UNITED STATES DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

INDUSTRIAL MINERALS - TODAY AND TOMORROW

THE RAW MATERIALS TO BUILD THE UPPER MIDWEST

Edited and Compiled by

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U.S. Geological Survey in cooperation with the
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INDUSTRIAL MINERALS - TODAY AND TOMORROW: THE RAW MATERIALS TO BUILD THE UPPER MIDWEST

A Workshop Sponsored by the U.S. Geological Survey,
U.S. Bureau of Mines, and the Minnesota Geological Survey
in cooperation with the Geological Surveys of
Illinois, Indiana, Michigan, North Dakota
Ohio, South Dakota, and Wisconsin

September 10, 11, and 12, 1992
Holiday Inn Metrodome
Minneapolis, Minnesota

September 10, 1992

7:30a - Registration

8:30 - Poster Presentations with Continental Breakfast

R.F. Biek, *North Dakota industrial minerals: Production, statistics, and commentary*

B.A. Brown and T.J. Evans, *Nonmetallic mineral industry and resources of Wisconsin*

C. Buttleman, *Gravel pit reclamation in Minnesota*

S. Chadima and B. Regynski, *Industrial minerals in South Dakota*

V.W. Chandler, S. Hauck, M. Severson, J. Heine, J. Reichhoff, and B.D. Schaap, *Investigation of kaolin in eastern Redwood County, Minnesota, using gravity, magnetic, and electrical resistivity methods*

J.J. Eidel and 13 others, *Economic potential for industrial minerals in the Paducah 1° x 2° quadrangle in southern Illinois and adjacent Kentucky and Missouri: The results of CUSMAP assessment*

J.J. Heine and T.A. Toth, *Regional and local geologic, mineralogic, and geochemical controls of the industrial clay grades in the Minnesota River Valley*

A.M. Johnson, M.A. Gere, Jr., and S.P. Sundeen, *Industrial minerals exploration and research in Michigan*

W.H. Langer, *Natural aggregates - National and regional assessments*

J.D. Lehr, *Minnesota's aggregate mapping program*

S. Manydeeds, *Mineral frontiers on Indian lands*

D.G. Mikulic and J. Kluessendorf, *The impact of urban development on the stone industry of the Chicago-Milwaukee metropolitan area*

J.H. Mossler, *Industrial minerals information for local government: Geologic resources plates of the Minnesota County Geologic Atlas Program*

H.B. Niles and J.H. Mossler, *Evaluation of the carbonate resources of southern Minnesota*

M.W. Oberhelman and R. Riihiluoma, *Dimension stone inventory of northern Minnesota*

J.A. Oreskovich, *Kittson County, Minnesota, bloating clays*

D.R. Setterholm and G.B. Morey, *Kaolinitic saproliths of central and western Minnesota*

D. Shangreaux and H. Shi, *Mineral assessment, inventory, and marketing study program of the Oglala Sioux Pine Ridge Indian Reservation*

T.A. Thompson, P.N. Irwin, C.H. Ault, and S.J. Baedke, *Mineral resource and wetland occurrences in Hamilton County, Indiana*

U.S. Bureau of Mines, *The minerals source*

S.L. Weisgarber and D.A. Stith, *Industrial minerals in Ohio*

11:30 - Luncheon

12:45p - Welcoming - G.B. Morey, Minnesota Geological Survey, and W.C. Brice, Minnesota Department of Natural Resources

1:00 - Nancy Rutledge Connery - Kick-Off Speaker - *Problems of U.S. infrastructure in the Twenty-First Century*

1:45 - Geoff Harris - *New construction materials demands and resource availability*

2:20 - Marshall Thompson - *Research required for improved quality control*

2:55 - Coffee Break

3:15 - Ernest Lehmann - *Environmental issues and solutions - The prisoners' dilemma: A look at environmental decision-making and the mineral industry*

3:50 - Haydn Murray - *Economics of production, distribution, and marketing*

4:25 - Anthony Bauer - *Land use - conflict and resolutions: Integrating aggregate mining into the planning process*

5:00 - Dinner Break

6:45 - 9:00 - Poster Presentations with refreshments - (see a.m. for listing)

September 11, 1992

7:00a - Continental Breakfast
8:00 - H. Lynwood Bourne - Moderator - *Case studies - promises and pitfalls*
8:15 - Randall Graves - *Planning for mineral extraction: Pits & pitfalls*
8:55 - Mark Wyckoff - *Mineral extraction meets planning and zoning*
9:35 - Ed Sieben - *County planning, preservation, regulation, and reclamation*
10:15 - Coffee Break
10:40 - Todd Thompson - *Land use classification and conflict*
11:20 - Carl Schenk - *A regional approach to evaluating aggregate needs*
12:00 - Break for Lunch
1:30p - Panel Discussion - James Dunn, Dunn Corporation - Moderator - *Industrial Minerals to the Year 2000--How Will We Meet the Demand?*

Panel Members

George Dirkes, Illinois Association of Aggregate Producers
Donald Hey, Hey & Associates
Lee Roy Lee, Wisconsin Academy of Sciences, Arts, & Letters
Robert Meskimen, Midwest Division, Martin Marietta Aggregates
Charles M. Preston, Stoner, Preston & Boswell, Chartered

4:00 - Coffee Break
4:15 - Louis Guzzo - Keynote Speaker - *Whatever Happened to Common Sense?*
5:00 - Cash Bar with Hor d'oeuvres

September 12, 1992

Field Trip conducted by the Minnesota Geological Survey will leave from the Holiday Inn Metrodome at 7:00 a.m. and return at 7:30 p.m. Stops in the Minnesota River Valley will include dimension stone quarries in fossil-rich Ordovician limestone and the 3.6 billion-year-old Rainbow Granite, a riprap mine in the Early Proterozoic Sioux Quartzite, as well as a clay pit in Cretaceous strata, and a saprolite pit developed on the Precambrian bedrock surface. Transportation by bus and meals at Fort Ridgely State Park and Jackpot Junction are provided.

ORAL PRESENTATIONS

PROBLEMS OF U.S. INFRASTRUCTURE IN THE TWENTY-FIRST CENTURY

Nancy Rutledge Connery
RR 1, Box 1314
Woolwich, ME 04579

The significant problems we face today
cannot be solved at the same level of
thinking we were at when we created them.

--Albert Einstein

Renewing America's infrastructure is more than patching potholes or pushing traffic along a bit faster. The task also bids us to repair the frayed connective tissue, both structural and spiritual, between us as Americans of different races, classes, and beliefs, between our cities, suburbs, and small towns, and between us as humans and our respective *biota.*

We need compelling images and principles, not "wish-lists" of projects, to guide public investment and to balance long-term growth in the face of increasingly austere economic and environmental realities and demographic changes. We need confidence that our investment choices will adequately support and sustain an unpredictable economy, as well as our families, our cities and towns, and the surrounding environment. Similarly, we need trustworthy information that our choices do not just divert a set of problems to another region or compound them for the next generation.

While a determined chorus of voices intones for more investment, too few people seem to be talking critically and passionately about what a proper infrastructure is and does and what it means for the future.

In a nutshell, no amount of capital or concrete substitutes for better understanding. Infrastructure renewal starts with a profound shared commitment to people and to places. The strength of this commitment, along with our individual values, efforts, and aspirations, and collective investment, is manifested in the quality of the public realm. As the commitment erodes, so go our bridges, public parks, and pump storage stations.

A more hopeful version was offered recently by a resident of Los Angeles after his community erupted in riots: "We're not into just rebuilding what we had here before.... We want to finally build a community of hope."

NEW CONSTRUCTION MATERIALS DEMANDS AND RESOURCE AVAILABILITY

Geoff C. Harris
American Aggregates Corporation
6450 Sand Lake Road
Dayton, OH 45414-2659

Enactment of the Federal Highway Act raises hope that public works spending may increase enough to end the decline in our nation's infrastructure.

We in the construction materials industry also wish for adequate funding for public projects. However, we have concerns about the government's ability to deliver the necessary revenues. We also know that regulatory constraints on minerals extraction seriously impinge on our ability to continue supplying materials at today's prices.

Compared with other regions, our industry in the Upper Midwest is characterized by a balance of sand and gravel and crushed stone, more delivery by water and less by rail, and below average difficulty with government regulations. Projected demand in our region reflects moderate growth enhanced by the need to repair and replace an extensive existing infrastructure.

Suburban growth, restrictive environmental and zoning regulations, and depletion of reserves at existing sites will influence the future supply of construction aggregates. A larger volume must be supplied from fewer sites. Aggregates will be delivered over longer distances. Water, rail, and customer's plants on quarry site will increase over truck transport. Crushed stone volume will increase compared with sand and gravel, and quarry operators will more favorably consider underground mining vs. open-cut. More materials, primarily asphalt and concrete, will be recycled. Substitute materials such as rubber, ash, and slag will gain more emphasis. All of these trends will increase costs.

Continued supply of construction materials at reasonable costs will depend on governments:

1. Adopting master planning to identify and protect mineral deposits from development and restrictive zoning.
2. Enacting zoning and permitting codes which encourage mining activities as a prelude to other land uses, ranging from recreation and residential to landfill and industrial.

3. Requiring materials specifications and mix designs which build more durable roads, thereby minimizing maintenance, resurfacing, and replacement.
4. Providing adequate, stable, and predictable funding of infrastructure needs free from unrelated political issues and based on dedicated taxes and user fees protected from reduction or diversion to other uses.

RESEARCH REQUIRED FOR IMPROVED QUALITY CONTROL

Marshall R. Thompson
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University of Illinois
205 N. Mathews Ave, MC250
Urbana, IL 61801

Construction aggregates are extensively utilized in infrastructure construction as a "bulk material" or as the major ingredient (on a volume basis) in many "bound materials." Typical bulk material applications are pavement base and subbase layers and railroad ballast and subballast. Some widely used "bound" materials are asphalt concrete, portland cement concrete, and "cementitiously stabilized" mixtures.

The pertinent aggregate properties and characteristics essential to ensure acceptable PERFORMANCE vary considerably for different applications. Many State Highway Agencies are in the process of adopting QA/QC programs where the contractor/materials supplier is responsible for the bulk of the physical testing. Rapid, but acceptably accurate and reproducible, test procedures expedite the QA/QC process.

When aggregates are utilized in new applications, the testing procedures, specification requirements, and quality control procedures should be carefully considered. Current procedures and requirements may not be adequate, and appropriate and new approaches must be established. An excellent current example is the significant interest in Stone Mastic Asphalt (SMA), where coarse aggregate contact is accentuated.

Current developments, quality control concerns, and research needs relating to such pertinent properties as DURABILITY, DEGRADATION, SHAPE-ANGULARITY-SURFACE TEXTURE, and STRIPPING POTENTIAL will be considered.

ENVIRONMENTAL ISSUES AND SOLUTIONS - THE PRISONERS' DILEMMA: A LOOK AT ENVIRONMENTAL DECISION-MAKING AND THE MINERAL INDUSTRY

Ernest K. Lehmann
Ernest K. Lehmann & Associates, Inc.
430 First Avenue North, Suite 790
Minneapolis, MN 55401

In the present political climate, the Not In My Back Yard (NIMBY) syndrome is almost universally present in public consideration of significant projects. Often the NIMBY syndrome mutates into the "Not In Anybody's Back Yard" or NAMBY posture of the more radical environmentalists. This contrasts sharply with a humanistic view of environmentalism, which focuses on the wise use of natural resources for general societal good. Many mineral development projects bring these two views into sharp contrast and opposition. Mineral industry project proponents in general hold a conservationist or "wise use" view, while the opponents commonly have a parochial NIMBY position or a broadly based protectionist, anti-development NAMBY posture.

It is useful to examine these conflicts between proponents and opponents and the resultant societal costs in terms of Games Theory's classic game of "The Prisoners' Dilemma." A hypothetical sand and gravel development sited in the Minneapolis-St. Paul Metro area is examined in this manner. The analysis indicates that the likely outcome of such a conflict will result in a multi-million dollar added real cost to the community for necessary supplies of basic construction raw materials from even a single deposit supplying a small portion of the local market.

Few solutions to resolving these conflicts appear effective. A system of methodical resource identification, clear and workable rules and carefully circumscribed processes, though desirable, is, in all likelihood, Utopian and unachievable.

ECONOMICS OF PRODUCTION, DISTRIBUTION, AND MARKETING

Haydn H. Murray
Department of Geological Sciences
Indiana University
Bloomington, IN 47405

Industrial minerals are a key to a country's standard of living. For a higher standard of living, industrial minerals must be readily available, of good quality, and delivered at a cost that is economically attractive. The value of industrial minerals in the U.S. as reported by the USBM for 1991 was $19.6 billion and for metals was $11.2 billion.

Industrial minerals can be grouped into three distinct categories: low value, high volume; moderate value, moderate volume; and high value, low volume. Examples of these categories are sand and gravel and mineral aggregates as low value, high volume products; kaolin and pigment grade calcium carbonate as moderate value, moderate volume products; and talc and mica as high value, low volume products. Production and distribution costs must be effectively controlled in order to make Industrial Minerals cost effective and competitive. Geographic and geologic factors are exceedingly important particularly for the low value, high volume industrial minerals. Mining and processing costs must be low. In many instances, the cost of transportation is higher than the FOB value of the industrial mineral. Therefore, as one can see, the cost of production, distribution, and marketing cannot be generalized for industrial minerals. Examples that are given in this paper are for those industrial minerals and rocks cited above.

A serious problem for some industrial minerals is foreign competition. Some industrial minerals can be produced, transported, and marketed at a lower price from specific foreign countries than that same mineral in the United States.

Although the costs have significantly increased for many industrial mineral producers over the past twenty years because of higher labor and fuel costs and the cost of compliance with government regulations, the outlook for the industrial minerals industry continues to be positive.

LAND USE - CONFLICT AND RESOLUTIONS: INTEGRATING AGGREGATE MINING INTO THE PLANNING PROCESS

Anthony M. Bauer
Department of Landscape Architecture
Michigan State University
East Lansing, MI 48824-1221

One of the most common resources in the world, aggregate is inexpensive to produce, bulky to transport, and essential for sustaining the quality and growth of urban environments. But these resources are becoming increasingly inaccessible because of urban development, prohibitive zoning practices, and public opposition to mining. More seriously, aggregate reserves are lost because they are ignored in the planning process. Regulating aggregate mining is very common; protecting aggregate deposits from urban encroachment is very rare.

When reserves are properly managed and when the industry is effectively regulated, aggregate mining can be a positive and creative use in an urban environment. It can be used to preserve open space, influence development patterns, and shape the character of an urban landscape. The State of California and Province of Ontario have established regulations for protecting aggregate reserves. They have set the framework for incorporating this resource and land use into the community comprehensive planning process. To implement this process, and to use aggregate mining as a positive element in shaping urban landscapes, seven basic steps must be considered: (1) inventory the resource; (2) evaluate the spatial relationship between the resource locations and other community characteristics; (3) assess the aggregate market; (4) evaluate the physical consequences of mining in aggregate-bearing geologic formations; (5) establish a comprehensive land use and landscape character plan; and (6) develop mining and reclamation guidelines to implement the plan.

Aggregate mining is an urban land use with a potential for creating attractive and productive land uses. By incorporating aggregate resources protection guidelines into the comprehensive planning process, communities can reduce aggregate costs, control patterns of growth, and shape new and predictable landscapes through the mining and reclamation process.

PLANNING FOR MINERAL EXTRACTION: PITS AND PITFALLS

Randall Graves
City of Maple Grove
9401 Fernbrook Lane
Maple Grove, Minnesota 55369-9790

The city of Maple Grove, Minnesota, has experienced tremendous growth during the past 20 years while serving as a major source of building materials in the Twin Cities region. This dual role has not been without cost to the city, but it has provided an opportunity to more carefully plan a major portion of the area of the city.

The reservation of the mineral resources of Maple Grove for the benefit of the region has been a joint endeavor involving the property owners, the city government, and the regional planning agency.

This presentation will attempt to portray the pluses and minuses of exploiting a regional resource located in a small part of a municipality.

MINERAL EXTRACTION MEETS PLANNING AND ZONING

Mark Wyckoff
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302 S. Waverly Road
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Many mineral extraction activities are subject to extensive state and federal regulations. This is particularly true of large quarry operations and deep pit or shaft mining. However, most mineral extraction activities close to the surface are increasingly being subjected to a variety of local regulations. These regulations, often in the form of local zoning or other policing measures, attempt to deal with an increasingly wide array of concerns. The major focus is usually on preventing nuisance-like impacts of extraction activities on adjoining land uses. Other concerns include environmental impacts and reclamation.

This presentation examines the principal tools and approaches that are increasingly being used by local governments to regulate mineral extraction activities. Included is an examination of common zoning tools such as establishment of separate mineral districts, the use of special land use and planned unit development techniques, and the increasing emphasis on site plan review as the premier tool for managing the extraction activity. The presentation also examines court responses to extraction regulations and identifies some of the issues that commonly arise in such litigation. Sand and gravel activity will be the focus of most examples because of its prominence in the glaciated terranes of the upper midwest.

The presentation will also explore the benefits of an area-wide planning approach for identification of valuable mineral deposits as a prerequisite step to fair and effective regulation of extractive activity. The relationship of local regulations to protecting community character in rural areas will be discussed in context with other local land-use planning initiatives.

COUNTY PLANNING, PRESERVATION, REGULATION, AND RECLAMATION

Ed Sieben and Phillip S. Bus
Kane County Development Department
County Government Center
19 Batavia Avenue
Geneva, IL 60134

Kane County, Illinois, is on the western edge of the Chicago metropolitan area, about 45 miles due west of downtown Chicago. More than 80 percent of Kane County's 325,000 people are located along the Fox River in the urbanized eastern part of the county. There is great population pressure pushing from the east. Kane County itself has doubled in population since 1950 and has grown 14 percent since 1980.

Kane County's first land-use plan dates from 1976. It reflects our long-standing policies of concentrating future growth along the urbanized eastern edge and the rural villages. In addition to the protection of natural areas, a major concern in Kane County's new land-use plan is the preservation of prime farmland, which is among the best in the world. We also are preserving sites for possible future extraction of buried mineral resources. Development pressures from Chicago and the relatively cheaper prices for land in these areas make it essential to steer development away from some of these potential resources.

Land-use planning and geologic information are the key ingredients in providing for future growth and mineral resource protection. The Kane County Development Department has contracted with the Illinois State Geological Survey for a "Geology for Planning" study, which has provided valuable information on areas where mineral deposits should be protected until such time as extraction becomes feasible. Areas to be protected for future resource extraction must be sufficiently far or buffered from areas of future development to avoid potential land-use conflict.

Besides planning and preservation of areas, regulation and reclamation are important aspects of the mineral resource industry. Kane County realizes that a balance must exist between no regulation and too much regulation; this requires cooperation between the state, counties, owners, and operators. Kane County's strategy is the two "P's"--Plan and Preserve--and the two "R's"--Regulate and Reclaim. The long term benefit will be the protection of mineral resources for future generations and a boost to long-term economic development.

LAND USE CLASSIFICATION AND CONFLICT

Todd A. Thompson, Paul N. Irwin,
Curtis H. Ault, and Steven J. Baedke
Indiana Geological Survey
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Wetland regulations and pending changes to wetland policies have generated considerable concern to the mineral extraction industries. This concern is based on the belief that wetland regulations will prohibit or restrict mineral extraction because of the occurrence of wetlands within or adjacent to areas of mining. Most influenced by wetland regulations are surface mining operations. This is especially true for the sand and gravel industries, which commonly produce from riverine areas that contain wetlands. Currently, little information is available on the number of industrial-mineral producers that are affected by wetland regulations and the amount of industrial minerals that cannot be extracted under current regulations. A further complicating factor is that the definition of a wetland is not well established, and anticipated changes to the definition will require recalculations of the wetland-regulation impact on the industry.

State geological surveys commonly compile information on the distribution of mineral resources and maintain records about the number of producers in any given area. This information coupled with the digital National Wetland Inventory of the U.S. Fish and Wildlife Service can be used to estimate the impact of wetland policies on mineral extraction. Geographic Information Systems are most suitable for handling the large volume of information contained in the mineral resource and wetland databases. In addition, Geographic Information Systems yield information on the spatial relationships between the mineral resources and wetlands and can be manipulated under different search criteria to reflect changes in the wetland definition and regulatory policies.

A REGIONAL APPROACH TO EVALUATING AGGREGATE NEEDS

Carl J. Schenk
Metropolitan Council
230 East Fifth Street
St. Paul, MN 55101-1634

In the early 1980's, the Metropolitan Council, the regional planning body for the seven-county Twin Cities Metropolitan Area, Minnesota, was pressured by a major aggregate producer to require a local township to modify its proposed comprehensive plan to protect large deposits of aggregate owned by the company. The producer maintained that the deposits were of regional significance to the development of the Metropolitan Area.

The Council agreed to undertake a region-wide study of aggregate resources. The purposes of the study were: to inventory the resources (sand/gravel and crushed rock from dolomite/limestone deposits), estimate future demand, evaluate supply vs. demand, assess the impact of transportation costs and evaluate the effect of local planning and land use controls (zoning) on resource availability.

The Minnesota Geological Survey prepared an inventory for the Council of natural aggregates (sand/gravel) and crushed rock for the study. The study included the mapping of deposits, classification as to type, quality and availability, and estimates of the volumes present.

A chief conclusion of the Council's study is that the region has adequate supplies of potential aggregate resources to meet future needs and sufficient lead time to develop a mechanism for protecting the resource.

In 1984, the aggregate industry lobbied the Minnesota legislature to pass a law requiring local governments outside the Metropolitan Area to incorporate in their general land use plans an aggregate policy designed to encourage conservation of the resource. In the Twin Cities Metropolitan Area, the legislature established a temporary Advisory Committee on Aggregate Resources to evaluate the need for protection. The committee was to determine whether existing information was adequate to determine whether local comprehensive plans and land use controls should protect the resource, recommend a procedure for identifying the level of long-term protection, and recommend a method for long-term protection.

The advisory committee concluded that there was no need for legislation mandating protection in the Metropolitan Area. There is a 200-year supply of unencumbered aggregate resources in the region and undelineated resources in adjoining counties.

INDUSTRIAL MINERALS TO THE YEAR 2000--HOW WILL WE MEET THE DEMAND?

James R. Dunn
Dunn Corporation
12 Metro Park Road
Albany, NY 12205

The purpose of this panel is to explore ways of meeting regional demand for industrial minerals to the year 2000 (and beyond). Most discussion will pertain to mineral aggregates because solving problems of their supply will largely solve problems of supply of other industrial minerals.

The demand for industrial minerals will increase modestly as the population increases. Historically, demand for the major industrial mineral (aggregates) in the Midwest has averaged about 9 tons per year per person, although most people will not see the 9 tons they consume.

Shortages of aggregate have created the curious phenomenon of this high bulk, low cost material being shipped to the United States from Nova Scotia, Newfoundland, the Bahamas, the Yucatan Peninsula of Mexico, and Scotland. Shortages at the local level in the Midwest also loom. For example, a recent survey indicates that sand and gravel for the greater Detroit area will be depleted shortly after 2000 if new sources are not added. Shortages usually cause an increase in the cost of aggregates, in energy use, in wear on public roads, and in truck traffic. Shortages are generally not caused by limitations of natural resources, but by limitations as to where aggregate can be mined, i.e., the failing is human.

The most common scenario is that a small segment of the public situated near a potential new mining operation objects and prevents a new operation from getting a zoning variance. This small segment of the public looking out for its own perceived interests causes a much larger segment of the public to spend very large sums of money. As an example of the magnitude of such costs, if a group of people at Saratoga, N.Y. had successfully closed an existing quarry, the present value of projected costs to the people of the area would have been over $22,000,000 (capitalized at 10 percent over 20 years). The general public usually has no effective voice at zoning hearings, even though it is greatly impacted. Unfortunately, the general public is not aware of the potential cost of blocking aggregate resource development.

The panel will discuss the contributions which can be made by industry, industrial associations, planners, lawyers, geological surveys, and educators toward maintaining the flow of industrial minerals to meet future needs.

WHATEVER HAPPENED TO COMMON SENSE?

Louis R. Guzzo
KIRO-TV/Radio
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The United States and many other countries of the free world are threatened critically by the advance of an environmental cult that has eschewed good science, logic, and common sense.

With the assistance of news media too lazy or unwilling to do their research, some well-meaning but misguided scientists, and some unscrupulous individuals who prefer sensational publicity or government bucks in grants, political leaders have been pressured into making decisions based on popular notions, instead of hard-nosed science.

The militant environmentalist shoots from the hip and has neither time nor patience for science's peer-review system. More than any other factor, excessive and unreasonable environmentalism is to blame for the rapidly escalating cost of government--and, worse yet, the suppression of more freedoms guaranteed by the U.S. Constitution.

POSTER PRESENTATIONS

NONMETALLIC MINERAL INDUSTRY AND RESOURCES OF WISCONSIN

B.A. Brown and T.J. Evans
Wisconsin Geological and Natural History Survey
3817 Mineral Point Road
Madison, WI 53705

The nonmetallic mineral production of Wisconsin has an annual value in excess of $200 million. Leading products are crushed stone and sand and gravel, followed by lime, peat, industrial sand, dimension and ornamental stone.

The crystalline rocks of northern Wisconsin contain considerable resources of dimension stone and high durability aggregate, located favorably with respect to midwestern markets. Products currently in production include granite for building, ornamental, and landscape use; crushed granite; traprock; quartzite for railroad ballast and specialized aggregates; and metavolcanic rocks for roofing granules.

Ordovician and Silurian carbonates exposed in southern Wisconsin are major sources of crushed stone and support a small lime industry. Cambrian and Ordovician sandstones are a significant source of high-purity industrial sand. Abundant Quaternary deposits cover all but the southwestern quarter of the state and provide an abundant source of construction sand and gravel and peat.

The nonmetallic mineral industry, led by aggregate production in the more populous southern Wisconsin area, has maintained a slow but steady growth in the last decade. A notable new development in the aggregate industry has been increased production of hardrock products. This trend has been in response to demand for high-quality railroad ballast and new uses for wear-resistant aggregates in the paving industry.

State regulation plays only a minor role in permitting nonmetallic mineral operations in Wisconsin. Except for rules governing operations in proximity to navigable waterways, all operating permits and reclamation requirements are handled by local and county government. The Wisconsin Geological and Natural History Survey does not have any regulatory responsibility. The Survey conducts pure and applied research on the geology of Wisconsin and maintains an extensive database on the geology, mineral and water resources of the state.

GRAVEL PIT RECLAMATION IN MINNESOTA

Cindy Buttleman
Minnesota Department of Natural Resources
Division of Minerals
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Bemidji, MN 56601

Sand and gravel mining is an important Minnesota industry that contributes significantly to the state's economy. Preliminary 1991 figures compiled by the U.S. Bureau of Mines indicate that Minnesota ranks eighth nationally in construction sand and gravel with production of 26.5 million tons having a value of $61 million.

Gravel pits are a common and highly visible site throughout the state, especially along roads. According to a 1991 informal survey conducted by the Department of Natural Resources (DNR), there are more than 4,000 pits in Minnesota. Approximately 1,500 (or 38 percent) of these are active operations where noise, dust, traffic, and hours of operation are frequent concerns. These issues and final reclamation of the site are most often addressed through a county conditional land use permit.

The remaining 2,500 pits (or 62 percent) are either permanently abandoned or intermittently active and commonly fall outside the regulatory authority of the counties. Problems associated with these sites include dumping, safety, unauthorized activities, and lack of reclamation.

In the past, reclamation of gravel mining areas has not been a major environmental concern to the public. Today, however, gravel mining in Minnesota is increasingly viewed as a temporary use to be followed by another land use that is compatible with the surrounding landscape.

Since 1987, the DNR, the Department of Transportation, local government, and the aggregate industry have been working on issues related to gravel pit reclamation. The need to reclaim gravel pits and the demand for technical information on the subject was the motivation for a handbook recently completed by the DNR entitled "A Handbook for Reclaiming Sand and Gravel Pits in Minnesota". The handbook will provide technical information on gravel pit reclamation to landowners, government regulators, and operators.

In addition, research is underway in several abandoned pits to develop cost-effective reclamation methods. Warm-season native grasses appear to be particularly well suited to gravel pit reclamation because of their characteristic deep root systems and low fertility requirements. Various seed mixes, seeding methods, and cover crops are also being evaluated.

INDUSTRIAL MINERALS IN SOUTH DAKOTA

Sarah Chadima and Barb Regynski
South Dakota Department of Environment and Natural Resources
Science Center, University of South Dakota
Vermillion, SD 57069-2390

South Dakota produces a variety of nonmetallic, nonfuel industrial minerals. During 1991, approximately 10 million short tons of sand and gravel as well as crushed stone (quartzite) were extracted statewide, primarily for use in all phases of road construction. Nearly 2 million short tons of limestone were produced, 52 percent of which was used by the state-owned cement plant; the remainder was used primarily in construction. Shale (160,129 short tons), iron ore (53,443 short tons), and gypsum (27,590 short tons) were also produced, strictly for use in the cement-making process. All of the minerals required for cement production were quarried in the Black Hills region.

Granite was produced near Milbank, in the northeastern part of the state, for use as dimension stone (211,302 short tons). Slate and limestone are also quarried in the Black Hills for use as dimension stone.

Pegmatite minerals from the Black Hills region were quarried for feldspar, mica, and rose quartz content. All totalled, 3,861 short tons of pegmatite-bearing minerals were produced. Potash feldspar is used in the ceramic and glass industries. Scrap muscovite is used in roofing materials, paint, and rubber as well as other things. Rose quartz is valued as a decorative stone.

INVESTIGATION OF KAOLIN IN EASTERN REDWOOD COUNTY, MINNESOTA, USING GRAVITY, MAGNETIC, AND ELECTRICAL RESISTIVITY METHODS

Val W. Chandler[1], S. Hauck[2], M. Severson[2],
J. Heine[2], J. Reichhoff[2], and Bryan D. Schaap[1]

The utility of gravity, magnetic, and electrical resistivity methods for kaolin exploration was evaluated on a test-drilled 300-meter by 600-meter prospect in the Minnesota River Valley in eastern Redwood County, Minnesota. Seven Wenner soundings and three resistivity profiles were taken over the prospect, and interpretations were constrained by direct determinations at nearby bedrock exposures and by drill hole (regolith) data. High-precision gravity data also appear to reflect thickness variations in the low-density kaolin. The magnetometer is not sensitive to the kaolin itself, but it may be useful in detecting rocks in the protolith, such as diabase dikes, that yield chlorite-rich, weathered clays.

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ECONOMIC POTENTIAL FOR INDUSTRIAL MINERALS IN THE PADUCAH 1°x2° QUADRANGLE IN SOUTHERN ILLINOIS AND ADJACENT KENTUCKY AND MISSOURI: THE RESULTS OF CUSMAP ASSESSMENT

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The Conterminous U.S. Mineral Assessment Program (CUSMAP) of the U.S. Geological Survey (USGS), carried out in cooperation with State geological surveys, provides for detailed geological, geochemical, and geophysical studies in regions known to contain or have potential for mineral deposits. The program is designed to develop sufficient knowledge to determine the likelihood of finding new mineral resources or extensions of known deposits. A CUSMAP study of the Paducah 1°x2° quadrangle, including assessment of the industrial minerals, was begun in the fall of 1986 as a cooperative effort of the USGS, the Illinois State Geological Survey, and the Geological Surveys of Kentucky, Missouri, and Indiana. The study area encompasses approximately 7,500 square miles in southern Illinois and adjacent parts of Kentucky, Missouri, and Indiana. The recently completed assessment, using the Illinois Geographic Information System (IGIS), shows promising exploration targets for an array of industrial rocks and minerals, including limestone and dolomite, sand and gravel, clays, and tripoli.

Descriptive models were prepared and, from these models, diagnostic criteria were selected and weighted in proportion to their relative importance as indicators of the potential for occurrence of a resource. Nine industrial minerals models were constructed: high-calcium limestone, limestone and dolomite for aggregate, carbonate building stone, common clay, absorbent clay, ball clay, sand and gravel, chert gravel, and tripoli. The diagnostic criteria used included: (1) distribution of favorable bedrock or surficial formations; (2) occurrences (locations of active and inactive mines, quarries, prospect pits, and outcrop; (3) character and thickness of overburden (generally 0-20, 20-50, and greater

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than 50 feet); and (4) for tripoli, proximity to geophysically defined intrusive bodies. Appropriate buffer zones, assigned lesser weighting values, were chosen for both areally defined (distribution, overburden) and point source (occurrence) criteria. Following digitization of basic data, GIS techniques were used to provide buffer zones, assign previously chosen weights, and, for each model, produce the criteria-based data layers that were summed to produce the final assessments. The individual layers and the final results, showing areas of high, medium, and low potential for each of the nine industrial minerals, will be presented in poster format at this meeting.

REGIONAL AND LOCAL GEOLOGIC, MINERALOGIC, AND GEOCHEMICAL CONTROLS OF THE INDUSTRIAL CLAY GRADES IN THE MINNESOTA RIVER VALLEY

John J. Heine[1] and Tom A. Toth[2]

Late Cretaceous sedimentary rocks are found on both sides of the Minnesota River Valley. They consist of marine and non-marine shales, lignites, sandstones, kaolinitic sandstones, siltstones, and mudstones overlying a pre-Late Cretaceous kaolinite/chlorite-rich weathering profile developed on Precambrian gneisses and granites. Pleistocene glaciation has subsequently scoured and eroded parts or all of the Late Cretaceous sequence, resulting in deposition of a blanket of till and outwash material of varying thickness.

Using detailed stratigraphic sections of outcrops and drill holes, three paleostream channels (Renville-Nicollet, Crow-Purgatory, and North Redwood) can be delineated. The stream channels are defined by the presence of fluvially deposited secondary kaolinite (channel and overbank deposits) and differences in depth to the primary kaolinite or weathered Precambrian surface. The stream channels formed from erosion of deeply weathered Precambrian bedrock that formed during a period of intense weathering during the Late Jurassic to Late Cretaceous. Encroachment of the Western Interior Seaway in the Late Cretaceous produced a more humid environment that led to the deposition of the secondary kaolinitic sediments in the stream channels. A period of lateritization followed that produced pisolites on the overbank material within the stream channels.

The regional stratigraphic/paleogeographic model shows that the:

(1) grade and composition of primary kaolin was bedrock dependent;

(2) secondary kaolin was deposited in a fluvial environment;

(3) Late Cretaceous non-marine, organic-rich sediments were variable in thickness and poorly preserved; and

(4) glacial processes eroded and buried the Precambrian bedrock, primary and secondary kaolinite-rich, and overlying Late Cretaceous non-marine/marine sediments.

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The best grades of kaolinite occur in the overbank areas of the paleostream channels, and in the primary clays of the Fort Ridgely Granite or other felsic (meta)igneous rocks. Good refractory grade material occurs in the lateritic areas where thick pisolite sequences are developed.

INDUSTRIAL MINERALS EXPLORATION AND RESEARCH IN MICHIGAN

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The production and use of industrial rocks and minerals are vitally important to Michigan's economy and that of the Great Lakes region. Michigan is blessed with a diverse and rich resource base of industrial rocks and minerals, and when combined with the ready availability of low-cost lake transportation, which enables these low value products to be shipped throughout the Great Lakes area, it enjoys a competitive advantage--one which makes it one of the leading producers of a wide variety of mineral products.

Recognizing the importance of this resource, the Geological Survey Division of the Michigan Department of Natural Resources works closely with the research universities of the state on projects of mutual interest. Over the years, a number of projects involving exploration for and the utilization of industrial minerals have been undertaken in cooperation with Michigan Technological University, which maintains a strong minerals component in both education and research. Some of the more important joint projects are:

1. Building and decorative stone--Michigan has abundant resources of attractive stone which are presently underutilized for building and decorative uses. A current project is designed to evaluate the most appealing stones.

2. Limestone/dolostone--Michigan has huge resources of high quality carbonate rock, which are mined and processed and used extensively in metallurgical, chemical, construction, agricultural, manufacturing, and environmental applications.

3. Foundry sand--Great lakes dune sand has set the standard for quality in the foundry industry. With increasing efforts to protect and preserve shoreline dunes, the industry is using more inland sources which require beneficiation to remove clays and acid-consuming carbonates.

4. Graphite--Precambrian sedimentary rocks associated with iron-formations in Michigan contain significant resources of graphitic rock, some grading as high as 35 percent graphite. The amorphous graphite has potential for use as a pigment, lubricant,

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metallurgical reductant, and as a shale of substitute for portland cement manufacture. Higher value crystalline graphite may also be present in some areas.

5. Shale/slate for portland cement manufacture--Michigan is also a leading producer of portland cement. The cement is produced by firing limestone with shale, which provides the needed silica and alumina to produce a cement klinker. The very demanding chemical requirements for the shale material require low alkalis and low sulfur levels, which are difficult to achieve. Current work involves exploration for suitable shale substitutes in the sedimentary rocks of the Precambrian terrain of the western Upper Peninsula of Michigan.

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NATURAL AGGREGATES--NATIONAL AND REGIONAL ASSESSMENTS

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Crushed stone and sand and gravel are the two main sources of natural aggregates, and together amount to approximately half the volume of mined material in the United States. U.S. aggregate production in 1990 had a value of approximately $9.1 billion (U.S. Bureau of Mines, 1991); thus, aggregates are among the leading nonfuel mineral commodities produced in the U.S. Their 1990 value by far exceeded that of iron ore ($1.8 billion), copper ($4.2 billion), or the combined value of precious metals including gold, silver, and the platinum group metals ($4.7 billion).

Although crushed stone and sand and gravel commonly are used interchangeably, these essential construction materials are not readily available in all parts of the United States. Some areas are devoid of sand and gravel, and potential sources of crushed stone may be lacking or covered by a sufficient thickness of overburden to make surface mining uneconomical. In some areas, aggregates do not meet the physical-property requirements for certain uses, or they contain mineral constituents that react adversely when used in concrete. Furthermore, zoning, regulations, and competing land uses may restrict or preclude aggregate mining.

Two sets of U.S. Geological Survey maps can serve as valuable data sets for regional analyses of natural aggregates. On the National scale, two 1:5,000,000-scale maps (1 in. ≈ 79 mi) have been completed for the conterminous U.S. One map shows the major potential sources of sand and gravel aggregate, and the other shows the distribution of selected types of bedrock normally considered for use as crushed stone (Langer, 1988). On a regional scale, a 52-map set of 1:1,000,000-scale maps (1 in. ≈ 16 mi) showing the Quaternary geology of the conterminous U.S. is currently being prepared. The Quaternary geologic map of the Minneapolis 4° x 6° quadrangle is an example (Richmond and Fullerton, 1983).

The National overview maps demonstrate that natural aggregates are distributed throughout the U.S. in a variety of geologic environments. The map showing potential sources of sand and gravel is divided into geographic regions based primarily on geologic

history and physiography. The mode of distribution of sand and gravel is similar within a region and is fairly distinct from that of other regions. Within each of these regions, major areas of sand and gravel are shown.

Crushed stone aggregates are mined from a wide variety of parent bedrock materials, including limestone and other carbonate rocks, granite, and other igneous rocks. The National maps show that limestone is widespread throughout the Central and Eastern U.S., and is scattered in the West. Granite is widely distributed in the Eastern and Western U.S. and is exposed in a few small areas in the Midwest. Igneous rocks (excluding granite) are largely concentrated in the Western U.S. and in a few isolated localities in the East.

The National maps also demonstrate that aggregates are in limited supply or of poor quality in approximately one-third of the conterminous U.S. In the High Plains, aggregate is largely restricted to stream channels and terraces, and commonly lacks gravel. Large areas of glaciolacustrine deposits in Michigan and North and South Dakota lack significant deposits of sand and gravel. The seaward sections of the Coastal Plain are primarily sand that commonly lacks gravel. Much of the Mississippi River alluvial plain and adjacent loess-mantled uplands lack significant deposits of sand and gravel.

The Quaternary geologic map of the Minneapolis 4° x 6° quadrangle shows 8 map units that are possible sources of sand and gravel. For regional planning purposes, these areas can be highlighted. A generalized ranking of sand and gravel availability prepared from this map illustrates that, although this quadrangle area might contain an abundance of sand and gravel resources, there are significant areas where these deposits are sparse.

Because aggregate will continue to be in demand, provisions to protect available aggregate and to provide for uninterrupted economical supplies should be made. Identification of areas with adequate sources of aggregate represents only the first step in land-use planning and commercial exploitation. Proper long-range planning and environmentally conscious zoning techniques can help assure that adequate supplies of aggregate are available near market areas, while simultaneously protecting the public from the undesirable effects of mining operations. The interrelated problems associated with aggregate availability, aggregate quality, and socioeconomic needs and restrictions present

a challenging setting for the development of new techniques and methodologies for aggregate assessment.

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MINNESOTA'S AGGREGATE MAPPING PROGRAM

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Minnesota Statute 84.94 mandates that the DNR, in cooperation with the Minnesota Geological Survey and the Minnesota Department of Transportation (MN-DOT), conduct a program to identify and classify potential aggregate resources in Minnesota outside the seven-county metropolitan area. This statute further specifies that priority be given to those areas of the state where urbanization or other factors may result in a loss of aggregate resources to development. Mapping has been completed in Sherburne, Wright, and Isanti Counties and is currently in progress in Benton County. Aggregate mapping is scheduled for Clay and Blue Earth Counties.

Mapping of aggregate resources entails initial mapping in the office of all surficial geologic materials. This is accomplished by stereoscopic study of high-altitude aerial photographs with geologic contacts drawn on 7.5-minute topographic maps. These interpretations are supplemented by study of published reports, including geologic and soils maps. This preliminary geologic map is then checked in the field through observations of geomorphology and examination of sediments in exposures such as gravel pits, excavations, and road cuts. Subsurface data, including MN-DOT test borings and well logs from field-located domestic water wells, are used to substantiate inferences about shallow subsurface sediments. Aggregate sieve and quality test data from MN-DOT files are summarized in order to quantify the physical properties of the aggregate deposits. Following field work, the geologic contacts are adjusted and finalized using aerial photographs.

Upon completion of mapping, the geologic information is digitized in ARC/INFO from the 7.5-minute field maps for incorporation into geographic information systems. The final map is produced at a scale of 1:100,000, utilizing existing base map data (DLG and TIGER, for example), where available.

Those geologic units that contain potential aggregate resources are grouped together and shown on the map with an overlay pattern. A report describing the Quaternary geology of the county and its relationship to the occurrence of aggregate accompanies each map.

In addition to the paper map and report, the digital map data are provided to the county for use in their geographic information system. These data are then used by the county to establish zoning and land-use plans that will preserve for future use those areas with the highest potential for aggregate resources.

MINERAL FRONTIERS ON INDIAN LANDS

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The Division of Energy and Mineral Resources of the Bureau of Indian Affairs provides services to the Indian mineral owner that are unique within the Department of Interior. The primary goal of the Division is to provide the best available technical, economic, and land-use data and advice to Indian landowners, and to bureau and department personnel who are assisting Indian owners seeking to manage and develop their mineral resources. In addition, the Division cooperates in the planning, management, and development of mineral resources with tribes, other agencies, councils, and commissions, and assists tribes in achieving the maximum income, employment, training, and business opportunities from utilization of their mineral resources.

The Division of Energy and Minerals is a national office in the BIA. It provides staff assistance and advice to the Director of Office of Trust and Economic Development in analyzing, evaluating, developing, and coordinating Bureau-wide Indian energy and mineral resource policies and programs. It prepares regulations and develops procedures for application by area and agency offices in activities pertaining to the conservation, development, and leasing of mineral resources on Indian lands.

The Division coordinates Bureau energy and minerals resources activities with other bureaus within the Department, other governmental agencies, and industry personnel; and advises Bureau management on mineral-related technical issues. Some of the services include reviewing mineral accounting procedures; managing the Bureau's minerals inventory program; reviewing environmental impact statements; providing comments related to mineral resource development; and monitoring contracts and production programs in oil and gas.

The Division is responsible for economic analyses and other activities related to coal, oil, gas, uranium, copper, molybdenum, tungsten, and other energy and mineral resources. Since the Division was first organized in 1977, more than 20 million acres of tribal lands in

the lower forty eight states plus Alaska have received or are in the process of receiving mineral assessments. This represents just over 47 percent of tribal trust lands in these areas. The long term goal of the Division is to complete mineral studies on all reservations.

The Division has the following technical capabilities in mineral resource management: *Technical Support for Management; Geological/Engineering Studies; Economic Analysis; and Assessment of Decline Curves.*

Major Division programs include: *Geotechnical Analysis and Transfer (GAT); Mineral Database Management; Mineral Assessment; Outreach and Special Projects.*

The Divisions Outreach program includes several meetings each year with industry, government, and Indian mineral owners. The program is designed to (1) inform industry of which Indian Tribes may be interested in considering a mineral proposal; (2) highlight the positive effects of doing business on Indian lands; (3) establish ground rules for proposals and negotiations; (4) present exploration methods that are proven to be successful on various deposit types; and (5) provide geological information on Indian lands.

THE IMPACT OF URBAN DEVELOPMENT ON THE STONE INDUSTRY OF THE CHICAGO-MILWAUKEE METROPOLITAN AREA

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A large, locally derived stone industry has supplied northeastern Illinois and southeastern Wisconsin with a variety of construction materials since pioneer settlement of the area. In turn, the availability of these stone products has had a significant impact on the development and character of this region, which encompasses the major metropolitan centers of Chicago and Milwaukee. However, urban growth and changing material needs, both constrained by geologic factors, threaten the future availability of these stone products.

Geology is the fundamental control on the availability of stone materials in this region. A thick cover of glacial deposits and lake sediments severely limits the area in which bedrock occurs at or near the ground surface. The quality of bedrock composition and thickness of useable stone also vary greatly across the region, with the most desirable quarry sites located closest to Lake Michigan.

Throughout the 19th century, lime and building stone were the main products, with large production centers located in Cook, Kankakee, and Will Counties, Illinois, and Milwaukee, Racine, and Waukesha Counties, Wisconsin. Portland cement, which was introduced in the late 19th century for use in concrete pavement, blocks, etc., eliminated most of the demand for these local materials. Since then, aggregate has been the dominant product of the region, although lime is still produced in Cook County, and "stone" is quarried as decorative building stone in Waukesha County.

While it has been able to adapt to changing product demand, the stone industry is being seriously threatened by urban expansion. Numerous quarry sites have been forced to close, and many potential sites have been lost to development. In northeastern Illinois, only 20 quarries are still operating, while at least 253 stone pits have been abandoned. Only 19 pits are operating in southeastern Wisconsin; 148 have been abandoned. Urban growth is encroaching upon many existing quarry sites, and strong local opposition to quarry

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expansion, deepening and opening of new pits, even in rural areas, threatens remaining operators. Operators face this opposition alone, and public agency support is needed to explain the benefits of the stone industry to the community and to outline geologic constraints that prevent a quarry from opening "farther down the road."

INDUSTRIAL MINERALS INFORMATION FOR LOCAL GOVERNMENT: GEOLOGIC RESOURCES PLATES OF THE MINNESOTA COUNTY GEOLOGIC ATLAS PROGRAM

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Counties involved in land-use planning are increasingly interested in obtaining information about their industrial mineral resources. As part of the County Geologic Atlas program, the Minnesota Geological Survey has produced geologic resources plates for the Hennepin (Balaban, 1989) and Dakota (Balaban and Hobbs, 1990) County atlases. These plates, displayed in the accompanying exhibit, discuss sand and gravel, bedrock (for crushed rock and dimension stone), and clay resources. Hennepin County has led the state in production of sand and gravel, and Dakota County contains about half the rock aggregate and sand and gravel resources of the seven-county Twin Cities Metropolitan Area. Discussions of the bedrock resources on the plates relate local stone types to familiar, historic buildings in the counties and consider problems associated with use of the Platteville Formation for construction in Hennepin County. In combination with the other maps of the county atlases (surficial and bedrock geologic maps, and interpretive maps of hydrogeology and ground-water sensitivity), the geologic resources plates put industrial mineral resources into context for county planners.

EVALUATION OF THE CARBONATE RESOURCES OF SOUTHERN MINNESOTA

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Paleozoic carbonate deposits in southeastern Minnesota, consisting of several formations ranging from limestone to dolomite, constitute an important mineral resource of the state. They are quarried extensively for aggregate, aglime, and dimension stone. However, new uses are being developed for carbonate rocks that require greater adherence to specifications for chemical composition. Extensive channel samples and diamond drill-hole samples were collected for chemical analyses from the Paleozoic section. Sixty locations were sampled and a total of 615 samples were analyzed for CaO, MgO, LOI, SiO_2, Al_2O_3, TiO_2, Fe, MnO, Na_2O, K_2O, P_2O_5, S, and Cl. These analyses provide the basic information needed by a company to make a preliminary assessment of these materials for commercial exploitation. They represent a potential source of flux for Minnesota taconite operations.

DIMENSION STONE INVENTORY OF NORTHERN MINNESOTA

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The dimension stone industry has experienced significant growth over the past few years. Correspondingly, the demand for new colors and uniquely textured stone has steadily increased. The results of a recent dimension stone inventory reinforce the idea that Minnesota offers excellent potential for high quality quarry stone.

A dimension stone inventory is currently being conducted on state lands in northern Minnesota and federal lands in the Superior National Forest. The purpose of this inventory is to identify areas of "granite" rock that exhibit potential for quarrying and encourage the stone industry to further evaluate the prospects.

A report entitled "Dimension Stone Inventory of Northern Minnesota" (1991) is available. This report summarizes the first two years of the inventory. A color brochure entitled "Minnesota Granite" is also available. The brochure contains photographs of polished tiles from prospect sites. New prospect site information is placed in open files and made available for distribution as the inventory progresses.

As a result of this inventory, three quarry prospect sale areas offered by the Superior National Forest on federally owned lands have been acquired by Cold Spring Granite Co. The company is currently core drilling and collecting bulk samples to further evaluate these sites.

Rules and regulations for leasing industrial minerals on state-owned lands are currently being drafted. An environmental review of proposed quarry areas will be conducted before quarrying is permitted.

Polished tiles from each prospect site are available for inspection at the DNR Minerals offices and the Superior National Forest office in Duluth.

KITTSON COUNTY, MINNESOTA, BLOATING CLAYS

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Glacial Lake Agassiz clays from Kittson County in northwestern Minnesota exhibit a characteristic spherical bloating habit when fired to 2,050 °F. The bloating characteristics were identified in 1989 during a regional study of the characteristics of Minnesota's clay resources. Extruded briquets of Brenna Formation material (collected in 1985 by the USBM) bloat spheroidally even when fired to relatively low temperatures. Further research confirms the highly expanding spherical nature of the clays, in both processed (crushed to -50 mesh) and raw clay form. Current research has determined that the clays can be rotary kiln fired. The resulting fired product is suitable for lightweight aggregate in structural concrete, meeting the requirements of Standard Specifications ASTM C 330. The processing and pelletizing characteristics of the Kittson clays are presently being studied. This study demonstrates that the Kittson clays can be processed, extruded, cut into pellet form, and fired to produce a lightweight, highly expanded, uniformly sized, near-spherical product with a moisture absorption resistant shell.

The Kittson clays consist of clay and silt (rock flour) deposited in Pleistocene Glacial Lake Agassiz. The bloating clays occur in the Sherack (alluvial clays - locally bloat) and Brenna (glacial lake clays) Formations. These clays are widespread and flat-lying and within 0-30 feet of the surface. The maximum thickness tested is about 75 feet, with the optimum range for the best expanded material being about 25 feet thick at an average depth of 25 feet. Bulk X-ray mineralogy indicates that the expanding clays consist of quartz with minor kaolinite, illite, and smectite and trace amounts of feldspar and carbonate.

Bloating temperature ranges from 1,900 °F to 2,200 °F, depending on processing method and desired end product. Bulk density of the fired material is 33.2 lbs./ft^3. Specific gravity is 1.1 gm/cm^3. Water absorption on the rotary kiln processed clays is 11.1 percent at four hours. Upper parts of the Brenna Formation expand as much as 300 percent on firing.

Potential use of the Kittson clays lies in their expanded state. Rotary kiln processing of the dried raw clay will produce lightweight aggregate suitable for structural concrete and landscaping material. Further processing of the dried raw clay--crushing, screening, wetting, extruding, firing--will produce a uniform spheroidal aggregate with potential use in insulating concrete, as a filler, as a substitute for perlite in horticultural growing mixes, in filtration columns, and in cracking columns.

KAOLINITIC SAPROLITHS OF CENTRAL AND WESTERN MINNESOTA

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A thick mantle of residual weathering products covers the Precambrian bedrock in much of western and central Minnesota. Within the residuum, a sequence of four lithologic units representing progressively more weathered material upward from the fresh bedrock surface is typical. From bottom to top, they are: (1) a zone of very slightly weathered rock, (2) saprock, or weathered rock that is firm but distinctly altered, (3) saprolite that is typically so weak it can easily be crushed by hand, but that mostly retains the structures and textures of the parent rock, and (4) a hard lateritic clay characterized by iron oxide-rich pisolites. This sequence may be partly eroded and (or) overlain by Cretaceous and (or) Quaternary deposits. In some places, the Cretaceous deposits consist of relatively pure kaolinitic shale derived from the reworking of the saprolith.

Natural gamma logging has been developed as a quick and inexpensive means of recognizing weathering products, evaluating the degree of weathering, and measuring the extent of the deposit. Natural gamma radiation in rocks is generally related to their content of potassium, uranium, and thorium. In its most common application, gamma logging responds to the presence of potassium-bearing minerals. Thus, illite and the smectites cause high gamma readings compared to other weathering products. In Minnesota, the upper parts of the residuum have low gamma signatures because kaolinite and quartz are the dominant minerals. In general, gamma values increase with depth through the saprolith and into the protolith. Bauxitic parts of the profile have pronounced gamma signatures because of remobilized thorium.

It may be possible to calibrate gamma signatures with chemical changes involving: (1) loss of CaO, Na_2O, K_2O, FeO, and some SiO_2, (2) gain in CO_2, and (3) relative gains or consistency in Fe_2O_3, MgO, TiO_2, and water. The correlation of chemical alteration indices with modal mineralogy shows that the loss of Na_2O, CaO, K_2O, and possibly some SiO_2 corresponds with the disappearance of plagioclase, followed by potassium feldspar. However, diagenetic processes have typically added SiO_2, CO_2, Fe_2O_3, and Na_2O to the

upper parts of weathering profiles. Potential users of kaolinite require a deposit that is thick, widespread, rich in kaolin, and relatively free of impurities that would tend to color the product. The upper part of the saprolitic interval, where the most intense chemical weathering has occurred, best meets these needs. However, diagenetic changes are also most likely to occur in this zone and the user must expect that at least some beneficiation will be necessary.

MINERAL ASSESSMENT, INVENTORY, AND MARKETING STUDY PROGRAMS OF THE OGLALA SIOUX PINE RIDGE INDIAN RESERVATION

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Pine Ridge, SD 57770

The Pine Ridge Indian Reservation, which is the home of Oglala Lakota people, is situated in the southwest part of South Dakota, within the counties of Shannon, Bennett, and Jackson. The Reservation is the second largest Indian Reservation in the United States, containing 2.7 million acres with 20,000 tribal members. Shannon County has the lowest per capita income and the highest unemployment rates of any county in the United States. The following three major mineral resources have been identified for future economic development, which can solve the twin problems in the Reservation.

Zeolite: Approximately 75 million tons of clinoptilolite-rich rock is present near the surface on 4 square miles of tribal land near Wanblee, South Dakota. The zeolite is moderately rich in both potassium and calcium. The water-holding capacity (intergranular) of zeolite is about 40 gallons per ton, and the ammonium-holding capacity is about 34 pounds per ton. Ammonium-exchanged zeolite provides nitrogen that is available to plants by slow release, and, thus, it provides a mechanism of abatement of nitrate and nitrite pollution of ground water that is commonly caused by repeated applications of the highly soluble synthetic fertilizers in present use. Other applications of this zeolite include cat litter, refrigeration, deodorant, hydroponic helping, lightweight aggregate, and some waste treatment.

Clays: Large clay deposits (more than 20 million tons) have been evaluated near the Pine Ridge Village. The laboratory tests have indicated that the principal minerals are quartz, kaolinite, illite, montmorillonite, and mixed-layer clay. The studies on the clays have been performed for adobe block construction materials, ceramic or refractory clays products, and pottery and kindred clay products.

Sand and Gravel: The program has studied major sand and gravel resources in the Red Shirt Table (about 2 million tons) and the Rockyford areas (about 1 million tons). The quality evaluations have been completed for the building industry, such as in portland cement concrete, mortar, and plaster; and highway road paving industry, such as in both asphaltic mixtures and portland cement concrete.

THE MINERALS SOURCE

U.S. Bureau of Mines
5629 Minnehaha Avenue South
Minneapolis, MN 55417

The mission of the Bureau is to help ensure that the Nation has an adequate and dependable supply of fuel and nonfuel minerals to meet its defense and economic needs. The Bureau conducts research aimed at minimizing the environmental, health, and safety costs of mineral extraction and processing; acquiring and analyzing domestic and international minerals data; and engaging in activities to advance minerals and materials science.

In the area of mining technology, the Bureau's Organic Act (Public Law 63-283) mandates research to improve productivity, increase resource recovery, and reduce environmental problems associated with mining. The Federal Mine Safety and Health Amendments Act of 1977 (Public Law 95-164) provided for the first time one piece of comprehensive legislation for both coal and metal-nonmetal mining operations, extending the research mandates of prior legislation to all segments of the mining industry.

The Bureau's experience in technological developments spans all aspects of mineral location, mining, and processing, including reduction of mining waste, improved efficiency of mineral recovery from primary ores and from wastes, and reduction of hazardous wastes resulting from present and past operations.

Cooperative Research Opportunities and Industrial Minerals type projects will be exhibited.

INDUSTRIAL MINERALS IN OHIO

Sherry L. Weisgarber and David A. Stith
Ohio Department of Natural Resources
Division of Geological Survey
4383 Fountain Square Dr., Bldg B
Columbus, OH 43224-1362

The total value of nonfuel industrial minerals sold in Ohio in 1991 was $413,198,118. Minerals produced in Ohio are limestone, dolomite, sand, gravel, salt, sandstone, conglomerate, clay, shale, gypsum, and peat. One or more of these commodities were produced in 85 of Ohio's 88 counties in 1991. Limestone, dolomite, sand, and gravel constituted the bulk of industrial mineral production in Ohio, both in terms of tonnage (90 percent) and value (80 percent). In 1991, Ohio ranked first nationally in the production of common clay and shale, fourth in salt and construction sand and gravel, and tenth in stone.

Limestone/dolomite production in Ohio increased every year from 1982 through 1990. Eighty-five percent of 1991 production came from Silurian- and Devonian-age rocks. Sand/gravel production increased most years since 1983. Except for the recession years of the early 1980's, production of limestone/dolomite and sand/gravel since 1965 was generally in the range of 40-50 million tons and 35-45 million tons, respectively.

Following peak production of more than 6 million tons in the late 1960's and early 1970's, salt production from Silurian bedrock units generally fluctuated around 4 million tons from the mid-1970's to 1990. After sustained levels of more than 2 million tons per year from the 1950's to the 1970's, sandstone/conglomerate production generally declined from 1979 to the 1991 level of 1.7 million tons. More than 95 percent of sandstone/conglomerate production in Ohio came from Mississippian and lowermost Pennsylvanian units in 1991. Clay production generally declined from a peak of over 4 million tons in the late 1950's to 0.7 million tons in 1982, but increased almost every year since 1982. Seventy-five percent of the clay produced in Ohio came from Pennsylvanian-age rocks in 1991. Shale was one commodity not showing a lengthy decline during the recession of the early 1980's. Production generally ranged from 1.5 to 2.5 million tons since the mid 1950's. Eighty-five percent of the 1991 shale production came from Pennsylvanian-age rocks; the remainder was almost evenly split between Devonian and Mississippian units.

FACT SHEETS

THE MINERAL INDUSTRY OF ILLINOIS, 1989 [1]

This fact sheet has been adapted from a chapter in the Bureau of Mines *Minerals Yearbook Report, 1989*. The Minerals Yearbook chapter was prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey, Illinois Department of Energy and Natural Resources, for collecting information on all nonfuel minerals.

By Doss H. White, Jr. [2]

In 1989, Illinois nonfuel mineral production was valued at $633.4 million, a new State record, see Table 1. This was the first year that mineral value exceeded $600 million. Crushed stone, portland cement, and construction sand and gravel were the three leading commodities, accounting for 76% of the State's nonfuel mineral value. This illustrated the mineral industry's dependency on the health of the construction industry in Illinois and surrounding States. The State continued to rank 17th in total mineral value.

REVIEW BY NONFUEL MINERAL COMMODITIES

Industrial Minerals

Industrial minerals production and sales accounted for approximately 99% of the Illinois mineral value in 1989. There were 436 industrial mineral mines in operation during 1989, according to the U.S. Mine Safety and Health Administration, see Figure 1.

Cement

The Illinois cement industry produced both portland and masonry cement. Portland cement value ranked second in the State's industrial mineral output and accounted for 19% of the mineral value. The State ranked 8th among the 38 portland cement-producing States and 27th among the 36 States with masonry cement production.

Portland cement production increased 469,000 short tons over that reported in 1988; output has increased every year since 1981. Masonry cement output declined 20%, and value fell almost 28% in 1989, the second consecutive year that tonnage and value fell.

Clays

The Illinois clay industry produced both common clay and fuller's earth. Clay value ranked sixth among the 12 industrial minerals mined or manufactured, but accounted for less than 5% of the total value. The industry ranked 32nd in tonnage among the 43 States reporting common clay and shale output and 3rd among the 9 States with fuller's earth production.

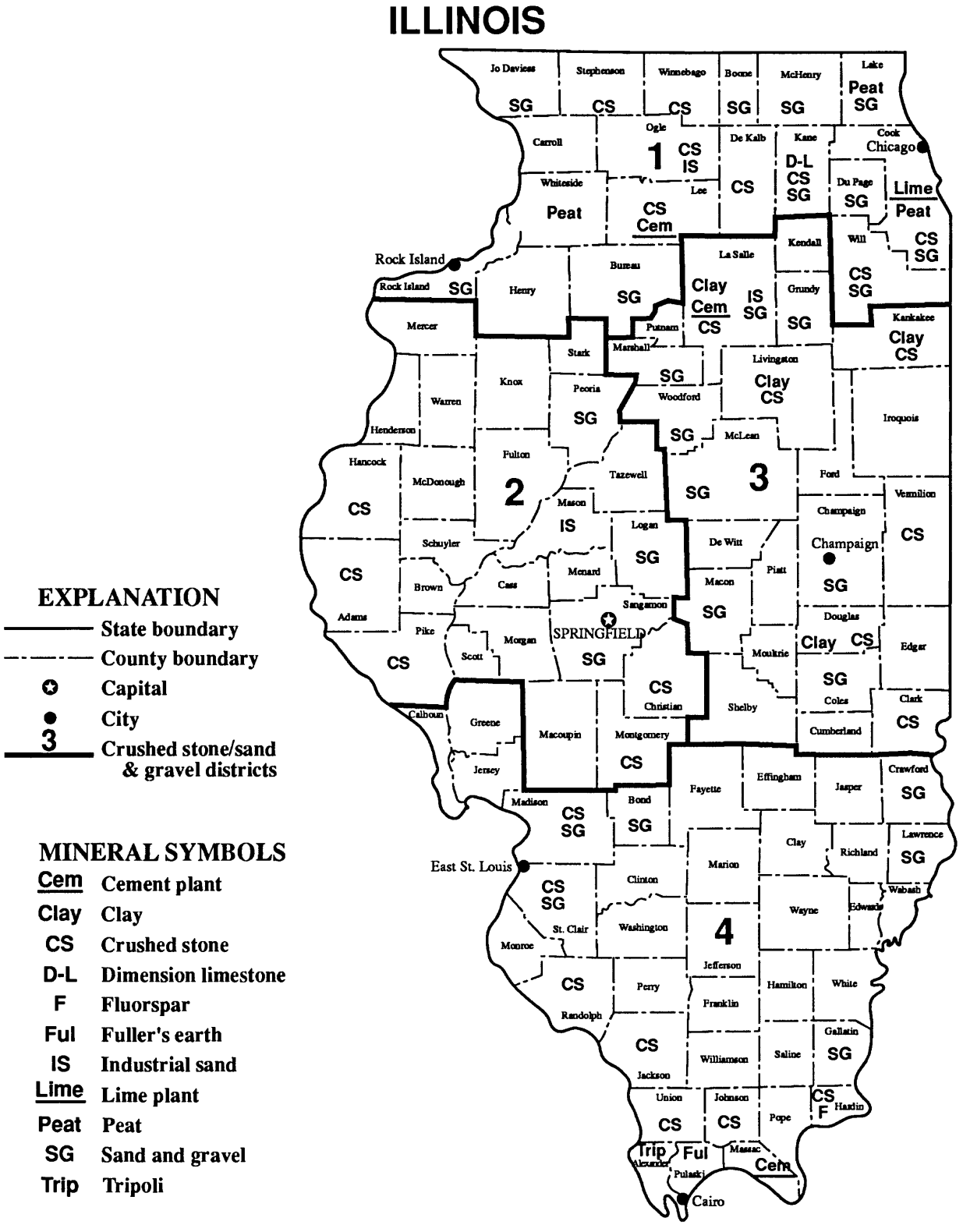

Figure 1. Principal Mineral-Producing Localities in Illinois in 1989.

COMMON CLAY

Five companies produced common clay, a substance sufficiently plastic to permit ready molding and with a vitrification level usually below 1,100 degrees Celsius. The clay mining operations were located in the Kankakee, La Salle, and Livingston Counties area in north-central and northeastern Illinois and in Bond County in the southeastern part of the State. The clay was mined by surface methods and trucked to brick plants where it was shredded, extruded, cut into brick-size pieces, fired, and placed on pallets for shipping.

Production, 142,000 tons, was 22,000 short tons below the 1988 level; value declined from $704,000 in 1988 to $641,000 in 1989. This was the third consecutive year that clay production fell. Leading end uses were face brick, cement, and drain tile.

FULLER'S EARTH

Two firms mined and processed fuller's earth, a clay with superior absorbent properties. Both firms used surface mining methods followed by drying, crushing, calcining, and screening to produce a material marketed as a pet waste absorbent and as an agricultural products carrier. Output rose more than 35%, and value increased about 27%.

Fluorspar

Illinois again was the leading State, and one of two, with fluorspar production. Over 98% of the Nation's fluorspar production was mined in Illinois. Production and value each increased almost 6%. Fluorspar, the commercial name for the mineral fluorite, a calcium fluoride, ranked seventh in value among the State's 12 industrial minerals.

Lime

The State maintained its seventh place ranking among the 32 lime-producing States. The steel industry remained the lime producers' principal customer; however, increased sales to powerplants and chemical firms were anticipated. Output increased approximately 4%, while value was up about 5%.

Peat

Illinois fell from fourth to sixth among the 21 States reporting peat production. Three firms, one less than in 1988, harvested peat in Lake and Whiteside Counties. Reed-sedge was the predominant peat type sold, followed by hypnum and sphagnum. Sales were for general soil improvement. Production plummeted almost 43%, and value dropped about 25%.

Sand and Gravel

CONSTRUCTION

Construction sand and gravel production is surveyed by the Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. This chapter contains estimates for 1987 and 1989 and actual data for 1988.

Illinois rose one position to eighth among the 50 states with construction sand and gravel production. The estimated construction sand and gravel production, 33 million short tons valued at $109 million, ranked third in Illinois mineral value. Sand and gravel sales accounted for 17% of the State's nonfuel mineral value.

In 1988, the last year that the industry reported full-year statistics, 107 companies operated 157 mines in 55 counties. Most of the mines (83%) were conventional, dry-land operations, while 17% used dredges in the mining operation. Over 50% of the total tonnage mined came from the Kane, Lake, and McHenry Counties contiguous area in northeastern Illinois.

INDUSTRIAL

The State's five industrial sand producers maintained their first-place ranking among the 38 States with industrial sand output. Production, 4.6 million short tons, increased 254,000 tons over the 1988 level. Value, however, fell about $3.2 million because of a unit price decrease that resulted from out-of-State competition.

The five producers operated seven mines, one less than in 1988, in La Salle and Ogle Counties in the north-central part of the State and in Mason County in west-central Illinois. The five leading end uses, accounting for about 83% of the sales, were foundry molds and cores (30%), glass container manufacture (28%), flat glass manufacture (11%), chemical manufacture/processing (7%), and hydraulic fracturing (7%). Unit prices varied from a high of almost $74 for ground fillers to $7.68 for chemical manufacture and processing.

Stone

Stone production is surveyed by the Bureau of Mines for odd-numbered years only; data for even-numbered years are based on annual company estimates. This chapter contains actual data for 1987 and 1989 and estimates for 1988.

CRUSHED

Stone continued to rank as the principal mineral commodity produced in Illinois, both in output and sales. Production and value in 1989, 61 million short tons valued at $257 million, exceeded that reported by industry in 1987 by almost 9 million short tons and $43 million, see Table 2. Crushed stone production was reported from 179 quarries, 20 less than in 1987. Limestone, dolomite, and sandstone were quarried and crushed by 103 companies operating in 54 counties. The

five leading counties, Cook, Du Page, Hardin, St. Clair, and Winnebago, accounted for 54% of the output.

Production of limestone and dolomite was reported by 102 companies, dolomite only by 16, and sandstone by 1. The five leading end uses reported were graded road base (12.1 million short tons), concrete aggregate (6.1 million short tons), agricultural limestone (4.1 million short tons), bituminous aggregate (3.6 million short tons), and cement manufacture (3 million short tons).

The Bureau of Mines compiles crushed stone statistics by districts for some States. Table 3 presents end-use data for crushed stone produced in the four Illinois districts depicted in the State map (see Figure 1).

DIMENSION

One firm produced dolomite from a quarry in Kane County. The dolomite was marketed as quarry-run material for riprap and finished for veneer and flagging.

Tripoli

The State maintained its first place ranking among the four States with tripoli output. Tripoli, a microcrystalline silica, was used as an abrasive and for filler and extender applications. According to company production and value data, tripoli production decreased slightly, but value increased over 250%. The apparent anomaly was caused by a three-fold change: (1) less tripoli was sold to the abrasives industry and more to the filler industry, and filler commanded a higher unit price, (2) there was an across-the-board increase in unit value, and (3) a change in reporting procedures.

Other Industrial Minerals

Barite and slag were recovered as a result of the beneficiation of other minerals and iron and steel production. Iron and steel slag, a byproduct of metal making, was marketed for road base material, asphaltic concrete, mineral wool, railroad ballast, and fill. Illinois ranked 8th of 12 States in iron slag output and 10th of 25 States in steel slag production.

A variety of mineral commodities mined in other States or imported from foreign sources were shipped into Illinois for processing into higher value products.

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[1] A portion of the information in this chapter was developed by the late James J. Hill. Mr. Hill was the State Mineral Officer from 1979 until his death in 1990.

[2] State Mineral Officer, Bureau of Mines, Tuscaloosa, AL. He has 29 years of industry and government experience and has covered the mineral activities in Illinois for 1989. Assistance in the preparation of the chapter was given by Wanda West and Maylene Hubbard, editorial assistants.

TABLE 1

NONFUEL MINERAL PRODUCTION IN ILLINOIS [1]

Mineral		1987 Quantity	1987 Value (thousands)	1988 Quantity	1988 Value (thousands)	1989 Quantity	1989 Value (thousands)
Cement (portland)	thousand short tons	2,119	$86,210	2,307	$101,760	2,776	$117,224
Clay [2]	metric tons	211,328	977	163,571	704	142,207	641
Gem stones		NA	15	NA	30	NA	W
Sand and gravel:							
Construction	thousand short tons	e28,300	e93,300	39,098	93,504	e33,000	e108,900
Industrial	do.	4,346	45,547	4,328	56,142	4,582	52,935
Stone:							
Crushed	do.	52,102	216,212	e57,900	e251,200	[3] 60,829	[3] 256,832
Dimension	short tons	W	W	e1,175	e129	W	W
Combined value of barite (1989), cement (masonry), clays (fuller's earth), copper, fluorspar, lead, lime, peat, silver, stone (crushed sandstone, 1989), tripoli, zinc, and values indicated by symbol W		XX	74,945	XX	84,157	XX	96,829
Total		XX	517,206	XX	587,626	XX	633,361

e Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

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

[2] Excludes certain clays; kind and value included with "Combined value" data.

[3] Excludes certain stones; kind and value included with "Combined value" data.

TABLE 2

ILLINOIS: CRUSHED STONE [1] SOLD OR USED BY PRODUCERS IN 1989, BY USE

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+ 1 1/2 inch):		
Macadam	865	3,550
Riprap and jetty stone	642	3,416
Filter stone	191	768
Coarse aggregate, graded:		
Concrete aggregate, coarse	6,111	24,851
Bituminous aggregate, coarse	3,627	17,552
Bituminous surface treatment aggregate	1,048	4,525
Railroad ballast	234	1,033
Fine aggregate (- 3/8 inch):		
Stone sand, concrete	870	3,175
Stone sand, bituminous mix or seal	327	1,495
Screening, undesignated	997	3,912
Coarse and fine aggregates:		
Graded road base or subbase	12,089	44,002
Unpaved road surfacing	2,229	8,417
Crusher run or fill or waste	426	1,781
Other construction materials [2]	1,274	4,550
Agricultural: Agricultural limestone and poultry grit and mineral food	4,146	14,645
Chemical and metallurgical: Cement manufacture	2,979	9,690
Special: Other fillers or extenders	799	25,000
Other miscellaneous uses [3]	1,341	4,449
Unspecified: [4]		
Actual	17,258	66,554
Estimated	3,377	13,466
Total [5]	60,829	256,832

[1] Includes limestone, and dolomite; sandstone withheld to avoid disclosing company proprietary data.

[2] Includes stone used in coarse and fine aggregates, large and graded.

[3] Includes stone used in lime manufacture, flux stone, chemical stone for alkali works, mine dusting or acid water treatment, asphalt and other fillers or extenders, and roofing granules.

[4] Includes production reported without a breakdown by end use and estimates for nonrespondents.

[5] Data may not add to totals shown because of independent rounding.

TABLE 3

ILLINOIS: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1989,
BY USE AND DISTRICT

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:								
Coarse aggregate (+ 1 1/2 inch) [1]	840	4,069	287	1,040	182	1,012	406	1,648
Coarse aggregate, graded [2]	6,951	30,640	508	2,214	2,108	9,801	1,756	6,446
Fine aggregate (- 3/8 inch) [3]	1,360	5,456	187	730	301	1,273	805	2,750
Coarse and fine aggregates [4]	9,625	35,515	941	3,020	1,926	7,207	2,387	8,992
Other construction aggregates	26	100	13	36	84	225	235	857
Agricultural [5]	532	1,623	592	2,739	1,144	5,090	1,878	5,194
Chemical and metallurgical [6]	W	W	---	---	W	W	1,574	5,760
Special [7]	---	---	W	W	W	W	199	714
Other miscellaneous	1,193	3,547	672	24,392	1,481	4,726	---	---
Unspecified:								
Actual [8]	12,762	47,386	1,250	4,990	1,361	5,894	1,885	8,284
Estimated [9]	1,662	6,316	506	2,199	381	1,744	827	3,207
Total [10]	34,950	134,651	4,958	41,359	8,967	36,970	11,953	43,851

W Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."

[1] Includes macadam, riprap and jetty stone, filter stone, and other coarse aggregates.

[2] Includes concrete aggregate (coarse), bituminous aggregate (coarse), bituminous surface treatment aggregate, railroad ballast, and other graded coarse aggregates.

[3] Includes stone sand (concrete), stone sand (bituminous mix or seal), and fine aggregate (screening-undesignated).

[4] Includes crushed stone for graded road base or subbase, unpaved road surfacing, terrazzo and exposed aggregates, and crusher run or fill or waste.

[5] Includes agricultural limestone and poultry grit and mineral food.

[6] Includes crushed stone for cement manufacture, lime manufacture, flux stone, chemical stone for alkali works, and sulfur oxide removal.

[7] Includes crushed stone for mine dusting or acid water treatment, asphalt fillers or extenders, other fillers or extenders, and roofing granules.

[8] Includes production reported without a breakdown by end use.

[9] Includes estimates for nonrespondents.

[10] Data may not add to totals shown because of independent rounding.

ILLINOIS

INDUSTRIAL MINERAL INFORMATION AND REGULATION

compiled by

J. James Eidel
Illinois State Geological Survey

1. **Responsible Regulatory Agency/Division**:

Illinois Department of Mines and Minerals
330 W. Jefferson Street
Suite 300, PO Box 10137
Springfield, IL 62791-1137
(217) 782-6791

Drilling Permits: Duane Pulliam
Oil and Gas Division
Illinois Dept. of Mines and Minerals
300 West Jefferson, Suite 300
Springfield, IL 62791
(217) 782-7756

Land Reclamation: Dean Spindler
Land Reclamation Division
Illinois Dept. of Mines and Minerals
300 West Jefferson, Suite 300
Springfield, IL 62791
(217) 782-4970

Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, IL 62708
(217) 782-3397

Water Pollution: Thomas McSwiggin
Permits
Water Pollution Control
Illinois EPA
2200 Churchill Road
Springfield, IL 62794-9276
(217) 782-0610

Air Pollution:

Don Sutton
Air Pollution Control
Illinois EPA
2200 Churchill Road
Springfield, IL 62794-9276
(217) 782-2113

Land Pollution:

Larry Eastep
Land/Permits
Illinois EPA
Land Pollution Control
2200 Churchill Road
Springfield, IL 62794-9276
(217) 782-6762

2. **Objectives of regulatory industrial minerals programs:**

To ensure environmentally sensitive use of land and water.

3. **Legal steps necessary for opening an industrial mineral quarry or mining operation:**

The following permits are ordinarily required for the installation and operation of pits and quarries in Illinois:

a. Special use permit. Most pits and quarries operate in lands zoned for agriculture under a special use permit issued by local (usually county) zoning agencies. State agencies are not necessarily involved in this permitting process. Applications submitted and reviewed by the zoning board are then referred to the county board of supervisors for approval. Some counties require that a copy of the application also be submitted to the county soil and water conservation district whose response and report is required for the application to proceed.

b. Mining permit. A mining permit is required if the operation is to disturb more than 10 acres of land/year or involve the removal of more than 10 feet of overburden. The application goes to the Illinois Department of Mines and Minerals (IDMM) and at the same time is filed with the county clerk. IDMM prepares an Environmental Impact Statement (EIS) from information furnished by the applicant on a questionnaire that must be submitted upon application for the permit. The county has 45 days in which to respond. If no objections are lodged, IDMM issues the permit in a minimum of 60 days after the date of the application. If there are objections and call for a public hearing, the time period is extended indefinitely. Permits are for three years and are extendable for 1 year. Permits must be required for lateral expansion. If, after three years, no development has occurred on the property, the 1-year extension is limited to ¼ of the original acreage. IDMM permits are required for surface, not underground mines.

Directly applicable state laws and regulations include: 62 Illinois Administrative Code 300.10-300.180; State of Illinois Public Act 77-1568, Surface Mined Land Conservation and Reclamation Act; and Illinois Environmental Protection Agency Title 35, Subtitle D, Mine Related Pollution.

c. Construction and operating permits. Construction and operating permits from the Illinois Environmental Protection Agency (IEPA) are required. Applications must be accompanied by an EIS prepared by the applicant.

d. Dredging permits. Dredge operations require a permit from the U.S. Corp of Engineers.

4. **Legal steps necessary to close an industrial mineral quarry or mining operation:**

Permitted operations must complete reclamation plans within one year of closure. See Section 3.b above for a list of applicable state laws and regulations.

5. **Responsible Non-regulatory Agency:**

Illinois State Geological Survey
615 East Peabody Drive
Champaign, IL 61820
(217) 333-4747

General Contact Person: J. James Eidel
(217) 333-5116

Contact Person by Commodities:

Clay and Shale Resources
Randall E. Hughes
(217) 244-0080

Sand and Gravel, Industrial Sand, Tripoli, Peat
John M. Masters
(217) 244-2516

Limestone and Dolomite
Donald G. Mikulic (Chicago area)
(217) 244-2518

James W. Baxter (Statewide)
(217) 333-5107

Fluorspar and Related Minerals
James W. Baxter
(217) 333-5107

6. **Objectives of the ISGS Industrial Minerals Program**

a. To maintain a program of field and laboratory research on the non-fuels minerals of Illinois using modern geologic concepts, available technology, and the supportive resources of the Survey in order to promote responsible exploration for, and optimal use of, mineral resources with minimal detrimental effect on the environment.

b. To communicate findings to industry, governmental agencies and the general public. And

c. To maintain a repository of data and material that may aid to this continuing mission.

ILLINOIS

INDUSTRIAL MINERAL REFERENCE LIST

List of Publications:

Publication Sales
Illinois State Geological Survey
615 East Peabody Drive
Champaign, IL 61820
Telephone orders: (217) 333-4747

Colleges and Universities in Illinois may also be able to provide information on industrial minerals.

Pertinent State Organizations:

Mineral Resources and Engineering Branch
Illinois State Geological Survey
615 East Peabody Drive
Champaign, IL 61820
Telephone request: (217) 333-5116

State Mineral Industry Directory:

ISGS Publication Sales (see address above)

Production Reports:

ISGS Publication Sales (see address above)

Pre-Publication Production Data, (when available):

Mineral Economics Section
Illinois State Geological Survey
615 East Peabody Drive
Champaign, IL 61820
Telephone requests: (217) 333-7409

State Laws:

Illinois Department of Mines and Minerals
330 W. Jefferson St.
Suite 300, P.O. Box 10137
Springfield, IL 62791-1137
(217) 782-6791

THE MINERAL INDUSTRY OF INDIANA, 1989

This fact sheet has been adapted from a chapter in the Bureau of Mines *Minerals Yearbook Report, 1989*. The Minerals Yearbook chapter was prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Indiana Department of Natural Resources, for collecting information on all nonfuel minerals.

By Wanda J. West [1]

Buoyed by record production and/or prices for several commodities, the value of nonfuel mineral production in Indiana increased for the seventh consecutive year to a record $434.1 million in 1989, see Table 4. Record-high total values were set for portland cement, gypsum, construction sand and gravel, crushed stone, and dimension stone. Ranking 24th nationally in the value of nonfuel mineral production, the State was the leading supplier of dimension stone and ranked second and third, respectively, in sales of masonry cement and peat. Portland cement, construction sand and gravel, and crushed stone each registered gains over 1988 production levels; together they accounted for 79% of the State's nonfuel mineral value.

REVIEW BY NONFUEL MINERAL COMMODITIES

Industrial Minerals

Cement

Nationally, Indiana ranked second and tenth in shipments of masonry and portland cement, respectively. Cement sales contributed about 30% of Indiana's nonfuel mineral production value in 1989. Raw materials consumed in the manufacturing process included 3.4 million short tons of limestone, 308,000 short tons of clay and shale, 157,000 short tons of gypsum, and smaller amounts of fly ash, pyrite, sand, and slag, see Figure 2.

Clays

Indiana ranked 12th of 30 States in common clay and shale production. Sales declined 16% in quantity and 17% in value during 1989, reversing a 6-year trend of increases. Ten companies reported production from 13 pits. Cement manufacturing consumed about 68% of the clay produced, and 12% was used for brick manufacture. It was also used in the manufacture of tile and concrete block and as a filler or extender for a variety of products.

Gypsum

In 1989, record highs were established in the State's 35-year history of gypsum mining when quantity and value increased 1% and 22%, respectively, over those of 1988. Indiana ranked seventh among 21 producing States.

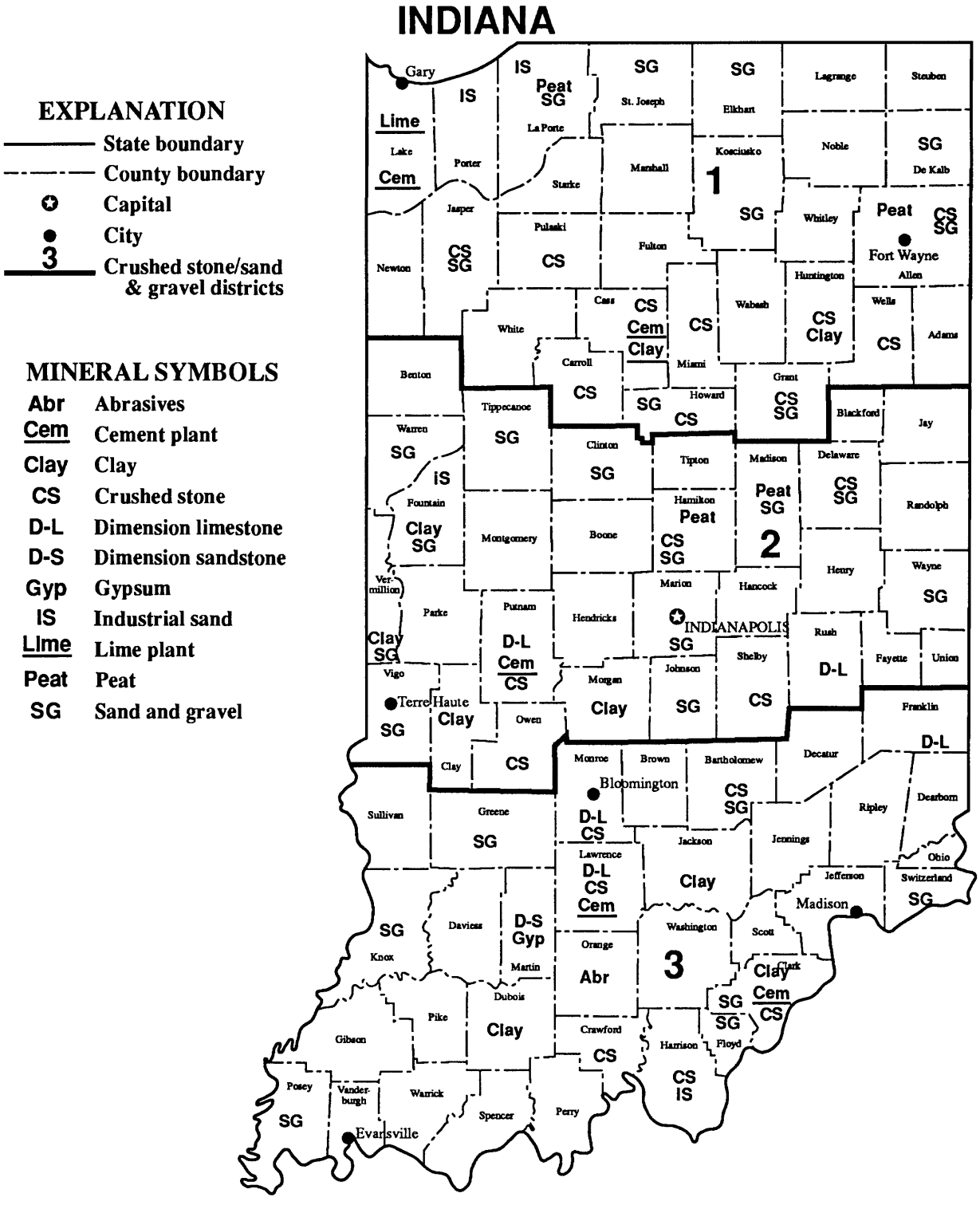

Figure 2. Principal Mineral-Producing Localities in Indiana in 1989.

Lime

Nationally, Indiana ranked tenth of the 32 States producing lime. Limestone used in the manufacturing process was shipped in by lake freighter from Michigan quarries.

Indiana ranked second, behind Pennsylvania, in lime consumption. Lime shipments to and within Indiana, from all domestic sources, totaled 1.5 million short tons of quicklime and 30,000 short tons of hydrated lime, compared with 1.6 million short tons of quicklime and 26,000 short tons of hydrated lime in 1988.

Peat

In spite of a 37% decline in its peat sales, Indiana again ranked third among the producing States. Only Michigan and Florida reported greater sales during the year. Reed sedge was the predominant type produced, with smaller quantities of humus and hypnum also reported. About two-thirds of the sales was for general soil improvement. The remainder was for use on golf courses, as an ingredient for potting soils, as an earthworm culture, for use by nurseries, and for packing flowers, plants, shrubs, etc. Most sales were in packaged form.

Perlite (Expanded)

Four Indiana plants expanded perlite mined in Western States. Sales of 22,000 short tons, valued at $5.8 million, were for use in concrete, horticultural, and plaster aggregates, fillers, filter aids, and insulation.

Sand and Gravel

CONSTRUCTION

Construction sand and gravel production is surveyed by the Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. This chapter contains estimates for 1987 and 1989 and actual data for 1988.

Nationally, Indiana ranked 10th in the production of sand and gravel, the State's third leading commodity in terms of value in 1989. Sales were estimated at 29.6 million short tons, valued at $99.2 million. These record highs represented increases of 14% and 24%, respectively, over the 1988 totals. An accelerated highway construction program, spurred by the receipts of a 1988 1-cent-per-gallon increase in the fuel tax, contributed to the rise.

INDUSTRIAL

After 3 consecutive years of growth, industrial sand production fell sharply in 1989. Closure of major operations resulted in the State's lowest production level since 1983. Most of the sand produced in 1989 was for refractory use.

Stone

Stone production is surveyed by the Bureau of Mines for odd-numbered years only; data for even-numbered years are based on annual company estimates. This chapter contains actual data for 1987 and 1989 and estimates for 1988.

CRUSHED

Crushed stone production increased to a record high in 1989, see Table 5, reflecting a sharp increase in highway construction and repair. Thirty-eight companies reported production of crushed limestone/dolomite from 81 operations (including six underground mines) in 40 of the State's 92 counties. Crawford County led in production, followed by Allen, Putnam, and Clark Counties. Agricultural marl was produced by one company in Lagrange County.

Indiana crushed stone statistics are compiled by geographical districts as depicted in the State map. Table 6 presents end-use statistics for Indiana's three districts.

DIMENSION

Indiana led the Nation in dimension stone output for the third consecutive year. Production increased slightly over that estimated for 1988 as a resurgence of the dimension limestone industry, particularly the demand for building stone, continued. Quantity sold was the highest since 1978, and its attendant value set a record high for the State. The industry employed about 800 persons during 1989, perhaps twice as many as 10 years earlier.[2] Twelve companies reported dimension limestone production from 18 quarries and 1 underground mine. Lawrence and Monroe Counties in south-central Indiana's limestone belt accounted for the bulk of the production. One company reported production of dimension sandstone from quarries in Martin County.

Sulfur (Recovered)

Recovered byproduct sulfur sales increased slightly compared with those of 1988.

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[1] Editorial assistant, Bureau of Mines, Minneapolis, MN.

[2] Sunday, The Chicago Tribune Magazine. Cutting Edge. Sept. 24, 1989, p. 15.

TABLE 4
NONFUEL MINERAL PRODUCTION IN INDIANA [1]

Mineral		1987 Quantity	1987 Value (thousands)	1988 Quantity	1988 Value (thousands)	1989 Quantity	1989 Value (thousands)
Cement:							
Masonry	thousand short tons	422	$32,299	405	$27,442	357	$24,054
Portland	do.	2,320	103,177	2,315	107,179	2,364	108,297
Clays	metric tons	[2] 940,451	[2] 4,056	1,035,837	4,630	871,179	3,836
Gem stones		NA	10	NA	10	NA	W
Peat	thousand short tons	44	W	54	W	34	607
Sand and gravel:							
Construction	do.	[e] 18,900	[e] 65,200	25,923	79,985	[e] 29,600	[e] 99,200
Industrial	do.	230	1,357	362	1,829	W	W
Stone:							
Crushed	do.	31,067	106,770	[e] 36,600	[e] 130,000	[3] 36,188	[3] 136,252
Dimension	short tons	183,609	23,115	[e] 195,444	[e] 24,956	[3] 198,531	[3] 27,212
Combined value of abrasives, clays (fire clay, 1987) gypsum, lime, stone (crushed marl and miscellaneous, 1989; dimension sandstone, 1989), and values indicated by symbol W		XX	27,881	XX	30,358	XX	34,657
Total		XX	363,865	XX	406,389	XX	434,115

[e] Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

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

[2] Excludes certain clays; kind and value included with "Combined value" figure.

[3] Excludes certain stones; kind and value included with "Combined value" figure.

TABLE 5

INDIANA: CRUSHED STONE [1] SOLD OR USED BY PRODUCERS IN 1989, BY USE

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+ 1 1/2 inch):		
Macadam	1,173	4,951
Riprap and jetty stone	751	2,672
Filter stone	159	668
Coarse aggregate, graded:		
Concrete aggregate, coarse	4,309	13,545
Bituminous aggregate, coarse	2,641	8,924
Bituminous surface-treatment aggregate	1,514	4,950
Railroad ballast	322	1,210
Fine aggregate (- 3/8 inch):		
Stone sand, bituminous mix or seal	121	437
Screening, undesignated	158	512
Coarse and fine aggregates:		
Graded road base or subbase	3,235	12,105
Unpaved road surfacing	989	3,850
Crusher run or fill or waste	373	1,439
Other construction material [2]	3,241	16,301
Agricultural: Agricultural limestone and poultry grit and mineral food	1,903	9,159
Chemical and metallurgical:		
Cement manufacture	3,738	10,411
Other miscellaneous uses [3]	496	2,579
Unspecified: [4]		
Actual	10,724	41,286
Estimated	341	1,253
Total	36,188	136,252

[1] Includes limestone, dolomite, and marl; miscellaneous stone and value for marl withheld to avoid disclosing proprietary data.

[2] Includes stone used in coarse aggregates (large and graded), fine aggregates, and stone sand (concrete).

[3] Includes stone used in terrazzo and exposed aggregate, flux stone, sulfur oxide removal, mine dusting or acid water treatment, asphalt and other fillers or extenders, and whiting or whiting substitute.

[4] Includes production reported without a breakdown by end use and estimates for nonrespondents.

TABLE 6

INDIANA: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1989,
BY USE AND DISTRICT

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:						
Coarse aggregate (+ 1 1/2 inch) [1]	1,260	5,406	182	819	671	2,195
Coarse aggregate, graded [2]	2,226	8,793	1,318	5,568	5,440	15,157
Fine aggregate (- 3/8 inch) [3]	210	752	116	529	50	145
Coarse and fine aggregates [4]	2,056	7,183	3,563	17,326	1,342	5,027
Other construction aggregates	87	289	452	2,323	13	52
Agricultural [5]	857	5,406	233	1,467	813	2,286
Chemical and metallurgical [6]	W	W	W	W	2,416	8,302
Special [7]	---	---	W	W	W	W
Other miscellaneous	684	1,255	1,112	3,348	22	86
Unspecified:						
Actual [8]	4,177	16,156	2,892	10,913	3,655	14,217
Estimated [9]	246	904	---	---	95	349
Total [10]	11,804	46,144	9,869	42,292	14,516	47,816

W Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."

[1] Includes macadam, riprap and jetty stone, filter stone, and other coarse aggregates.

[2] Includes concrete aggregate (coarse), bituminous aggregate (coarse), bituminous surface-treatment aggregate, railroad ballast, and other graded coarse aggregates.

[3] Includes stone sand (concrete), stone sand (bituminous mix or seal), fine aggregate (screening-undesignated), and other fine aggregates.

[4] Includes crushed stone for graded road base or subbase, unpaved road surfacing, terrazzo and exposed aggregates, and crusher run or fill or waste.

[5] Includes agricultural limestone, poultry grit and mineral food, and other agricultural uses.

[6] Includes crushed stone for cement manufacture, flux stone, and sulfur oxide removal.

[7] Includes crushed stone for mine dusting or acid water treatment, asphalt fillers or extenders, whiting or whiting substitutes, and other fillers or extenders.

[8] Includes production reported without a breakdown by end use.

[9] Includes estimates for nonrespondents.

[10] Data may not add to totals shown because of independent rounding.

INDIANA

INDUSTRIAL MINERAL INFORMATION AND REGULATION

compiled by

Kathryn R. Shaffer
Geological Survey Division, Indiana DNR

The U.S. Mine Safety and Health Administration (M.S.H.A.) must be notified when a new quarry or mine site is to be opened. However, this agency does not issue permits. M.S.H.A. jurisdiction does not cover ready-mix cement or asphalt plants; these plants are administered by Occupational Safety and Health Administration (46 E. Ohio, Indianapolis, IN 46204, 317-226-7290).

There is no central State agency in Indiana that handles permitting for industrial minerals operations. All clay and shale operations are required to obtain a permit from the Department of Natural Resources, Division of Reclamation. Other environmentally related permits are issued by various agencies for mines and quarries when applicable.

Basic information on State permits follow the M.S.H.A. requirements presented below for all industrial mineral operations. County or local regulations may also apply. Contact local officials for details.

Mine Safety and Health Administration

1. **Responsible Agency/Division:**

George Lalumondiere, Field Supervisor
U.S. Dept. of Labor
Mine Safety and Health Administration
Metals and Nonmetals
P.O. Box 927
Vincennes, IN 47591
812-882-0696
(office covers the area from Kokomo south)

Ralph Christiansen, Field Supervisor
U.S. Dept. of Labor
Mine Safety and Health Administration
Metals and Nonmetals
Illinois Valley Office
2200 Marquette Rd.
Peru, IL 61354
815-223-0697
(office covers the area for northwest Indiana)

Tom Anderson
U.S. Dept. of Labor
Mine Safety and Health Administration

Metals and Nonmetals
Federal Building, Rm. 252
Lansing, MI 48933
517-377-1751
(office covers the area from South Bend eastward)

2. **Objectives of program:**

   To promote health and safety among miners.

3. **Legal steps required before an industrial minerals quarry or mine may operate under M.S.H.A. jurisdiction:**

   A phone call or visit must be made to the appropriate field office designated above. A field officer will be sent out to inspect the property with the papers required to file a legal I.D. with the Department of Labor.

   Legal requirements are covered under Code of Federal Regulations CFR 30

   56.1000 Notification of commencement of operations
   Part 41, 109DAssignment of legal I.D.

   Failure to notify the Mine Safety and Health Administration of intent to begin operations will result in a citation for each of the above regulations.

4. **Legal steps required to close a quarry or mine under M.S.H.A. jurisdiction:**

   A phone call or visit to the appropriate field office as designated above. Legal requirements are covered under Code of Federal Regulations CFR 30, 56.1000, Notification of commencement of operations.

Division of Reclamation

Permit requirements for all clay and shale operations

1. **Responsible Agency/Division:**

   Kevin Geier
   Indiana Department of Natural Resources
   Division of Reclamation
   201 W. Main St., P.O. Box 147
   Jasonville, IN 47438
   812-665-2207 or 800-772-MINE

2. **Objectives of program:**

   To ensure that mined areas are restored to approved post-mining land uses.

3. **Legal steps required before a clay or shale operation may operate under Division of Reclamation jurisdiction:**

   A permit application must be submitted to the Division of Reclamation at the above address for review and approval. A performance bond must also be submitted.

   The permit is for a term of one year. At the end of each year a permit renewal must be obtained. Each year, within 60 days of the expiration of the permit, a Report of Affected Area that defines what has been mined must be submitted.

   Legal requirements for opening and closing clay and shale operations are covered under Indiana Code 13-4-6 as Amended, an act regulating surface mining of coal, clay, and shale. This law was passed in January of 1968, and is still in effect for clay and shale (but not for coal which is now regulated under Indiana Code 13-4.1).

4. **Legal steps required to close a clay or shale operation under Division of Reclamation jurisdiction:**

   The permit will specify post-mining land use; the land must be returned to a condition that satisfies those requirements. This will require back-filling pits, complete grading, and establishment of permanent vegetation.

Other Environmental Requirements and General Information

Below is a list of agencies issuing environmental permits in Indiana that may be required depending on the circumstances of each operation. This list may not be comprehensive. More information can be obtained from "The Permit Assistance Handbook for Building and Environmental Permitting in the State of Indiana," available from:

Indiana Department of Commerce
Office of Regulatory Ombudsman
Permit Assistance Center
One North Capitol, Suite 700
Indianapolis, IN 46204-2288
(317)-232-7304 or (800) 824-2476
FAX 317-232-4146.

This agency can provide assistance in determining which permits are necessary for individual operations.

Air and Water Quality, Waste Disposal

Indiana Dept. of Environmental Management
105 South Meridian
Indianapolis, IN 46225
(317) 232-8603

Water Quality

Indiana Dept. of Natural Resources
Division of Water
2475 Directors Row
Indianapolis, IN 46241
(317) 232-4160
(northwestern Indiana)

U.S. Army Engineer District, Louisville
P.O. Box 59
Louisville, KY 40201
ATTN: ORLOP-FP
(502) 582-6461
(southern two-thirds of Indiana)

U.S. Army Engineer District, Chicago
29 S. Dearborn St.
Chicago, IL 60604
(312) 353-6400
(northwestern Indiana)

U.S. Army Engineer District, Detroit
P.O. Box 1027
Detroit, MI 63103
(314) 425-4607
(northeastern Indiana)

Wetlands (see addresses above)

U.S. Army Corps of Engineers
Indiana Dept. of Environmnetal Management
Indiana Division of Water

Miscellaneous Permits and General Information - Other permits may be required to conduct business in Indiana. County authorities should also be contacted to see if local regulations apply.

Incorporation:

Indiana Secretary of State
Corporations Division
155 State House
Indianapolis, IN 46204
(317) 232-6576

Drilling Permits for exploratory test holes for all minerals that extend 200 feet below the ground surface:

Indiana Dept. of Natural Resources
Division of Oil and Gas
309 W. Washington St.,
Suite 601
Indianapolis, IN 46204
(317) 232-4055

Transportation/road construction:

Indiana Dept. of Transportation
Permit Section
State Office Bldg., Rm. 1108
100 N. Senate Ave.
Indianapolis, IN 46204
(317) 232-5436

Building Codes:

Indiana Dept. of Fire and Building Services
ATTN: Plan Review
1099 N. Meriden St., Suite 900
Indianapolis, IN 46204
(317) 232-6385

Internal Revenue Service:

Indiana Dept. of Revenue
Central Registration Section
208 State Office Bldg.
100 N. Senate Ave.
Indianapolis, IN 46204
(317) 232-2240

INDIANA

INDUSTRIAL MINERAL REFERENCE LIST

1. List of Publications:

Publications Section
Indiana Geological Survey
611 N. Walnut Grove Ave.
Bloomington, IN 47405
812-855-7736

Colleges and Universities in Indiana may also be able to provide information on industrial minerals.

2. Pertinent State Organizations:

Indiana Geological Survey
611 N. Walnut Grove Ave.
Bloomington, IN 47405
812-855-2687

Geological Survey personnel and specialty areas:

Donald Carr, Principal Geologist, Coal and Industrial Minerals Section; dimension limestone, physical testing, industry liaison

Curtis Ault, Head, Mineral Resources Section
aggregate, faulting and jointing, stratigraphy

Nelson Shaffer, Geologist, Mineral Resources Section
clay and shale, ore deposits, mineralogy, geochemistry

Walt Hasenmueller, Geologist, Mineral Resources Section; mineral resource mapping, mineral resource databases

Kathryn Shaffer, Mineral Statistician, Mineral Resources Section; mineral production statistics, relevant legislation, and company and government activities

and

Kevin Geier
Indiana Department of Natural Resources
Division of Reclamation
201 W. Main St., P.O. Box 147
Jasonville, IN 47438
812-665-2207 or 800-772-MINE

(permits for clay and shale operations, clay and shale reclamation requirements)

John Humes, Regulatory Ombudsman
Office of Regulatory Ombudsman
Permit Assistance Center
Indiana Department of Commerce
One North Capitol
Indianapolis, IN 46204
317-232-8926 or 800-824-2476
FAX 317-232-4146
(general information to help businesses get started)

4. State Mineral Industry Directory:

   There are separate directories for clay, shale, and gypsum; crushed stone, ground limestone, cement, and lime; and dimension limestone. These publications are available from the Indiana Geological Survey, Publications Section (see address above).

5. Production Reports:

   Lou Prosser, State Mineral Officer
   U.S. Bureau of Mines
   Cochrans Mill Road
   P.O. Box 18070
   Pittsburgh, PA 15236-0070
   412-892-4423
   (The Mineral Industry of Indiana, Mineral Industry Surveys)

   Kathryn Shaffer, Mineral Statistician
   Mineral Resources Section
   Indiana Geological Survey
   611 N. Walnut Grove Ave.
   Bloomington, IN 47405
   812-855-2687
   (Annual Report on Indiana Mineral Production)

6. State laws:

   Kevin Geier
   Indiana Department of Natural Resources
   Division of Reclamation
   201 W. Main St., P.O. Box 147
   Jasonville, IN 47438
   812-665-2207 or 800-772-MINE
   (for coal, clay and shale only)

   Indiana Department of Environmental Management
   105 S. Meridian

Indianapolis, IN 46225
317-232-8603
(If air will be affected, as with a crushing operation, a permit may be required. This agency also handles water quality. Contact a Permit Engineer at this address for details.)

Indiana Dept. of Natural Resources
Division of Water
2475 Directors Row
Indianapolis, IN 46241
317-232-4160

THE MINERAL INDUSTRY OF MICHIGAN, 1989

This fact sheet has been adapted from a chapter in the Bureau of Mines *Minerals Yearbook Report, 1989*. The Minerals Yearbook chapter was prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division, Michigan Department of Natural Resources for collecting information on all nonfuel minerals.

By Leon E. Esparza [1] and Milton A. Gere, Jr. [2]

Michigan's nonfuel mineral production was valued at $1.6 billion in 1989, about the same as in 1988, see Table 7. Significant increases in the values of calcium chloride, portland cement, and iron ore were the main factors in offsetting decreases reported for several commodities, including bromine, gold, lime, magnesium compounds, salt, and construction and industrial sand and gravel. Iron ore was the State's leading commodity, followed by portland cement, construction sand and gravel, and crushed stone. Industrial minerals accounted for 57% of the total nonfuel mineral production. Michigan ranked fifth, nationally, in the value of nonfuel mineral production, accounting for 5% of the U.S. total. Michigan was the Nation's leading producer of natural calcium compounds, crude iron oxide pigments, magnesium compounds, and peat. It was the second leading producer of iron ore, construction sand and gravel, and industrial sand, behind Minnesota, California, and Illinois, respectively; the third leading producer of gypsum; and the fourth leading producer of masonry and portland cement and potash.

REVIEW BY NONFUEL MINERAL COMMODITIES

Industrial Minerals

Calcium Chloride

Calcium chloride was produced from well brine in two counties by two companies, see Figure 3. Michigan was again the Nation's leading producer, far ahead of California, its closest rival. In 1989, production and value increased about 20% and 180%, respectively. Calcium chloride was used as a drying and dehumidifying agent. In a hydrated state, it was used to suppress dust, deice roads, and accelerate concrete curing.

Cement

In 1989, Michigan ranked fourth, nationally, in sales of masonry and portland cement. In 1988, it ranked fourth in portland cement and fifth in masonry cement. The value of portland cement shipments, the State's second most valuable nonfuel mineral, increased nearly 10% and averaged about $46.49 per short ton, compared with a U.S. sales average of $48.41 per ton. The value of masonry cement shipments decreased almost 3% and averaged about $87.50 per ton, compared with a U.S. sales average of $68.93 per ton. Part of this rather large price variation may be attributed to the comparatively large demand of Illinois customers.

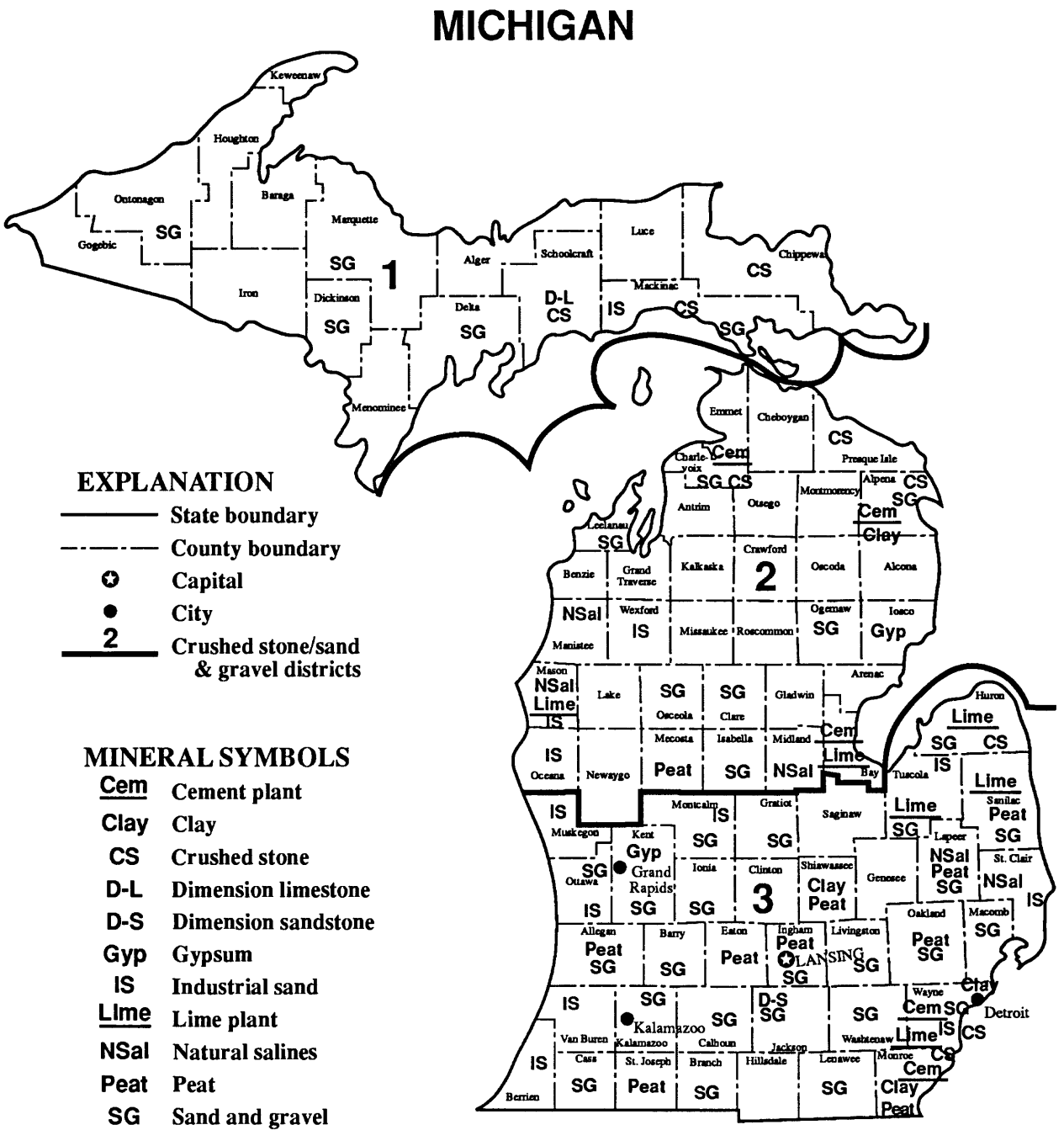

Figure 3. Principal Mineral-Producing Localities in Michigan in 1989.

Michigan's four cement plants operated at 93% of their clinker production capacity in 1989, unchanged from 1988. Apparent annual capacity of all Michigan plants was about 4.9 million short tons.

Portland cement produced in Michigan had the following end uses in 1989: ready-mixed concrete (75%), concrete product manufacturers (12%), highway contractors (7%), building material dealers (4%), and other uses (2%).

About 9.5 million short tons of raw materials were consumed in the manufacturing process, including 6.8 million tons of limestone, 1.6 million tons of clay and shale, 538,000 tons of clinker, 270,000 tons of gypsum, and lesser quantities of anhydrite, fly ash, iron ore, sand, and other materials.

Clays

Production of common clay and shale in Michigan during 1989 increased slightly compared with 1988 levels; value increased about 4% during the same period. Alpena County led the State's production and was one of four counties yielding clay from pits mined by five companies. Most of the clay output was used in cement production, with the remainder used in brick and pottery manufacturing.

Gem Stones

The value of gem stones was estimated to have decreased about 60% in 1989. Specimens were collected by dealers, rockhounds, mineral collectors, and other hobbyists. Gem stones common to the State include: small, colorful, richly banded agates; ankerite; chlorastrolite, domeykite; jasper; laumontite; native copper; petoskey agates (fossilized coral); and prehnite. Many of these were collected on the Keweenaw Peninsula and along the beaches of Lake Superior.

Gypsum

Michigan ranked 3d of 21 States in crude gypsum production and 12th of 28 States in the output of calcined gypsum. Crude gypsum output increased about 7%, and calcined gypsum decreased about 4% in 1989 after posting virtually no changes the 2 previous years. Value of crude production was up about 34%, and calcined value decreased nearly 6%.

Lime

Michigan was 11th of 32 States in lime production. In 1989, quantity sold or used decreased about 13% and value decreased 10%. Five companies operated eight plants in six counties. Production included both hydrated and quicklime types. Wayne County led the State's production.

Magnesium Compounds

Michigan ranked first of six producing States in production of magnesium compounds. Compounds produced were caustic-calcined magnesia, magnesium carbonate, magnesium hydroxide, magnesium sulfate, and refractory magnesia.

Peat

Michigan maintained its position as the Nation's leading producer of peat in 1989. This was in spite of an 11% decrease in sales. Michigan accounted for 37% of the Nation's sales. Peat was harvested at 14 locations by 12 companies in 10 counties. Sanilac County was the State's leading producer. About 90% of the peat sold was used for soil improvement. Reed-sedge accounted for 69% of the harvested peat, followed by humus and sphagnum. Most of the State's peat was sold in packaged form; the remainder was sold in bulk.

Salt

Salt sales declined 2% in 1989 compared with 1988 figures.

Sand and Gravel

CONSTRUCTION

Construction sand and gravel production is surveyed by the Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. This chapter contains estimates for 1987 and 1989 and actual data for 1988.

Nationally, Michigan ranked second, behind California, in production of construction sand and gravel. The State was estimated to have decreased its 1989 production by about 10% compared with the 1988 figure.

INDUSTRIAL

Michigan was also the Nation's second leading producer of industrial sand, behind Illinois. Production and value decreased about 6% and 9%, respectively. Sand was mined by 8 companies in 12 counties from 16 pits. The leading counties in terms of value of production were Muskegon, Ottawa, Van Buren, Wayne, and Wexford.

Stone

Stone production is surveyed by the Bureau of Mines for odd-numbered years only; data for even-numbered years are based on annual company estimates. This chapter contains actual data for 1987 and 1989 and estimates for 1988.

CRUSHED

Crushed stone production increased about 5% in 1989. Demand for crushed stone used in iron ore pelletizing and steelmaking supported the gain. Value of production reached a record high of $123.7 million. This was an increase of nearly 3% over the 1988 estimated value, see Table 8.

Michigan's crushed stone statistics are compiled by geographical districts as depicted in the State map. Table 9 presents end-use statistics for Michigan's three districts.

DIMENSION

Dimension stone production was reported to have increased about 62%; however, value decreased 41%.

Other Industrial Minerals

Perlite from out-of-State sources was expanded. Perlite sales and value decreased about 1% and 10%, respectively. Processed iron and steel slag was sold mostly for road base material or asphalt and concrete aggregate. Sales decreased about 9%. Sulfur, recovered from two of the State's petroleum refineries, posted a sales decrease of 6%; however, value increased 3%. Exfoliated vermiculite was produced from out-of-State raw material sources. Shipments and value both decreased about 7%.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN. Assistance in the preparation of the chapter was given by Wanda J. West, editorial assistant.

[2] Regional geologist, Geological Survey Division, Michigan Department of Natural Resources, Marquette, MI.

TABLE 7

NONFUEL MINERAL PRODUCTION IN MICHIGAN [1]

Mineral		1987 Quantity	1987 Value (thousands)	1988 Quantity	1988 Value (thousands)	1989 Quantity	1989 Value (thousands)
Cement:							
Masonry	thousand short tons	263	$23,004	265	$22,915	255	$22,286
Portland	do.	4,755	207,332	5,253	231,141	5,449	253,324
Clays	metric tons	1,209,730	5,338	1,248,121	4,432	1,249,198	4,599
Gem stones		NA	25	NA	25	NA	10
Gypsum	thousand short tons	1,977	12,190	1,958	11,630	2,098	15,589
Iron ore	thousand metric tons	12,509	W	14,623	W	15,045	W
Lime	thousand short tons	569	30,320	714	36,088	621	32,479
Peat	do.	281	5,290	r322	6,256	286	6,082
Sand and gravel:							
Construction	do.	e42,800	e105,300	53,508	138,171	e48,000	e132,000
Industrial	do.	2,792	22,451	3,045	27,150	2,865	24,577
Stone (crushed)	do.	37,909	109,514	e38,800	e120,300	40,905	123,678
Combined value of bromine (1987-88), calcium chloride (natural), copper, gold, iron oxide pigments (crude), magnesium compounds, potassium salts (1989), salt, silver, stone (dimension), and values indicated by symbol W		XX	844,846	XX	989,453	XX	984,347
Total		XX	1,365,610	XX	1,587,561	XX	1,598,971

e Estimated. r Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

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

TABLE 8

MICHIGAN: CRUSHED STONE [1] SOLD OR USED BY PRODUCERS IN 1989, BY USE

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+ 1 1/2 inch):		
Riprap and jetty stone	186	1,057
Filter stone	2,134	7,621
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,956	11,941
Bituminous aggregate, coarse	918	2,450
Railroad ballast	194	659
Fine aggregate (- 3/8 inch):		
Stone sand, concrete	176	533
Stone sand, bituminous mix or seal	120	177
Screening, undesignated	286	1,032
Coarse and fine aggregates:		
Graded road base or subbase	2,977	8,806
Unpaved road surfacing	1,493	5,614
Crusher run or fill or waste	35	133
Other construction materials [2]	1,193	3,711
Agricultural: Agricultural limestone	237	1,192
Chemical and metallurgical:		
Cement manufacture	6,118	10,717
Flux stone	2,724	10,273
Other miscellaneous uses [3]	1,752	5,681
Unspecified: [4]		
Actual	15,992	49,555
Estimated	412	2,528
Total [5]	40,905	123,678

[1] Includes limestone, dolomite, marl, sandstone, quartzite, traprock, marble, and miscellaneous stone.
[2] Includes stone used in macadam, bituminous surface-treatment aggregate, and terrazzo and exposed aggregate.
[3] Includes stone used in poultry grit and mineral food, other agricultural uses, lime manufacture, and sulfur oxide removal.
[4] Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5] Data may not add to totals shown because of independent rounding.

TABLE 9

MICHIGAN: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1989,
BY USE AND DISTRICT

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:						
Coarse aggregate (+ 1 1/2 inch) [1]	73	315	3,042	10,305	352	1,650
Coarse aggregate, graded [2]	1,327	3,695	W	W	W	W
Fine aggregate (- 3/8 inch) [3]	218	668	125	343	238	730
Coarse and fine aggregates [4]	979	1,470	863	2,305	2,671	10,803
Other construction aggregates	---	---	3,016	7,940	767	3,509
Agricultural [5]	107	399	---	---	181	973
Chemical and metallurgical [6]	3,168	12,250	([7])	([7])	([7])	([7])
Other miscellaneous	---	---	6,158	9,987	1,218	4,252
Unspecified:						
Actual [8]	3,281	10,074	9,391	24,393	3,320	15,088
Estimated [9]	---	---	15	65	397	2,463
Total [10]	9,154	28,871	22,609	55,338	9,142	39,469

W Withheld to avoid disclosing company proprietary data; included with "Other construction aggregates."

[1] Includes macadam, riprap and jetty stone, and filter stone.

[2] Includes concrete aggregate (coarse), bituminous aggregate (coarse), and railroad ballast.

[3] Includes stone sand (concrete), stone sand (bituminous mix or seal), fine aggregate (screening-undesignated).

[4] Includes crushed stone for graded road base or subbase, unpaved road surfacing, terrazzo and exposed aggregates, and crusher run or fill or waste.

[5] Includes agricultural limestone, poultry grit and mineral food, and other agricultural uses.

[6] Includes crushed stone for cement manufacture, lime manufacture, flux stone, and sulfur oxide removal.

[7] Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."

[8] Includes production reported without a breakdown by end use.

[9] Includes estimates for nonrespondents.

[10] Data may not add to totals shown because of independent rounding.

MICHIGAN

INDUSTRIAL MINERAL INFORMATION AND REGULATION

compiled by

S. Paul Sundeen
Geological Survey Division, Michigan DNR

1. **Responsible Agency/Division:**

Industrial mineral activities in Michigan fall under the jurisdiction of a variety of state agencies as well as the jurisdiction of local government organizations through zoning regulations. For more information on the requirements of industrial mineral operations in Michigan, the following persons are suggested as initial contacts.

Dr. James Henderson
Permit Coordinator
Michigan Department of Natural Resources
Box 30028
Lansing, MI 48909
(517) 335-4235

(for information on the environmental permitting process)

Dr. Paul Sundeen
Geological Survey Division
Michigan Department of Natural Resources
Box 30256
Lansing, MI 48909
(517) 334-6930

(for general information on geology, exploration, and mining of industrial minerals)

Mr. Rodger Whitener
Geological Survey Division
Michigan Department of Natural Resources
Box 30256
Lansing, MI 48909
(517) 334-6976

(for information on mine permitting and reclamation requirements)

2. **State laws that regulate or may affect industrial mineral mining or quarrying operations:**

Some of these laws directly regulate mining, while others cover activities which may only be an ancillary part of mining or quarrying operations. As a result, the detailed permitting steps and procedures required to operate a quarry or pit will vary and will depend on the commodity, size, location and nature of the operation. To open an industrial mineral operation, it is necessary to deal with a number of state agencies, primarily divisions of the Department of Natural Resources.

Regulations dealing with the closing and/or reclamation of mines or quarries are also not uniform. As with start-up regulations, they vary depending on the commodity, size, location, and nature of the operations.

Industrial mineral operations are subject to county or local zoning regulations in most parts of the state, and it is important to check with the appropriate local government agencies in planning any potential operations.

The following state laws, and associated regulations, apply in whole or in part to industrial mineral operations in Michigan. The state agency responsible for administering each of the laws is shown in parentheses after the number and name of the law; all are divisions of the Michigan Department of Natural Resources (DNR).

(1) Act 92 PA 1970, Act 124 PA 1972 - Mine Reclamation Act and Rules (Geological Survey Division, DNR)

(2) Act 315 PA 1969, as amended - Mineral Well Act (Geological Survey Division, DNR)

(3) Act 222 PA 1976 - Sand Dune Protection and Management Act (Geological Survey Division, DNR)

(4) Act 346 PA 1972 - Inland Lakes and Stream Act (Land and Water Management Division, DNR)

(5) Act 245 PA 1970 - Shorelands Protection and Management Act (Land and Water Management Division, DNR)

(6) Act 203 PA 1979 - Goemaere-Anderson Wetland Protection Act (Land and Water Management Division, DNR)

(7) Act 247 PA 1955 - Great Lakes Submerged Lands Act (Land and Water Management Division, DNR)

(8) Act 231 PA 1970 - Natural Rivers Act (Land and Water Management Division, DNR)

(9) Act 300 PA 1989 - Dam Safety Act (Land and Water Management Division, DNR)

(10) National Pollutant Discharge Elimination System (NPDES) permit, EPA (Surface Water Quality Division, DNR)

(11) Act 348 PA 1965 - Air Pollution Act (Air Quality Division, DNR)

(12) Act 245 PA 1929 - Michigan Water Resources Commission Act (Waste Management Division, DNR) and (Land and Water Management Division, DNR)

(13) Act 17 PA 1921 - Special Use Permit (for nonmetallic minerals on state lands) (Forest Management Division, DNR)

(14) Act 280 PA 1909, as amended and Act 17 PA 1921 - Authority for State of Michigan Nonmetallic Mineral Lease (Real Estate Division, DNR)

For information on the above state laws and on the rules and regulations which apply to them, the responsible administering divisions of the Department of Natural Resources should be contacted.

MICHIGAN

INDUSTRIAL MINERAL REFERENCE LIST

List of Publications:

Maps and Publications
Geological Survey Division
Michigan Department of Natural Resources
Box 30256
Lansing, MI 48909
(517) 334-6907
FAX (517) 334-6038

Colleges and Universities in Michigan may also be able to provide information on industrial minerals.

Production Reports:

U.S. Department of the Interior
Bureau of Mines
5629 Minnehaha Avenue South
Minneapolis, MN 55417

Other state organizations or information sources:

County Road Association of Michigan
417 Seymour Street
PO Box 12067
Lansing, MI 48901
(517) 482-1189
(organization of state county road commissions)

Michigan Mineral Resources Association
(George Gallup, President)
1781 Boynton
Lansing, MI 48917
(517) 321-0515
(organization of industrial mineral operators)

County Soil Surveys
U.S.D.A. Soil Conservation Service
1405 S. Harrison Road
East Lansing, MI 48823
(517) 337-6701

(to obtain county soil survey maps and reports)

Planning and Zoning Center, Inc.
302 S. Waverly Road
Lansing, MI 48917
(local and regional zoning education organization)

State Laws:

Applicable state laws and regulations can be obtained from the individual state agencies that have administrative responsibility for each of these laws. Refer to the list of laws above.

THE MINERAL INDUSTRY OF MINNESOTA, 1989

This fact sheet has been adapted from a chapter in the Bureau of Mines *Minerals Yearbook Report, 1989*. The Minerals Yearbook chapter was prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Mineral Resources Research Center, University of Minnesota, for collecting information on all nonfuel minerals.

By Leon E. Esparza [1]

Minnesota's nonfuel mineral production in 1989 was valued at more than $1.4 billion, an increase of about $170 million over that of 1988, see Table 10. The 13% increase in value paralleled a 13% rise in the value of iron ore shipments, which accounted for 89% of the State's nonfuel mineral production value. Significant increases also were reported in the value of lime, construction and industrial sand and gravel, and crushed and dimension stone production. Minnesota ranked seventh nationally in nonfuel mineral production value and accounted for 4% of the U.S. total. The State supplied 70% of the Nation's usable iron ore shipments. Minerals used in construction accounted for 11% of the State's nonfuel mineral production value.

REVIEW BY NONFUEL MINERAL COMMODITIES

Industrial Minerals

About 11% of Minnesota's total nonfuel mineral value was attributed to the production of eight industrial minerals, see Figure 4. Six of these were used largely in building or road construction. Peat was used mostly in horticultural products, and semiprecious gem stones were collected mainly by hobbyists. In 1989, the value of industrial minerals produced in the State increased about 14% to about $152 million, compared with $133 million in 1988.

Clays

In 1989, clay production decreased about 3%, but value increased about 3%.

Lime

Lime production dropped about 4%, reversing the recorded high posted in 1988. The value of production, however, increased nearly 20%. All production was used in processing sugar beets. Quicklime and hydrated lime were produced from limestone shipped from out-of-State sources. Lime consumed within the State from all domestic sources was about 301,000 short tons, a drop of 7% from the 324,000 short tons reported in 1988.

Peat

Minnesota ranked seventh of 21 peat-producing States in 1989. Quantity of peat produced was down 7%, the second consecutive year of decline. Value of production, however, remained virtually unchanged at about 1.4 million. Peat was produced in six counties by seven producers. All of the production was used in horticultural activities. Leading end uses, in declining order of

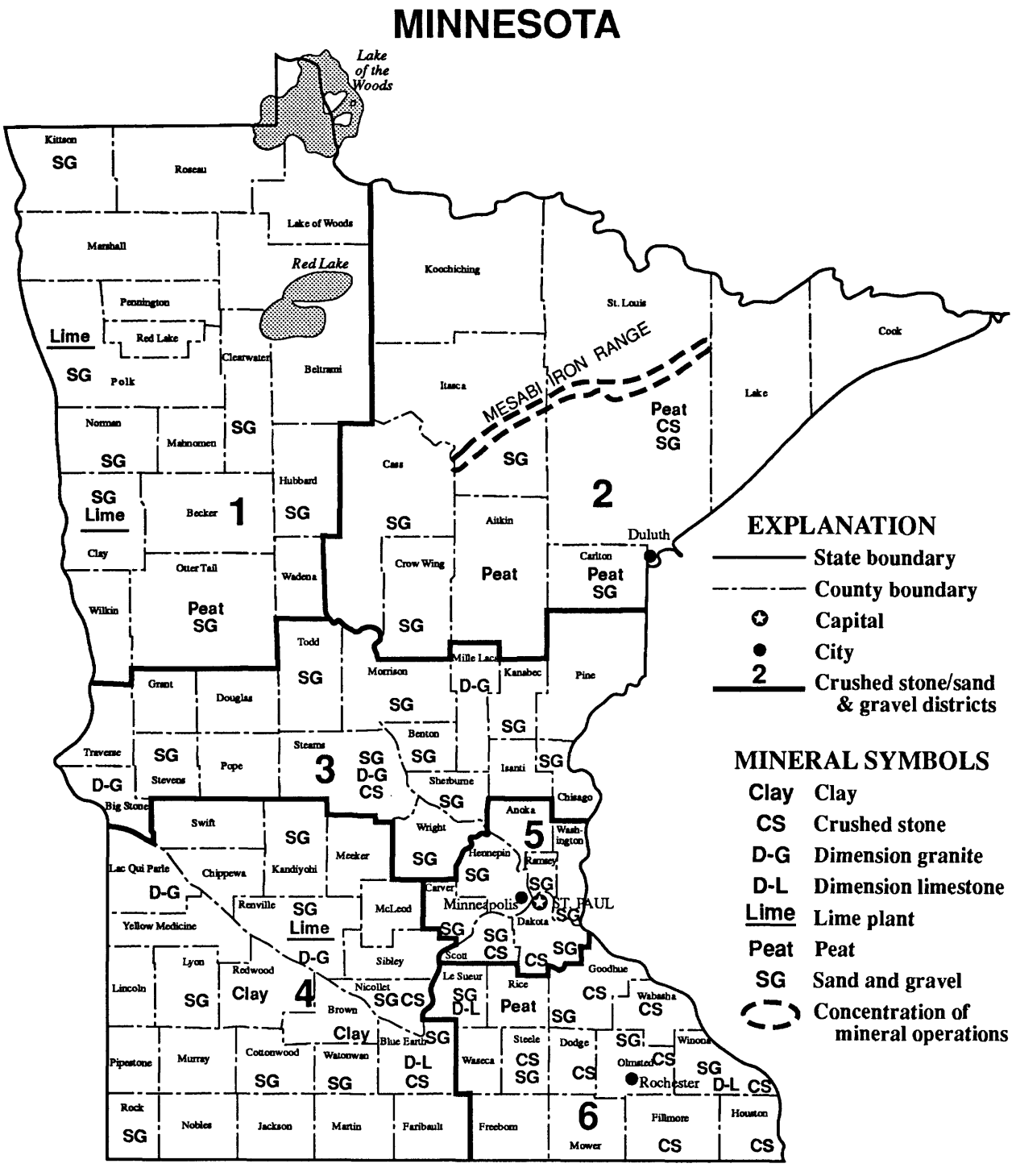

Figure 4. Principal Mineral-Producing Localities in Minnesota in 1989.

output, were general soil improvement, potting soil ingredient, and nursery. About 58% of the sales were in packaged form. Varieties and relative percent of total production were sphagnum, 61%; reed-sedge, 25%; and hypnum, 14%.

Sand and Gravel

CONSTRUCTION

Construction sand and gravel production is surveyed by the Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. This chapter contains estimates for 1987 and 1989 and actual data for 1988.

Minnesota ranked seventh of all States in construction sand and gravel production. Following iron ore, this was the second leading mineral commodity produced in the State in terms of value. Although quantity produced in 1989 was estimated to have remained at the 1988 level, value was estimated to have increased 14%.

INDUSTRIAL

Industrial sand production and value increased 22% and 25%, respectively. Industrial sand was mined from the Jordan Sandstone of Upper Cambrian age in three counties. The greatest amount was used in hydraulic fracturing, followed by glass container manufacturing, sand blasting, and foundry molding and core.

Stone

Stone production is surveyed by the Bureau of Mines for odd-numbered years only; data for even-numbered years are based on annual company estimates. This chapter contains actual data for 1987 and 1989, and estimated for 1988.

CRUSHED

Production and value increased 6% and 7%, respectively, see Table 11. Minnesota crushed stone statistics are compiled by geographical districts as depicted in the State map, see Figure 4. Table 12 presents end-use statistics for Minnesota's six districts.

DIMENSION

The quantity of dimension stone produced in 1989 was relatively unchanged from the 1988 estimate. Value, however, increased 23%. Five producers operated 11 quarries. Granite and limestone were quarried. Quarried rock most frequently was used as cut veneer stone, followed by sawed blocks, dressed monumental stone, and rough blocks. Cut veneer stone, with a unit value of $291 per short ton, accounted for 63% of the total stone value. Sawed blocks provided 30% of the total stone value and had a unit value of $832 per short ton. The sawed stone block unit value was the highest of all stone types produced in Minnesota and irregular-shaped stone was the lowest at

$87 per short ton.

Other Industrial Minerals

Gem stones and mineral specimens were estimated to have contributed $42 thousand to the total State nonfuel mineral value, an increase of 5% over that of 1988. Perlite from out-of-State sources was expanded. Sulfur was recovered by two petroleum refineries, one each in Dakota and Washington Counties. Quantity sold or used and value of sulfur increased 2% and 7%, respectively.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN. Assistance in the preparation of the chapter was given by Wanda J. West, editorial assistant.

TABLE 10

NONFUEL MINERAL PRODUCTION IN MINNESOTA [1]

Mineral	1987 Quantity	1987 Value (thousands)	1988 Quantity	1988 Value (thousands)	1989 Quantity	1989 Value (thousands)
Gem stones:	NA	$40	NA	$40	NA	$42
Iron ore thousand metric tons	34,274	1,012,788	40,735	1,134,539	41,044	1,285,807
Peat thousand short tons	30	W	29	r1,414	27	1,415
Sand and gravel (construction) do.	e25,200	e67,400	33,769	72,678	e33,700	e82,600
Stone						
Crushed do.	8,995	29,246	e8,300	e28,200	8,760	30,218
Dimension short tons	41,354	12,967	e45,000	e13,000	44,605	16,031
Combined value of clays, (common, kaolin), lime, sand and gravel (industrial) and value indicated by symbol W	XX	20,308	XX	18,015	XX	22,022
Total	XX	1,142,749	XX	1,267,886	XX	1,438,135

e Estimated. r Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

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

TABLE 11

MINNESOTA: CRUSHED STONE [1] SOLD OR USED BY PRODUCERS IN 1989, BY USE

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+ 1 1/2 inch):		
Riprap and jetty stone	71	361
Filter stone	154	521
Coarse aggregate, graded:		
Concrete aggregate, coarse	467	1,897
Bituminous aggregate, coarse	159	470
Fine aggregate (- 3/8 inch):		
Stone sand, bituminous mix or seal	281	923
Screening, undesignated	100	497
Coarse and fine aggregates:		
Graded road base or subbase	2,244	7,238
Unpaved road surfacing	430	1,288
Other construction materials [2]	1,202	5,268
Agricultural: Agricultural limestone	221	780
Other miscellaneous uses [3]	237	1,358
Unspecified: [4]		
Actual	2,490	8,197
Estimated	704	1,420
Total	8,760	30,218

[1] Includes limestone, dolomite, granite, traprock, and miscellaneous stone.
[2] Includes stone used in macadam, other coarse aggregate, bituminous surface-treatment aggregate, railroad ballast, terrazzo and exposed aggregate, and crusher run or fill or waste.
[3] Includes stone used in cement manufacture and other fillers or extenders.
[4] Includes production reported without a breakdown by end use and estimates for nonrespondents.

TABLE 12

MINNESOTA: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1989,
BY USE AND DISTRICT

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:						
Coarse aggregate (+ 1 1/2 inch) [1]	---	---	W	W	W	W
Coarse aggregate, graded [2]	---	---	W	W	W	W
Fine aggregate (- 3/8 inch) [3]	---	---	W	W	W	W
Coarse and fine aggregates [4]	---	---	W	W	W	W
Other construction aggregates	---	---	---	---	W	W
Agricultural [5]	---	---	---	---	---	---
Chemical and metallurgical [6]	---	---	---	---	---	---
Special [7]	---	---	---	---	---	---
Other miscellaneous	---	---	---	---	---	---
Unspecified:						
Actual [8]	---	---	---	---	---	---
Estimated [9]	---	---	---	---	W	W
Total [10]	---	---	W	W	W	W

Continued on next page

Table 12 -- continued.

Use	District 4		District 5		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:						
Coarse aggregate (+ 1 1/2 inch) [1]	W	W	231	927	6	18
Coarse aggregate, graded [2]	W	W	354	1,188	78	([11])
Fine aggregate (- 3/8 inch) [3]	W	W	127	566	---	---
Coarse and fine aggregates [4]	W	W	2,049	6,767	316	882
Other construction aggregates	---	---	86	447	207	749
Agricultural [5]	W	W	89	244	107	436
Chemical and metallurgical [6]	---	---	---	---	([12])	([12])
Special [7]	---	---	([12])	([12])	---	---
Other miscellaneous	---	---	157	998	80	360
Unspecified:						
Actual [8]	---	---	1,395	4,393	1,095	3,804
Estimated [9]	---	---	12	45	320	817
Total [10]	W	W	4,501	15,576	2,208	7,066

W Withheld to avoid disclosing company proprietary data.

[1] Includes macadam, riprap and jetty stone, filter stone, and other coarse aggregates.

[2] Includes concrete aggregate (coarse), bituminous aggregate (coarse), bituminous surface-treatment aggregate, and railroad ballast.

[3] Includes stone sand (bituminous mix or seal) and fine aggregate (screening-undesignated).

[4] Includes crushed stone for graded road base or subbase, unpaved road surfacing, terrazzo and exposed aggregates, and crusher run or fill or waste.

[5] Includes agricultural limestone.

[6] Includes crushed stone for cement manufacture.

[7] Includes crushed stone for other fillers or extenders.

[8] Includes production reported without a breakdown by end use.

[9] Includes estimates for nonrespondents.

[10] Data may not add to totals shown because of independent rounding.

[11] Withheld to avoid disclosing company proprietary data; included with "Other construction aggregates."

[12] Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."

MINNESOTA

INDUSTRIAL MINERAL INFORMATION AND REGULATION

compiled by

Minnesota Department of Natural Resources
Division of Minerals

1. **Responsible Agency/Division/Department:**

   Local units of government are the primary regulatory authority for industrial minerals mining in Minnesota. The Department of Natural Resources and the Pollution Control Agency may also require permits if water will be appropriated or discharged from the mining area.

2. **Objective of Industrial Minerals Program:**

   The Minerals Division in the DNR has an industrial mineral program that seeks to assist responsible expansion of the industry into new markets and new regions of the state.

3. **Legal steps necessary for opening an industrial mining or quarry operation:**

   Environmental review in the form of an Environmental Assessment Worksheet is required for an industrial minerals mine that will excavate 40 acres to a near depth of 10 feet. An Environmental Impact Statement is mandatory for operations greater than 160 acres. The need for state and local permits depend on the size and scope of the proposed operation.

4. **Legal steps necessary to close an industrial mineral quarry or mining operation:**

   Closure of an industrial minerals mining facility is governed by local land use regulations. Reclamation is most often a special term in a local conditional land use permit.

5. **Local and County laws:**

   The most extensive review of industrial minerals operations currently takes place at the local level of government. Minnesota has 37 counties, 1,802 townships, and 855 cities. Each county, township, and city has the authority to regulate industrial minerals through zoning ordinances and land use planning.

6. **Responsible Non-Regulatory Agency:**

   Since 1987, the DNR, the Department of Transportation, local government, and the aggregate industry have been working on issues relating to gravel pit reclamation. The need to reclaim gravel pits and the demand for technical information on the subject has been the motivation for a handbook recently completed by the DNR entitled "A Handbook for Reclaiming Sand and Gravel Pits in Minnesota". The handbook will provide technical information on gravel pit reclamation to landowners, government regulators, and industry.

7. **Sources of Information:**

A good place to start is:

Buttleman, C.G., 1992, A handbook for reclaiming sand and gravel pits in Minnesota: Minnesota Department of Natural Resources, Division of Minerals, 100 p.

MINNESOTA

INDUSTRIAL MINERAL REFERENCE LIST

List of Publications:

Minnesota Geological Survey
2642 University Avenue
St. Paul, MN 55114-1057
(612) 627-4782

Colleges and Universities in Minnesota may also be able to provide information on industrial minerals.

Other Pertinent State Organizations:

Natural Resource Research Institute
University of Minnesota, Duluth
5013 Miller Trunk Highway
Duluth, MN 55811

Minnesota Department of Natural Resources
Division of Minerals
500 Lafayette Road
St. Paul, MN 55155

Minnesota Department of Health
Division of Environmental Health
925 Southeast Delaware Street
PO Box 59040
Minneapolis, MN 55459-0040

State Mineral Industry Directory:

DNR Division of Minerals (see address above)

Production Reports:

U.S. Department of the Interior
Bureau of Mines
5629 Minnehaha Avenue South
Minneapolis, MN 55417

State Laws:

DNR Division of Minerals (see address above)

Minnesota Department of Health (see address above)

THE MINERAL INDUSTRY OF NORTH DAKOTA, 1989

This fact sheet has been adapted from a chapter in the Bureau of Mines *Minerals Yearbook Report, 1989*. The Minerals Yearbook chapter was prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the North Dakota Geological Survey for collecting information on all nonfuel minerals.

By Leon E. Esparza [1]

The value of North Dakota's nonfuel mineral production was about $13.7 million in 1989, a decrease of more than 27% from that of 1988, see Table 13. The decreased value was attributed mainly to a 23% drop in the value of lime production and the 1988 termination of salt solution mining operations. The State ranked 48th nationally in nonfuel mineral production, accounting for less than 1% of the U.S. total. Construction sand and gravel contributed the greatest amount to the State's nonfuel mineral value, accounting for 59% of the total, see Figure 5. Other commodities produced, in order of decreasing value, included lime, clays, peat, and gem stones. Elemental sulfur was recovered from natural gas processing. Most of North Dakota's nonfuel mineral production was used in construction.

REVIEW BY NONFUEL MINERAL COMMODITIES

Industrial Minerals

Sand and Gravel

Construction sand and gravel production is surveyed by the Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. This chapter contains estimates for 1987 and 1989 and actual data for 1988. Production in 1989 was estimated to be down about 5%, with the total value unchanged from levels reported in 1988.

Other Industrial Minerals

Clay production and value declined about 38% from levels reported in 1988.

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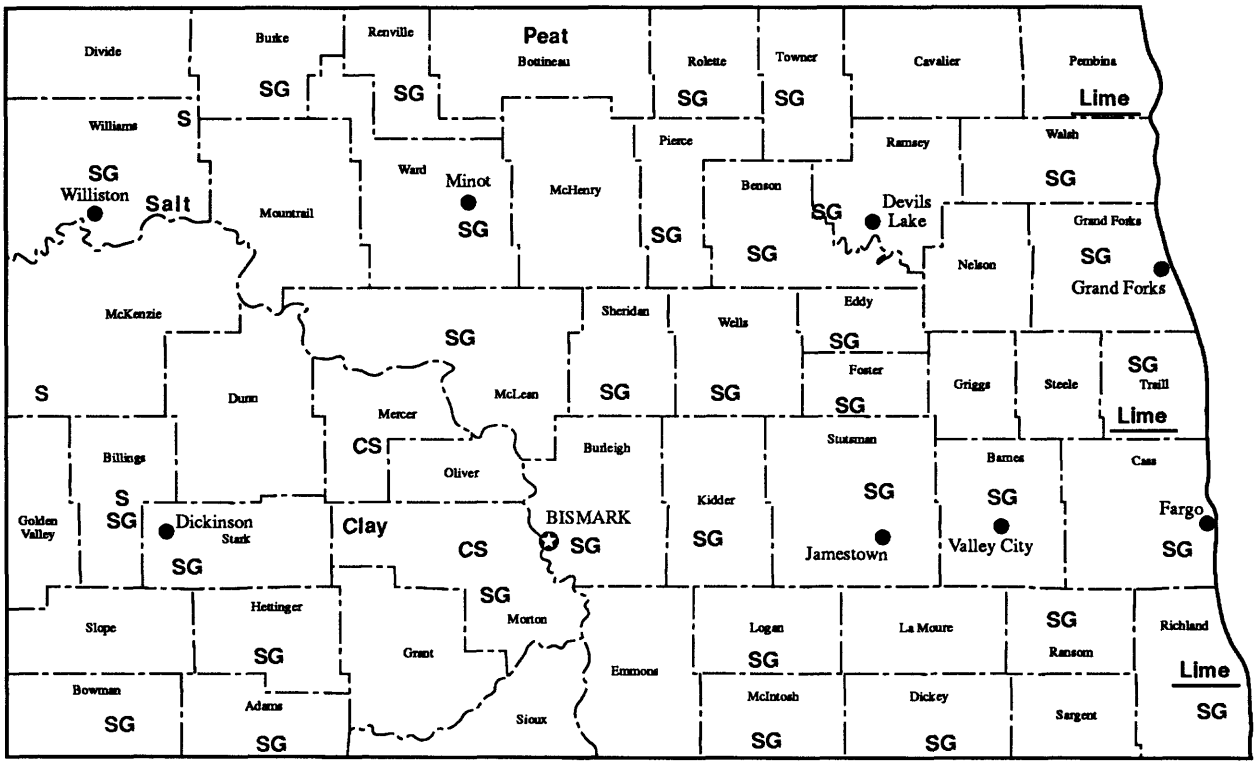
[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN. Assistance in the preparation of the chapter was given by Wanda J. West, editorial assistant.

NORTH DAKOTA



EXPLANATION

- State boundary
- County boundary
- Capital
- City

MINERAL SYMBOLS

Clay	Clay
CS	Crushed stone
Lime	Lime plant
Peat	Peat
SG	Sulfur
Salt	Salt
SG	Sand and gravel

Figure 5. Principal Mineral-Producing Localities in North Dakota in 1989.

TABLE 13

NONFUEL MINERAL PRODUCTION IN NORTH DAKOTA [1]

Mineral	1987 Quantity	1987 Value (thousands)	1988 Quantity	1988 Value (thousands)	1989 Quantity	1989 Value (thousands)
Clays metric tons	45,451	$100	76,918	$147	47,903	W
Gem stones	NA	2	NA	2	NA	$10
Lime thousand short tons	127	11,912	108	7,094	107	5,439
Sand and gravel (construction) do.	e4,900	e10,200	3,772	8,079	e3,600	e8,100
Combined value of peat, salt (1987-88), sand and gravel (industrial, 1987), stone (crushed miscellaneous, 1987-88) and value indicated by symbol W	XX	4,097	XX	3,485	XX	111
Total	XX	26,311	XX	18,807	XX	13,660

e Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Combined value" figure. XX Not applicable.

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

NORTH DAKOTA

INDUSTRIAL MINERAL INFORMATION AND REGULATION

compiled by

Robert F. Biek
North Dakota Geological Survey

1. **Responsible Agency/Division:**

   North Dakota Geological Survey
   600 E. Boulevard Ave.
   Bismarck, ND 58505-0840
   (Tel. 701-224-4109)

   Contact: John P. Bluemle, State Geologist

   North Dakota Soil Conservation Committee
   608 E. Boulevard Ave., 18th Floor
   Bismarck, ND 58505
   (Tel. 701-224-2650)

   Contact: Blake Vander Vorst, Executive Secretary

2. **Objectives of Industrial Minerals Program:**

   To encourage industrial mineral production in an environmentally responsible manner, and to evaluate and report on industrial mineral resources in the state.

3. **Legal steps necessary for opening an industrial mineral mining operation:**

   The following compilation lists common permits and procedures necessary to conduct an industrial mineral mining operation. Operators are responsible for determining if other permits or procedures are required.

   a. Special Use Permit. Industrial mineral mining operations are normally regulated at the local level by County Commissions or, in some cases, Township Boards. Most rural land in North Dakota is zoned for agricultural use wherein industrial mineral mining operations are generally a conditionally permitted use. Rural areas in some counties are not zoned; there, no county or township permit is required.

   b. Surface Mining Reports. N.D.C.C. Chapter 38-16 "Surface Mining Reports" regulates industrial mineral surface mining operations that remove more than 10,000 cu. yds. of material or affect one-half acre or more. The Surface Mining Reports law is administered by the North Dakota Soil Conservation Committee. The law requires annual production and reclamation reports to be submitted to the NDSCC, and a written reclamation agreement with the landowner. No permit or bond is required under N.D.C.C. Chapter 38-16, and no mine site inspections are performed.

c. Subsurface or Solution Mining. Regulated pursuant to N.D.C.C. Chapter 38-12 "Regulation, Development, and Production of Subsurface Minerals" and N.D.A.C. Chapter 43-02-02 "Subsurface Mineral Exploration and Development." Requires a permit from the North Dakota Geological Survey prior to commencement of operations for the exploration, evaluation, or production of non-coal subsurface minerals; a bond is also required. An approved mining plan is required prior to mining or production.

d. Wetlands Permit. A permit to conduct a regulated activity in or that may affect a wetland or watercourse is required from the North Dakota Water Commission and/or the U.S. Army Corps of Engineers. For further information, contact:

Dale Frink, Director
North Dakota Water Commission
Water Development Division
900 E. Boulevard Avenue
Bismarck, ND 58505-0187
(Tel. 701-224-2752)

US Army Corp of Engineers
ND Regulatory Field Office
2000 University Dr.
Bismarck, ND 58504
(Tel. 701-255-0015)

e. NPDES Permit. A National Pollutant Discharge Elimination System permit is required for any water discharged to waters of the United States. For further information, contact:

ND Dept. of Health and Consolidated Laboratories
1200 Missouri Ave.
Bismarck, ND 58502-5520
(Tel. 701-221-5150)

4. **Legal steps necessary to close an industrial mineral mining operation.**

The following is a list of concerns common to the closing of an industrial mineral mining operation. Operators are responsible for determining if other permits or procedures are required.

a. Surface mining operations: Closure is governed by reclamation agreement between the landowner and operator. Such an agreement is required only for sand and gravel operations under N.D.C.C. 38-16.

b. Subsurface or solution mining operations: Closure or abandonment of wells and earthen pits is governed by N.D.A.C. 43-02-02 "Subsurface Mineral Exploration and Development," administered by the North Dakota Geological Survey. A notice of intention to abandon any well must be filed with the State Geologist, and standards for plugging are given.

NORTH DAKOTA

INDUSTRIAL MINERAL REFERENCE LIST

List of Publications:

North Dakota Geological Survey
1022 E. Divide Avenue
mailing address
600 E. Boulevard Avenue
Bismarck, ND 58505-0840
Tel. (701) 224-4109

Mining and Mineral Resources Research Institute
University of North Dakota
P.O. Box 8103, University Station
Grand Forks, ND 58202
Tel. (701) 777-5125

Production Reports:

North Dakota Soil Conservation Committee
608 E. Boulevard Avenue, 10th and 18th Floors
Bismarck, ND 58505-0790
Tel. (701) 224-2650

State Mineral Industry Directory:

North Dakota Soil Conservation Committee

Other Pertinent State Organizations:

North Dakota Water Commission
Water Development Division
900 E. Boulevard Ave.
Bismarck, ND 58505-0187
(Tel. 224-2752)

North Dakota Dept. of Health and Consolidated Laboratories
1200 Missouri Ave.
Bismarck, ND 58502-5520
(Tel. 701-221-5150)

THE MINERAL INDUSTRY OF OHIO, 1989

This fact sheet has been adapted from a chapter in the Bureau of Mines *Mineral Yearbook Report, 1989.*

By L. J. Prosser, Jr. [1]

The value of nonfuel mineral production in Ohio dropped to about $700 million in 1989. However, the production of most mineral commodities remained about the same as in 1988, see Table 14. A significant decrease in the price reported for crushed stone accounted for most of the decline in value. Ohio ranked 15th nationally in the value of nonfuel mineral production, accounting for about 2.2% of the U.S. total. Metals manufacturing remained significant to the State's economy, and Ohio ranked among the top States in production of aluminum and steel.

Demand for mineral aggregates by the construction industry remained strong. Ohio produced more than 90 million short tons of aggregates for only the second time in the past 10 years, see Figure 6.

REVIEW BY NONFUEL MINERAL COMMODITIES

Industrial Minerals

Lime

Production declined by 9%, and Ohio dropped from first to second in lime output in the United States. The major consumer of lime manufactured in Ohio, the steel industry, also reported a decline in production in 1989. Lime sold or used in steelmaking in Ohio was down 13% for the year compared with that of 1988.

Salt

Ohio ranked fourth in the Nation in salt production.

Sand and Gravel

Construction sand and gravel production is surveyed by the Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. Table 1 contains estimates for 1987 and 1989 and actual data for 1988.

In 1989, Ohio ranked third nationally in output of construction sand and gravel, producing an estimated 44.4 million short tons. During the decade of the 1980's, Ohio produced about 350 million tons of sand and gravel valued at about $1.2 billion.

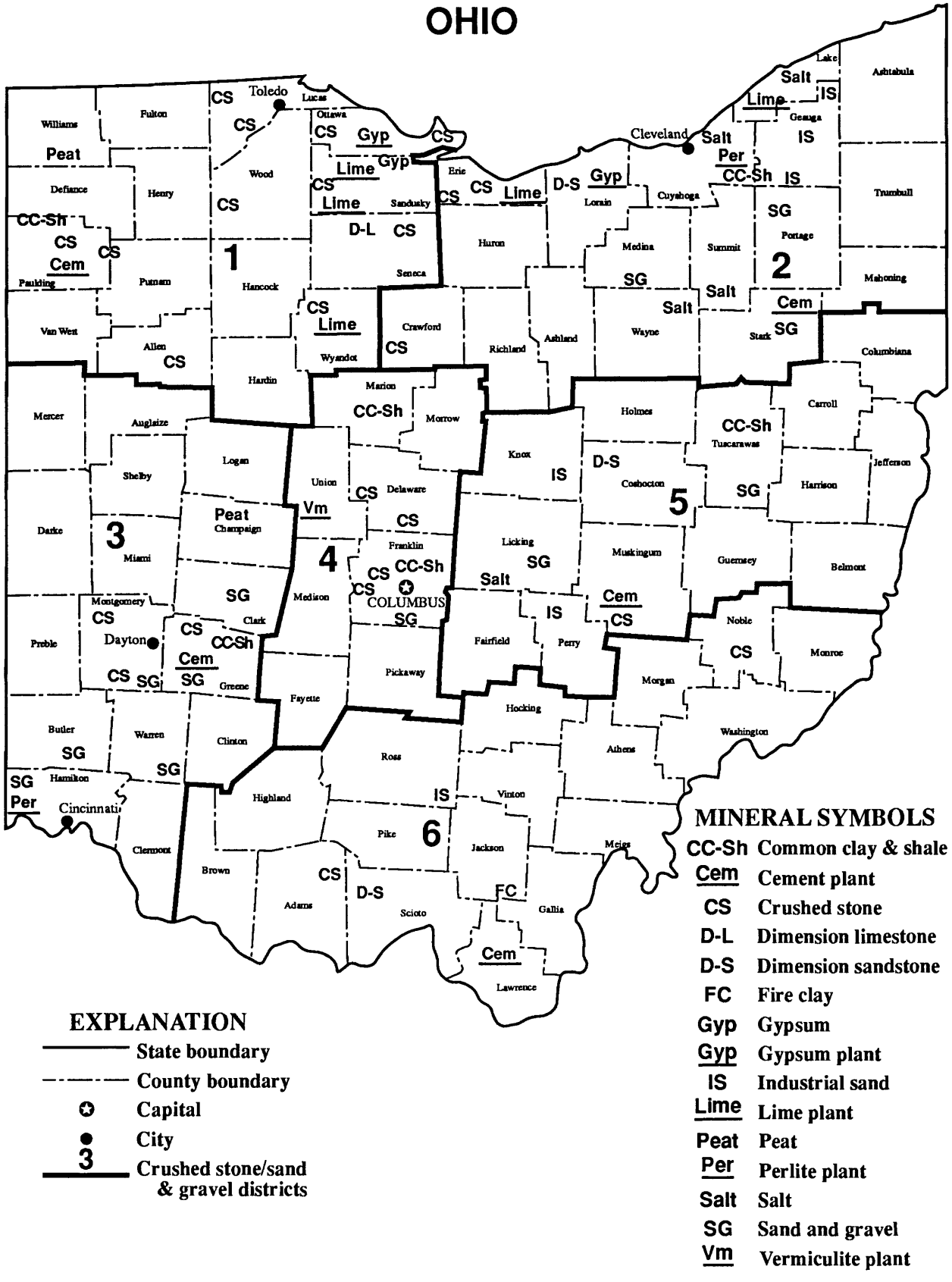


Figure 6. Principal Mineral-Producing Localities in Ohio in 1989.

Stone

Stone production is surveyed by the Bureau of Mines for odd-numbered years only; data for even-numbered years are based on annual company estimates. This chapter contains actual data for 1987 and 1989 and estimates for 1988.

For the fifth year in a row, crushed stone was the leading mineral commodity produced in Ohio, see Table 15. In the 1980's, the State's crushed stone industry produced 405 million short tons of stone valued at $1.6 billion. From 1987 to 1989, about 146 million tons of stone was mined in Ohio, the highest 3-year total in State history.

Ohio stone statistics are compiled by geographical districts as depicted in the State map. Table 16 presents end-use statistics for Ohio's six districts.

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[1] State Mineral Officer, Bureau of Mines, Pittsburgh, PA. He has covered the mineral activities in Ohio for 5 years. Assistance in the preparation of the chapter was given by Sally J. Stephenson, editorial assistant.

TABLE 14

NONFUEL MINERAL PRODUCTION IN OHIO [1]

Mineral		1987 Quantity	1987 Value (thousands)	1988 Quantity	1988 Value (thousands)	1989 Quantity	1989 Value (thousands)
Cement:							
Masonry	thousand short tons	139	$11,964	129	$11,140	128	$11,233
Portland	do.	1,748	83,661	1,424	70,816	1,446	73,230
Clays	metric tons	2,891,446	12,714	3,365,164	14,423	3,519,668	14,983
Gem stones		NA	10	NA	10	NA	18
Lime	thousand short tons	1,926	93,108	2,065	87,431	1,888	94,157
Peat	do.	W	W	W	W	8	182
Salt	do.	3,276	104,099	3,795	115,860	W	W
Sand and gravel:							
Construction	do.	e36,400	e136,900	46,104	156,318	e44,400	e148,700
Industrial	do.	1,249	21,292	1,361	23,441	1,394	24,662
Stone:							
Crushed	do.	51,590	300,096	e48,000	e252,000	46,426	183,190
Dimension	short tons	47,816	2,427	e38,300	e3,137	59,923	3,455
Combined value of other industrial minerals		XX	2,510	XX	2,676	XX	145,346
Total		XX	768,781	XX	737,252	XX	699,156

e Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Combined value." XX Not applicable.

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

TABLE 15

OHIO: CRUSHED STONE [1] SOLD OR USED BY PRODUCERS IN 1989, BY USE

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+ 1 1/2 inch):		
Macadam	1,086	3,694
Riprap and jetty stone	707	3,310
Filter stone	122	522
Coarse aggregate, graded:		
Concrete aggregate, coarse	3,046	11,327
Bituminous aggregate, coarse	1,724	6,619
Bituminous surface-treatment aggregate	697	4,017
Railroad ballast	1,188	3,435
Fine aggregate (- 3/8 inch):		
Stone sand, concrete	248	955
Stone sand, bituminous mix or seal	340	1,209
Screening, undesignated	432	1,022
Coarse and fine aggregates:		
Graded road base or subbase	5,018	28,722
Unpaved road surfacing	4,694	18,899
Crusher run or fill or waste	1,638	5,708
Other construction materials [2]	133	611
Agricultural: Agricultural limestone	874	3,820
Chemical and metallurgical		
Cement manufacture	1,453	3,694
Flux stone	205	816
Other miscellaneous uses [3]	920	4,102
Unspecified: [4]		
Actual	19,834	72,887
Estimated	2,067	7,821
Total	46,426	183,190

[1] Includes limestone, dolomite, sandstone, and quartzite.
[2] Includes stone used in coarse aggregates.
[3] Includes stone used in other agricultural uses, lime manufacture, dead-burned dolomite, asphalt or other fillers or extenders, and whiting or whiting substitute.
[4] Includes production reported without a breakdown by end use and estimates for nonrespondents.

TABLE 16

OHIO: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1989,
BY USE AND DISTRICT

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:						
Coarse aggregate (+ 1 1/2 inch) [1]	1,130	3,912	400	1,233	169	731
Coarse aggregate, graded [2]	2,462	9,120	2,418	9,313	1,049	3,502
Fine aggregate (- 3/8 inch) [3]	291	1,022	316	938	151	542
Coarse and fine aggregates [4]	4,910	18,068	1,959	8,000	1,465	5,498
Other construction aggregates	12	20	---	---	50	198
Agricultural [5]	481	1,701	(6)	(6)	90	784
Chemical and metallurgical [7]	(6)	(6)	---	---	(6)	(6)
Special [8]	(6)	(6)	---	---	(6)	(6)
Other miscellaneous	1,720	4,956	104	388	821	3,478
Unspecified:						
Actual [9]	5,286	19,375	2,587	9,997	2,535	8,749
Estimated [10]	764	3,031	90	211	701	2,514
Total [11]	17,058	61,204	7,875	30,080	7,032	25,997

Continued on next page

Table 16 -- continued.

Use	District 4		District 5		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:						
Coarse aggregate (+ 1 1/2 inch) [1]	41	180	94	517	98	1,033
Coarse aggregate, graded [2]	269	1,175	W	W	W	W
Fine aggregate (- 3/8 inch) [3]	44	123	W	W	W	W
Coarse and fine aggregates [4]	839	3,003	938	4,599	1,240	14,160
Other construction aggregates	10	40	629	2,774	87	347
Agricultural [5]	109	541	([6])	([6])	88	400
Chemical and metallurgical [7]	---	---	---	---	17	63
Special [8]	---	---	---	---	---	---
Other miscellaneous	---	---	22	121	---	---
Unspecified:						
Actual [9]	8,098	29,491	758	2,716	569	2,558
Estimated [10]	---	---	117	426	395	1,640
Total [11]	9,409	34,553	2,558	11,154	2,494	20,202

W Withheld to avoid disclosing company proprietary data; included with "Other construction aggregates."

[1] Includes macadam, riprap and jetty stone, filter stone, and other coarse aggregates.

[2] Includes concrete aggregate (coarse), bituminous aggregate (coarse), bituminous surface-treatment aggregate, and railroad ballast.

[3] Includes stone sand (concrete), stone sand (bituminous mix or seal), and fine aggregate (screening-undesignated).

[4] Includes crushed stone for graded road base or subbase, unpaved road surfacing, and crusher run or fill or waste.

[5] Includes agricultural limestone and other agricultural uses.

[6] Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."

[7] Includes crushed stone for cement manufacture, lime manufacture, dead-burned dolomite, and flux stone.

[8] Includes crushed stone for asphalt fillers or extenders, whiting or whiting substitutes, and other fillers or extenders.

[9] Includes production reported without a breakdown by end use.

[10] Includes estimates for nonrespondents.

[11] Data may not add to totals shown because of independent rounding.

OHIO

INDUSTRIAL MINERAL INFORMATION AND REGULATION

Compiled by

David A. Stith
Ohio Division of Geological Survey

and

Pat Fagan
Ohio Division of Reclamation

1. **Responsible Agency/Division:**

Ohio Department of Natural Resources
Division of Reclamation
Industrial Minerals
1855 Fountain Square Court
Columbus, OH 43224-1362
(Tel. 614-265-6624)

Ohio Department of Natural Resources
Division of Geological Survey
Mineral Resources and Geochemistry Section
4383 Fountain Square Drive
Columbus, OH 43224-1362
(Tel. 614-265-6602)

2. **Mineral Resource Information:**

The Mineral Resources and Geochemistry Section of the Division of Geological Survey is responsible for research on Ohio's mineral fuels and industrial mineral resources. These activities are threefold: resources investigations, statistical data compilations, and public information/outreach.

Resource investigations are varied, involving both chemical and physical properties of rocks and both in-house and contract-lab analyses. The industrial minerals component of the resource investigations has included work on chemical and physical properties of carbonate rocks, brine, shale, sand, and till. Geologic and surficial mapping, sand and gravel investigations, and other field studies are also undertaken by other Sections of the Division.

The Section is responsible for the compilation of production, use, sales, and employment figures on coal and all industrial minerals produced in Ohio. These statistics are reported each year in the "Annual Report on Ohio Mineral Industries."

The Section coordinates the annual "Ohio's Mineral Industries Teachers Workshop," which is jointly presented by ODNR and the University of Akron. This week-long workshop is designed

to familiarize teachers with the geology, economic mineral resources, and mineral industries of Ohio. Section staff also respond to inquires on mineral resources.

3. **Legal steps necessary for conducting an industrial mineral mining operation:**

The following compilation is NOT all-inclusive. It is only a summary of the primary permits and procedures needed to establish a non-coal surface mine in the State of Ohio as of June 1992.

a

Surface Mine Permit. Ohio Revised Code, Chapter 1514 "Surface Mine Law" requires anyone engaging in surface mining or conducting a surface mining operation to get a Surface Mine Permit from the Division of Reclamation (see address above) before beginning any mining operation. Bond and fees are due upon application approval. Once the application is approved, and bond and fees received, a permit will be issued for a 10-year period. An annual report and map are required on each anniversary date of permit issuance.

The law requires that all mined areas are restored in accordance with the reclamation plan filed in the permit application. This includes the grading of final slopes to a 3:1 grade, resoiling affected areas with topsoil or subsoil, and the establishment of a permanent diverse vegetative cover of grasses and legumes. Highwalls may be left if they are compatible with the future intended use and permanent impoundments left must provide for public safety. Reclamation must be completed within three years after the completion of mining.

The reclamation bond is held by the State and returned to the operator when it is deteremined that he has completed reclamation in accordance with his plan. If the operator fails to reclaim, he will be sent an Order from the Division requiring the reclamation be completed. Failure to complete reclamation will result in a forfeiture of the bond to the State and the State will then be responsible for completing the reclamation.

b. Zoning Regulations and Permits. Zoning activities in Ohio are conducted at the Township level of government. In order to obtain the proper zoning for a mineral extraction operation, the individual or operator must contact the LOCAL Township Trustees office or, in some cases, the LOCAL Regional Planning Commission for the specific area involved. (Zoning generally is NOT handled at either the County or State level.)

c. Ohio Environmental Protection Agency Permits.

NPDES Permit. A permit under the National Pollutant Discharge Elimination System (NPDES) is required for any water discharged to waters of the United States.

PTI, Wastewater. A Permit To Install (PTI) is needed for any wastewater treatment facilities, settling ponds, etc.

PTI, PTO, Air Quality. A PTI followed by a Permit to Operate (PTO) as related to air emissions would be needed for extractive operations, haul roads, storage piles, processing operations, etc. (The PTI and PTO for air quality would also have to meet the Rules on Emission Control Requirements.)

Information on and applications for the various water, wastewater, and air permits can be obtained from the appropriate Ohio Environmental Protection Agency District Office as follows (also see Figure 7):

Ohio EPA
Central District Office
2305 Westbrooke Dr., Bldg. C
P.O. Box 2198
Columbus, OH 43266-2198
(614) 771-7505

Ohio EPA
Northeast District Office
2110 East Aurora Rd.
Twinsburg, OH 44087
(216) 425-9171

Ohio EPA
Northwest District Office
347 North Dunbridge Rd.
Bowling Green, OH 43402
(419) 352-8461

Ohio EPA
Southeast District Office
2195 Front St.
Logan, OH 43138
(614) 385-8501

Ohio EPA
Southwest District Office
40 South Main St.
Dayton, OH 45404
(513) 285-6357

d. U.S. Army Corps of Engineers Permits.

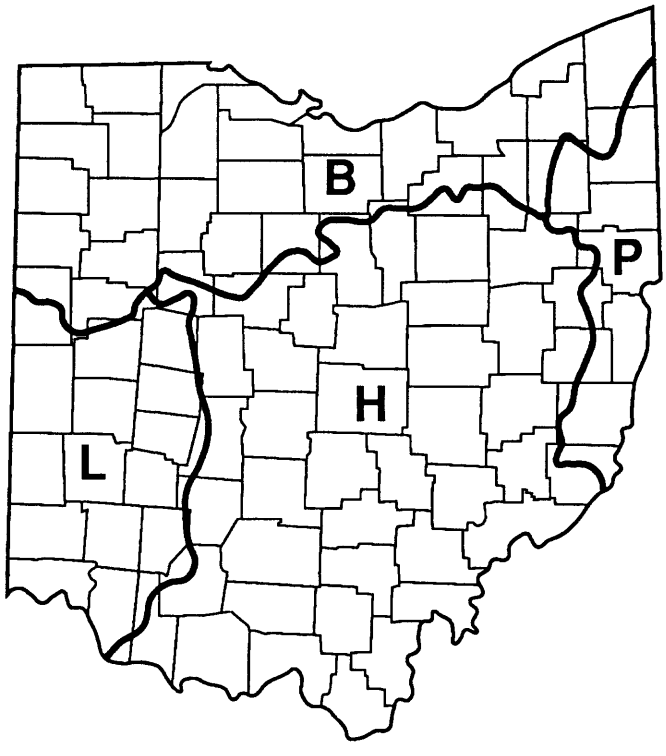
Stream Relocations. A Permit is required to change the location and routing of a stream in a mining operation.

Stream Crossing. A Permit is required to construct a haul road or other crossing of a stream in a mining operation.

Section 404 Permit. A Permit and prior authorization is required before any dredging or filling operation is performed on any water of the United States, including WETLANDS.

Section 10 Permit. This Permit is required for dredging in any stream of the United States defined as navigable.

Ohio EPA Districts



U. S. Corps of Engineers Districts

B - Buffalo, H - Huntington, L - Louisville, P - Pittsburgh

Figure 7. EPA and U. S. Corps of Engineers Districts in Ohio.

Information on and applications for the various USCE permits can be obtained from the appropriate U.S. Army Corps of Engineers District Office as follows (also see Figure 7):

U.S. Army Corps of Engineers
Buffalo District
1776 Niagara St.
Buffalo, NY 14207
(716) 879-4330

U.S. Army Corps of Engineers
Pittsburgh District
1000 Liberty Ave.
Pittsburgh, PA 15222
(412) 644-6872

U.S. Army Corps of Engineers
Louisville District
ATTN: CEORL-OR-F
P.O. Box 59
Louisville, KY 40201-0059
(502) 582-5607

U.S. Army Corps of Engineers
Huntington District
OR-F0
502 Eighth St.
Huntington, WV 25701
(304) 529-5210

e. Dam, Dike, or Levee Permit. Ohio Revised Code, Chapter 1521. Construction of a dam, dike, or spoil-pile levee in a mineral operation may require the prior issuance of a permit from the ODNR, Division of Water. Before submitting a preliminary design report, contact the Division for further information.

Ohio Department of Natural Resources
Division of Water
Construction Permits
1939 Fountain Square Court, Bldg. E-3
Columbus, OH 43224
(614) 265-6720

f. Floodplain Regulations and Permits. Any mining activity in a stream floodplain MAY require some type of permit OR zoning ruling. In order to participate in the National Flood Insurance Program (NFIP) communities have to agree to adopt and enforce Federal Emergency Management Agency (FEMA) minimum floodplain management criteria. This can be done by a variety of zoning, subdivision regulations, or other special purpose regulations. Information on the actual type of permit required can be obtained from the applicable County Commissioners' or County Clerk's Office for unincorporated areas or the Mayor's Office for municipalities.

Questions about whether a particular area participates in the NFIP can be obtained from:

Ohio Department of Natural Resources
Division of Water
Floodplain Management
1939 Fountain Square Court, Bldg. E-3
Columbus, OH 43224
(614) 265-6755

g. Mine Safety. All mining operations are subject to inspections to enforce federal standards on noise, dust, and mining safety. The operator is required at the start of mining to contact the Mine Safety & Health Administration (MSHA) to fill out the MSHA Legal ID Form.

U.S. Department of Labor
Mine Safety & Health Administration
Metal & Non-Metal Section
2035 Reddington Rd.
Newark, OH 43055
(614) 522-3139

Mining operations in Ohio are subject to safety inspections by the Ohio Division of Mines. However, no advance permit or notification by the operator is required. The Division of Mines is notified by the Division of Reclamation that a Surface Mine Permit has been issued. At that time a State Mine Number is assigned and the operation is put into the inspection schedule. Information about the State inspections can be obtained from:

Ohio Department of Industrial Relations
Division of Mines
2323 West Fifth Ave.
P.O. Box 825
Columbus, OH 43216
(614) 644-2234

h. Taxation. Ohio Revised Code, Chapter 5749. All mining operations in Ohio are required to pay an excise tax levied on the severance of natural resources from the soil or water of Ohio. Current severance tax levels on the industrial minerals are as follows:

Commodity	¢/ton
Limestone/dolomite	2
Sand/gravel	2
Sandstone/conglomerate	1
Shale	1
Clay	1
Salt	4
Gypsum	1

Severance tax returns are due quarterly. A new operator should contact the Ohio Department of Taxation and request an Application for Severer's License.

Ohio Department of Taxation
ATTN: Excise Tax and Assessment Unit
P.O. Box 530
Columbus, OH 43266-0030
(614) 466-7026

OHIO

INDUSTRIAL MINERALS REFERENCE LIST

List of Publications:

Ohio Department of Natural Resources
Division of Geological Survey
4383 Fountain Square Drive
Columbus, OH 43224-6588
(614) 265-6602 or 265-6588

Colleges and Universities in Ohio may also be able to provide information on industrial minerals.

Production Reports:

Ohio Division of Geological Survey (address above)

State Mineral Industry Directory:

Ohio Division of Geological Survey (address above)

Other Pertinent State Organizations:

Ohio Department of Natural Resources
Division of Reclamation
1855 Fountain Square Court
Columbus, OH 43224-1362
(614) 265-6635

Ohio Environmental Protection Agency
1800 Watermark Dr.
P.O. Box 1049
Columbus, OH 43266
(614) 644-3020

Ohio Department of Industrial Relations
Division of Mines
2323 West Fifth Ave.
P.O. Box 825
Columbus, OH 43216
(614) 644-2234

Ohio Department of Taxation
ATTN: Excise Tax and Assessment Unit
P.O. Box 530
Columbus, OH 43266-0030
(614) 466-7026

State Laws:

Surface Mining and Reclamation
Ohio Division of Reclamation (see address above)

Administration of Mining Laws (Safety)
Ohio Division of Mines (see address above)

General
Contact nearest major local library, OR

State Library of Ohio
Reference Service
65 South Front St.
Columbus, OH 43266-0334
(614) 644-7054

The Ohio State University
Law Library
1659 North High St.
Columbus, OH 43210
(614) 292-6691

THE MINERAL INDUSTRY OF SOUTH DAKOTA, 1989

This fact sheet has been adapted from a chapter in the Bureau of Mines *Minerals Yearbook Report, 1989* . The Minerals Yearbook chapter was prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota Geological Survey for collecting information on all nonfuel minerals.

By Leon E. Esparza [1]

In 1989, the value of South Dakota's nonfuel mineral production was about $284 million, a slight decrease compared with the 1988 value, see Table 17. A 31% decrease in the value of crushed stone production offset increases recorded for other major commodities, including cement, gold, construction sand and gravel, and dimension stone. South Dakota ranked 32d in the value of nonfuel mineral production, accounting for about 1% of the U.S. total. Gold, the State's leading commodity, accounted for 70% of the total value of nonfuel minerals produced in the State in 1989, followed by portland cement and crushed stone. Minerals used in construction accounted for about 30% of the nonfuel mineral production value.

REVIEW BY NONFUEL MINERAL COMMODITIES

Industrial Minerals

Cement

The South Dakota cement plant set a sales record in 1989, reversing a 3-year decline. Total sales for the year were reported by the company to have been about 677,000 short tons.[2] The sales increase resulted from taking advantage of spot shortages in some West Coast markets and increased road construction activity in Minnesota and North Dakota. The plant was the State's only cement operation and was owned by the State of South Dakota and governed by a seven-person commission appointed by the Governor. A large percentage of the plant's earnings have been remitted to the State's general fund each year.

Feldspar and Mica

Feldspar and mica continued to be produced from small pegmatite deposits, mostly near Custer in the southern Black Hills, see Figure 8. In 1989, feldspar production and value decreased about 13% and 31%, respectively, compared with 1988 figures. During the same period, scrap mica decreased about 14% in quantity and value. South Dakota ranked second of seven producing States.

Sand and Gravel

Construction sand and gravel production is surveyed by the Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. This chapter contains estimates for 1987 and 1989 and actual data for 1988. Construction sand and

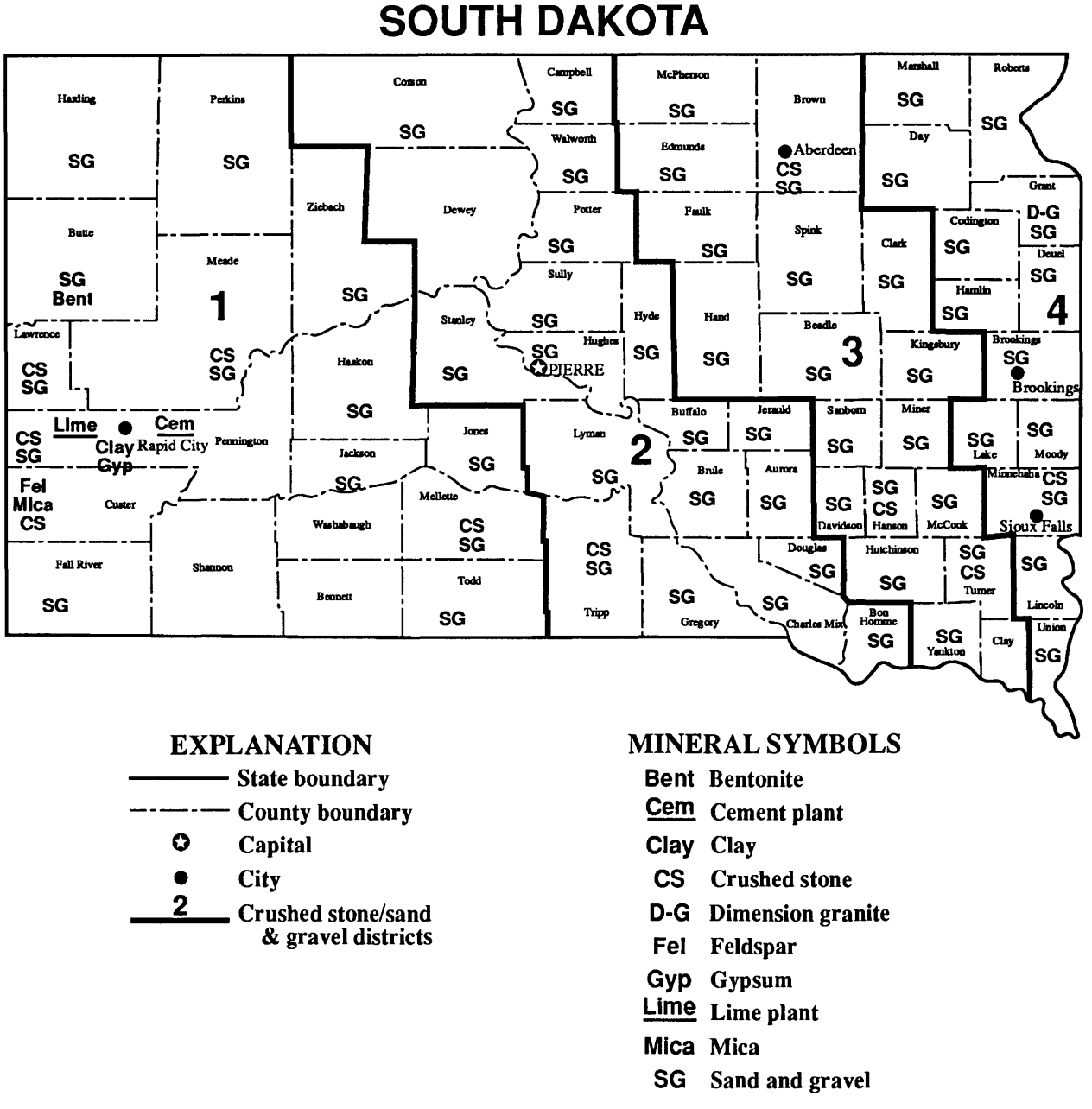


Figure 8. Principal Mineral-Producing Localities in South Dakota in 1989.

gravel production was estimated to have decreased 19%; however, value was estimated to have increased 11%.

Stone

Stone production is surveyed by the Bureau of Mines for odd-numbered years only; data for even-numbered years are based on annual company estimates. This chapter contains actual data for 1987 and 1989 and estimates for 1988.

CRUSHED

Crushed stone was produced from 13 quarries in 7 counties by 13 operators. Production and value in 1989 decreased about 30% and 31%, respectively, compared with estimates for 1988, see Table 18. Counties leading in production were Minnehaha, Pennington, and Hanson. Leading uses for crushed stone were in concrete aggregate, cement manufacturing, railroad ballast, and lime manufacturing. The leading uses for crushed limestone and dolomite were in cement manufacturing, concrete aggregate, and lime manufacturing.

South Dakota's crushed stone statistics are compiled by geographical districts as depicted in the state map, see Figure 8. Table 19 presents end-use statistics for South Dakota's four districts.

DIMENSION

South Dakota ranked ninth of 34 States in dimension stone production. Grant County hosted five granite dimension stone operations, all near Milbank. Production and value of dimension stone increased 26% and 8%, respectively, in 1989.

Other Industrial Minerals

Common clay and shale increased in production and value about 29% and 22%, respectively, during 1989. Crude gypsum decreased about 9%, and value decreased about 10%. All of the gypsum was used in cement manufacturing by the State's plant at Rapid City. Hydrated lime and quicklime production and value decreased 8% and 7%, respectively.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN. Assistance in the preparation of the chapter was given by Wanda J. West, editorial assistant.

[2] The Rapid City Journal. Cement Plant Sets Record. Jan. 19, 1990, p. A6.

TABLE 17

NONFUEL MINERAL PRODUCTION IN SOUTH DAKOTA [1]

Mineral		1987 Quantity	1987 Value (thousands)	1988 Quantity	1988 Value (thousands)	1989 Quantity	1989 Value (thousands)
Cement:							
Masonry	thousand short tons	4	W	4	W	W	W
Portland	do.	519	W	490	W	W	W
Gem stones		NA	$100	NA	$100	NA	$150
Gold [2]	kilograms	W	W	13,981	197,026	16,123	198,318
Lead [2]	metric tons	---	---	---	---	4	3
Sand and gravel: (construction)	thousand short tons	e9,600	e19,100	7,929	18,681	e6,400	e20,800
Silver [2]	metric tons	W	W	3	552	4	705
Stone:							
Crushed	thousand short tons	5,070	18,515	e5,500	e20,600	3,833	14,303
Dimension	short tons	50,718	18,209	e43,297	e16,472	54,623	17,738
Combined value of beryllium concentrates (1987), clays (common), feldspar, gypsum, iron ore (1988-89), lime, mica (scrap), and values indicated by symbol W		XX	206,968	XX	32,288	XX	32,341
Total		XX	262,892	XX	285,719	XX	284,358

e Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

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

2 Recoverable contents of ores, etc.

TABLE 18

SOUTH DAKOTA: CRUSHED STONE [1] SOLD OR USED BY PRODUCERS IN 1989, BY USE

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+ 1 1/2 inch):		
Riprap and jetty stone	75	336
Coarse aggregate, graded:		
Concrete and bituminous aggregate (coarse)	598	2,864
Bituminous surface-treatment aggregate	99	506
Fine aggregate (- 3/8 inch): Stone sand, concrete and bituminous mix or seal	166	515
Coarse and fine aggregate:		
Graded road base or subbase	186	701
Crusher run or fill or waste	13	39
Other construction materials [2]	307	1,278
Other miscellaneous uses [3]	1,064	2,023
Unspecified: [4]		
Actual	773	4,258
Estimated	552	1,783
Total	3,833	14,303

[1] Includes limestone, quartzite, sandstone, and miscellaneous stone.
[2] Includes stone used in railroad ballast, screenings (fine), unpaved road surfacing, and terrazzo and exposed aggregate.
[3] Includes stone used in cement manufacture, lime manufacture, and abrasives.
[4] Includes production reported without a breakdown by end use and estimates for nonrespondents.

TABLE 19

SOUTH DAKOTA: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1989, BY USE AND DISTRICT

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:								
Coarse aggregate (+ 1 1/2 inch) [1]	([2])	([2])	---	---	W	W	W	W
Coarse aggregate, graded [3]	([2])	([2])	---	---	W	W	W	W
Fine aggregate (- 3/8 inch) [4]	([2])	([2])	---	---	W	W	W	W
Coarse and fine aggregates [5]	([2])	([2])	---	---	W	W	W	W
Other construction aggregates	676	2,776	---	---	---	---	---	---
Chemical and metallurgical [6]	([7])	([7])	---	---	---	---	---	---
Special [8]	---	---	---	---	---	---	W	W
Other miscellaneous	1,049	1,985	---	---	---	---	---	---
Unspecified:								
Actual [9]	---	---	---	---	---	---	W	W
Estimated [10]	552	1,783	---	---	---	---	---	---
Total	[11] 2,276	6,544	---	---	W	W	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Includes riprap and jetty stone and filter stone.

[2] Withheld to avoid disclosing company proprietary data; included with "Other construction aggregates."

[3] Includes concrete aggregate (coarse), bituminous aggregate (coarse), bituminous surface-treatment aggregate, and railroad ballast.

[4] Includes stone sand (concrete), stone sand (bituminous mix or seal), and fine aggregate (screening-undesignated).

[5] Includes crushed stone for graded road base or subbase, unpaved road surfacing, terrazzo and exposed aggregates, and crusher run or fill or waste.

[6] Includes crushed stone for cement manufacture and lime manufacture.

[7] Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."

[8] Includes crushed stone for abrasives.

[9] Includes production reported without a breakdown by end use.

[10] Includes estimates for nonrespondents.

[11] Data do not add to total shown because of independent rounding.

SOUTH DAKOTA

INDUSTRIAL MINERAL INFORMATION AND REGULATION

compiled by

Michael Cepak
Office of Minerals and Mining

1. **Responsible Agency/Division/Department:**

Office of Minerals and Mining
Division of Environmental Regulation
Department of Environment and Natural Resources
Joe Foss Building
523 East Capitol
Pierre, SD 57501
(605) 773-4201

Contact: Mike Cepak, Natural Resources Engineer

2. **Objectives of Industrial Minerals Program.**

The objective of the South Dakota minerals program is to protect the environment and public health and safety from the impacts of mineral development. Also, it is the program's objectives to ensure that land affected by mining will be returned to a usable and productive state once mining is complete.

3. **Legal steps necessary for opening an industrial mineral mining or quarry operation.**

In South Dakota there are two permitting mechanisms for the mining of industrial minerals: mine license and mine permit.

a. Mine License. Mine licenses are governed under SDCL 45-6 (the Sand, Gravel and Construction Aggregate Mining statutes). A mine license is required for sand, gravel, rock crushed and used in construction, pegmatite minerals, and for limestone, iron ore, sand, gypsum or shale used in the process of making cement.

A notice of intent must be submitted to various state agencies and local newspapers. Although no formal written operating or reclamation agreement is required, a reclamation bond must be posted.

b. Mine Permit. For all other minerals, a mine permit under SDCL 45-6B (Mined Land Reclamation statutes) and ARSD 74:29 (Mined Land Reclamation regulations) is required. Two types of mining permits issued by the State: Large Scale Mining Permit and Small Scale Mining Permit. A large scale permit is required for operations extracting more than 25,000 tons of ore or overburden per year and/or affecting more than 10 acres. A small scale mining permit is required for operations extracting less than 25,000 tons per year and affecting less than 10 acres. Any operation that employs a chemical (e.g., cyanide) or biological leaching

crushed and used in construction, pegmatite minerals, and for limestone, iron ore, sand, gypsum or shale used in the process of making cement.

A notice of intent must be submitted to various state agencies and local newspapers. Although no formal written operating or reclamation agreement is required, a reclamation bond must be posted.

b. Mine Permit. For all other minerals, a mine permit under SDCL 45-6B (Mined Land Reclamation statutes) and ARSD 74:29 (Mined Land Reclamation regulations) is required. Two types of mining permits issued by the State: Large Scale Mining Permit and Small Scale Mining Permit. A large scale permit is required for operations extracting more than 25,000 tons of ore or overburden per year and/or affecting more than 10 acres. A small scale mining permit is required for operations extracting less than 25,000 tons per year and affecting less than 10 acres. Any operation that employs a chemical (e.g., cyanide) or biological leaching process, regardless of size, must follow the requirements for a large scale permit.

A mine permit application - submitted to the Department of Environment and Natural Resources (DENR) and to the Register of Deeds in the appropriate county - and a hearing before the Board of Minerals and Environment is required. A reclamation surety is required prior to mining. The Board makes the final decision about permitting the mining or quarry operation.

4. **Legal steps necessary to close an industrial mineral quarry or mining operation:**

a. Sites operating under a mine license. After cessation of mining the operator has three years to complete reclamation (the deadline can be extended by the Board of Minerals and Environment). The reclamation surety is not released until DENR site inspection and approval. The Board makes the final decision for release of the minesite.

b. Sites operating under a mine permit. After cessation of mining the operator has five years to complete reclamation (the deadline can be extended by the Board of Minerals and Environment). The reclamation surety is not released until DENR site inspection and approval. The Board makes the final decision for release of the minesite.

5. **Local and county laws:**

For mine licenses (SDCL 45-6), the statutes contain no prohibition on local governmental zoning or other regulations affecting this type of mining.

For mine permits (SDCL 45-6B), no governmental office of any political subdivision of the state has the authority to require or issue a permit or to require any surety for mining operations. However, the Board may not grant a permit for an operation unless the applicant has complied with all city or county ordinances and requirements and obtained necessary city and county permits.

SOUTH DAKOTA

INDUSTRIAL MINERAL REFERENCE LIST

List of Publications:

Division of South Dakota Geological Survey
SD Department of Environment and Natural Resources
Akeley 301
University of South Dakota
Vermillion, SD 57069-2390
(605) 677-5227

Office of Minerals and Mining
SD Department of Environment and Natural Resources
Joe Foss Building
523 East Capitol
Pierre, SD 57501
(605) 773-4201

Colleges and Universities in South Dakota may also be able to provide information on industrial minerals.

Production Reports:

Office of Minerals and Mining (see address above)

U.S. Department of the Interior
Bureau of Mines
5629 Minnehaha Avenue South
Minneapolis, MN 55417

State Mineral Industry Directory:

Quartzite Rock Association
PO Box 661
Sioux Falls, SD 57101
(605) 339-1520

Office of Minerals and Mining (see address above)
(Operator listings for mine licenses and permits)

Other Pertinent State Organizations:

Department of Environment and Natural Resources (DENR)
Foss Building
Pierre, SD 57501-3181
(605) 773-5559

Department of Game, Fish and Parks
Joe Foss Building
Pierre, SD 57501
(605) 773-3387

Department of Education and Cultural Affairs
Kneip Building
Pierre, SD 57501
(605) 773-3134
(includes State Historical Society, State Archaeologist)

Department of Health
Foss Building
Pierre, SD 57501
(605) 773-3361
(Worker safety, public health)

Department of Agriculture
Anderson Building
Pierre, SD 57501
(605) 773-3375

6. State laws:

Office of Minerals and Mining (see address above).

Law libraries:

Supreme Court Library
500 East Capital
Pierre, SD 57501-5070

University of South Dakota - School of Law
McKusick Library
Vermillion, SD 57069
(605) 677-5259

THE MINERAL INDUSTRY OF WISCONSIN, 1989

This fact sheet has been adapted from a chapter in the Bureau of Mines *Minerals Yearbook Report, 1989*. The Minerals Yearbook chapter was prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Wisconsin Geological and Natural History Survey for collecting information on all nonfuel minerals.

By Leon E. Esparza [1] and Thomas J. Evans [2]

Wisconsin's nonfuel mineral production in 1989 was valued at about $185 million,[3] a drop of about 10%, see Table 20. Nationally, Wisconsin ranked 38th in the value of nonfuel mineral production. Leading commodities produced were crushed stone, construction sand and gravel, industrial sand, and lime, see Figure 9. Virtually all of the State's mined products were used in construction.

REVIEW BY NONFUEL MINERAL COMMODITIES

Industrial Minerals

Lime

Wisconsin ranked 12th of 32 States in production of lime. Quicklime and hydrated lime were produced by three companies in four counties. In 1989, lime production and value dropped 3% and 24%, respectively, after having posted all-time highs in 1988. Average value per short ton dropped 22% to $41.49, down from $53.07 the previous year. Value of quicklime production accounted for 57% of the total value of lime produced. The State's total lime consumption from all domestic sources was 159,000 short tons, down 4%. Hydrated lime consumption was down 6%, to 47,000 short tons, and quicklime consumption fell 3%, to 112,000 short tons.

Peat

Peat was harvested in two counties by four companies and sold in bulk and packaged form. Sales and value increased 18% and 14%, respectively. Peat varieties produced from Waukesha County, the State's leading production area, were humus, reed-sedge, and sphagnum. The hypnum variety was produced from Kewaunee County. Peat was sold for use mostly as a soil conditioner.

Sand and Gravel

CONSTRUCTION

Construction sand and gravel production is surveyed by the Bureau of Mines for even-numbered years only; data for odd-numbered years are based on annual company estimates. This chapter contains estimates for 1987 and 1989 and actual data for 1988.

The State was estimated to have ranked 12th of 50 producing States. Production and value were estimated to have fallen 13% and 6%, respectively. Construction sand and gravel was the State's second leading mineral commodity in terms of value.

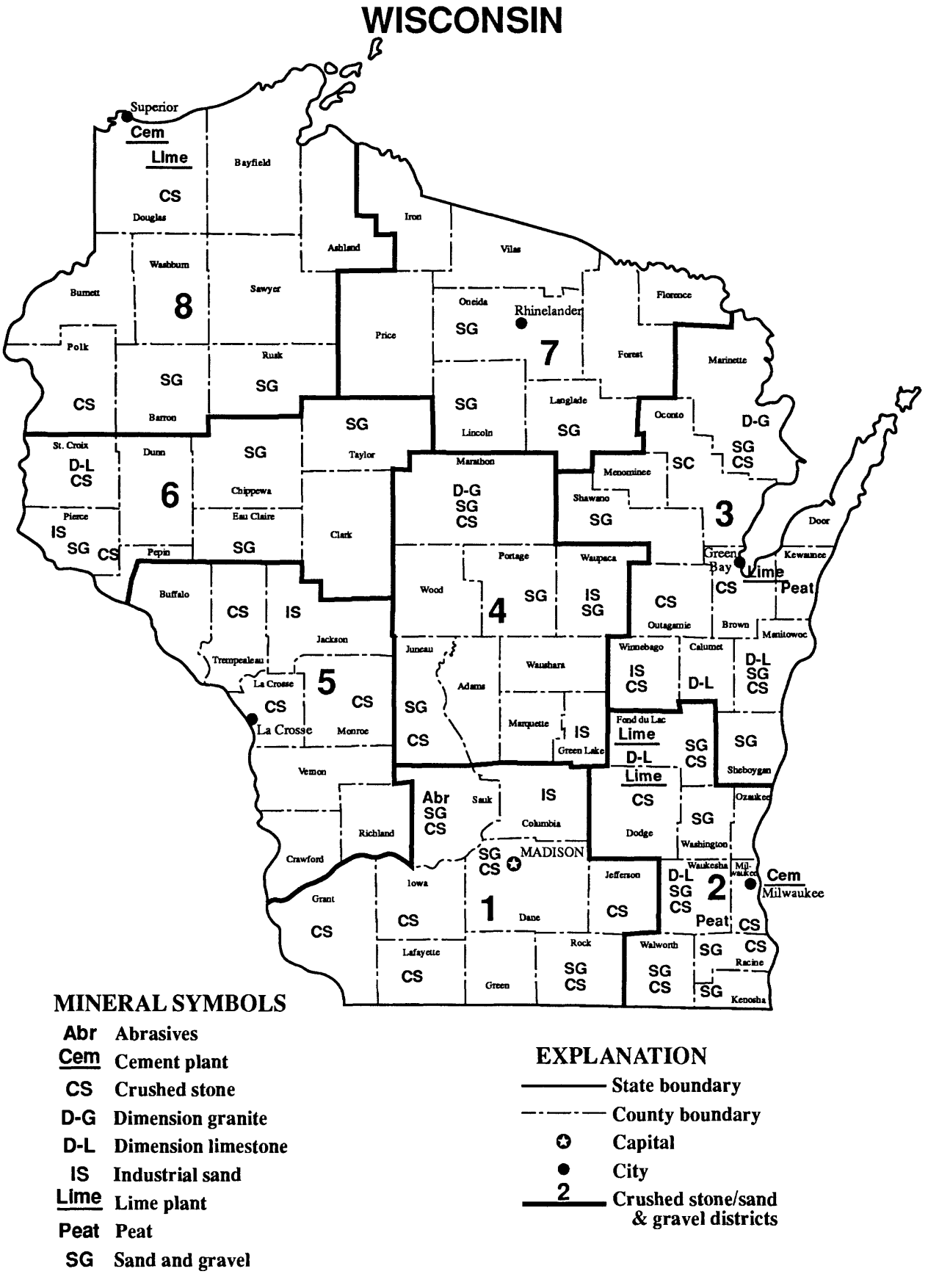

Figure 9. Principal Mineral-Producing Localities in Wisconsin in 1989.

INDUSTRIAL

Industrial sand production and value increased 12% and 45%, respectively. Wisconsin ranked seventh of 38 producing States. Industrial sand was produced by four companies in five counties from seven pits. About 51% of the State's production was used as foundry molding and core. Other large applications were in hydraulic fracturing, glass container manufacturing, and sandblasting. Average unit value for all sand production was $14.79 per short ton, but ranged from $55.56 per ton for ground fillers--used in manufacturing rubber, paint, paper, or plastics--to $3.44 per ton for traction sand.

Stone

Stone production is surveyed by the Bureau of Mines for odd-numbered years only; data for even-numbered years are based on annual company estimates. This chapter contains actual data for 1987 and 1989 and estimates for 1988.

CRUSHED

Wisconsin ranked 19th of 48 producing States. Crushed stone, excluding traprock, decreased in production and value, 7% and 15%, respectively, see Table 21. Crushed stone production was reported from 241 quarries in 45 counties by 109 operators. Types of stone produced included dolomite, granite, limestone, sandstone, and traprock. Of these, limestone was produced in the largest quantity.

Wisconsin's crushed stone statistics are compiled by geographical districts as depicted in the State map (see Figure 9). Table 22 presents end-use statistics for Wisconsin's eight districts.

DIMENSION

Wisconsin ranked 12th of 34 States producing dimension stone. Production and value decreased 29%. Eleven companies operated 15 quarries and produced 8 varieties of finished product. Limestone and/or dolomite was produced at 10 quarries and granite at 5. Dressed monumental stone, cut-veneer stone, and rough monumental stone were the most valuable varieties produced. Unit value for all uses averaged $123 per short ton, but ranged as high as $665 for dressed monumental stone and as low as a small fraction of this for rough blocks.

Other Industrial Minerals

Iron oxide pigments were produced. Perlite from out-of-State sources was expanded. Finished products included cavity fill insulation, horticultural aggregates, concrete aggregates, and acoustic tile. Sulfur was recovered as a petroleum refining byproduct. Vermiculite was expanded for use in manufacturing insulation and filtration media. Quantity and value increased 12% and 15%, respectively.

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[1] State Mineral Officer, Bureau of Mines, Minneapolis, MN. Assistance in the preparation of the chapter was given by Wanda J. West, editorial assistant.

[2] Associate professor, Minerals Information, Wisconsin Geological and Natural History Survey, Madison, WI.

[3] This is a partial total. It excludes the gem stones value to prevent disclosure of proprietary information provided by U.S. Shell Co., a freshwater pearl grower.

TABLE 20

NONFUEL MINERAL PRODUCTION IN WISCONSIN [1]

Mineral		1987 Quantity	1987 Value (thousands)	1988 Quantity	1988 Value (thousands)	1989 Quantity	1989 Value (thousands)
Gem stones		NA	$15	NA	$15	NA	W
Lime	thousand short tons	393	21,733	452	23,986	437	$18,129
Peat	do.	9	237	11	270	13	309
Sand and gravel:							
Construction	do.	e23,900	e57,000	25,048	60,080	e21,700	e56,400
Industrial	do.	1,314	15,168	1,351	15,458	1,514	22,399
Stone:							
Crushed	do.	[2] 22,757	[2] 71,776	e [2] 28,500	e98,300	26,520	83,664
Dimension	short tons	36,903	3,697	e49,900	e6,200	35,587	4,376
Combined value of other industrial minerals value indicated by symbol W		XX	16,846	XX	564	XX	([3])
Total		XX	186,472	XX	204,873	XX	[4] 185,277

e Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

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

[2] Excludes certain stones; value included with "Combined value" figure.

[3] Value excluded to avoid disclosing company proprietary data.

[4] Partial total, excludes values that must be concealed to avoid disclosing company proprietary data.

TABLE 21

WISCONSIN: CRUSHED STONE [1] SOLD OR USED BY PRODUCERS IN 1989, BY USE

(Thousand short tons and thousand dollars)

Use	Quantity	Value
Coarse aggregate (+ 1 1/2 inch):		
Riprap and jetty stone	125	724
Filter stone	267	814
Coarse aggregate, graded:		
Concrete aggregate, coarse	1,297	4,636
Bituminous aggregate, coarse	398	1,498
Bituminous surface-treatment aggregate	286	968
Fine aggregate (- 3/8 inch):		
Stone sand, bituminous mix or seal	44	122
Screening, undesignated	233	560
Coarse and fine aggregate:		
Graded road base and subbase	5,124	15,348
Unpaved road surfacing	1,549	3,188
Crusher run or fill or waste	464	1,119
Other construction [2]	1,352	4,974
Agricultural:		
Agricultural limestone and poultry grit	1,099	6,464
Other miscellaneous [3]	200	559
Unspecified: [4]		
Actual	8,952	27,843
Estimated	5,131	14,846
Total [5]	26,520	83,664

[1] Includes limestone, dolomite, granite, sandstone, and traprock.
[2] Includes stone used in macadam, railroad ballast, stone sand (concrete), and combined aggregates.
[3] Includes stone used in lime manufacture, flux stone, and other fillers and extenders.
[4] Includes production reported without a breakdown by end use and estimates for nonrespondents.
[5] Data may not add to totals shown because of independent rounding.

TABLE 22

WISCONSIN: [1] CRUSHED STONE SOLD OR USED BY PRODUCERS IN 1989, BY USE AND DISTRICT

(Thousand short tons and thousand dollars)

Use	District 1		District 2		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:								
Coarse aggregate (+ 1 1/2 inch) [2]	17	45	228	1,159	115	299	6	25
Coarse aggregate, graded [3]	1,226	4,642	1,339	5,017	484	1,447	47	131
Fine aggregate (- 3/8 inch) [4]	65	220	W	W	164	359	W	W
Coarse and fine aggregates [5]	875	2,282	3,016	10,210	1,109	3,002	1,160	1,437
Other construction aggregates	---	---	18	45	([6])	1	([6])	1
Agricultural [7]	221	982	162	1,459	647	3,435	---	---
Chemical and metallurgical [8]	---	---	([9])	([9])	([9])	([9])	---	---
Special [10]	---	---	([9])	([9])	([9])	([9])	---	---
Other miscellaneous	---	---	11	36	144	426	42	90
Unspecified:								
Actual [11]	315	868	267	849	2,431	7,584	1,465	4,350
Estimated [12]	1,273	3,996	1,785	4,431	1,042	2,643	314	1,503
Total [13]	3,992	13,035	6,827	23,207	6,136	19,196	3,033	7,539

Continued to next page.

Table 22-- continued.

Use	District 5		District 6		District 7		District 8	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Construction aggregates:								
Coarse aggregate (+ 1 1/2 inch) [2]	38	210	---	---	---	---	7	7
Coarse aggregate, graded [3]	---	---	---	---	---	---	---	---
Fine aggregate (- 3/8 inch) [4]	5	10	---	---	---	---	---	---
Coarse and fine aggregates [5]	307	1,143	167	478	---	---	---	---
Other construction aggregates	---	---	---	---	---	---	---	---
Agricultural [7]	15	81	23	299	---	---	([9])	([9])
Chemical and metallurgical [8]	---	---	---	---	---	---	---	---
Special [10]	---	---	---	---	---	---	---	---
Other miscellaneous	---	---	3	7	---	---	32	208
Unspecified:								
Actual [11]	2,896	9,383	545	1,726	---	---	1,032	3,083
Estimated [12]	83	335	565	1,715	---	---	60	194
Total [13]	3,344	11,162	1,303	4,226	---	---	1,131	3,491

W Withheld to avoid disclosing company proprietary data; included with "Other construction aggregates."

[1] Excludes 753,680 short tons valued at $1,807,819 not reported by county.

[2] Includes macadam, riprap and jetty stone, and filter stone.

[3] Includes concrete aggregate (coarse), bituminous aggregate (coarse), bituminous surface-treatment aggregate, and railroad ballast.

[4] Includes stone sand (concrete), stone sand (bituminous mix or seal), and fine aggregate (screening-undesignated).

[5] Includes crushed stone for graded road base or subbase, unpaved road surfacing, and crusher run or fill or waste.

[6] Less than 1/2 unit.

[7] Includes agricultural limestone and poultry grit and mineral food.

[8] Includes crushed stone for lime manufacture and flux stone.

[9] Withheld to avoid disclosing company proprietary data; included with "Other miscellaneous."

[10] Includes crushed stone for other fillers or extenders.

[11] Includes production reported without a breakdown by end use.

[12] Includes estimates for nonrespondents.

[13] Data may not add to totals shown because of independent rounding.

WISCONSIN

Pertinent legislation and permitting procedures in Wisconsin.

1) **Responsible State Agencies:**

Department of Natural Resources
Bureau of Water Regulation
and Zoning
101 S. Webster Street
Madison, WI 53703
(608) 266-8030

Department of Industry,
Labor, and Human Relations
Division of Mine Safey
201 E. Washington Avenue
Madison, WI 53704
(608) 266-1818

2) **Objective of program:**

Minimize the adverse effects caused during and after excavation, grading, or dredging in or near navigable waterways as a consequence of sand, gravel, or rock excavation and reclamation.

3) **Legal steps to start an industrial mineral operation:**

a) Pursuant to Chapter 30.19, 30.195, and 30.20, Wis. Stats., permits must be obtained prior to disturbance of the materials or course of navigable waterways as a consequence of sand, gravel, and rock excavation. "Chapter 30 permits" are required for such activites if they occur within 500' of navigable waterways.

Acquisition of necessary permits from the state involves:

1. description of proposed operation
2. legal description of all land in the project area, including ownership states
3. operation and reclamation plan
4. proposed timetable for operation and reclamation activity
5. evidence of compliance with local, state, and federal permits or license application procedures
6. evidence that proposed operator is financially and technically qualified
7. estimated cost of progressive and final reclamation of the project site.

State regulatory requirements are specified in Chapter NR 340, Wis. Administrative Code.

b) All other permits and zoning must be obtained from local (Town or County) or federal (Corps. of Engineers Sec. 404 permits) officials.

4) **Steps necessary for closing an operation:**

Site closure must be in compliance with local, state, and federal permit stipulations. For state-permitted operations, site closure must comport to the approved operation and reclamation plan approval obtained with the Chapter 30 permits. Also, closed mine sites must be properly fenced for safety reasons in compliance with IND 7 and 8, Wis. Admin. Code,

Wisconsin Department of Industry, Labor and Human Relations.

5) **Local and county laws apply to all areas; operations within 500 feet of a navigable stream are the only instances where state rules apply.**

WISCONSIN

Industrial Minerals Reference list for Wisconsin

1) State Geological Survey List of Publications

Wisconsin Geological and Natural History Survey
Map and Publication Sales
3817 Mineral Point Road
Madison, WI 53705
608-263-7389

2) University-related List of Publications

None specific to Industrial Minerals

3) Pertinent State Organizations

Wisconsin Department of Development
123 W. Washington Avenue
Madison, WI 53703
608-266-1018

Wisconsin Manufacturers and Commerce (Private)
501 E. Washington Avenue
Madison, WI 53703
608-258-3400

4) State Mineral Industry Directory

Directory of Wisconsin Mineral Producers
Wisconsin Geological and Natural History Survey
Information Circular 42
(see #1, above, for address)

5) Production Reports

U.S. Bureau of Mines

6) State Laws

Wisconsin Department of Natural Resources
101 S. Webster Street
Madison, WI 53703
608-267-3579

SOLID-MINERAL LEASES ON INDIAN LANDS

Richard Wilson, Chief
Bureau of Indian Affairs,
Division of Energy and Mineral Resources
730 Simms, Room 239
Golden, CO 80401
(303) 231-5070
FAX (303) 231-5085

INTRODUCTION

The Bureau of Indian Affairs as a representative of the Secretary of the Interior is charged with responsibility of assisting Indian tribes and individual Indian mineral owners in the development of their mineral resources as a source of income and employment. The Bureau of Indian Affairs assists and encourages Indian tribes and individual Indians to enter into mineral leases or agreements for the development of their trust and restricted lands with the intent of obtaining a maximum economic recovery and reasonable compensation for the development and disposition of their resources. The leasing of Indian mineral resources is influenced by three objectives; (1) orderly and timely resource development, (2) environmental protection, and (3) minimal cultural impacts associated with their development. These objectives are accomplished through proper planning and oversight of development operations by agencies of the Department of Interior. The principal objective of these agencies is to ensure that there are minimal detrimental effects from the exploitation of mineral resources from Indian lands.

The Congress established the scope of the federal trust responsibility on Indian lands which was further defined for the Department of Interior by the federal courts. As a result of Supreme Court decisions, government officials are held to the moral obligations of the highest responsibility and trust and the most exacting fiduciary standards and are bound by every moral and equitable consideration to discharge their trust with good faith and fairness. When the government assumes control over resources and property belonging to Indians, a fiduciary relationship is then established. The elements of a common-law trust are: (1) a trustee (the United States), (2) a beneficiary (the Indian allottees or tribes), and (3) an entire trust estate (Indian timber, lands, resources, land funds). Because of these charges, the Secretary of the Interior is responsible for oversight of Indian lessors interests and has a duty to maximize revenues from mineral agreements and leases.

As a result of tribal sovereignty tribal governments have substantial authority within their reservations. Tribal government authority is distinct from the responsibilities and authority of the Department of the Interior pursuant to Federal regulations and the trust responsibility. In regards to mineral leasing, States have very limited authority on Indian lands.

FEDERAL AND INDIAN AUTHORITIES

Statutory Authority

Mineral agreements on most tribal and Indian lands are authorized by The Indian Mineral Development Act of 1982, 96 Stat. 1938; 25 U.S.C. 2101-2108), and it is the method for formalizing development agreements of tribal mineral lands by direct negotiations and allows allottees to include

their resources in a tribal minerals agreement subject to the concurrence of all the parties involved and approval by the Secretary of the Interior.

Another method is to obtain leases on most tribal lands under the authorization of the Act of May 11, 1938 (52 Stat. 347; 25 U.S.C. 396a-g). Leases on most allotted lands are authorized through the Act of March 3, 1909 (35 Stat. 781-783; 25 U.S.C. 396). Both of these leasing Acts provide for the leasing of Indian mineral lands through competitive bidding and direct negotiations with the mineral industry, but require a waiver from competitive bidding from the Assistant Secretary for Indian Affairs.

Regulatory Authority

*25 CFR 211, Leasing of Tribal Lands for Mining
*25 CFR 212, Leasing of Allotted Lands for Mining
25 CFR 216, Surface Exploration, Mining, and Reclamation of Lands
*25 CFR 225, (Proposed) Oil and Gas, Geothermal, and Solid Mineral Agreements

* 25 CFR 211, 212, and 225 were published in the Federal Register on November 21, 1991, for a comment period of 90 days. 25 CFR 211 and 212 were retitled and now read: 25 CFR 211, Leasing of Tribal Lands for Mineral Development and 25 CFR 212, Leasing of Allotted Lands for Mineral Development.

RESPONSIBILITIES OF GOVERNMENT AGENCIES

There are three U.S. Government agencies that have responsibilities in the administration of Indian mineral agreements, leases, and permits. The general responsibilities of these three agencies are summarized as follows:

Bureau of Indian Affairs

- Approves mineral agreements, leases, and permits.
- Office of record for all mineral agreements, leases, and permits.
- Collects and distributes bonus and rental monies on nonproducing mineral agreement contract lands and leases.
- Approves and maintains files on required surety bonds and corporate information.
- Cancel mineral agreements, leases, and permits.

Bureau of Land Management

- Provide presale and postsale evaluation and technical assistance to the Bureau of Indian Affairs to assist in the approval of mineral agreements, leases, and permits.
- Approve all exploration and mining plans involving Indian lands.
- Performs routine inspection of active mining operations for compliance with the Bureau of Land Management operating regulations, as well as compliance with environmental requirements associated with the mining operations.
- Performs regularly scheduled production verification of minerals

being mined from Indian lands in support of the Minerals Management Service royalty management activities.

Minerals Management Service

- Collects rents and royalties and accounts for monies owed and paid to Indian mineral owners on producing leases, agreements and permits.
- Verifies production volumes associated with sales revenue.
- Collects Monthly Report of Operations from operators/companies.
- Performs routine audits of royalties and rentals paid to Indian mineral owners.
- Provide technical input on the royalty provisions of mineral agreements.

PROCEDURES FOR ACQUIRING MINERAL LEASES, PERMITS, AND MINERAL AGREEMENT

Mineral Agreements and Leasing

There are two methods by which mineral agreements and leases can be acquired on Indian mineral lands. First is through the authority of the Indian Mineral Development Act of 1982 (proposed 25 CFR 225 regulations), which provides for any Indian tribe to enter into a minerals agreement, subject to approval of the Secretary of the Interior. The Indian Mineral Development Act of 1982 also provides for individual allottees to participate in such agreements with tribes, if it is determined by the Secretary of Interior that such participation is in their best interest and agreed upon by all parties. Second, 25 CFR 211 (tribal) and 25 CFR 212 (allotted) provide a means by which a mining company can acquire a lease through an advertised sale.

Negotiations

Tribes may negotiate directly with mining companies under the authority of the Indian Mineral Development Act of 1982 (proposed 25 CFR 225 regulations). This Act empowers tribal governments to enter into any joint venture, operating, production sharing, service, managerial, lease or other agreement, or any amendment, supplement or other modification of such agreement providing for the exploration, extraction, processing, or other development of oil, gas, uranium, coal, geothermal resources, or other energy or nonenergy mineral resources in which tribes own a beneficial or restricted interest, or providing for the sale or other disposition of production or products from their mineral resources.

Agreements negotiated under the authority of the Indian Mineral Development Act of 1982 do not have a prescribed form. All terms are negotiable (i.e., rents, royalty, shut-in royalties, exploration rights, length of term, etc.). The only provisions in an Indian Mineral Development Act of 1982 minerals agreement that are not negotiable are the applicable operating regulations of the Bureau of Land Management and the applicable royalty management reporting requirements of the Minerals Management Service.

Alternatively, mineral leases may be negotiated under the 25 CFR 211 and 212 regulations with the approval of the Secretary of the Interior or his authorized representative. There is no requirement to first advertise mining leases before requesting permission from the Secretary of the Interior to negotiate a mining lease under the authority of 25 CFR 211 or 212. Negotiations conducted under the provisions of 25 CFR 211 authorize the tribes to negotiate directly with mining companies, if all of the requirements have been met. The 25 CFR 212 regulations also contain the same requirements, except that the individual Indian mineral owners cannot negotiate directly with a mining company. The Secretary of the Interior has delegated this responsibility to the appropriate Bureau of Indian Affairs official.

Permits

Prospecting permits for exploration on Indian lands, not associated with an Indian Mineral Development Act of 1982 minerals agreement, may be granted by the Indian mineral owner with approval from the Secretary of the Interior or his delegated authorized official. These types of permits do not automatically grant preferential rights to obtain a lease or leases; unless, there is a separate agreement that is associated with the permit application that has been executed by all parties involved and approved by the Secretary of the Interior.

SUMMARY

The Bureau of Indian Affairs 25 CFR 211, 212, and proposed 225, which implement the Indian Mineral Development Act of 1982, govern the issuance of agreements and leases covering Indian owned minerals for minerals exploration and development. Leases issued under the first two regulations contain minimum acceptable royalty and rental provision and a maximum term of ten (10) years; unless, extended by production in paying quantities. Both regulations allow for Indian mining leases to be leased through competitive bidding or negotiated with approval from the Secretary of the Interior. The tribal leasing regulations allow tribes to do their own negotiating and the allotted leasing regulations provide for the Bureau of Indian Affairs to negotiate on behalf of the individual Indian mineral owner. The enactment of the Indian Mineral Development Act of 1982 for entering into various types of agreements listed under the **Negotiation** section eliminated all of the minimum required terms contained in the 25 CFR 211 regulations for the leasing of tribal lands. If allotted lands are affected by a tribal minerals agreement and are made part of the agreement, then the minimum required terms contained in 25 CFR 212 are also eliminated. The 1982 Act offers tribes and the mining industry greater latitude in negotiating their own mineral agreements that best suit their needs and meet the three stated objectives regarding (1) orderly and timely resource development, (2) environmental protection, and (3) minimal cultural impacts.

Any mining company wishing to enter into negotiations with an Indian tribe for the acquisition of their minerals resources through a 1982 Act minerals agreement can contact the tribe directly or submit the proposal to the local servicing Bureau of Indian Affairs office. This procedure is not available for allotted lands. Allotted lands can only be leased for mineral development through the procedures outlined in 25 CFR 212, except when such lands are affected by a tribal minerals agreement, then the individual Indian mineral owner may participate under the umbrella of the agreement. The individual Indian mineral owner will enjoy all of the benefits that are offered to the tribes when their lands are committed to a minerals agreement.