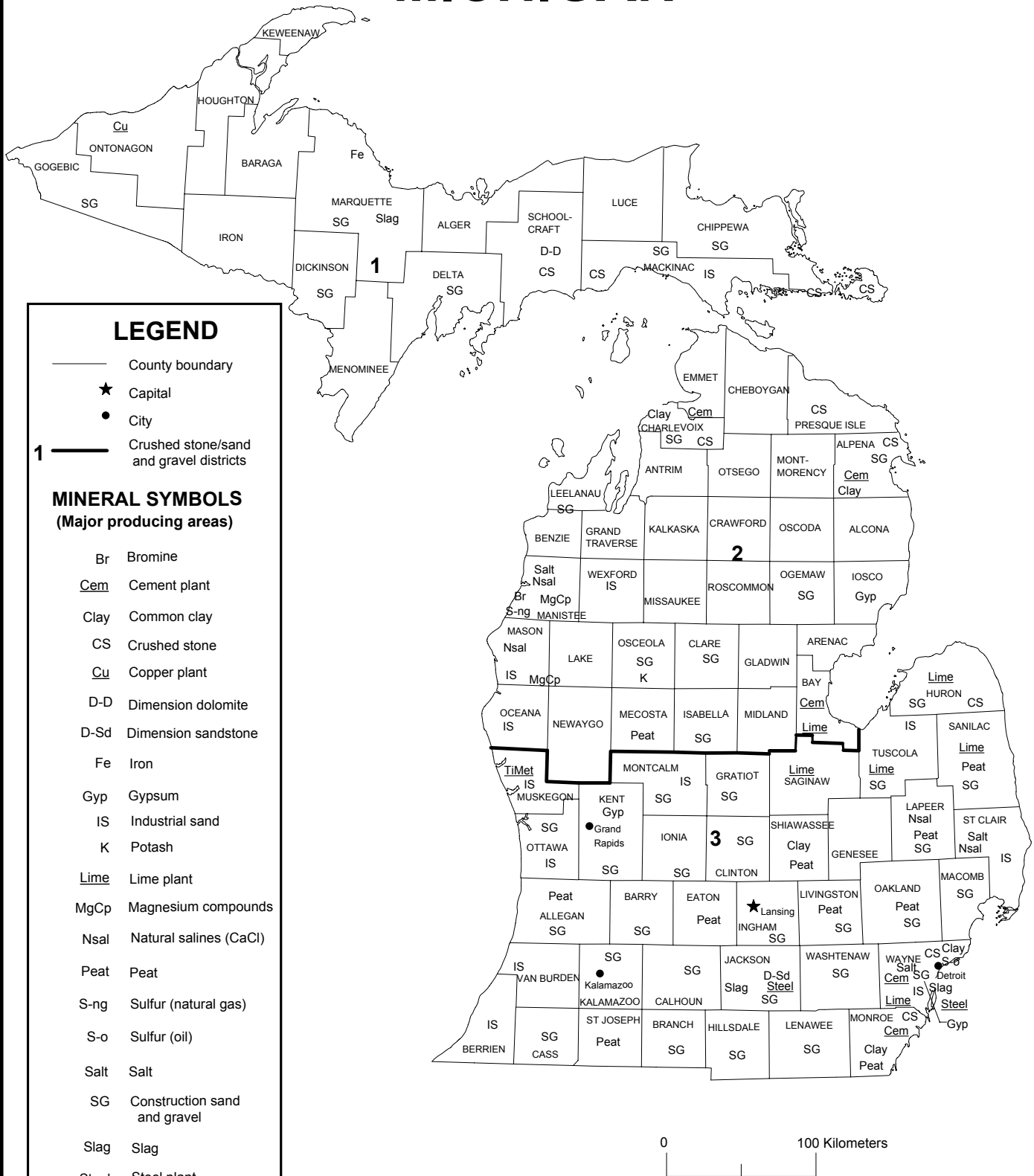


MICHIGAN



LEGEND

- County boundary
- ★ Capital
- City
- 1** — Crushed stone/sand and gravel districts

MINERAL SYMBOLS (Major producing areas)

- Br Bromine
- Cem Cement plant
- Clay Common clay
- CS Crushed stone
- Cu Copper plant
- D-D Dimension dolomite
- D-Sd Dimension sandstone
- Fe Iron
- Gyp Gypsum
- IS Industrial sand
- K Potash
- Lime Lime plant
- MgCp Magnesium compounds
- Nsal Natural salines (CaCl)
- Peat Peat
- S-ng Sulfur (natural gas)
- S-o Sulfur (oil)
- Salt Salt
- SG Construction sand and gravel
- Slag Slag
- Steel Steel plant
- TiMet Titanium metal plant

Source: Michigan Department of Environmental Quality, Geological Survey Division/U.S. Geological Survey (2001)

THE MINERAL INDUSTRY OF MICHIGAN

This chapter has been prepared under a Memorandum of Understanding between the U.S. Geological Survey and the Michigan Department of Environmental Quality, Geological Survey Division, for collecting information on all nonfuel minerals.

In 2001, the estimated value¹ of nonfuel mineral production for Michigan was \$1.62 billion, based upon preliminary U.S. Geological Survey (USGS) data. This was a 1% decrease from that of 2000² and followed a 4.5% increase in 2000 from 1999. The State continued as sixth in rank among the 50 States in total nonfuel mineral production value, of which Michigan accounted for more than 4% of the U.S. total.

Michigan continued to be the Nation's second leading iron ore-producing State in 2001. Although iron ore production represented a very significant percentage of the State's nonfuel mineral economy, portland cement (for the third consecutive year) was Michigan's leading nonfuel mineral commodity. Iron ore was second, followed by construction sand and gravel, crushed stone, magnesium compounds, and salt. In 2001, cement (masonry and portland) represented almost 30% of the State's total nonfuel mineral production value. When cement is combined with the values of Michigan's other major construction materials—construction sand and gravel, crushed stone, and gypsum (in descending order of value)—the total accounted for about 58% of the State's total value as shown in table 1.

In 2000, increases of about \$24 million each in salt and construction sand and gravel (descending order of change), about \$12 million each in magnesium compounds and cement (portland and masonry), \$8 million and \$4 million, respectively, in crushed stone and gypsum, plus smaller increases in potash and peat more than offset the only decreases of \$1 million or more in bromine, iron ore, and lime. All other changes were small and had little effect on the net results.

Compared with USGS estimates of the quantities produced in the other 49 States in 2001, Michigan remained first in magnesium compounds; second in iron ore, industrial sand and gravel, and peat, as well as second of two bromine-producing

¹The terms "nonfuel mineral production" and related "values" encompass variations in meaning, depending upon the minerals or mineral products. Production may be measured by mine shipments, mineral commodity sales, or marketable production (including consumption by producers) as is applicable to the individual mineral commodity.

All 2001 USGS mineral production data published in this chapter are preliminary estimates as of August 2002 and are expected to change. For some mineral commodities, such as construction sand and gravel, crushed stone, and portland cement, estimates are updated periodically. To obtain the most current information, please contact the appropriate USGS mineral commodity specialist. Specialist contact information may be retrieved over the Internet at URL <http://minerals.usgs.gov/minerals/contacts/comdir.html>; alternatively, specialists' names and telephone numbers may be obtained by calling USGS information at (703) 648-4000 or by calling the USGS Earth Science Information Center at 1-888-ASK-USGS (275-8747). All Mineral Industry Surveys—mineral commodity, State, and country—also may be retrieved over the Internet at URL <http://minerals.usgs.gov/minerals>.

²Values, percentage calculations, and rankings for 2000 may differ from the Minerals Yearbook, Area Reports: Domestic 2000, Volume II, owing to the revision of preliminary 2000 to final 2000 data. Data for 2001 are preliminary and are expected to change; related rankings may also change.

States; third in construction sand and gravel and third of three States that produce potash; fourth in portland cement; and seventh in masonry cement. Additionally, the State was a significant producer of crushed stone, lime, common clays, and dimension stone (listed in descending order of value). Michigan rose to third from fourth in the Nation in the manufacture of raw steel with an output of 6.13 million metric tons, as reported by the American Iron and Steel Institute.

The following narrative information was provided by the Michigan Department of Environmental Quality (MDEQ), Geological and Land Management Division, and the Michigan Department of Natural Resources (MDNR), Forestry, Mineral, and Fire Management Division.³ Iron ore production declined in 2001 because of depressed market conditions. Cleveland-Cliffs Inc. (CCI) continued mining and processing of iron ore at the Empire Mine and at the Tilden Mine in the western Upper Peninsula. The Empire and Tilden mines collectively produce plain and fluxed pellets and a small amount of siliceous iron ore that is shipped to steel mills in the United States and Canada for processing. The depressed market conditions resulted in a decrease in production at both mines. CCI announced in November that it would permanently reduce the production capacity of the Empire Mine to about 6 million metric tons per year (Mt/yr) from about 8 Mt/yr. The workforce was also reduced by 300. LTV Steel Co., a partner in the Empire Mine, filed for protection under the Chapter 11 bankruptcy laws (Skillings Mining Review, 2001a). Production at the Tilden Mine was also scaled back, and a pelletizing kiln problem curtailed production. Adverse market conditions also affected the users of CCI's pellets. Rouge Steel Co. in Detroit cut production significantly. Algoma Steel, Inc. of Sault Ste. Marie, Ontario, Canada, announced a restructuring early in 2001, and CCI acquired Algoma's 45% interest in the Tilden Mine (Skillings Mining Review, 2001b).

The Caledonia Mine, in Ontonagon County of the western Upper Peninsula, is Michigan's only active copper mine. Red Metal Minerals operates the mine, producing a very limited quantity of copper, silver, and other mineral specimens for sale to mineral collectors and museums. White Pine Copper Refinery, Inc. continued to process imported anode copper at its electrolytic refinery adjacent to the former White Pine copper mine in Ontonagon County.

Michigan continued to be a major producer of nonmetallic minerals, including gypsum, potash, salt, sand and gravel, stone, and others. Sibley Limestone LLC moved into the old Michigan Foundation Quarry Co. operations at the Sibley Quarry in Trenton, near Detroit. It has a 10-year contract to

³The text of mineral industry information was authored by Milton A. Gere, Jr., Geologist, Minerals and Land Management Section, Forestry, Mineral, and Fire Management Division, Michigan Department of Natural Resources, and Paul Sundeen, Resource/Mine Reclamation Specialist (retired), Geological and Land Management Division, Michigan Department of Environmental Quality.

mine limestone for the Detroit Edison Co.

USG Corp., parent of U.S. Gypsum Co., filed for Chapter 11 bankruptcy court protection resulting from building product asbestos content liability. U.S. Gypsum has a gypsum quarry at Alabaster in Iosco County.

Local opposition to aggregate mining stirred controversies mainly in the Grand Rapids area of the western Lower Peninsula. Zoning provisions and court challenges resulted in restrictions on hours of operation, truck routes, and duration of mining operations at five different aggregate mining operations.

Studies by Dr. Alan Arbogast, Department of Geography, Michigan State University, East Lansing, indicated that some sand dunes have grown as much as 9 meters (m) in the past 500 years. Prior to this, many thought that the dunes stopped forming 5,000 years ago. The new information is not expected to affect regulation of mining of Michigan's dunes for industrial sand (Michigan State University, 2001).

At the end of 2001, there were 12 active sand dune mining operations in the State, all located along the Lake Michigan shoreline. The dunes are the source of about 90% of the foundry sand used in the automobile industry. A property owners' group challenged the issuance of a permit for sand dune mining in Berrien County, alleging that the operator was not qualified for a permit under the law. The Circuit Court ruled in favor of the MDEQ and the mine operator. The case was appealed to the Michigan Court of Appeals.

Exploration companies conducted fieldwork exploring for nonferrous and precious metals on a mixture of Federal, State, and privately owned lands. Exploration efforts are expected to continue in 2002. The MDEQ reported that two companies have drilled 14 exploration drill holes totaling nearly 1,640 m in two counties on private leases in fiscal year 2001. Drilling is expected to continue periodically as exploration takes place in 2002.

Bitterroot Resources, Ltd., and Kennecott Exploration Co. announced an option/joint-venture agreement covering copper, nickel, palladium, platinum, and targets in Michigan's Upper Peninsula. The bedrock of the 82-square-kilometer area consists of Early Proterozoic aged sediments and Middle Proterozoic (Keweenawan age) intrusives, lava flows, and sediments. Palladium mineralization, along with some copper, gold, nickel, and platinum values equaling 0.25 gram to 0.40 gram per metric ton were located on a State of Michigan metallic mineral lease from surface rock samples. The discovery was made while exploring 570 hectares of mineral land leases to Yooper Exploration Services Inc. (Skillings Mining Review, 2001c).

A 15-metric-ton native copper boulder was hoisted from the bottom of Lake Superior in early July and placed on display at the Quincy Mine Hoist Museum, Hancock, MI, by the A.E. Seaman Mineral Museum (SMM), of Michigan Technological University, Houghton, MI (Barron, 2001). The copper specimen belongs to the State and is on loan to the SMM through an agreement with the MDNR. The SMM continued to raise money to build a new museum facility at the Quincy location.

In 2000, the State capped a collapsed abandoned shaft of the former Chapin Iron Mine at Iron Mountain, Dickinson County, at a cost of \$140,000. The capping prevented drainage of ground water and caused flooding of the lower level of the adjacent Cornish Pump Museum. Plans to drill a drain

hole/mine vent in the new reinforced concrete mine cap were discussed.

The MDNR continued to update the Abandoned Underground Mine Inventory and to review and to repair public safety problems at old mine sites on State-owned lands. Two small contracts were let for review and updating activities. The MDNR contracted for fencing and/or capping at 29 abandoned mine shafts in four counties. The MDNR also participated in the U.S. Department of Labor's Mine Safety and Health Administration's 2001 "Stay Out, Stay Alive" campaign.

In May, expansion of cave-ins at an abandoned iron mine in Iron County caused concern over possible impacts to a sewer line and a nearby local road. The Mine Inspector and local officials sought funding to repair the problem.

An idle underground gypsum mine at Wyoming, Kent County, has long been used for storage of food and other dry items by the Michigan Natural Storage Company. However, in 2001, part of the 26-m-deep mine was converted to a computer data center and went online in July as Underground Secure Data Center Operations. The mine has a constant temperature of 50 degrees Fahrenheit, a constant low humidity, and provides security for the data stored there (Grand Rapids Press, 2001).

Early in 2001, the U.S. Great Lakes shipping of coal, iron ore, and other materials was dependent on the U.S. Coast Guard icebreakers. The largest icebreaker, Mackinaw, built in 1944, needs replacing. Funds have been approved, and the contract was to be awarded in September. Low water levels in the Great Lakes affected mineral product shipping because of shallow water in the channels and loading facilities.

The Canadian National Railway Company (CN) announced in September that it had acquired Wisconsin Central Transportation Corporation (WC). WC runs the Escanaba iron ore dock and hauls much of the iron ore pellets in Michigan's Upper Peninsula.

In December 2001, vessel shipments of iron ore from the Escanaba dock for the year totaled 5.7 million metric tons (Mt), and shipments from the Marquette dock totaled 6.9 Mt.

The MDNR manages leasing of State-owned lands for the exploration and development of metallic and nonmetallic minerals, oil and gas, and underground gas storage. Most of the lease and royalty revenues goes to the Michigan Natural Resources Trust Fund, which is used to purchase and maintain public recreation lands and facilities.

The production of nonmetallic minerals from State-owned land continued to be an important source of locally utilized materials for road and other construction purposes. During fiscal year 2001, total income from nonmetallic minerals activities on State lands was \$1,142,863. One direct lease was issued during fiscal year 2001 for expansion and reclamation of a sand and gravel pit in Oakland County.

The State of Michigan allows private companies to lease land in order to produce minerals. In some cases, the companies are only involved in exploration and development, and, in other cases, they may be mining a deposit. In fiscal year 2001, the State received 9 lease applications and issued 64 direct leases for metallic minerals in the western part of the Upper Peninsula. The MDNR received eight exploration plans for mineral exploration on State lands and approved five plans. The MDNR will continue reviewing and processing of pending applications

and mining plans in fiscal year 2002. Total income in 2001 from metallic minerals activities on State lands was \$122,063. One company announced that they discovered palladium mineralization on a State metallic mineral lease.

References Cited

Barron, R.J., 2001, Underwater trolling for copper: Skillings Mining Review, v. 90, no. 38, September 8, p. 4-6.

Grand Rapids Press, 2001, On guard underground: Grand Rapids Press, November 24, p. D4.
 Michigan State University, 2001, State News: East Lansing, MI, Michigan State University, November 15, p. 1.
 Skillings Mining Review, 2001a, Cleveland-Cliffs to lay off 30 salaried workers at Empire Mine: Skillings Mining Review, v. 90, no. 6, February 10, p. 8.
 Skillings Mining Review, 2001b, Cliffs to acquire another 45% of Tilden Mine: Skillings Mining Review, v. 90, no. 45, November 17, p. 9.
 Skillings Mining Review, 2001c, Palladium find in upper Michigan: Skillings Mining Review, v. 90, no. 14, April 7, p. 4.

TABLE 1
 NONFUEL RAW MINERAL PRODUCTION IN MICHIGAN 1/ 2/

(Thousand metric tons and thousand dollars)

Mineral	1999		2000		2001 p/	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement:						
Masonry	283	28,100 e/	296	28,900 e/	280 e/	27,600 e/
Portland	5,810	439,000 e/	5,790	450,000 e/	5,810 e/	452,000 e/
Clays, common	615	3,550	594	3,210	594	3,210
Gemstones	NA	1	NA	1	NA	1
Gypsum, crude	2,170	15,700	1,980	19,800	1,820	19,500
Lime	781	43,900	W	W	W	W
Peat	195	4,520	207	5,750	202	5,220
Sand and gravel:						
Construction	70,200	245,000	75,600	269,000	77,200	279,000
Industrial	2,550	28,100	2,520	27,800	2,610	31,400
Stone, crushed 3/	41,200 r/	140,000 r/	42,200	148,000	42,500	154,000
Combined values of bromine, iron ore (usable), iron oxide pigments (crude), magnesium compounds, potash, salt, stone (crushed marl and miscellaneous, dimension dolomite and sandstone), and values indicated by symbol W	XX	625,000	XX	691,000	XX	651,000
Total	XX	1,570,000 r/	XX	1,640,000	XX	1,620,000

e/ Estimated. p/ Preliminary. r/ Revised. W Withheld to avoid disclosing company proprietary data; value included with "Combined values" data. XX Not applicable.

1/ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

2/ Data are rounded to no more than three significant digits; may not add to totals shown.

3/ Excludes certain stones; kind and value included with "Combined values" data.

TABLE 2
MICHIGAN: CRUSHED STONE SOLD OR USED, BY KIND 1/

Kind	1999				2000			
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Unit value	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Unit value
Limestone 2/	22	32,700	\$100,000	\$3.36	23	34,400	\$118,000	\$3.43
Dolomite	5 r/	8,440 r/	29,900 r/	3.54 r/	5	7,770	30,300	3.90
Calcareous marl	1	W	W	W	1	W	W	W
Sandstone	1	12	195	16.25	1	12	195	16.25
Miscellaneous stone	1	W	W	W	1	W	W	W
Total or average	XX	41,200 r/	140,000 r/	3.40 r/	XX	42,200	148,000	3.52

r/ Revised. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

1/ Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

2/ Includes limestone-dolomite reported with no distinction between the two.

TABLE 3
MICHIGAN: CRUSHED STONE SOLD OR USED BY PRODUCERS
IN 2000, BY USE 1/ 2/

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Construction:			
Coarse aggregate (+1 1/2 inch):			
Macadam	W	W	\$5.43
Riprap and jetty stone	140	\$2,310	16.48
Filter stone	W	W	6.03
Other coarse aggregate	75	665	8.87
Coarse aggregate, graded:			
Concrete aggregate, coarse	3,060	12,700	4.17
Bituminous aggregate, coarse	969	4,500	4.65
Bituminous surface-treatment aggregate	W	W	6.50
Railroad ballast	35	179	5.11
Other graded coarse aggregate	15	62	4.13
Fine aggregate (-3/8 inch):			
Stone sand, concrete	W	W	3.44
Stone sand, bituminous mix or seal	339	1,720	5.07
Screening, undesignated	297	1,050	3.53
Coarse and fine aggregates:			
Graded road base or subbase	1,370	6,090	4.45
Unpaved road surfacing	201	708	3.52
Crusher run or fill or waste	W	W	3.50
Other coarse and fine aggregates	1,050	4,340	4.14
Other construction materials	5	37	7.40
Agricultural, limestone	71	592	8.34
Chemical and metallurgical:			
Cement manufacture	6,490	13,400	2.07
Lime manufacture	W	W	3.47
Flux stone	W	W	4.07
Unspecified: 3/			
Reported	22,300	78,600	3.53
Estimated	2,400	8,100	3.37
Total or average	42,200	148,000	3.52

W Withheld to avoid disclosing company proprietary data; included in "Total."

1/ Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

2/ Includes, dolomite, limestone, limestone-dolomite, and sandstone; excludes calcareous marl and cellaneous stone to avoid miscellaneous stone.

3/ Reported and estimated production without a breakdown by end use.

TABLE 4
MICHIGAN: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2000, BY USE AND DISTRICT 1/ 2/

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1 1/2 inch) 3/	W	W	W	W	149	1,980
Coarse aggregate, graded 4/	W	W	W	W	898	4,420
Fine aggregate (-3/8 inch) 5/	W	W	W	W	W	W
Coarse and fine aggregate 6/	W	W	W	W	(7/)	(7/)
Other construction materials	--	--	5	37	(7/)	(7/)
Agricultural 8/	W	W	W	W	W	W
Chemical and metallurgical 9/	W	W	W	W	W	W
Unspecified: 10/						
Reported	3,750	12,400	13,800	45,600	4,730	20,600
Estimated	820	2,700	--	--	1,600	5,400
Total	11,100	40,400	20,900	63,600	10,200	44,500

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Includes dolomite, limestone, limestone-dolomite, and sandstone; excludes calcareous marl and miscellaneous stone to avoid disclosing company proprietary data.

3/ Includes filter stone, macadam, riprap and jetty stone, and other coarse aggregate.

4/ Includes bituminous aggregate (coarse), bituminous surface-treatment aggregate, concrete aggregate (coarse), railroad ballast, and other graded coarse aggregate.

5/ Includes stone sand (bituminous mix or seal), stone sand (concrete), and screening (undesigned).

6/ Includes crusher run (select material or fill), graded road base or subbase, unpaved road surfacing, and other coarse and fine aggregates.

7/ Less than 1/2 unit.

8/ Includes agricultural limestone.

9/ Includes cement manufacture, flux stone, and lime manufacture.

10/ Reported and estimated production without a breakdown by end use.

TABLE 5
MICHIGAN: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2000,
BY MAJOR USE CATEGORY 1/

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand)	7,500	\$29,000	\$3.86
Plaster and gunit sands	132	785	5.95
Concrete products (blocks, bricks, pipe, decorative, etc.)	206	1,150	5.57
Asphaltic concrete aggregates and other bituminous mixtures	6,030	25,900	4.30
Road base and coverings	11,100	35,400	3.20
Road stabilization (cement)	472	1,810	3.83
Road stabilization (lime)	761	1,390	1.83
Fill	8,450	19,000	2.25
Snow and ice control	731	2,220	3.03
Railroad ballast	30	320	10.67
Filtration	134	446	3.33
Other miscellaneous uses	386	2,250	5.83
Unspecified: 2/			
Reported	22,000	84,200	3.82
Estimated	18,000	65,000	3.67
Total or average	75,600	269,000	3.55

1/ Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

2/ Reported and estimated production without a breakdown by end use.

TABLE 6
MICHIGAN: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2000,
BY USE AND DISTRICT 1/

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3		Unspecified districts	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products 2/	109	584	966	3,970	6,770	26,300	--	--
Asphaltic concrete aggregates and other bituminous mixtures	69	841	760	3,280	5,200	21,800	--	--
Road base and coverings 3/	608	1,790	2,190	6,150	9,510	30,700	--	--
Fill	168	194	495	770	7,790	18,000	--	--
Snow and ice control	110	191	130	299	491	1,730	--	--
Other miscellaneous uses 4/	--	--	42	418	508	2,600	--	--
Unspecified: 5/								
Reported	138	248	300	1,100	21,600	82,800	25	42
Estimated	2,100	8,300	3,500	12,000	12,000	44,000	260	730
Total	3,270	12,100	8,370	28,000	63,600	228,000	283	774

-- Zero.

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

2/ Includes plaster and gunite sands.

3/ Includes road and other stabilization (cement and lime).

4/ Includes filtration and railroad ballast.

5/ Reported and estimated production without a breakdown by end use.