MINERAL INDUSTRY OF MICHIGAN, 1975

ANNUAL
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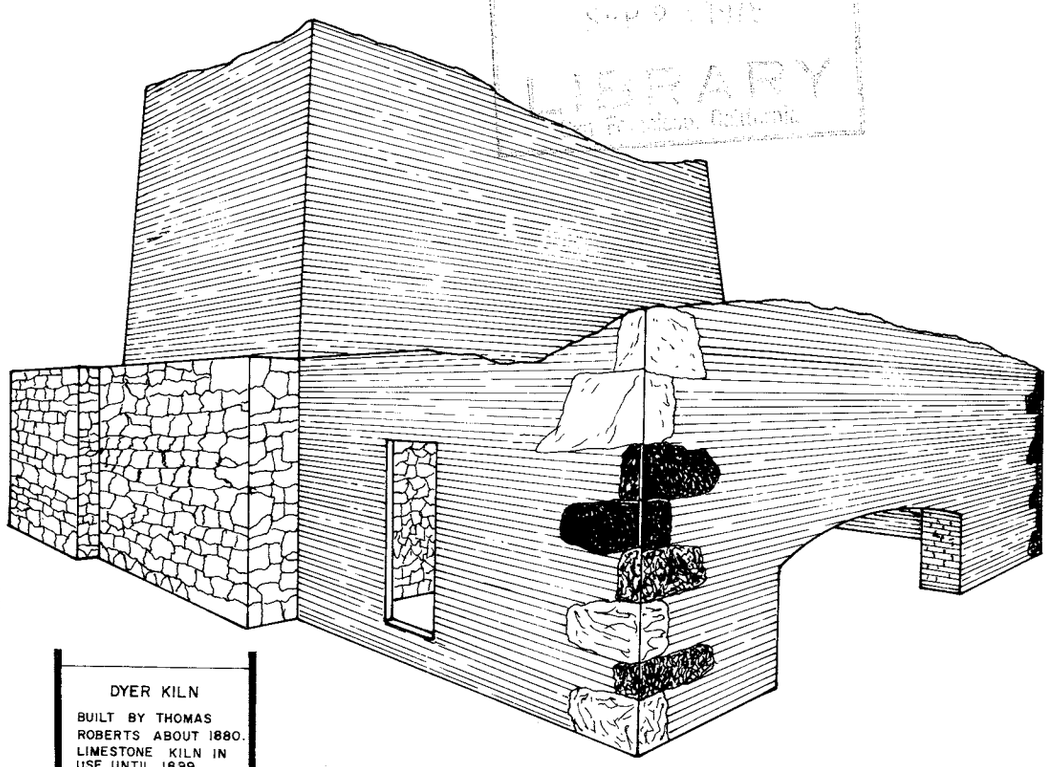
SUMMARY 25
1978



DYER KILN

BUILT BY THOMAS ROBERTS ABOUT 1880. LIMESTONE KILN IN USE UNTIL 1899. LIME FOR MORTAR IN STATE CAPITOL BUILDING IN LANSING CAME FROM THIS KILN.

DR

Geological Survey Division
Michigan Department of Natural Resources

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BUREAU OF MINES MINERALS YEARBOOK

The Mineral Industry of Michigan

In cooperation with

Bureau of Mines

Geological Survey Division

Lansing, Michigan

UNITED STATES DEPARTMENT OF THE INTERIOR • Cecil D. Andrus, Secretary
BUREAU OF MINES

This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals, Minerals,* and *Fuels; Volume II, Area Reports: Domestic; Volume III, Area Reports: International.* The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

PREFACE

The covers of this report illustrate the Dyer Lime Kiln near Bellevue, Eaton County, and were drawn by Donald E. Raymond of the Geological Survey Division staff. The front cover depicts the kiln as presently preserved. The back cover shows the detail of the kiln firing area.

The Dyer Kiln was one of many lime kilns which operated in Michigan in the past. However, it is said that the Dyer Kiln is distinguished by having manufactured lime for the production of the mortar used in construction of the State Capitol.

In 1975 there were nine operating lime kilns in the State which produced about 1,434,000 short tons of lime worth about $36,540,000. Michigan ranked fifth in the value of lime produced in the U. S. in 1975. These operations are currently confined to the Southern Peninsula. A map showing these locations is found on the inside back cover.

Lime is a mineral product which is produced by heating limestone ($CaCO_3$) in a kiln to about 900°C which causes the limestone to form lime (CaO) and the gas carbon dioxide (CO_2). Chemistry books illustrate the process like this:

$$CaCO_3 \xrightarrow{900^{\circ}C} CaO + CO_2\uparrow$$

The limestone used in this process is sometimes transported great distances from the location where it is extracted.

The lime producers in Michigan report that their lime is produced for the following uses and products: 1) Alkalies (ammonium, potassium, and sodium compounds); 2) Steel (basic oxygen converters, electric furnaces, open-hearth furnaces); 3) Water purification and softening; 4) Food and food products; 5) Paper and pulp (include bleach and filler used in paper); 6) Sewage and trade-wastes treatment (includes neutralization of waste acids); 7) Sulfur removal from stack gases; 8) Plastics; 9) Sugar refining; and 10) Other chemical and industrial uses and products.

Michigan is an important producer of many different types of minerals and mineral products. Some of these commodities are in great demand and are shipped all over the United States and abroad, while others are mined and processed for local use.

In 1975, Michigan led the nation in the production of gypsum, peat, iodine, magnesium compounds, marl and industrial sand. Second place for U. S. production was maintained for iron ore,

bromine, salt, and calcium-magnesium chloride compounds. The total amount of sand and gravel produced put Michigan in third place nationally.

"The Mineral Industry of Michigan, 1975", was written and published by the U. S. Bureau of Mines as a chapter of their 1975 "Minerals Yearbook", and by agreement is additionally offered as a publication of the Geological Survey Division of the Michigan Department of Natural Resources as Annual Statistical Summary 25. A companion publication by the Geological Survey Division is the Annual Directory entitled "Michigan Mineral Producers". The directory contains the names, addresses and locations of mineral producer operations plus numerous maps and historical production and value charts along with associated geological information.

Single copies of the directory and the list of available Geological Survey Division publications may be obtained free from: Information Services Center, Michigan Department of Natural Resources, Box 30028, Lansing, Michigan 48909.

Statistics on Michigan's oil and gas production, drilling, exports and imports, and other pertinent data are published as "Annual Statistical Summary, Michigan's Oil and Gas Fields". This is compiled by the Oil and Gas Section of the Geological Survey Division, Michigan Department of Natural Resources, and is usually published the year following the closing of the year the data covers. The most recent edition is available for $2.00 from the above address.

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Lansing, Michigan
June, 1978

The Mineral Industry of Michigan

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division of the Michigan Department of Natural Resources, under a memorandum of understanding for collecting information on all minerals except coal and liquid fuels.

By Edward C. Peterson [1] and Esther A. Middlewood [2]

Spurred by record petroleum and natural gas production and continued inflationary pressures, the value of Michigan's raw mineral output rose to an alltime high of $1.3 billion in 1975. This was an increase of 24.7% over that of 1974. Iron ore continued to be the leading commodity in terms of value followed by crude petroleum, cement, copper, stone, and sand and gravel.

Production of nonmetallic minerals declined for the fifth successive year. These commodities, however, contributed the major portion of Michigan's total mineral value, accounting for $515.6 million or 39.9% of the total. The drop in production was attributed to the continued slowness in the construction industry which utilizes most of these minerals.

Metals accounted for $436.5 million, or 33.8% of the total mineral value. Although production of iron ore nationally was lower in 1975, Michigan's shipments and value rose 21% and 59%, respectively, over 1974. Initial production from the Tilden mine and the Empire mine expansion was responsible for the increase. Copper production increased 10% over that of 1974, but its value decreased almost 9%, reflecting the depressed copper prices prevalent throughout 1975.

Output of mineral fuels (natural gas, natural gas liquids, peat, and petroleum) was valued at $339.6 million, or 26.3% of the total mineral value. Petroleum and natural gas production increased almost 45% over that of 1974. Michigan continued to be the largest domestic producer of peat. A small amount of coal was mined for local consumption. This was the first coal actually produced in the State since 1952.

A milestone was reached during 1975 when the 1-billionth ton of Michigan iron ore was produced. The total iron ore mined in the State since the first mine on the Marquette Range of the Upper Peninsula began production in 1845 would make almost 653 million tons of steel. The ore, at current prices, would be valued at more than $14 billion. Due to fluctuating prices during the past 130 years, however, the ore probably had a value of only about $6 billion.

With the startup of the Tilden mine in late 1974 and the completion of the Empire mine expansion in 1975, Michigan's annual iron ore production capacity increased by almost 6 million tons. In addition, Cleveland-Cliffs Iron Co. (CCI) officials announced plans for a new expansion of the Empire mine. The $150 million project will boost iron ore pellet production at the facility by an additional 2.8 million tons annually, bringing the mine's yearly capacity to 8 million tons. Production from the expanded facility is slated to start early in 1980.

Michigan's production of sand and gravel continued to be adversely affected by the depressed conditions existing in the con-

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Table 1.—Mineral production in Michigan [1]

Mineral	1974 Quantity	1974 Value (thousands)	1975 Quantity	1975 Value (thousands)
Cement:				
Portland thousand short tons	5,903	$140,513	4,573	$131,324
Masonry do	217	6,309	183	6,429
Clays do	2,161	4,074	1,818	3,580
Copper (recoverable content of ores, etc.) short tons	67,012	103,601	73,690	94,618
Gem stones	NA	8	NA	8
Gypsum thousand short tons	1,482	7,258	1,224	5,936
Iron ore (usable) thousand long tons, gross weight	11,602	213,598	14,089	339,113
Lime thousand short tons	1,528	30,036	1,434	36,540
Magnesium compounds short tons, MgO equivalent	503,281	53,302	W	W
Natural gas million cubic feet	69,133	34,843	102,113	64,740
Natural gas liquids:				
Natural gasoline thousand 42-gallon barrels	466	3,089	656	3,294
LP gases do	849	5,383	1,348	5,945
Peat thousand short tons	244	3,811	245	3,206
Petroleum (crude) thousand 42-gallon barrels	18,021	154,746	24,420	262,352
Salt thousand short tons	4,445	62,055	4,020	68,353
Sand and gravel do	60,027	82,617	47,051	73,397
Silver (recoverable content of ores, etc.) thousand troy ounces	643	3,028	632	2,795
Stone thousand short tons	47,479	72,748	39,946	73,800
Value of items that cannot be disclosed: Bromine, calcium chloride, iodine, and values indicated by symbol W	XX	r 54,411	XX	116,223
Total	XX	r 1,035,430	XX	1,291,653
Total 1967 constant dollars	XX	489,551	XX	p 511,495

p Preliminary. r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed." XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Michigan, by county [1]

(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Alcona	$134	$124	Sand and gravel.
Alger	88	77	Do.
Allegan	1,823	2,474	Sand and gravel, petroleum, natural gas, stone, peat.
Alpena	66,819	61,660	Cement, stone, clays, sand and gravel.
Antrim	785	W	Petroleum, natural gas, clays, sand and gravel.
Arenac	2,271	W	Petroleum, stone, sand and gravel.
Baraga	126	110	Sand and gravel.
Barry	845	W	Sand and gravel, petroleum.
Bay	11,632	11,801	Cement, petroleum, sand and gravel, lime.
Benzie	23	33	Sand and gravel.
Berrien	4,487	4,691	Sand and gravel, stone.
Branch	355	488	Do.
Calhoun	11,752	17,909	Petroleum, natural gas, sand and gravel, stone.
Cass	W	W	Sand and gravel, stone.
Charlevoix	W	W	Cement, stone, sand and gravel.
Cheboygan	179	188	Stone, sand and gravel.
Chippewa	W	W	Do.
Clare	3,107	3,930	Petroleum, sand and gravel, natural gas.
Clinton	W	W	Sand and gravel, clays.
Crawford	5,689	9,741	Petroleum, natural gas, sand and gravel.
Delta	223	W	Sand and gravel, stone.
Dickinson	W	W	Iron ore, sand and gravel, stone.
Eaton	3,388	4,969	Petroleum, natural gas, stone, sand and gravel, clays, peat.
Emmet	13,957	16,025	Cement, stone, sand and gravel, clays.
Genesee	692	W	Sand and gravel, petroleum.
Gladwin	2,182	W	Petroleum, sand and gravel.
Gogebic	162	249	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Michigan, by county [1]—Continued

(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Grand Traverse	$12,221	$36,065	Petroleum, natural gas, sand and gravel.
Gratiot	9,343	11,030	Magnesium compounds, calcium chloride, salt, bromine, sand and gravel, petroleum, natural gas.
Hillsdale	19,146	20,410	Petroleum, natural gas, natural gas liquids, sand and gravel.
Houghton	332	1,375	Copper, sand and gravel, stone, silver.
Huron	W	W	Stone, sand and gravel, lime.
Ingham	21,036	30,872	Petroleum, natural gas, natural gas liquids, sand and gravel, peat.
Ionia	397	627	Sand and gravel.
Iosco	W	W	Gypsum, sand and gravel.
Iron	5,164	W	Iron ore, sand and gravel.
Isabella	1,905	W	Petroleum, sand and gravel.
Jackson	6,793	6,984	Petroleum, natural gas, sand and gravel, stone.
Kalamazoo	W	W	Sand and gravel, stone.
Kalkaska	39,028	64,541	Petroleum, natural gas, natural gas liquids.
Kent	6,011	5,028	Sand and gravel, petroleum, gypsum, peat, natural gas.
Keweenaw	23	31	Sand and gravel.
Lake	778	W	Petroleum, sand and gravel.
Lapeer	3,750	2,832	Sand and gravel, petroleum, peat, calcium chloride, natural gas.
Leelanau	371	W	Sand and gravel.
Lenawee	W	W	Sand and gravel, clays.
Livingston	W	W	Sand and gravel, natural gas, petroleum.
Luce	44	W	Sand and gravel.
Mackinac	14,097	W	Stone, sand and gravel.
Macomb	2,922	W	Sand and gravel, natural gas, petroleum.
Manistee	45,993	61,375	Magnesium compounds, salt, petroleum, natural gas, bromine, sand and gravel.
Marquette	171,177	W	Iron ore, sand and gravel, stone.
Mason	50,278	57,984	Magnesium compounds, calcium chloride, lime, bromine, petroleum, natural gas, sand and gravel.
Mecosta	971	845	Sand and gravel, petroleum, peat, natural gas.
Menominee	46	174	Sand and gravel.
Midland	r 38,934	38,178	Bromine, calcium chloride, magnesium compounds, salt, petroleum, iodine.
Missaukee	W	7,558	Petroleum, natural gas, sand and gravel.
Monroe	28,925	23,538	Cement, stone, clays, sand and gravel, petroleum, peat.
Montcalm	1,082	W	Petroleum, sand and gravel.
Montmorency	W	4	Sand and gravel, petroleum.
Muskegon	W	W	Sand and gravel, salt, petroleum.
Newaygo	W	W	Sand and gravel, petroleum.
Oakland	W	16,434	Sand and gravel, natural gas, petroleum, peat.
Oceana	W	W	Sand and gravel, petroleum.
Ogemaw	4,457	W	Petroleum, sand and gravel, natural gas.
Ontonagon	W	W	Copper, silver, sand and gravel.
Osceola	4,413	W	Petroleum, natural gas liquids, sand and gravel.
Oscoda	W	W	Sand and gravel, petroleum.
Otsego	38,235	68,324	Petroleum, natural gas, sand and gravel.
Ottawa	6,424	5,264	Sand and gravel, petroleum, natural gas.
Presque Isle	31,328	30,144	Stone, sand and gravel, petroleum.
Roscommon	3,130	4,115	Petroleum, natural gas, sand and gravel.
Saginaw	2,714	2,440	Sand and gravel, lime, petroleum, clays.
St. Clair	30,990	40,988	Salt, petroleum, natural gas, sand and gravel.
St. Joseph	W	W	Sand and gravel, stone, peat.
Sanilac	W	W	Peat, sand and gravel, lime.
Schoolcraft	W	W	Stone, sand and gravel.
Shiawassee	1,202	951	Peat, sand and gravel, clays, petroleum.
Tuscola	W	W	Sand and gravel, petroleum, lime.
Van Buren	706	W	Sand and gravel, petroleum.
Washtenaw	2,248	W	Do.
Wayne	69,235	77,175	Lime, cement, salt, stone, sand and gravel, clays, petroleum.
Wexford	1,017	3,167	Petroleum, natural gas, sand and gravel.
Undistributed [2]	227,854	538,727	
Total [3]	r 1,035,430	1,291,653	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Value of petroleum and natural gas are based on an average price per barrel and cubic foot, respectively, for the State.
[2] Includes values for gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Michigan business activity

		1974	1975 p	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	3,943.0	3,922.0	−0.5
Unemployment	do	337.0	490.0	+45.4
Employment (nonagricultural):				
Mining	do	13.4	13.5	+0.7
Manufacturing	do	1,105.9	980.0	−11.4
Contract construction	do	125.0	96.1	−23.1
Transportation and public utilities	do	153.6	143.7	−6.4
Wholesale and retail trade	do	669.7	657.4	−1.8
Finance, insurance, and real estate	do	131.0	128.9	−1.6
Services	do	521.0	519.7	−.2
Government	do	561.9	588.0	+4.6
Total nonagricultural employment	do	3,281.4	3,127.3	−4.7
Personal income:				
Total	millions	$53,302	$56,526	+6.0
Per capita		$5,846	$6,173	+5.6
Construction activity:				
Number of private and public residential units authorized		44,291	36,980	−16.5
Value of nonresidential construction	millions	$720.3	$605.8	−15.9
Value of State road contract awards	do	$218.0	$266.0	+22.0
Shipments of portland and masonry cement to and within Michigan	thousand short tons	3,180	2,475	−22.2
Mineral production value:				
Total crude mineral value	millions	$1,035.4	$1,291.7	+24.7
Value per capita, resident population		$113.57	$141.77	+24.8
Value per square mile		$17,786.00	$22,187.25	+24.7

p Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

struction and automotive industries. Construction Aggregates Corp.'s gravel plant on the Grand River, near Ferrysburg, reportedly the world's largest shipper of gravel, was closed half the summer. Normally the plant loads more than 100 lake freighters each shipping season, but less than a third of that number were loaded in 1975, leaving the plant yards piled high with gravel. Major customers of the company include the automobile manufacturers for foundry sand and the construction industry for gravel products.

Construction on Detroit Edison Co.'s new coal-loading terminal at Superior, Wis., began in late 1974 and continued through 1975. The new $35 million facility, owned by Midwest Energy Resources Co., a wholly owned subsidiary of Detroit Edison, is expected to be in operation by the middle of 1976. The terminal is designed to handle coal produced in southeastern Montana and transported to Superior by 110-car unit trains. At the Wisconsin site, the coal will be loaded into self-unloading lake vessels for delivery to Detroit Edison's powerplants in St. Clair, Mich. The terminal is equipped to handle 12 million tons of coal annually and can be expanded to handle 20 million tons.

Scientists from The Dow Chemical Co. at Midland predict the time is approaching when they can tap some 2.5 trillion barrels of oil from Michigan shale. The Antrim shale holding the oil covers two-thirds of the State's lower peninsula in beds up to 200 feet thick, down to a depth of 2,500 feet. Dow has had a demonstration shale drilling site in Sanilac County since 1972. In 1975, the Energy Research and Development Administration (ERDA) asked Congress for a $42 million grant for a 7-year demonstration project for Dow. No final decision was reached by yearend.

Scientists hope that a 57-foot rock core extracted from more than 3 miles below the ground will provide a record of an ancient segment of Michigan's geologic history. The core was extracted from a 17,400-foot well drilled in Gratiot County, near Ithaca, in the heart of the Michigan basin. McClure Oil Co., operator of the well, and Amoco Production Co., a participant in the drilling, are working with scientists from the universities of Wisconsin, Michigan, Northwestern, and Purdue in the extraction of the core and in a number of other geological and geophysical tests. Oil company scientists plan to study portions of the core to gain additional knowledge

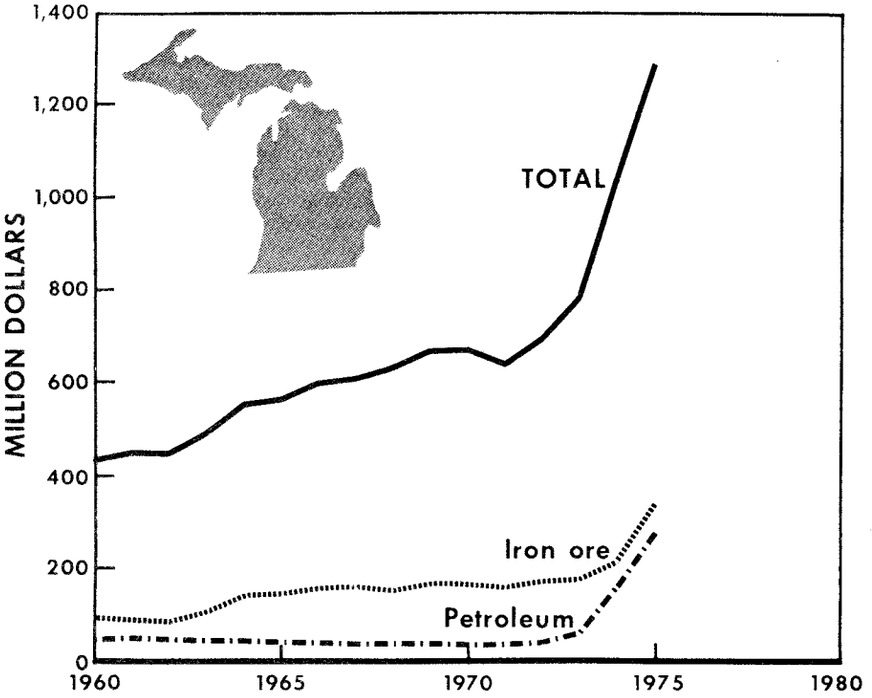


Figure 1.—Value of iron ore, petroleum, cement, and total value of mineral production in Michigan.

of the Michigan Basin as it pertains to oil and gas accumulations, while university scientists, under the auspices of the National Science Foundation, conduct other geologic tests.

Bethlehem Steel Corp. and CCI continued to explore for nonferrous minerals in the Lake Superior region through efforts of their Beth-Cliffs joint venture. In November of 1975, however, Bethlehem Steel withdrew from the joint venture. CCI has indicated that they will continue the exploration program.

Samples were taken by Michigan's Department of Natural Resources (DNR) from the State's only active coal mine at Williamston and at another deposit near Grand Ledge in 1975. The samples, analyzed by the U.S. Geological Survey, proved to be unusually high in germanium content and additional samples will be taken during 1976.

A Canadian firm was hired by the Tennessee Valley Authority (TVA) to prospect for uranium in the western part of Michigan's Upper Peninsula. Neither the company nor the State has released the exact location nor the size of the proposed area. Uranium exploration is not new to Michigan. In the early 1950's the Atomic Energy Commission explored large areas of the region.

Chevron Minerals, a wholly owned subsidiary of Chevron Oil Co., conducted drilling and exploration in Marquette County as part of a joint venture with CCI during 1975. The property under survey is the Kona-copper prospect in Michigan's Upper Peninsula owned by CCI and once drilled by Bear Creek. It is believed that the area may be an important stratabound copper deposit.

Environmental matters continued to be increasingly important elements in the

various phases of oil and gas exploration and development, and in the administration of Michigan's oil and gas statutes. Environmental impact statements (EIS) are part of each drilling application and for many other phases of oil and gas activities, such as pipeline construction and conversion of gas reservoirs to gas storage use. While these controls may add to the costs of drilling and producing oil and gas, to date they have not seriously impeded the orderly development of Michigan's energy resources.

Transportation.—The possibility of a deepwater harbor at Monroe, Mich., took a major step forward based on findings of an economic development study prepared by a firm of port consultants. During the course of the study, port shipping increased from 27,400 tons in 1973 to 215,423 tons in 1974. Projected shipments for 1975 amounted to 695,000 tons. All shipments are coal.

One State senator introduced a resolution in the State legislature (S.C.R. 341) calling for a study leading to a Michigan port development plan. He proposed creation of a special senate committee to examine the status of Michigan's commercial ports and the problems surrounding the development of those ports. Michigan utilizes the Great Lakes to transport coal consumed by electric power companies, as well as to ship many mineral commodities.

The Michigan State Highway Commission approved a 1-year, $34.5 million State rail program that could preserve virtually all of the 1,100 miles of rail threatened with abandonment by the Federal CONRAIL system. The commission said its purpose would assure continuation of freight service to more than 100 communities along the bankrupt Penn Central and Ann Arbor railroad lines not included in the CONRAIL reorganization plan. The program went to the State legislature for consideration. The railroad lines in question are used to transport industrial sand, sand and gravel, petrochemical feedstocks, and coal used as fuel in some areas of Michigan.

Legislation.—Michigan legislators faced many controversial issues during the 1975 session. Numerous bills designed to protect the environment were introduced, only to be defeated or referred to legislative committees.

One such bill, H.B. 5455 (S.B. 1003) was introduced to alter Michigan's 1970 Environmental Protection Act. The bill was defeated, but only after months of debate. The bill would have exempted the construction and operation of mining facilities which extract and process metallic mineral resources from legal action and jurisdiction under the act, after all required environmental impact reports had been filed and required permits had been obtained from appropriate State agencies. The bill was strongly opposed by many of Michigan's citizen environmental groups.

The unique composition of dune sand from the Lake Michigan area makes its use integral in a variety of industries. Dune sand is used to make highway concrete, glass moldings, and metal castings for the automotive industry, among others. At the present time, sand mining in the dune area is unregulated. Mining permits, impact statements, and reclamation plans are not required of sand mining operations. An attempt was made during 1975 to establish legislative controls over the mining of dune sand (H.B. 4038). The measure, which passed the house in November, was routed to the senate for approval. At the end of 1975, the bill remained in the Senate Committee on Conservation.

Legislation to repeal P.A. 264 of 1967, entitled "Mine Safety Act of 1967," was introduced in mid-1975. The act originally provided for the inspection of mining operations in Michigan by the State Department of Labor, but has not been funded since 1973. The bill (H.B. 5580) was referred to the Committee on Labor for review.

Michigan's Resource Recovery Commission, established by P.A. 366 of 1974, held its organizational meeting in August 1975. The purpose of the commission is to "encourage the conservation of natural resources through the promotion or development of systems to collect, separate, reclaim, and recycle metals, glass, paper, and other materials from waste, for energy production uses, and to provide a coordinated statewide waste management and resource recovery program."

Executive Order 1974–4 established an Environmental Review Board in the State of Michigan. During the 1975 legislative session, bills (H.B. 5398 and S.B. 1127) were introduced to create the Environmental Review Board as an autonomous entity within the Department of Natural Resources. The board's duties would include providing advice and making recommendations to the legislature and State agencies on environmental issues and policies, administering an environmental report program to be established by the bill, and publishing rules for the implementation of the bill.

Under Section 2, P.A. 17 of 1921, "persons contracting to remove oil, gas, coal, or other mineral products from State lands are required to obtain approval of the State administrative board." Provisions of H.B. 5505, introduced in 1975, amend this section to specify only metallic minerals would need prior approval for removal. The bill was referred to the Committee on Conservation, Environment, and Recreation.

A bill to regulate the construction and use of oil and gas pipeline facilities (H.B. 4846) was again introduced during the 1975 session. The bill was referred to the Committee on Public Utilities for consideration.

The senate introduced legislation (S.B. 852) designed to "regulate nonmetallic surface mining, to protect the environment, to encourage and maintain essential mining activities, to provide for the orderly development of surface mining, to guarantee environmental reclamation, and to provide penalties." The bill, known as the "nonmetallic surface mining conservation and reclamation act," remained in the Committee on Conservation at the close of 1975.

Government Programs.—Active Federal Bureau of Mines contracts and grants to State universities and private industry in Michigan total a little over $2 million. Some of these projects are continued from previous years, but approximately $600,000 of new contracts were issued during calendar year 1975. The contracts and grants involve such areas as industrial safety, mining technology, industrial hygiene, ground control, and mineral availability.

A $42,500 fellowship program in mining and minerals research was awarded to Michigan Technological University during 1975. The eight fellowships are for masters degree candidates in the fields of mineral exploration, mineral extraction, and rock mechanics. The program is scheduled to run from September 1975 through August 1976. The grants are available under Title IX of the Higher Education Assistance Act.

Employment.—Michigan was hard-hit in terms of unemployment during 1975. Unemployment for the State averaged 14% during the year, according to statistics released by the Michigan Employment Security Commission. Most of the layoffs centered around the declining production of automobiles which also affected the metal industries, including foundries.

A total of 13,700 workers were employed in Michigan's mining industries (including metal mining, oil and gas extraction, and nonmetallic mining—except fuels) as of December 31, 1975. This was an increase in employment when compared with the 1974 figure of 12,800 workers. However, Copper Range Co. announced a scheduled layoff of 2,100 workers at the White Pine mine, accompanied by a reduction in production, due to depressed conditions existing in the world copper market. The layoff was scheduled to begin in January 1976.

According to data gathered by the Michigan field offices of the Mining Enforcement and Safety Administration (MESA), 38 women were employed in the mining industry in various capacities during the year. Of the total, 31 women were employed by iron mining companies in Michigan's Upper Peninsula.

The two Michigan field offices of MESA conducted a total of 1,045 inspections [3] during 1975. At the close of 1975, the Upper Peninsula field office moved to new quarters in Marquette.

Data for 1974 and 1975, compiled by MESA's Health and Safety Analysis Center, regarding employment and injuries in Michigan's mineral industries (excluding petroleum) are shown in table 4.

[3] Includes spot and special investigations, as well as regular inspections.

Table 4.—Michigan: Employment and injury statistics in the mineral industry

	Number of men	Man-hours worked	Number of injuries		Frequency injury rate per million man-hours [1]	
			Fatal	Nonfatal disabling	Fatal injuries	Nonfatal disabling injuries
1974						
Metal:						
Iron	3,537	6,339,916	1	233	.16	36.75
Copper	2,576	5,302,283	3	196	.57	36.97
Total metal	6,113	11,642,199	4	429	.34	36.85
Nonmetal:						
Sand and gravel	1,585	1,857,953	--	31	--	15.07
Stone	1,483	2,525,140	--	27	--	10.69
Other nonmetals [2]	970	1,615,432	--	47	--	29.09
Total nonmetal	4,038	5,998,525	--	105	--	17.51
Total, 1974	10,151	17,640,724	4	534	.23	29.42
1975						
Metal:						
Iron	4,324	8,905,153	--	340	--	37.96
Copper	2,793	5,448,222	1	134	.18	23.68
Total metal	7,117	14,353,375	1	474	.07	32.54
Nonmetal:						
Sand and gravel	1,627	2,249,507	--	39	--	16.89
Stone	1,873	3,745,167	--	24	--	5.61
Other nonmetals [2]	697	1,318,483	--	6	--	4.55
Total nonmetal	4,197	7,313,157	--	69	--	9.44
Total, 1975	11,314	21,666,532	1	543	.05	24.55

[1] All injuries and all man-hours reported and in file will be tabulated, but when computing injury-frequency rates, only those injuries for which man-hours are reported and in file will be used.

[2] Includes clay, gypsum, peat, and salt.

NOTE.—All data are preliminary.

Source: Mining Enforcement and Safety Administration.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—Michigan remained second to Ohio in the manufacture of metallic abrasives in 1975, although production and value in the State declined 9.3% and 2.3%, respectively. Metallic abrasives were produced by three companies during 1975: Abrasive Materials, Inc. at its Hillsdale plant; Cleveland Metal Abrasives, Inc. at its Howell plant; and Ervin Industries, Inc. at its plant in Adrian.

Bromine.—Bromine was recovered from well brines in Michigan by The Dow Chemical Co. at its Ludington and Midland plants in Mason and Midland Counties, respectively; by Morton Chemical Co. at its Manistee plant, Manistee County; and by Michigan Chemical Corp. at its St. Louis plant, Gratiot County. Output of elemental bromine decreased 4.7% in quantity and 1.7% in value in 1975. Michigan ranks second in production and value of bromine in the United States.

Calcium Chloride.—The Dow Chemical Co., Michigan Chemical Corp., and Wilkinson Chemical Corp. produced calcium chloride from brine in Gratiot, Lapeer, Mason, and Midland Counties. Although production decreased in 1975, Michigan remained the leading U.S. producer of calcium chloride.

Cement.—In July 1975, the administrative offices of Peerless Cement Co. moved to the company's plant location. The move placed all Peerless personnel in the Detroit area at the same location.

Also during 1975, Huron Cement Div. of National Gypsum Co. completed a major modernization and pollution control program which reflected a cooperative effort by National Gypsum, company employees, the

Table 5.—Michigan: Portland cement salient statistics

(Short tons)

	1974	1975
Number of active plants	8	8
Production	5,844,211	4,634,247
Shipments from mills:		
Quantity	5,902,599	4,572,739
Value	$140,513,188	$131,323,993
Stocks at mills, Dec. 31	685,264	691,376

Table 6.—Michigan: Masonry cement salient statistics

(Short tons)

	1974	1975
Number of active plants	4	5
Production	199,594	220,129
Shipments from mills:		
Quantity	217,400	183,456
Value	$6,309,322	$6,429,396
Stocks at mills, Dec. 31	50,688	78,885

county of Alpena, and State governmental agencies to keep the plant operating and to bring the facility into compliance with environmental standards. Two new kilns, scheduled for completion in August and October, came onstream early. Kiln 722 came onstream June 30, and kiln 723 came onstream on August 7. On July 2, 1975, the sale of $13.6 million of tax-exempt pollution control bonds was completed. Proceeds of the sale were used to partly finance the kiln modernization project.

Clays.—The manufacture of clay products is one of Michigan's oldest mineral industries. Present operations include tile plants at Tecumseh and Grand Ledge, a brick plant at Corunna, and a pottery plant at Rockwood. In addition, clay and shale resources are used by six cement companies at plants in Michigan. Approximately 93% of the clay and shale produced in the State during 1975 was used in manufacturing cement, compared with 89% in 1974. The remaining clay and shale was used in manufacturing such products as drain tile, sewer pipe, brick, and pottery. Clays and shale were mined in 10 counties and 11 pits during 1975. Output of clay and shale decreased 15.9% in quantity and 12.1% in value compared with 1974. Principal producing counties were Alpena, Antrim, Emmet, Monroe, and Wayne.

Because of the increasing price of fuel and other economic considerations, Construction Aggregates Corp. ceased production of clay in Ottawa County at the close of 1974. A decision to permanently discontinue operations was made early in 1975.

Gem Stones.—Semiprecious stones found in Michigan include algodonite, chlorastrolite, datolite, Petoskey stones, prehnite, quartz crystal, agates, thompsonite, and wollastonite. An undetermined number of these stones are collected each year through the activities of hundreds of amateur "rockhounds." The stones are polished and often cut for use in jewelry and other art objects. Other stones are preserved as specimens for exhibit in collections.

Gypsum.—Production of gypsum in Michigan for use in the plaster industry began in the period 1837–41, when gypsum quarried from a ledge in Plaster Creek, near Grand Rapids, was ground on a small scale in corn mills.[4] The industry has grown to rank second in production of crude gypsum in the United States. Michigan ranks third among the States in the value of crude gypsum, preceded by Iowa and California.

National Gypsum Co., United States Gypsum Co., Michigan Gypsum Co., Georgia-Pacific Corp., and Grand Rapids Gypsum Co. mined 1,223,961 short tons of crude gypsum valued at $5,936,000 in Iosco and Kent Counties during 1975. Output declined 17.4% compared with 1974. The decline reflected the continued depressed home construction industry. National Gypsum's mine at Tawas was reported as the second largest producing gypsum mine in the United States during 1975.

United States Gypsum Co., Georgia-Pacific Corp., National Gypsum Co., and Grand Rapids Gypsum Co. calcined gypsum in Iosco, Kent, and Wayne Counties during the year. Output declined 13.1% to 384,838 tons valued at $9,689,000 in 1975. Calcined gypsum is used in manufacturing plaster board, lath, and plaster.

Iodine.—Crude iodine continued to be recovered at Midland by The Dow Chemi-

[4] Grimsley, G. P. The Gypsum of Michigan and the Plaster Industry. Geol. Survey of Michigan, v. 9, pt. 2, 1904, pp. 42–52.

cal Co., sole U.S. producer during 1975. Production showed a 12% decrease in 1975, with a 2% increase in value compared with 1974 levels. The decrease reflected the impact of imports from Japan on the U.S. market.

Lime.—Six companies produced 1,433,810 tons of quicklime during 1975 compared with 1,528,000 tons in 1974. Wayne and Mason Counties accounted for 97% of the total production. Leading producers were BASF Wyandotte Corp., Detroit Lime Co., Marblehead Lime Co., and The Dow Chemical Co. Michigan continued to rank fifth among the States in both production and value.

BASF Wyandotte Corp., one of the State's leading lime producers, purchased a powerplant in October 1975 from the Detroit Edison Co. The plant, Edison's Wyandotte South plant, was originally purchased from BASF Wyandotte's predecessor company, Wyandotte Chemicals Corp. It is the first time any U.S. power company has sold a working generating plant to one of its customers according to officials at Detroit Edison.

Magnesium Compounds.—Michigan maintained its position as the Nation's leading producer of magnesium compounds in 1975, accounting for 59% of the U.S. total. Production, originating in four counties, decreased in quantity and rose in value over 1974 levels.

Martin Marietta Chemical Corp.'s remodeling and construction program at the former Kaiser Aluminum & Chemical Co. plant at Midland continued during 1975. Work is scheduled for completion in late 1976. The plant will produce a form of magnesium oxide used to maintain steel-producing furnaces. Employment of 35 to 40 people is anticipated with an estimated annual payroll of $600,000. The plant has been idle since 1970.

Martin Marietta Refractories Div. expanded its periclase manufacturing facility at Manistee with two additions during the year. The first was brought online in the first quarter of 1975; the second, nearing completion at yearend, is scheduled to begin producing periclase in the first quarter of 1976. Combined, the two additions will nearly triple production.

Perlite.—Crude perlite, mined in Western States, continued to be expanded in Michigan during 1975. Output of expanded perlite from the State's three manufacturers in Kalamazoo, Wayne, and Iosco Counties decreased 25% in quantity and 4.2% in value from those of 1974. The expanded perlite was used for filter aid and plaster aggregate.

Salt.—Michigan is fifth in the national ranking of salt producers. Salt is produced by evaporating natural brines at the St. Louis plant of Michigan Chemical Co. (Gratiot County). Salt is manufactured from artificial brines in Manistee, St. Clair, and Wayne Counties. Rock salt is mined in only one locality in Michigan, at Detroit (Wayne County), by the International Salt Co., Inc. The salt in this mine is obtained from a depth of approximately 1,150 feet beneath the surface. Production of salt in 1975 amounted to 4,020,000 short tons, a decrease of 9.6% from 1974 levels. The value of salt sold or used during the year was $68,352,591, an increase of 10% in value over 1974.

A work stoppage at a large salt mine in Ojibway, Ontario, Canada, left two of Michigan's main salt companies, Diamond Crystal and Morton, short a total of 100,000 to 150,000 tons of rock salt at the beginning of the 1975–76 winter season. Both of these companies usually spend the summer months stockpiling rock salt imported from the Canadian mine. Meanwhile, International Salt Co., Inc. experienced high levels of production during the 1975–76 winter season that could lead to a substantial increase in 1976 production totals. In late 1975, poor weather conditions in the northern part of the United States, including frequent snow and ice storms, combined with the Canadian work stoppage, contributed towards an increased demand for rock salt.

In May 1975, Morton Salt Co. announced a $2.8 million expansion program at its Manistee salt plant aimed at raising annual production of evaporated salt by 100,000 tons. The expansion will consist of adding a new vacuum pan to the existing evaporation process. Completion of the project is scheduled for early 1977.

In September 1975, Diamond Crystal Salt Co. officials authorized a $2.5 million expansion and modernization program for the company's refinery at St. Clair. Production capacity will be increased by one-third by adding a new evaporator. In addition, Diamond Crystal plans to replace an old building housing two units of the company's exclusive Alberger process for producing flake salt. Scheduled completion of the project is approximately 2 years.

Sand and Gravel.—A continued slump in the construction industry resulted in a further decrease in Michigan's annual production of sand and gravel. Output for the year amounted to 47,051,000 short tons valued at $73,397,000. This compares with 60,027,000 tons and $82,617,000 in 1974. Nearly every county in the State reported sand and gravel production and output exceeded 1 million tons in each of nine counties. These counties provided approximately 50.1% of the total State production.

A breakdown of sand and gravel statistics for the 1975 calendar year is provided in tables 7 and 8.

Completion of American Aggregate Corp.'s newest gravel processing operation at Milford was accomplished during 1975. The facility, under construction during 1974, uses a 20-inch hydraulic dredge as the primary pit excavator to extract pebble sizes of gravel for sale in the Detroit area. Deposits at the existing Brighton plantsite were exhausted in the fall of 1975. The new modular concept of plant design engineered in 1970 made it possible to dismantle and move the facility to another location in the same general area. Sand will be the primary product at the Brighton location. American Aggregate's smaller plant at Kalamazoo has reserves indicating less than 5 years of plant life.

Mining operations at the sand and gravel plant operated by Construction Aggregates Corp. were suspended in midsummer for the first time in more than 40 years because of a decline in roadbuilding and general construction. The plant was closed through August. The temporary shutdown of mining and barge operations at Ferrysburg resulted in a layoff of 40 employees. Normal production of the screening and processing plant is 8,000 tons per hour. Major customers are the automotive industry for foundry sand and the construction industry for gravel products.

Michigan continued to lead the Nation in the production of industrial sand during 1975. Most of the sand is from the sand dunes found along the Lake Michigan shoreline. Secondary production comes from other sources in Wexford County and the Saginaw Bay area. The sand is in demand by foundries and other automotive-related industries because of its physical and chemical properties. Declines registered in both quantity (15.3%) and value (6.7%) reflected the general slowdown of the automotive industry during 1975. Table 9 presents a comparison of industrial sand

Table 7.—Michigan: Construction aggregate[1] and industrial sand sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value[2]	Quantity	Value[2]
Processed:				
Construction aggregate:				
Nonresidential and residential construction	11,791	18,671	8,208	15,211
Highway and bridge construction	3,819	4,763	3,480	5,276
Other construction uses (dams, waterworks, airports, etc.)	1,013	1,281	518	846
Concrete products (cement blocks, brick, pipe, etc.)	3,366	5,617	2,697	4,709
Bituminous paving (asphalt and tar paving)	7,518	10,171	6,250	9,492
Roadbase and subbase	17,955	22,152	13,945	19,430
Fill	1,248	1,385	1,592	1,692
Other	494	736	478	1,022
Total	47,204	64,776	37,168	57,678
Unprocessed:				
Roadbase and subbase	2,761	1,522	2,046	764
Fill	4,895	2,280	3,396	1,799
Other	--	--	69	57
Total	7,656	3,802	5,511	2,620
Industrial sand	5,167	14,039	4,372	13,099
Total construction aggregate and industrial sand	60,027	82,617	47,051	73,397

[1] Includes blended sand and gravel.
[2] Values f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

Table 8.—Michigan: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines [1]	Quantity	Value	Number of mines [1]	Quantity	Value
Alcona	3	149	134	4	146	124
Alger	1	75	88	3	55	77
Allegan	9	1,121	936	12	944	1,215
Alpena	4	185	213	2	W	W
Antrim	2	W	W	4	208	224
Arenac	2	W	W	1	27	7
Baraga	3	138	126	4	67	110
Barry	7	561	744	7	442	697
Bay	2	W	W	1	W	W
Benzie	1	16	23	1	32	33
Berrien	11	1,718	4,487	11	1,683	4,689
Branch	3	238	353	4	360	486
Calhoun	12	849	957	11	541	603
Cass	10	960	1,021	12	706	1,337
Charlevoix	4	176	265	4	153	177
Cheboygan	5	187	73	4	86	76
Chippewa	3	159	170	5	138	118
Clare	4	352	297	5	307	303
Clinton	11	919	1,098	13	1,153	1,785
Crawford	2	W	W	3	118	145
Delta	5	116	223	7	433	432
Dickinson	4	144	244	5	272	433
Eaton	9	674	701	8	264	408
Emmet	5	183	243	6	146	198
Genesee	3	268	375	3	183	298
Gladwin	--	--	--	1	W	W
Gogebic	3	188	162	6	225	249
Grand Traverse	5	254	551	4	141	426
Gratiot	7	572	569	13	385	426
Hillsdale	4	500	554	5	584	669
Houghton	3	255	267	2	W	W
Huron	6	422	394	7	255	281
Ingham	7	779	833	9	483	534
Ionia	5	415	397	14	534	627
Iosco	2	W	W	3	W	W
Iron	4	136	197	3	W	W
Isabella	6	908	824	4	620	655
Jackson	4	681	987	4	515	720
Kalamazoo	11	3,168	6,144	9	783	1,386
Kent	20	2,710	4,529	24	1,728	3,713
Keweenaw	1	62	23	1	37	31
Lake	1	W	21	2	35	37
Lapeer	8	1,056	999	11	775	919
Leelanau	4	260	371	3	W	W
Lenawee	7	747	963	6	683	1,023
Livingston	8	2,711	4,001	14	2,371	3,494
Luce	1	57	44	3	W	W
Mackinac	3	134	89	6	252	217
Macomb	8	2,010	2,785	7	1,205	2,151
Manistee	3	322	882	3	121	80
Marquette	5	602	805	6	696	1,115
Mason	2	W	W	2	W	W
Mecosta	3	633	595	5	331	437
Menominee	3	56	46	13	166	174
Missaukee	3	66	55	3	193	133
Monroe	2	W	W	2	W	W
Montcalm	8	547	326	4	385	281
Montmorency	2	W	W	1	16	4
Muskegon	3	606	1,783	2	W	W
Newaygo	2	W	W	8	294	405
Oakland	33	14,303	17,133	28	10,256	15,194
Oceana	6	282	320	7	630	1,184
Ogemaw	4	432	356	5	445	502
Ontonagon	3	201	128	1	145	48
Osceola	4	350	405	5	400	588
Oscoda	1	W	W	1	W	W
Otsego	5	230	269	4	157	197
Ottawa	15	2,971	5,736	15	2,346	4,534
Presque Isle	3	386	313	3	437	305
Roscommon	3	39	65	2	34	57
Saginaw	5	1,079	2,234	5	889	1,890
St. Clair	5	277	865	2	W	W
St. Joseph	5	537	485	5	549	521
Sanilac	5	369	355	3	724	891

See footnotes at end of table.

Table 8.—Michigan: Sand and gravel sold or used by producers, by county—Continued

(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines [1]	Quantity	Value	Number of mines [1]	Quantity	Value
Schoolcraft	1	43	27	2	W	W
Shiawassee	10	531	668	7	247	356
Tuscola	9	1,249	1,682	11	1,056	1,798
Van Buren	7	587	642	5	245	351
Washtenaw	9	2,122	2,237	9	2,225	2,810
Wayne	4	881	1,223	3	765	1,373
Wexford	4	470	971	5	413	764
Undistributed [2]	--	2,642	3,537	--	2,811	5,872
Total [3]	430	60,027	82,617	478	47,051	73,397

W Withheld to avoid disclosing individual company confidential data.
[1] Reflects only mines that have reported production in response to the annual canvass of operators.
[2] Includes data withheld and some sand and gravel that cannot be assigned to specific counties.
[3] Data may not add to totals shown because of independent rounding.

Table 9.—Michigan: Industrial sand sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Glass	124	291	W	W
Molding	2,904	8,819	2,104	7,102
Blast	601	1,204	W	W
Fire or furnace	W	W	W	W
Engine	32	103	207	451
Chemical	W	W	--	--
Foundry	1,167	3,013	W	W
Metallurgical	--	--	W	W
Other uses	339	609	2,061	5,545
Total	5,167	14,039	4,372	[1] 13,099

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Data do not add to total shown because of independent rounding.

sold or used, by use category, for 1974 and 1975.

Slag (Iron and Steel).—Michigan remained one of the Nation's leading producers of slag during 1975. Edward C. Levy Co., in Detroit (Wayne County), processed all slag from the Ford Motor Co. Steel Div., Great Lakes Steel Co., and McLouth Steel Corp. Slag is categorized as a manufactured mineral, along with cement and lime, and used by the construction industry.

Stone.—Production of 39,946,000 tons of stone from 54 reporting quarries in 1975 placed Michigan sixth in the Nation. Five producers in the State accounted for 80% of the total output. Tables 10 and 11 provide detailed information on the type of stone quarried and its use.

Limestone is the most important type of stone produced in Michigan. Large deposits of high-grade limestone exist in Alpena, Presque Isle, Cheboygan, Emmet, Charlevoix, Mackinac, and Schoolcraft Counties; and similarly, extensive belts of dolomite exist in Chippewa, Mackinac, and Schoolcraft Counties. Limestone and dolomite beds are also found, to a lesser extent, in Arenac, Huron, Wayne, Monroe, and Eaton Counties in the southern part of the State.

Sandstone, mined in Jackson County, was used as building and decorative stone. The Sylvania sandstone, used for industrial sand, was mined in Wayne County by Ottawa Silica Co., Michigan Div.

Marl is a form of limestone found throughout Michigan in small deposits. It

is used for treating soils that are deficient in lime. In 1975, Michigan ranked fifth in the Nation, with production of marl amounting to 85,173 tons reported from seven counties. The bulk of the material came from Allegan, Calhoun, Cass, and Kalamazoo Counties.

In addition to the three major types of stone (limestone/dolomite, sandstone, and marl), there are appreciable amounts of other types of stone produced in Michigan. In the western part of the Upper Peninsula, considerable quantities of traprock are quarried for road metal, concrete aggregate, and railroad ballast. Much of the production is by county road commissions, but additional quantities are produced by private companies. Other types of stone produced in smaller amounts include feldspar, amphibolite, marble, granite, and rhyolite. An isolated deposit of Kona-dolomite, in Marquette County, is individually owned by a sand and gravel operator. The dolomite, found during regular mining operations, is sold to a local rock shop to be cut, polished, and used for making table tops, bookends, and other decorative purposes.

Table 10.—Michigan: Stone sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind	1974		1975	
	Quantity	Value	Quantity	Value
Dimension stone total [1]	6	117	7	138
Crushed and broken:				
Limestone	37,223	50,897	30,672	52,104
Dolomite	9,228	17,232	7,970	16,565
Marl	151	258	85	153
Traprock	W	W	9	17
Other [2]	872	4,243	1,202	4,822
Total [3]	47,474	72,631	39,938	73,662
Grand total [3]	47,479	72,748	39,946	73,800

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes limestone, dolomite, and sandstone.
[2] Includes granite and sandstone, and kinds indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Table 11.—Michigan: Crushed stone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate	984	1,397	754	1,258
Concrete aggregate	5,287	7,292	5,037	8,586
Dense graded roadbase stone	1,332	2,273	797	1,633
Macadam aggregate	1,933	3,368	1,214	2,520
Surface treatment aggregate	194	377	120	290
Other construction aggregate and roadstone	1,482	2,635	1,430	2,151
Agricultural purposes [1]	642	1,107	635	1,231
Cement manufacture	8,730	9,322	7,334	12,253
Lime manufacture	10,412	15,450	8,707	14,932
Flux stone	13,681	22,435	10,192	19,356
Railroad ballast	223	335	278	496
Riprap and jetty stone	400	589	255	409
Other uses [2]	2,173	6,051	3,184	8,547
Total [3]	47,474	72,631	39,938	73,662

[1] Includes agricultural limestone, agricultural marl and other soil conditioners, poultry grit, and mineral food.
[2] Includes filter stone (1975), manufactured fine aggregate, terrazzo, refractory stone, chemical stone, bedding material (1974), glass, paper manufacture, and sugar refining.
[3] Data may not add to totals shown because of independent rounding.

METALS

Copper.—The Lake Superior copper district of Michigan's Upper Peninsula was the first American copper area of importance and is now one of the oldest of the leading copper-producing districts in the world. Although copper sulfides are extensively mined at White Pine Copper Co.'s operation in Ontonagon County, Michigan is one of the few places in the world where pure native copper exists in any quantity.

In 1975, the Quincy Mining Co. of Hancock made a grant of $5,000 to the Michigan Technological University for studies on the development of an underground leaching process for treating the local native copper ores found in the Upper Peninsula. This brings the total amount provided by the company for these studies to $15,000. Although unstable economic conditions have caused Quincy to proceed cautiously, the company plans to reopen its No. 8 shaft for exploration purposes. Quincy ceased mining operations at the end of World War II.

At Calumet, also part of the native copper area, Homestake Copper Co. officially launched operation of a pilot concentrator in June 1975. The concentrator is capable of processing 750 tons of copper ore per day. The first copper to be mined in 7 years at the Centennial mine of the former Calumet & Hecla Co. was processed at the concentrator and shipped in early September 1975. The shipment, consisting of 65 tons of concentrate, went to the Clarabelle, Ontario, plant of International Nickel Co. of Canada for smelting. The property is being operated by Homestake Copper Co. in a joint venture with International Nickel Co. which owns 40% of the project.

Presently, work is being conducted by Homestake Copper Co. to determine the existence of sufficient mineralization and to study the mining and concentrating characteristics of native copper deposits on the Keweenaw Peninsula. By 1977, when this part of the project is scheduled for completion, more than 4,200 feet of shaft will have been sunk, 7,500 feet of exploration and development drifting will have been driven, and over 400,000 tons of ore will have been processed. At that time, a decision is expected to be made whether to proceed with a major new mining operation at the Centennial property.

In December 1975, officials of Homestake Copper announced the discovery of a new copper deposit west of Gratiot Lake in Keweenaw County. The ore encountered is a disseminated copper sulfide rather than the native copper generally found in the area. Diamond drilling continued in the area to outline the formation and to assess the grade of mineralization and tonnage.

According to the 1975 annual report of the Copper Range Co., White Pine copper mine produced an average of 25,291 tons of copper ore per day at an average grade of 20.22 pounds of copper per ton of ore. The average price received per pound was $0.58 compared with $0.83 in 1974. Productivity gains at the mine were made possible through the installation of new mobile rock breaking devices known as feeder breakers. These devices permit the reduction of ore vehicle haulage distances from the mining face to conveying points. Fourteen feeder breakers were on the property by the end of 1975. The installation of major belt systems also contributed to more efficient operations. The company installed belting for approximately 12,000 feet of conveyors. The mine also completed renovation of belt systems started in 1974.

The White Pine mill (concentrator) set a new record in 1975 by processing 8,975,366 tons of ore for an average daily milling rate of 25,212 tons. The recovery rate of 85.59% of copper-bearing minerals from the ore during the year was slightly down from the 85.71% figure of 1974.

During 1975, the White Pine smelter produced 145,831,000 pounds of marketable copper compared with 134,024,000 pounds of copper in the previous year. The highlight of the year occurred during April when a monthly record of 15,172,052 pounds of copper was produced.

At the end of 1975, Copper Range announced a temporary curtailment of operations at the White Pine mine and concentrator. The curtailment, part of a cash conservation and cost reduction plan for 1976, reportedly would result in the layoff of approximately 2,100 employees as of January 4, 1976. The principal impact of the cutback will be at the mine, where ore production is expected to be at about 20% of capacity.

Gold.—In January 1975, the Ropes gold mine, owned by Arcadian Copper Mine Tours, Inc., of Hancock, was pur-

Table 12.—Michigan: Mine production (recoverable) of silver and copper

	1973	1974	1975
Mines producing: Lode	1	1	2
Material sold or treated:			
Copper ore—thousand short tons	8,884	8,301	9,033
Production (recoverable):			
Quantity:			
Silver—troy ounces	850,273	642,944	632,336
Copper—short tons	72,221	67,012	73,690
Value:			
Silver—thousands	$2,175	$3,028	$2,795
Copper—do	85,943	103,601	94,618
Total—do	88,118	106,629	97,413

chased by the Callahan Mining Corp. of Darien, Conn. The company has no immediate plans to reopen the mine. Exploration of the mine to evaluate its potential is being considered.

Over a 14-year mining period (1883–1897), the Ropes gold mine in Marquette County reached a depth of 800 feet and had extracted $647,902 in gold and silver.[5]

Iron Ore.—Michigan's iron mining has grown from its first shipment of 200 pounds of ore in 1846 to 14,089,000 long tons in 1975. The later figure could not have been so large without the development of an ore-milling process called beneficiation. The introduction of this process has effectively guaranteed the Nation a steady future supply of iron ore for hundreds of years.[6]

Iron ore is produced at four open pit and two underground mines in Michigan. Producers are CCI at four locations in Marquette County, Inland Steel Co. in Iron County, and Hanna Mining Co. in Dickinson County.

Pellet production at CCI's Michigan operations rose to a new high of 12.3 million tons in 1975, an increase of 41% from the 1974 figure of 8.7 million tons.[7] The increase is attributable to the new Tilden mine and the Empire mine expansion.

Tilden's production of 2.8 million tons in 1975 was only 70% of the facility's designed capacity. It should be noted that Tilden has yet to reach its designed capacity on a sustained basis owing to difficulty in controlling moisture levels in the filtering section of the plant. As a result, an expansion of the mine's annual capacity is temporarily being deferred to provide additional time for evaluating operations.

The Empire mine also operated short of its designed capacity in 1975. This was due in part to gearing failures in the five primary autogenous mill lines in the expansion section of the concentrating plant. Empire's 1975 production of 4.7 million tons was 90% of its annual capacity.[8] By yearend these problems had been resolved. Further expansion of the Empire mine, the third in the past 10 years, is currently being planned. The expansion will increase Empire's annual capacity to 8 million tons of pellets per year.

Iron ore pellet production at the Republic mine in Humboldt and the Pioneer Pellet Plant at Eagle Mills amounted to 4.8 million tons, slightly below the record 5 million tons of a year ago.

Production at the Mather B mine, CCI's only underground mine, amounted to 1.7 million tons in 1975. Natural ore production from the Mather B is treated at the company's Ore Improvement Plant and most of the treated ore is delivered to the Pioneer Pellet Plant for pelletizing.

Inland Steel Co. shipped 242,186 long tons of natural ore from the Sherwood underground mine at Iron River during 1975.[9] The 49% decrease in shipments was due in part to the development of a new level at the Sherwood mine.

Iron Oxide Pigments.—Shipments of crude iron oxide pigments in Michigan decreased 37% in quantity and 28% in value from 1974 levels. The decrease was caused by the depressed automotive and construction industries during 1975. The primary use of these pigments, produced by

[5] Segall, R. T., and Glenna. Fourteen Years of 24-Karat Mining. Michigan Natural Resources, November-December 1975, p. 7.
[6] Michigan Department of Natural Resources, Geological Survey Division. Michigan Mineral Producers, 1975. Ninth Annual Directory. P. 15.
[7] Cleveland-Cliffs Iron Co. Annual Report 1975, p. 5.
[8] Work cited in footnote 7.
[9] Skillings' Mining Review. V. 65, No. 8, Feb. 21, 1975, p. 8.

Table 13.—Michigan: Usable iron ore[1] produced (direct-shipping and all forms of concentrates), by range

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total		
				Gross weight		Iron content (percent)
				Ore	Iron content	
1854–1970	390,098	292,926	249,625	932,649	NA	NA
1971	9,495	2,424	--	11,919	7,384	61.95
1972	9,131	2,533	--	11,664	7,332	62.86
1973	9,036	2,404	--	11,440	7,210	63.02
1974	8,920	2,419	--	11,339	7,153	63.08
1975	12,448	2,331	--	14,774	9,327	63.13
Total	439,123	[2] 305,037	[2] 249,625	993,785	NA	NA

NA Not available.
[1] Exclusive after 1905 of iron ore containing 5% or more manganese.
[2] Distribution by range partly estimated before 1906.

Table 14.—Michigan: Iron ore shipped from mines

(Thousand long tons)

Year	Direct-shipping ore[1]	Concentrates and agglomerates, total	Total usable ore[2]	Proportion of beneficiated ore to total usable ore (percent)
1971	1,439	10,393	11,833	87.8
1972	727	11,965	12,692	94.3
1973	463	11,927	12,389	96.3
1974	548	11,054	11,602	95.3
1975	288	13,801	14,089	98.0

[1] Includes crushed, screened, and sized ore not further treated.
[2] Data may not add to totals shown because of independent rounding.

Cleveland-Cliffs Iron Co. in Marquette County, is the manufacture of paint.

Construction continued on a new finished iron oxide pigment facility at Wyandotte. The plant, owned by BASF Wyandotte and controlled by its Colors and Chemicals Div., is expected to begin production during 1976. Original plans called for completion of the facility by the end of 1975; however, testing is still being conducted.

Iron and Steel.—According to the American Iron and Steel Institute (AISI), Michigan's production of raw steel continued its decline in 1975. A figure of 9,093,000 tons was recorded, compared with 10,459,000 tons in 1974, and 10,945,000 tons in 1973. Michigan, with a total of 7,282,000 short tons, placed fourth in the national ranking of pig iron consumption in 1975. Pig iron production during the year decreased 7.9%, while value increased 17.3% over comparable figures for 1974.

Ford Motor Co. completed the addition of a new electric furnace for the Steel Div.'s Rouge plant at Dearborn during 1975. The furnace is part of a continuing expansion program that will increase Ford's production capacity to 3.75 million tons per year.

In November 1975, North Star Steel Co., jointly owned by Cargill Inc. of Minneapolis and Co-Steel International of Canada, cancelled plans to build a new minimill at Muskegon. According to company officials, the plans were cancelled because of delays in obtaining approval for the project from the U.S. Corps of Engineers and also because of environmental suits from some local citizens. North Star is still considering five other Michigan communities for the minimill. Key elements in the firm's decision were Michigan's role as a major consumer of products made by its mills, an adequate supply of raw materials, and its central location to major ports. The $50

million plant will initially employ about 500 persons.

At the Detroit plant of McLouth Steel Corp., capital expenditures for 1975 included the installation of the No. 11 continuous anneal and pickle line for stainless steel. The 660-foot facility is a sophisticated, high-speed stainless line. It will enable McLouth to improve material flow. Other improvements included installing a new 165-ton crane in the melt shop and relining a stove at No. 2 blast furnace.

Construction of the MacSteel (a division of Michigan Seamless Tubing Co.) electric steel plant in Jackson was completed in early 1975. A second furnace, added in December 1975, brought rated annual capacity to 180,000 tons per year. The plant, using a French-developed centrifugal casting process never before tried in the United States, is now casting between 5,000 to 6,500 tons of steel per month. The plant produced high-quality, 1½-ton round bars used to make seamless tubing and forgings. Michigan Seamless Tubing also manufactures specialty steel in plants located at South Lyons and Detroit.

Some 1,000 Warren, Mich., steelworkers received Federal benefits averaging $2,000 each because imported steel resulted in their layoff. The payments were made under the Trade Readjustment Act of 1974, which provides special Federal assistance to workers laid off because of foreign imports. Increased imports of steel products created layoffs also at the Jones & Laughlin Corp.'s (J&L) stainless steel plant in Detroit beginning December 1975. As many as 800 workers were on indefinite layoff at one point. The J&L plant is one of the major producers of stainless steel in Michigan.

Iron and Steel Scrap.—Work continued at the steel wire rod plant of Hoover Ball & Bearing Co. The plant, located in Bridgman, was established in 1973 in joint ownership with Pechiney Ugine Kuhlmann of France. The company expected to be in full production by July 1975, but met with some delays. The plant will process scrap steel into wire rod without remelting, thus eliminating the larger per-ton capital investment required for melting. The raw material, scrap steel, will be shredded at various locations and shipped to the plant for further refining and processing.

At the end of 1974, Grede Foundries, Inc. completed a major plant addition at its foundry in Kingsford for the production of hydraulic valves and related parts for the fluid power industry. The new facility, under construction for the last 18 months, is a self-contained module consisting of its own automated molding unit, a 28-ton channel induction holding furnace, a turntable pouring line, and a conveyorized shakeout and cleaning room operation. The Kingsford foundry was originally placed in operation by Grede Foundries, Inc. in January 1947.

Kelsey-Hayes Co. closed its McGraw Avenue foundry in Detroit in June. The foundry produced drum castings. The closing affected about 400 hourly employees who were given the right to transfer to other Kelsey-Hayes operations in the area.

Silver.—White Pine Copper Co. (Copper Range) continued to recover silver from copper ore mined in Ontonagon County during 1975. Production of silver dropped 1.7%, while value fell 7.7% below 1974 levels.

Uranium.—The Tennessee Valley Authority (TVA) contracted with a Canadian firm, David Robertson Associates, Ltd. of Ontario, Canada, during 1975 to conduct preliminary exploration for uranium west of Marquette in Michigan's Upper Peninsula. At the close of 1975, several other mining companies had applied for leases on State land in the general area for exploration purposes.

In conjunction with growing interest in the possibility of commercial deposits of uranium in Michigan, ERDA granted a 1-year contract to the Michigan Technological University, Department of Geological Engineering. The contract, in the amount of $16,000, is for the purpose of evaluating the uranium and thorium potential of Michigan's Precambrian rocks. The objectives of the study are to assemble information on uranium occurrences in the region, to interpret the geology in terms of its resemblance to geological settings for known types of uranium deposits, and to evaluate some of the settings for their possible uranium potential. The contract expires on June 30, 1976.

MINERAL FUELS

Coal.—Identified bituminous coal resources in Michigan, as of January 1, 1974, amounted to 205 million short tons.[10] Michigan Aggregates Corp., a sand and gravel operator in Ingham County, was the sole producer of coal in the State. Production for 1975 amounted to approximately 10,000 tons, all of which was sold to a local utility.

The Dow Chemical Co. announced plans for a small-scale continuous coal liquefaction pilot plant during 1975, along with several supportive projects. No actual construction had begun at yearend.

An experimental pilot plant is being constructed at Ann Arbor to determine the feasibility of removing approximately 50% of the sulfur and ash from coal, by means of a coal beneficiation process, before burning. The project is being funded jointly by Detroit Edison, and the Townsend and Bottum Co. of Ann Arbor.

In early 1975, the Bureau of Mines awarded a $17,000 grant to the Michigan Technological University, Institute of Mineral Research for a study concerning the magnitude and quality of the State's coal resources. The objectives of the yearlong study were to determine the extent and thickness of the coal beds, to obtain coal samples and analyze them to determine the quality of the coal beds, to determine the thickness of glacial overburden, and to update reserve estimates.

Natural Gas.—According to the DNR's Geological Survey Div., natural gas production increased substantially during 1975, rising from 69,807 million cubic feet in 1974 to a record 102,678 million cubic feet in 1975. The large increase in production is directly due to Niagaran reef developments over the past few years. Gas production, which represents actual sales of Michigan-produced gas, is expected to continue to rise over the next few years. Michigan's no-flare order is an important element in increasing gas production. In effect since late 1971 and applying primarily to the new areas of actual or potential Niagaran reef production, the order requires Niagaran oil wells to be shut-in until market connections are made for the sale of oil-well gas. As of January 1, 1976, about 100 oil wells and 60 gas-condensate wells were waiting sales connections or pipeline construction.

New figures for natural gas reserves, provided by the American Gas Association, credit Michigan with 1,607 billion cubic feet. After allowing for a 1975 alltime record production, this represented a net increase of 148.5 billion cubic feet.

Natural gas imports to Michigan markets and gas storage fields by way of pipelines from Texas, Louisiana, Oklahoma, and Kansas fields remained at a high level. Preliminary import figures, compiled by the Gas Section, Public Utilities Div., Michigan Department of Commerce, indicated gas imports amounted to 769,958 million cubic feet during 1975. This was a decrease from the 851,903 million cubic feet imported in 1974.

The gross value of Michigan-produced gas amounted to $65,098,000 in 1975. The average value of this resource was calculated to be $0.634 per thousand cubic feet.[11]

The Williamsburg gas eruptions, which occurred in 1973, continued to be a subject of concern for some local citizens, State agencies, and environmental groups. The well that caused the gas eruptions remains temporarily sealed and has not yet been properly completed for gas production. Environmental impact statements (EIS) prepared by the DNR to justify reopening and completing the well have been rejected as inadequate by review groups. A new EIS has been prepared and will be reviewed early in 1976.

Michigan Consolidated Gas Co., a Detroit-based utility, has signed an agreement with Shell Oil Co. to buy up to 400 billion cubic feet of natural gas from reserves under development in a geological formation extending from Manistee County northeast to Otsego County in the northwestern Lower Peninsula. The gas involved is enough to heat about 200,000 homes for a period of 10 years.

Michigan Wisconsin Pipe Line Co., an affiliate of American Natural Gas Co., began operating its new 463-acre Muttonville storage field near Detroit. The field has an ultimate working capacity of 11 billion cubic feet.

After a yearlong study contracted by the Michigan Public Service Commission, Stanford Research Institute of Menlo Park, Calif., recommended that Consumers Power

[10] Averitt, P. Coal Resources of the United States, January 1, 1974. U.S. Geol. Survey Bull. 1412, p. 11.

[11] Production and Proration Unit, Geological Survey Division, Michigan Department of Natural Resources.

Co.'s Marysville processing plant should be eventually closed if spiraling costs can't be brought under control. Much of the high cost of the plant's operation was blamed on the $5.20 per barrel export duty Canada puts on the liquid natural gas feedstock. The plant, which supplies 20% of Consumers' natural gas requirements, uses 50,000 barrels of liquid natural gas feedstock per day, piped in from Alberta, Canada. Wellhead costs of the feedstock have also risen dramatically and, with the export charge, now have risen to $12.27 per barrel. Instead of being able to produce synthetic gas for $1 to $1.25 per million British thermal units, the cost has risen to $3.40. Other options suggested by Stanford are for Consumers to buy supplemental feedstock, that the Canadian contract be renegotiated, or that the firm be allowed to include the cost of the plant in its gas rate base. Consumers Power is currently under a 15-year contract with Canadian suppliers.

Natural Gas Liquids.—According to the American Gas Association, proved reserves of natural gas liquids totaled 20.6 million barrels at yearend 1975, up approximately 400,000 barrels from 1974 levels.[12]

Peat.—Michigan is the Nation's leading producer of peat, accounting for about 31.7% of the U.S. total in 1975. Fifteen operators produced 272,066 tons of peat, registering a drop of approximately 10% below the level of 1974. This decrease was due in part to heavy rains in the early part of 1975 which hindered operations. Most of Michigan's peat was used as a soil conditioner, with the remainder used as an ingredient for potting soils, for mushroom beds, and for packing flowers.

Petroleum.—At present oil is produced in 50 counties in Michigan. The principal fields are located in northern lower Michigan—primarily Otsego, Kalkaska, Grand Traverse, and Manistee Counties. These counties accounted for almost 51% of the oil and approximately 67% of the State's natural gas production in 1975.

[12] Oil and Gas News. V. 82, No. 17, Apr. 23, 1976, p. 16.

Table 15.—Michigan: Natural gas production and value, by county

County	1974		1975	
	Quantity (million cubic feet)	Value[1] (thousands)	Quantity (million cubic feet)	Value[1] (thousands)
Allegan	189.8	$95.7	49.4	$31.3
Antrim	130.7	65.9	1,394.8	884.3
Calhoun	4,434.7	2,235.0	5,024.2	3,185.3
Clare	102.0	51.4	112.6	71.4
Crawford	266.4	134.2	598.1	379.2
Eaton	467.1	235.4	2,950.0	1,870.3
Grand Traverse	10,716.2	5,401.0	19,842.9	12,580.3
Gratiot	2.7	1.3	2.3	1.5
Hillsdale	4,615.6	2,326.3	4,507.5	2,857.8
Ingham	5,238.5	2,640.2	3,991.0	2,530.3
Jackson	2,390.0	1,204.4	2,316.3	1,468.5
Kalkaska	25,105.6	12,653.2	36,313.2	23,022.6
Kent	7.4	3.8	6.1	3.9
Lapeer	30.1	15.1	33.6	21.3
Livingston	487.9	246.0	1,361.0	862.9
Macomb	787.1	397.0	324.3	205.6
Manistee	--	--	1,956.1	1,240.2
Mason	1,191.2	600.3	3,927.9	2,490.3
Mecosta	18.2	9.2	14.5	9.2
Missaukee	660.1	332.8	632.2	400.8
Oakland	968.6	488.2	1,327.0	841.3
Ogemaw	263.7	132.9	254.3	161.2
Osceola	--	--	56.1	35.6
Otsego	7,050.2	3,553.3	10,601.0	6,721.0
Ottawa	84.4	42.5	51.5	32.7
Roscommon	333.7	168.2	370.3	234.8
St. Clair	4,260.0	2,146.9	2,843.0	1,802.4
Wexford	4.6	2.3	1,817.0	1,152.0
Total	69,806.5	35,182.5	102,678.2	65,098.0

[1] County values calculated by using State average value per Mcf: $0.504 for 1974 and $0.634 for 1975.

Source: Michigan Department of Natural Resources, Geological Survey Division, Petroleum Geology Unit.

According to data supplied by the DNR, a new State record of crude oil production was established in 1975. The 1975 production figure of just over 24 million barrels represented the largest volume ever produced by Michigan wells in a 12-month period, exceeding 1939's high mark of 23.4 million barrels. Daily production, amounting to 56,800 barrels of crude in January 1975, rose steadily to reach over 77,160 barrels per day in December.[13] Northern counties in the productive Niagaran reef area from Ludington to just east of Gaylord made the most significant contributions to the State's increased production, accounting for nearly 54% of the total crude oil production. In all, six fields produced in excess of 1 million barrels of crude in 1975.

According to records kept by the Production and Proration Unit, Geological Survey Div. of the DNR, the gross value of Michigan-produced oil amounted to $262,351,653 in 1975. The average value per barrel was calculated to be $10.74.

Michigan registered a continued gain in crude oil reserves in 1975, according to the American Petroleum Institute. Reserve estimates, as of December 31, 1975, were 93.3 million barrels. This represents a net gain of approximately 11 million barrels, after accounting for actual production during the year.[14]

Total imports of crude oil into Michigan refineries through pipeline from Western and Midwestern States and from Western Canadian oilfields amounted to 37,599,514 barrels, compared with 42,099,556 barrels reported in 1974. Of the total 1975 imports, Canadian crude amounted to 22,277,674 barrels, a decrease from 27,317,964 barrels of the previous year.

The decrease in imports of Canadian crude oil was not the result of a slack in demand. It was the result of Canadian governmental curtailment of exports to the United States. The flow is expected to be reduced even further in 1976. TOTAL Petroleum (North America) Ltd., has been hit heavily by the cutbacks and allocation practices. At one time TOTAL was using as much as 23,000 barrels daily from Canadian sources. During the past 2 years, however, daily imports for the plant have reached the 16,000- to 17,000-barrel mark. Other refiners in Michigan may not feel the cutbacks so quickly, but eventually the allocation of Canadian crude may be eliminated entirely.

Although the bulk of Michigan-produced crude oil has always been consumed by Michigan refineries, some is exported to other States. In recent years, the amount of exports has increased. Records kept by DNR's Production and Proration Unit show exports amounting to 6,889,744 barrels in 1975, compared with 2,766,487 barrels in 1974.

Exploration and Development.—Kenting Exploration Services Ltd. of Calgary, Canada, requested permission from Michigan's DNR to take seismic soundings in Lakes Erie, Huron, and Michigan during 1975. This is normally a preliminary step in drilling for oil. Oil firms believe substantial oil pools may exist under the Great Lakes. The Natural Resources Commission (NRC), the DNR's policymaking body, supported an executive decision by the director of the DNR to deny the request because it would violate a policy against offshore drilling adopted by the NRC in 1945 and affirmed in 1961. Shell Oil Co. received approval from DNR for similar soundings in 1971, but plans were never executed.

Members of the privately owned Canada Creek Ranch, a wildlife reserve in Montmorency County, considered a leasing arrangement offered by Northern Michigan Exploration Co. during the year. Northern Michigan, a subsidiary of Consumers Power Co. of Jackson, offered nearly $6 million to lease all of Canada Creek Ranch's mineral rights on its 14,000-acre property for drilling purposes. To finalize the agreement, about 1,400 shareholders in the wildlife reserve must be polled. A decision is expected early in 1976.

The Michigan Audubon Society is also considering an offer of $18,000 made by Mobil Oil Co. for drilling rights in the Baker Sanctuary in Calhoun County. Opposition by members caused the measure to be tabled at the end of 1975. The issue is expected to be resolved during a statewide meeting in January 1976. Mobil Oil Co. has offered to follow a system of rigid controls to be laid down by the sanctuary committee after seismic work is completed.

[13] Oil and Gas News. V. 82, No. 9, Feb. 27, 1976, p. 6.
[14] Work cited in footnote 12.

Table 16.—Michigan: Crude oil production and value, by county
(Thousand 42-gallon barrels and thousand dollars)

County	1974 r		1975	
	Quantity	Value [1]	Quantity	Value [1]
Allegan	85.9	735	111.2	1,194
Antrim	36.5	312	205.9	2,211
Arenac	179.5	1,536	187.8	2,017
Barry	10.4	89	10.3	111
Bay	198.0	1,695	193.6	2,079
Calhoun	1,000.1	8,561	1,313.9	14,111
Clare	322.3	2,759	331.1	3,556
Crawford	647.1	5,539	857.8	9,213
Eaton	79.6	681	177.3	1,904
Genesee	37.1	317	12.4	133
Grand Traverse	738.5	6,321	2,152.3	23,116
Gladwin	254.9	2,182	236.1	2,536
Gratiot	.7	6	5.2	56
Hillsdale	1,441.1	12,336	1,312.0	14,091
Huron	.1	1	--	--
Ingham	2,017.3	17,268	2,462.7	26,449
Isabella	126.3	1,081	117.6	1,263
Jackson	524.4	4,489	432.1	4,641
Kalkaska	2,835.8	24,274	3,463.3	37,196
Kent	68.2	584	59.7	641
Lake	88.4	757	87.1	936
Lapeer	70.6	604	77.9	837
Livingston	--	--	1.4	15
Macomb	2.8	24	2.1	23
Manistee	13.1	112	1,040.9	11,179
Mason	152.3	1,304	283.7	3,047
Mecosta	40.9	350	36.5	392
Midland	160.0	1,369	166.8	1,791
Missaukee	701.7	6,006	654.7	7,032
Monroe	5.5	47	5.9	63
Montcalm	88.3	756	79.9	858
Montmorency	--	--	.1	1
Muskegon	9.8	84	9.5	102
Newaygo	11.4	97	14.3	154
Oakland	--	--	33.3	358
Oceana	34.5	295	33.2	357
Ogemaw	464.5	3,976	509.4	5,471
Osceola	362.7	3,104	368.7	3,960
Oscoda	.9	8	.7	8
Otsego	4,038.5	34,569	5,719.2	61,424
Ottawa	58.1	497	65.4	702
Presque Isle	.5	4	.2	2
Roscommon	338.4	2,896	355.8	3,821
Saginaw	16.6	142	16.9	181
St. Clair	764.3	6,542	1,029.3	11,055
Shiawassee	5.6	48	5.2	56
Tuscola	47.5	406	46.8	503
Van Buren	7.5	64	9.3	100
Washtenaw	1.3	11	2.0	21
Wayne	7.3	63	4.0	43
Wexford	5.0	43	117.4	1,260
Total	18,101.8	154,944	24,419.9	262,270

r Revised.
[1] County values calculated using State average value per barrel: $8.54 for 1974 and $10.74 for 1975.

Source: Michigan Department of Natural Resources, Geological Survey Division, Petroleum Geology Unit.

The Pigeon River State Forest area (Otsego, Montmorency, and Cheboygan Counties) continued to be a matter of controversy throughout 1975. At yearend, the NRC had still not released a decision either approving or denying plans for exploration and drilling in the area. According to DNR, Geological Survey Div., total recoverable oil is estimated at more than 143 million barrels; total recoverable natural gas is estimated at 143.5 billion cubic feet. Value of the oil is estimated at a little under $1.6 billion and of the gas, $107 million. In addition to considerable revenue already paid for the original lease, the State would receive an estimated $190 million in royalties and $44 million in severance tax.

The original lease was auctioned to Amoco Production Co. by the State in August 1968. Amoco assigned a 50% interest to Northern Michigan Exploration Co. Amoco and Northern Michigan applied for a drilling permit on the lease in early 1971. The permit was denied. In January 1972, Amoco and Northern Michigan assigned a portion of the lease to the Michigan Oil Co., an affiliate of McClure Oil Co. Michigan Oil filed for a drilling permit in July 1972. It was also denied on environmental grounds. The permit denial was immediately appealed to the NRC. At least 78 separate leases in the area could be affected by the final ruling by NRC. About 90% of the 100,000 acres involved is under lease to Shell, Amoco, and Northern Michigan.

Petroleum Pipelines.—The new 10-inch-diameter, 44-mile crude oil pipeline between Bay City and Alma was completed on schedule in 1975, according to the 1975 annual report of TOTAL Petroleum (North America) Ltd. The completion of this line gives the necessary capacity to transport increased quantities of northern Michigan crude to the refinery at Alma. The new line enabled TOTAL to abandon 110 miles of obsolete pipeline that has been environmentally troublesome in recent years. The new pipeline represented the first stage of a 3-year modernization program for the TOTAL pipeline network.

Table 17.—Michigan: Oil and gas well drilling completions, by county, in 1975

County	Proved field wells [1]			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Allegan	--	--	--	--	--	1	1	2,675
Antrim	--	--	--	--	--	3	3	16,141
Arenac	--	--	1	--	--	1	2	4,352
Barry	--	--	--	--	--	1	1	5,390
Benzie	--	--	--	--	--	4	4	21,934
Berrien	--	--	1	--	--	2	3	2,226
Calhoun	21	4	20	6	1	15	67	227,283
Cass	3	--	--	--	--	--	3	2,148
Cheboygan	--	--	--	--	--	1	1	4,740
Clare	--	--	--	--	--	1	1	4,270
Crawford	2	--	1	1	--	--	4	28,141
Eaton	6	--	5	1	--	7	19	78,617
Gladwin	--	--	1	--	--	--	1	3,900
Grand Traverse	13	6	18	12	9	34	92	547,302
Gratiot	--	--	--	--	--	4	4	14,381
Hillsdale	7	--	2	--	--	1	10	40,396
Ingham	3	--	3	1	--	9	16	67,439
Ionia	--	--	--	--	--	1	1	2,862
Isabella	1	--	4	--	--	2	7	23,703
Jackson	--	--	1	--	--	1	2	8,340
Kalamazoo	--	--	--	--	--	1	1	2,976
Kalkaska	7	1	6	6	2	17	39	258,388
Kent	--	--	--	--	--	1	1	2,610
Lapeer	3	--	--	--	--	--	3	9,198
Livingston	--	--	--	--	--	1	1	4,490
Macomb	--	1	1	--	1	3	6	22,497
Manistee	27	3	26	16	2	22	96	465,996
Mason	4	--	2	--	--	3	9	35,839
Mecosta	--	--	2	--	--	1	3	11,522
Midland	--	--	--	2	--	1	3	13,049
Missaukee	4	--	1	--	--	--	5	22,251
Montcalm	--	--	--	--	--	7	7	27,182
Montmorency	--	--	3	--	1	6	10	45,942
Oakland	--	--	--	--	--	3	3	12,939
Oceana	--	--	1	--	--	8	9	22,271
Ogemaw	1	--	--	--	--	--	1	92
Osceola	--	--	3	--	--	1	4	10,788
Otsego	8	1	10	6	1	20	46	258,524
Ottawa	--	--	--	--	--	1	1	1,550
Presque Isle	--	--	--	--	--	7	7	19,169
Roscommon	3	--	--	--	--	--	3	13,441
St. Clair	--	--	1	--	--	5	6	18,728
Van Buren	1	--	1	--	--	--	2	2,284
Washtenaw	--	--	--	--	--	1	1	3,460
Wexford	--	--	--	4	--	3	7	38,102
Total	114	16	114	55	17	200	516	2,429,528

[1] Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Operator of the new line will be Michigan-Ohio Pipeline Co., a TOTAL subsidiary. The route taken by the artery will cross portions of Bay, Saginaw, Midland, and Gratiot Counties.

Buckeye Pipeline Co. received approval for a 12-inch products line which will run northwest from the Michigan-Ohio border of Monroe County to the company's Ann Arbor junction. This leg of the pipeline is approximately 12.3 miles long. The line will then turn northeast and extend an additional 8.9 miles to the company's Ostrander junction. Both the Michigan-Ohio and Buckeye facilities will operate as common carriers.

Refineries.—Refining activity in Michigan is a stable and relatively little-noticed industry. There are six refining operations currently active in Michigan. They have a combined rated daily capacity of 131,300 barrels per day, and the current total throughput is 121,200 barrels of crude daily. Capacities vary from the 3,000-barrel-per-day capability of Bay Refining (Dow Chemical) at Bay City, to the 65,000-barrel-per-day potential at Marathon's refinery in Detroit. Michigan's refiners employ nearly 2,700 people and have an annual payroll of $32 million.

The following tabulation lists the refineries, their capacities and sources of crude oil: [15]

Operation	(Barrels per day)	Source
Bay Refining (Dow Chemical)	3,000	Canada.
Lakeside Refining Co.	5,600	Canada and Michigan.
Crystal Refining Co.	6,200	Canada and United States.
Osceola Refining Co.	9,500	Canada and Michigan.
TOTAL Petroleum (N.A.) Ltd.	42,000	Canada, 75%; United States, 25%.
Marathon Oil Co.	65,000	Michigan, Louisiana, Wyoming, Canada, Libya.

In August 1975, Dow Chemical halted production and marketing of gasoline from its Bay Refining Div. High costs of imported crude oil and decreasing sales at retail stations were reasons given for the closure. Bay Refining continued to operate its topping unit as an "in-house" facility to feed the Dow Chemical complex at Midland. No layoffs at the refinery occurred when the change took place because employees were transferred elsewhere in the plant. Dow has operated the refinery at Bay City since 1956.

Crude oil processed by TOTAL Petroleum (North America) Ltd. at its Alma refinery totaled 13,728,523 barrels in 1975, according to the company's 1975 annual report. This amount represented an increase of 1.7% over the quantity processed in 1974, and also represented a record crude run. The volume of gasoline produced at the refinery increased from 48.7% in 1974 to 52.5% in 1975, as a percentage of crude oil run. This was largely because of improved operation of the fluid catalytic cracking unit. A comprehensive energy conservation program initiated at the refinery resulted in a 7.5% reduction in energy use in 1975 compared with 1972 figures.

[15] Oil and Gas News. V. 82, No. 16, Apr. 16, 1976, p. 11.

Table 18.—Principal producers

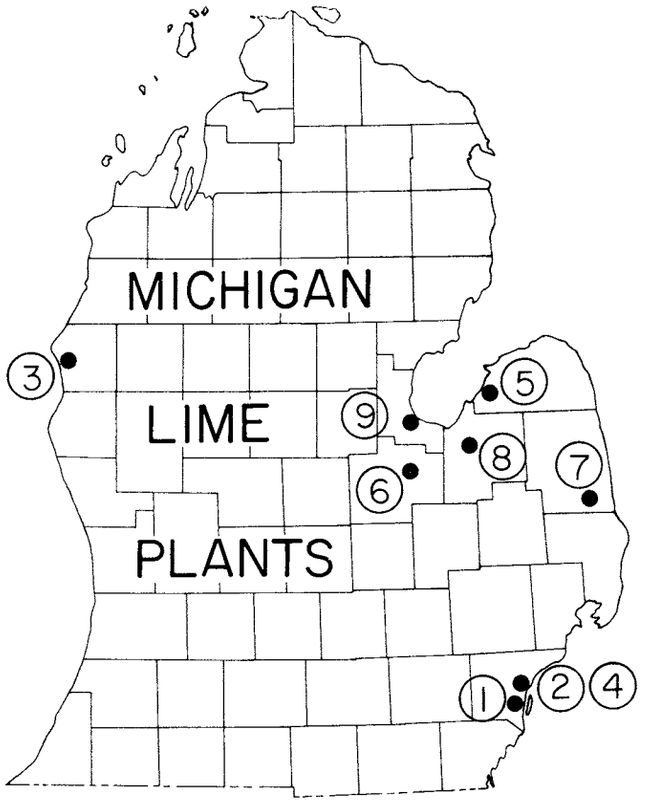
Commodity and company	Address	Type of activity	County
Abrasives:			
Abrasive Materials, Inc	Box 291 Hillsdale, Mich. 49242	Plant	Hillsdale.
Cleveland Metal Abrasive Co.	887 E. 67th St. Cleveland, Ohio 44103	----do	Livingston.
Ervin Industries, Inc	Box 1168 Ann Arbor, Mich. 48106	----do	Lenawee.
Cement:			
Amcord, Inc.[1]	610 Newport Center Dr. Newport Beach, Calif. 92660	----do	Wayne.
Dundee Cement Co.[1]	Box 317 Dundee, Mich. 48131	----do	Monroe.
Edward C. Levy Co.[2]	8941 W. Jefferson Ave. Detroit, Mich. 48209	----do	Wayne.
Medusa Cement Co.[1]	Box 5668 Cleveland, Ohio 44101	----do	Charlevoix.
Clays:[3]			
Coke: Allied Chemical Corp	Box 70 Morristown, N.J. 07960	----do	Wayne.
Copper: White Pine Copper Co.[4]	Box 427 White Pine, Mich. 49971	Mine and plant	Ontonagon.
Gypsum:			
Georgia-Pacific Corp	900 SW. Fifth Ave. Portland, Oreg. 97204	----do	Kent.
Grand Rapids Gypsum Co	Grand Rapids, Mich. 49501	----do	Do.
Michigan Gypsum Co	2840 Bay Rd. Saginaw, Mich. 48601	Surface mine	Iosco.
National Gypsum Co.[5]	325 Delaware Ave. Buffalo, N.Y. 14202	Surface mine and plant.	Do.
United States Gypsum Co.[6]	101 S. Wacker Dr. Chicago, Ill. 60606	----do	Wayne.
Iron ore:			
Cleveland-Cliffs Iron Co.[7]	1460 Union Commerce Bldg. Cleveland, Ohio 44115	Surface and underground mines, plants.	Marquette.
Hanna Mining Co	100 Erieview Plaza Cleveland, Ohio 44114	Surface mine and plant.	Dickinson.
Inland Steel Co.[8]	30 W. Monroe St. Chicago, Ill. 60603	Mine	Iron.
Iron and steel			
Ford Motor Co.[9]	The American Rd. Dearborn, Mich. 48121	Plant	Wayne.
McLouth Steel Corp	300 S. Livernois Ave. Detroit, Mich. 48217	----do	Do.
National Steel Corp.[9]	2800 Grant Bldg. Pittsburgh, Pa. 15219	----do	Do.
Lime:			
BASF Wyandotte Corp.[10]	100 Cherry Hill Rd. Parsippany, N.J. 07054	----do	Do.
The Dow Chemical Co.[11]	2020 Dow Center Midland, Mich. 48640	----do	Mason.
Marblehead Lime Co	300 W. Washington St. Chicago, Ill. 60606	----do	Wayne.
Magnesium compounds: Martin Marietta Corp.	Executive Plaza II Hunt Valley, Md. 21030	Brine wells	Manistee.
Natural gas processors:			
Consumers Power Co	212 W. Michigan Jackson, Mich. 49201	Plant	St. Clair.
Michigan Wisconsin Pipe Line Co.	1 Woodward Ave. Detroit, Mich. 48226	----do	Osceola.
Mobile Oil Corp	P.O. Box 258 Mason, Mich. 48854	----do	Ingham.
Peat:			
Anderson Peat Co	332 Graham Rd. Imlay City, Mich. 48444	Bog and plant	Lapeer.
Fletcher and Rickard	54001 Grand River Rd. New Hudson, Mich. 48165	----do	Oakland.
Michigan Peat Inc	P.O. Box 66388 Houston, Tex. 77006	----do	Sanilac.
Scenic Lakes, Inc	Box 926 East Lansing, Mich. 48823	----do	Shiawassee.
Expanded perlite: Harborlite Corp.	P.O. Box 458 Escondido, Calif. 92025	Plant	Kalamazoo.
Petroleum refineries:			
Crystal Refining Co	901 N. Williams Carson City, Mich. 48811	----do	Montcalm.

See footnotes at end of table.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum refineries—Continued			
Lakeside Refining Co	2705 E. Cork Kalamazoo, Mich. 49001	Plant	Kalamazoo.
Marathon Oil Co.[12]	1300 S. Fort St. Detroit, Mich. 48217	do	Wayne.
Osceola Refining Co	Box 178 Reed City, Mich. 49677	do	Ogemaw.
TOTAL Petroleum (N.A.) Ltd.	E. Superior St. Alma, Mich. 48801	do	Gratiot.
Salt:			
Diamond Crystal Salt Co	916 S. Riverside St. Clair, Mich. 48079	Brine wells and plant.	St. Clair.
Hardy Salt Co	Drawer 449 St. Louis, Mo. 61366	Plant	Manistee.
Hooker Chemical Corp	Box 295 Montague, Mich. 49437	Brine wells	Muskegon.
International Salt Co., Inc	Clarks Summit, Pa. 18411	Mine	Wayne.
Michigan Chemical Corp.[14]	351 E. Ohio St. Chicago, Ill. 60611	Brine wells and plant.	Gratiot.
Morton-Norwich Products, Inc.[15]	Chicago, Ill. 60606	do	Manistee.
Pennwalt Corp	3 Penn Center Philadelphia, Pa. 19102	do	Wayne.
Sand and gravel:			
American Aggregates Corp	Drawer 160 Greenville, Ohio 45331	Pits and plants	Kalamazoo, Livingston, Macomb, Oakland.
Sargent Sand Co	2840 Bay Rd. Saginaw, Mich. 48604	do	Bay, Mason, Saginaw, Tuscola.
Stone:			
Bethlehem Steel Corp	701 E. Third St. Bethlehem, Pa. 18016	Quarry	Chippewa.
The France Stone Co	1800 Toledo Trust Bldg. Toledo, Ohio 43603	do	Monroe.
Ottawa Silica Co	33620 Streicher Rd. Rockwood, Mich. 48173	Quarry and plant	Wayne.
Presque Isle Corp	Box 426 Alpena, Mich. 49707	Quarry	Presque Isle.
United States Steel Limestone Operation.	Rogers City, Mich. 49770	Quarries and plant	Mackinac and Presque Isle.
Vermiculite (exfoliated): W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Wayne.

[1] Also clays.
[2] Also lime.
[3] Principal producers of clay are listed under other nonmetallic materials.
[4] Also silver, and smelting facilities.
[5] Also clays, stone, and expanded perlite.
[6] Also expanded perlite.
[7] Also iron oxide pigments.
[8] Also stone.
[9] Also coke.
[10] Also salt.
[11] Also bromine, calcium compounds, magnesium compounds, and natural gas and petroleum refining.
[12] Also natural gas and recovered elemental sulfur.
[13] Also recovered elemental sulfur.
[14] Also bromine, calcium, and magnesium compounds.
[15] Also bromine and magnesium compounds.



Name of Operation	Map No.	Limekiln Location	Reported products and uses (see Preface)
BASF WYANDOTTE CORP. 100 Cherry Hill Road Parsippany, New Jersey 07054	(1)	Wyandotte WAYNE COUNTY	1
DETROIT LIME CO. 8800 Dix Avenue Detroit, Michigan 48209	(2)	River Rouge WAYNE COUNTY	2, 3, 10
DOW CHEMICAL CO. Ludington Division 2020 Dow Center Midland, Michigan 48640	(3)	Ludington MASON COUNTY	1, 10
MARBLEHEAD LIME CO. 300 W. Washington St. Chicago, Illinois 60606	(4)	River Rouge WAYNE COUNTY	2, 3, 4, 5, 6, 7, 8
MICHIGAN SUGAR CO. Box 1091 Saginaw, Michigan 48606	(5) (6) (7) (8)	Sebewaing HURON COUNTY Carrollton SAGINAW COUNTY Croswell SANILAC COUNTY Caro TUSCOLA COUNTY	9 9 9 9
MONITOR SUGAR 2600 S. Euclid Avenue Bay City, Michigan 48706	(9)	Bay City BAY COUNTY	9