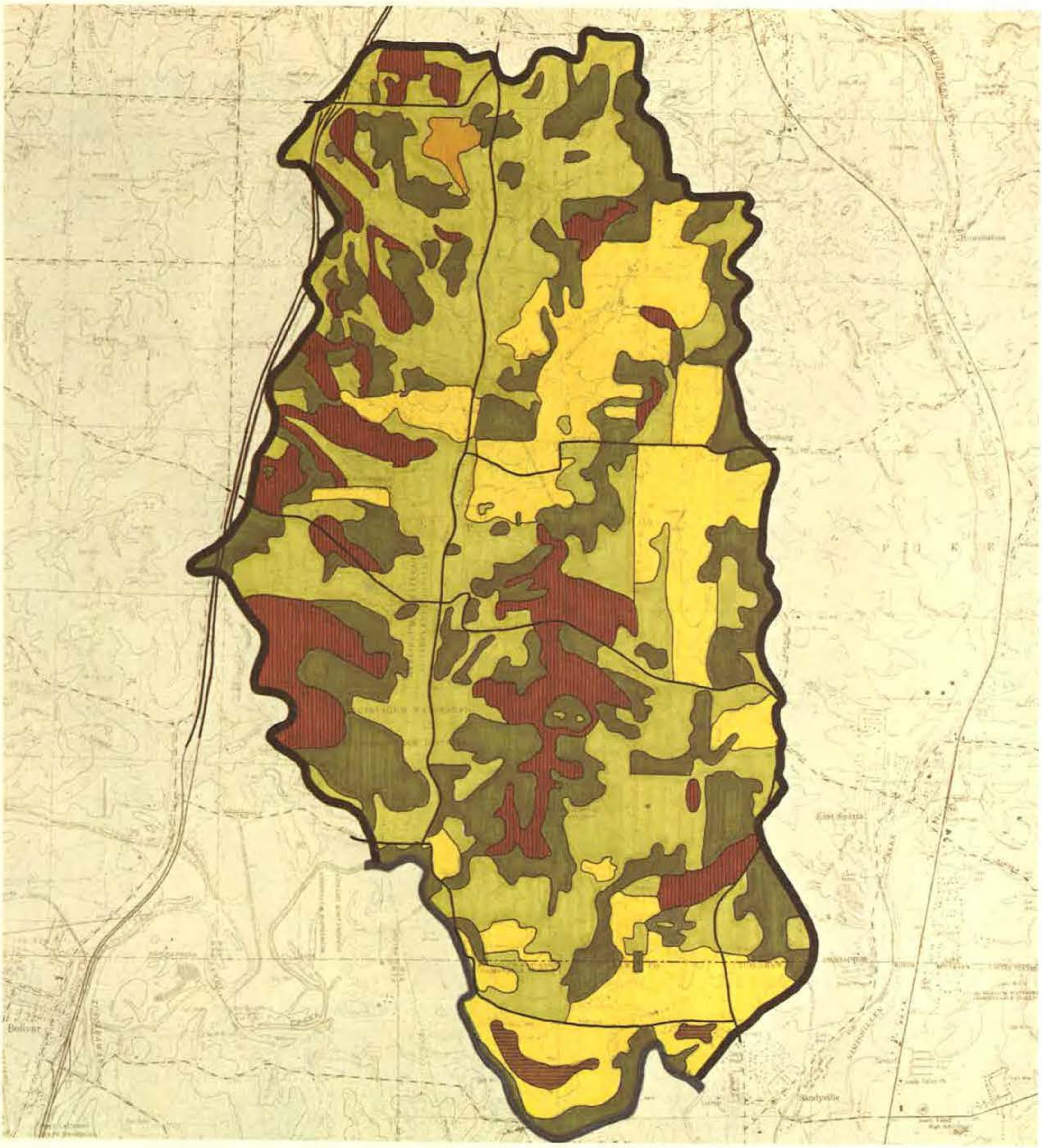
- flood plain
- stream and river directional flow
- ridge line

0 ¼ ½ 1
MILES

hydrology

Existing Land Use

Existing land use data is an important data component for the assessment of existing and developing land use patterns. A typical existing land use map would include further categories such as residential type and density, commercial, industrial, institutional, and recreation.



legend

- interstate
- major highway
- forest
- active agriculture
- old field agriculture
- unreclaimed strip mine
- sand pit
- trailer park

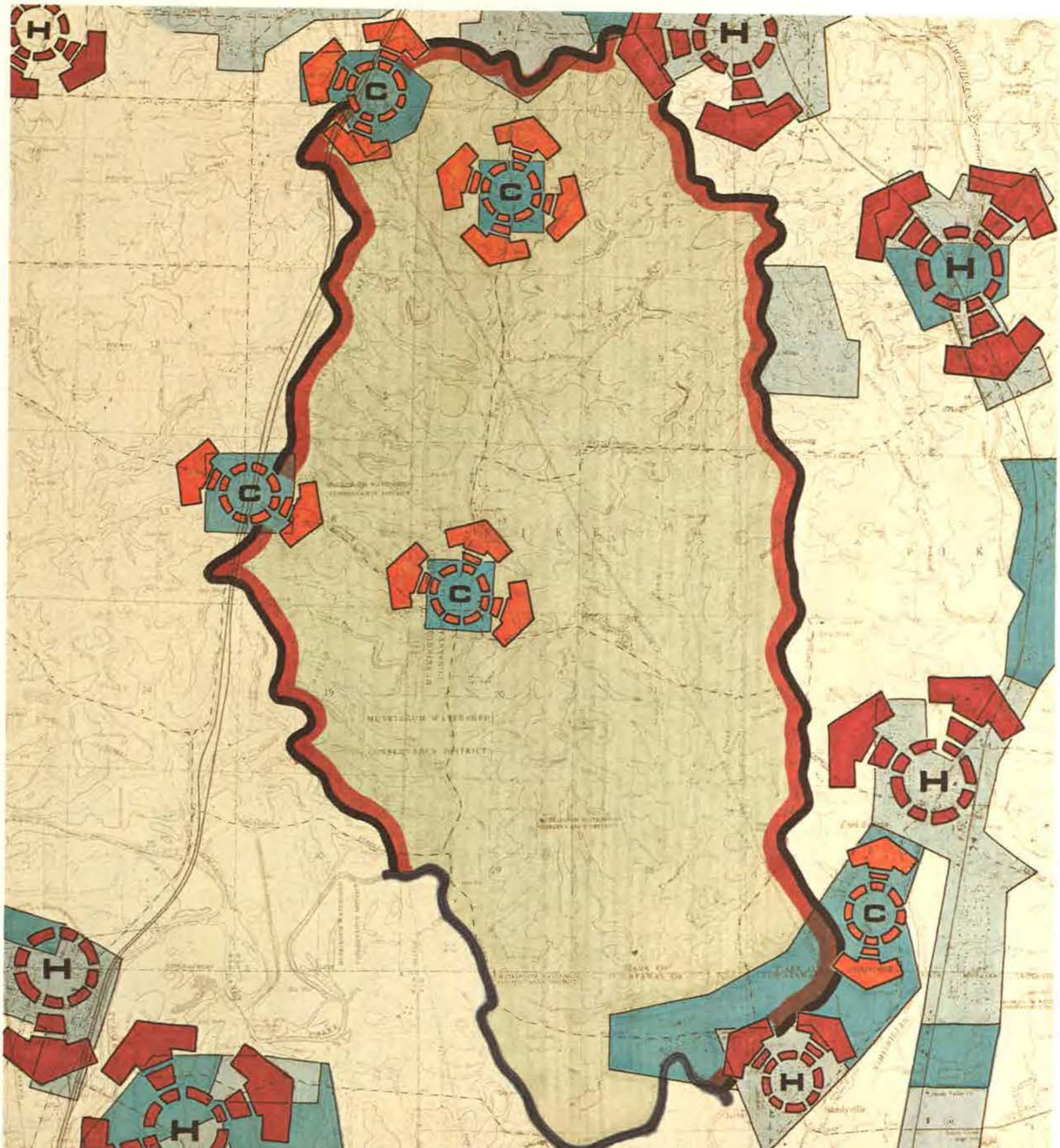
0 ¼ ½ 1
MILES

existing land use

Development Pressures and Primers

These two maps are cursory examples of the types of summary information which could be expected from an indepth socio-economic investigation. Within a study area the ultimate land use plan depends greatly on the ability of the planners to anticipate directions and magnitude of development by type and to channel that growth through zoning restrictions or encourage that growth by developing growth primers in accordance with the land use planning objectives.

Because the geographic extent of sub-watersheds is much less than entire watersheds, considerably more detailed information can be obtained from state agencies, regional planning commissions, county planning organizations, and local agencies for each area under study. Some data can be shown graphically as illustrated in this section. Other information, such as that provided by social agencies, cannot be mapped and is mostly descriptive.

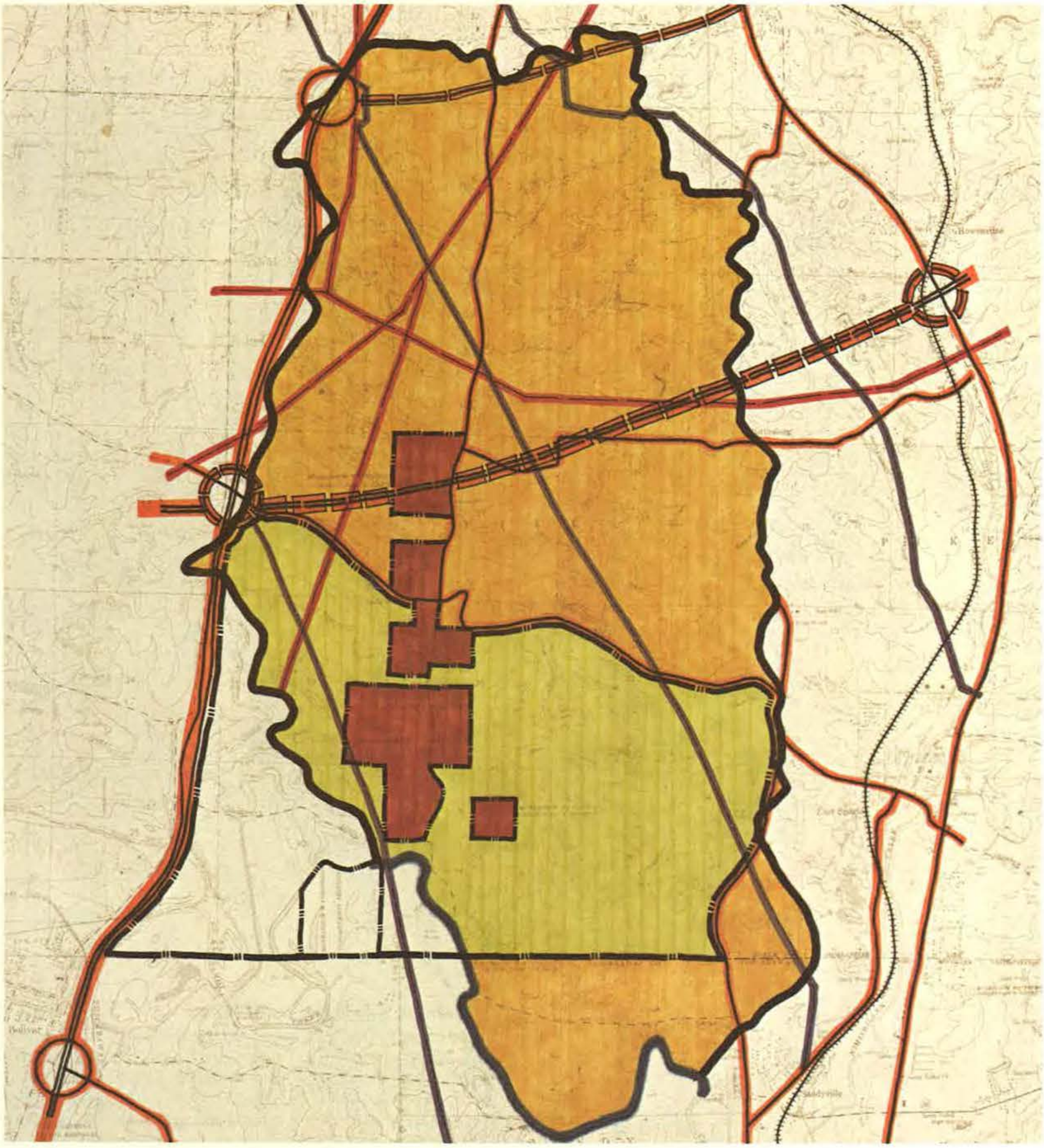


legend

- development demand 1970
- development demand 2000
- major development pressure
- minor development pressure
- H housing
- C commercial-industrial

0 ¼ ½ 1
MILES

development pressures



legend

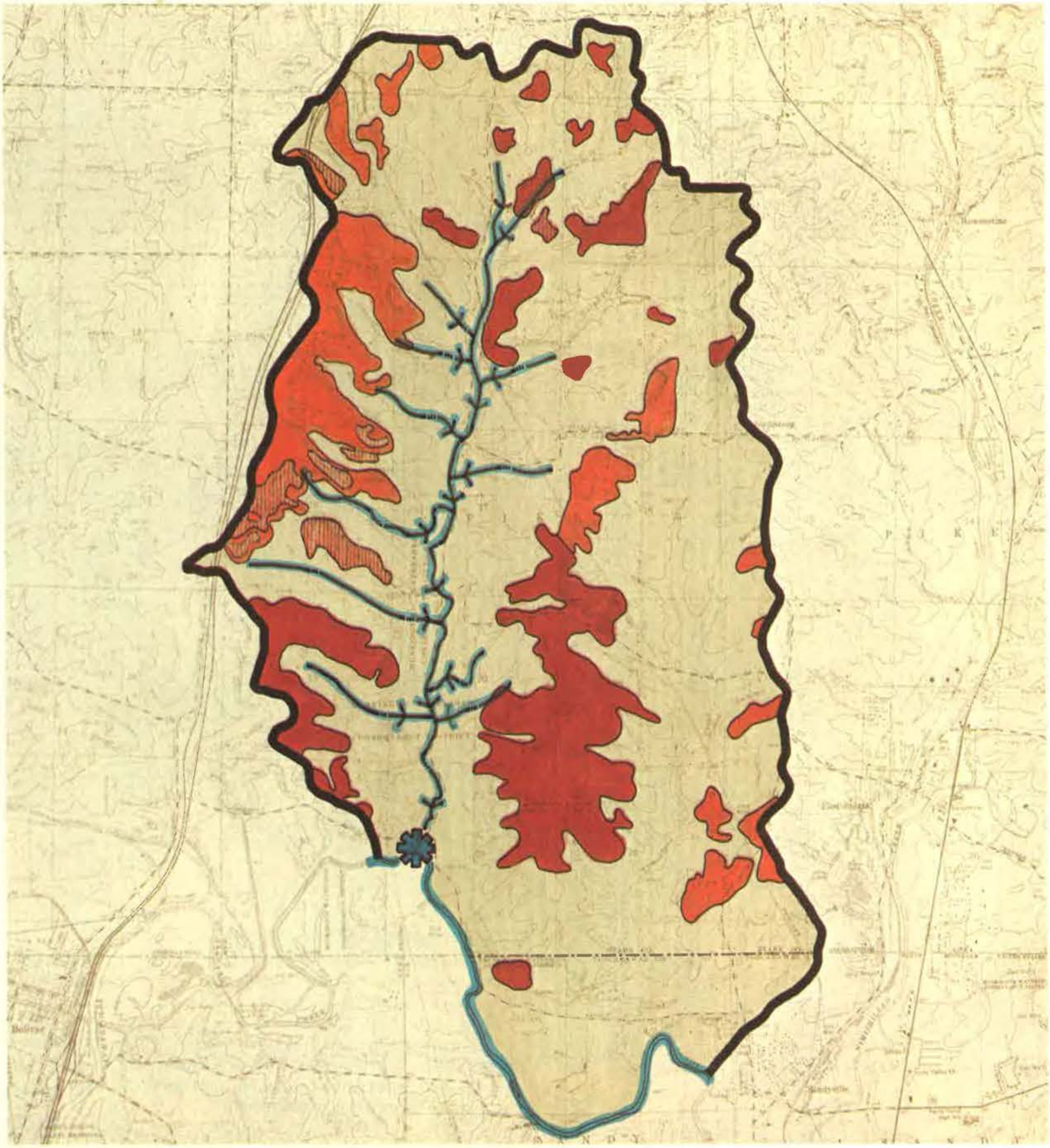
interstate	proposed interstate
major highway	proposed highway
interchange	proposed interchange
railroad	future county metropolitan park
power line	conservancy district
pipe line	

0 ¼ ½ 1
MILES

development primers

Unreclaimed Strip Mined Land Analysis

The quantitative and qualitative analysis of the unreclaimed strip mines within the sub-watershed study area will locate and describe the sources of mine drainage pollution. The analysis will further establish a reclamation priority for the unreclaimed strip mines within the sub-watershed and determine the recommended type and relative cost of reclamation for each unreclaimed mine area. This illustration uses information developed in earlier sections of this report with the addition of acid clay strip mine spoil as perhaps an indicator of the most critical unreclaimed strip mine lands. The water quality sample take for Bear Run exhibited a net acidity of 170 mg./liter, iron-.8 mg./liter, and sulfates—180 mg./liter. This stream could be characterized as being severely polluted and exhibiting serious erosion and stream siltation.



legend

- reclaimed – class 2
- slightly reclaimed – class 3
- acid clay strip mine spoil
- water quality measure

0 ¼ ½ 1
MILES

unreclaimed strip mined land analysis

Natural Systems Analysis

Analysis of natural systems opportunities and constraints is directed toward quantifying areas in need of conservation protection by mapping ecologically sensitive areas and areas of developable land. It is also necessary to address the types of development appropriate in sensitive and developable zones. The preparation of definite performance criteria for all development zones and types should also be considered an essential component of this section of the model.

legend

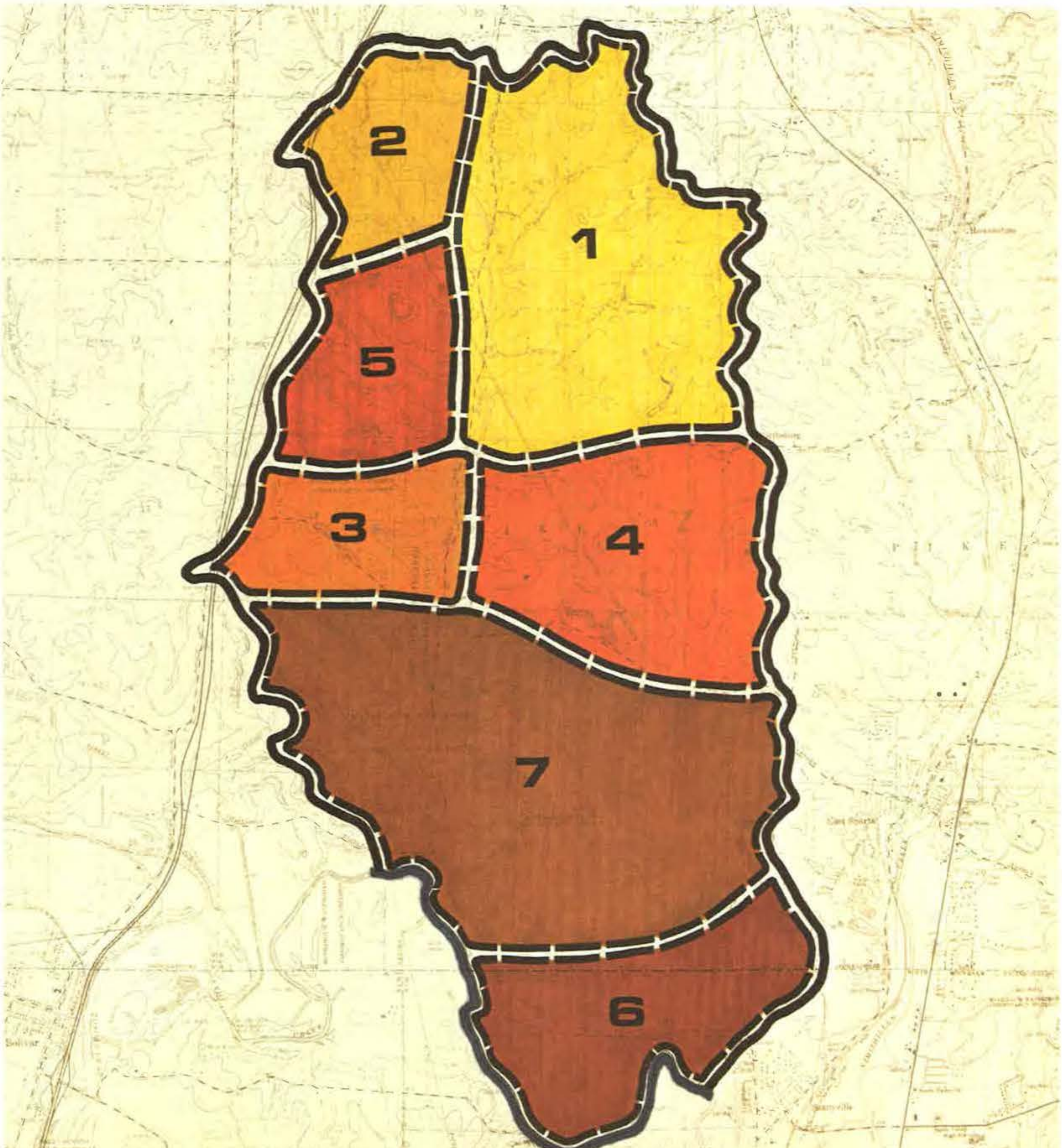
- slope limitations
- flood plain
- hydrologically sensitive soil
- silts and clays: high plasticity
- strip mine
- acid strip mine
- developable land

0 1/4 1/2 1
MILES

natural systems analysis

Attractiveness for Development

This analysis map describes general priority zones of development pressure based on socio-economic indicators. A far more sophisticated and quantified description will be formulated for the type and magnitude of development pressures as well as a description of the ideal site conditions and location for each development type in the actual applications of the Implementation Planning and Strategy Model.

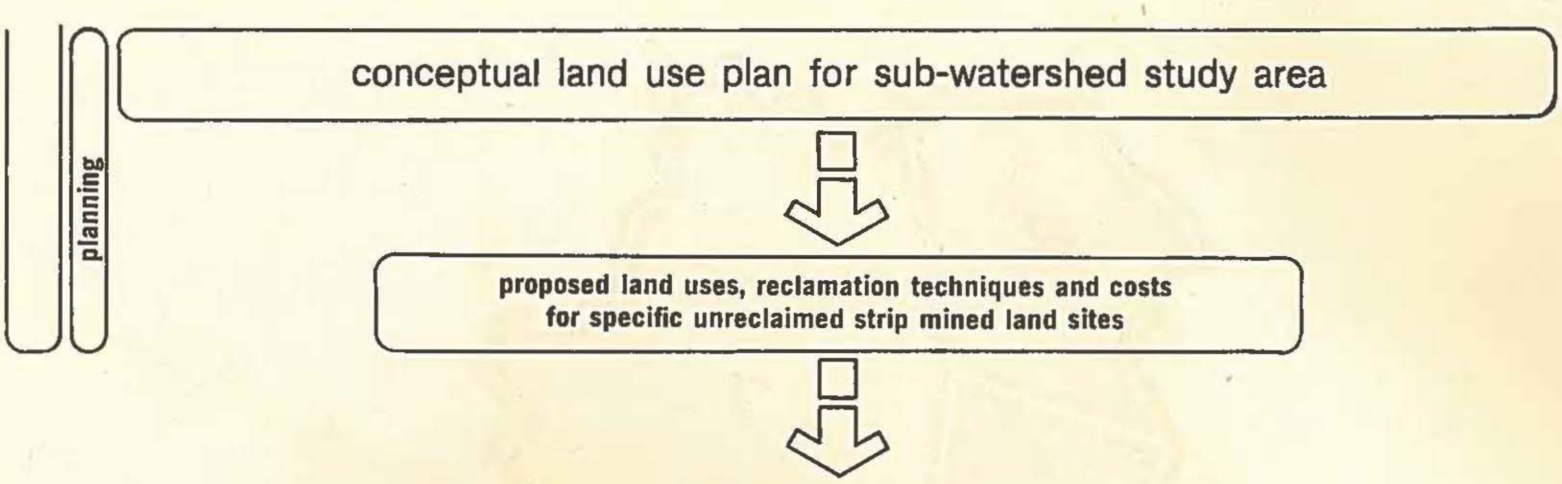


legend

zone 1—high attractiveness for development
zone 2—high attractiveness for development
zone 3—high attractiveness for development
zone 4—high attractiveness for development
zone 5—high attractiveness for development
zone 6—high attractiveness for development
zone 7—low attractiveness for development

0 ¼ ½ 1
MILES

attractiveness
for development



Certain conclusions must be drawn as to possible specific land uses for each of the mine sites and specific reclamation techniques. Phasing of reclamation work and detailed descriptions of selected projects will be an integral part of the conclusions of this phase.

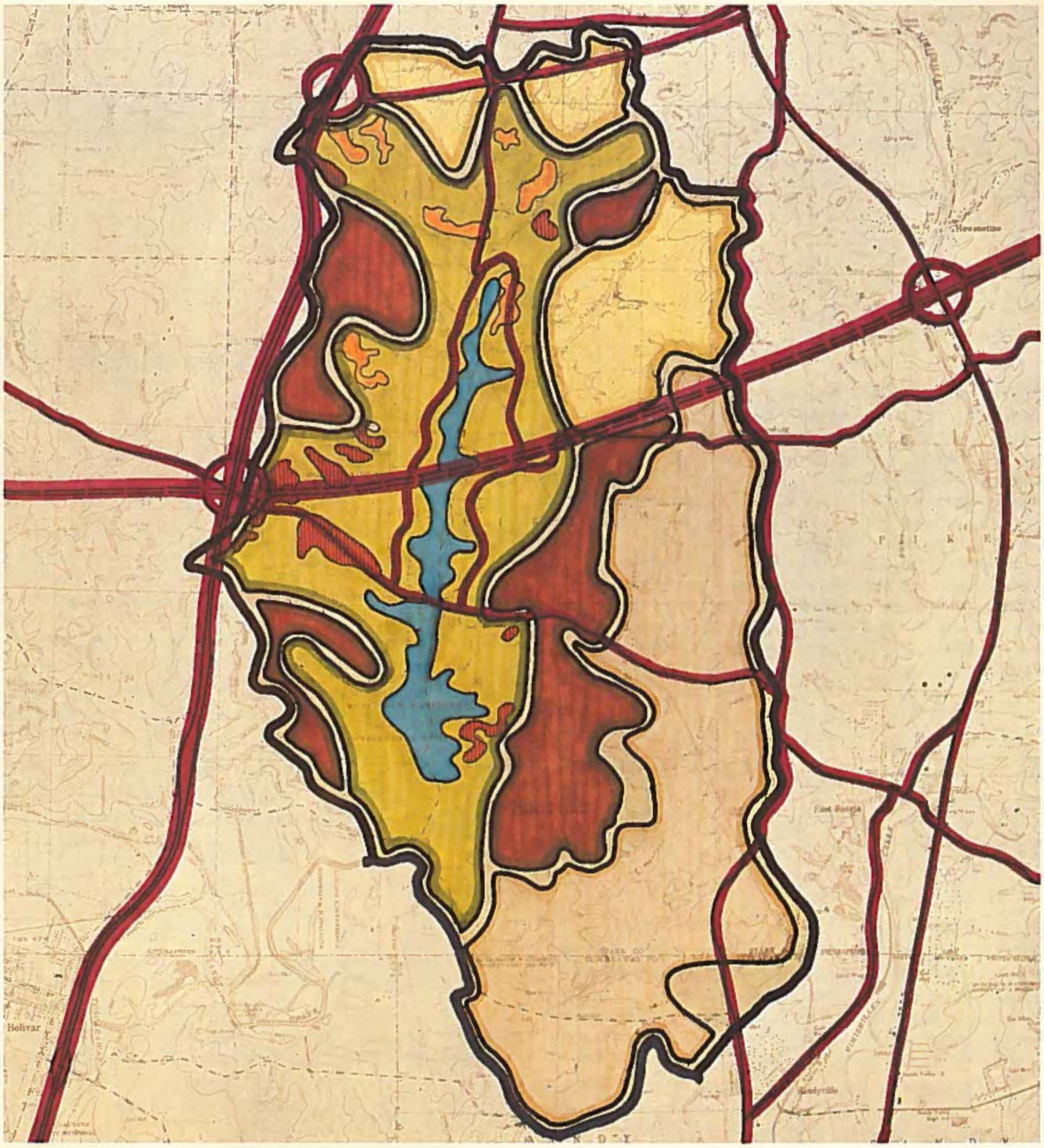
The following Conceptual Land Use Plan (see page 89) is included to illustrate the level of detail which might be expected in such a planning effort. This illustration is subjective at best and should not be regarded as a complete comprehensive plan. The Conceptual Land Use Plan should be regarded as illustration of a set of objectives, assumptions, and resource management and reclamation policies and should not be considered to be a "master plan" to be followed religiously. The Conceptual Land Use Plan is thus intended as a basic guideline for future land development and management.

Conceptual Land Use Plan

This conceptual land use plan prepared for descriptive purposes in this report as a product of the suggested model is based on five major assumptions:

1) To begin reclamation in this sub-watershed area the most critical unreclaimed mined lands as determined by the mined lands analysis, should be reclaimed by public or quasi-public groups.
2) The proposed Stark County Metropolitan Park and Reservoir should be reoriented and extended to include the hydrologically critical areas of the Bear Run Watershed.
3) The headwater streams of the Bear Run Reservoir should be protected by a conservancy district or site specific land use performance criteria zoning plan.
4) A second conservancy district should be established in the Sandy Run watershed to encourage and protect the existing agricultural district and associated very low density land uses.
5) Certain zones of non-critical unreclaimed mines should be temporarily left in their present state to determine if the Stark County Metropolitan Park would function as a growth primer and encourage private reclamation for development.

Although these assumptions may not be applicable in other watersheds the use of innovative reclamation planning techniques developed with the Implementation Planning and Strategy Planning Model presented herein should center on creating conditions for quality public and private reclamation and future environmental protection through sensitive land use planning.

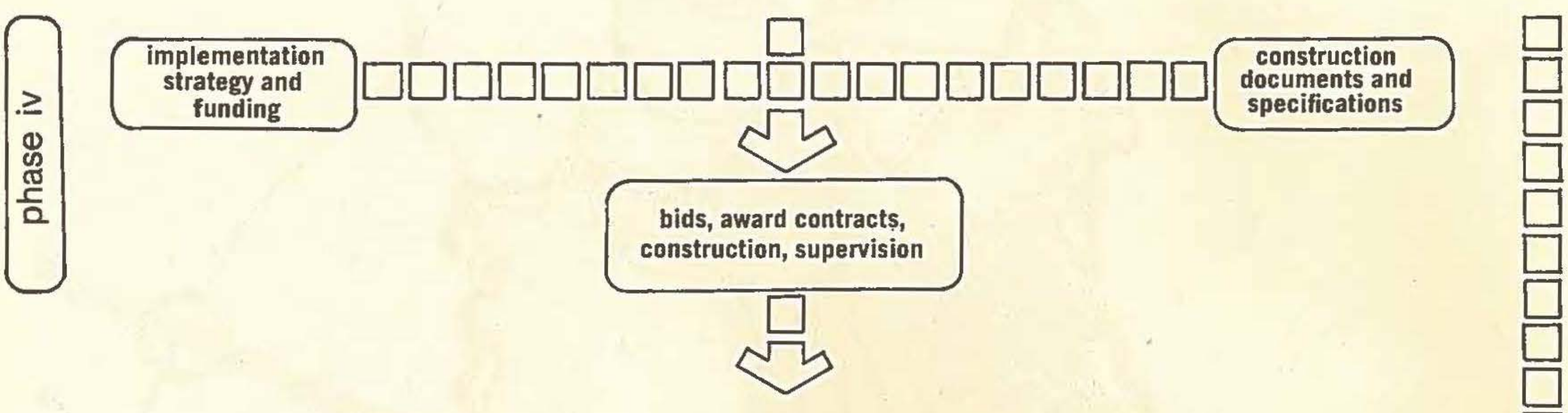


legend

- major roads
- conservancy district-type I
- conservancy district-type II
- strip mine-acid clay spoil
- strip mine-non acid spoil
- proposed reservoir
- proposed County Metropolitan Park
- proposed private reclamation

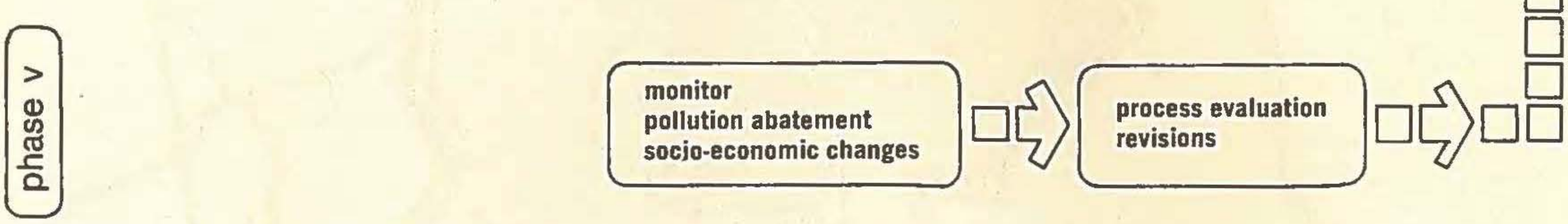
0 ¼ ½ 1
MILES

conceptual land use plan



Phase IV — Implementation Strategy

Phase IV of the Implementation Planning and Strategy Model concerns itself with implementation strategy to determine the best methods for funding particular projects. Consideration should also be given to certain growth primers and development incentives which could possibly be used to relieve the State of Ohio from a portion of the economic burden for reclamation of all the strip mine lands. This phase will also require the preparation of detailed construction documents, letting of construction bids when appropriate and field supervision during the construction phase. This phase will be the most expensive phase of the project, but will also be the first physically positive step in a long comprehensive program to restore a portion of Ohio's physical environment.



Phase V — Monitor Results

Phase V of the Implementation Planning and Strategy Model is the final phase of the initial step toward reclaiming all of Ohio's unreclaimed strip mined lands. This phase would best be described as a period of monitoring a variety of positive benefits which may occur, as well as an opportunity to evaluate the study and implementation process for future revision and application.

It is essential that this phase measure positive physical improvements within the sub-watershed module area as regards water quality and quantity. It is equally essential to monitor changes in various socio-economic indicators such as population and employment, land values, and investment to determine what if any positive benefits accrue due to strip mine reclamation. It must be recognized that there are factors other than reclamation projects that contribute to an area's socio-economic well being.

The initial monitoring program would identify all positive benefits of strip mine reclamation for comparison with costs which will be helpful in determining the viability of public reclamation of abandoned strip mined lands.

All of the efforts towards reclamation prior to phase V are based on an assumption that restoration of our environment has net benefits. However, data to prove such benefits are not available. The monitoring process will allow determination through studies of the positive benefits accruing to the people of Ohio as a result of efforts to restore the environment of the State.

bibliography

The information in this Executive Report is derived entirely from the technical reports prepared for the Ohio Department of Natural Resources and the Board on Unreclaimed Strip Mined Lands by the consultants involved in the study. Each of these technical reports contains a comprehensive bibliography which cites all specific information sources, with over 120 individual references listed. The reports are listed below:

Arthur Young and Company, *Final Report Including: History of the Study Area, Appraisal Report, Land Ownership Statistics,* September, 1973.

Battelle Columbus Laboratories, *Final Interim Report on the Unreclaimed Strip Mined Lands Study,* August, 1973.

Battelle Columbus Laboratories, *Working Paper: Methodology to Assess Demand and Economic Need on Unreclaimed Strip Mined Land Study,* November, 1973.

Division of Landscape Architecture, School of Architecture, Ohio State University, *Unreclaimed Strip Mined Lands Study Visual Analysis,* November, 1973.

Hayward Cooper Straub Walinski Cramer and Company, *Report on Legal Aspects Relating to Implementation, Unreclaimed Strip Mined Lands Study,* November, 1973.

Skelly and Loy, Engineers and Consultants, *Technical Report for the Board of Unreclaimed Strip Mined Lands Study,* December, 1973.

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