

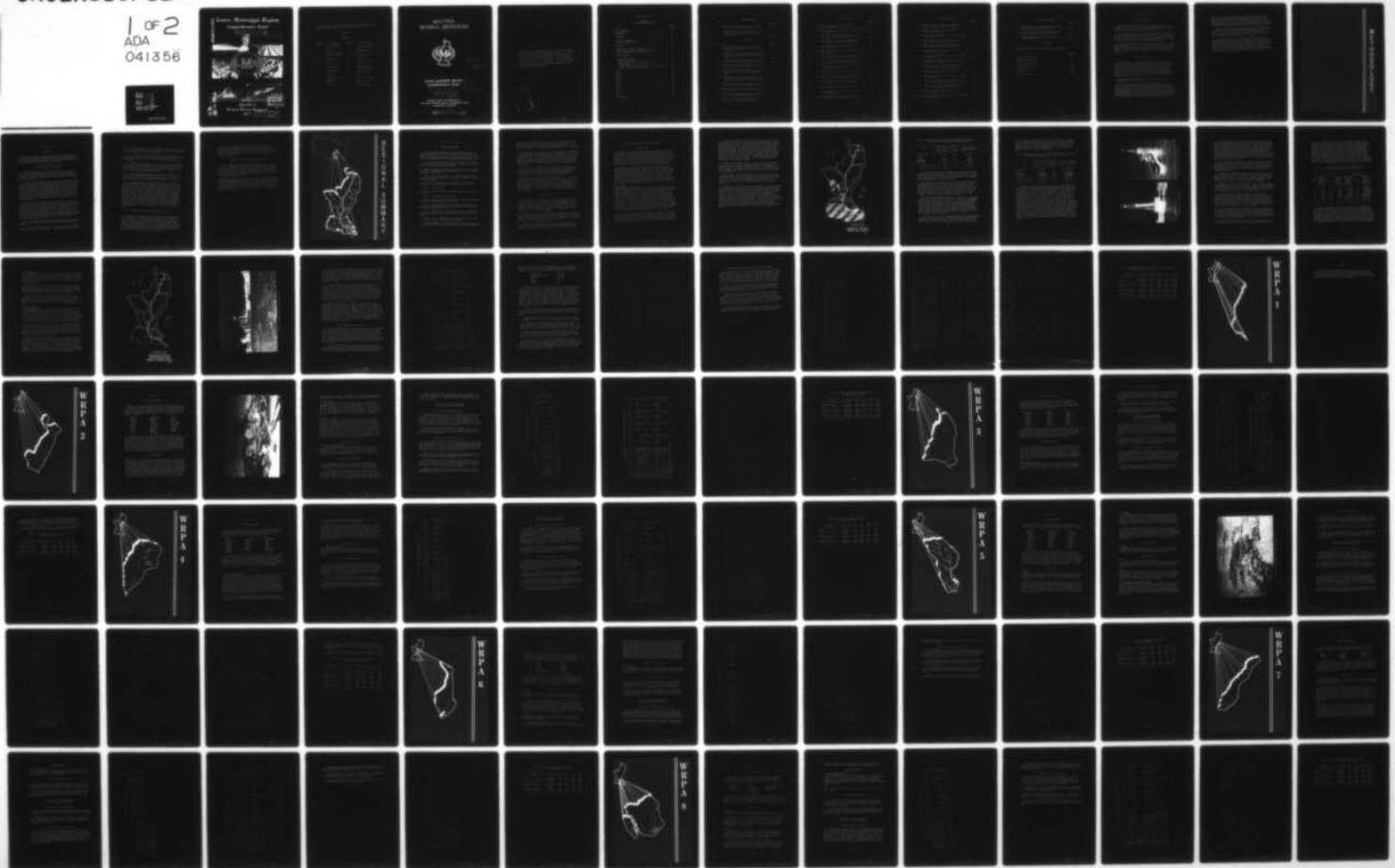
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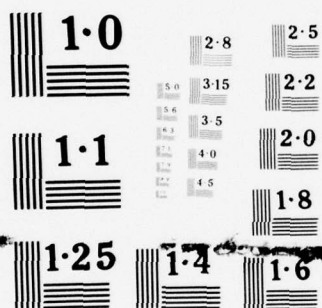
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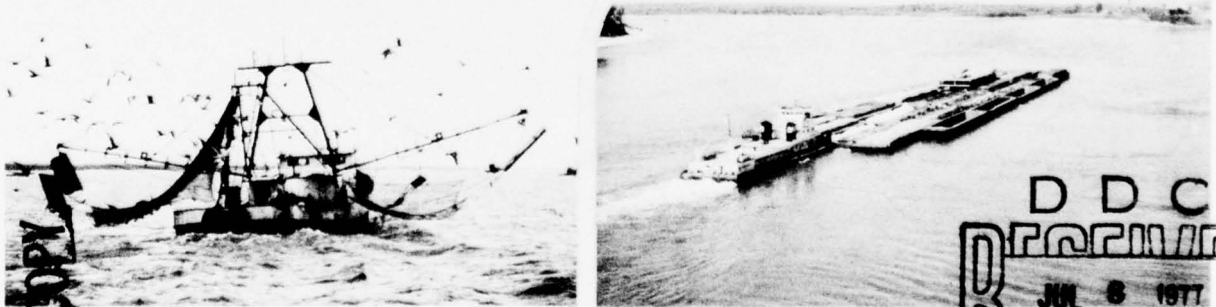
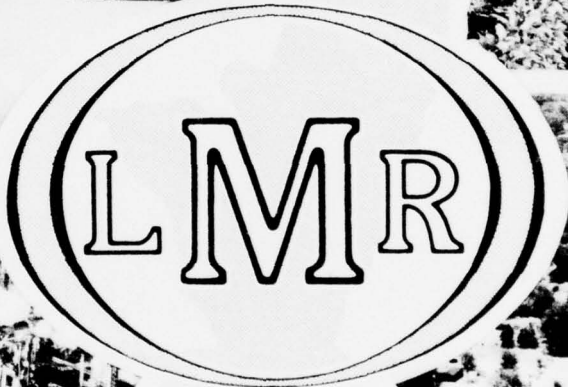
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Lower Mississippi Region Comprehensive Study

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Appendix G Related Mineral Resources 1974

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This appendix is one of a series of 22 documents comprising the complete Lower Mississippi Region Comprehensive Study. A list of the documents is shown below.

Main Report

Appendixes

<u>Appendix</u>	<u>Description</u>	<u>Appendix</u>	<u>Description</u>
A	History of Study	K	M and I Water Supply
B	Economics	L	Water Quality and Pollution
C	Regional Climatology Hydrology & Geology	M	Health Aspects
D	Inventory of Facilities	N	Recreation
E	Flood Problems	O	Coastal and Estuarine Resources
F	Land Resources	P	Archeological and Historical Resources
G	Related Mineral Resources	Q	Fish and Wildlife
H	Irrigation	R	Power
I	Agricultural Land Drainage	S	Sediment and Erosion
J	Navigation	T	Plan Formulation
		U	The Environment

1

RELATED
MINERAL RESOURCES.



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LOWER MISSISSIPPI REGION
COMPREHENSIVE STUDY.

Appendix G. ←

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This report was prepared at field level by the Lower Mississippi Region Comprehensive Study Coordinating Committee and is subject to review by interested Federal agencies at the departmental level, by Governors of the affected States, and by the Water Resources Council prior to its transmittal to the President of the United States for his review and ultimate transmittal to the Congress for its consideration.

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INTRODUCTION

PURPOSE OF APPENDIX

Appendix G, Related Mineral Resources, is one of 21 appendixes developed for the Lower Mississippi Region Comprehensive Study. Background data required for the minerals portion of the study were compiled, reviewed, and organized during calendar years 1970-71.

The primary purpose of the estimates of mineral industry output and related water and land needs, as developed herein, is to make these basic data available to interested groups for subsequent use in regional resources evaluation and development planning within each of the broadly defined regional subdivisions of the Lower Mississippi Region.

Estimates of mineral industry production listed herein, when integrated with parallel data related to other sectors of the economy, should provide the framework needed for more detailed analysis, objective planning, and optimum development of resources--in line with established conservation principles--in the several areas of the Lower Mississippi Region.

SUMMARY AND CONCLUSIONS

Mineral industry has contributed substantially to the growth economy of the Lower Mississippi Region during the 1956-69 interval. In terms of 1967 dollars, value of mineral production was \$4.6 billion in 1969, up approximately 185 percent from the \$1.61 billion in 1956. Projections for the future, formulated under two sets of criteria, Program A (National Income) and Program B (Regional Development), with 1969 as the base year, indicate that the value of mineral production should increase to the \$5.7-7.5 billion range by 1980, or a further advance of about 25-65 percent.

By 2020, output could vault to the \$9.5-17.0 billion range, a quantum increase of 105-270 percent.

Present water needs of mineral industry are moderate; diversions and depletions in 1969 were about 675 and 171 thousand acre-feet, respectively. Anticipated efficiencies in water use by the industry will be countered by the need to process lower quality raw materials--especially construction minerals--in the future; therefore, increased water requirements through 2020 will exceed increased value of mineral output by a substantial margin. Water diversions are expected to increase to about 970-1,180 thousand acre-feet by 1980, up 45-75 percent, and to attain a

range of 2,100-3,270 thousand acre-feet by 2020, up 310-480 percent. Depletions should rise to 250-330 thousand acre-feet by 1980, a 45-95 percent increase, and surge to 620-1,210 thousand acre-feet by 2020, a 260-610 percent increase. A strong expansion in secondary recovery of petroleum and pronounced growth of salt and sulfur output through 2020 are the underlying causes of this expected sharp upturn in water consumption.

Regionwide land needs for mineral production are negligible; lands in use in 1969 were approximately 66,640 acres, about 0.1 percent of the region's 65.5-million-acre total. Land needs are projected to increase to about 87-100 thousand acres by 1980, up 30-50 percent, and to 180-250 thousand acres by 2020, up 170-280 percent.

The mineral resource base in the region seems quite capable of supporting projected mineral production through 2020 in most cases. Resource limitations, however, may preclude any further increase in output of base metals from the in-region portion of the Missouri lead belt after 1980. Petroleum and natural gas (and byproduct natural gas liquids) are definite problem resources. Natural gas in particular appears certain to be in critically short supply, if not fully exhausted, in several areas within the region by the end of this century.



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GENERAL

Projections of mineral production and mineral industry water and land needs have been made for two programs, National Income (Program A) and Regional Development (Program B). For details of methodology underlying economic projections, see Appendix B, Economics.

PROJECTIONS OF MINERAL PRODUCTION

Production and value data for minerals produced in the Lower Mississippi Region during the 1956-69 interval were used to develop regional mineral output trends. Base-year data were 1969 figures as recorded or, if not truly representative because of external influences, 1966-69 data were used.

Historic mineral production and value data are recorded on a county (or parish) basis by the Bureau of Mines. Projections, too, are based upon anticipated mineral developments within county lines rather than hydrologic boundaries. In the Lower Mississippi Region, the difference between projected mineral output within political or hydrologic boundaries is not believed to be of notable importance except in two cases. First, base metal production in Iron County, Mo., is expected to be recovered outside the hydrologic boundary of WRPA 2. And second, much offshore oil and gas is recovered at sites well removed from the lands of WRPA 9 and 10. These exceptions are noted in some detail in appropriate WRPA sections.

Value of historic mineral production traditionally is recorded in current dollars. Projected values of mineral production were developed in terms of constant 1967 dollars with values in base year 1969 adjusted according to Bureau of Mines price indexes for selected metals, minerals, and fuels. (It is noteworthy that the price index for crude petroleum was 105.7 in 1969 with 1957-59=100. Crude oil value, which represented about 60 percent of the value of mineral output in the Lower Mississippi Region during the 1960's, was essentially unchanged in terms of real dollars at the end of the decade--a striking contrast to the pronounced inflation of the period.)

Value-of-production projections for the leading mineral commodities produced in the region in base-year 1969 were developed in general as follows:

1. Value-of-production data for the 1956-69 interval were plotted on rectangular coordinate graph paper. Data points that were noticeably

out of line with other points were rechecked for accuracy, and, if still out of line, subsequently were investigated to determine the reason for the marked departure from prevailing trends.

2. Trend lines or channels were sketched on the graph paper so as to include all or almost all of the historic data, and projection lines were sketched lightly towards 2020 for an initial approximation of future output.

3. Mineral reserves and the resource base (supply) were reviewed as appropriate and were determined or assumed to be sufficient to meet all foreseeable needs through 2020, with the exception of base metals in WRPA 2 and natural gas (and byproduct natural gas liquids) in several WRPA's as noted in the individual area reviews.

4. Market requirements (demand) for pertinent commodities over the short term, commonly through 1975, 1980, or 1985, as estimated by various industry, private, or government groups, were reviewed for background data. These estimates generally were national in scope.

5. Projections of mineral fuels in the region were based upon national projections with due consideration for the region's favorable crude oil potential and possible natural gas limitation. Projections of metallic minerals in WRPA 2 and WRPA 5 were based upon reserve and resource estimates and the judgment of those familiar with the general mining districts and specific mining operations. Projections of non-metallic minerals were based upon market opportunities. Construction minerals projections were a function of area growth as projected in basic data. Other nonmetallic minerals were projected in line with national trends for the specific commodities, with due consideration given to favorable regional factors, such as the strong resource base and competitive transportation facilities that favor growth in output of salt and sulfur in the region. Regression analysis was used to develop projections for those commodities with relatively stable production records.

PROJECTIONS OF MINERAL INDUSTRY WATER NEEDS

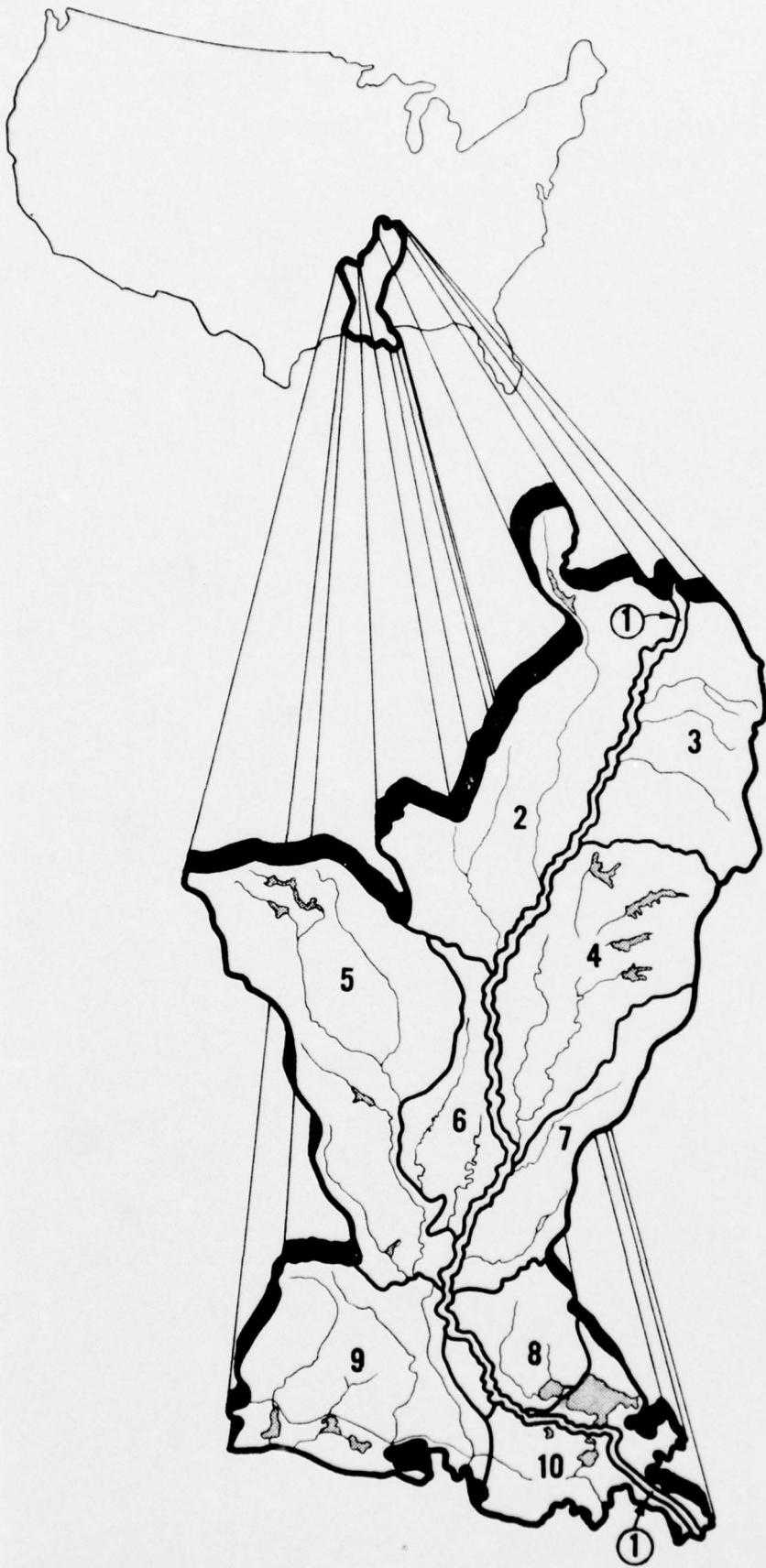
Mineral industry water-use data for 1962 were accumulated by the Bureau of Mines in a nationwide water canvass in 1963. A number of water-use studies have been performed and published by universities and by leading national research organizations that contain substantial sections on mineral-commodity and mineral-industry water use. These sources of information have been reviewed in determining base-year use and estimating future water needs by mineral industry; the basic sources of essentially all data finally used in development of projections, however, were Bureau of Mines water canvass data.

Two factors--a diversion factor and a depletion factor--were developed for the important mineral commodities in each area. Each factor indicated water needs in gallons per (1967) dollar value of mineral output. Subsequently, the volume of water required was converted into acre-feet, and all water needs in this report are expressed in terms of acre-feet.

PROJECTIONS OF MINERAL INDUSTRY LAND NEEDS

Mineral industry land-use data are not requested by the Bureau of Mines in its annual canvass of mineral industry activities. However, land-use data have been included in descriptions of mineral properties presented in many Bureau publications, some reports and maps of the U. S. Geological Survey, and some technical journals. These data have served as the basis for estimating land use at the larger mineral industry operations in base-year 1969.

Surface land use at the numerous small mineral industry operations was estimated. Minerals recovered from vein-type deposits usually involve only negligible land use whereas, in contrast, sedimentary mineral deposits recovered by surface-mining methods commonly require a substantial land area even for relatively small operations. Based upon prior studies, oil and gas wells were estimated to occupy an average of one-third acre per well.



REGIONAL SUMMARY

REGIONAL SUMMARY

PHYSICAL ENVIRONMENT

The Lower Mississippi Region includes the drainage area of the Mississippi River below the mouth of the Ohio, except for the White, Arkansas, and Red Rivers above the effects of Mississippi River back-water; the Louisiana coastal area between the drainage divides of the Pearl and Sabine Rivers; and the flood protected area at Cairo, Ill.

To provide a practical basis for plan formulation, the region has been divided into the following hydrologic areas that are referred to as water resource planning areas or WRPA's:

WRPA 1. The main stem of the Mississippi River below the mouth of the Ohio, extending to and including the levees or to the top bank where levees do not exist.

WRPA 2. The St. Francis Basin, St. Johns-New Madrid Floodway, Lower White, and Bayou Meto Basins, including the Arkansas River below Pine Bluff, Arkansas.

WRPA 3. The drainage basins of west Kentucky, west Tennessee, extreme northern Mississippi, and the Cairo, Illinois area.

WRPA 4. The Yazoo Basin.

WRPA 5. The Ouachita Basin, including the Lower Red River below Hot Wells, La.

WRPA 6. The Boeuf and Tensas Basins.

WRPA 7. The Big Black Basin and basins of southwest Mississippi streams that drain into the Mississippi River.

WRPA 8. The Baton Rouge area, including the drainage area of streams that flow into Lake Pontchartrain except for the Tchefuncta River and streams to the east.

WRPA 9. The Louisiana coastal area from the east limits of the Atchafalaya Floodway to east hydrologic boundary of the Sabine River Basin.

WRPA 10. The New Orleans areas, including the Tchefuncta River area and the area east of the Atchafalaya Floodway.

Economic boundaries of the region include 161 parishes and counties in Louisiana, Mississippi, Arkansas, Tennessee, Missouri, and Kentucky,

and the flood protected area at Cairo, Ill. The region stretches about 600 miles from the northernmost Missouri County south to the Gulf of Mexico and spans east-west a maximum width of about 315 miles. The area of the region is approximately 105,000 square miles or 65.5 million acres.

Mineral industry statistical data are compiled herein by traditional counties and parishes rather than by hydrologic boundaries. Generally this procedure does not prove troublesome; however, there are two notable exceptions. First, all base metal mining in Iron County, Mo., is outside of the hydrologic boundary. Second, much of the very substantial offshore oil and gas production is recovered beyond the 3-mile limit, but such output is credited statistically to the several Louisiana Gulf Coast parishes.

Mineral production from WRPA 1, the main stem of the Mississippi River, is credited to the nearest county or parish; therefore, WRPA 1 is not specifically considered herein. Mineral output from WRPA 1, such as sand, gravel and clay, as well as subsurface oil and gas, is included in other appropriate WRPA mineral data summaries.

Approximately one-third of the region is made up of the flat and extremely fertile alluvial valley of the Mississippi River. The remaining area varies from the gentle relief of the Bayou Meto and Grand Prairie area to the more rugged mountainous area in the Ouachita Basin. Detailed descriptive data on the region's physical environment may be found in Appendix C, Regional Hydrology and Geology, in Appendix F, Land Resources, in Appendix O, Coastal and Estuarine, and in Appendix T, Plan Formulation.

ECONOMIC ENVIRONMENT

Mineral production, manufacturing, and agriculture are the three major sectors of economic activity in the Lower Mississippi Region. Petroleum, natural gas, and sulfur were the leading minerals in terms of value of output in 1969. Leading manufacturing industries were chemical and allied products, food and kindred products, and petroleum refining. Leading agricultural products were soybeans, rice, corn, cotton, beef, pork, fowl, eggs, and milk.

Population of the region in 1970 was approximately 6.29 million, up from 5.83 million in 1960 and 5.55 million in 1950. In 1968, regional personal income amounted to \$15.4 billion in 1967 dollars, or \$2,447 per capita. Earnings in 1967 dollars were \$12.3 billion in 1968, or \$5,550 per worker, for the 2.2 million employed.

Moderate to substantial growth is visualized for all sectors of the regional economy through 2020. Detailed descriptive data on the region's economic environment may be found in Appendix B, Economics.

MINERAL RESOURCES, INDUSTRY, AND NEEDS

Resource Base

Projections of mineral output, to be meaningful, must be based upon factual data quantifying in some degree available mineral reserves and resources. By definition, mineral reserves are those resources that have been investigated and delineated by generally accepted methods, and that have been proven to exist in the quantity and grade required to satisfy a fairly definite market demand. Mineral resources, on the other hand, are assumed to exist on the basis of geologic projection and may be used in the future to satisfy a presumed market demand.

Ordinarily it is not realistic to develop reserve data beyond certain limits, depending upon a number of technical and economic considerations for specific mineral commodities. Available reserve data for most of the mineral resources produced in the region are not sufficient to support 50-year projections of output. Often such mineral reserve data are held confidential by those in the industry who have developed the information at substantial cost. Therefore, mineral resource data, which are more generalized and are based upon production records, reserve data, geologic information, and broad assumptions, are used to develop the mineral resource base herein.

Mineral Fuels

Petroleum and natural gas. Reserve data for oil and gas are disturbing when viewed in the light of domestic annual production-consumption trends. On December 31, 1969, oil reserves were about 29.6 billion barrels (excluding the recent Alaskan North Slope discoveries), or enough to supply about 8.8 years of output at the 3.37-billion-barrel rate of production in 1969. Similarly, natural gas reserves were 275 trillion cubic feet, enough to provide about 13.2 years of gas supply at the 20.9-trillion-cubic-foot rate of production in 1969. Considering recent annual growth rates in the demand for oil and gas, which are on the order of 3 and 6 percent respectively, the reserve figures are even more alarming. Somewhat comforting considerations include the alternative mineral fuels, such as coal and uranium, synthetic potential based upon coal, oil shale, and tar sands, and the promise of an increased percentage recovery from known and probable discoveries of oil and gas.

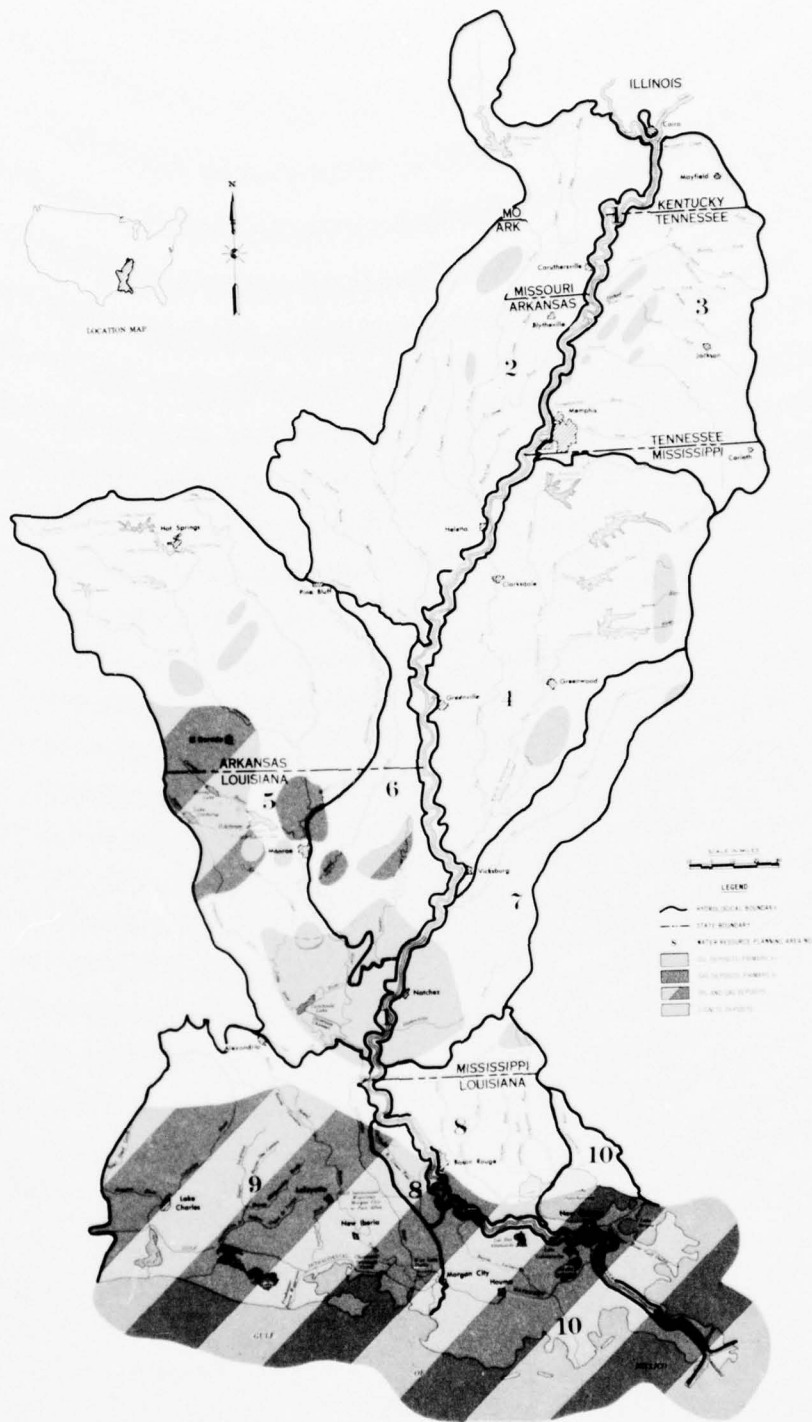
This apparent squeeze upon limited mineral resources, such as oil and gas, has stimulated the study of "ultimate" recoveries. One of the more recent studies, which seems to strike a median range, was developed by T. A. Hendricks of the U.S. Geological Survey and has served as the foundation for projections of oil and gas output developed herein for the Lower Mississippi Region.

Hendricks estimated that a total of 1,600 billion barrels of crude oil was originally in place in the United States. Through 1960, approximately 400 billion barrels had been discovered, leaving 1,200 billion barrels still to be found. (Updated to the 1969 base year, the figures would be approximately 425 and 1,175 billion barrels, respectively. All subsequent figures are updated through 1969.) Hendricks estimated that only about 1,000 billion barrels of the original resource can be developed profitably. Further, the ultimate recovery median is assumed to be 75 percent, or 750 billion barrels. (Secondary recovery and reworking of older fields are included.) Cumulative production through 1969 was 88 billion barrels; therefore, about 660 billion barrels of recoverable crude oil remain in place.

Using the 1969 domestic output of crude oil as a base and allowing for 3 percent annual growth in output (a commonly used assumption), cumulative domestic production through 2020 would be approximately 525 billion barrels. The domestic resource base, then, seems sufficient to support demand through 2020, provided that future discoveries are made in a timely manner.

Reserve data are not available for the several WRPA's in the Lower Mississippi Region. Data are available by State, however, and assuming a national reserve-resource relationship may be broken down into a state-by-state reserve-resource relationship, then it may be possible to develop an indication of oil and gas potential for the region (figure 1).

Cumulative oil production would reach a maximum level of 110 billion barrels through 2020 in the Lower Mississippi Region, an estimate computed by using somewhat more conservative annual growth rates of approximately 1.2 percent for Program A and 2.7 percent for Program B. This estimate is about 21 percent of projected national output for the period. In the 1960's the Lower Mississippi States produced about 25 percent of total national crude oil output--and essentially all of this output was from the Lower Mississippi Region. Reserves for the region were 20.8 billion barrels on December 31, 1969. If the reserve-resource relationship prevails on the regional level, the resource base in the region is 137 billion barrels and, therefore, capable of supporting projected oil production through 2020. These data are summarized in table 1.



LOWER MISSISSIPPI REGION
 COMPREHENSIVE STUDY
**GENERALIZED LOCATION OF
 MINERAL FUEL DEPOSITS**

FIGURE 1

Table 1 - Proved Crude Oil Reserves and Estimated Crude Oil Resources
in the Lower Mississippi Region, December 31, 1969

Area	Proved Crude Oil Reserves		Crude Oil Resource, million barrels
	million barrels	percent	
United States	29,632	100	660,000
Arkansas	127	0.4	2,640
Louisiana	5,689	19.2	126,720
Mississippi	360	1.2	7,920
Lower Miss. Region	6,176	20.8	137,280

A widespread thick section of sedimentary rocks underlies most of the region, except for some limited outcrops of igneous rocks in southeast Missouri and central Arkansas. Such sedimentary deposits, considered in conjunction with certain other geologic features, offer promise of containing economic oil and gas resources.

The following data are pertinent to a parallel analysis based upon the Hendricks review of the Nation's natural gas potential. Natural gas originally in place in the United States is estimated at 4,000 trillion cubic feet. Of this volume, 2,500 trillion cubic feet can be found and developed profitably, and about 90 percent or 2,250 trillion cubic feet can be recovered. Through 1969, about 350 trillion cubic feet has been wasted (in earlier years) or marketed. The resource remaining, therefore, is about 1,900 trillion cubic feet.

Based upon 1969's marketed output of 20.7 trillion cubic feet, the resource base would last about 90 years at the 1969 rate of consumption. Growth in output would have to be limited to slightly less than 2 percent annually if the resource base is to provide natural gas through 2020. Although annual growth in marketed gas has been around the 6-percent rate in recent years, it is now widely believed that conventional natural gas output has reached a plateau. Further increases in domestic supplies, therefore, must be obtained from imports (both overland pipeline gas and overseas liquefied gas) and from conversion of coal and other hydrocarbons into gas.

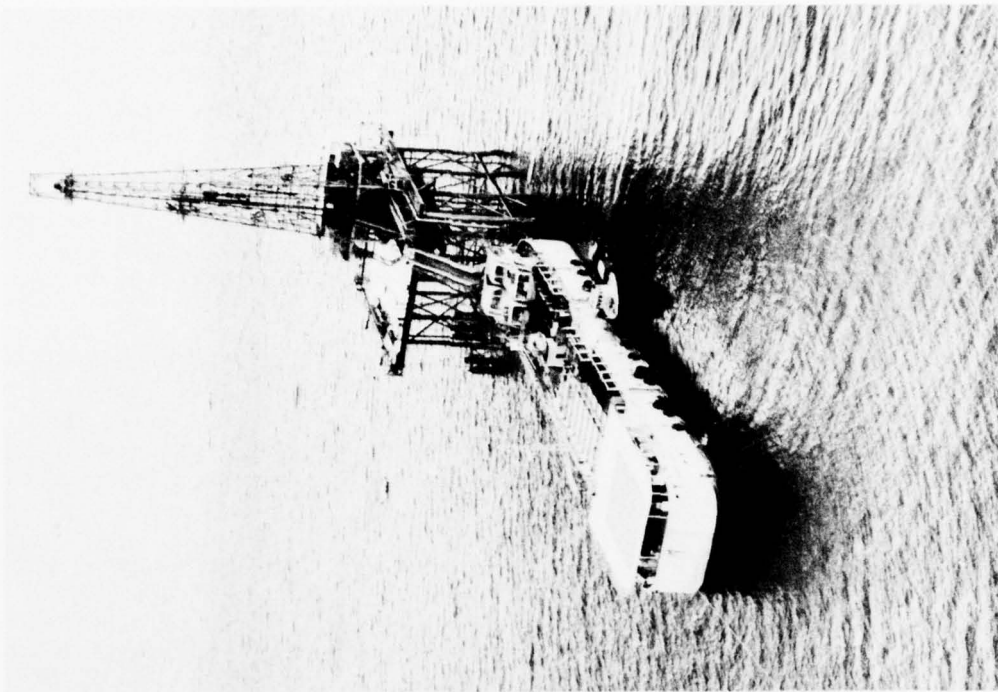
In the 1960's, the Lower Mississippi Region provided about one-third of domestic natural gas output. (Production actually increased uninterruptedly from 25 percent of national output in 1960 to 36 percent in 1969.) Because of this exceptional production record and the inviting

geologic conditions throughout most of the region, it seems reasonable to expect further growth in natural gas output. Projections, therefore, indicate some growth--somewhat less than 1½ percent for Program A and about 2 percent for Program B--through 2020. Data for natural gas are summarized in table 2, using the same approach as in developing the reserve-resource distribution for crude oil.

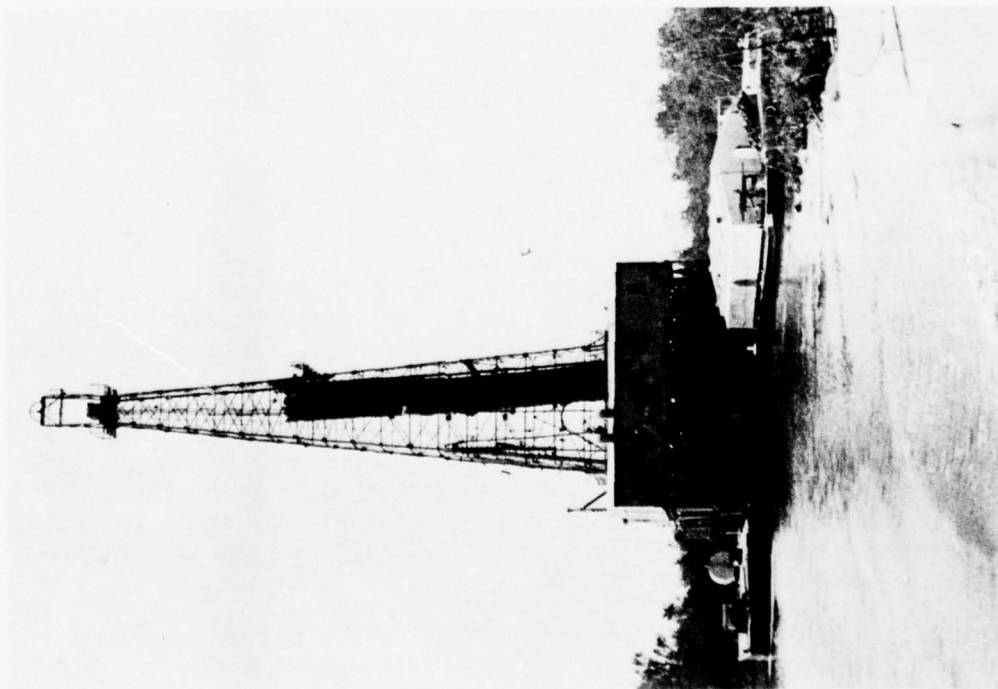
Table 2 - Proved Natural Gas Reserves and Estimated Natural Gas Resources in the Lower Mississippi Region, December 31, 1969

Area	Proved Natural Gas Reserves		Natural Gas Resource, million cubic feet
	million cubic feet	percent	
United States	275,000,000	100	1,900,000,000
Arkansas	2,630,000	1.0	19,000,000
Louisiana	85,060,000	30.9	587,000,000
Mississippi	1,410,000	0.5	10,000,000
Lower Miss. Region	89,100,000	32.4	6 16,000,000

If natural gas output in the Lower Mississippi Region increases at about 2 percent annually, the cumulative production through 2020 would be about 650 trillion cubic feet, or approximately 6 percent more than the estimated resource of 616 trillion cubic feet listed in table 2. Considering the methodology used to determine the resource, this is not a matter of grave concern. However, there is one additional factor related to future oil and gas production in the region that is noteworthy, and that is offshore production. Most of the offshore oil and gas has been produced within 50 miles or so of the Louisiana coast. Essentially all of this output has been piped to onshore oil refineries and natural gas processing plants in southern Louisiana, and subsequently distributed through product pipelines to in- and out-of-State markets. Future oil and gas likely will be recovered at increasing distances southward from the Louisiana coast as known fields are extended and further discoveries are made. Increasing the distance to offshore production also expands greatly the array of variables and unknowns, introducing complexities that preclude any firm or well founded consideration of remote offshore output in projections of mineral production in the Lower Mississippi Region. Some of these imponderables are discussed briefly below.



Offshore oil drilling rig and tender.



Oil drilling rig at Bayou Sale, La.

A casual scanning of a map of the Gulf of Mexico reveals that as crude oil discoveries are made farther south of the Louisiana coastline an area is reached where crude may be piped a shorter distance westward to the Texas coast. Refining facilities in east Texas were under less pressure from increasing in-State output of crude during the 1960's. (Crude oil output in Texas increased from 930 million barrels in 1960 to 1,150 million barrels in 1969, a 24-percent increase, whereas in Louisiana output jumped from 400 to 840 million barrels for a 110-percent increase during the same time interval.) Therefore, it is quite likely that some of the anticipated remote offshore oil may be directed to and processed in Texas in future years.

Another reasonable conclusion is that natural gas from remote offshore areas could be directed eastward to the Florida coast. Natural gas processing facilities are considerably less capital intensive than petroleum refineries; therefore, a substantial saving in transport cost could materialize by piping gas directly to the Florida area for processing and marketing.

An underlying assumption in both concepts is that the floor of the Gulf of Mexico is conducive to the laying of long-distance pipelines generally east and west. An alternative, if needed, could be offshore tanker loading of crude oil (and possibly liquefied natural gas) for shipment to the northeast States for refining and marketing.

Eventually, of course, remote southern offshore production areas could impinge on Mexican Territorial waters. Moreover, with respect to jurisdiction, it has been proposed in some quarters to invest ownership in or to arrange for some form of royalty payments from seabed resources to the United Nations to help meet its financing needs.

In any event, such variables and unknowns preclude precise or meaningful estimations of the future impact of remote offshore oil and gas production upon the development of the Lower Mississippi Region. However remote the seaward limits of production may become by 2020, it is likely that offshore output will continue to have some impact upon the economy of the region--in such sectors as employment and related service industries, for example--but the impact upon the region's water and land resources seemingly will become negligible.

Offshore oil and gas, then, probably will make a significant contribution to total Lower Mississippi Region energy output through much of the remainder of the century. Beyond 2000, however, the impact of the more distant offshore production is exceedingly difficult to estimate and therefore, such probable output is given only general consideration in the 2000-2020 projection interval.

Distribution of the resource potential of the region among the several WRPA's is based upon their oil and gas output during the 1956-69

interval. Oil and gas output in the Lower Mississippi Region (the hydrologic region) represents about 90 percent of the output from the six Lower Mississippi States. Northwest Louisiana, southwest Arkansas, and eastern Mississippi are the noteworthy out-of-region production areas in the Lower Mississippi States. Considering the elementary approach in developing the distribution of resource potential among the WRPA's, this small percentage difference does not seem significant. Potential probably has been understated in the northern part of the region where exploration has been limited, as well as in the offshore areas where ultimate distance from coastline is not readily definable. Nevertheless, the oil and gas potential for the WRPA's is believed to be indicative of actual production capability, at least for the next decade or two. Resource potential is distributed among the WRPA's in table 3.

Table 3 - Estimated Oil and Gas Potential in WRPA's in the Lower Mississippi Region, December 31, 1969

WRPA	Crude Oil			Natural Gas		
	Cumulative Production 1956-69, million barrels	Percent	Resource Distribution million barrels	Cumulative Production 1956-69, million cubic feet	Percent	Resource Distribution, million cubic feet
4	30	0.4	550	500	-	1,000,000
5	406	5.5	7,550	2,778,000	5.4	33,000,000
6	201	2.7	3,710	747,000	1.4	8,500,000
7	124	1.7	2,330	217,000	0.4	2,500,000
8	201	2.7	3,710	662,000	1.3	8,000,000
9	1,997	27.0	37,070	27,671,000	53.3	328,000,000
10	4,451	60.0	82,360	19,813,000	38.2	235,000,000
LMR	7,410	100	137,280	51,889,000	100	616,000,000

Lignite. Widespread but discontinuous deposits of lignite occur in northern Louisiana, southern and eastern Arkansas, western Mississippi, and western Tennessee (figure 1). There are no lignite operations in the region; it is noteworthy in recent years, however, that similar lignite deposits in east Texas have been developed for use in electric power generation and for some limited use in the chemical industry. It seems probable that some of the lignite resources in the region will be developed through 2020, but it is impossible even to approximate the location of such developments because of limited resource and related information.

Metallic Minerals

Metallic mineral resources have been produced in important quantities in southeast Missouri and central Arkansas (figure 2). Although reserved data are limited and are frequently held confidential, the near-term future is virtually certain to be marked by some growth in output. Beyond 1980, output may level off, but it should be sustained on a high plateau through 2020.

Base metals (lead, zinc, and copper) and iron ore are produced in southeast Missouri. Byproducts include silver and periodically some minor amounts of nickel and cobalt. Production trends, reserve data, and the geologic environment all suggest that the resource base probably is strong enough to support the output projections in WRPA 2.

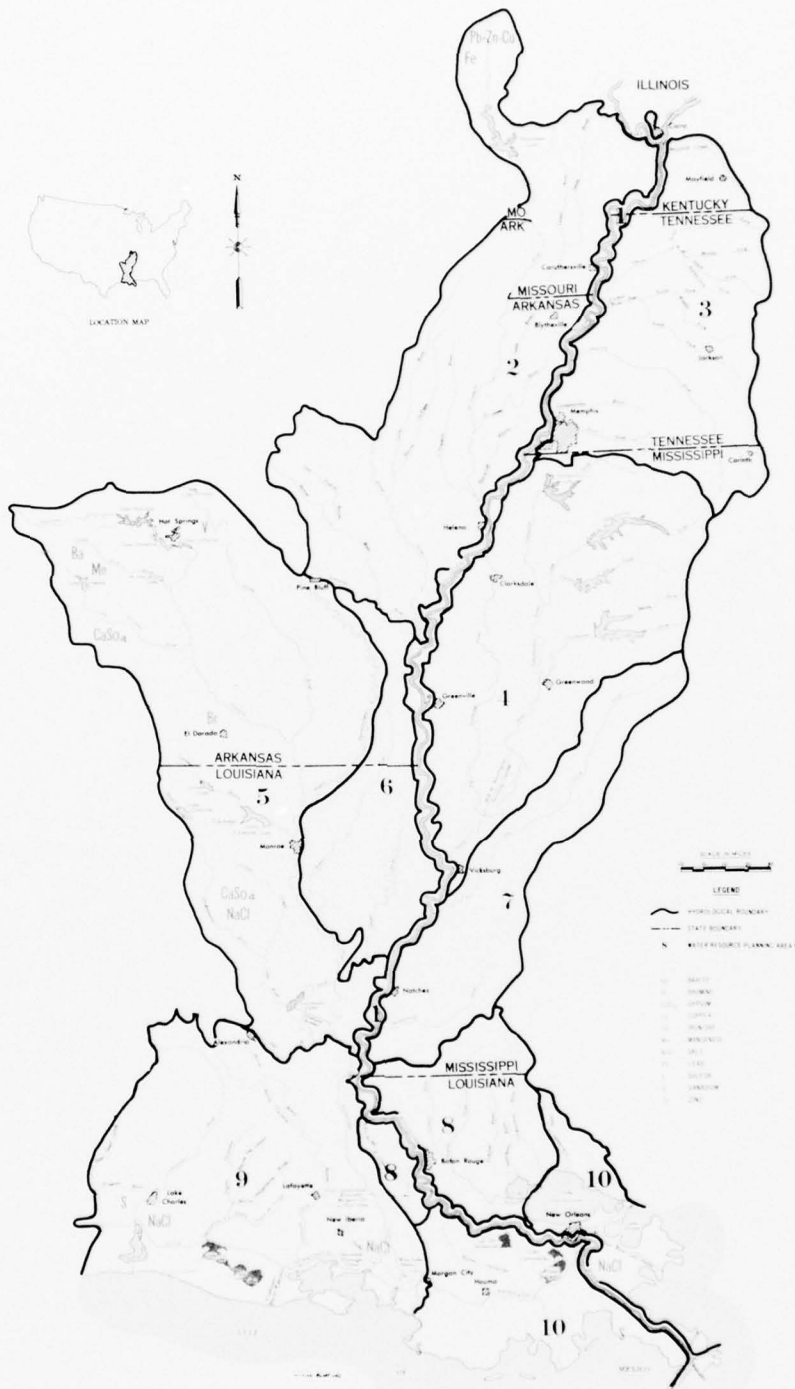
Vanadium is produced in Garland County, Ark., in WRPA 5. The vanadium ore is associated with alkaline igneous rocks and is unique in this respect in the Nation. Information is limited; it is assumed, however, that the resource base will prove capable of supporting the modest production of this ferroalloy, possibly with some growth, through 2020.

Nonmetallic Minerals

Construction minerals. A number of the more common construction minerals--sand, gravel, stone, gypsum, and clays--are found in the region. Although quality problems exist, sand and gravel deposits are widespread. Stone, gypsum, and clays are more localized, but usually occur in large deposits. Access to these low value minerals is a matter of concern, and the slowly declining quality of some of these resources is a growing problem. Reserve data are sparse; in general, however, the resource base for most of the important construction minerals is huge.

Barite. Barite deposits are found in the Arkansas part of WRPA 5 (figure 2). Much of the regional production is used in preparing drilling mud for the petroleum industry, and future demand is expected to keep pace with exploration for and development of regional oil and gas deposits. Reserve data are limited, but the geologic environment suggests that the resource potential in the region is ample to support the moderate production projected through 2020.

Bromine. Bromine is extracted from brines found in the Smackover limestone (of Jurassic age) in the Arkansas section of WRPA 5 (figure 2). The resource base is believed to be sufficient to support the moderate growth in output projected through 2020. Bromine is used to manufacture ethylene dibromide, a fuel additive for gasoline engines. Used as a scavenger of combustion products (mainly lead), this principal market for bromine is in jeopardy because of the transitional status of gasoline additives. Nevertheless, markets are growing in the chemical and photographic industries, and some increase in output is anticipated.



LOWER MISSISSIPPI REGION
 COMPREHENSIVE STUDY
**GENERALIZED LOCATION OF
 SELECTED METALLIC AND
 NONMETALLIC MINERAL DEPOSITS**

FIGURE 2



Bromine extraction plant in Union County, Ark.

Salt. Louisiana has been the Nation's leading salt-producing State in recent years. Salt domes in southern Louisiana are immense and numerous. The resource base is essentially inexhaustible (figure 2). Salt is a widely used mineral in the chemical and food industries, and rock salt is used for snow and ice removal and roadbed stabilization. In 1969 domestic production was 44.2 million tons. The chemical industry used over two-thirds of the output to make chlorine, caustic soda, soda ash, and other chemicals.

Salt is a commonplace mineral and is produced annually in 16 to 20 States. About 85 percent of domestic production is recovered in Louisiana, Texas, Ohio, New York, and Michigan. Substantial output is noted in industrial areas in close proximity to the Great Lakes near Cleveland, Ohio, in western New York State, and from an underground mine in Detroit, Mich. The winter shutdown of shipping on the Great Lakes is a regional handicap to the low-cost transport of low-value, high-bulk salt. In contrast, the advantageous coastline location of Louisiana salt deposits should be a stimulant to exceptional growth in salt production for much of the East Coast market.

Sulfur. Louisiana also has been the Nation's leading sulfur-producing State in recent years. Sulfur is produced by the Frasch process from both inshore and offshore deposits (figure 2). The sulfur is associated with salt domes and, although the occurrence of economically recoverable sulfur deposits is not commonplace, the resource base in the geologically favorable Gulf Coast environment would seem to be sufficient to supply projected output through 2020. Of the 9.2 million long tons of sulfur used in the Nation in 1969, approximately half was consumed in the production of fertilizers. The remaining half found widespread use in many varied industries--so much so that sulfur consumption is a reliable indicator of industrial activity.

Mineral Production and Projections

Value of mineral production in the Lower Mississippi Region amounted to \$4.75 billion in 1969, up from \$1.29 billion in 1956. This value represented about 18 percent of the Nation's \$26.9 billion in mineral output in 1969, up from 7 percent of the Nation's \$17.3 billion in output in 1956. These data are in current dollars and are detailed in table 4. The table lists the mineral commodities produced in the region, unit of production, and quantity and value for the years 1956, 1965, and 1969. Total quantity and value data for the years 1956-69 inclusive also are listed.

The economic importance of mineral industry to the region is obvious. Less evident is the vital importance of regional mineral output to the Nation. The following list of important minerals, presenting the percent of national output produced in the region in 1969, points up the

Table 4 - Lower Mississippi Region, Mineral Production, 1956, 1963, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956		1963		1969		Total, 1956-1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Abrasive ^{1/}short tons..	151	\$37	W	W	W	W	W	W
Barite.....do.....	486,254	4,256	W	W	W	W	W	\$38,280
Bromine.....thousand pounds..	0	0	W	W	W	W	W	75,725
Cement:								
Masonry.....280-pound barrels..	W	W	W	W	W	W	W	W
Portland.....thousand 576-pound barrels..	W	W	W	W	W	W	W	W
Clays.....short tons..	2,058,464	7,109	1,742,403	\$7,451	2,147,425	\$10,248	26,278,072	107,588
Copper ^{2/}do.....	1,965	905	177	109	NA	5,205	14,988	11,250
Iron stones.....pounds..	NA	25	8,093	42	NA	24	NA	345
Gypsum, crude.....short tons..	W	W	W	W	W	W	W	8,290
Iron ore (usable).....thousand long tons..	3	17	65	447	W	W	W	18,255
Lead ^{2/}thousand short tons..	14	4,260	16	3,520	104	30,902	1,398	86,787
Lime.....short tons..	W	W	W	W	W	W	W	W
Mercury.....76-pound flasks..	0	0	0	0	0	0	350	170
Natural gas.....million cubic feet..	1,614,715	184,146	3,631,646	718,405	6,936,582	1,331,751	51,888,791	9,290,770
Natural gas liquids.....thousand barrels..	20,436	60,636	46,830	106,574	119,299	252,938	710,241	1,697,697
Petroleum.....do.....	295,154	906,481	514,682	1,603,911	855,934	2,816,982	7,679,855	23,442,427
Salt.....thousand short tons..	W	W	W	W	W	W	W	459,456
Sand and gravel.....do.....	17,143	17,692	19,395	20,791	28,998	35,261	287,337	323,370
Silver ^{2/}troy ounces..	5,006	5	41,904	54	501,363	W	871,455	1,382
Stone.....thousand short tons..	5,538	8,581	5,941	8,823	13,160	17,662	89,104	152,000
Sulfur, Frasch.....thousand long tons..	W	W	2,445	48,905	3,999	108,299	40,624	1,070,471
Vanadium.....short tons..	0	0	0	0	W	W	W	W
Zinc ^{2/}do.....	0	0	0	0	15,362	4,486	20,776	6,017
Total.....	1,288,021	2,584,008	4,750,642	57,174,268				

W Not available. W Withheld to avoid disclosing company confidential information.

^{1/} Includes tripoli.

^{2/} Recoverable content of ores.

vital contribution of regional mineral industry to national mineral demands. (Fractions are used to approximate the region's share of national output when company confidential information is involved.)

Natural gas	34 percent
Natural gas liquids	31 do.
Petroleum	25 do.
Lead	20 do.
Bromine	1/5
Salt	1/3
Sulfur	2/3

Based upon reserve data, developing mineral projects, and on-going exploration efforts, increased output of all minerals produced in the Lower Mississippi Region is virtually assured through 1980. Beyond 1980, however, resource problems are evident. Natural gas (and associated natural gas liquids) is probably the best example. If substantial gas discoveries are made offshore, at greater depths in Louisiana, and in WRPA's 2, 3, and 4, then projected output through 2020 is quite possible. These discovery assumptions, however, are quite demanding, and the possibility of a deficient natural gas resource base after 2000 must be weighed. Crude oil output in some of the older producing districts, such as southwest Arkansas, may decline somewhat more than anticipated, too.

Production of metallic minerals in southeast Missouri probably will expand through 2020. WRPA 2 is only partially within this district, however, and it is unlikely to share fully in the district's increased output.

Although nonmetallic minerals available present quality problems in some parts of the region, the resource base appears to be adequate.

In summary, the mineral resource base is generally believed to be capable of supporting most projected mineral output through 2020. A parallel assumption is that access to land and suitable incentives will spur mineral industry exploration and development efforts in the region.

Base-year production and value by mineral commodity and mineral group and projections for the years 1980, 2000, and 2020 are listed in table 5. The appropriate unit of production for each mineral is indicated, and all value data are in terms of 1967 dollars.

At the Program A and B levels of estimated production through 2020, mineral fuels output would increase about 100-260 percent, metallic minerals 75-130 percent, nonmetallic minerals 230-390 percent, and total minerals 110-270 percent. For individual minerals the most pronounced growth in output is expected to be that of salt, up 560-620 percent, followed by sulfur, up 245-500 percent.

Table 3 - Lower Mississippi Region, Mineral Production and Value, 1995, and Projections for 1990, 2000, and 2020
(Thousand 1997 dollars adjusted to Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	Projection	1990		1995		2000		2020	
		Production	Value	Production	Value	Production	Value	Production	Value
Fuels									
Natural gas.....million cubic feet.....	Program A..	6,037,000	\$1,287,191	8,379,000	\$1,295,790	11,261,000	\$2,131,896	14,493,200	\$2,690,937
(B).....do.....	Program B..	6,037,000	1,287,191	8,379,000	1,295,790	11,261,000	2,046,133	18,772,000	3,483,014
Natural gas liquids.....thousand barrels.....	Program A..	419,200	297,067	189,242	418,008	236,880	634,299	526,686	813,430
(B).....do.....	Program B..	419,200	297,067	197,853	432,040	323,134	804,702	449,370	1,110,768
Petroleum.....do.....	Program A..	803,034	2,038,882	1,017,230	3,160,801	1,298,230	4,033,352	1,599,763	4,941,783
(B).....do.....	Program B..	803,034	2,038,882	1,433,091	4,338,916	2,438,134	7,007,117	3,453,920	10,733,837
Summary, fuels.....	Program A..	4,313,140	-	8,175,493	-	6,791,497	-	8,130,630	-
(B).....do.....	Program B..	4,243,140	-	6,816,447	-	11,007,292	-	10,306,830	-
Metals, minerals									
Copper.....do.....	Program A..	W	W	10,300	8,138	10,300	8,138	10,300	8,138
(B).....do.....	Program B..	W	W	11,000	8,932	13,170	11,200	13,170	10,200
Iron ore (metallic).....thousand long tons.....	Program A..	W	W	1,336	12,706	1,228	12,706	1,536	12,706
(B).....do.....	Program B..	W	W	1,336	12,706	1,228	12,706	1,536	12,706
Lead.....do.....	Program A..	104	20,328	109	56,118	200	36,400	200	36,400
(B).....do.....	Program B..	104	20,328	248	91,476	250	7,300	250	70,000
Silver.....do.....	Program A..	502	1,074	960	2,054	960	2,054	960	2,054
(B).....do.....	Program B..	502	1,074	1,032	2,231	1,300	2,600	1,700	2,600
Vanadium.....do.....	Program A..	W	W	1,000	3,000	1,000	3,000	1,000	3,000
(B).....do.....	Program B..	W	W	1,000	3,000	2,000	6,000	3,000	9,000
Zinc.....do.....	Program A..	13,362	4,286	29,388	8,109	30,000	8,370	30,000	8,370
(B).....do.....	Program B..	13,362	4,286	32,700	8,084	37,000	10,320	37,000	10,320
Summary, metallic minerals.....	Program A..	-	31,490	-	90,295	-	50,748	-	90,748
(B).....do.....	Program B..	-	31,490	-	104,083	-	114,522	-	117,702
Nonmetallic minerals									
Asbestos.....do.....	Program A..	W	W	7,000	341	7,000	308	6,000	472
(B).....do.....	Program B..	W	W	8,000	380	8,000	380	8,000	380
Barite, crude.....do.....	Program A..	W	W	213,800	4,917	230,200	5,063	227,000	5,250
(B).....do.....	Program B..	W	W	204,000	6,776	434,700	9,498	375,200	13,436
Bromine.....do.....	Program A..	W	W	105,183	24,944	122,462	20,115	134,385	37,052
(B).....do.....	Program B..	W	W	107,960	23,634	170,803	20,045	235,968	36,432
Clay.....do.....	Program A..	W	W	277,180	793	323,000	820	306,373	1,007
(B).....do.....	Program B..	W	W	295,000	749	304,001	927	335,083	1,131
Portland.....do.....	Program A..	W	W	8,087	22,727	9,034	30,957	11,010	37,935
(B).....do.....	Program B..	W	W	8,087	22,727	7,534	10,722	13,338	13,096
Clay.....do.....	Program A..	2,117,433	7,720	2,877,839	11,812	4,074,091	20,818	5,982,70	31,794
(B).....do.....	Program B..	2,117,433	7,720	1,990,391	12,13	4,087,487	23,406	6,022,019	36,343
Iron, cast.....do.....	Program A..	W	W	33	33	33	33	33	33
(B).....do.....	Program B..	W	W	33	33	33	33	33	33
Iron, crude.....do.....	Program A..	W	W	185,370	381	217,917	681	364,165	829
(B).....do.....	Program B..	W	W	107,133	719	249,683	755	365,353	938
Lead.....do.....	Program A..	W	W	800,267	11,332	1,097,207	13,799	1,337,891	16,073
(B).....do.....	Program B..	W	W	977,020	13,198	1,230,303	15,476	1,535,141	19,435
Salt.....do.....	Program A..	12,435	66,308	13,048	67,456	43,308	216,223	69,053	348,271
(B).....do.....	Program B..	12,435	66,308	21,002	107,204	33,528	208,476	86,941	418,437
Sand and gravel.....do.....	Program A..	28,938	34,137	31,011	36,442	37,130	43,411	46,117	53,220
(B).....do.....	Program B..	28,938	34,137	33,476	39,445	41,772	48,787	51,882	61,420
Stone.....do.....	Program A..	13,130	47,092	14,114	48,265	16,034	22,080	20,314	26,795
(B).....do.....	Program B..	13,130	47,092	15,772	20,420	18,710	24,947	23,147	30,768
Sulfur.....do.....	Program A..	3,969	117,988	6,245	206,041	10,126	336,000	17,802	437,480
(B).....do.....	Program B..	3,969	117,988	8,205	283,497	16,236	373,076	23,054	700,376
Summary, nonmetallic minerals.....	Program A..	-	391,217	-	478,170	-	726,830	-	1,018,540
(B).....do.....	Program B..	-	500,915	-	530,286	-	1,096,038	-	1,301,293
Total, all minerals.....	Program A..	4,607,337	-	8,195,660	-	7,603,044	-	9,344,724	-
(B).....do.....	Program B..	4,607,337	-	7,330,818	-	12,148,212	-	19,770,234	-

W Not available. K Withheld to avoid disclosing company confidential information.
 1/ Recycled by content of ores.
 2/ Includes trisulfate.
 3/ Includes shell.

Mineral Industry Water and Land Needs and Projections

Mineral industry in the Lower Mississippi Region diverted an estimated 675 thousand acre-feet of water and depleted 171 thousand acre-feet of this supply to record its 1969 output. Based upon the range of projected increases in mineral production through 2020, diversions should rise to 2,097-3,265 thousand acre-feet, an increase of about 210-380 percent. During the same 1969-2020 interval, depletions should climb to about 619-1,207 thousand acre-feet, an increase of 260-600 percent.

Projections of mineral industry water needs in the region--both diversions and depletions--for the production of individual mineral commodities and mineral groups, as well as industry-wide summaries for the years 1980, 2000, and 2020, are listed in table 6.

Land use by the mineral industry in the Lower Mississippi Region is a small part of the region's 65.5-million-acre total. In 1969, approximately 67 thousand acres was used by mineral industry in the region. Total land needs are projected to increase to 182-253 thousand acres by 2020, an increase of about 170-280 percent. This mineral industry land use represents roughly 0.10 percent of the regional total in 1969, and 0.27-0.37 percent in 2020.

Projections of estimated land needs in the region for the production of fuels, metallic minerals, and nonmetallic minerals, together with summaries for the years 1980, 2000, and 2020, are listed in table 7.

Table 6

Commodity, unit of production	Pro
Fuels:	
Natural gas.....million cubic feet..	Prog
Do.....do.....	Prog
Natural gas liquids.....thousand barrels..	Prog
Do.....do.....	Prog
Petroleum:	
Production.....do.....	Prog
Do.....do.....	Prog
Drilling.....thousand feet.....	Prog
Do.....do.....	Prog
Secondary recovery ^{2/}thousand barrels..	Prog
Do.....do.....	Prog
Summary, fuels.....	Prog
Do.....	Prog
Metallic minerals:	
Copper ^{3/}short tons..	Prog
Do.....do.....	Prog
Iron ore (usable).....thousand long tons..	Prog
Do.....do.....	Prog
Lead ^{4/}thousand short tons..	Prog
Do.....do.....	Prog
Silver ^{5/}thousand troy ounces..	Prog
Do.....do.....	Prog
Vanadium.....short tons..	Prog
Do.....do.....	Prog
Zinc ^{6/}do.....	Prog
Do.....do.....	Prog
Summary, metallic minerals.....	Prog
Do.....	Prog
Nonmetallic minerals:	
Abrasives ^{5/}short tons..	Prog
Do.....do.....	Prog
Barite.....do.....	Prog
Do.....do.....	Prog
Bromine.....thousand pounds..	Prog
Do.....do.....	Prog
Cement:	
Masonry.....280-pound barrels..	Prog
Do.....do.....	Prog
Portland.....thousand 376-pound barrels..	Prog
Do.....do.....	Prog
Clays.....short tons..	Prog
Do.....do.....	Prog
Gem stones.....pounds..	Prog
Do.....do.....	Prog
Gypsum, crude.....short tons..	Prog
Do.....do.....	Prog
Lime.....do.....	Prog
Do.....do.....	Prog
Salt.....thousand short tons..	Prog
Do.....do.....	Prog
Sand and gravel.....do.....	Prog
Do.....do.....	Prog
Stonew ^{6/}do.....	Prog
Do.....do.....	Prog
Sulfur, Frasch.....thousand long tons..	Prog
Do.....do.....	Prog
Summary, nonmetallic minerals.....	Prog
Do.....	Prog
Total, all minerals.....	Prog
Do.....	Prog

NA Not available. W Withheld to avoid disclosure

1/ No significant water use.

2/ Assume 40 percent of production is by secondary

3/ Recoverable content of ores.

4/ Combined with water use for lead mining.

5/ Includes tripoli.

6/ Includes shell.

Table 6 - Lower Mississippi Region, Projections of Mineral Production and Water Needs, 1969, 1980, 2000, and 2020

Commodity, unit of production	Projection	1969			1980			2000			Product
		Production	Water needs, acre-feet		Production	Water needs, acre-feet		Production	Water needs, acre-feet		
			Diversion	Depletion		Diversion	Depletion		Diversion	Depletion	
Fuels:											
Natural gas.....million cubic feet..	Program-A..	6,957,000	(1)	(1)	8,579,000	(1)	(1)	11,561,000	(1)	(1)	14,492
Do.....do.....do.....	Program-B..	6,957,000	(1)	(1)	9,672,000	(1)	(1)	14,365,000	(1)	(1)	18,772
Natural gas liquids.....thousand barrels..	Program-A..	119,299	446,999	27,674	168,242	630,274	39,031	246,686	924,197	57,230	326
Do.....do.....do.....	Program-B..	119,299	446,999	27,674	197,855	741,280	45,809	525,144	1,210,827	74,972	449
Petroleum:											
Production.....do.....do.....	Program-A..	855,934	(1)	(1)	1,017,250	(1)	(1)	1,298,535	(1)	(1)	1,589
Do.....do.....do.....	Program-B..	855,934	(1)	(1)	1,155,981	(1)	(1)	2,428,134	(1)	(1)	5,455
Drilling.....thousand feet.....	Program-A..	41,144	10,614	10,614	49,200	12,695	12,695	62,887	16,229	16,229	76
Do.....do.....do.....	Program-B..	41,144	10,614	10,614	64,804	15,929	15,929	95,324	24,696	24,696	129
Secondary recovery ^{2/}thousand barrels..	Program-A..	342,374	117,918	103,630	508,620	175,801	154,006	895,989	310,916	271,305	1,583
Do.....do.....do.....	Program-B..	342,374	117,918	103,630	727,990	245,590	221,497	1,675,412	558,977	510,476	5,004
Summary, fuels.....do.....do.....	Program-A..	-	575,531	141,918	-	818,770	205,732	-	1,251,542	544,774	-
Do.....do.....do.....	Program-B..	-	575,531	141,918	-	1,002,799	285,325	-	1,794,410	610,054	-
Metallic minerals:											
Copper ^{3/}short tons.....	Program-A..	W	(4)	(4)	10,500	(4)	(4)	10,500	(4)	(4)	10
Do.....do.....do.....	Program-B..	W	(4)	(4)	11,500	(4)	(4)	15,170	(4)	(4)	15
Iron ore (usable).....thousand long tons..	Program-A..	W	2,319	142	1,356	2,985	185	1,356	2,980	183	1
Do.....do.....do.....	Program-B..	W	2,319	142	1,584	5,485	214	1,584	5,480	213	1
Lead ^{3/}thousand short tons.....	Program-A..	104	342	36	199	1,037	70	200	1,040	70	1
Do.....do.....do.....	Program-B..	104	342	36	218	1,136	76	250	1,300	87	1
Silver ^{3/}thousand troy ounces.....	Program-A..	502	(4)	(4)	960	(4)	(4)	960	(4)	(4)	1
Do.....do.....do.....	Program-B..	502	(4)	(4)	1,052	(4)	(4)	1,200	(4)	(4)	1
Vanadium.....short tons.....	Program-A..	W	1,100	549	1,000	1,306	549	1,000	1,306	549	1
Do.....do.....do.....	Program-B..	W	1,100	549	1,500	1,959	825	2,000	2,612	1,097	3
Zinc ^{3/}do.....do.....	Program-A..	15,362	(4)	(4)	29,388	(4)	(4)	30,000	(4)	(4)	30
Do.....do.....do.....	Program-B..	15,362	(4)	(4)	32,200	(4)	(4)	37,000	(4)	(4)	37
Summary, metallic minerals.....do.....do.....	Program-A..	-	3,961	727	-	5,326	802	-	5,326	802	-
Do.....do.....do.....	Program-B..	-	3,961	727	-	6,580	1,113	-	7,392	1,397	-
Nonmetallic minerals:											
Abrasives ^{5/}short tons.....	Program-A..	W	27	1	7,500	27	1	7,000	25	1	6
Do.....do.....do.....	Program-B..	W	27	1	8,000	29	1	8,000	29	1	8
Barite.....do.....do.....	Program-A..	W	3,523	300	213,800	3,946	306	220,200	3,097	316	227
Do.....do.....do.....	Program-B..	W	3,523	300	294,600	4,046	422	434,700	7,299	623	575
Bromine.....thousand pounds.....	Program-A..	W	466	466	90,183	581	581	122,362	789	789	154
Do.....do.....do.....	Program-B..	W	466	466	107,060	689	689	170,804	1,100	1,100	253
Cement:											
Masonry.....280-pound barrels.....	Program-A..	W	101	44	277,180	162	70	325,020	189	82	396
Do.....do.....do.....	Program-B..	W	101	44	293,060	172	75	304,801	212	91	453
Portland.....thousand 576-pound barrels..	Program-A..	W	3,860	1,656	8,987	4,714	2,022	3,644	5,622	2,441	11
Do.....do.....do.....	Program-B..	W	3,860	1,656	8,598	5,013	2,150	10,725	6,255	2,681	15
Clays.....short tons.....	Program-A..	2,147,423	963	114	2,827,850	1,265	147	4,074,681	1,822	213	5,682
Do.....do.....do.....	Program-B..	2,147,423	963	114	3,060,961	1,575	160	4,647,487	2,077	242	6,622
Gem stones.....pounds.....	Program-A..	NA	(1)	(1)	NA	(1)	(1)	NA	(1)	(1)	-
Do.....do.....do.....	Program-B..	NA	(1)	(1)	NA	(1)	(1)	NA	(1)	(1)	-
Gypsum, crude.....short tons.....	Program-A..	W	27	17	185,370	45	27	217,017	65	41	264
Do.....do.....do.....	Program-B..	W	27	17	197,255	45	28	240,685	73	47	305
Lime.....do.....do.....	Program-A..	W	37	37	909,267	42	42	1,097,507	49	49	1,557
Do.....do.....do.....	Program-B..	W	37	37	977,020	45	45	1,239,359	56	56	1,555
Salt.....thousand short tons.....	Program-A..	W	33,050	9,155	19,948	52,984	14,684	43,508	115,361	32,034	69
Do.....do.....do.....	Program-B..	W	33,050	9,155	21,902	58,172	16,120	55,828	142,971	39,639	89
Sand and gravel.....do.....do.....	Program-A..	28,998	6,338	3,548	31,051	6,789	3,798	37,231	8,136	4,560	46
Do.....do.....do.....	Program-B..	28,998	6,338	3,548	33,376	7,355	4,107	41,775	9,131	5,113	52
Stone ^{6/}do.....do.....	Program-A..	13,159	2,797	1,078	14,114	3,004	1,177	16,634	3,550	1,407	20
Do.....do.....do.....	Program-B..	13,159	2,797	1,078	15,272	3,257	1,267	18,716	3,985	1,580	23
Sulfur, Frasch.....thousand long tons..	Program-A..	W	44,164	11,504	6,243	68,945	18,100	10,196	112,580	29,537	13
Do.....do.....do.....	Program-B..	W	44,164	11,504	8,593	94,896	24,912	16,296	179,952	47,241	23
Summary, nonmetallic minerals.....do.....do.....	Program-A..	-	95,333	28,010	-	142,502	40,955	-	252,094	71,460	-
Do.....do.....do.....	Program-B..	-	95,333	28,010	-	175,072	49,976	-	353,138	98,423	-
Total, all minerals.....do.....do.....	Program-A..	-	674,825	170,655	-	966,598	247,489	-	1,508,762	417,036	-
Do.....do.....do.....	Program-B..	-	674,825	170,655	-	1,184,451	334,414	-	2,154,040	709,874	-

NA Not available; W Withheld to avoid disclosing company confidential information.

1/ No significant water use.

2/ Assume 40 percent of production is by secondary recovery in 1969, 50 percent in 1980, 69 percent in 2000, and 87 percent in 2020.

3/ Recoverable content of ores.

4/ Combined with water use for lead mining.

5/ Includes tripoli.

6/ Includes shell.

Table 6 - Lower Mississippi Region, Projections of Mineral Production and Water Needs, 1969, 1980, 2000, and 2020

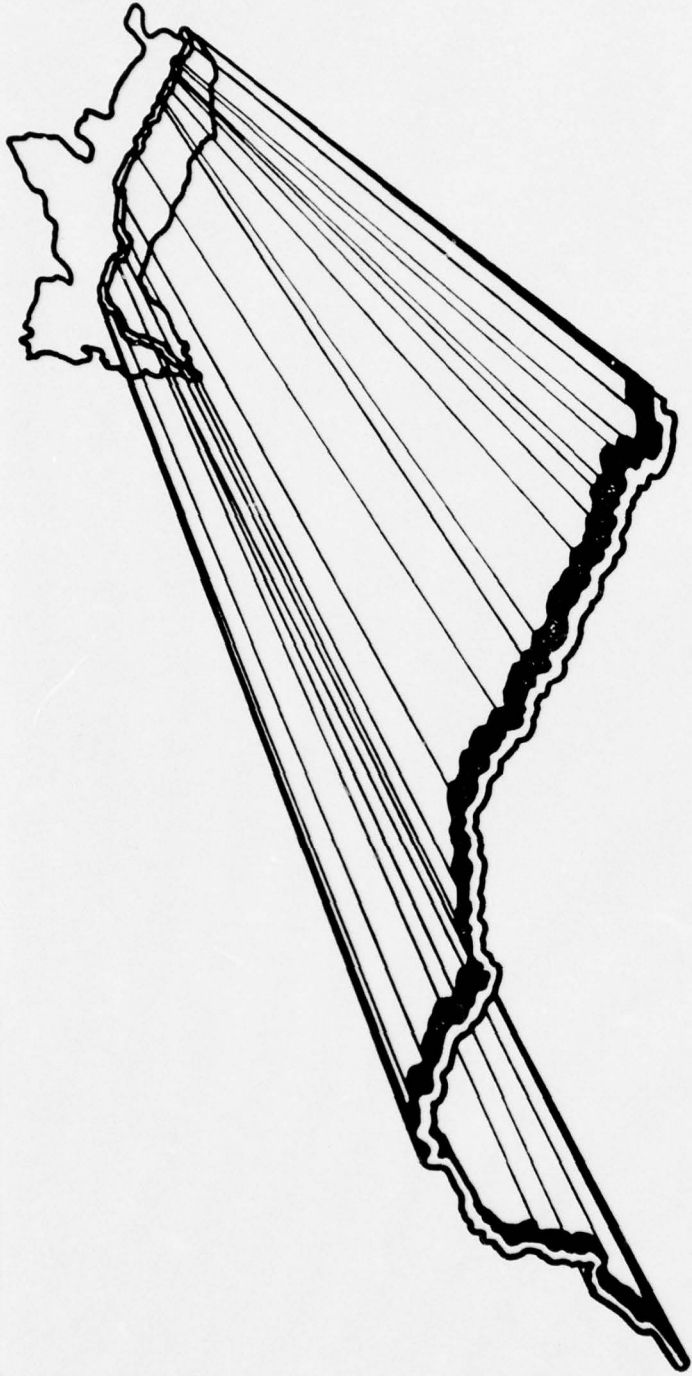
Production	Projection	1969			1980			2000			2020		
		Production	Water needs, acre-feet		Production	Water needs, acre-feet		Production	Water needs, acre-feet		Production	Water needs, acre-feet	
			Diversion	Depletion		Diversion	Depletion		Diversion	Depletion		Diversion	Depletion
on cubic feet..	Program-A..	6,957,000	(1)	(1)	8,579,000	(1)	(1)	11,561,000	(1)	(1)	14,492,900	(1)	(1)
.....do.....	Program-B..	6,957,000	(1)	(1)	9,672,000	(1)	(1)	14,368,000	(1)	(1)	18,772,900	(1)	(1)
.....do.....	Program-A..	119,299	446,999	27,674	168,242	639,274	39,031	240,688	924,197	57,240	326,086	1,225,781	75,797
.....do.....	Program-B..	119,299	446,999	27,674	197,853	741,280	45,899	525,144	1,210,827	74,072	449,530	1,684,310	194,183
.....do.....	Program-A..	855,934	(1)	(1)	1,017,239	(1)	(1)	1,298,535	(1)	(1)	1,589,763	(1)	(1)
.....do.....	Program-B..	855,934	(1)	(1)	1,435,981	(1)	(1)	2,428,134	(1)	(1)	3,453,928	(1)	(1)
.....do.....	Program-A..	41,144	10,614	10,614	49,200	12,695	12,695	62,887	16,220	16,220	76,375	19,748	19,748
.....do.....	Program-B..	41,144	10,614	10,614	61,801	15,929	15,929	95,524	24,606	24,606	129,951	33,505	33,505
.....do.....	Program-A..	342,374	117,918	103,630	508,620	175,801	154,006	895,989	558,977	510,176	3,094,910	996,125	916,722
.....do.....	Program-B..	342,374	117,918	103,630	727,990	245,590	221,497	1,675,412	-	-	-	-	-
.....do.....	Program-A..	-	575,531	141,918	-	818,770	205,732	-	1,251,342	344,774	-	1,725,811	514,694
.....do.....	Program-B..	-	575,531	141,918	-	1,002,799	285,525	-	1,794,410	610,954	-	2,713,940	1,054,812
.....do.....	Program-A..	W	(4)	(4)	10,500	(4)	(4)	10,500	(4)	(4)	10,500	(4)	(4)
.....do.....	Program-B..	W	(4)	(4)	11,500	(4)	(4)	13,170	(4)	(4)	13,170	(4)	(4)
.....do.....	Program-A..	W	2,519	142	1,356	2,985	183	1,356	3,480	213	1,356	2,980	183
.....do.....	Program-B..	W	2,519	142	1,584	3,485	214	1,584	1,940	70	1,584	3,480	213
.....do.....	Program-A..	104	342	56	199	1,037	70	200	1,300	87	250	1,300	87
.....do.....	Program-B..	104	342	56	218	1,136	76	250	1,300	87	250	1,300	87
.....do.....	Program-A..	502	(4)	(4)	960	(4)	(4)	960	(4)	(4)	1,200	(4)	(4)
.....do.....	Program-B..	502	(4)	(4)	1,052	(4)	(4)	1,200	(4)	(4)	1,200	(4)	(4)
.....do.....	Program-A..	W	1,100	349	1,000	1,306	349	1,000	1,306	349	1,000	1,306	349
.....do.....	Program-B..	W	1,100	349	1,500	1,959	823	2,000	2,612	1,097	3,000	3,918	1,646
.....do.....	Program-A..	15,362	(4)	(4)	29,388	(4)	(4)	30,000	(4)	(4)	37,000	(4)	(4)
.....do.....	Program-B..	15,362	(4)	(4)	32,200	(4)	(4)	37,000	(4)	(4)	37,000	(4)	(4)
.....do.....	Program-A..	-	3,961	727	-	5,326	892	-	5,326	892	-	5,326	892
.....do.....	Program-B..	-	3,961	727	-	6,580	1,115	-	7,392	1,397	-	8,698	1,946
.....do.....	Program-A..	W	27	1	7,500	27	1	7,000	25	1	6,500	25	1
.....do.....	Program-B..	W	27	1	8,000	29	1	8,000	29	1	8,000	29	1
.....do.....	Program-A..	W	3,525	300	215,800	3,946	306	220,200	3,697	316	227,800	3,825	326
.....do.....	Program-B..	W	3,525	300	294,600	4,046	422	334,700	7,299	625	375,300	9,663	825
.....do.....	Program-A..	W	466	466	90,185	581	581	122,562	789	789	164,585	994	994
.....do.....	Program-B..	W	466	466	107,060	689	689	170,804	1,100	1,100	233,968	1,307	1,307
.....do.....	Program-A..	W	101	44	277,180	162	70	325,020	180	82	396,575	252	99
.....do.....	Program-B..	W	101	44	295,060	172	75	364,801	212	91	453,083	264	114
.....do.....	Program-A..	W	3,860	1,656	8,087	4,714	2,022	9,644	5,622	2,411	11,010	6,942	2,977
.....do.....	Program-B..	W	3,860	1,656	8,598	5,015	2,150	10,725	6,255	2,681	15,358	7,893	3,384
.....do.....	Program-A..	2,147,423	965	114	2,827,850	1,265	147	4,074,681	1,822	213	5,682,716	2,538	296
.....do.....	Program-B..	2,147,423	965	114	3,060,961	1,575	160	4,047,487	2,077	242	6,602,010	2,957	346
.....do.....	Program-A..	NA	(1)	(1)	NA	(1)	(1)	NA	(1)	(1)	NA	(1)	(1)
.....do.....	Program-B..	NA	(1)	(1)	NA	(1)	(1)	NA	(1)	(1)	NA	(1)	(1)
.....do.....	Program-A..	W	27	17	185,370	43	27	217,017	65	41	264,165	79	50
.....do.....	Program-B..	W	27	17	197,255	45	28	240,683	73	47	305,303	92	58
.....do.....	Program-A..	W	37	37	909,267	42	42	1,097,507	49	49	1,357,891	61	61
.....do.....	Program-B..	W	37	37	977,920	45	45	1,239,359	56	56	1,355,141	69	69
.....do.....	Program-A..	W	33,030	9,155	19,948	52,984	14,684	43,398	115,361	32,034	69,993	185,206	51,527
.....do.....	Program-B..	W	33,030	9,155	21,302	58,172	16,120	53,828	142,971	39,639	89,241	238,801	66,210
.....do.....	Program-A..	28,998	6,338	3,548	31,051	6,789	3,798	37,331	8,136	4,569	46,119	10,080	5,645
.....do.....	Program-B..	28,998	6,338	3,548	35,576	7,535	4,107	41,775	9,131	5,113	52,882	11,563	6,475
.....do.....	Program-A..	15,159	2,797	1,078	14,114	3,004	1,477	16,634	3,559	1,407	20,244	4,333	1,731
.....do.....	Program-B..	15,159	2,797	1,078	15,272	3,257	1,267	18,716	3,985	1,589	23,247	4,971	1,983
.....do.....	Program-A..	W	44,164	11,594	6,243	68,045	18,100	10,196	112,589	29,557	13,852	152,968	40,157
.....do.....	Program-B..	W	44,164	11,594	8,593	94,896	24,912	16,296	179,352	47,241	25,952	264,502	69,437
.....do.....	Program-A..	-	95,535	28,010	-	142,502	40,955	-	252,094	71,460	-	367,981	103,864
.....do.....	Program-B..	-	95,535	28,010	-	173,072	49,976	-	333,138	98,423	-	542,401	150,409
.....do.....	Program-A..	-	674,825	179,655	-	966,598	247,489	-	1,508,762	417,036	-	2,097,118	619,270
.....do.....	Program-B..	-	674,825	179,655	-	1,184,451	334,414	-	2,154,940	709,874	-	3,265,039	1,206,867

01d to avoid disclosing company confidential information.

duction is by secondary recovery in 1969, 50 percent in 1980, 69 percent in 2000, and 87 percent in 2020.
res.
for lead mining.

Table 7 - Lower Mississippi Region, Projections of Land Use Needs
for Mineral Resources, Acres

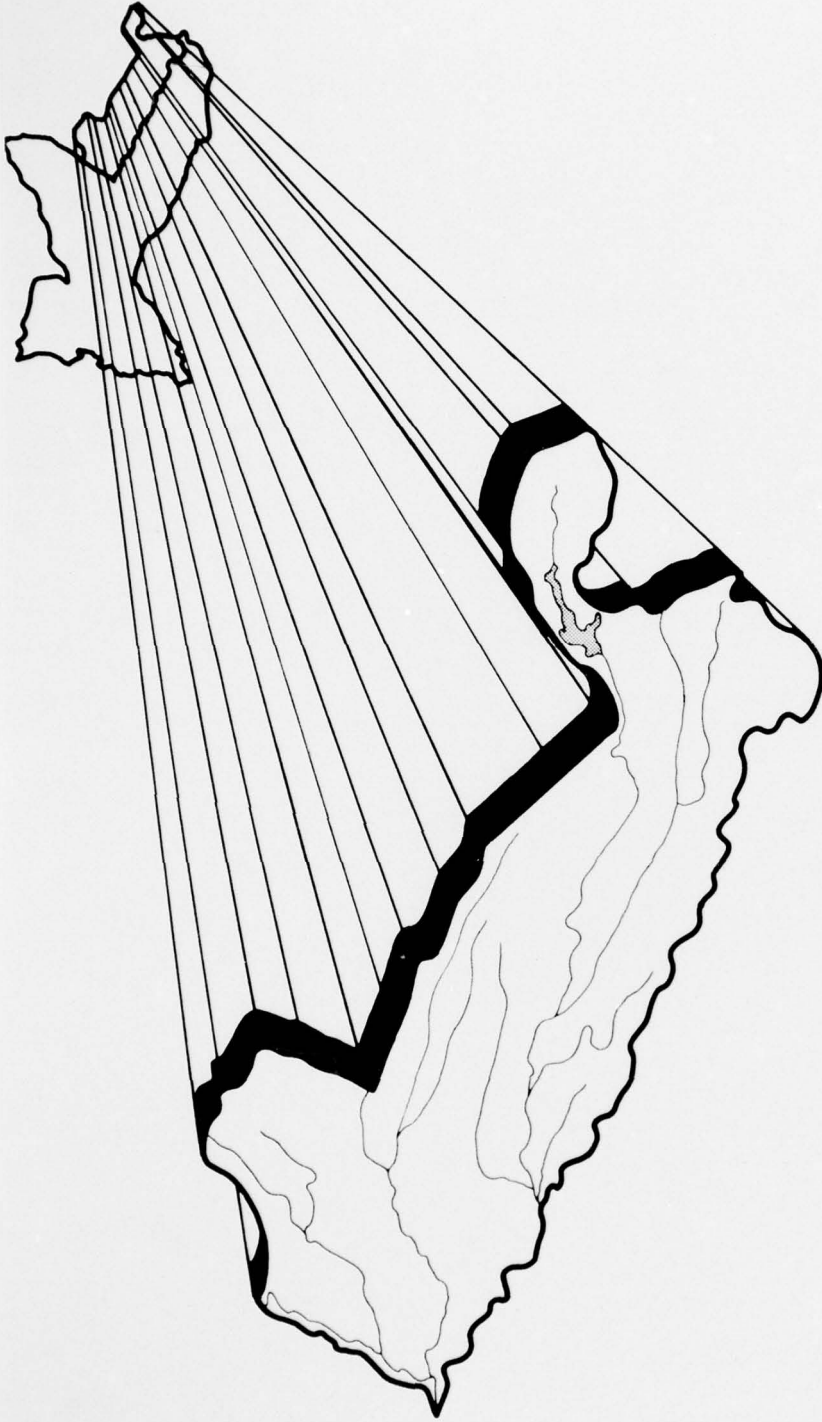
Commodity	Projection	1969	1980	2000	2020
Fuels.....	Program-A.	20,620	24,910	32,765	40,880
Do.....	Program-B.	20,620	31,145	48,675	66,740
Metallic minerals.....	Program-A.	22,600	32,000	52,000	82,000
Do.....	Program-B.	22,600	36,500	68,000	115,000
Nonmetallic minerals..	Program-A.	23,420	29,930	42,435	59,015
Do.....	Program-B.	23,420	32,770	50,040	71,410
Total, all minerals...	Program-A.	66,640	86,840	127,200	181,895
Do.....	Program-B.	66,640	100,415	166,715	255,150



W
R
P
A
1

W R P A 1

Mineral production from WRPA 1, the main stem of the Mississippi River, is credited to the nearest county or parish; therefore, WRPA 1 is not specifically considered herein. Mineral output from WRPA 1, such as sand, gravel, and clay, as well as subsurface oil and gas, is included in other appropriate WRPA mineral data summaries.



**W
R
P
A
2**

W R P A 2

MINERAL RESOURCE BASE

WRPA 2, the northernmost area in the Lower Mississippi Region, is in southeast Missouri and northeast Arkansas. It is bordered by Missouri and Illinois counties on the north, by counties in Kentucky, Tennessee, and Mississippi on the east, by Arkansas counties on the south, and by counties in Arkansas and Missouri on the west. The 26 counties in the area are as follows:

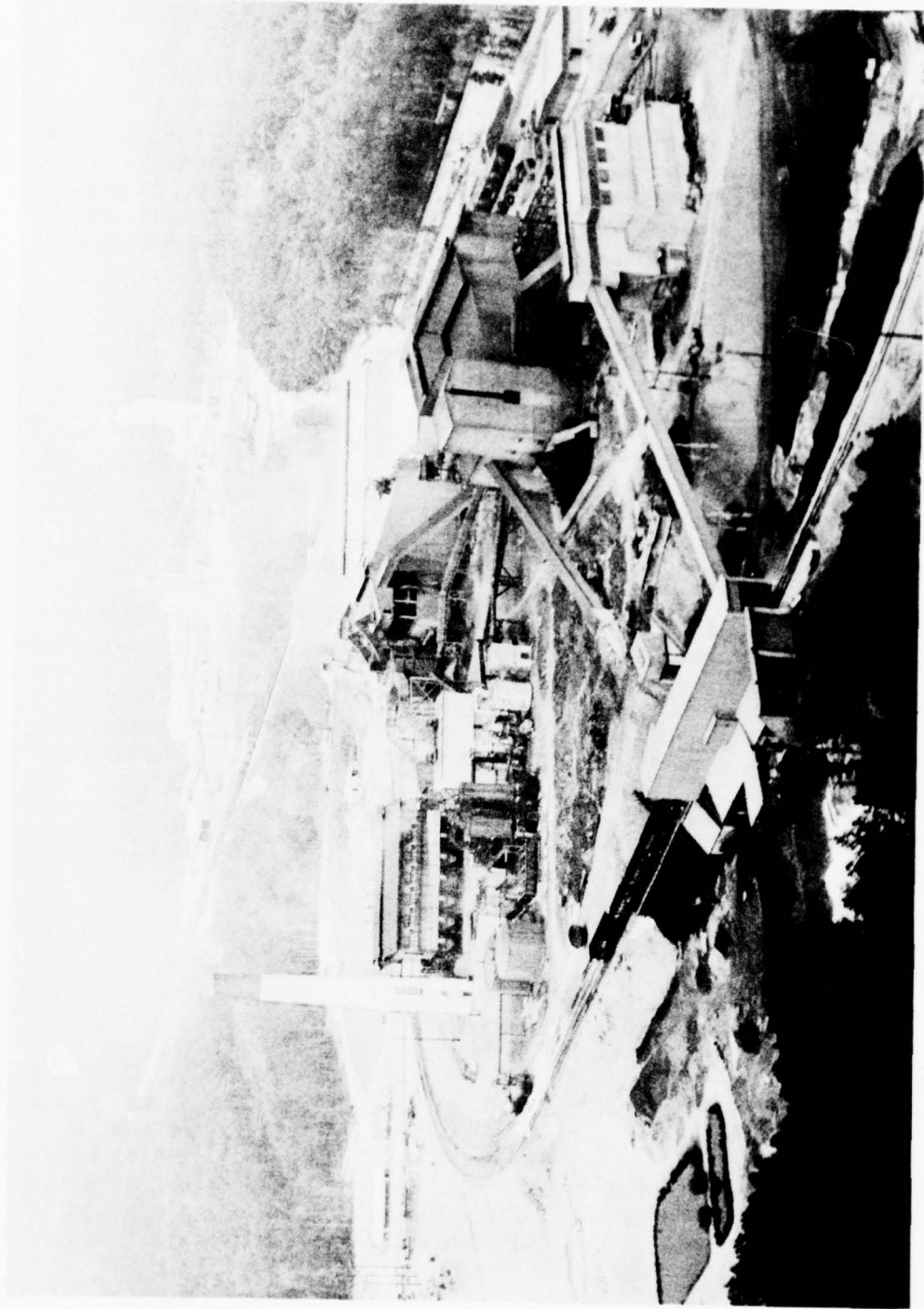
ARKANSAS	Mississippi	Dunklin
Arkansas	Monroe	Iron
Clay	Phillips	Madison
Craighead	Poinsett	Mississippi
Cross	Prairie	New Madrid
Greene	St. Francis	Pemiscot
Jackson	White	Scott
Lee	Woodruff	Stoddard
Lonoke	MISSOURI	Wayne
	Bollinger	

Nonmetallic minerals are produced in almost all counties in the area in any given year. The base metals, lead-zinc-copper and byproduct silver, are produced in Iron County, Mo. Iron ore also is produced in Iron County. Lignite deposits exist in the Arkansas part of the area, but their near-term development is not foreseen. The sedimentary rock column increases in thickness from north to south, building to 20,000+ feet of strata in the southernmost part of the area. Although oil and gas are not produced nor is such output foreseen at present, the long-range potential for production remains worthy of note.

Metallic Minerals

Lead

Lead ores are found in the southeast Missouri lead district in the Viburnum trend (new lead belt), a north-south trend of mineralization outside of the hydrologic region in western Iron County. The Viburnum trend is about 50 miles west of the old lead belt, site of lead discoveries by French explorers at the turn of the 18th century. Lead resources in southeast Missouri probably are sufficient to satisfy the most optimistic projections of growth in demand. Limited to the counties within WRPA 2, wherein the area covered by the Viburnum trend is not as extensive as the area of the old lead belt, the resource base is assumed to be somewhat constrained. The lead resource base, however, is taken to



Aerial view of Magmont mine and mill (background) and lead smelter of Missouri Lead Trollers (foreground), Iron County, Mo.

to be sufficient to support a substantial increase in output through 1980, and then capable of sustaining a high plateau of production through 2020.

Zinc and Copper

Zinc ores have been produced in southeast Missouri, but only in negligible tonnage. Zinc as well as copper, however, are recovered in substantial quantities as byproducts from lead ores. Silver also is recovered in notable amounts, and in the past relatively minor quantities of cobalt and nickel have been recovered as byproducts. Lead and the zinc and copper byproducts remain the principal metals of economic interest. In approximate terms, the lead-zinc-copper ratio in lead ores is 20:3:1.

Iron Ore

Extensive deposits of limonite (brown iron ore) and filled-sink hematite deposits occur in southern Missouri and extend into northern Arkansas. The low phosphorous content of the limonite ores made them attractive for blending with other ores in the recent past. Technological trends in iron smelting now favor the hematite and magnetite ores of Precambrian age found in southeast Missouri. Iron ore of current interest in WRPA 2 is found in the region of the Ozark uplift which is centered in Iron County. Iron resources in southern Missouri are huge, but in counties within WRPA 2, the resource base is constrained. Iron resources are viewed as sufficient to support increased output through 1980, and a plateau of steady production through 2020.

Nonmetallic Minerals

Clays, Sand, Gravel, and Stone

Sand and gravel deposits exist throughout most of WRPA 2. Stone outcrops are found in the western part of the area, well removed from the Mississippi River. Clays are fairly common in the area. The resource base of all these construction raw materials is adequate to satisfy projections of output through 2020.

PRESENT MINERAL PRODUCTION

Mineral production in WRPA 2 historically has been dominated by lead and associated metals output in southeastern Missouri. It is expected that this base-metal dominance will continue through 2020.

In 1969, total value of mineral production in the area was \$48.2 million. Metallic minerals comprised about 85 percent of this total. Nonmetallic minerals made up the remainder of the total value. Almost all counties in the area record some nonmetallic minerals output in any given year. There was no 1969 production of mineral fuels in WRPA 2.

Table 8 lists the mineral production in WRPA 2 by commodity, unit of production, quantity, and value (in current dollars) for the years 1956, 1963, and 1969, and a summary of quantity and value for the years 1956-69, inclusive.

PROJECTIONS OF MINERAL PRODUCTION AND RELATED WATER AND LAND NEEDS

Projections of Mineral Production

Metallic minerals output in WRPA 2 is expected to increase appreciably through 1980 and then remain at a high level through 2020 for Program A. Projected value of metallic minerals increases from \$48.8 million in 1969 to \$87.2 million in 1980, a 79-percent increase. Non-metallic minerals output is expected to increase throughout the period. Value of production is projected to increase from \$8.45 million in 1969 to \$11.34 million in 2020, a rise of 34 percent.

Projections for individual minerals and summaries for the years 1980, 2000, and 2020 are listed in table 9. Data are projected in the specific unit of production for each of the minerals, and all values are in terms of 1967 dollars.

Projections of Water and Land Needs

Mineral industry in WRPA 2 diverted an estimated 4,450 acre-feet of water and depleted 659 acre-feet of this supply to record its 1969 output. Based upon projected increases in mineral production through 2020, diversions should rise to 6,154-7,230 acre-feet, an increase of 38-62 percent. During the same 1969-2020 period, depletions should climb to about 900-1,042 acre-feet, an increase of 37-58 percent.

Projections of water needs--both diversions and depletions--for the production of individual mineral commodities and summary totals for the years 1980, 2000, and 2020 are listed in table 10.

Land use in WRPA 2 by mineral industry is a relatively small part of total acreage in the area. In 1969, approximately 25,600 acres was in use. Total land needs are expected to increase to about 86.5-118.2 thousand acres by 2020, a 240-360 percent escalation.

Projections of estimated land needs for the production of metallic and nonmetallic minerals, and summaries for the years 1980, 2000, and 2020, are listed in table 11.

Table 8 - WPA 2, Mineral Production, 1956, 1963, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956		1963		1969		Total 1956 - 1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Clays.....short tons..	7,970	\$8	W	W	194,895	\$342	947,892	\$1,195
Copper ^{1/}do.....	1,065	905	177	\$109	W	5,205	14,088	11,230
Iron ore (usable).....thousand long tons..	5	17	5	17	W	W	1,277	17,417
Lead ^{1/}thousand short tons..	14	4,260	16	5,529	104	50,902	511	86,787
Natural gas.....million cubic feet..	0	0	0	0	0	0	6	1
Sand and gravel.....thousand short tons..	2,520	1,657	2,417	2,510	5,401	5,515	41,459	40,530
Silver ^{1/}thousand troy ounces..	5	5	42	54	502	W	871	1,582
Stone.....thousand short tons..	483	884	1,667	2,056	2,985	5,702	20,784	50,151
Zinc ^{1/}short tons..	0	0	0	0	15,362	4,486	20,776	6,017
Total.....		7,754		W		48,152		194,758

W Withheld to avoid disclosing company confidential information.
1/ Recoverable content of ores.

Table 9 - WPPA 2, Mineral Production and Value, 1969, and Projections for 1980, 2000, and 2020
(thousand 1967 dollars adjusted by Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	Projection	1969		1980		2000		2020	
		Production	Value	Production	Value	Production	Value	Production	Value
<u>Metallic minerals:</u>									
Copper ^{1/}short tons..	Program-A.	W	10,500	8,138	10,500	8,138	10,500	10,500	8,138
Do.....do.....	Program-B.	W	11,500	8,912	13,170	10,200	13,170	13,170	10,200
Iron ore (usable).....thousand long tons..	Program-A.	W	1,356	12,706	1,356	12,706	1,356	1,356	12,706
Do.....do.....	Program-B.	W	1,584	14,842	1,584	14,842	1,584	1,584	14,842
Lead ^{1/}thousand short tons..	Program-A.	104	529,328	56,118	200	56,400	200	200	56,400
Do.....do.....	Program-B.	104	29,328	61,476	250	70,500	250	250	70,500
Silver ^{1/}thousand troy ounces..	Program-A.	502	1,074	2,054	960	2,054	960	960	2,054
Do.....do.....	Program-B.	502	1,074	2,251	1,200	2,600	1,200	1,200	2,600
Zinc ^{1/}short tons..	Program-A.	15,362	4,286	8,199	30,000	8,370	30,000	30,000	8,370
Do.....do.....	Program-B.	15,362	4,286	8,984	37,000	10,320	37,000	37,000	10,320
Summary, metallic minerals.....	Program-A.	-	48,807	87,215	-	87,668	-	-	87,668
Do.....	Program-B.	-	48,807	96,465	-	108,462	-	-	108,462
<u>Nonmetallic minerals:</u>									
Clays.....short tons..	Program-A.	194,895	232	199,767	238	225,155	266	261,549	311
Do.....do.....	Program-B.	194,895	232	221,791	264	246,152	293	300,333	357
Sand and gravel.....thousand short tons..	Program-A.	5,401	3,741	5,486	3,835	3,894	4,283	4,564	5,020
Do.....do.....	Program-B.	2,985	4,477	3,060	4,257	4,295	4,724	5,241	5,765
Stone.....do.....	Program-A.	2,985	4,477	3,060	4,590	3,418	5,127	4,006	6,009
Do.....do.....	Program-B.	2,985	4,477	3,397	5,095	3,770	5,655	4,600	6,900
Summary, nonmetallic minerals.....	Program-A.	-	8,450	-	8,665	-	9,676	-	11,540
Do.....	Program-B.	-	8,450	-	9,616	-	10,672	-	13,022
Total, all minerals.....	Program-A.	-	57,257	-	95,878	-	97,344	-	99,008
Do.....	Program-B.	-	57,257	-	106,081	-	119,154	-	121,482

W Withheld to avoid disclosing company confidential information.

^{1/} Recoverable content of ores.

Table 20 - WBA 2, Projections of Mineral Production and Water Needs, 1961, 1980, 2000, and 2020

Commodity, unit of production	1961				2000				2020			
	Projection	Water needs, acre-feet		Production	Water needs, acre-feet	Water needs, acre-feet		Production	Water needs, acre-feet	Water needs, acre-feet		
		inversion	depletion			inversion	depletion			inversion	depletion	
Metals, minerals:												
Copper,.....	short tons	8	(2)	10,500	(2)	(2)	10,500	(2)	(2)	10,500	(2)	(2)
Do.....	do	8	(2)	11,520	(2)	(2)	11,520	(2)	(2)	11,520	(2)	(2)
Iron ore (acidic).....	thousand long tons	8	2,510	1,556	2,043	183	1,373	2,083	183	1,373	2,083	183
Do.....	do	8	2,510	1,554	2,485	214	1,384	2,14	214	1,384	2,14	214
Lead,.....	thousand short tons	104	542	179	1,037	79	200	250	87	200	250	87
Do.....	do	104	542	179	1,136	76	230	280	87	230	280	87
Silver,.....	thousand fine ounces	502	(2)	960	(2)	(2)	1,200	(2)	(2)	1,200	(2)	(2)
Do.....	do	502	(2)	1,062	(2)	(2)	1,200	(2)	(2)	1,200	(2)	(2)
Zinc,.....	short tons	15,262	(2)	29,388	(2)	(2)	30,000	(2)	(2)	30,000	(2)	(2)
Do.....	do	15,262	(2)	32,250	(2)	(2)	37,000	(2)	(2)	37,000	(2)	(2)
Summary, metallic minerals.....			2,461	178	4,020	253	4,920	353	4,020	4,920	353	4,020
Do.....	Program A		2,461	178	4,020	253	4,920	353	4,020	4,920	353	4,020
Do.....	Program B											
Nonmetallic minerals:												
Clay.....	short tons	104,809	86	104,707	88	10	255,155	90	12	261,549	116	14
Do.....	do	104,809	86	104,707	88	10	255,155	90	12	261,549	116	14
Sand and gravel.....	thousand short tons	1,401	45	212,480	762	427	5,894	631	426	5,261	641	426
Do.....	do	1,401	45	212,480	762	427	5,894	631	426	5,261	641	426
Stone.....	thousand short tons	2,585	760	3,060	846	474	4,295	570	45	4,250	520	74
Do.....	do	2,585	760	3,060	846	474	4,295	570	45	4,250	520	74
Do.....	do	2,585	760	3,207	895	63	3,779	90	69	4,000	1,171	85
Summary, nonmetallic minerals.....			1,839	481	1,620	495	1,620	457	457	2,474	627	427
Do.....	Program A		1,839	481	1,620	495	1,620	457	457	2,474	627	427
Do.....	Program B		1,839	481	1,620	495	1,620	457	457	2,474	627	427
Total, all minerals.....			4,300	659	5,640	740	6,540	808	808	7,400	900	4,012
Do.....	Program A		4,300	659	5,640	740	6,540	808	808	7,400	900	4,012
Do.....	Program B											

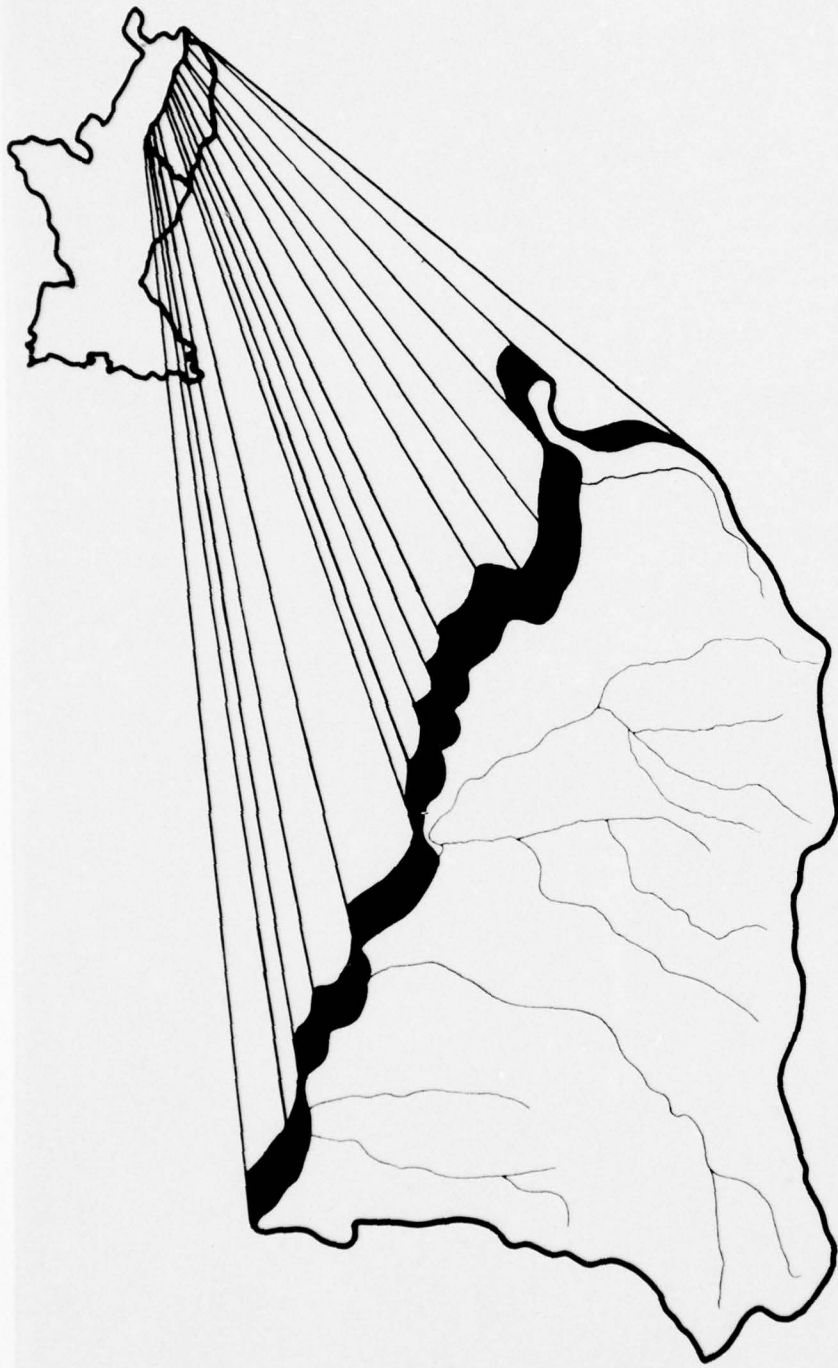
8 Withheld to avoid disclosing company confidential information.

1/ recoverable content of ores.

2/ Combined with water use for load mining.

Table 11 - WRPA 2, Projections of Land Use Needs
for Mineral Resources, Acres

Commodity	Projection	1969	1980	2000	2020
Metallic minerals.....	Program-A.	21,600	31,000	51,000	81,000
Do.....	Program-B.	21,600	35,000	66,000	112,000
Nonmetallic minerals....	Program-A.	4,000	4,100	4,600	5,500
Do.....	Program-B.	4,000	4,500	5,100	6,200
Total, all minerals.....	Program-A.	25,600	35,100	55,600	86,500
Do.....	Program-B.	25,600	39,500	71,000	118,200



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WRPA 3

MINERAL RESOURCE BASE

WRPA 3 is located mostly in western Tennessee, but extends into Arkansas, Kentucky, and Mississippi. It is bordered by counties in Kentucky and Missouri on the north, and by counties in Tennessee on the east, Mississippi on the south, and Arkansas and Missouri on the west. The 23 counties in the area are as follows:

ARKANSAS	Tippah	Haywood
Crittenden	TENNESSEE	Lake
KENTUCKY	Carroll	Lauderdale
Carlisle	Chester	McNairy
Fulton	Crockett	Madison
Graves	Dyer	Obion
Hickman	Fayette	Shelby
MISSISSIPPI	Gibson	Tipton
Alcorn	Hardeman	Weakley

Nonmetallic minerals are produced in most counties in the area in any given year. The resource base is assumed to be sufficient to support the projections of mineral production through the year 2020. There are no known metallic mineral deposits in the area. Neither oil nor gas is produced nor is such production foreseen. Lignite deposits exist in western Tennessee, but its production is not anticipated.

Nonmetallic Minerals

Clay

Extensive deposits of ball clay, a high-grade ceramic raw material, are found in Weakley County, Tenn., and extend into Graves County, Ky. Ball clay is highly plastic because of its very fine particle size and generally is refractory. Similar in use to china clay, it is blended with feldspar and flint in the manufacture of whitewares. The resource base is believed to be adequate to meet foreseen production through 2020. Other clays, mostly of local importance, are found in scattered deposits in the area.

Sand, Gravel, and Stone

Sand and gravel deposits of variable quality are found throughout most of the area. The resource base is sufficient to meet anticipated output through 2020. Readily accessible stone deposits are limited in the area.

PRESENT MINERAL PRODUCTION

Mineral production in WRPA 3 has been limited to the important ball clay output in the northern part of the area, fairly widespread sand and gravel output, and stone production in the vicinity of Memphis. Ball clay is marketed extensively, whereas sand, gravel, and stone are locally consumed.

In 1969, total value of mineral production in WRPA 3 was in excess of \$6 million. Nonmetallic minerals accounted for all output.

Table 12 lists the mineral production in the area by commodity, unit of production, quantity, and value (in current dollars) for the years 1956, 1963, and 1969, and includes a summary of quantity and value for the years 1956-69, inclusive.

PROJECTIONS OF MINERAL PRODUCTION AND RELATED WATER AND LAND NEEDS

Projections of Mineral Production

Production of ball clay in WRPA 3 is expected to increase sharply during the 1969-2020 interval to satisfy national demands. Output of sand, gravel, and stone should expand in step with area growth. Value of nonmetallic mineral output may advance from about \$6 million to the \$28.8-29.8 million range by 2020 (all in terms of 1967 dollars), which represents an increase of approximately 380 percent in value of production.

Projections of mineral production and value, as well as summaries for the years 1980, 2000, and 2020, are listed in table 15. Data are projected in the specified unit of production for the individual mineral commodities, and all values are in terms of 1967 dollars.

Projections of Water and Land Needs

Mineral industry in WRPA 3 diverted an estimated 810 acre-feet of water and depleted 346 acre-feet of this supply to record its 1969 output. Based upon foreseen increases in mineral output through 2020, diversions are expected to rise to about 2.3-2.5 thousand acre-feet, an increase of about 185-210 percent. During the same 1969-2020 interval, depletions should climb to approximately 788-898 acre-feet, an increase of 130-160 percent.

Projections of water needs--both diversions and depletions--for the production of individual mineral commodities, together with summaries for the years 1980, 2000, and 2020, are listed in table 14.

Table 12 - WRPA 3, Mineral Production, 1956, 1965, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956		1965		1969		Total 1956 - 1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Clays.....short tons..	515,084	\$4,960	499,021	\$5,128	519,703	\$5,711	6,045,721	\$68,812
Sand and gravel.....thousand short tons..	2,511	2,206	5,756	5,152	2,651	2,902	41,270	41,476
Stone.....do.....	0	0	0	0	W	W	W	W
Total ^{1/}		7,165		8,580		W		110,968

W Withheld to avoid disclosing individual company confidential data.

^{1/} Figures may not add because of rounding.

Table 13 - WRPA 3, Mineral Production and Value, 1969, and Projections for 1980, 2000, and 2020
(Thousand 1967 dollars adjusted by Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	Projection	1969		1980		2000		2020	
		Production	Value	Production	Value	Production	Value	Production	Value
Nonmetallic minerals:									
Clays.....short tons..	Program-A-B	519,705	\$5,358	659,400	\$6,716	1,352,200	\$13,992	2,131,500	\$22,587
Sand and gravel.....thousand short tons..	Program-A..	2,651	2,626	2,990	2,984	4,020	4,012	5,420	5,409
do.....do.....	Program-B..	2,651	2,626	5,275	4,570	4,561	4,561	6,300	6,287
Stone.....do.....	Program-A..	W	W	421	534	567	718	764	969
do.....do.....	Program-B..	W	W	463	586	645	817	888	1,125
Total, nonmetallic minerals.....	Program-A..	-	W	-	10,254	-	18,722	-	28,765
do.....	Program-B..	-	W	-	10,575	-	19,370	-	29,799

W Withheld to avoid disclosing company confidential information.

Table 14 - ACPA 3, Projections of Mineral Production and Water Needs, 1995, 1998, 2000, 2005, and 2020

Commodity, unit of production	1995				2000				2005				2010				2020				
	Production		Water needs, acre-feet		Production		Water needs, acre-feet		Production		Water needs, acre-feet		Production		Water needs, acre-feet		Production		Water needs, acre-feet		
	Production	Diversion	Production	Depletion	Production	Diversion	Production	Depletion	Production	Diversion	Production	Depletion	Production	Diversion	Production	Depletion	Production	Diversion	Production	Depletion	
Nonmetallic minerals	314,791	141	637,470	282	1,755,200	508	60	1,151,200	941	111											
Clay	2,031	273	2,000	611	4,020	879	482	1,350	1,185	665											
Sand and gravel	4,035	575	3,480	403	4,570	996	559	6,764	1,377	771											
Stone	8	94	411	107	967	144	12	888	226	26											
Other	8	99	405	118	645	104	12	888	226	26											
Other, nonmetallic minerals	8	99	405	118	645	104	12	888	226	26											
Other, metallic minerals	8	99	405	118	645	104	12	888	226	26											
Other, metallic minerals	8	99	405	118	645	104	12	888	226	26											
Other, metallic minerals	8	99	405	118	645	104	12	888	226	26											

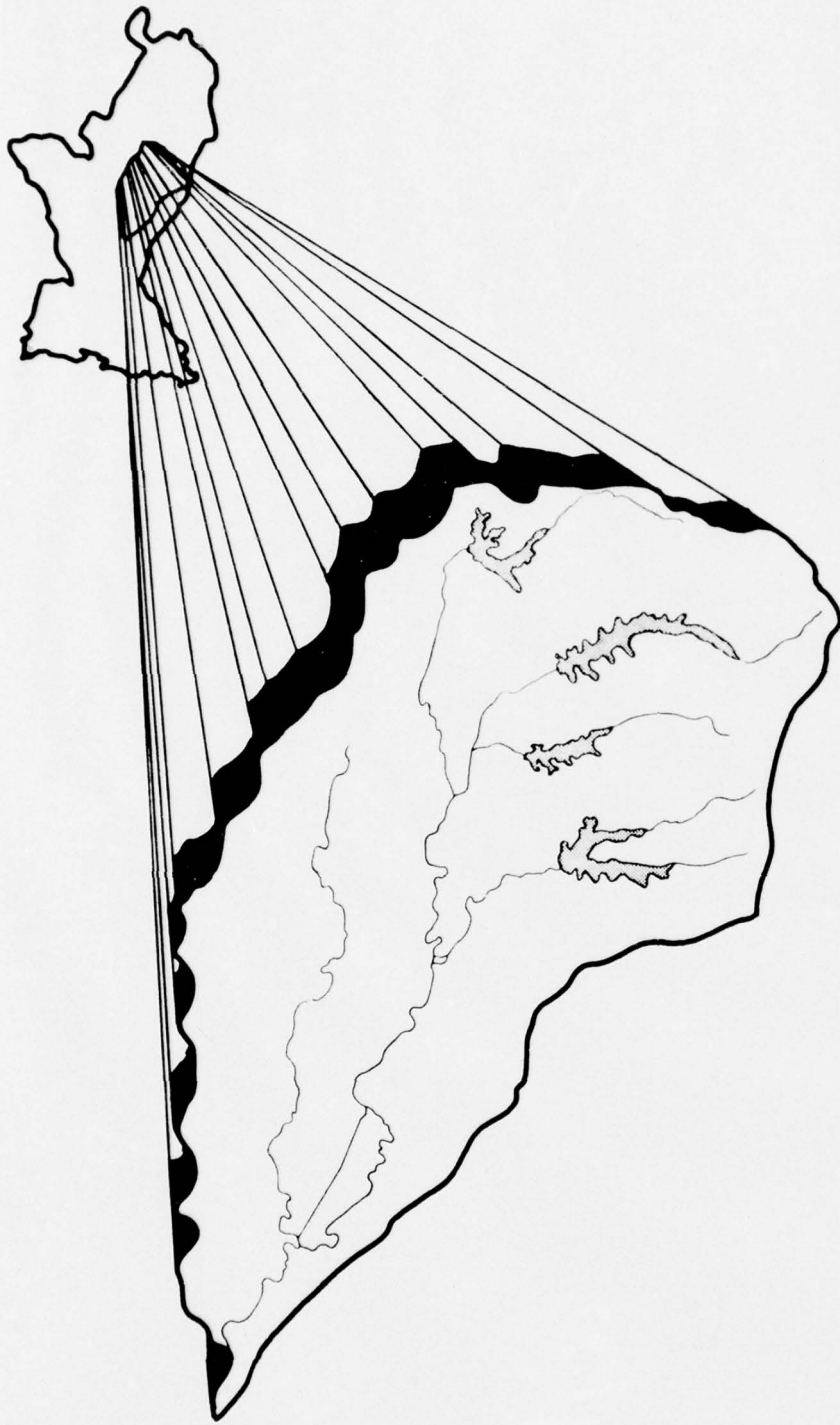
1/ Excludes 10 percent of national demand.
 2/ Assume 15 percent will be wasted.

Land use by mineral industry in WRPA 3 is a very small fraction of total acreage in the area. In 1969, mineral industry land use amounted to 2.4 thousand acres. By 2020, land needs are expected to swell to about 14.0-14.2 thousand acres, representing about a 480-percent increase.

Projections of estimated land needs for the production of nonmetallic minerals for the years 1980, 2000, and 2020 are listed in table 15.

Table 15 - WRPA 3, Projections of Land Use Needs for Mineral Resources, Acres

Commodity	Projection	1969	1980	2000	2020
Nonmetallic minerals...	Program-A.	2,400	4,400	8,900	14,000
Do.....	Program-B.	2,400	4,450	9,000	14,200
Total, all minerals....	Program-A.	2,400	4,400	8,900	14,000
Do.....	Program-B.	2,400	4,450	9,000	14,200



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WRPA 4

MINERAL RESOURCE BASE

WRPA 4 is in northwestern Mississippi. It is bordered by counties in Arkansas and Louisiana on the west (along the Mississippi River), Tennessee counties on the north, and Mississippi counties on the east and south. The 26 counties in the area are as follows:

Benton	Issaquena	Sunflower
Bolivar	Lafayette	Tallahatchie
Calhoun	Leflore	Tate
Carroll	Marshall	Tunica
Coahoma	Pauola	Union
DeSoto	Pontotoc	Warren
Grenada	Quitman	Washington
Holmes	Sharkey	Yalobusha
Humphrey		Yazoo

Oil and gas are produced in the southern part of the area. Geologic conditions are favorable for oil and gas accumulations northward into the central part of the area. Lignite deposits exist in the southern and eastern parts, and their possible future development should be noted. Nonmetallic minerals are produced in about two-thirds of the 26 counties in the area in any given year. Metallic minerals are not produced in the region, and geologic conditions do not favor their occurrence.

Mineral Fuels

Petroleum and Natural Gas

Most oil and gas produced in Mississippi is recovered from the tier of counties that make up the southern one-third of the State. Production in WRPA-4 has been limited to the area's southernmost counties, which are in the middle-third of the State. However, the Desha basin underlies the west-central part of the area and, containing up to 20,000 feet of sediments, it has a good potential for oil and gas deposits. Unfortunately, the cost of drilling exploration wells increases almost geometrically with depth and, therefore, is a negative factor in exploration programs. (Average depth of all wells drilled in Mississippi in recent years has been in excess of 8,000 feet, compared with a national average of a little less than 5,000 feet.)

Specific reserve data for WRPA 4 are not available, but as of December 31, 1969, Mississippi had proved recoverable reserves of 360 million barrels of crude oil and 1.41 trillion cubic feet of natural gas.

The Lower Mississippi Region had estimated resources of 137 billion barrels of oil and 616 trillion cubic feet of gas.

During the period 1956-69, WRPA 4 produced about 4 percent of the crude oil and 0.2 percent of the natural gas in the region. Assuming a similar share of the total estimated resources, WRPA 4 would have approximately 550 million barrels of oil and 1.0 trillion cubic feet of gas remaining (table 3). Projected total petroleum output through 2020 ranges between 200 and 254 million barrels. Cumulative gas output through 2020 would be a maximum of 14 billion cubic feet. The oil and gas resource base, therefore, seems capable of supporting production projections through 2020.

Nonmetallic Minerals

Clay, Sand, Gravel, and Stone

Clays, sand, and gravel are found throughout much of the area. Stone outcrops are less commonplace. The resource base of these construction minerals generally is adequate to meet foreseen production through 2020.

PRESENT MINERAL PRODUCTION

Oil and gas output in the southern part of WRPA 4 and widespread production of construction minerals define the mineral industry activity in the area. Sand and gravel is produced in more than half the counties in the area in any given year to meet local needs. Clay is produced in several counties, mostly for local consumption, and stone is produced in Warren County. Cement is manufactured in Warren County from locally produced minerals for regionwide markets.

Total value of mineral output in WRPA 4 in 1969 was almost \$15 million and about equally divided between fuels and nonmetallic minerals.

Table 16 lists the mineral production in the area by commodity, unit of production, quantity, and value (in current dollars) for the years 1956, 1965, and 1969, plus a summary of quantity and value for the years 1956-69, inclusive.

Table 16 - WPPA 4, Mineral Production, 1956, 1963, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956		1963		1969		Total 1956 - 1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Cement:								
Masonry.....280-pound barrels...	0	0	W	W	W	W	W	W
Portland.....thousand 576-pound barrels...	0	0	W	W	W	W	W	W
Clays.....short tons...	106,698	\$578	215,589	\$940	503,904	\$1,643	2,766,761	\$13,022
Natural gas.....million cubic feet.	1/NA	1/NA	10	2	112	20	477	84
Petroleum.....thousand barrels...	NA	11,486	5,267	9,016	2,627	7,663	29,653	126,533
Sand and gravel.....thousand short tons...	2,082	1,997	1,954	2,084	5,451	5,900	54,253	36,054
Stone.....do.....	0	0	W	W	W	W	W	W
Total.....		15,861		14,767		14,718		204,085

W Withheld to avoid disclosing company confidential information.

1/ Included with petroleum.

PROJECTIONS OF MINERAL PRODUCTION AND RELATED WATER AND LAND NEEDS

Projections of Mineral Production

Production of oil and gas is expected to increase about 250 percent by 2020 from the modest output in 1969. In all probability, the statistical method used to develop this estimate does not do justice to the oil and gas potential of this area. Value of mineral fuels output should increase from \$7.2 million in 1969 to \$14.2-17.7 million in 2020 (all in terms of 1967 dollars). Value of nonmetallic mineral production is projected to grow from \$7.5 million to \$12.3-17.3 million. Total value of mineral production, therefore, is projected to increase from \$14.7 million in 1969 to \$26.6-34.9 million in 2020, about an 80- to 140-percent increase during the interval.

Projection data for individual minerals and summaries for the years 1980, 2000, and 2020 are listed in table 17. Data are projected in the specified unit of production for each of the mineral commodities, and all values are in terms of 1967 dollars.

Projections of Water and Land Needs

Mineral industry water needs in WRPA 4 were an estimated 1,205 acre-feet of diversions and 598 acre-feet of depletions during 1969. Water needs to support projected mineral output through 2020 would climb to 1.8-2.2 thousand acre-feet of diversions, an increase of about 50-85 percent. Depletions would advance to about 840-990 acre-feet, an increase of 40-65 percent.

Projections of water needs--both diversions and depletions--for the production of individual mineral commodities are listed in table 18, together with summaries for the years 1980, 2000, and 2020.

Land use by mineral industry in WRPA 4 is a small fraction of total acreage in the area. Mineral industry land use amounted to an estimated 3.3 thousand acres in 1969. By 2020, land use is expected to increase to 5.3-7.4 thousand acres, an increase of 60-125 percent.

Projections of estimated land needs for minerals output for the years 1980, 2000, and 2020 are listed in table 19.

Table 17 - MPPA 4, Mineral Production and Value, 1969, and Projections for 1980, 2000, and 2020
(Thousand 1967 dollars adjusted by Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	1969		1980		2000		2020	
	Production	Value	Production	Value	Production	Value	Production	Value
Fuels:								
Natural gas.....million cubic feet..	112	\$19	150	\$26	220	\$38	289	\$49
Do.....do.....	112	19	183	31	305	52	426	73
Petroleum.....thousand barrels..	2,627	7,159	3,213	8,755	4,235	11,540	5,204	14,181
Do.....do.....	2,627	7,159	3,307	9,557	5,012	13,658	6,452	17,582
Summary, fuels.....	-	7,178	-	8,781	-	11,578	-	14,230
Do.....	-	7,178	-	9,588	-	13,710	-	17,655
Nonmetallic minerals:								
Cement:								
Masonry.....280-pound barrels..	W	W	10,000	30	10,900	33	13,000	39
Do.....do.....	W	W	10,800	52	12,400	37	14,700	44
Portland.....thousand 576-pound barrels..	W	W	410	1,414	418	1,546	529	1,823
Do.....do.....	W	W	442	1,525	508	1,755	601	2,073
Clays.....short tons..	303,904	2,240	362,400	2,671	517,700	3,815	766,200	5,647
Do.....do.....	303,904	2,240	430,400	3,319	828,400	6,105	1,309,900	9,654
Sand and gravel.....thousand short tons..	3,451	3,755	3,350	3,645	3,694	4,019	4,363	4,747
Do.....do.....	3,451	3,753	3,651	3,972	4,189	4,558	4,958	5,394
Stone.....do.....	W	W	60	70	66	77	78	91
Do.....do.....	W	W	65	76	74	87	88	103
Summary, nonmetallic minerals.....	-	7,541	-	7,850	-	9,490	-	12,549
Do.....	-	7,541	-	8,924	-	12,340	-	17,268
Total, all minerals.....	-	14,719	-	16,611	-	21,068	-	26,579
Do.....	-	14,719	-	18,512	-	26,250	-	34,923

W Withheld to avoid disclosing company confidential information.

Table 18 - WPA 4, Projections of Mineral Production and Water Needs, 1969, 1980, 2000, and 2020.

Commodity, unit of production	1969				2000				2020			
	Production		Water needs, acre-foot		Production		Water needs, acre-foot		Production		Water needs, acre-foot	
	Production	Diversion	Production	Diversion	Production	Diversion	Production	Diversion	Production	Diversion	Production	Diversion
Iron												
Million cubic feet..... Program A	112	(1)	159	(1)	220	(1)	289	(1)	289	(1)	289	(1)
..... Program B	112	(1)	183	(1)	305	(1)	426	(1)	426	(1)	426	(1)
Aluminum												
Thousand barrels..... Program A	2,627	(1)	7,213	(1)	4,233	(1)	3,204	(1)	3,204	(1)	3,204	(1)
..... Program B	2,627	(1)	3,207*	(1)	5,012	(1)	6,452	(1)	6,452	(1)	6,452	(1)
Phosphate												
Thousand barrels..... Program A	168	43	226	26	388	26	488	26	488	26	488	26
..... Program B	168	43	243	33	388	36	488	36	488	36	488	36
Coal												
Short tons..... Program A	0	8	122	14	199	24	313	23	313	23	313	23
..... Program B	0	8	122	14	236	14	313	14	313	14	313	14
Secondary Recovery^{1/}												
Thousand barrels..... Program A	0	8	122	14	199	24	313	23	313	23	313	23
..... Program B	0	8	122	14	236	14	313	14	313	14	313	14
Summers, fuels												
..... Program A	51	51	69	68	78	37	97	37	129	29	129	29
..... Program B	51	51	77	77	116	113	149	109	169	109	169	109
Nonferrous minerals												
Copper												
Short tons..... Program A	8	6	10,000	6	10,000	6	15,000	5	15,000	5	15,000	5
..... Program B	8	6	10,800	6	11,400	6	14,700	6	14,700	6	14,700	6
Lead												
Short tons..... Program A	8	8	410	239	105	263	112	229	112	229	112	229
..... Program B	8	8	442	238	111	266	127	230	127	230	127	230
Zinc												
Short tons..... Program A	303,004	133	362,400	160	442	259	517,500	357	766,000	401	1,200,000	438
..... Program B	303,004	133	400,000	199	25	638,400	422	1,200,000	422	1,200,000	422	1,200,000
Sand and gravel^{2/}												
Thousand short tons..... Program A	3,451	754	3,200	732	411	410	3,094	454	3,505	644	3,534	644
..... Program B	3,451	754	3,051	705	441	416	3,058	454	3,058	454	3,058	454
Stone												
Thousand short tons..... Program A	8	20	65	16	74	19	88	22	88	22	88	22
..... Program B	8	20	65	16	74	19	88	22	88	22	88	22
Summers, nonmetallic minerals												
..... Program A	1,134	547	1,132	536	1,321	595	1,321	595	1,321	595	1,321	595
..... Program B	1,134	547	1,277	585	1,404	687	1,404	687	1,404	687	1,404	687
Total, all minerals												
..... Program A	1,295	598	1,231	604	1,419	692	1,419	692	1,419	692	1,419	692
..... Program B	1,295	598	1,354	662	1,720	802	1,720	802	1,720	802	1,720	802

^{1/} Based on 50 percent of production by secondary recovery in 1969, 60 percent in 1980, 60 percent in 2000, and 87 percent in 2020.

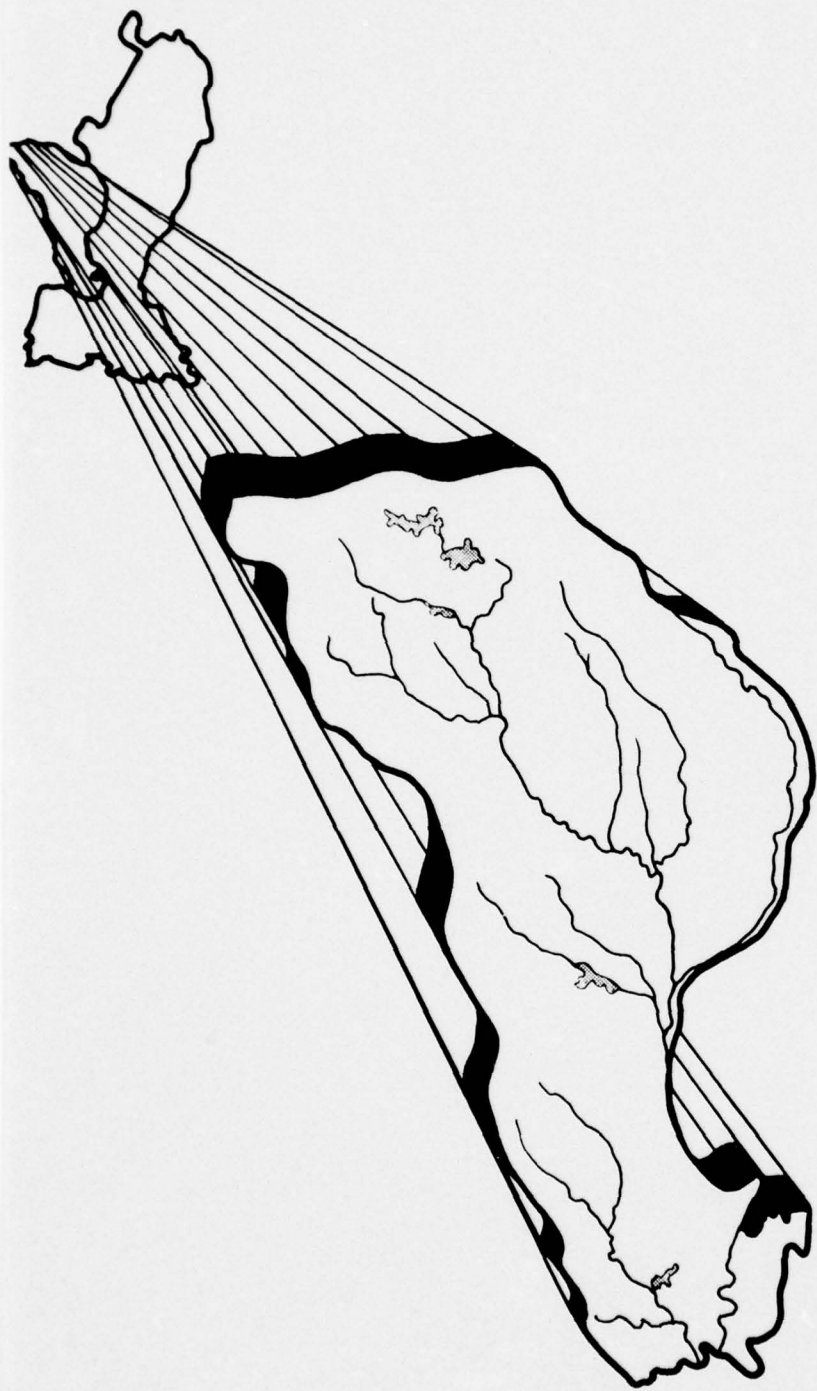
^{2/} Based on 40 percent of production by secondary recovery in 1969, 50 percent in 1980, 60 percent in 2000, and 87 percent in 2020.

^{3/} Based on 40 percent of production by secondary recovery in 1969, 50 percent in 1980, 60 percent in 2000, and 87 percent in 2020.

^{4/} Based on 95 percent of production will be washed.

Table 19 - WRPA 4, Projections of Land Use Needs
for Mineral Resources, Acres

Commodity	Projection	1969	1980	2000	2020
Fuels.....	Program-A.	100	100	125	150
Do.....	Program-B.	100	125	150	200
Nonmetallic minerals....	Program-A.	3,200	3,300	3,850	5,100
Do.....	Program-B.	3,200	3,700	5,200	7,200
Total, all minerals.....	Program-A.	3,300	3,400	3,975	5,250
Do.....	Program-B.	3,300	3,825	5,350	7,400



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WRPA 5

MINERAL RESOURCE BASE

WRPA 5 in south-central Arkansas and north-central Louisiana is bordered by out-of-area counties and parishes in Arkansas and Louisiana. The 18 counties and 12 parishes in the area are as follows:

ARKANSAS	Hot Spring	Caldwell
Ashley	Jefferson	Catahoula
Bradley	Lincoln	Claiborne
Calhoun	Montgomery	Grant
Clark	Nevada	Jackson
Cleveland	Ouachita	La Salle
Dallas	Pike	Lincoln
Drew	Union	Ouachita
Garland	LOUISIANA	Rapides
Grant	Avoyelles	Union
Hempstead		Winn

Oil or gas is produced in about two-thirds of the counties and parishes, and the resource base, particularly in the southern part of the area, is excellent. Undeveloped lignite deposits exist in several parts of the area, and their probable future utilization should be noted. Nonmetallic minerals are produced in almost all the counties and parishes in any given year, and the resource base generally is sound. Vanadium is produced in Garland County, Ark., and the resource base is believed to be sufficient to support projected output through 2020.

Mineral Fuels

Petroleum

Crude oil is produced in all the Louisiana parishes in the area and in six of the southern Arkansas counties (Bradley, Calhoun, Hempstead, Nevada, Ouachita, and Union). Reserve data for WRPA 5 are not readily available.

During the period 1956-69, WRPA 5 produced about 5.5 percent of the crude oil in the region. Assuming that the area contains a similar share of the total estimated resource, WRPA 5 would have approximately 7,550 million barrels of oil remaining (table 3). Total petroleum output through 2020 at the high level of production would be about 2,200 million barrels. The crude oil base, therefore, seems ample to supply the output projected through 2020.

Natural Gas

Natural gas is recovered in almost all of the Louisiana parishes and in Union County, Ark. Most of the natural gas is produced in the northern Louisiana parishes. The future for gas output in southern Arkansas is generally viewed by informed petroleum industry sources as not particularly promising; therefore, it is likely that by 1980-2000 most marketed natural gas will be produced in the Louisiana portion of the area.

WRPA 5 produced about 5.4 percent of the natural gas output in the region during the 1956-69 interval. If the area contains a similar share of the region's total estimated resource, WRPA 5 would have about 33 trillion cubic feet of gas remaining (table 3). Cumulative gas output through 2020 would be approximately 14 trillion cubic feet at the Program B level of production. The natural gas resource base, therefore, seems sound.

Metallic Minerals

Vanadium

Vanadium ore is produced from open pit mines and processed into vanadium oxide concentrate in Garland County, Ark. The resource base is sufficient to support output projections through 2020.

Nonmetallic Minerals

Barite

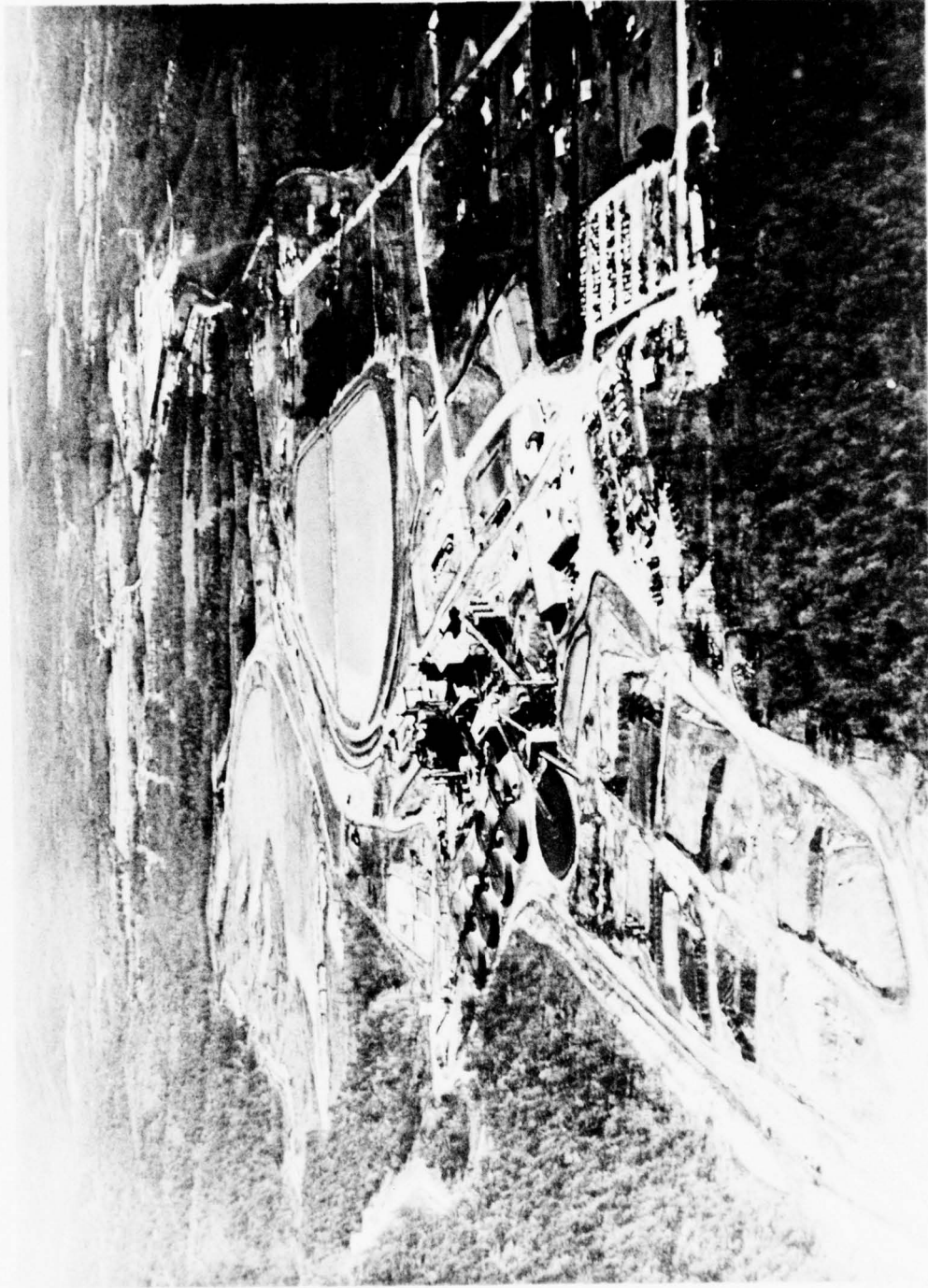
Barite is produced in Hot Spring County, Ark., for use in drilling muds used for oil and gas wells. The resource base is believed to be sufficient to satisfy the moderate growth in output projected through 2020.

Bromine

Bromine is recovered from brine produced from the Smackover limestone in Union County, Ark. Reserves are not quantitatively estimated. Considering the extent of the Smackover limestone in the area and the moderate rate of production, however, the resource base seems quite sufficient to assure projected output through 2020.

Clays, Gypsum, Sand, Gravel, and Stone

Construction minerals are produced in essentially all counties and parishes in WRPA 5 in any given year (Caldwell Parish, however, rarely records anything but oil and gas output). Although some clay is produced for chemical industry use, most of it is used for construction purposes. Quality of the construction minerals varies, but the resource base in the area is huge; therefore, no supply problems are anticipated through 2020.



Aerial view of vanadium mill in Garland County, Ark.

PRESENT MINERAL PRODUCTION

Mineral output in WRPA 5 is dominated by the petroleum industry, although a wide variety of nonmetallic minerals is produced. Oil and gas should continue to overshadow other mineral production through 2020, but nonmetals production is expected to increase at a greater rate.

In 1969, total value of mineral output in the area was about \$200 million. Mineral fuels made up \$155 million or about 78 percent of this total.

Table 20 lists the mineral production in WRPA 5 by commodity, unit of production, quantity, and value (in current dollars) for the years 1956, 1963, and 1969, and summarizes quantity and value for the years 1956-69, inclusive.

PROJECTIONS OF MINERAL PRODUCTION AND RELATED WATER AND LAND NEEDS

Projections of Mineral Production

Minerals output in WRPA 5 is expected to increase through 2020. Projected value of mineral fuels increases from \$155 million in 1969 to \$233-322 million in 2020, a 50-110 percent increase. Metallic and non-metallic minerals are foreseen to increase from about \$36 million in 1969 to \$62-98 million in 2020, about a 70-170 percent increase.

Projections for individual minerals and summaries for the years 1980, 2000, and 2020 are listed in table 21. Data are projected in the specific unit of production for each of the minerals, and all values are in terms of 1967 dollars.

Projections of Water and Land Needs

Mineral industry in WRPA 5 diverted an estimated 61,600 acre-feet of water and depleted about 9,800 acre-feet of this supply in 1969. Based upon projected increases in mineral output through 2020, diversions would rise to 100,900-161,400 acre-feet, an increase of 65-160 percent. During the same interval, depletions would climb to about 20,600-28,800 acre-feet, an increase of 110-190 percent.

Projections of water needs--both diversions and depletions--for the production of individual mineral commodities and summary totals for the years 1980, 2000, and 2020 are listed in table 22.

Table 20 - WPPA 5, Mineral Production, 1956, 1965, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956		1965		1969		Total 1956 - 1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Abrasives.....short tons..	151	\$57	W	W	W	W	W	\$2,001
Barite.....do.....	480,254	4,256	W	W	W	W	W	58,280
Bromine.....thousand pounds..	0	0	W	W	W	W	W	75,726
Clays.....short tons..	W	W	W	W	W	W	W	11,011
Gem stones.....pounds..	NA	25	8,093	\$42	NA	\$24	NA	345
Gypsum, crude.....short tons..	W	W	W	W	W	W	W	8,290
Iron ore.....long tons..	0	0	W	W	0	0	0	807
Lime.....short tons..	0	0	W	W	W	W	W	5,481
Manganese.....do.....	0	0	0	0	0	0	0	114
Mercury.....76-pound flask..	0	0	0	0	0	0	0	170
Natural gas.....million cubic feet..	199,790	22,668	255,423	46,149	155,146	29,770	2,777,916	482,776
Natural gas Liquids.....thousand barrels..	5,966	17,337	6,885	15,622	15,370	55,865	92,910	253,682
Petroleum.....do.....	29,857	85,745	22,657	72,952	31,003	98,392	405,315	1,213,787
Salt.....thousand short tons..	W	W	W	W	W	W	W	11,789
Sand and gravel.....do.....	4,415	5,030	5,774	4,945	6,617	7,270	69,527	86,146
Stone.....do.....	450	1,025	W	W	W	W	W	18,293
Vanadium.....short tons..	0	0	0	0	0	0	0	W
Total.....		136,928		149,114		W		1/2,200,000

W Withheld to avoid disclosing company confidential information.

NA Not available.

1/ Approximate total.

Table 41 - MPA 5, Mineral Production and Value, 1960, 1969, and Projections for 1980, 2000, and 2020
(Thousand 1967 dollars adjusted by Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	1960		1980		2000		2020	
	Production	Value	Production	Value	Production	Value	Production	Value
fuels:								
Natural gas.....million cubic feet..	135,116	\$28,552	217,000	\$30,928	251,000	\$42,504	245,000	\$45,080
do.....do.....	135,116	28,552	267,500	49,128	330,000	60,720	394,000	72,496
Natural gas liquids.....thousand barrels..	13,370	57,291	18,750	46,757	19,201	49,775	21,190	52,765
do.....do.....	13,370	57,291	25,000	57,494	28,545	71,077	34,080	84,850
Petroleum.....do.....	31,005	93,150	33,500	100,527	58,450	117,215	44,100	135,114
do.....do.....	31,005	93,150	55,200	106,594	44,270	132,111	53,800	165,000
summary, fuels.....								
do.....	154,653	154,653	187,492	187,492	-	201,492	-	252,057
do.....	154,653	154,653	215,216	215,216	-	269,908	-	322,555
metallic minerals:								
Vanadium ore.....short tons..	W	W	1,000	5,080	1,000	5,080	1,000	5,080
do.....do.....	W	W	1,500	4,620	2,000	6,160	3,000	9,240
Summary, metallic minerals.....								
do.....	-	W	-	5,080	-	5,080	-	5,080
do.....	-	W	-	4,020	-	6,160	-	9,240
nonmetallic minerals:								
Asbestos.....short tons..	W	W	7,500	544	7,000	508	6,500	472
do.....do.....	W	W	8,000	580	8,000	580	8,000	580
Barite, crude.....do.....	W	W	215,800	4,917	220,200	5,065	227,800	5,250
do.....do.....	W	W	204,000	6,776	454,700	9,998	575,500	13,236
Bromine.....thousand pounds..	W	W	90,185	21,644	122,562	29,415	154,585	37,052
do.....do.....	W	W	107,000	25,694	170,804	40,293	233,968	56,152
Clays.....short tons..	W	W	535,525	612	598,216	719	490,537	887
do.....do.....	W	W	502,400	655	440,675	795	506,156	1,024
Gem stones.....pounds..	NA	NA	55	55	NA	55	NA	55
do.....do.....	NA	NA	55	55	NA	55	NA	55
Gypsum, crude.....short tons..	W	W	185,370	581	217,017	691	264,165	829
do.....do.....	W	W	197,255	649	240,683	755	303,303	958
do.....do.....	W	W	6,067	120	7,127	141	8,811	175
do.....do.....	W	W	6,490	129	7,879	156	10,171	201
do.....do.....	W	W	6,883	9,178	8,045	10,714	9,753	12,911
Sand and gravel.....thousand short tons..	6,617	8,805	7,804	9,225	8,919	11,929	11,240	14,912
do.....do.....	6,617	8,805	522	1,424	612	1,435	750	1,758
do.....do.....	W	W	557	1,595	678	1,930	866	2,050
do.....do.....	W	W	557	1,595	678	1,930	866	2,050
Summary, nonmetallic minerals.....								
do.....	34,060	34,060	58,855	58,855	-	48,715	-	59,558
do.....	34,060	34,060	45,618	45,618	-	66,922	-	89,128
Total, all minerals.....								
do.....	W	W	429,427	429,427	-	261,285	-	295,595
do.....	W	W	265,554	265,554	-	339,890	-	420,725

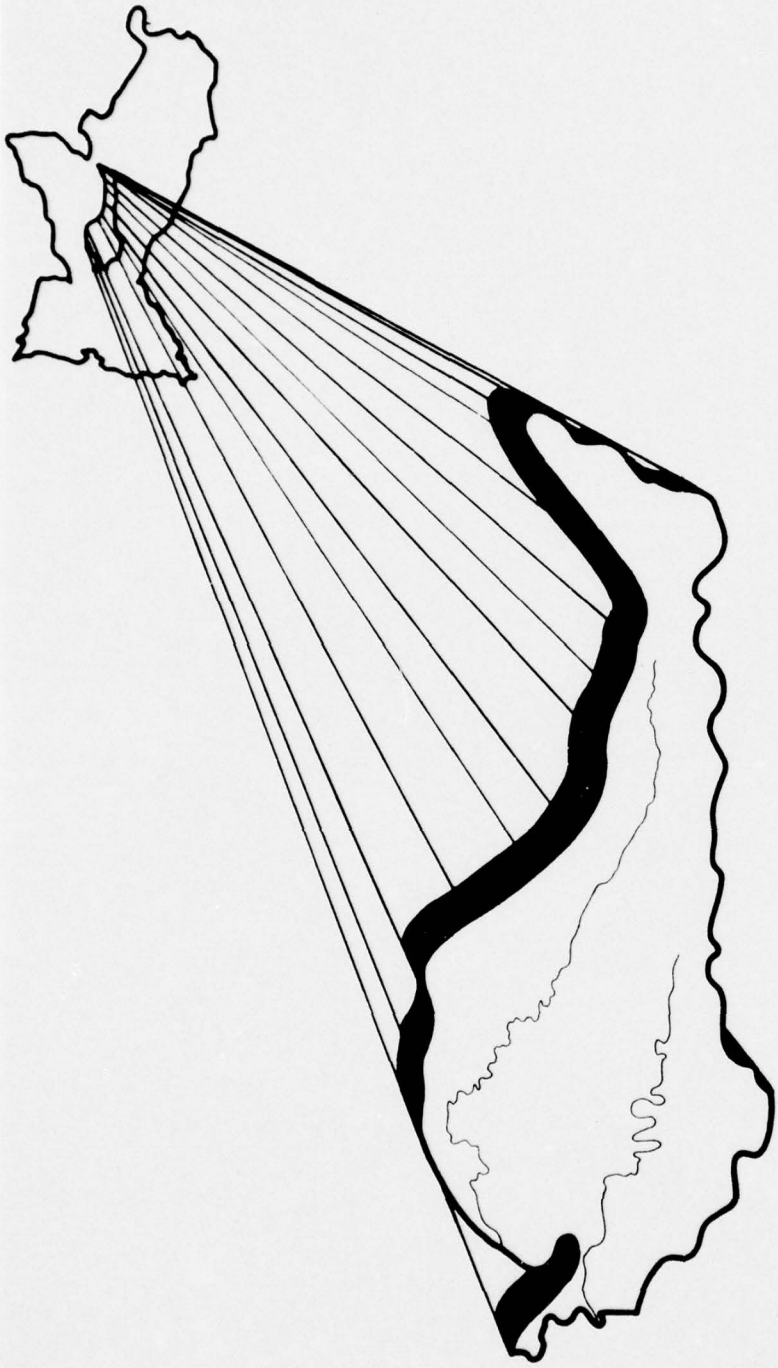
NA Not available.
W Withheld to avoid disclosing company confidential information.

Land use in WRPA 5 by mineral industry, totaling about 8,400 acres in 1969, is a small part of total acreage in the area. Such land needs are expected to increase to about 10-15 thousand acres by 2020, a 20-80 percent increase.

Projections of estimated land needs for the production of minerals and summaries for the years 1980, 2000, and 2020 are listed in table 25.

Table 25 - WRPA 5, Projections of Land Use Needs for Mineral Resources, Acres

Commodity	Projection	1969	1980	2000	2020
Fuels.....	Program-A.	4,400	4,600	4,800	5,000
Do.....	Program-B.	4,400	4,950	5,550	6,200
Metallic minerals.....	Program-A.	1,000	1,000	1,000	1,000
Do.....	Program-B.	1,000	1,500	2,000	3,000
Nonmetallic minerals...	Program-A.	3,000	3,050	3,620	4,250
Do.....	Program-B.	3,000	3,260	4,200	5,350
Total, all minerals....	Program-A.	8,400	8,650	9,420	10,250
Do.....	Program-B.	8,400	9,710	11,750	14,550



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WRPA 6

MINERAL RESOURCE BASE

WRPA 6 is centrally located in the region and is comprised of counties in southeast Arkansas and parishes in northeast Louisiana. It is bordered by out-of-area counties and parishes in Arkansas and Louisiana on the north, west, and south, and by Mississippi on the east. The two counties and eight parishes in the area are as follows:

ARKANSAS	Franklin
Chicot	Madison
Desha	Morehouse
LOUISIANA	Richland
Concordia	Tensas
East Carroll	West Carroll

Oil or gas is produced in all of the Louisiana parishes. Sand and gravel are produced in small quantities in a few of the counties and parishes in any given year. Geologic conditions favor substantially increased output of natural gas and moderately increased output of crude oil through 2020. The resource base of sand and gravel, although variable in quality, is essentially unlimited.

Mineral Fuels

Petroleum

Crude oil has been produced in most of the Louisiana parishes in WRPA 6 in recent years. Reserve data for the area are not readily available.

During the 1956-69 interval, WRPA 6 produced about 2.7 percent of the crude oil in the region. Assuming that a similar share of the total regional resource exists in WRPA 6, the area would have about 3,710 million barrels of oil remaining (table 3). Cumulative petroleum production through 2020 at the Program B level of output would be less than 1 billion barrels; therefore, the estimated resource base would be quite capable of supporting projected output through 2020.

Natural Gas

All of the parishes in the Louisiana portion of the area have recorded natural gas output in recent years. Reserve data for WRPA 6 are not readily available.

Natural gas production in WRPA 6 amounted to about 1.4 percent of regional output during the 1956-69 period. Assuming that this production

is indicative of the resource base, 8.5 trillion cubic feet of gas would remain. The cumulative output of natural gas through 2020, influenced by a recent strong uptrend, would approximate 11 trillion cubic feet, thereby exceeding the estimated resource by about a 30-percent margin. It is probable, then, based upon the methodology used to estimate the resource base, that exhaustion of the natural gas resource would occur in WRPA 6 sometime between 2000 and 2020. Countering this negative statistical factor is a positive physical factor--namely, the area is underlain by sediments 20,000 feet thick, and much of the area has not been probed. In summary, the natural gas resource base in WRPA 6, may prove troublesome in the long-range future--possibly soon after 2000.

Nonmetallic Minerals

Sand and Gravel

Sand and gravel are produced in small amounts in both the Arkansas and Louisiana parts of the area. The resource base, although of inferior quality in some places, is essentially inexhaustible in WRPA 6.

PRESENT MINERAL PRODUCTION

Oil and gas output, for all practical purposes, constitutes the mineral industry in WRPA 6. In 1969, total value of mineral output in the area was about \$68 million, and oil and gas values made up 99.5 percent of this total. The remainder was sand and gravel output.

Table 24 lists the mineral production in WRPA 6 by commodity, unit of production, quantity, and value (in current dollars) for the years 1956, 1963, and 1969, and summarizes quantity and value for the years 1956-69, inclusive.

PROJECTIONS OF MINERAL PRODUCTION AND RELATED WATER AND LAND NEEDS

Projections of Mineral Production

Minerals output in WRPA 6 is expected to increase through 2020. Natural gas should show the sharpest growth, increasing by about 100 percent through 2000, and possibly some additional growth through the remaining 20 years. Output of crude oil should be up some 80 percent by 2020. Sand and gravel production should grow moderately through 2020.

Projections for individual minerals and summaries for the years 1980, 2000, and 2020 are listed in table 25. Data are projected in the

Table 24 - BRPA 6, Mineral Production, 1956, 1965, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956		1965		1969		Total 1956 - 1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Natural gas.....million cubic feet...	56,675	\$4,181	41,226	\$8,165	112,815	\$21,660	747,057	\$152,142
Natural gas liquids.....thousand barrels...	464	1,091	1,676	3,816	1,600	4,208	16,157	39,580
Petroleum.....do.....	14,953	45,845	15,727	42,871	12,729	42,066	201,198	655,515
Sand and gravel.....thousand short tons...	269	171	469	452	293	521	5,746	8,218
Total.....		49,288		55,302		68,255		815,455

Table 25 - 80(V) 6, Mineral Production and Value, 1969, and Projections for 1980, 2000, and 2020
 (thousand 1967 dollars adjusted by Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	1969		1980		2000		2020	
	Production	Value	Production	Value	Production	Value	Production	Value
Fuels:								
Natural gas.....million cubic feet..	112,815	\$20,870	115,000	\$21,275	185,000	\$53,855	252,000	\$46,620
Do.....do.....	112,815	20,870	128,000	25,680	225,000	41,625	320,000	50,200
Natural gas liquids.....thousand barrels..	1,600	4,000	1,630	4,075	2,600	6,500	3,600	9,000
Do.....do.....	1,600	4,000	1,820	4,550	3,200	8,000	4,550	11,375
Petroleum.....do.....	12,729	59,714	13,000	40,560	13,800	45,056	14,700	45,864
Do.....do.....	12,729	59,714	13,500	48,560	19,000	59,280	22,800	71,136
Summary, fuels.....	-	64,584	-	65,910	-	85,411	-	101,484
Do.....do.....	-	64,584	-	76,500	-	108,005	-	141,711
Nonmetallic minerals:								
Sand and gravel.....thousand short tons..	295	363	271	326	271	336	292	362
Do.....do.....	295	363	280	358	285	355	321	398
Summary, nonmetallic minerals.....	-	363	-	356	-	356	-	362
Do.....do.....	-	363	-	358	-	355	-	398
Total, all minerals.....	-	64,947	-	66,246	-	85,747	-	101,846
Do.....do.....	-	64,947	-	76,048	-	100,258	-	142,100

specific unit of production for each of the minerals, and all values are in terms of 1967 dollars.

Projections of Water and Land Needs

Mineral industry diverted an estimated 7,900 acre-feet and depleted 2,300 acre-feet of water in WRPA 6 during 1969. Through 2020, diversions are expected to rise to 17,900-23,800 acre-feet, an increase of about 125-200 percent. Depletions would climb to 5,100-7,700 acre-feet, an increase of about 120-235 percent.

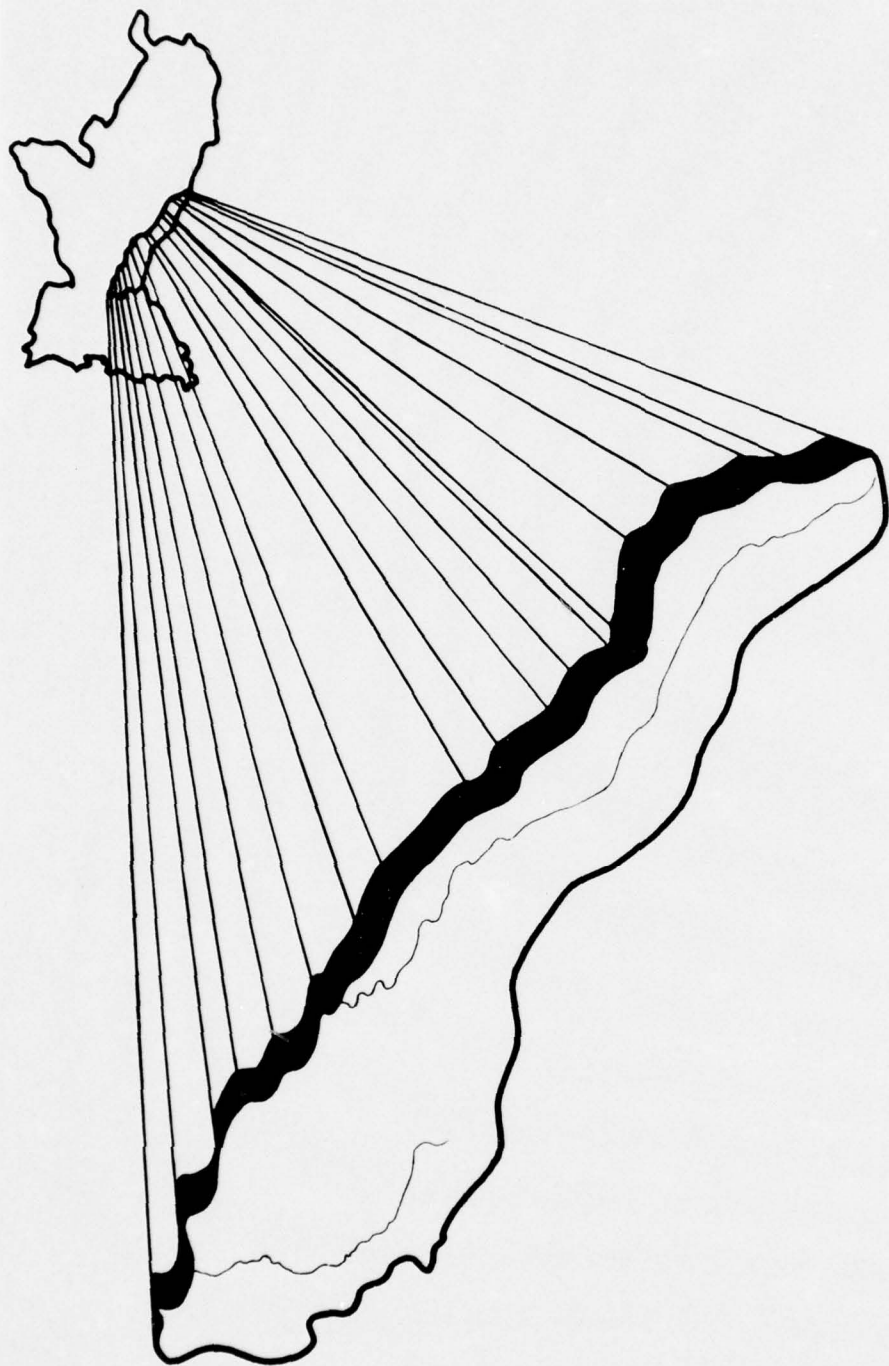
Projections of water diversions and depletions for the production of individual mineral commodities, together with summary totals for the years 1980, 2000, and 2020, are listed in table 26.

Land use in WRPA 6 by mineral industry is negligible. In 1969, a total of about 1,800 acres was occupied, and this use is expected to increase to about 3,600 to 4,700 acres in 2020, a 100-160 percent increase.

Projections of estimated land needs for the production of minerals and summaries for the years 1980, 2000, and 2020 are listed in table 27.

Table 27 - WRPA 6, Projections of Land Use Needs
for Mineral Resources, Acres

Commodity	Projection	1969	1980	2000	2020
Fuels.....	Program-A.	1,800	1,900	2,700	3,600
Do.....	Program-B.	1,800	2,150	3,375	4,650
Nonmetallic minerals....	Program-A.	30	30	30	30
Do.....	Program-B.	30	30	30	40
Total, all minerals.....	Program-A.	1,850	1,930	2,730	3,630
Do.....	Program-B.	1,850	2,180	3,405	4,690



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WRPA 7

MINERAL RESOURCE BASE

WRPA 7 is located in central and southwest Mississippi. It is bordered on the southwest by Louisiana and elsewhere by out-of-area counties in Mississippi. The 10 counties in the area are as follows:

Adams	Claiborne	Montgomery
Attala	Franklin	Webster
Choctaw	Jefferson	Wilkinson
	Madison	

Crude oil or natural gas is produced in about half the counties in the area in any given year. Small quantities of clay, sand, and gravel are produced in a few counties for local use. The area possesses favorable geologic conditions for oil and gas accumulations, and increased output through 2020 is expected. The resource base for the nonmetallic minerals currently produced is strong.

Mineral Fuels

Petroleum and Natural Gas

Crude oil and natural gas have been produced in most of the counties in recent years, and the bulk of the output was recovered from the southwestern cluster of counties.

During the 1956-69 period, WRPA 7 recorded about 1.7 percent of the oil output and 0.4 percent of the gas output in the region. If it contains a parallel share of the region's resources, the area would have about 2,350 million barrels of oil and 2.5 trillion cubic feet of gas remaining (table 3). Total petroleum production through 2020 at the high rate of output would be about 1,500 million barrels, while gas output would be about 0.35 trillion cubic feet. The estimated resource base, therefore, appears quite capable of supplying the projected output through 2020.

Lignite

Discontinuous deposits of lignite exist in the central-Mississippi tier of counties. As in other areas of the Lower Mississippi Region, no development is projected for these deposits through 2020 in any particular area; however, some utilization within the Lower Mississippi Region is quite likely. Specific deposits to be put into production will be determined both by increased knowledge of the various lignite deposits and by developing regional demand for the lignite as a mineral fuel and possibly as feed material for the regional chemical industry.

Nonmetallic Minerals

Clay, Sand, and Gravel

Small amounts of clay, sand, and gravel are produced in the region to satisfy local needs. The resource base is ample to meet the modest volume of output anticipated through 2020.

PRESENT MINERAL PRODUCTION

The petroleum industry accounted for about \$48 million of the approximate total \$50 million in minerals output in 1969. Sand, gravel, and clay made up the remaining 3 percent of value of mineral production.

Table 28 lists the mineral production in WRPA 7 by commodity, unit of production, quantity, and value (in current dollars) for the years 1956, 1963, and 1969, and summarizes quantity and value for the years 1956-69, inclusive.

PROJECTIONS OF MINERAL PRODUCTION AND RELATED WATER AND LAND NEEDS

Projections of Mineral Production

Steady moderate growth in minerals output through 2020 is foreseen for WRPA 7. Oil and gas should maintain their dominant position throughout the period.

Projections for individual minerals and summaries for the years 1980, 2000, and 2020 are listed in table 29. Data are projected in the specific unit of production for each of the minerals, and all values are in terms of 1967 dollars.

Projections of Water and Land Needs

Water use in WRPA 7 in 1969 included an estimated 4,100 acre-feet of diversions and 4,000 acre-feet of depletions. By 2020, diversions are projected to increase to 9,900-12,200 acre-feet, up about 140-200 percent. Depletions would parallel this increase to 9,600-11,900 acre-feet, a rise in the same percentage range as diversions. Most of the water is used by the petroleum industry, principally in secondary recovery operations wherein water is injected into oil-bearing strata to augment recoveries.

Table 28 - WSPA 7, Mineral Production, 1956, 1963, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956		1963		1969		Total 1956 - 1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
		\$3						
Clays.....short tons..	2,813	(1)	0	0	0	0	205,914	\$1,828
Iron ore (usable).....long tons..	185	(2)	52,367	\$5,826	3,364	\$592	52	1
Natural gas.....million cubic feet..	NA	(2)	174	571	65	140	216,661	39,940
Natural gas liquids.....thousand barrels..	NA		9,655	26,648	16,285	47,501	1,765	4,109
Petroleum.....do....	NA	3/35,547	401	609	862	980	123,995	486,505
Sand and gravel.....thousand short tons..	489	757					7,087	10,184
Total.....		54,307						542,367

NA Not available.

1/ Less than 1/2 unit.

2/ Combined with petroleum.

3/ Includes natural gas and natural gas liquids.

Table 29 - WPA 7, Mineral Production and Value, 1969, and Projections for 1980, 2000, and 2020
(Thousand 1967 dollars adjusted by Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	Projection	1969		1980		2000		2020	
		Production	Value	Production	Value	Production	Value	Production	Value
Fuels:									
Natural gas.....million cubic feet..	Program-A	3,364	\$576	4,149	\$709	5,623	\$961	7,063	\$512
Do.....do.....do.....do.....do.....	Program-B	5,364	576	4,757	814	7,243	1,239	9,605	1,642
Natural gas liquids.....thousand barrels..	Program-A	65	160	118	288	190	465	262	645
Do.....do.....do.....do.....do.....	Program-B	65	160	119	291	193	471	266	650
Petroleum.....do.....do.....do.....do.....	Program-A	16,285	44,295	19,917	54,175	26,251	71,403	32,245	87,706
Do.....do.....do.....do.....do.....	Program-B	16,285	44,295	21,741	59,435	31,072	84,516	39,996	108,789
Summary, fuels.....do.....do.....do.....	Program-A	-	45,051	-	55,172	-	72,829	-	89,556
Do.....do.....do.....do.....do.....	Program-B	-	45,051	-	60,240	-	86,226	-	111,081
Nonmetallic minerals:									
Clays.....do.....do.....do.....do.....do.....	Program-A	W	W	11,500	108	12,800	122	15,100	144
Do.....do.....do.....do.....do.....	Program-B	W	W	12,500	119	14,000	142	17,700	169
Sand and gravel.....thousand short tons..	Program-A	862	1,224	885	1,251	1,000	1,414	1,185	1,675
Do.....do.....do.....do.....do.....	Program-B	862	1,224	978	1,382	1,163	1,644	1,588	1,962
Summary, nonmetallic minerals.....do.....	Program-A	-	W	-	1,539	-	1,536	-	1,819
Do.....do.....do.....do.....do.....	Program-B	-	W	-	1,501	-	1,786	-	2,131
Total, all minerals.....do.....do.....do.....	Program-A	-	W	-	56,531	-	74,365	-	91,575
Do.....do.....do.....do.....do.....	Program-B	-	W	-	61,741	-	88,012	-	113,212

W Withheld to avoid disclosing company confidential information.

Projections of water diversions and depletions for the production of individual mineral commodities and summary totals for the years 1980, 2000, and 2020 are listed in table 30.

Mineral industry land use in WRPA 7 is negligible. In 1969, approximately 800 acres was used, and future use is expected to increase to about 1,400-1,650 acres by 2020, a 75-105 percent increase.

Projections of estimated land needs for mineral industry for the years 1980, 2000, and 2020 are listed in table 31.

Table 30 - MPA 7, Projections of Mineral Production and Water Needs, 1969, 1980, 2000, and 2020

Commodity, unit of production	1969				2000				2020			
	Production		Water needs, acre-feet		Production		Water needs, acre-feet		Production		Water needs, acre-feet	
	Production	Depletion	Production	Depletion	Production	Depletion	Production	Depletion	Production	Depletion	Production	Depletion
Hydrocarbons:												
Natural gas, million cubic feet.....	5,264	(1)	4,459	(1)	5,632	(1)	7,465	(1)	7,465	(1)	7,465	(1)
D.....	5,264	(1)	4,459	(1)	5,632	(1)	7,465	(1)	7,465	(1)	7,465	(1)
Natural gas liquids, thousand barrels.....	55	26	4,717	(1)	7,235	(1)	9,282	(1)	9,282	(1)	9,282	(1)
D.....	55	26	4,717	(1)	7,235	(1)	9,282	(1)	9,282	(1)	9,282	(1)
Petroleum:												
Production.....	26,480	(1)	19,417	(1)	20,421	(1)	32,243	(1)	32,243	(1)	32,243	(1)
D.....	26,480	(1)	19,417	(1)	20,421	(1)	32,243	(1)	32,243	(1)	32,243	(1)
Production, including:	15,668	(1)	11,741	(1)	11,072	(1)	30,006	(1)	30,006	(1)	30,006	(1)
D.....	15,668	(1)	11,741	(1)	11,072	(1)	30,006	(1)	30,006	(1)	30,006	(1)
Production, excluding:	10,812	(1)	7,676	(1)	9,349	(1)	2,237	(1)	2,237	(1)	2,237	(1)
D.....	10,812	(1)	7,676	(1)	9,349	(1)	2,237	(1)	2,237	(1)	2,237	(1)
Secondary recovery ² , thousand barrels.....	6,254	774	9,959	1,354	18,313	2,154	3,078	3,078	3,078	3,078	3,078	3,078
D.....	6,254	774	9,959	1,354	18,313	2,154	3,078	3,078	3,078	3,078	3,078	3,078
Summary, fuels.....												
D.....	3,120	3,883	10,470	4,094	21,439	2,433	34,737	4,433	34,737	4,433	34,737	4,433
D.....	3,120	3,883	10,470	4,094	21,439	2,433	34,737	4,433	34,737	4,433	34,737	4,433
Nonferrous minerals:												
Clay.....												
Production.....	8	5	11,200	5	11,800	5	15,100	7	15,100	7	15,100	7
D.....	8	5	11,200	5	11,800	5	15,100	7	15,100	7	15,100	7
Sand and gravel ³ , thousand short tons.....	862	188	855	193	1,060	219	1,185	209	1,185	209	1,185	209
D.....	862	188	855	193	1,060	219	1,185	209	1,185	209	1,185	209
Silica, nonmetallic minerals.....												
Production.....	193	197	198	199	198	199	198	197	198	197	198	197
D.....	193	197	198	199	198	199	198	197	198	197	198	197
Total, all minerals.....	4,113	3,992	11,470	5,193	21,439	4,584	36,919	5,203	36,919	5,203	36,919	5,203
D.....	4,113	3,992	11,470	5,193	21,439	4,584	36,919	5,203	36,919	5,203	36,919	5,203

¹ - Withheld to avoid disclosing company confidential information.

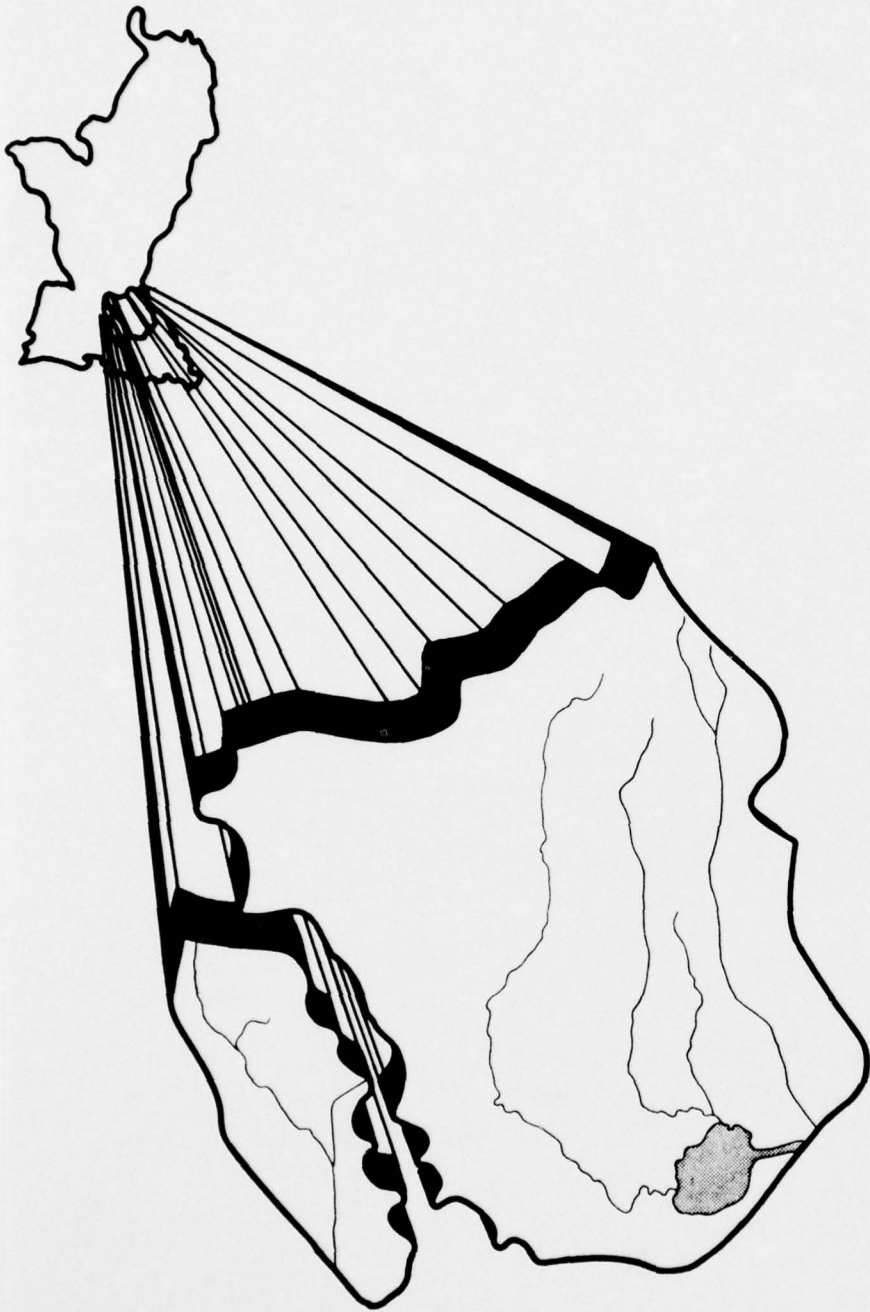
² - Assumed to be secondary recovery.

³ - Assume 40 percent of production will be washed.

⁴ - No iron ore production is projected because it probably is not competitive with other sources.

Table 31 - WRPA 7, Projections of Land Use Needs
for Mineral Resources, Acres

Commodity	Projection	1969	1980	2000	2020
Fuels.....	Program-A.	420	510	690	880
Do.....	Program-B.	420	570	800	1,040
Nonmetallic minerals.....	Program-A.	390	400	435	535
Do.....	Program-B.	390	430	510	620
Total, all minerals.....	Program-A.	810	910	1,125	1,415
Do.....	Program-B.	810	1,000	1,310	1,660



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WRPA 8

MINERAL RESOURCE BASE

WRPA 8 parishes are clustered about the city of Baton Rouge, La. It is bordered by out-of-area parishes on the east, south, and west, and by Mississippi counties on the north. The area is comprised of 10 parishes and 1 county as follows:

LOUISIANA	Iberville	W. Baton Rouge
Ascension	Livingston	W. Feliciana
E. Baton Rouge	Pointe Coupee	MISSISSIPPI
E. Feliciana	St. Helena	Amite
	Tangipahoa	

Petroleum or natural gas is produced in most of the parishes and in Amite County. Sand and gravel output also is recorded in most of the parishes, and clays, lime, and salt are also produced in the Louisiana portion of the area. The outlook for the petroleum industry is optimistic. The resource base for the nonmetallic minerals is very favorable.

Mineral Fuels

Petroleum

Crude oil has been produced in large quantities in recent years, and the western part of the area has contributed the bulk of the output.

During the 1956-69 period, WRPA 8 produced about 2.7 percent of the oil output in the region. Assuming that a similar share of the total regional resource exists in the area, WRPA 8 would have about 3,710 million barrels of crude oil remaining (table 3). Cumulative output through 2020 would be approximately 2,300 million barrels, well within the estimated total resource.

Natural Gas

Most of the oil-producing parishes and Amite County also record gas output. Value of the natural gas production (including natural gas liquids) has increased in recent years, but remains in the shadow of petroleum value. (In the late 1960's, crude oil accounted for about 70 percent of the petroleum industry's value of output.)

Natural gas production in WRPA 8 amounted to about 1.3 percent of the regional total during 1956-69. Assuming the output to be an indication of the resource potential, about 8 trillion cubic feet of natural gas would remain in place (table 3). Total gas output through 2020 would be 9.6 trillion cubic feet, somewhat in excess of the estimated

resource. Although geologic conditions are very favorable in the area, a resource problem does seem quite possible between 2000 and 2020.

Nonmetallic Minerals

Clay, Lime, Sand, and Gravel

Sand and gravel are mined in most of the parishes, and clays are produced in five parishes on a fairly steady basis. Lime is produced in E. Baton Rouge County and is used in the manufacture of cement for regional needs. Although quality and access are local problems, the resource base in the area is believed to be adequate to satisfy projected output through 2020.

Salt

Salt is produced in Ascension and Iberville Parishes. The resource base is immense.

PRESENT MINERAL PRODUCTION

In recent years the petroleum industry has accounted for about 70 percent of the value of mineral output in WRPA 8. Salt and the construction minerals make up the remainder of mineral production. No metallic minerals are produced.

Table 32 lists the mineral production in WRPA 8 by commodity, unit of production, quantity, and value (in current dollars) for the years 1956, 1965, and 1969, and summarizes quantity and value for the years 1956-69, inclusive.

PROJECTIONS OF MINERAL PRODUCTION AND RELATED WATER AND LAND NEEDS

Projections of Mineral Production

Minerals output in WRPA 8 is projected to increase sharply through 2020. Salt production should show the most pronounced increase--on the order of 600 percent. Crude oil output should increase by as much as 220 percent, and if the resource base of natural gas proves to be more promising than is currently assumed, gas output also could rise more than 200 percent by 2020. Nonmetallic minerals as a group in 1969 made up about 30 percent of the total value of mineral output, but by 2020 this group could represent 35 to 40 percent of value of minerals output.

Table 32 - WAPA 8, Mineral Production, 1956, 1965, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956		1965		1969		Total 1956 - 1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Cement:								
Masonry.....280-pound barrels..	W	W	W	W	W	W	W	W
Portland.....thousand 576-pound barrels..	W	W	W	W	W	W	W	W
Clays.....short tons..	W	W	W	W	825,731	W	6,354,706	8,581
Lime.....do.....	0	0	W	W	W	W	5,550,076	58,013
Natural gas.....million cubic feet..	2/30,596	\$5,488	42,701	\$8,445	91,071	W	662,510	116,766
Natural gas liquids.....thousand barrels..	19	66	198	452	2,850	W	8,495	17,450
Petroleum.....do.....	2/10,152	29,710	12,788	59,305	21,593	\$70,374	200,899	634,739
Salt.....thousand short tons..	W	W	W	W	W	W	32,043	101,968
Sand and gravel.....do.....	2,838	2,525	5,996	3,875	5,525	W	49,166	47,602
Stone.....do.....	41	41	0	0	0	0	44	45
Total.....		46,174		69,468		130,270		1,068,967

W Withheld to avoid disclosing company confidential information.
 1/ Less than 1/2 unit.
 2/ Estimated.

Projections for individual minerals and summaries for the years 1980, 2000, and 2020 are listed in table 35. Data are projected in the specific unit of production for each of the minerals, and all values are in terms of 1967 dollars.

Projections of Water and Land Needs

Mineral industry water needs in WRPA 8 amounted to about 31,200 acre-feet of diversions and 8,300 acre-feet of depletions in 1969. Diversions are projected to increase to 126-165 thousand acre-feet by 2020, a 300-450 percent increase. Depletions are expected to rise to 39-49 thousand acre-feet for a 370-490 percent increase.

Projections of water diversions and depletions for the production of individual mineral commodities and summary totals for the years 1980, 2000, and 2020 are listed in table 34.

Land use by mineral industry in WRPA 8 is minor. In 1969, an estimated total of 3,750 acres was used. By 2020, land use could reach 7,800-9,400 acres, about a 110-150 percent increase.

Projections of estimated land needs for the production of listed minerals and summaries for the years 1980, 2000, and 2020 are listed in table 35.

Table 33 - MRPA 8, Mineral Production and Value, 1969, and Projections for 1980, 2000, and 2020
(Thousand 1967 dollars adjusted by Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	Projection	1969		1980		2000		2020	
		Production	Value	Production	Value	Production	Value	Production	Value
Fuels:									
Natural gas.....million cubic feet..	Program-A.	91,071	W	112,000	\$20,720	152,000	\$28,120	191,000	\$55,355
Do.....do.....	Program-B.	91,071	W	153,000	24,605	211,000	39,035	287,000	53,095
Natural gas liquids.....thousand barrels..	Program-A.	2,850	W	3,500	8,750	4,800	12,000	6,000	15,000
Do.....do.....	Program-B.	2,850	W	4,200	10,500	6,600	16,500	9,000	35,500
Petroleum.....do.....	Program-A.	21,593	\$66,318	28,700	88,970	42,200	130,820	55,700	172,670
Do.....do.....	Program-B.	21,593	66,318	31,500	97,650	49,600	153,760	67,900	210,490
Summary, fuels.....	Program-A.	-	90,291	-	118,440	-	170,940	-	223,005
Do.....	Program-B.	-	90,291	-	132,755	-	209,295	-	286,085
Nonmetallic minerals:									
Cement:									
Masonry.....280-pound barrels..	Program-A.	W	W	65,080	179	76,320	216	95,380	270
Do.....do.....	Program-B.	W	W	66,960	189	84,440	239	108,040	306
Portland.....thousand 576-pound barrels..	Program-A.	W	W	2,130	6,607	2,580	8,075	3,220	10,079
Do.....do.....	Program-B.	W	W	2,260	7,074	2,850	8,920	3,650	11,424
Clays.....thousand short tons..	Program-A.	826	W	945	1,125	1,196	1,423	1,827	2,075
Do.....do.....	Program-B.	826	W	1,020	1,214	1,340	1,595	1,742	2,075
Lime.....short tons..	Program-A.	W	W	439,570	5,354	556,280	6,775	713,680	8,693
Do.....do.....	Program-B.	W	W	474,130	5,775	623,080	7,589	809,970	9,865
Salt.....thousand short tons..	Program-A.	W	W	7,690	28,453	16,770	62,049	26,980	99,826
Do.....do.....	Program-B.	W	W	8,440	31,228	20,750	76,775	34,670	128,279
Sand and gravel.....do.....	Program-A.	5,525	W	6,326	6,589	8,006	8,086	10,271	10,574
Do.....do.....	Program-B.	5,525	W	6,825	6,891	8,967	9,057	11,657	11,774
Stone.....do.....	Program-A.	0	0	1	1	1	1	1	1
Do.....do.....	Program-B.	0	0	1	1	2	2	2	2
Summary, nonmetallic minerals.....	Program-A.	-	35,566	-	48,168	-	86,625	-	131,070
Do.....	Program-B.	-	35,566	-	52,572	-	104,177	-	163,725
Total, all minerals.....	Program-A.	-	125,657	-	166,608	-	257,565	-	354,075
Do.....	Program-B.	-	125,657	-	185,127	-	313,472	-	449,808

W Withheld to avoid disclosing company confidential information.

Table 35 - WRPA 8, Projections of Land Use Needs
for Mineral Resources, Acres

Commodity	Projection	1969	1980	2000	2020
Fuels.....	Program-A.	850	1,100	1,500	2,000
Do.....	Program-B.	850	1,300	2,000	2,700
Nonmetallic minerals....	Program-A.	2,900	3,400	4,400	5,800
Do.....	Program-B.	2,900	3,600	5,050	6,700
Total, all minerals.....	Program-A.	3,750	4,500	5,950	7,800
Do.....	Program-B.	3,750	4,900	7,050	9,400

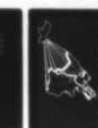
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LOWER MISSISSIPPI REGION COMPREHENSIVE STUDY. APPENDIX G. RELAT--ETC(U)
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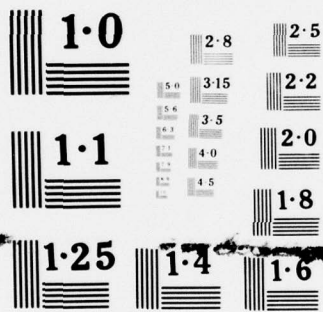
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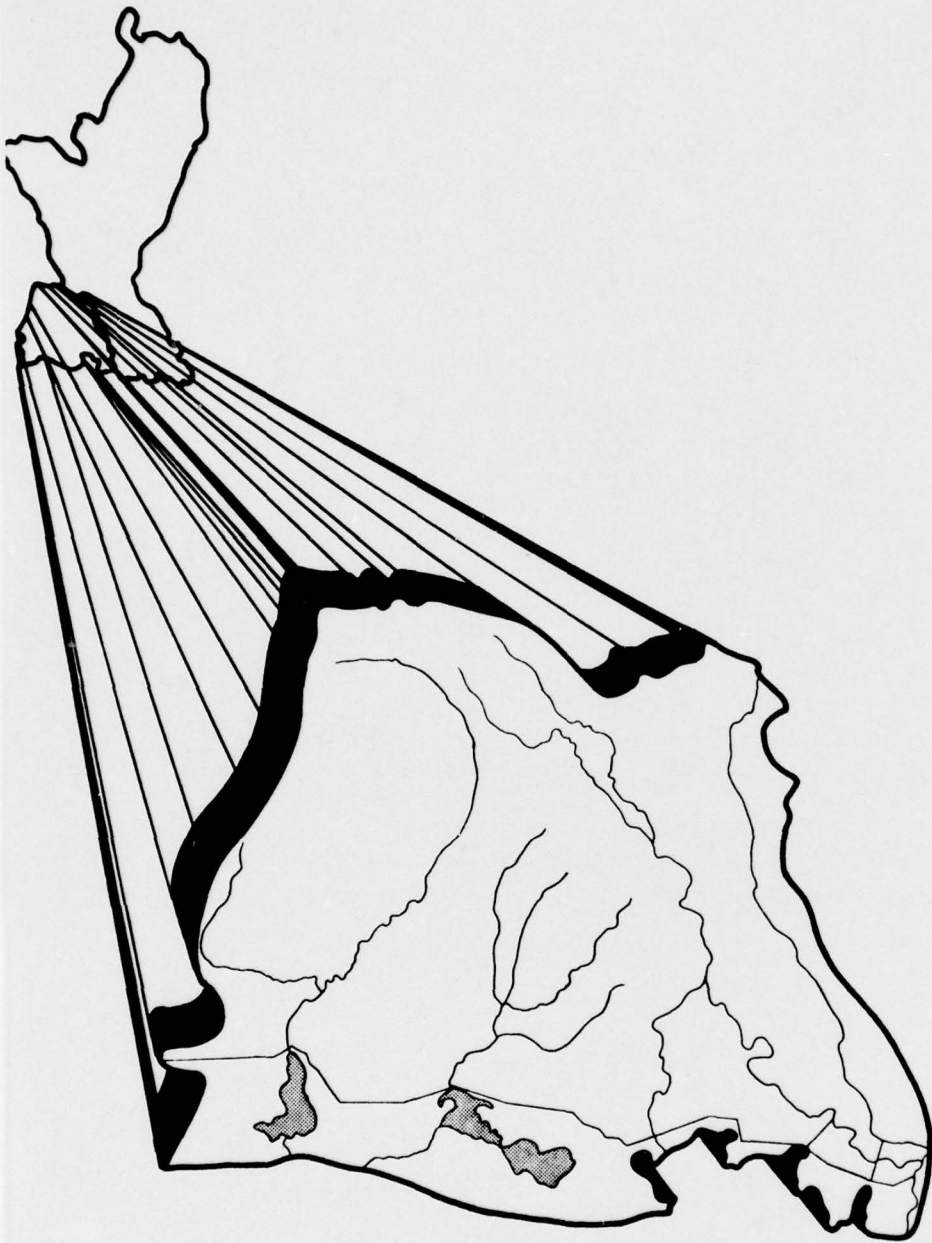


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WRPA 9

MINERAL RESOURCE BASE

WRPA 9 in southwest Louisiana is bordered by the Gulf of Mexico on the south, Texas on the west, and out-of-area Louisiana parishes on the north and east. The 14 Louisiana parishes within the area are as follows:

Acadia	Evangeline	St. Landry
Allen	Iberia	St. Martin
Beauregard	Jefferson Davis	St. Mary
Calcasieu	Lafayette	Vermillion
Cameron		Vernon

Mineral fuels or nonmetallic minerals are produced in all parishes in the area. The resource base of fuels and nonmetallic minerals generally is assumed to be sufficient to support the projections of mineral production through the year 2020. There are no known metallic deposits of economic significance in the area.

Mineral Fuels

Crude oil and natural gas have been produced in all parishes except Vernon Parish during the late 1960's. Offshore production has become particularly important in recent years.

Petroleum

During the 1956-69 interval, about 27 percent of the oil produced in the region was recovered in WRPA 9. If a similar share of the regional resource is assumed to exist in the area, WRPA 9 would still possess about 37 billion barrels of oil (table 3). Cumulative output through 2020 would be somewhat more than 18 billion barrels at the high rate of production, well within the estimated resource.

Natural Gas

WRPA 9 has been the leading producer of natural gas in the Lower Mississippi Region in the late 1960's. Value of output was about equal to that of petroleum in the area.

Approximately 53 percent of the region's natural gas output was recovered from WRPA 9 during the 1956-69 interval. Assuming a parallel share of the resource base, the area would have about 328 trillion cubic feet of gas remaining (table 3). Total gas production through 2020 at the estimated high rate of output would be about 310 trillion cubic feet. The resource base, then, appears to be quite tight; a more optimistic view probably would be apparent, however, if offshore potential was fully considered.

Nonmetallic Minerals

Salt

Resources of salt in WRPA 9 are virtually unlimited. Of the 88 known salt domes in the area (43 onshore and 45 offshore), salt volumes have been published for only 37 domes (27 onshore and 10 offshore). These 37 have an estimated total volume of 146.2 cubic miles of salt at depths less than 10,560 feet. At the 1969 rate of production for the United States--about 0.0042 cubic miles (44 million short tons)--and assuming 50 percent recovery, the 37 domes could supply the Nation's needs for 17,000 years.

Sand, Gravel, Clay, and Stone (Shell)

Sand, gravel, clay, and stone (shell) resources are virtually unlimited within WRPA 9. Moreover, most of these minerals are replenished. Quality problems exist, but, nevertheless, the resource base is quite adequate.

Sulfur

It is estimated that sulfur reserves in salt domes in Louisiana, including reserves offshore and that sulfur recovered from oil and gas production, total approximately 130 million long tons. It is not known what portion of this can be attributed to WRPA 9, but of the 183 known salt domes in Louisiana (116 onshore and 67 offshore), 88 are in WRPA 9. On this basis, about 62 million long tons of sulfur are in the area. Total projected production from 1969 to 2020 is 4.3 million long tons; therefore, the sulfur reserves are believed to be adequate.

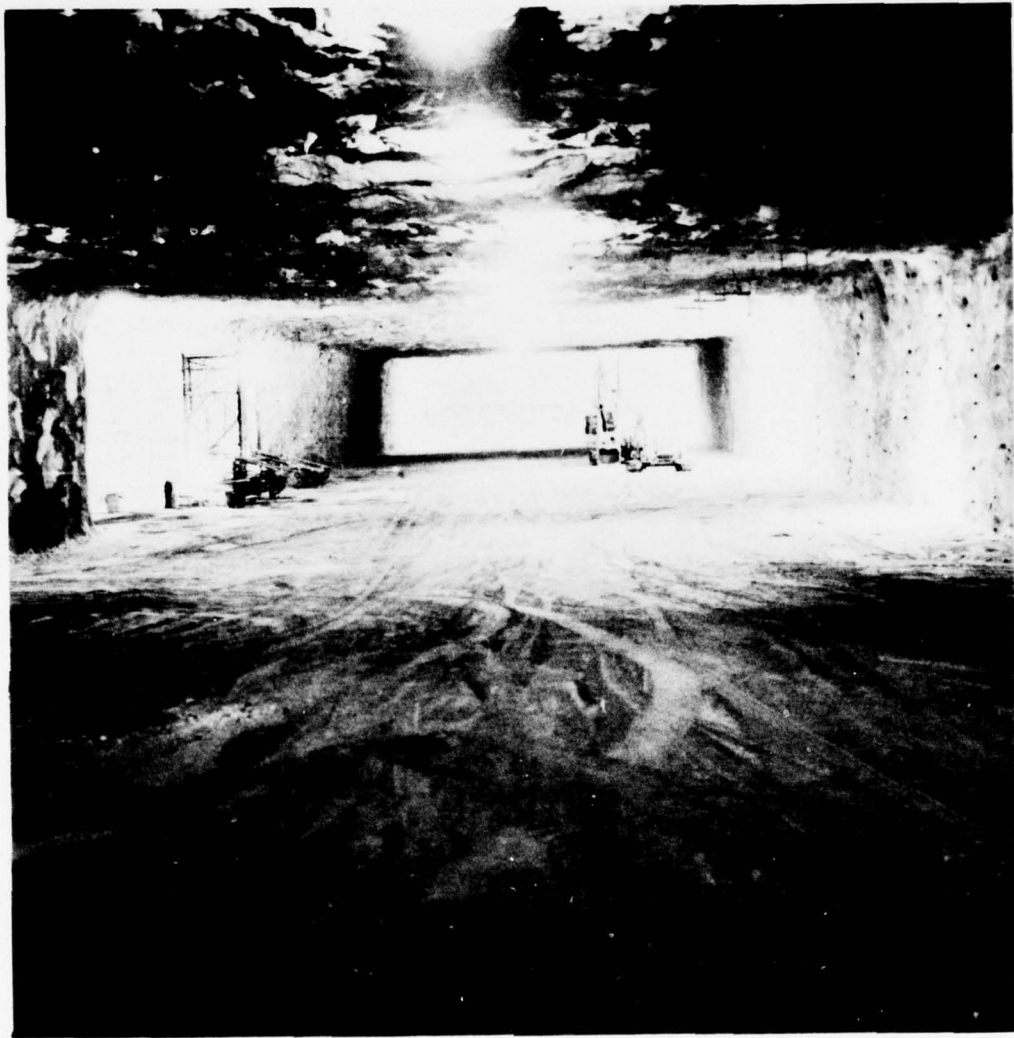
Cement and Lime

Cement and lime are traditionally listed with nonmetallic minerals. They are derived from the previously reviewed *clay and shell minerals* through a relatively simple manufacturing process. The resource base, again, is sufficient.

PRESENT MINERAL PRODUCTION

Mineral production in WRPA 9 historically has been dominated by the mineral fuels--petroleum, natural gas, and natural gas liquids. It is expected that this commanding position will prevail for many years; salt and sulfur, however, may exhibit more pronounced growth in output through 2020.

In 1969, total value of mineral production in WRPA 9 was \$1.57 billion, about 33 percent of the \$4.75 billion total value of mineral production in the Lower Mississippi Region. Mineral fuels accounted for \$1.51 billion or 96 percent of WRPA 9 output, salt added 2.6 percent, and other nonmetallics made up the remaining 1.4 percent.



Underground salt mining in southern Louisiana.

The nonmetallic minerals produced in the area, with the exception of salt and sulfur, are construction commodities. Value of construction minerals, clay, lime, sand, gravel, and stone, totaled \$13.8 million in 1969. With the closure of the Lone Star Cement Corp. plant at Lake Charles in April 1968, output of portland and masonry cement ceased in WRPA 9; it is assumed that because of general construction activity in the area, cement production will be resumed in the near future.

There was no 1969 production of metallic minerals in WRPA 9.

Table 36 lists mineral production in the area by commodity, unit of production, quantity, and value (in current dollars) for the years 1956, 1963, and 1969, and summarizes quantity and value for the years 1956-69, inclusive.

PROJECTIONS OF MINERAL PRODUCTION AND RELATED WATER AND LAND NEEDS

Projections of Mineral Production

Mineral output in WRPA 9 is expected to increase markedly during the 1969-2020 interval. Projections indicate that the value of mineral fuels may increase from \$1.48 billion in 1969 to the \$3.26-3.73 billion range by 2020 (all in terms of 1967 dollars), which represents an advance of about 120- to 150-percent. Value of nonmetallics output may rise from the \$57 million level in 1969 to the \$265-336 million range by 2020, an increase of 365- to 490-percent. Total value of mineral production, therefore, is projected to grow from \$1.53 billion to \$3.53-4.07 billion, a 130- to 165-percent increase during the period.

Projection data for individual minerals and summaries for the years 1980, 2000, and 2020 are listed in table 37. Data are projected in the specified unit of production for each of the mineral commodities, and all values are in terms of 1967 dollars.

Projections of Water and Land Needs

Mineral industry in WRPA 9 diverted an estimated 305 thousand acre-feet of water and depleted 49 thousand acre-feet of this supply to record its 1969 output. Based upon foreseen increases in mineral production through 2020, diversions are expected to rise to about 1,160-1,250 thousand acre-feet, an increase of 280-300 percent. During the same 1969-2020 interval, depletions should climb to approximately 201-257 thousand acre-feet, an increase of 310-380 percent.

Table 36 - WPPA 9, Mineral Production, 1956, 1963, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956		1963		1969		Total 1956 - 1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Cement:								
Masonry.....280-pound barrels..	0	0	149,741	\$390	0	0	896,268	\$2,327
Portland.....thousand 576-pound barrels..	0	0	1,205	5,484	0	0	11,356	53,477
Clays.....short tons..	W	W	W	W	W	W	W	W
Lime.....do..	W	W	W	W	W	W	W	W
Natural gas.....million cubic feet..	894,576	\$101,981	1,960,491	388,177	3,612,924	W	27,671,457	4,941,279
Natural gas liquids.....thousand barrels..	42,565	58,200	30,398	69,213	65,412	W	439,924	1,053,424
Petroleum.....do..	98,287	288,187	138,134	431,284	296,017	\$680,851	1,996,900	6,297,728
Salt.....thousand short tons..	2,365	13,973	3,422	22,391	6,981	40,921	53,030	532,949
Sand and gravel.....do..	W	W	2,122	3,253	2,437	3,630	26,091	39,386
Stone (shell).....do..	W	W	W	W	W	W	26,490	55,875
Sulfur, Frasch.....thousand long tons..	W	W	0	0	21	576	608	14,692
Total.....		452,491		923,622		1,568,542		12,797,186

W Withheld to avoid disclosing company confidential information.

Table 37 - MIPA 9, Mineral Production and Value, 1969, and Projections for 1980, 2000, and 2020
(Thousand 1967 dollars adjusted by Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	1969			1980			2000			2020		
	Production	Value	Projection	Production	Value	Projection	Production	Value	Projection	Production	Value	Projection
Fuels:												
Natural gas.....million cubic feet..	5,615,000	W	Program-A..	4,498,000	\$887,000	6,041,000	\$1,116,000	7,576,000	\$1,496,000			
Do.....do.....	5,615,000	W	Program-B..	4,816,000	892,800	6,724,000	1,226,200	8,433,000	1,562,400			
Natural gas liquids.....thousand barrels..	65,412	W	Program-A..	105,024	236,470	170,006	423,300	238,054	592,620			
Petroleum.....do.....	206,017	W	Program-A..	251,050	786,240	332,099	1,033,840	407,914	1,272,960			
Do.....do.....	206,017	W	Program-B..	275,033	858,000	393,980	1,226,160	505,978	1,578,720			
Summary, fuels.....			Program-A..		1,879,710		2,575,140		3,260,580			
Do.....do.....			Program-B..		2,007,270		2,895,660		3,733,740			
Nonmetallic minerals:												
Cement:												
Masonry.....280-pound barrels..	0	0	Program-A..	92,700	256	105,000	263	119,700	305			
Do.....do.....	0	0	Program-B..	99,000	252	118,800	305	139,500	356			
Portland.....thousand 576-pound barrels..	0	0	Program-A..	1,030	2,966	1,130	3,312	1,530	5,830			
Do.....do.....	0	0	Program-B..	1,100	3,168	1,320	3,802	1,530	4,464			
Clays.....short tons..	W	W	Program-A..	154,500	179	172,500	200	199,500	231			
Do.....do.....	W	W	Program-B..	165,000	101	198,000	230	232,500	270			
Lime.....do.....	W	W	Program-A..	349,400	4,280	590,000	4,778	431,000	5,325			
Do.....do.....	W	W	Program-B..	373,100	4,570	417,700	5,184	323,700	6,440			
Salt.....thousand short tons..	6,981	W	Program-A..	11,200	67,088	24,430	146,336	39,300	235,407			
Do.....do.....	6,981	W	Program-B..	13,300	75,677	30,223	181,036	50,300	302,495			
Sand and gravel.....do.....	2,437	W	Program-A..	2,810	3,863	2,803	4,517	3,241	4,091			
Do.....do.....	2,437	W	Program-B..	2,681	4,129	3,211	4,034	3,777	5,817			
Stone (shell).....do.....	W	W	Program-A..	4,030	6,732	5,520	7,507	6,395	8,697			
Do.....do.....	W	W	Program-B..	5,280	7,195	6,547	8,632	7,453	10,136			
Sulfur, Frasch.....thousand long tons..	W	W	Program-A..	45	1,089	90	3,724	152	3,928			
Do.....do.....	W	W	Program-B..									
Summary, nonmetallic minerals.....		57,106	Program-A..		87,035		170,437		264,914			
Do.....do.....		57,106	Program-B..		94,869		208,165		335,906			
Total, all minerals.....		1,532,272	Program-A..		1,266,745		2,745,577		3,525,494			
Do.....do.....		1,532,272	Program-B..		2,102,139		3,103,825		4,069,646			

W Withheld to avoid disclosing company confidential information.

Projections of water needs--both diversions and depletions--for the production of individual mineral commodities and summary totals for the years 1980, 2000, and 2020 are listed in table 38.

Land use by mineral industry in WRPA 9 is a relatively small part of total acreage in the area. In 1969, the approximately 6,500 acres being used was less than 0.1 percent of the total land area. Total land needs are expected to increase to about 25.6-25.6 thousand acres by 2020, a 260-290 percent escalation.

Projections of estimated land needs for the production of mineral fuels and nonmetallics, together with summaries for the years 1980, 2000, and 2020, are listed in table 39.

Table 38 - 8000 9. Projections of Mineral Production and Water Needs, 1960, 1980, 2000, and 2020

Commodity, unit of production	Projection	1960				2000				2020			
		Production		Water needs, acre-feet		Production		Water needs, acre-feet		Production		Water needs, acre-feet	
		Production	Diversion	Depletion	Depletion	Production	Diversion	Depletion	Depletion	Production	Diversion	Depletion	
Metals:													
Natural gas.....million cubic feet.....	Program A.....	3,013,000	(1)	(1)	6,418,000	(1)	(1)	6,941,000	(1)	(1)	7,576,000	(1)	(1)
.....	Program B.....	3,211,000	(1)	(1)	4,816,000	(1)	(1)	6,724,000	(1)	(1)	8,433,000	(1)	(1)
.....	Program C.....	65,412	243,185	15,406	4,015,024	386,247	23,886	170,006	637,330	39,423	238,034	80,262	55,102
Nonferrous:													
.....	Program A.....	286,017	(1)	(1)	532,099	(1)	(1)	532,099	(1)	(1)	407,214	(1)	(1)
.....	Program B.....	300,000	(1)	(1)	505,080	(1)	(1)	505,080	(1)	(1)	505,078	(1)	(1)
.....	Program C.....	10,474	1,706	1,706	1,441	1,441	1,441	1,441	1,441	1,441	1,441	1,441	1,441
.....	Program D.....	10,474	2,706	2,706	3,524	3,524	3,524	3,524	3,524	3,524	4,248	4,248	4,248
.....	Program E.....	52,407	30,001	25,478	125,980	39,059	38,059	229,148	108,616	70,807	351,881	169,433	169,433
.....	Program F.....	82,407	50,001	25,478	137,546	65,185	42,672	271,225	138,361	83,204	441,201	208,655	136,058
Secondary fuels:													
.....	Program A.....	286,017	44,320	44,320	448,005	63,886	63,886	749,066	114,250	114,250	1,065,425	169,006	169,006
.....	Program B.....	286,017	45,350	45,350	454,634	60,882	60,882	770,635	127,059	127,059	1,107,050	197,373	197,373
Nonmetallic minerals:													
.....	Program A.....	0	0	0	92,700	54	23	105,000	60	26	110,700	70	30
.....	Program B.....	0	0	0	99,000	58	25	118,800	60	30	130,500	81	35
.....	Program C.....	0	0	0	1,030	600	258	1,150	670	288	1,330	775	332
.....	Program D.....	0	0	0	1,400	641	275	1,520	730	330	1,650	904	388
.....	Program E.....	0	0	0	10,400	98	9	12,500	76	9	139,500	88	10
.....	Program F.....	0	0	0	10,400	98	9	12,500	76	9	139,500	88	10
.....	Program G.....	0	0	0	30,000	17	17	30,000	17	17	30,000	17	17
.....	Program H.....	0	0	0	375,000	17	17	447,000	20	20	524,000	20	20
.....	Program I.....	0	0	0	41,200	26,040	8,245	24,430	50,800	17,985	30,300	91,373	28,633
.....	Program J.....	0	0	0	11,300	18,398	9,055	3,223	70,268	21,257	50,209	117,412	37,178
.....	Program K.....	0	0	0	2,510	348	307	2,803	613	543	3,241	709	306
.....	Program L.....	0	0	0	4,951	586	528	5,217	703	303	3,777	826	462
.....	Program M.....	0	0	0	5,200	834	478	5,120	952	533	6,955	1,103	618
.....	Program N.....	0	0	0	5,200	834	478	5,120	952	533	6,955	1,103	618
.....	Program O.....	0	0	0	4,348	121	121	6,347	1,095	613	7,433	1,286	720
.....	Program P.....	0	0	0	43	178	130	96	1,033	277	132	1,675	411
.....	Program Q.....	0	0	0	17,849	5,078	4,611	60,343	10,478	10,478	95,816	30,780	30,780
.....	Program R.....	0	0	0	17,849	5,078	4,611	60,343	10,478	10,478	95,816	30,780	30,780
Total, all minerals:													
.....	Program A.....	3,013,000	243,185	15,406	4,816,000	386,247	23,886	6,418,000	637,330	39,423	8,433,000	80,262	55,102
.....	Program B.....	3,211,000	243,185	15,406	4,816,000	386,247	23,886	6,418,000	637,330	39,423	8,433,000	80,262	55,102
.....	Program C.....	65,412	243,185	15,406	4,015,024	386,247	23,886	170,006	637,330	39,423	238,034	80,262	55,102
.....	Program D.....	286,017	1,706	1,706	532,099	1,441	1,441	532,099	1,441	1,441	407,214	1,441	1,441
.....	Program E.....	300,000	2,706	2,706	505,080	3,524	3,524	505,080	3,524	3,524	505,078	3,524	3,524
.....	Program F.....	10,474	2,706	2,706	1,441	3,524	3,524	1,441	3,524	3,524	1,441	3,524	3,524
.....	Program G.....	10,474	2,706	2,706	1,441	3,524	3,524	1,441	3,524	3,524	1,441	3,524	3,524
.....	Program H.....	52,407	30,001	25,478	125,980	39,059	38,059	229,148	108,616	70,807	351,881	169,433	169,433
.....	Program I.....	82,407	50,001	25,478	137,546	65,185	42,672	271,225	138,361	83,204	441,201	208,655	136,058
.....	Program J.....	286,017	44,320	44,320	448,005	63,886	63,886	749,066	114,250	114,250	1,065,425	169,006	169,006
.....	Program K.....	286,017	45,350	45,350	454,634	60,882	60,882	770,635	127,059	127,059	1,107,050	197,373	197,373
.....	Program L.....	0	0	0	92,700	54	23	105,000	60	26	110,700	70	30
.....	Program M.....	0	0	0	99,000	58	25	118,800	60	30	130,500	81	35
.....	Program N.....	0	0	0	1,030	600	258	1,150	670	288	1,330	775	332
.....	Program O.....	0	0	0	1,400	641	275	1,520	730	330	1,650	904	388
.....	Program P.....	0	0	0	10,400	98	9	12,500	76	9	139,500	88	10
.....	Program Q.....	0	0	0	10,400	98	9	12,500	76	9	139,500	88	10
.....	Program R.....	0	0	0	30,000	17	17	30,000	17	17	30,000	17	17
.....	Program S.....	0	0	0	375,000	17	17	447,000	20	20	524,000	20	20
.....	Program T.....	0	0	0	41,200	26,040	8,245	24,430	50,800	17,985	30,300	91,373	28,633
.....	Program U.....	0	0	0	11,300	18,398	9,055	3,223	70,268	21,257	50,209	117,412	37,178
.....	Program V.....	0	0	0	2,510	348	307	2,803	613	543	3,241	709	306
.....	Program W.....	0	0	0	4,951	586	528	5,217	703	303	3,777	826	462
.....	Program X.....	0	0	0	5,200	834	478	5,120	952	533	6,955	1,103	618
.....	Program Y.....	0	0	0	5,200	834	478	5,120	952	533	6,955	1,103	618
.....	Program Z.....	0	0	0	4,348	121	121	6,347	1,095	613	7,433	1,286	720
.....	Program AA.....	0	0	0	43	178	130	96	1,033	277	132	1,675	411
.....	Program AB.....	0	0	0	17,849	5,078	4,611	60,343	10,478	10,478	95,816	30,780	30,780
.....	Program AC.....	0	0	0	17,849	5,078	4,611	60,343	10,478	10,478	95,816	30,780	30,780
Total, all minerals:													
.....	Program A.....	3,013,000	243,185	15,406	4,816,000	386,247	23,886	6,418,000	637,330	39,423	8,433,000	80,262	55,102
.....	Program B.....	3,211,000	243,185	15,406	4,816,000	386,247	23,886	6,418,000	637,330	39,423	8,433,000	80,262	55,102
.....	Program C.....	65,412	243,185	15,406	4,015,024	386,247	23,886	170,006	637,330	39,423	238,034	80,262	55,102
.....	Program D.....	286,017	1,706	1,706	532,099	1,441	1,441	532,099	1,441	1,441	407,214	1,441	1,441
.....	Program E.....	300,000	2,706	2,706	505,080	3,524	3,524	505,080	3,524	3,524	505,078	3,524	3,524
.....	Program F.....	10,474	2,706	2,706	1,441	3,524	3,524	1,441	3,524	3,524	1,441	3,524	3,524
.....	Program G.....	10,474	2,706	2,706	1,441	3,524	3,524	1,441	3,524	3,524	1,441	3,524	3,524
.....	Program H.....	52,407	30,001	25,478	125,980	39,059	38,059	229,148	108,616	70,807	351,881	169,433	169,433
.....	Program I.....	82,407	50,001	25,478	137,546	65,185	42,672	271,225	138,361	83,204	441,201	208,655	136,058
.....	Program J.....	286,017	44,320	44,320	448,005	63,886	63,886	749,066	114,250	114,250	1,065,425	169,006	169,006
.....	Program K.....	286,017	45,350	45,350	454,634	60,882	60,882	770,635	127,059	127,059	1,107,050	197,373	197,373
.....	Program L.....	0	0	0	92,700	54	23	105,000	60	26	110,700	70	30
.....	Program M.....	0	0	0	99,000	58	25	118,800	60	30	130,500	81	35
.....	Program N.....	0	0	0	1,030	600	258	1,150	670	288	1,330	775	332
.....	Program O.....	0	0	0	1,400	641	275	1,520	730	330	1,650	904	388
.....	Program P.....	0	0	0	10,400	98	9	12,500	76	9	139,500	88	10
.....	Program Q.....	0	0	0	10,400	98	9	12,500	76	9	139,500	88	10
.....	Program R.....	0	0	0	30,000	17	17	30,000	17	17	30,000	17	17
.....	Program S.....	0	0	0	375,000	17	17	447,000	20	20	524,000	20	20
.....	Program T.....	0	0	0	41,200	26,040	8,245	24,430	50,800	17,985	30,300		

Table 39 - WRPA 9, Projections of Land Use Needs
for Mineral Resources, Acres

Commodity	Projection	1969	1980	2000	2020
Fuels.....	Program-A.	5,100	7,200	11,000	14,700
Do.....	Program-B.	5,100	7,500	11,600	15,600
Nonmetallic minerals.....	Program-A.	1,400	3,400	5,400	8,900
Do.....	Program-B.	1,400	3,500	6,000	10,000
Total, all minerals.....	Program-A.	6,500	10,600	16,400	23,600
Do.....	Program-B.	6,500	11,000	17,500	25,600



**W
R
P
A
10**

WRPA 10

MINERAL RESOURCE BASE

WRPA 10 parishes surround the city of New Orleans in the southeast corner of the Lower Mississippi Region. This area is bordered by out-of-area parishes on the north and west, the Gulf of Mexico on the south and southeast, and by Mississippi on the northeast. The area is comprised of 11 parishes as follows:

Assumption	Plaquemines	St. James
Jefferson	St. Bernard	St. John
Lafourche	St. Charles	St. Tammany
Orleans		Terrebonne

All parishes have recorded petroleum and natural gas output in the 1960's. In 1968 and 1969, value of mineral production in Plaquemines Parish exceeded \$1 billion--a unique statistic in the Nation. Petroleum, natural gas (both from onshore and offshore), and sulfur made up the bulk of this value. In 1969, only the value of mineral output in the States of Texas, California, and Oklahoma (as well as Louisiana) surpassed that of Plaquemines Parish. The area in recent years has produced about 60 percent of the Nation's sulfur. Salt is also produced, and a number of construction minerals are recovered for local use. The resource base for all minerals currently produced seems sound.

Mineral Fuels

Petroleum

Crude oil has been produced in prolific quantity in the area, and all parishes have contributed to output. Offshore production has become increasingly important in recent years.

During the 1956-69 period, WRPA 10 produced about 60 percent of the petroleum in the region. Assuming that a similar share of the total regional resource exists in the area, WRPA 10 would have about 82 billion barrels of crude oil remaining (table 3). Cumulative output through 2020 would be approximately 85 billion, essentially the same as the resource base. (Offshore potential probably is not fully indicated in the resource base.)

Natural Gas

Natural gas is second only to petroleum in the area, and the value of output has been on the order of one-third that of crude oil in recent years.

Production of natural gas in WRPA 10 amounted to about 38 percent of the regional total during 1956-69. Assuming this output is an indication of the resource potential, there would be approximately 235 trillion cubic feet of natural gas remaining (table 3). Total gas output through 2020 would be about 310 trillion cubic feet at the high level of production. This is considerably more gas than is estimated to exist in the area; therefore, without the benefit of offshore gas (not fully considered herein), it is apparent that a gas resource problem could materialize soon after 2000 in WRPA 10.

Nonmetallic Minerals

Clay, Lime, Sand, Gravel, and Stone (Shell)

Construction minerals are produced in most parishes in the area. Lime is produced in Orleans Parish and is used in manufacturing cement for regional needs. Quality of these minerals is variable and in places a troublesome factor; the area's resource base, however, seems ample to support projected output through 2020.

Salt

Salt is produced in Assumption, Jefferson, and Plaquemines Parishes. The resource base is immense.

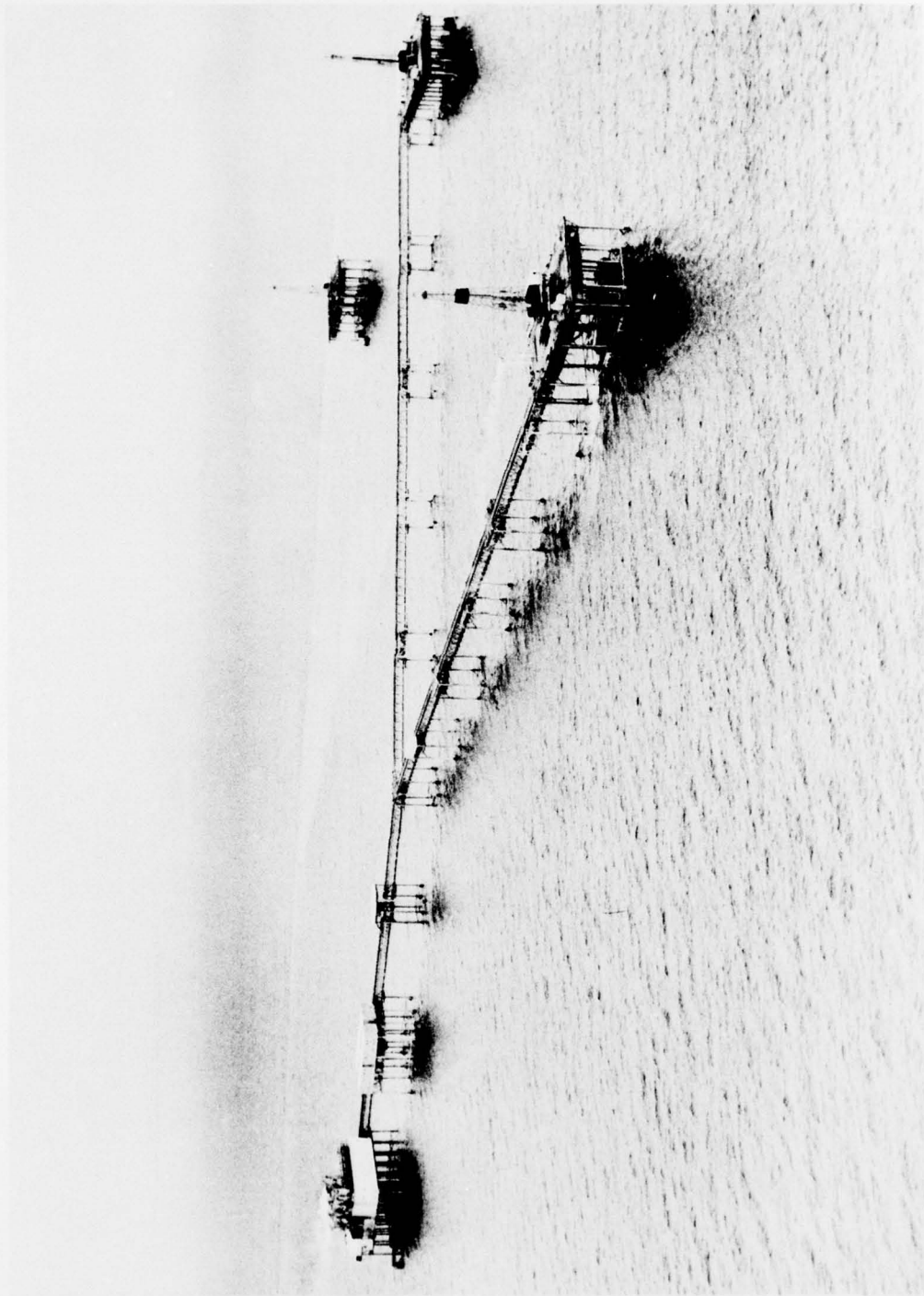
Sulfur

Sulfur is produced in Jefferson, Lafourche, Plaquemines, and Terrebonne Parishes. Associated with the huge salt domes in the area, sulfur deposits are considerably less extensive and more difficult to recover. The resource base, however, is assumed to be capable of satisfying output projected through 2020.

PRESENT MINERAL PRODUCTION

Petroleum industry output of crude oil and natural gas (including natural gas liquids) makes up about 90-95 percent of the area's value of mineral production. Sulfur, salt, and cement contribute most of the remainder of mineral output. No metallic minerals are produced. In 1969, this 11-parish area comprised about 10 percent of the Nation's total value of mineral output.

Table 40 lists the mineral production in WRPA 10 by commodity, unit of production, quantity, and value (in current dollars) for the years 1956, 1963, and 1969, and summarizes quantity and value for the years 1956-69, inclusive.



Grand Isle sulfur mine, south of Jefferson Parish, La.

Table 40 - WPA 10, Mineral Production, 1956, 1963, 1969, and Total 1956-1969
(Values in thousand current dollars)

Commodity, unit of production	1956			1963			1969			Total 1956 - 1969		
	Quantity	Value	W	Quantity	Value	W	Quantity	Value	W	Quantity	Value	W
Cement:												
Masonry.....280-pound barrels..	W		W	0		W	0		W	765,488		W
Portland.....thousand 576-pound barrels..	W		W	W		W	W		W	40,040		W
Clays.....Short tons..	W		W	W		W	W		W	1,521,270		W
Lime.....do..	0		0	W		W	W		W	709,869		W
Natural gas.....million cubic feet..	453,078	\$51,651	1,321,428	\$261,643	2,961,152	W	19,812,904	5,577,782	W			W
Natural gas liquids.....thousand barrels..	1,422	3,022	7,510	17,100	36,002	W	150,992	348,472	W			W
Petroleum.....do..	141,925	416,140	314,474	981,857	565,889	\$1,870,135	4,451,277	14,047,822	\$1,870,135			W
Salt.....thousand short tons..	0		0	0		0	660	2,441	2,441	3,440		12,730
Sand and gravel.....do..	388	481	W	W		W	3,781	4,058	4,058	12,728		13,574
Stone.....do..	2,688	4,085	W	2,031	2,690	W	W		W	33,147		45,591
Sulfur, Frasch.....thousand long tons..	W		W	2,445	48,905	5,978	107,723		W	40,016		1,053,779
Total.....		539,741		1,321,348		2,645,330		19,246,770				

W Withheld to avoid disclosing company confidential information.

PROJECTIONS OF MINERAL PRODUCTION AND RELATED WATER AND LAND NEEDS

Projections of Mineral Production

Minerals output in WRPA 10 is projected to increase smartly through 2020, and assuming the offshore resource potential for natural gas (as well as crude oil and sulfur) proves to be favorable, the growth in mineral production could be extraordinary. Crude oil output should increase by as much as 385 percent through 2020, while gas production could be up 215 percent. Sulfur and salt output could increase as much as 500 and 625 percent, respectively. Nonmetallic minerals as a group in 1969 made up about 6 percent of the total value of mineral output, but by 2020 this group could represent as much as 10 percent of total value of output.

Projections for individual minerals and summaries for the years 1980, 2000, and 2020 are listed in table 41. Data are projected in the specific unit of production for each of the minerals, and all values are in terms of 1967 dollars.

Projections of Water and Land Needs

Mineral industry water needs in WRPA 10 amounted to about 259 thousand acre-feet of diversions and 95 thousand acre-feet of depletions in 1969. Diversions are projected to swell to 670-1,660 thousand acre-feet, a 160-540 percent increase. Depletions are expected to rise to 340-870 thousand acre-feet, a 260-800 percent increase.

Projections of water diversions and depletions for the output of individual commodities, together with summary totals for the years 1980, 2000, and 2020, are listed in table 42.

Land use by mineral industry in WRPA 10 is relatively significant when compared with mineral land use in the rest of the Lower Mississippi Region. It amounted to an estimated 14,050 acres in 1969, about 20 percent of mineral industry land use in the region. By 2020, land use could reach 29,450-57,450 acres for about an 110-310 percent increase. Land use in the area in 2020 would still hover about the 20 percent level of 1969.

Projections of estimated land needs for the production of listed mineral groups and summaries for the years 1980, 2000, and 2020 are listed in table 43.

Table 41 - WPPA 10, Mineral Production and Value, 1969, and Projections for 1980, 2000, and 2020
(Thousand 1967 dollars adjusted by Bureau of Mines price indexes for selected minerals)

Commodity, unit of production	1969			1980			2000			2020		
	Projection	Value	Production	Projection	Value	Production	Projection	Value	Production	Projection	Value	Production
Fuels:												
Natural gas.....million cubic feet..	Program-A.	W	2,961,152	3,633,000	\$675,758	4,948,000	\$920,328	6,321,000	\$1,157,166	9,528,000	1,755,008	1,755,008
do.....do.....	Program-B.	W	2,961,152	4,323,000	804,078	6,867,000	1,277,262	9,528,000	1,755,008	143,424	143,424	
Natural gas liquids.....thousand barrels..	Program-A.	W	36,002	41,200	102,588	49,100	122,259	37,600	163,600	407,364	407,364	
do.....do.....	Program-B.	W	36,002	63,600	163,344	114,600	285,454	163,600	407,364	3,213,288	3,213,288	
Petroleum.....do.....	Program-A.	W	565,880	\$1,765,546	2,081,604	841,500	2,625,480	1,029,800	2,757,000	8,601,840	8,601,840	
do.....do.....	Program-B.	W	565,880	1,765,546	5,549,520	1,886,100	5,881,632	2,757,000	8,601,840	4,513,818	4,513,818	
Summary, fuels.....	Program-A.	W	-	2,405,937	-	2,859,990	-	3,668,167	-	10,744,212	-	10,744,212
do.....	Program-B.	W	-	2,405,937	-	4,316,742	-	7,447,248	-	-	-	-
Nonmetallic minerals:												
Cement:												
do.....280-pound barrels..	Program-A.	W	660	111,400	260	134,800	314	168,495	395	168,495	395	
do.....do.....	Program-B.	W	660	118,300	276	149,161	348	190,843	445	190,843	445	
Portland.....thousand 376-pound barrels..	Program-A.	W	4,517	4,517	14,680	5,466	17,764	6,831	22,201	22,201	22,201	
do.....do.....	Program-B.	W	4,517	4,796	15,587	6,047	19,655	7,157	25,145	25,145	25,145	
Clays.....do.....	Program-A.	W	175,700	223	223	221,600	281	283,500	360	360	360	
do.....do.....	Program-B.	W	175,700	247	247	247,000	314	321,800	409	409	409	
Lime.....do.....	Program-A.	W	114,300	1,598	1,598	144,100	2,015	184,400	2,926	184,400	2,926	
do.....do.....	Program-B.	W	114,300	1,724	1,724	160,700	2,247	209,300	2,926	209,300	2,926	
Salt.....thousand short tons..	Program-A.	W	2,442	1,058	3,915	2,855	10,564	5,715	13,738	13,738	13,738	
do.....do.....	Program-B.	W	2,442	1,162	4,290	3,208	8,540	4,771	17,653	17,653	17,653	
Sand and gravel.....do.....	Program-A.	W	5,781	4,310	4,359	5,500	6,270	7,050	8,037	8,037	8,037	
do.....do.....	Program-B.	W	5,781	4,310	5,358	6,150	7,011	8,000	9,120	9,120	9,120	
Stone.....do.....	Program-A.	W	5,978	5,100	5,712	6,450	7,224	8,250	9,240	9,240	9,240	
do.....do.....	Program-B.	W	5,978	5,500	6,160	7,200	8,064	9,150	10,472	10,472	10,472	
Sulfur, Frasch.....thousand long tons..	Program-A.	W	131,115	131,115	204,552	10,100	532,896	13,700	451,552	451,552	451,552	
do.....do.....	Program-B.	W	131,115	131,115	281,808	16,200	533,452	23,800	784,448	784,448	784,448	
Summary, nonmetallic minerals.....	Program-A.	W	-	158,546	-	255,609	-	375,504	-	508,099	-	508,099
do.....	Program-B.	W	-	158,546	-	515,453	-	582,153	-	850,618	-	850,618
Total, all minerals.....	Program-A.	W	-	2,564,283	-	3,095,689	-	4,043,371	-	5,021,917	-	5,021,917
do.....	Program-B.	W	-	2,564,283	-	4,632,195	-	8,029,401	-	11,594,850	-	11,594,850

W withheld to avoid disclosing company confidential information.

Table 42 - WDA 10, Projections of Mineral Production and Water Needs, 1960, 1980, 2000, and 2020

Commodity, unit of production	1960			1980			2000			2020		
	Production	Water needs, acre-feet	Depletion	Production	Water needs, acre-feet	Depletion	Production	Water needs, acre-feet	Depletion	Production	Water needs, acre-feet	Depletion
Fuels:												
Mineral gas..... million cubic feet.....	2,061,112	(1)	(1)	5,633,000	(1)	(1)	4,149,000	(1)	(1)	6,221,000	(1)	(1)
Oil..... thousand barrels.....	2,402,122	(1)	(1)	4,121,000	(1)	(1)	6,875,000	(1)	(1)	8,128,000	(1)	(1)
Natural gas liquids..... thousand barrels.....	36,002	135,771	8,340	34,200	153,459	11,386	49,400	16,270	11,386	21,344	12,337	
Petroleum.....		134,771	8,340	34,200	153,459	11,386	49,400	16,270	11,386	21,344	12,337	
Production.....	561,480	(1)	(1)	667,200	(1)	(1)	841,500	(1)	(1)	1,620,000	(1)	(1)
Oil.....	561,480	(1)	(1)	4,072,000	(1)	(1)	1,886,100	(1)	(1)	2,727,000	(1)	(1)
Brilliant.....	11,114	3,122	5,122	15,600	4,031	19,782	19,782	4,108	5,108	24,225	6,544	6,344
Oil.....	11,114	3,122	5,122	15,600	4,031	19,782	19,782	4,108	5,108	24,225	6,544	6,344
Secondary recovery..... thousand barrels.....	228,332	7,382	69,404	371,200	6,202	14,361	44,361	11,433	11,433	84,843	16,718	16,718
Oil.....	228,332	7,382	69,404	371,200	6,202	14,361	44,361	11,433	11,433	84,843	16,718	16,718
Secondary recovery.....	228,332	7,382	69,404	371,200	6,202	14,361	44,361	11,433	11,433	84,843	16,718	16,718
Summary, fuels.....		208,375	81,105		262,003	116,320		300,460	105,261		300,460	105,261
Oil.....		208,375	81,105		262,003	116,320		300,460	105,261		300,460	105,261
Nonmetallic minerals:												
Asbestos.....												
Barium.....												
Beryllium.....												
Bismuth.....												
Chromium.....												
Cobalt.....												
Copper.....												
Fluorine.....												
Gold.....												
Iron.....												
Lead.....												
Mercury.....												
Molybdenum.....												
Nickel.....												
Phosphorus.....												
Potash.....												
Silver.....												
Sulfur.....												
Tungsten.....												
Vanadium.....												
Zinc.....												
Zirconium.....												
Summary, nonmetallic minerals.....												
Oil.....												
Total, all minerals.....												
Oil.....												
Production.....												
Water needs, acre-feet.....												
Depletion.....												
Production.....												
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Depletion.....					</							

Table 43 - WRPA 10, Projections of Land Use Needs
for Mineral Resources, Acres

Commodity	Projection	1969	1980	2000	2020
Fuels.....	Program-A.	7,950	9,500	11,900	14,550
Do.....	Program-B.	7,950	14,550	25,200	36,350
Nonmetallic minerals.....	Program-A.	6,100	7,850	11,200	14,900
Do.....	Program-B.	6,100	9,300	14,950	21,100
Total, all minerals.....	Program-A.	14,050	17,350	23,100	29,450
Do.....	Program-B.	14,050	23,850	40,150	57,450

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