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MINNESOTA GEOLOGICAL SURVEY

PRISCILLA C. GREW, *Director*

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**INDUSTRIAL MINERALS—TODAY AND  
TOMORROW: THE RAW MATERIALS  
TO BUILD THE UPPER MIDWEST—  
WORKSHOP PROCEEDINGS**

Gary B. Sidder and P.K. Sims, *Compilers and Editors*

Presentations and discussion at a workshop held  
September 10–11, 1992, in Minneapolis, Minnesota

*Report of Investigations 42*

ISSN 0076-9177

UNIVERSITY OF MINNESOTA

Saint Paul — 1993



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## INTRODUCTION

By Gary B. Sidder and P.K. Sims

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This volume contains the proceedings of the industrial minerals workshop held in Minneapolis, Minnesota, on September 10-11, 1992. The workshop examined the major factors concerning the availability of the raw materials needed to build the Upper Midwest. Participants considered the current status of these mineral materials, the projected need for them, problems associated with mining them, and the development of a strategy for assuring their availability. This workshop was the fifth sponsored by the U.S. Geological Survey. The others were held in 1988 at Tempe, Arizona (Tooker, 1989), in 1989 at Marina del Rey, California (Tooker and Beeby, 1990), in 1990 at Salt Lake City, Utah (Tooker, 1992), and in 1991 at St. Louis, Missouri (Bush and Hayes, in preparation). The Minneapolis workshop was held in cooperation with the U.S. Bureau of Mines and the Minnesota Geological Survey and with the assistance of the state geological surveys of Illinois, Indiana, Michigan, Ohio, North and South Dakota, and Wisconsin. Material in this Proceedings Volume faithfully reproduces presentations, discussions, and comments made during the meeting. However, opinions expressed by participants, including U.S. Government employees, do not in any way reflect the policies or positions of the U.S. Geological Survey or the U.S. Government.

U.S. Geological Survey Open-File Report 92-514<sup>1</sup> is the Program with Abstracts volume for the meeting; abstracts for all oral and poster presentations are included there. In addition, the Open-File Report contains fact sheets for each of the eight states and Indian lands that report nonfuel mineral commodity production in 1989, as well as current (as of June, 1992) sources of industrial mineral information and regulation, legal steps necessary for opening and closing industrial mineral quarry and(or) mining operations, and responsible non-regulatory agencies. These latter data are included in the appendix of this volume.

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<sup>1</sup>Open-File Report 92-514 may be ordered for \$23.00 (\$4.00 for a microfiche copy) from:

U.S. Geological Survey  
DFC, Box 25286, MS-517  
Denver, CO 80225  
303-236-7476

The opening kickoff speaker addressed the theme of the workshop, "Problems of U.S. infrastructure in the Twenty-First Century." This was followed by presentations on demand and availability, quality control, environmental issues, economics, and land-use conflicts and solutions. An evening session featured 21 poster presentations on industrial minerals and reclamation in the eight-state region and on Indian lands. During the second day, the morning session included five oral presentations by land-use planners on planning for mineral extraction; planning and zoning; planning, preservation, regulation, and reclamation; land-use classification and conflict; and a regional approach to evaluating needs. The afternoon panel presentation was followed by discussion and comments by workshop participants. The workshop concluded with the keynote speech, which emphasized the extremism of some environmental groups against mining, against science, and against technology.

Several ideas to ensure a sufficient supply of industrial minerals and construction materials for the future were presented. These included the concepts of mining as the primary land use and land banking. Mining should be considered as the first, primary, perhaps temporary, use of the land in some cases. Then, rather than mining under an agricultural permit or a special-use permit, a mining permit would be issued. This would recognize mining as the primary use, its importance to our society, and protect quality resources. In land banking, areas with known resources would be developed for temporary use only or withdrawn entirely from use until the resources were needed for mining. Mining therefore would be established as the primary use of the land, even though mining of the resource may not be required for tens of years. Inherent in these concepts are two vital requirements. One, we must identify where industrial mineral resources and construction materials are located. This means that geologic mapping and resource assessment must be conducted nationwide so that urban and suburban development does not overtake critical resources. Moreover, local planning agencies must recognize and account for these resources in their comprehensive long-range community plans. Secondly, reclamation of the land after mining has to be planned before mining starts and should proceed during the mining stage as

certain parts of the resource are exhausted and abandoned. Subsequent development on the land may even begin before the mining operation is totally completed.

The end-use options for pits and quarries are numerous and varied. Recreation sites, ponds and lakes, office parks, arboretums, amphitheaters, gardens, housing areas of all types, agricultural lands, and golf courses are among the many developments on mined lands. In order to accomplish these goals, the general public must be made aware through educational and public relations programs of both the significance of and the need for industrial minerals and construction materials. The public must also be informed of the incremental additional cost on different kinds of development by removing an available, nearby resource from the market. Coalitions of industry, state and Federal geological and mining surveys, state and local government planners, land-use managers, and regulators, environmental groups, academia, and users of industrial minerals and construction materials need to be formed to address and resolve these issues. Until these diverse groups begin to work together to solve our problems of resource availability, the cost of development, both in dollars and impact on the environment, will continue.

A total of 103 participants and observers from 19 states attended. They represented a broad spectrum from the mining industry, state and federal government agencies, city and county planning agencies, and academia, all of which in one way or another provide scientific and environmental expertise and governmental regulatory and land-management responsibilities. The sessions were recorded and subsequently transcribed, compiled, and edited into their present form. Participant discussions and comments are anonymous; panelist's replies to discussion are acknowledged.

The workshop was followed by a one-day field trip to several current industrial mineral operations as well as roadside exposures in southwestern Minnesota. A total of 37 people participated in the field trip, which was conducted by the Minnesota Geological Survey.

#### ACKNOWLEDGMENTS

The state geological surveys of Illinois, Indiana, Michigan, Minnesota, North Dakota, Ohio, South Dakota, and Wisconsin assisted in the planning of the conference. J. James Eidel, Norman Hester, S. Paul Sundeen, G.B. Morey and Priscilla Grew, Robert Biek,

David Stith, Sarah Chadima, and Bruce Brown, respectively, Zareh Mozian and Stephen Swan, U.S. Bureau of Mines, and Gary Sidder, Michael Foose, and Paul Sims, U.S. Geological Survey, served on the planning committee. Jim Eidel particularly played an important role in defining topics for presentation and identifying and inviting speakers. The U.S. Geological Survey's Office of Mineral Resources provided financial support for the conference and field trip and financially assisted the travel of some participants. The Administrative Office of the Branch of Central Mineral Resources, including Kay Sloan, Vicky Stricker, Diane Schreiber, and Helen Kelly, facilitated travel and logistical arrangements for the conference. The Office Support Staff of the Branch of Central Mineral Resources, including Louise Reif, Marjorie Keithly, Margaret Clemensen, and Louise Taylor, were instrumental in planning and handling the logistics of the conference and preparation of this Proceedings Volume and the Program with Abstracts Volume. Jo Ann Bush admirably performed the painstaking task of transcribing the audio tapes into written text.

#### ABBREVIATIONS AND ACRONYMS

The following list identifies abbreviations commonly used in this volume:

AC	Asphaltic cement
ACIR	Advisory Commission on Intergovernmental Relations
ASR	Alkali-silica reactivity
ASTM	American Society for Testing and Materials
DNR	Department of Natural Resources
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
GPO	U.S. Government Printing Office
HMAC	Hot Mix Asphalt Concrete
ISTEA	Intermodal and Surface Transportation Efficiency Act of 1991
LID	Local Improvement District
LUD	Local "Unimprovement" District
NA(M)BY	Not in anyone's backyard!
NIMBY	Not in my backyard!
PCA	Pollution Control Agency
QA/QC	Quality assurance and quality control
R&D	Research and Development
SMA	Stone matrix asphalt
SME	Society of Mining, Metallurgy, and Exploration
SHRP	Strategic Highway Research Program
USGS	U.S. Geological Survey

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## WELCOME

By G.B. Morey and W.C. Brice

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G.B. Morey: I am Chief Geologist and Associate Director of the Minnesota Geological Survey. I am subbing for Priscilla Grew, the Director who is in Japan attending the International Geological Congress. I want to welcome you on behalf of the Minnesota Geological Survey, the University of Minnesota, and on behalf of the U.S. Geological Survey and the U.S. Bureau of Mines, who are co-sponsors.

I would like to introduce for a few brief comments also, Dr. William Brice, the Director of the Division of Minerals, Minnesota Department of Natural Resources (DNR). He is Chairman of the Minerals Coordinating Committee within the state of Minnesota, which is a legislatively mandated group composed of the DNR Division of Minerals, the Minnesota Geological Survey, and the Natural Resources Research Institute, part of the University of Minnesota in Duluth. Civil and mineral engineering is sort of within the University of Minnesota, but the University now has a 10-year program, at least we hope it will be 10 years, to accelerate mineral exploration and development in the state of Minnesota and part of that mineral development has to do with industrial minerals. Dr. Brice.

W. C. Brice: I have to warn you, the last time I did a welcoming was in June at a mined-land reclamation conference, and I invited people not to spend all their time in meetings; instead, I suggested that they should go out and enjoy Minnesota because we have wonderful things to see and do. I pulled out my friend J.D.'s agate and showed it to the crowd and

said, "You know, this isn't a very good one, but Minnesota has wonderful agates, and, in fact, they're on the north shore, but around here they are in virtually every gravel pit east of where you are and the St. Croix River." It then proceeded to rain and storm and was probably the worst weather Duluth had all summer. I figure the sweater industry really did well that week, and I can't believe anyone went agate picking. So I am going to try it again. This morning my wife said I have a tee time at 10:30, and it's beautiful out, and by 10:30, I noticed, there were big clouds out there. So you should really enjoy Minnesota while you are here, as well as see some of the things in the Upper Midwest that we are doing as far as industrial minerals. I don't know how to tell you to go agate picking around here, because you kind of have to trespass everywhere you go, but as long as you do it in a non-obvious fashion, some of the gravel pits have the best agates in the whole state. They are much bigger than those little dinky ones you find on the north shore of Lake Superior. So that's my little plea, and I hope it doesn't turn to rain and you all have to spend Saturday in that casino down southwest, instead of out looking at the rocks. Because I think seeing Minnesota outside of casinos and conference centers is a whole lot better than sitting listening to people talk.

Anyway, I'm supposed to say the Minerals Coordinating Committee is a unique organization in Minnesota. It's designed to tie together all of the geologic and mineral activities in the state, so that we're not duplicating things, so that we push the buck as far

as you can push it because in these short times, there just aren't that many dollars to go around; so it's important, I think, to try to use the best people available to do projects and to try to get as much work done as possible and spread it around to the organizations in Minnesota that can best do this. As a result, as you probably noticed in the Poster session, we have quite a few projects ongoing. Our Sand and Gravel Handbook was a joint effort of a whole bunch of people. Our work on sand and gravel inventory is presented, as is some work on carbonates and clay. All

those things are important to our future in Minnesota. Industrial minerals are a big industry here. Everybody thinks of Minnesota as an iron ore producer; iron ore is great, but if you look at the numbers, you'll find industrial minerals are a big piece of the economy as well.

G. B. Morey: Thank you, Bill. Our Kickoff Speaker, Nancy Rutledge Connery, is currently a consultant, but formerly was Executive Director of the National Council on Public Works Improvement.

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## RETHINKING AMERICA'S INFRASTRUCTURE TOWARD THE 21st CENTURY

By Nancy Rutledge Connery, Kickoff Speaker

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

*Albert Einstein*

### INTRODUCTION

A few weeks ago, I was asked to make a luncheon address to a large group of local elected officials from around the United States who had gathered in conjunction with the annual meeting of the American Public Works Association. My hosts were quite specific about my task: "We want a really exciting 25-minute talk about infrastructure." It occurred to me that this may be the ultimate oxymoron -- a "really exciting" luncheon address on infrastructure is something like a really enthusiastic neighborhood at the prospect of a new resource recovery plant or a sand-and-gravel operation nearby.

Nevertheless, the subject demands as much spirit and creativity as we can muster -- not only to keep sleepy luncheon audiences awake, but also to accomplish serious infrastructure renewal in the United States.

I am not talking about glitzy marketing campaigns or celebrity endorsements. These may have their place, but they cost a bundle and last about one half-second in the public consciousness. Instead, I want to help engender a passionate commitment to people and places -- the true basis of infrastructure renewal. Regardless of what some of the "experts" say, no amount of capital or concrete substitutes for better understanding and design.

Here is a good example of what I mean.

### STATUE OF LIBERTY AS A BEACON FOR INFRASTRUCTURE RENEWAL<sup>1</sup>

The 100th Anniversary of the U.S. Statue of Liberty in 1986 signified much more than a customary American centennial. Besides the spectacular fireworks,

musical tributes, and lofty rhetoric, the event also chronicled the successful repair and rehabilitation of our nation's most visible piece of infrastructure.

As infrastructure, the function of the Statue of Liberty is more symbolic but no less *real* than say, transportation, waste disposal, or water supply. A close reading of her famous Emma Lazarus inscription:

"Give me your tired, your poor,  
Your huddled masses yearning to breathe free,  
The wretched refuse of your teeming shore.  
Send these, the homeless, tempest-tossed, to me;  
I lift my lamp beside the golden door!"

sets forth America as a vast *human* recycling/resource recovery center for the oppressed of the world. More often than not, its operation is raucous and uneven, but the hope inherent in Liberty's torch is still "the grand incarnation of the American spirit."<sup>2</sup>

In 1982, this beacon of freedom in New York Harbor was close to the point of irreversible decline. Nearly a century of botched modifications, neglect, and intense human use had resulted in significant corrosion. After several more years of political and organizational turmoil, a spirited fund-raising campaign finally emerged -- including prominent executives and countless schoolchildren -- to support and fund a full-scale restoration.

(T)he restoration of the statue as a sculpture would call upon the resources of historians and artists, ... the renovation of the structure would challenge architects and engineers, ... traditional craftsmanship was blended with modern technology, ... the demands of preservation, restoration, and renovation came together to give new life to the symbol.<sup>3</sup>

While the cost to restore the Statue of Liberty exceeded that of the original French production, failure to make her last was unthinkable to most Americans. We knew that we could never duplicate what President Reagan called, her "uncanny fusion of art and engineering."<sup>4</sup>

Behind Liberty's long skirts lies a vast network of other aging, overworked, and neglected infrastructure throughout the United States, waiting its turn to be renewed. Once again, ideals are at stake along with structures. The problem is that, as a nation, we are much less clear or in accord about what infrastructure's guiding principles should be.

*Then is every man an Emerson  
Aghast at the everlasting, wild with surmise  
His daily paper dewy with the news  
Of history's long, slow slouch toward  
That Gotterdammerung...*

*Tom Disch  
"The Crumbling Infrastructure"*

#### REVIEW OF RECENT RESEARCH ON U.S. INFRASTRUCTURE<sup>5</sup>

Infrastructure began its long, slow climb out of political obscurity in the U.S. during the early 1980s. *America in Ruins: The Decaying Infrastructure* by Pat Choate and Susan Walter in 1982 was the "clarion call" which was followed by numerous magazine and newspaper reports about a steady decline in both the safety and capacity of public works facilities throughout the country.

The tragic collapse of the Mianus Bridge in Connecticut in 1983 provided a riveting illustration that major public facilities no longer appeared to be as reliable or in as good condition as we expected them to be.

Several major groups, including the Joint Economic Committee of the Congress, the Congressional Budget Office, and the Associated General Contractors, attempted to quantify the scope and impact of unfilled needs. While their methodologies and estimates varied widely, they were able to document declining trends in capital investment in infrastructure with enough consistency to indicate a serious problem within a rough order of magnitude. This information naturally fueled demands by various public and private interest organizations for increased Federal funding.

During the same period -- the late 1970s to early 1980s -- public confidence in the role of the Federal government as problem-solver began to wane. Constriction of various Federal grant programs and the emergence of a large national debt and a host of other competing priorities signalled that less money was likely to be flowing out of Washington.

In the midst of this conundrum, the U.S. Congress established the National Council on Public Works Improvement (the "Council") in late 1984 to provide an objective and comprehensive overview of the nation's infrastructure. Its mandate was to assemble a series of reports to the President and Congress on such questions as the age and condition of public works, finance methods, maintenance needs, the capacity of public works to sustain the economy, and the criteria and procedures needed to properly assess the nation's public works at all levels of government. This effort was given a rigorous schedule and a statutory sunset date of April, 1988.

At the outset of the project in early 1986, the Council determined that it would not undertake another physical inventory of the nation's infrastructure needs. This decision was based on the conviction that the inventory process was impractical in view of the limited time and resources available to the Council and that it would offer very little substantive policy guidance to the Congress.

Several other national needs studies, as mentioned earlier, were already in the public record. Collectively, these studies offered a reasonably complete view of *available* information on existing facilities.

The Council concluded that assessing infrastructure needs is more than counting and measuring the condition of existing facilities against various technical standards. To the public, infrastructure represents a *flow of services*, such as reliable transport of goods and people, fresh water, protection from floods, and safe disposal of wastes. These are all basic elements which determine the nation's quality of life and its economic vitality.

Government has responsibility to ensure the provision of these services in a safe, reliable, and equitable manner, but that duty does not necessarily bind it to the preservation of all current facilities or to conventional methods of construction and operation. Long-term alternatives may involve new technologies

and better designs, new or improved forms of management, better training and professional staff development, more aggressive maintenance, land-use planning, demand management and user education, joint development with the private sector, or cooperative regional and multiple-use approaches to the provision of services. These practices offer no "quick fixes," but represent a few of the many alternatives and opportunities absent in most needs assessments or crisis-oriented news stories.

For example, as Americans, we tend to believe that mobility in single-occupancy vehicles is a "free good" as well as a God-given right. If we shift our thinking only a little as we have begun to do with water, electric power, and waste recycling, we may begin to regard mobility as a precious resource to be husbanded with the same care that Westerners have learned to do with water and that residents of South Florida are now tragically learning to do with everything. [Editors note: The conference was held shortly after Hurricane Andrew had devastated South Florida.]

A few weeks back, in a radio lecture to the Commonwealth Club, the Chairman of Pacific Power and Gas announced that his company's chief profit center for the next several decades would be the production of "negawatts" -- that is, not producing power by increasing conservation and efficiency. His vision was surely not one of hardship and austerity; he simply acknowledged the immense opportunities for reducing waste without sacrificing overall economic productivity or quality of life. He also expected to make a lot of money by not incurring the staggering costs of new facilities and by making existing plants work better.

In its final report to the President and Congress, *Fragile Foundations: A Report on America's Public Works* (1988), the Council:

found convincing evidence that the quality of America's infrastructure is barely adequate to fulfill current requirements and insufficient to meet the demands of future economic growth and development.

And unless we dramatically enhance the capacity and performance of the nation's public works, our own generation will forfeit its place in the American tradition of commitment to the future.<sup>6</sup>

Besides the famous "Public Works Report Card" and an often misquoted rhetorical statement about doubling the rate of public investment, the Council also recommended specific strategies, such as:

- Clarification of the respective roles of the federal, state, and local governments in infrastructure construction and management to focus responsibility and increase accountability;
- More flexible administration of federal and state mandates to allow cost-effective methods of compliance;
- Financing of a larger share of the cost of public works by those who benefit;
- Strong incentives for maintenance of capital assets and the use of low-capital techniques such as demand management, coordinated land-use planning, and waste reduction and recycling;
- Additional support for research and development to accelerate technological innovation and for training of public works professionals; and
- A rational capital budgeting process at all levels of government.<sup>7</sup>

Several other major Federal infrastructure reports followed in the Council's wake, including: *New Directions for the Nation's Public Works*, issued by the Congressional Budget Office of the U.S. Congress in 1988; *Rebuilding the Foundations: A Special Report on State and Local Public Works Financing and Management* (1990) by the Office of Technology Assessment of the U.S. Congress; *Paying for Progress: Perspectives on Financing Environmental Protection* (1990) by the U.S. Environmental Protection Agency; *Moving America: New Directions, New Opportunities* by the U.S. Department of Transportation (1990); and *Delivering the Goods: Public Works Technologies, Management, and Financing* (1991) also by the Office of Technology Assessment.

Although the above reports, including several more by the independent National Academy of Sciences, have different emphases, technical information, and styles, they are all geared to approximately the same audience: policy-makers at all levels of government, especially in the U.S. Congress and Executive Branch. Together the reports render an imposing compilation of

guidance on improving long-term public works performance. They also signal that infrastructure has "come of age" as a serious national issue.

Curiously, none of them make much reference to the cultural, economic, or environmental context in which infrastructure operates. Nor does anybody mention what these often massive structures look like or how they relate (or not) to adjacent neighborhoods, communities, and landscapes or even wonder about such fundamental questions as these: What kind of place(s) do we want to create here? What should it look like and how should it operate? What kind of services do we really need? How much are we willing to spend, perhaps even sacrifice, to sustain it for the long-term?

At their roots, these overlooked questions and issues have much more to do with values than with engineering properties or economic ambitions. They also lead us back to a much broader range of options than may be obvious in the current political rhetoric about infrastructure.

*The world is so upset, that even our most platitudinous concepts, things that would once have been accepted by everyone, require to be looked at a second time.*

*Alfred North Whitehead*

#### INFRASTRUCTURE'S WOBBLY ROUTE INTO U.S. POLITICS

A pundit recently noted that "infrastructure" has become the new way for politicians to spell "M-O-N-E-Y."

After years of relative indifference, American politicians have discovered this ungainly word and now regularly thump the campaign drum about "rebuilding America." Along with infrastructure's enthusiastic and affluent advocates, they argue for big infusions of Federal funds, more construction jobs, private-public partnerships, assorted tax code changes, and innovative technology and training.<sup>8</sup>

A recent *New York Times* column announced that:

Bill Clinton wants Uncle Sam to invest an extra \$20 billion annually to "develop the world's best communication, transportation,

and environmental systems." Even the hard line free marketeers left in the Bush Administration seem reconciled to sweetening private investment in toll roads and bridges with Federal matching funds.<sup>9</sup>

In another column in the *New York Review of Books*, financier Felix Rohatyn recommended a trillion dollars in new public works investment, but contended that:

the fact of a sizeable long-term commitment to infrastructure on the part of the Federal government is more important than the exact amount to be invested ... The need for such investment *should no longer be a matter of debate* (italics added).<sup>10</sup>

One rationale for an investment of this magnitude is that many of our toughest trading competitors are investing much more than the U.S. for public infrastructure. For example, "Taiwan, approximately the size of Pennsylvania, has announced a six-year plan for investing \$600 billion ... West Germany will have invested \$1 trillion in East Germany, a country of 17 million, by the year 2000."<sup>11</sup>

Mr. Rohatyn does not offer any information on the current value, capacity, or condition of public works assets in these other nations compared to that of the United States. Thus, it is hard for the reader to draw any conclusion other than perhaps these nations failed or were unable to invest enough in infrastructure in the past and are now urgently trying to catch up.

Another driving force is a popular macroeconomic theory that this investment will promptly yield big increases in GNP and private investments. Its chief proponent, economist David Alan Aschauer of Bates College, estimates that:

a one percent increase in the level of core infrastructure will increase GNP by as much as 0.24 percent. Moreover, after four years or so, each additional dollar of public investment in infrastructure will raise private investment by 45 cents ....<sup>12</sup>

Other economists have vigorously challenged the statistical basis for this conclusion. For example, Dale Jorgenson of Harvard University contends that:



Infrastructure investment is productive but the taxes that finance this investment are a drag on the economy. Selecting the appropriate investment level involves weighing the benefits against the costs .... By failing to make use of markets in determining the appropriate level and distribution of infrastructure investments, we have overinvested in some areas and underinvested in others.<sup>13</sup>

Clifford Winston of the Brookings Institute argues that the Aschauer result is simply not relevant since the prices charged to use existing facilities bear little relation to actual cost. "If, for example, heavy trucks were charged for the damage they caused to highways, more freight would move by rail."<sup>14</sup>

The relationship between public and private investment and productivity is apt to be hotly debated for a long time. In the meantime, the theoretical arguments are nearly overwhelmed by the political need to produce jobs quickly in the U.S. -- regardless of their actual impact on infrastructure performance.

Nevertheless, there are at least three reasons why a substantial increase in Federal infrastructure investment for the sake of boosting productivity in the near-term may be problematical.

First, since the U.S. already has a substantial public works asset base<sup>15</sup>, new investment with an emphasis on prompt job creation carries the risk of simply "paving over" complex operational or structural problems with costly and inappropriate repair or built solutions. As observed by the National Council on Public Works Improvement:

Physical assets, such as pipes, bridges, and lane-miles of freeway make (infrastructure) service possible, but they come with no guarantee that they will deliver the quality, quantity, or cost of service needed to sustain our economy and standard of living.<sup>16</sup>

Infrastructure performance in both engineering and economic terms depends not only on the system's structural capacity, but also on its operational efficiency and quality of service, the dynamic physical, economic, and social environment in which it operates, and the changing patterns, resources, and expectations of the users. To invest in structures without paying close

attention to their context and the present and prospective patterns of usage may do little more than buy time. At worst, such ventures may cause even more intractable problems in the future due to our failure to fully understand and address the complex nature of the problem now.

While infrastructure planning, management, and accounting practices have improved slightly in recent years, the Council's research indicated that as of the late 1980s:

too many infrastructure investment decisions in America are made "by the seat of the pants." Small and medium-sized jurisdictions (and many large ones, too) do not have complete inventories or existing facilities; most do not conduct regular surveys of the condition of public facilities or collect information on the quality, quantity, or cost of services. Only a handful of jurisdictions take advantage of established analytic techniques for computer mapping, life-cycle cost analysis, automated asset management, or precise tracking of growth trends.

Traditional U.S. engineering education and professional development, while among the best in the world, strongly emphasizes design and construction techniques for new structures at the expense of other critical areas such as deterioration science, assessment technologies, and renewal engineering which are needed to properly rejuvenate existing structures and systems. Not surprisingly, the resources available to do basic research in these areas have also been extremely limited.

By virtue of education, tradition, and a great body of established regulatory standards and liability considerations, U.S. engineers and planners in public infrastructure management agencies are used to looking for "*the* right answer" in structural terms, notwithstanding the shifting nature of the question. There is an adage that aptly describes this process: "If all you've got is a hammer, the whole world looks like a nail."

For example, if traffic flows too slowly through a given stretch of road, transportation engineers will invariably argue to widen the road. To suggest that the problem could be solved instead by improving the visual image of the road, changing the drivers' habits and perceptions (particularly in terms of time),

modifying adjoining roads, or shifting the contiguous land-use patterns often draws long, blank stares, if not open contempt from many transportation professionals.

Thus, the available body of technical knowledge to "rebuild America" is still quite limited, as are often the attitudes of those assigned to undertake this challenge.

The second reason is financial, though directly related to the first. Capital investment represents only a fraction of the total life-cycle cost of a given facility, including maintenance, operations, depreciation, and eventual de-commissioning. Any major new Federal investment program that does not pay special attention to life-cycle costs and sources of committed and reliable tax or user-generated revenue may be creating an immense unfunded liability for state and local government, as we witnessed with earlier funding programs for secondary sewage treatment facilities. This is particularly problematical if the actual investments provide only modest or temporary economic benefits.

The third reason is a matter of politics. Former U.S. Speaker of the House Thomas "Tip" O'Neill allegedly said that "all politics are local." The same is true for infrastructure.

Most U.S. infrastructure is like homely, hidden underwear that the public would prefer not to see and to simply ignore (until some part of the system fails or is in serious peril). When it comes to siting and building critical large-scale projects such as highways, public transit, resource recovery, or hazardous waste disposal facilities, many citizens are openly skeptical about the benefits, costs, risks, and impacts of certain infrastructure projects in their communities and neighborhoods. Their wariness has spawned a famous acronym, "NIMBY," for *Not-In-My-Back-Yard* and another lesser known, but more pervasive campaign called: "NABY," for *Not-in-Anybody's-Back-Yard*.

Part of this skepticism is due to a common and often quite valid public perception that proposed facilities are designed at an inappropriate scale or quality and are simply massive and ugly in relation to the aesthetics of the community. Planners may not have sufficiently consulted local residents who will be directly affected. Benefits may not be distributed fairly in relation to the financial burden, particularly in terms of the extremely specific, technology-based standards

that often accompany certain environmental regulations in the U.S.

Often, the public does not have the tools to understand the nature of the possible risks. "Lacking a common framework for discussion and analyses of safety, the public and government officials are often poorly prepared to deal effectively with issues related to events that have small probabilities of occurrence and the potential for severe consequences."<sup>17</sup>

Not surprisingly, current political rhetoric at the national level rarely mentions any of the above issues and their possible solutions. Since they represent state and local responsibilities which are generally *not* supported by Federal funds, they are considered less important than capital investment. (One major exception is the new Intermodal Surface Transportation Efficiency Act passed by the U.S. Congress in 1991 which will be discussed briefly later.) They also fail to deliver immediate construction jobs.

The apparent coincidence of our nation's lackluster productivity with infrastructure's declining rates of investment is disquieting but not particularly instructive at the macroeconomic level. To characterize their complex relationship in mechanistic terms is futile and potentially misleading.<sup>18</sup>

French historian Fernand Braudel aptly characterizes the relationship in this way:

Always, causes and consequences are mingled and connected in an interactive system where each may by turns become cause, driving force, or consequence. Any period of prolonged decline, any long-term rise in living standards, any economic depression that does not right itself in the short term necessarily implies a combination of factors which may include anything: politics, society, culture, technology, war, et cetera. It is the complex as a whole that either stops working properly and begins to destroy itself, or else regains its capacities and stimulates recovery.<sup>19</sup>

There is no doubt that the immediate reality of rusting bridges, collapsing water mains, and traffic jams has serious social, political, and economic implications. So is the fact that U.S. infant mortality rate has risen to twenty-third among the world's nations, that homicide is now the leading cause of death among young black

males, that AIDS threatens the lives of countless Americans in an already overburdened health care system, that millions of Americans cannot read, write, or do simple computations, or that the U.S budget deficit threatens to thwart economic growth when we need it most.

And even at their worst, U.S. infrastructure problems can seem trifling in comparison to the resurgence of cholera and other water-borne diseases in Central and South America, widespread famine and starvation in the Horn of Africa, or the devastating pollution problems throughout Eastern Europe and the former Soviet Union.

At issue is not whether the U.S. should invest scarce resources in its vast public works trust; but rather, how, when, where, and how much in relation to a vast array of other compelling public needs.

One hopeful sign is that the U.S. *is* investing more in public works improvements now than any time since 1960s, due to successful passage of state and local bond referenda. According to George Peterson, Senior fellow at the Urban Institute: "Between 1984 and 1989, bond approval rates once again reached the high level of the post-war 1950s -- nearly 80 percent." He also notes that: "Voter support has been strongest for the core infrastructure functions of sewer systems, water systems, and roads and bridges."<sup>20</sup>

Another boost in public investment came at the end of 1991 when Congress passed the Intermodal Surface Transportation Efficiency Act. The \$155 billion, 6-year transportation program is expected to help rebuild the nation's highways, bridges, and transit systems. Besides the customary "pork barrel" (also known as political patronage) projects, the bill contains striking innovations in terms of state and local flexibility of funding and new emphases on planning, land-use, citizen participation, scenic byways and other aesthetic enhancements and environmental matters.

*As we rebuild the world, we rebuild ourselves.*

*E.V. Walter* <sup>21</sup>

#### ONE VIEW ON THE CURRENT AND FUTURE STATE OF THE UNION

The U.S. is a vast polyglot nation; both its political and actual landscapes grow more complex and

confusing every day. The problems of transportation, water supply, and waste disposal are as diverse and elusive as the many places in which these systems operate. Our concerns and expectations as citizens, consumers, environmentalists, or government and business leaders are even more disparate.

Generally, as a nation, we do not appear to be in a mood right now to take on major new financial risks in the wake of a prolonged and bruising recession and with the prospects of an even riskier economic future. "Planning concepts that rely on the certitude of a straight line running strong into the next century do not inspire confidence."<sup>22</sup>

Even more disquieting is the possibility that the structural decay is symptomatic of a deeper erosion of the "public realm" in America. Writer Mickey Kaus describes this as the:

sphere of life where money doesn't "talk," where the principles of the marketplace (i.e., rich beats poor) are replaced by the principles of equality and citizenship.<sup>23</sup>

Institutions such as public schools, libraries, city or town halls, highways, and parks are all key elements of the American public realm and provide a stage where "rich and poor ... actually rub shoulders with each other as equals"<sup>24</sup> and can rightfully expect equal access to service.

Historically, these institutions have served as the binding agents which held cities together in spite of great disparities of wealth and privilege. They also helped educate people in "the art of making public choices and agreements."<sup>25</sup> The late Renaissance scholar (and former U.S. Baseball Commissioner) Bart Giamatti described politics as "the ultimate act of negotiation in a city ... *flowing from the central choice not to live alone but among others* (italics added)."

Over millennia, this refinement of negotiation -- of balancing private need and public obligation ... becomes a civilization. That is the public version of what binds us. That state is achieved because city dwellers ... have smoothed the edges of private desire so as to fit, or at least work in, with all the city dwellers, ... without sharp edges forever nicking and wounding, each refining an individual capacity for those thousands of

daily, instantaneous negotiations that keep crowded city life from being a constant brawl or ceaseless shoving match.<sup>26</sup>

The chance to be "civilized" now holds less sway for the millions of Americans who have elected to leave the city (and its streets, libraries, and public schools) for racially and economically homogeneous, often private suburban enclaves. *The Economist* reports that: "Walled cities, popular in medieval Italy, are making a comeback in suburban America."<sup>27</sup> In 1989, "there were 130,000 community associations ... helping to administer the lives of 30 (million) people -- one out of every eight Americans." Some associations manage a single condominium building, but the great bulk, "some 80 (percent) of community associations administer territory as well as a building. Their average size, according to one recent study, is 543 housing units."<sup>28</sup>

The hope of cleaner air and safer streets and a widely dispersed pattern of highways and job opportunities have all strengthened and subsidized their choice. Left behind in this phenomenal migration is a tremendous historic investment in infrastructure and a growing concentration of the poor (including a high proportion of racial minorities) who are not readily welcomed in the suburbs and have fewer job openings in a shrinking and frequently impoverished city.

The absence of proximity means that the historic "ties that bind" all Americans, rich and poor, are pulled too far and crack just like the decks of a neglected concrete bridge. Also left behind is our first-hand experience and knowledge on how to navigate and negotiate within this rocky new public realm.

Architect and urban designer Eduardo Lozano has observed that: "... urban problems may be symptoms of increasing incoherence within the system ... the only way to bring about a viable new system would be to rearrange it structurally."<sup>29</sup> Convincing millions of Americans to step back within historic city borders is probably not realistic at this time. Yet neither can we realistically expect millions of Americans to continue to live on city's "meanest streets" without occasionally revisiting the kind of chaos we witnessed in Los Angeles. [Editor's note: Burning, looting, and protesting that followed the acquittal of police officers charged with beating motorist Rodney King in late April and May, 1992.] Humane infrastructure renewal should help to unite us rather than to drive us further

apart. The only real boundaries of communities are in our minds.

*Against the constant jeopardy of decay,  
there is the necessity of constant renewal.*

Wendell Berry

## TAKING CARE OF SYSTEMS AND STRUCTURES

Genuine renewal is to make something "as strong in body as in spirit" as we did with the Statue of Liberty. Thus, renewing America's infrastructure is more than patching potholes, plugging water leaks, privatizing garbage service, 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 effective means to understand and heal the causes of infrastructure decline, not merely its symptoms. 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.

As a set of facilities held in common, infrastructure is a kind of public trust or common wealth that should manifest something more than the sum of its separate parts. It serves as a slender thread that weaves together integral human needs and values with those of our environment. Renewal of its physical design and operation should move us toward coherence instead of fragmentation, awareness rather than contempt or disregard for nature, and dynamic rather than dulling relationships between people, communities, and the natural world.

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. Our economy is clearly shifting away from its historic base of natural resources and heavy manufacturing to services and high "value-added" products that stretch our creativity and keep us head-to-head with aggressive, highly-motivated competitors in Europe and the Pacific Rim.

Our most critical resource for future competitiveness then is *people*, rather than grain, coal, or steel. Creative, healthy people need similar kinds of places in which to live and work.

Clear moral leadership from political, religious, business, and community leaders represents the first step toward affirming civitas, our shared responsibility as citizens. Beyond the "bully pulpits," we need to swiftly develop and widely distribute engaging new tools so that the public -- both adults and especially children -- can discover what it means to live and work *in a place* and to make good investment decisions.

These tools must enable us to recognize competing interests and offer a means for helping us to balance them. They must offer a process which equips all participants to understand the kind of future they want for their cities, towns, and regions, and for visualizing the likely impacts, risks, and opportunities presented by each choice.

This new approach must reach well beyond what we conventionally view as technology. Ron Jensen, Public Works Director for the City of Phoenix, Arizona, and former President of the American Public Works Association, speaks eloquently of "the artist as a bridge to the community." Artists and designers can often see critical new connections that strengthen the function as well as the public acceptance of a project. He and other city officials have worked closely with artists on a variety of major public works projects to create both stunning and efficient structures such as Phoenix's new solid waste recycling/transfer station. The project which will come on line in the fall of 1992 is designed to solve specific and immediate trash problems; it will also help to "heal" a badly scarred landscape, improve water quality at the site, provide salvageable materials to artists and others, and attract and educate the public on the critical matter of waste disposal.

Technology offers tremendous opportunities for enhancing the consensus-building and decision process about infrastructure in addition to improving the

physical elements of the system. Techniques such as satellite observation, remote chemical and physical analyses, complex computer modeling, visualization, and decision-making systems, and other forms of computer processing of information can give us a wealth of information about the present condition of the system, the bases for creating and testing alternative scenarios for the future, and eventually the courage and commitment to select and implement the best course of action.

However, the key to future success lies in our social systems and ultimately in our ability to comprehend and act wisely on the problems we face. We need the artist and poet as well as the engineer to give us insight.

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."

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#### PARTICIPANTS DISCUSSION AND COMMENTS

• What is the current status of the National Council of Public Work Improvement?

Reply: In April 1988, according to the legislation, I closed the doors and turned \$600,000 back to the Treasury, so it's done. Unlike most Federal agencies, it did not continue, but the reports continued in a fairly active fashion through a number of other activities. There are at least half a dozen of them underway right now. "Rebuild America" is a very popular and active one, supported by a broad range of municipal organizations as well as contractors and various suppliers of infrastructure services. Senator Moynihan and others of Congress have continued to remain very active, and there will be continuing hearings, in fact, I understand there will be a whole series this fall. There is a number of other organizations, a Competitiveness Policy Council, that was set up by the Congress. This is one which is chaired by Fred Bergstrom and includes many corporate heavyweights throughout the country, has an infrastructure subcommittee, in fact, I am a member of it, that is going to be submitting a report to the full committee, which will submit it to the Congress and the President sometime early next year. Countless others. There is not any formal body within the Federal Government right now, and there is a great deal of concern about that. I know there have been some continuing discussions; the Army Corps of Engineers and the Advisory Commission on Intergovernmental Relations, which obviously is another Federal agency, are exploring how the Federal agencies might work together. There is no bridge now between them. Just for the first time ever, there is at least some kind of initial contact between, say for instance, the Department of Transportation and the Environmental Protection

Agency. The confluence of their decision is now just beginning to be realized but there is no kind of on-going kind of apparatus. Whether there should be is another question, but at least there is an effort to explore that question to see whether we need some sort of central focus. Long answer to a short question.

- I've been concerned about the National Council's report and others like it in states; in our state we have a report that looks at what infrastructure needs are required, looks at billions of dollars required to replace and repair, with no concern about the resources required and no concerns certainly of where they might come from. In some cases, we are looking at doubling the quantity of resources required, and my question is, "how can studies like this go on and attempted solutions be considered without looking at where these materials are going to come from?"

Reply: I think you have hit on one of the most critical questions, and, in fact, typically these studies have been produced by people who are sort of technically inclined to the question rather than the politics of it. My hope is that as this discussion begins to open up more political ground that the question of resources takes shape, because it isn't just a matter of funding these facilities. If we had a wish list, I mean, if we had, this money that would descend from heaven and we could have everything on the list, it would not necessarily give us better infrastructure. But I think the more important question is, when you're looking at a whole spate of demands right now, the process by which we have to sort them through, needs to be vastly improved. The public doesn't come easily into the political equation. It's a very hard thing to get people to attend local meetings on these questions, as you well know. I'm married to a politician now, and know how hard it is to get people to show up on critical questions even though they'll complain loudly and long about tax

raises that might come with it. My hope, frankly, is that our best shot is helping to educate our children how to look at these questions. I'm not sure that we're going to solve it any time soon. The political environment has become so fractious and so single-minded, with, single purpose organizations ramming through their own agendas, until we can begin to understand how they interact, particularly in relation to a defined area, it's just talk. The budget deficit is certainly going to keep some check on this, but, I wish I could give you a more succinct answer. It's a very difficult question.

- The Council reports were available after they were published for about a year and a half. Now they have vanished. I cannot find anything. I keep referring people to those reports. There is the main report, that would be the first one, and then there were about 100 and something additional reports. I don't expect all the files of those reports to be still available, but the main report. Is it still available and if so, where, please?

Reply: I am told, and I have not checked recently so I don't have this firsthand, but I am told that they are available through the Government Printing Office for \$15.00, so if you call whatever GPO number you've got in Washington, D.C., they can provide help to you, and if you don't get help from the GPO call the Advisory Commission on Intergovernmental Relations. ACIR, which is its acronym, was set up after the Council was closed down to provide a repository for this information. So I believe they have at least a few of those that they might be able to make available. I suppose if you all called, they would get a little wary, but there are at least some available through ACIR, but more importantly they can put the pressure directly on the GPO to reprint it. If there is enough demand, the GPO would be happy to reprint it because then they can make money.

# NEW CONSTRUCTION MATERIALS DEMANDS AND RESOURCE AVAILABILITY

By Geoff C. Harris

## INTRODUCTION

Most agree that America's infrastructure is badly in need of repair and upgrading. Federal spending on infrastructure projects increased at a rate of 4.3 percent per year between 1970 and 1989 (Chief Executive (U.S.), September 1991). During the 1980s, public works spending in the United States dropped to a mere 0.3 percent of gross domestic product, compared with 3.3 percent in the major European economies and 5.7 percent in Japan. The recent enactment of the Federal Highway Act and prospects for reduced defense spending after the end of the Cold War have raised hopes that public works spending may increase enough to end or even reverse the decline.

The construction materials industry shares a common wish in the return of levels of funding to adequate and stable levels. We also have to address the issues of increasing constraints on expanding existing mining sites or in creating new sites. These issues seriously impinge on our ability to maintain supplies of quality construction aggregates at today's competitive cost levels.

## FEDERAL PROGRAMS

Highway fund apportionments (fig. 1), if realized, would provide a major boost to the construction sector and, consequently, aggregate demands.

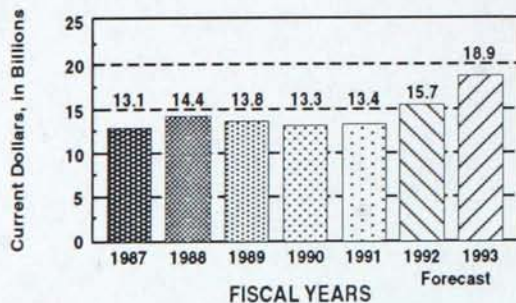


Figure 1. Federal highway apportionments, 1987-1993. Source: Portland Cement Association.

The impact of federally funded highway construction (fig. 2) on demand for aggregates, for example, differs markedly from state to state. The impact varies primarily as a function of the type of federal projects funded in any particular year (construction, resurfacing, planning and engineering, right of way acquisition, bridges) and the expenditures on federal highway projects as a share of total construction in each state. The direct impact of federal funds on aggregate demands varies from 11 percent of the Midwest states total annual usage to as high as 80 percent.

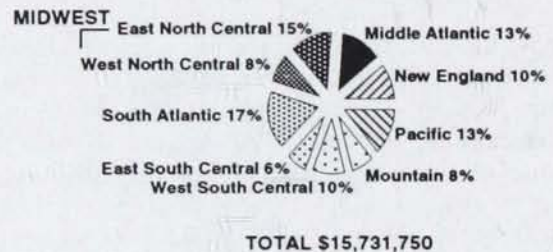


Figure 2. Federal highway apportionments by census districts for 1992. Source: Portland Cement Association.

Concerns over reliance on projected federal fund availability are well founded and are a consequence of the federal budget dilemma causing a choking of fund transfer from the Highway Trust Fund.

Further, the current recession combined with more fuel efficient automobiles has caused a shortfall in gas tax revenues of more than a billion dollars in FY 1992. The shortfall is expected to continue at the rate of \$1 billion per year through FY 1996.

Federal appropriations will not reach the levels authorized in the Highway Act. In the 1992 budget, President Bush requested actual spending for highways at a level \$2.25 billion less than authorized.

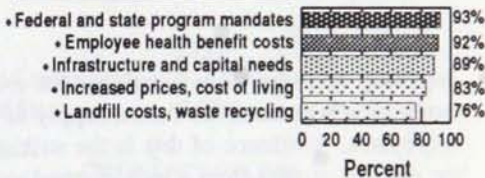
The House of Representatives of the U.S. Congress recently appropriated \$19.35 billion for the highway programs, an increase of \$1 billion, but still \$1.25 billion less than authorized. President Bush threatened a veto on this also.



To complicate matters, the shortage of state matching funds is a major obstacle to commissioning the much needed projects. Despite 1991 tax increases in 31 states, shortages in excess of \$12 billion still exist. Some 19 states are expected to vote on a fuel tax increase this year compared to 11 during 1991. Last year, fuel tax increases ranged from 0.5 to 5 cents per gallon; state fuel taxes now average 17.5 cents per gallon. States are simply running out of options for raising additional revenue.

The results of a survey by the National League of Cities illustrates the interlocking nature of the federal budget crisis, local budget problems, and reduced levels of capital spending (fig. 3).

**PRIMARY CAUSE OF FISCAL CRISIS**



**ACTIONS TAKEN IN RESPONSE TO FISCAL CRISIS**

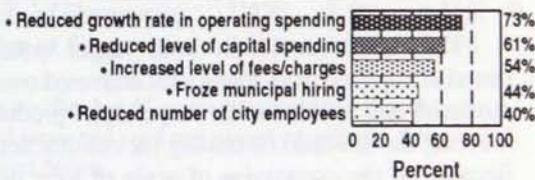


Figure 3. United States cities face a fiscal crisis. Fifty-four percent of cities have a negative balance sheet. The primary causes of fiscal crisis and actions taken in response to a fiscal crisis are shown. Source: National League of Cities, 1992 survey of 620 cities and towns.

**FUTURE SUPPLY OF CONSTRUCTION AGGREGATES**

In the background of the past and present economic forces, the demands on aggregates will continue to grow, but certainly at modest rates overall. Some regional areas will cycle more significantly than others as local forces prevail (e.g., Florida versus Texas versus Midwest, etc.).

Some of the issues the aggregates industry faces in the continuing effort to supply adequate quality materials will place much pressure on containing costs/prices at current economic levels (figs. 4 and 5).

**CRUSHED STONE**

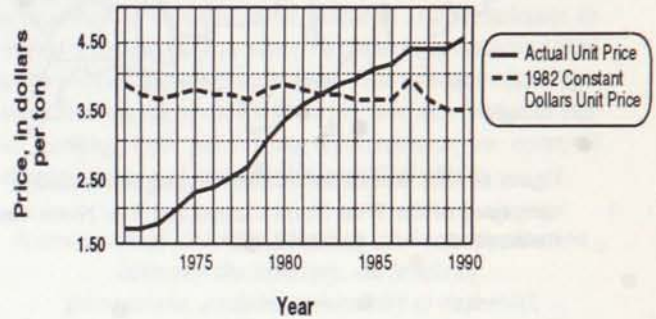


Figure 4. Time-price relations for crushed stone. Data for the years 1982, 1984, 1986, 1988, and 1990 are estimated. Source: U.S. Bureau of Mines, and Rock Products, June 1992.

**SAND AND GRAVEL**



Figure 5. Time-price relations for sand and gravel. Data for the years 1982, 1984, 1986, 1988, and 1990 are estimated. Source: U.S. Bureau of Mines, and Rock Products, June 1992.

By definition, the Midwest is the 12 states of the East North-Central and West North-Central census regions as shown on figure 6. The construction aggregate industry differs amongst the various regions of the U.S. Characteristics compared throughout the U.S. in the following categories are:

- Sand & gravel versus crushed stone.
- Relative share of truck versus water versus rail versus on-site delivery of aggregates.



Figure 6. The area of the Midwest aggregates industry, comprised of the West North-Central and East North-Central states, is shown in patterned fill.

- The degree of difficulty usually encountered with zoning and permitting of mineral production sites (fig. 7).

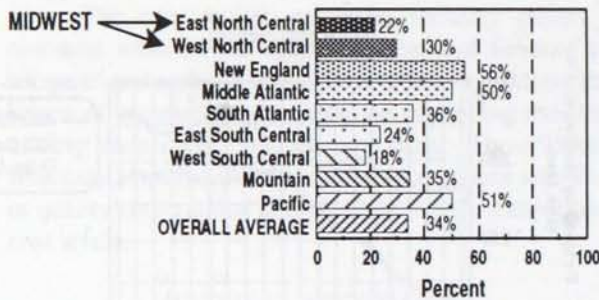


Figure 7. Percent of aggregate producers with permitting, zoning, and land-use problems by census regions for 1989. Source: Pit & Quarry, December, 1989, p. 70-74.

The Midwest produced 620 million tons of construction aggregates in 1990, or 29 percent of the U.S. total, delivered aggregate more by water and less by rail (fig. 8), and experienced moderate to below average difficulty in permitting.

#### PROBABLE CHANGES AND TRENDS

The changes and trends affecting the aggregates industry will tend to limit continuing access to raw materials and escalate current price levels. Growth of urban centers, planning and zoning restrictions, and environmental interest pressures combined with the

#### TRANSPORTATION OF AGGREGATES

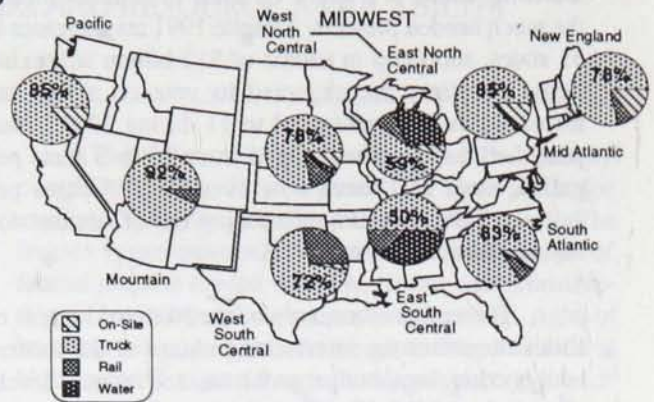


Figure 8. Mode of transportation of aggregates in census regions of the United States. Source: Pit & Quarry, May 1991, p. 29.

depletion of reserves at existing sites are all current trends which threaten the future supply of construction aggregates. Evidence of this is the striking decline in the number of sites from which crushed stone and sand are mined (fig. 9). In ten years, the number of sites has declined by about 2,100 (20 percent).

This trend results in both larger volumes of materials supplied from fewer sites delivered over longer distances, and upside for the recycling of products, thus reducing the demands on mining for construction needs. Because of the economies of scale of long distances, water, rail, and on-site delivery alternatives will be more utilized over truck transport. Crushed stone will continue its increase in usage compared to sand and gravel (fig. 10), and quarries will be fewer, larger, and more underground where economical. Recycling will continue its trend and overall acceptance.

#### NEEDS AND RECOMMENDATIONS

As indicated by the previous figures, industry improvements in efficiency and productivity have allowed aggregate prices to remain stable in constant dollar terms, increasing since 1971 at a rate below the rate of inflation. Continued resource availability and supply at reasonable costs and economics will depend on successfully addressing some of the following issues.

- Better construction aggregate specifications and end-product designs and mixes.

- States and cities need to adopt a master planning approach which identifies mineral deposits and provides a sensible plan of cooperation and coordination with future community needs.

I was most pleased to read articles which are to be presented by speakers tomorrow representing this strategy that is being applied in Minnesota and Illinois. A current experience within our company is demonstrated with the example from Florida (South Florida Freshwater Lake Belt Plan). There are many other examples within the Midwest of post-mining end use success involving attractive residential developments.

#### SAND & GRAVEL

Year	1979	1986	1990
Number of Companies	5,000	4,323	4,094
Number of Sites	7,000	5,797	5,665

#### CRUSHED STONE

Year	1979	1985	1989
Number of Companies	1,876	1,790	1,716
Number of Sites	4,200	3,557	3,416

Figure 9. Number of companies and sites from which crushed stone and sand and gravel are mined. Source: U.S. Bureau of Mines.

CENSUS REGION	TOTAL AGGREGATES	SAND & GRAVEL	%	CRUSHED STONE	%
Total U.S.	2,132,600	910,600	43	1,222,000	57
Midwest:					
East North Central	401,612	184,112	46	217,500	54
West North Central	219,514	97,714	51	21,800	55
New England	69,726	42,726	61	27,000	39
Middle Atlantic	221,395	64,495	29	156,900	71
South Atlantic	389,149	80,749	21	308,400	79
East South Central	185,756	43,556	23	142,200	77
West South Central	206,580	79,580	39	127,000	61
Mountain	145,858	113,858	78	32,000	22
Pacific	286,688	203,788	71	82,900	29

Figure 10. Annual production of sand and gravel and crushed stone, by census region. Amounts in thousands of tons. Source: U.S. Bureau of Mines.

- Finally, and perhaps the most difficult challenge, is the stabilization of funding for infrastructure needs at both the State and Federal levels, preferably based on dedicated

taxes and user fees to enable company's to commit long-term capital investment to long-term permitted mineral resources.

#### CONCLUSION

We are fully aware of the challenges ahead and are committed to investment in research and techniques to improve quality and productivity, but are concerned that costs will escalate nevertheless. The primary challenge of increasing regulation and longer haulage distances due to zoning and permitting restrictions on mineral reserves near markets calls for a unified effort.

*A commitment to better planning and communication between the industry, all levels of government, and the community is essential.*

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#### PARTICIPANTS DISCUSSION AND COMMENTS

- I've been reading in the last several months about how much longer the roads last in northern Europe than the roads in the United States. What do we have to do to make our roads last as long as theirs?

Reply: Can you write that question and mail it in to me and I'll get my technical expert to answer that! Well, certainly, the issue, if you look at the types of geology and resources available on the aggregate side of it, and that's only one part obviously of a road construction mix, it's the set up, it's the base material for drainage; by really applying a lot more stringent specifications, they do have some generally better products available, tighter envelopes and much more pressure on producing a better quality longer-term product than we have. In the past, we have not put ourselves in that particular area. Those simple examples that I put up there of deformation just really

is research available to everybody that has been completed in the last 12 to 18 months, or say by our particular company trying to establish what can be done in the Midwest. With very little cost and a little more focus, we can achieve significant improvements as incremental steps without going to any of these very sophisticated high-cost mixes that are produced in Europe. I use that term high-cost in relative terms. You've got to take the long-term view of a price. I think we can do a lot as an industry, but managing this conflict about the quality bit is the top issue, because what you have and, if I tread on someone's toes too bad, you've got issues where oil companies want to pump a lot of oil into the mix; you've got aggregate producers and Department of Transportation authorities looking at very esoteric specific areas of engineering and technical concern, but not the longer term view to what the end result in the pavement is going to be, and certainly I suspect a lot of the approaches have been a bit self-serving in the past. Put it down and it'll bust up in a couple of years, well, that's really just a waste of everybody's tax dollars. I think we can sell more and more aggregates in new construction rather than just pouring it back into maintenance that is not needed.

So, I'll be glad to have a longer, more technical discussion with you on those sorts of things, but I think in general terms there's a lot of knowledge and expertise in the industry by the producers from the aggregate side, engineering authorities, manufacturers of concrete, and asphalt. If we have a commitment to improve, our roads can be equal to if not better than European roads and built at a lot lower cost. For instance, you pay annual consumption of construction aggregates of about 360 million tons. Well, you recall the graphs I put up. We're talking about 2 billion tons of material a year, so we're talking much greater numbers, much greater economies of scale. We just need to do a much better job with what we've got.

- You had an illustration of two pieces of asphalt, one of which had undergone little or no deformation, by controlling the gradation of the materials. Is that part of an in-house study by American Aggregates? Is this part of a study that has been done by a state organization or a federal organization? What's the source of that information?

Reply: It's 18 months into an in-house study by American Aggregates but, once we got out of the political issues related to the Ohio Asphalt Producers

and Department of Transportation, we're now sharing all that work with them. We are also working with INDOT (Indiana DOT) and Kentucky DOT, and have been knocking on the doors in Michigan, but we haven't had them fly open yet, but we're hoping to make a presentation to them sometime in the next couple of months. And, certainly, we've got no particular bias of the limestone versus sand and gravel because 55 percent of our company's business is limestone and 45 percent is sand and gravel. So, it is in-house, but it's now being shared amongst the industry at large in Ohio and Indiana, and we're happy to work with Michigan as well.

- I would very much like to get a copy of it if it is available.

Reply: Pleasure.

- Your company, American Aggregates Corporation, probably has been one of the leading companies in the United States in the development of mined land. Can you share with us your opinion of the role that the industry, the company, should play in the actual development of the property that they mined out?

Reply: Certainly, as far as the role that the producer can play, it has to take a proactive approach with the local community. Get with the township fathers, township officials, and the local townspeople and sell them on the idea, and get them on the side of the idea of the end use of the mining property once it is completed. American Aggregates certainly in the 1950s, 1960s, and 1970s, has a number of mining operations that are now very beautiful residential areas. It was part of working with the community, working with the township and local planners to get everybody on side and certainly by demonstration, by staying with the project through to finality, making sure that this isn't a "well we'll mine it and leave it behind and abandon it and you fix it up later" attitude. I'm afraid the days of getting by with that are gone, and consequently you see some of the numbers I've put up in terms of the problems of getting permits. But some change of attitude is a long haul, and certainly with people anxious to put profits on the table and profits this month and this year are important for those who have got the ability to look far into the future; again, to get the rewards, the residuals just in the end. But, it's going to be a big culture change and a challenge for the industry to address that.

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## RESEARCH REQUIRED FOR IMPROVED QUALITY CONTROL

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By Marshall Thompson

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I am an Engineer, so I may be a little bit like a fish out of water at this meeting. It is always good to interact with those who are key players in the total program of *AGGREGATE QUALITY*. *QUALITY* in construction utilizing bulk quantities of aggregate is the focus of my comments.

There are obviously many unmet technology and information demands in terms of how to effectively and economically utilize aggregates in construction. My comments are primarily oriented to transportation infrastructure construction with a heavy emphasis on horizontal construction (highway and airfield pavements, railroads) and such things as that.

Horizontal construction consumes a large percentage of the total aggregate quantities that Geoff Harris mentioned. There are many people involved in the process of effectively and economically utilizing aggregates in construction. In many instances, we encounter difficulties because we do not involve **all** of the key players or we have **unrealistic expectations** of other key players. Nancy Connery is right on target with some of her comments, and I thoroughly enjoyed her presentation.

In Engineering Colleges of Universities, we are already finding it hard to get enough technical content in our curricula. We are trying to improve the curricula by presenting some of the concepts Nancy mentioned, i.e., topics such as life-cycle costing and overall systems engineering. These are difficult concepts to teach, and we need more professionals like Nancy to come to campus and emphasize these important factors to our students.

In terms of ensuring quality in construction and trying to identify some research and development needs, it is important to recognize the major elements. We have test procedures. Many of them are standardized. Frequently, we assume they are a lot better than they really are! This may be a problem.

We have specifications and criteria. A "number" from a test procedure means nothing unless it is properly incorporated into a specification along with

reasonable and achievable criteria. I have spent many hours with contractors, attorneys, construction agencies, and others trying to unravel "specification and criteria" problems. They are not simple problems. There are no hardcore bottom lines that are easily reached. Good testing procedures, and appropriate/ realistic specifications and criteria, are the key to achieving *QUALITY* in construction.

When one considers the expanded utilization of various aggregate sources (particularly when reduced *QUALITY* levels are involved), the existing envelope of technology is frequently "pushed." Sometimes we do not make good decisions in these circumstances, because of an inadequate technology base. If we make a mistake, those in the political arena may "bang" on some bureaucrat! Or, you may get local adverse publicity in the newspaper, on TV, etc. Many in the governmental bureaucracy do not want to take those kinds of chances. If we want to push the "technology envelope", we will have less than a 100 percent success rate.

Quality Control (QC) and Quality Assurance (QA) are both important in ensuring *QUALITY* in construction. There is a strong current emphasis in this arena. It is definitely a very appropriate emphasis. More and more frequently, increased and more extensive QC is expected of materials suppliers and contractors. QA is a follow-up activity executed by the purchaser and(or) the owner.

The increased QC and QA emphases may be burdens on some small producers and contractors. For example, to institute a modern quality control program in a hot mix asphalt plant, a major investment is required. You must have "certified personnel", "approved equipment", etc. Some smaller producers really get financially pinched! I was talking to a small asphalt contractor a few days ago. He said, "Hey, I can't do this QC stuff. I am going to have to rely on others to do QC for me or just bail out on certain types of projects." In implementing QC/QA procedures, we need to be cognizant of their impact on various segments (big/small producers and contractors) of the aggregates and construction industry.

QC/QA with heavy involvement on the part of producers, contractors, and agencies is here to stay. It is not a matter of "is it going to happen," but simply the rate at which it will happen. There is a tremendous interest at the national level in quality in construction. This is an appropriate emphasis. There were congressional hearings on the topic in 1992. A good friend of mine, Roger Yarbrough (a Past-President of the National Asphalt Pavement Association), testified at those hearings. Congress is asking, "What are we getting for our highway expenditures?" They want some answers and feedback from the construction industry and material suppliers! Increased attention must be provided to the QA/QC.

So, all of these components are important and essential. We have to pay attention to test procedures, specifications and criteria, and QC/QA. These components cut across a broad range of professional technology. We are all going to have to learn how to play this game together.

The QC process is outlined in figure 11. We have materials (aggregates, binders, etc.) and a production process(es) that provide a "final product." Throughout this process, we have QC interaction. For example, we expect a materials supplier (i.e., an aggregate producer) to do certain types of QC testing to ensure that we have adequate gradation. In the production process, the aggregates are shipped to a concrete "mixing plant." At that level, QC is also exercised. Ultimately, the final product (i.e., asphalt concrete, portland cement concrete, or a bulk aggregate material) will go into a constructed facility (i.e., a highway pavement). Additional QC is also employed at that level. Thus, there is constant assessment of quality in the construction operation.

#### QUALITY CONTROL

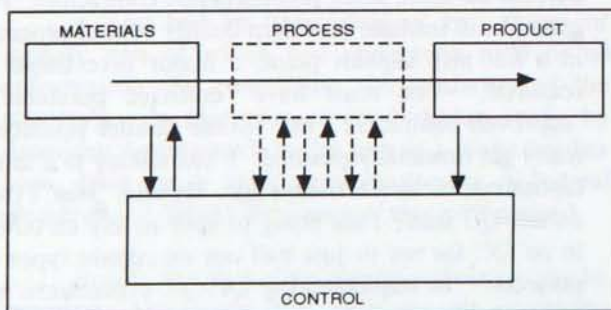


Figure 11. Outline of the Quality Control process.

As a result of the 1991 Asphalt Pavement and 1992 Concrete Pavement tours to Europe, there is an interest and concern about "warranties and guarantees" in pavement construction. In fact, ISTEA (Intermodal and Surface Transportation Efficiency Act of 1991) refers to these issues. There will be an increasing pressure for paving contractors to provide guarantees/warranties. If Joe Doe paving contractor is "under the gun" for providing guarantees/warranties, the aggregate supplier will also be "under the gun." A standard point of contention is that if something goes kaput in a mixture, is the problem associated with the asphalt or the cement, or is it an aggregate problem? In many instances, there is not a clear-cut answer! The guarantees/warranties issue will continue to be a matter of discussion and study for the near future. Figure 11 illustrates the tremendous amount of interaction required to achieve *QUALITY* in construction.

Construction aggregates have many uses. The nation uses tremendous quantities of aggregates as bulk materials for base and subbase in highways and airfields. Aggregates are also extensively utilized as railroad ballast and sub-ballast. These are what I call "first-line" uses. We take a material from a quarry crushing plant, gravel pit, sandpit, etc., and use it in its "natural" state.

On the other hand, we also consume large quantities of aggregate in "bound materials." Aggregate is the bulk ingredient. We use binders such as portland cement and asphalt to produce portland cement concrete and asphalt concrete. There are other "cemetitious" based systems. Lime and fly ash and portland cement and fly ash are used to produce "pozzolanic stabilized" materials. When aggregates are utilized in "bound materials," increased problems are encountered. For example, unsound (lack of freeze-thaw resistance, D-cracking) aggregate, alkali silica reactive (ASR) aggregate, or "stripping" aggregates present severe field performance problems in portland cement concrete and asphalt concrete.

Some typical aggregate requirements, which are routinely checked, include aggregate gradation, liquid limit and plasticity index of the fines, and degradation resistance, i.e., breakdown under handling or repeated loading in the facility. Degradation resistance problems occur frequently and are a particularly sensitive issue. For example, a material leaves the quarry "in spec", but it is checked on the grade, and it is "out of spec." Whose problem is it? Is it the responsibility of the

aggregate producer, or does it belong to the contractor that hauled, placed, and compacted the material.

Durability considerations are still very important and difficult to quantify. Cyclic freeze-thaw/soundness, alkali silica reactivity problems -- ASR distress -- which is now much more frequently noted, stripping in asphalt concrete, and, of course, our old, all-time favorite, deleterious materials, are still key issues. Degradation resistance and durability are areas where I think we have some very significant R&D needs. We are definitely not able to properly, in all cases, quantify the degradation resistance of aggregate materials. We are also experiencing difficulties in the area of durability. We certainly need to pursue R&D in those areas.

Let's examine some of these areas, for example, degradation resistance. In highway pavements, we are moving toward gradations that increase coarse aggregate contact. These gradations produce "big rock against big rock" contact without an intermediate matrix material between the coarse aggregate. We are using open graded sub-bases under portland cement concrete (PCC) pavements and incorporating larger aggregate into typical dense-graded Hot Mix Asphalt Concrete (HMAC). Stone Mastic Asphalt (SMA) is an open-graded material that is currently popular. SMA popularity is the direct result of the 1991 Asphalt Pavement European study tour conducted by the Federal Highway Administration in cooperation with a group of contractors and engineers.

A typical gradation for an open-graded subbase is shown in figure 12. Practically all concrete pavements are now constructed with open-graded sub-bases. Notice in figure 12 that 100 percent passes the 1.5 inch sieve, and only about 5 percent passes the #4. Obviously, there is "big rock-big rock" contact in the system. Open-graded subbases are used in the "natural" state, or a small amount of portland cement or asphalt cement is incorporated to provide some temporary strength while the pavement is being constructed. In either case (natural or treated subbase), there is "big rock on big rock" contact. The primary thrust for open-graded subbase is to provide a high permeability horizontal drainage layer so we can get water out of the structural pavement section into the shoulder edge drain system. Many endorse the use of open-graded subbases, but some of our aggregates may experience degradation problems.

## OPEN-GRADED SUBBASE

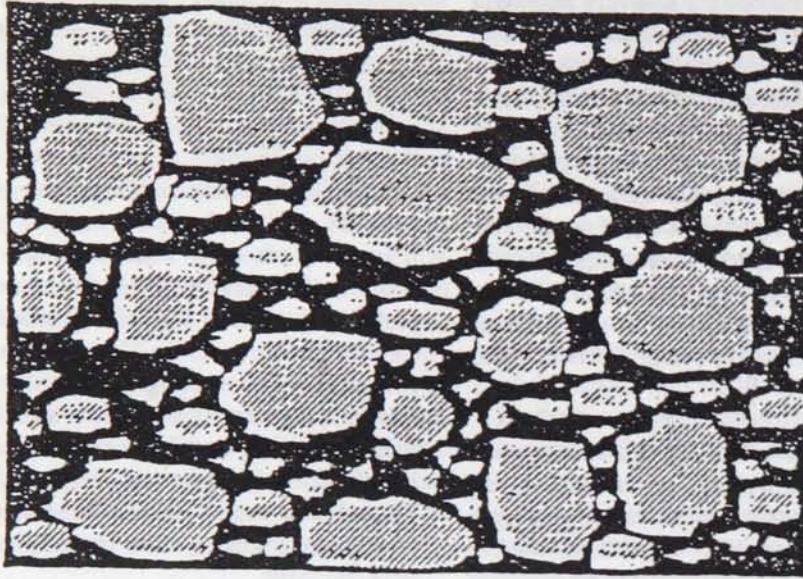
<u>SIEVE</u>	<u>PERCENT PASSING</u>
1.5"	100
1"	95 ± 5
0.5"	45 ± 15
4"	5 ± 5

Figure 12. Gradations for an open-graded subbase.

Let's examine SMA for a moment. This is probably the hottest topic at the moment in the asphalt concrete industry. In the SMA system, there is a higher percentage of coarse aggregate in the mix compared to HMAC. As a result, we have a significant increase in "big rock on big rock" contact, as illustrated in figure 13. In HMAC, the coarse large aggregate basically "floats" in a matrix of finer material, and there is a continuous gradation from the maximum size through the #200 sieve.

Now let us consider SMA. The SMA has increased contact between the large aggregates. The matrix material partially fills the voids, but the coarse aggregate particles are not "floating." This increased coarse aggregate particle to particle contact enhances SMA rutting resistance. Rutting is perhaps the most important property of an asphalt concrete mixture utilized in high truck traffic situations. However, in an SMA mix the propensity for the larger aggregates to break down under construction operations and repeated loading is significantly increased. In a SMA, the "cushioning effect" is not displayed as in a dense-graded HMAC. Typical examples of gradations for a dense-graded HMAC and SMA gradation are shown in figure 14. Notice HMAC is well-graded with about 4 percent or 5 percent passing the #200 sieve. SMA is gap-graded with about 10 percent passing the #200 sieve (fig. 14). In the SMA mix, we have gone "heavy" on the large aggregate fraction, and the finer fraction is fairly gap graded. Consequently, we wind up with a considerable change in the gradation of the aggregates used. Some proposed SMA gradations are shown in figure 15. SMA mixes are primarily used in near-surface course applications (the surface course is the upper 3-5 or 6 inches of asphalt concrete) where there is increased rutting potential. SMAs are rich in asphalt, typically 5-6 percent. Because SMAs have good durability and excellent rutting resistance, they are

# HMAC



# SMA

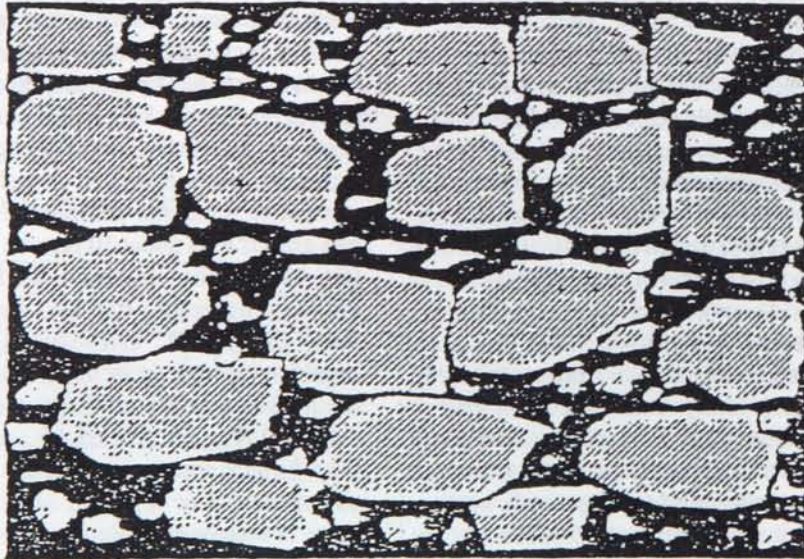


Figure 13. Types of contact between rocks in hot mix asphalt concrete and stone mastic asphalt.



# Mixture Comparison

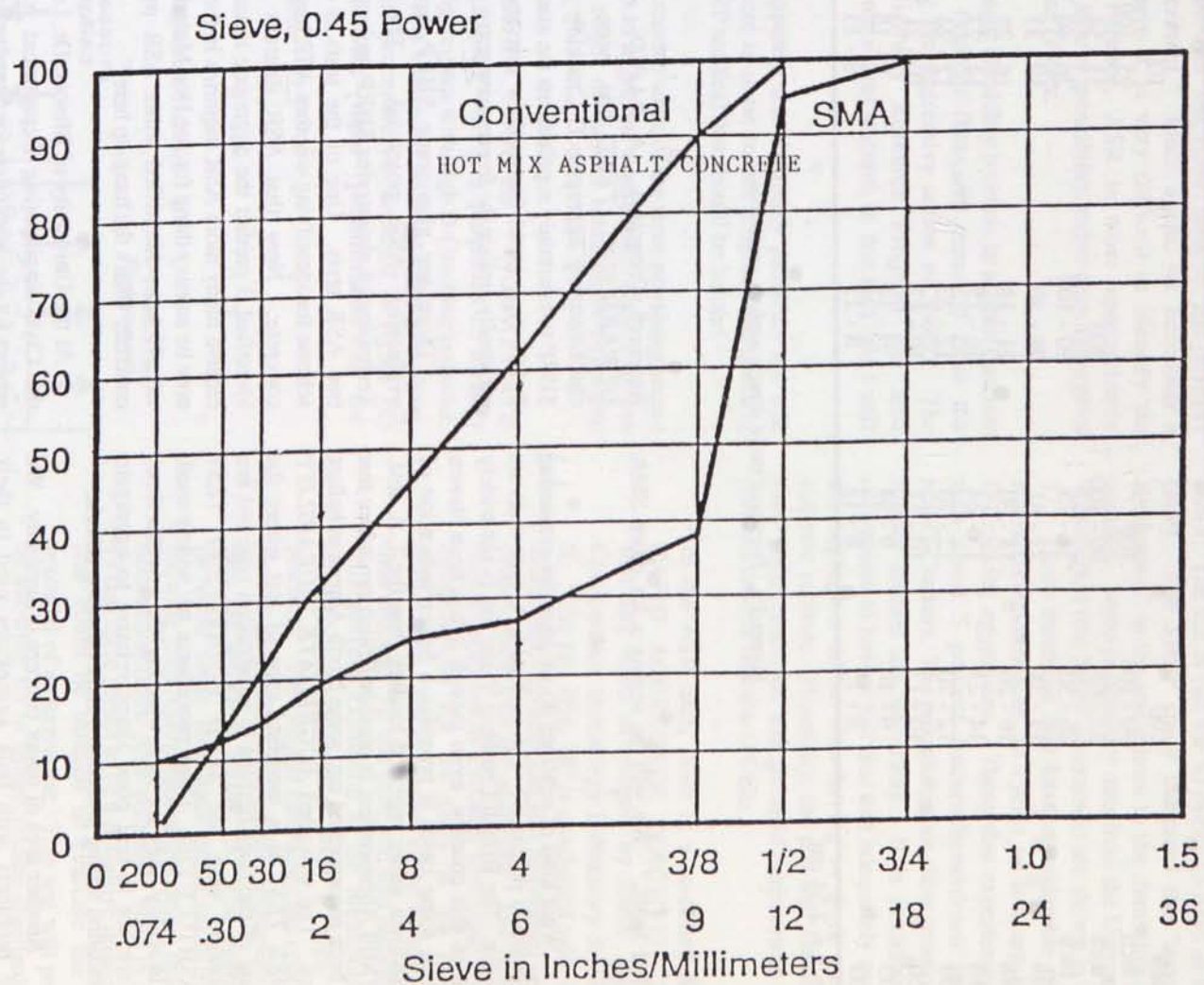


Figure 14. Comparison of gradation for a dense-graded hot mix asphalt concrete and a stone mastic asphalt.

Sieve Size	<u>Percent Passing Each Sieve Size</u>			<u>Meets Swedish Specification</u>	
	<u>Meets German Specification</u>			3/4 inch	1/2 inch
	3/4 inch	1/2 inch	3/8 inch		
1 inch	100			100	
3/4 inch	90 - 100	100		95 - 100	100
1/2 inch	33 - 66	90 - 100	100	33 - 54	95 - 100
3/8 inch	26 - 50	34 - 75	90 - 100	26 - 40	34 - 49
#4	19 - 34	23 - 41	28 - 50	19 - 33	23 - 37
#8	16 - 26	18 - 30	21 - 34	16 - 29	18 - 30
#16	14 - 23	15 - 24	16 - 25	14 - 27	15 - 27
#30	12 - 20	12 - 20	12 - 20	12 - 24	12 - 24
#50	10 - 17	10 - 17	10 - 17	10 - 21	10 - 21
#100	9 - 14	9 - 14	9 - 14	9 - 16	9 - 16
#200	8 - 13	8 - 13	8 - 13	8 - 13	8 - 13

1 inch = 2.54 cm

Figure 15. Proposed stone mastic asphalt gradations.

a "hot topic." We will be seeing a lot more SMA R&D.

What kind of schemes do we have for evaluating degradation potential? The various L.A. type tests are popular. The British Crushing Value test is not widely used in this country, even though it has been shown that in some cases it provides a better indication of breakdown under repeated loading than the L.A. test. The Mill Abrasion test is another British procedure that has been incorporated into some North American ballast specs. The so-called *AGGREGATE DURABILITY INDEX TEST* is a modified type of test where the nature of the fines derived in an abrasion type test are evaluated with the *SAND EQUIVALENT TEST* (AASHTO T 176). These procedures are widely used, but in reality, they are somewhat limited. At this time, we are not in real good shape relative to aggregate degradation testing procedures and evaluation criteria.

Another area of major concern is durability. We have problems with bulk aggregates used in their natural state and also in "bound" mixtures. In the unbound state, we are doing a pretty good job. When you start talking about bound materials, we get into difficulty with things such as D-cracking and ASR (Alkali-Silica-Reactivity) in portland cement concrete. There have been some recent durability testing developments in SHRP (the Strategic Highway

Research Program). A *RAPID AGGREGATE DURABILITY TEST* has been proposed for characterizing aggregate D-Cracking potential. The SHRP test certainly supplements the standard AASHTO T 161 type rapid freeze-thaw test and perhaps may eventually replace the freeze-thaw test.

There are also some SHRP developments in evaluating ASR potential. The Construction Technology Laboratories SHRP project has developed two ASR tests. One of the tests is a simple field scheme for identifying whether ASR has occurred in the concrete. Now that ASR distress can be easily identified, I predict the aggregate industry is going to receive many more ASR inquiries in the future. It will now be an easy thing for Joe Doe Materials Engineer to say, "I have identified some ASR problems in my concrete, what's the hang-up here?"

At the University of Illinois, Dr. Leslie Struble of the Civil Engineering Department is conducting a project for the Institution for Standards Research. The project is trying to unravel ASR problems from the perspective of cement-aggregate interactions. The major thrust is directed *toward the cement* (the alkali source) aspects of ASR problem. The study is trying to develop a test to determine which cements are more prone to produce ASR in PCC. Traditionally, we have always used something like a 0.6 percent maximum

alkali content and assumed everything will be O.K. Sometimes that criterion works, and sometimes it does not. When a concrete pavement is going "belly-up" with ASR related distress, the cement people say, "Oh, that must be an aggregate problem." The aggregate people respond with "Oh, I don't think so, you probably used a *bad cement*." Once again, we encounter a situation where it is very difficult to identify the "culprit." Perhaps, ASR is more appropriately considered a *joint responsibility*, rather than *aggregates versus portland cement*.

The major durability problem in asphalt concrete is stripping (asphalt films are removed from the aggregate by the aggressive action of water). The Strategic Highway Research Program has also sponsored some recent research in this area that I will discuss later.

It is apparent that durability problems are still with us! There is some recent progress (particularly from the SHRP studies) that should be helpful.

Let's examine some of the more promising recent developments in aggregate evaluation. They represent the "cutting edge" of current research in aggregate evaluation.

- The *SHRP RAPID AGGREGATE DURABILITY TEST* is purported to identify those aggregates with high D-Cracking potential. The test is conducted with the aggregate alone. The test procedure (as depicted in figure 16) includes the rapid pressurization of the

Test Conditions:

- 1150 psi
- 50 cycles

Test Results: percent fracture

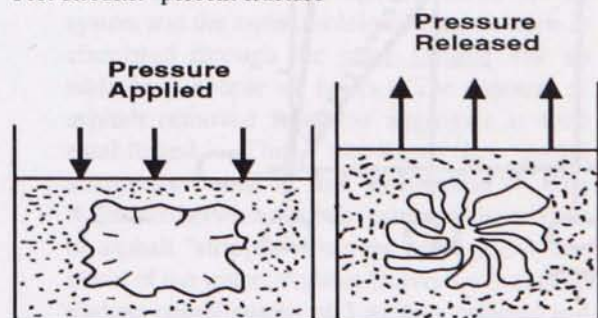


Figure 16. The Strategic Highway Research Program rapid aggregate durability test.

aggregate under 1150 psi in a water environment. The pressure is then rapidly released and an "explosive" internal force is generated. If the aggregate is "sound", the aggregate fractions do not break down. If the aggregate is not sound, the aggregate fraction does break down. The test is run for 50 cycles (5 days of testing time). The SHRP study indicated the "aggregate breakdown" in the test relates to the durability of the concrete. Some preliminary data from the University of Washington (the SHRP contractor) are shown in figure 17. Those materials that have considerable percent fracture/breakdown in 50 cycles of test are known D-Cracking aggregates. Those that experienced less than about 5 percent fracture/breakdown are the non-D-Crackers. The procedure does show promise, and further studies are underway. It is desirable and convenient to have a test that can adequately evaluate the aggregate, rather than having to work with the concrete mixture. Hopefully, the test will continue to show good correlation with the field performance of the portland cement concrete (PCC).

- In the ASR area, there is a so-called *SHRP RAPID AGGREGATE REACTIVITY TEST* that has been developed by Dave Stark at Construction technology Laboratory in Skokie, IL. The test (fig. 18) is conducted with either mortar bars (cement and fine aggregate) or PCC prisms made with the aggregate. The prisms or bars are exposed to a sodium hydroxide solution environment for 14 days at an elevated temperature. The expansion of the bars/prisms is then checked. At this time, the data indicate that 0.08 percent expansion is the breakpoint for identifying an aggregate with a high ASR potential. The Skokie laboratory has conducted several tests with some typical aggregates. The data are shown in figure 19. The aggregates included some that have been identified as showing high ASR potential and others that have demonstrated low ASR potential. Note in figure 19 that there seems to be a definitive relationship that could be utilized to evaluate the ASR potential of an aggregate. This test will perhaps be showing up in future testing standards and specification requirements. Hopefully, it will be better than the testing procedures and criteria we are currently using. It is difficult to evaluate an aggregate, mix it with a cement to produce a concrete, and accurately forecast its future performance relative to ASR.

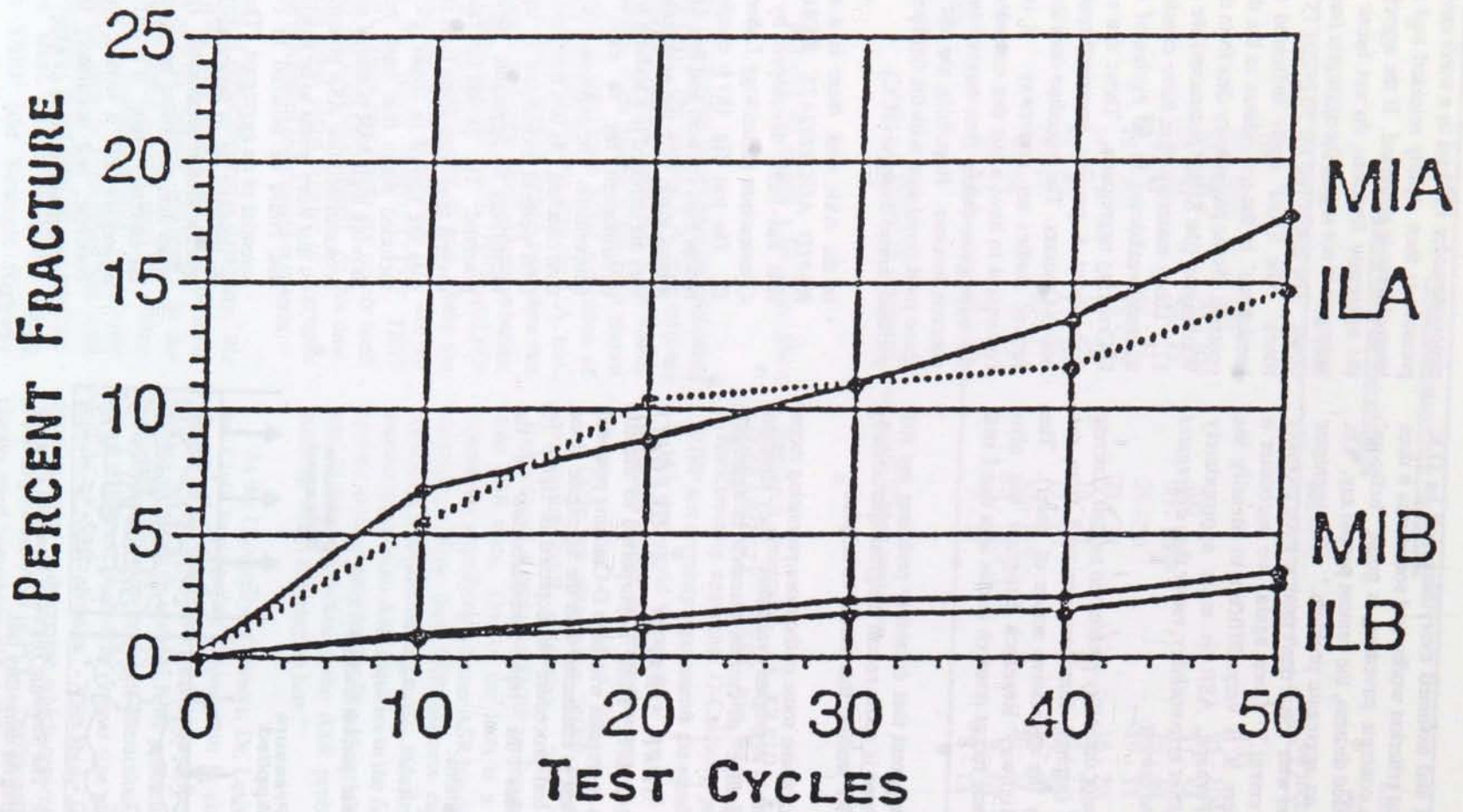


Figure 17. Preliminary results of the rapid aggregate durability test.

Procedure:  
 \*Mortar Bars/Concrete Prisms  
 \*1 N NaOH Solution  
 \*14 Days at 175°F

Results:  
 \*Percent Expansion  
 \*Criterion - 0.08/0.1 percent

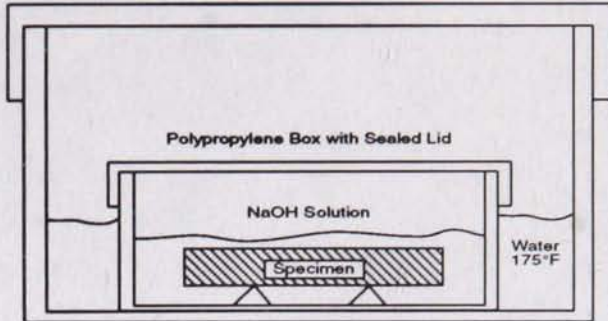


Figure 18. The Strategic Highway Research Program rapid aggregate reactivity test.

I spoke with a woman from South Dakota at this meeting. She indicated that some South Dakota PCC Interstate pavements are just now showing ASR distress after 25 years of service. All the engineers who designed that job have probably retired and are fishing in Florida by now! ASR problems are sometimes "long-term" in developing.

- The other area of recent research is the so-called "stripping" problem in asphalt-aggregate mixtures. Auburn University conducted a comprehensive stripping study in the SHRP program. They developed the so-called *NET ADSORPTION TEST*, illustrated in figure 20. A 50 gram sample of the minus #4 aggregate is evaluated. A solution of asphalt plus toluene is circulated through the system for approximately 6.5 hours. The amount of asphalt adsorbed out of the circulating solution is determined. A small amount of water is then introduced into the system and the asphalt-toluene-water solution is circulated through the same sample for an additional couple of hours. The amount of asphalt removed from the aggregate is then established. Thus, we have the "initial adsorption" and a "net adsorption". The difference between the two represents the amount of asphalt "stripped" from the aggregate by the affect of the water. Auburn University evaluated various combinations of 3 asphalt cements and 11 aggregates. Some of the aggregates were "strippers", and others were not. As a result of

their research, Auburn University concluded that the major problem in stripping is *associated with the aggregates and not with the asphalt*. This does not mean that the stripping potential in an asphalt concrete mixture cannot be reduced by changing asphalt cements or modifying the asphalt cement. I am sure that we are going to see a lot more happening in this R&D area. Hopefully, the Auburn University *NET ADSORPTION TEST* will prove to be successful for identifying high stripping potential aggregates.

- Another important area is the effect of *GEOMETRIC PROPERTIES* (shape-angularity-surface texture) on the engineering behavior of aggregates (in their bulk form, i.e., an aggregate base or subbase for an airfield or a highway pavement or as an aggregate for an asphalt concrete mixture). Asphalt concrete (AC) rutting and stability are of major concern. These AC properties are very much influenced by such factors as natural versus crushed sand and natural versus crushed coarse aggregate. SMA and "large max size" asphalt concrete mixture specifications typically require crushed aggregates. The *SHRP SUPER PAVE* specification for asphalt concrete will probably include some shape-angularity-surface texture requirements (probably by requiring something simple like a minimum value for "percent fractured faces"). There are some problems with simple terms like "fractured faces." It is not a "hard-core quantitative number." There is a compelling need to develop test procedures to better quantify *GEOMETRIC PROPERTIES* (shape-angularity-surface texture).

Current geometric property test procedures are limited. The ASTM "Particle Index" test was developed by Gene Huang at the University of Illinois in the late 1950s and early 1960s. If you have ever run this test, when you complete the test you may well say, "I hope I never have to do another one." The test is time consuming, elaborate, and it is "strung out." But, you do get some "good" and "helpful" numbers that relate to many aggregate uses (shear strength of aggregate bases/subbase, compactability, AC rutting resistance, PCC workability, etc.). There are not any tests of an "intermediate" nature (ease of test, well correlated to laboratory behavior and field performance, etc.).

# TYPICAL RAR TEST RESULTS

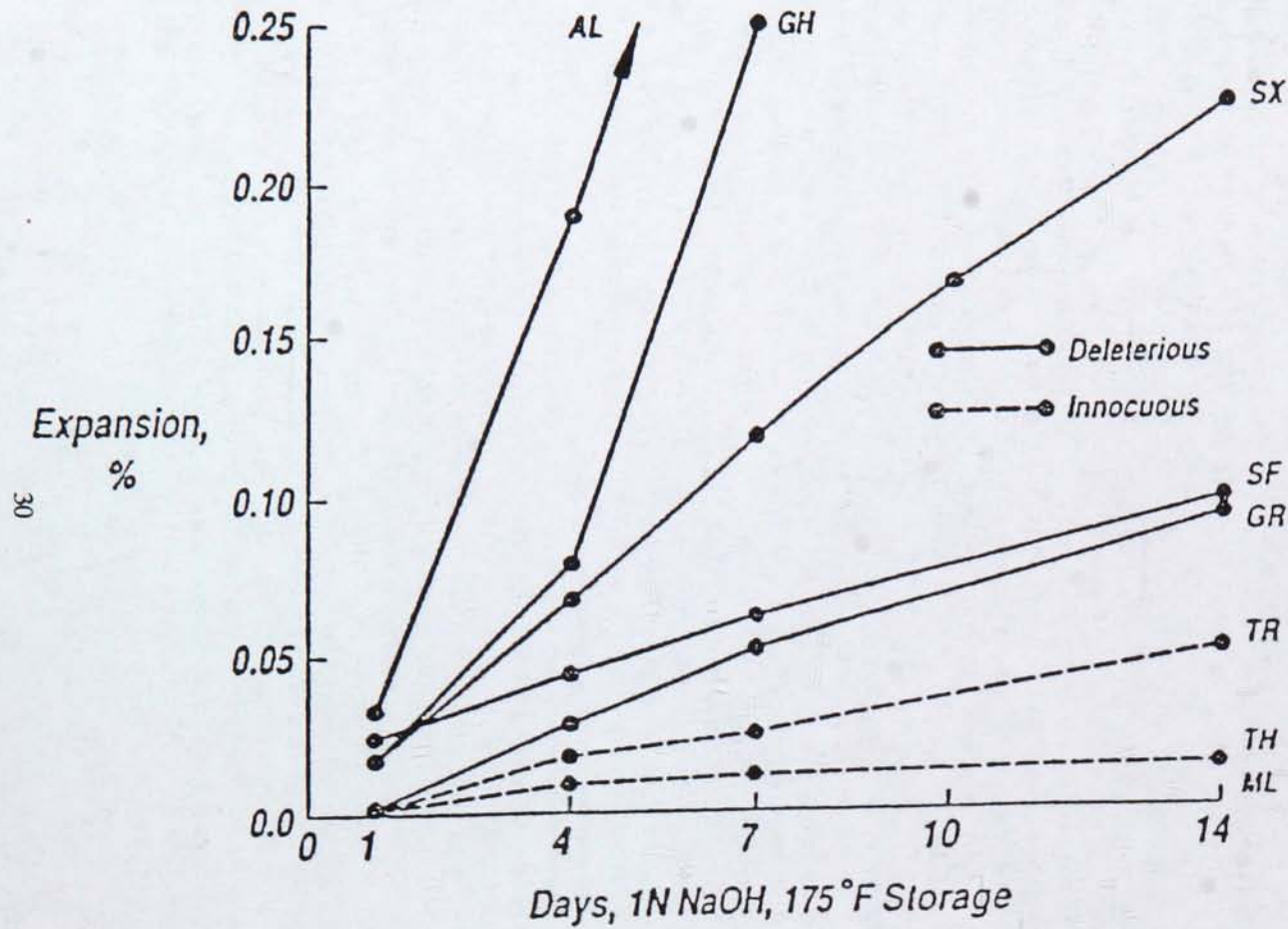


Figure 19. Results of typical rapid aggregate reactivity tests.

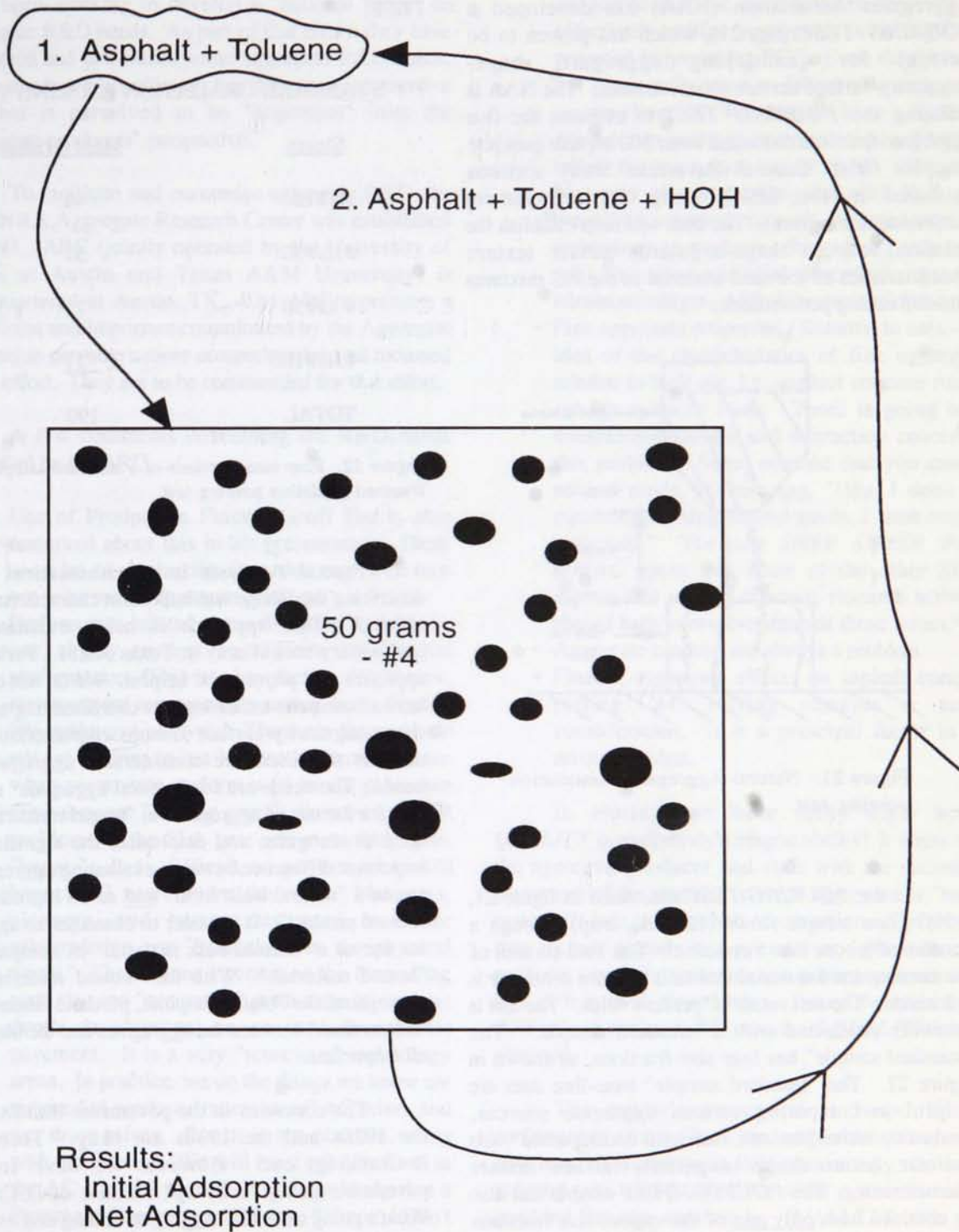


Figure 20. The Strategic Highway Research Program adsorption test.

There are some recent developments in evaluating aggregate geometric properties. The National Aggregates Association (NAA) has developed a *POURING TEST* (fig. 21), which has proven to be helpful for quantifying aggregate shape-angularity-surface texture characteristics. The NAA is utilizing the *POURING TEST* to evaluate the fine aggregate fractions extracted from 300 asphalt concrete samples (from General Pavement Study sections included in the SHRP Long Term Pavement Performance Program). The data will help establish the relation between shape-angularity-surface texture characteristics of the sand material in the AC mixtures and AC rutting performance.

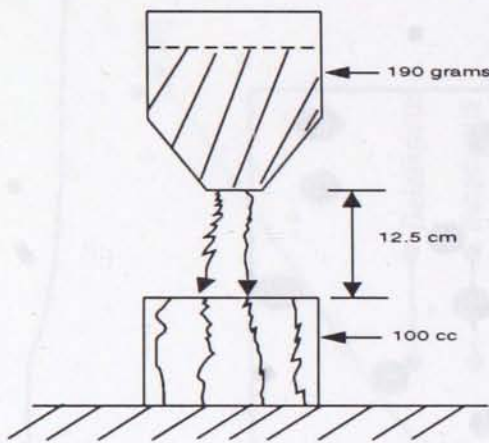


Figure 21. Natural Aggregates Association pouring test.

In the *POURING TEST* illustrated in figure 21, a 190 gram sample flows (12.5 cm drop) through a frustum of a cone into a container. The void content of the uncompacted material that falls into the container is calculated. The test result is "percent voids." The test is normally conducted with a "standard sample." The "standard sample" has four size fractions, as shown in figure 22. The "standard sample" base-line data are helpful in comparing various aggregate sources, production techniques, etc. Increased uncompacted voids indicate better shape -angularity-surface texture characteristics. The *POURING TEST* sample can also be obtained from only one of the various size fractions or from the "natural gradation" of the minus #4 fraction of a sand source. The test can easily be used for controlling the consistency of a product coming into a plant. The *POURING TEST* is coming along quite

well. It is easy to run and based on simple principles! There is activity in ASTM to standardize the *POURING TEST*.

#### STANDARD GRADATION POURING TEST

Sieves	Mass (grams)
#8/#16	44
#16/#30	57
#30/#50	72
#50/#100	<u>17</u>
TOTAL	190

Figure 22. Four size fractions of a standard sample for the standard gradation pouring test.

Fractal Analysis is a mathematical way of describing the "shape and bulk form characteristics of an object." This approach is being evaluated in a preliminary sort of way at Texas A&M. Perhaps this approach will prove to be helpful. We do not currently have an adequate technology for characterizing aggregate shape-angularity-surface texture characteristics. It is obvious that there are considerable aggregate R&D needs. The needs are for "natural aggregate" uses and also for the use of aggregates in "bound materials." We need to recognize and emphasize the significant and important difference between evaluating aggregates for use in a "natural bulk form" and as an ingredient in a "bound product". It is easier to characterize aggregates for use as a "natural bulk material" as compared to a "bound material." With the "bound materials", the aggregates, the "binder (asphalt, portland cement)", and "interactions" between the aggregates and the binders are all important.

The concretes in the pavements Illinois built in the 1920s and the 1930s are okay. There is no D-Cracking, etc. However we have Interstate pavements going "belly-up" because of D-Cracking! What's going on here? Aggregate testing and evaluation has always been a concern. We have to improve our capability to evaluate the bulk aggregates and the binders to predict how the mix is going to perform.



In recent years, the National Stone Association (NSA) and the National Aggregates Association (NAA) have been working to develop a "national focus" on aggregate R&D needs. As part of that effort, they have identified and prioritized some aggregate R&D needs. These needs are "unofficial", but they are representative of what is perceived to be "important" from the "aggregate producers" perspective.

To facilitate and encourage aggregate R&D, the NSA/NAA Aggregate Research Center was established in 1993. ARC (jointly operated by the University of Texas at Austin and Texas A&M University) is headquartered at Austin, TX. The ARC represents a significant and important commitment by the Aggregate Industry to promote a more comprehensive and focussed R&D effort. They are to be commended for that effort.

A few comments concerning the R&D needs identified by the ARC.

- Use of Production Fines - Geoff Harris also remarked about this in his presentation. There are a lot of production fines that may well turn out to be useful aggregate products.
- Performance-related tests - We need to improve our ability to test aggregates and predict performance. This is a key factor. Right now, the pavement community wants us to do 40-year life-cycle cost analysis! There are times we do not get sections to last 10 years! There are times when pavements perform well for 20 years (we think they are "looking good"); then we get ASR problems in the 25th year and everything goes "kaput." It is difficult to predict what will happen 40 years down the road. Managers, planners, and bureaucrats need to better acknowledge our "limitations in the physical world." There is not a person on the face of the earth that can "accurately" predict the 10-year rut depth development in an asphalt concrete pavement. It is a very "tenacious" technology arena. In practice, we do the things we know are required to produce "rut resistant" AC mixes and use those mixes. But, it is not possible to say with confidence, "We will have a 0.3 inch rut in the AC after 20 years." It is more likely that a Pavement Engineer would say, "Shoot, I don't know, but the rut depth will hopefully be less than 0.5 inches." These limitations are with us, and we need to continue our efforts to improve our proficiency in "predicting performance."

- ASR (Alkali silica reactivity) - ASR will continue to be a problem. A recent article suggested that we may have to learn how to effectively utilize aggregates with high ASR potential in producing PCC. Even though we do not necessarily want to follow this suggestion, we may have to! We may not have a choice. If you have to haul aggregates a couple of hundred miles, the price goes out of sight! What is the best way of using aggregates with high ASR potential in concrete mixes? We need improved technology to evaluate admixtures (such as fly ash) and other remedial procedures that may eliminate/mitigate ASR distress development.
- Fine aggregate properties / Relation to uses - The idea of the characteristics of fine aggregates relative to their use, i.e., asphalt concrete rutting, etc., is a major issue. There is going to be considerable debate and interaction concerning that problem! Some contend that you can use natural sands. Others say, "Hey, I don't feel comfortable using natural sands, I want crushed materials." The new *SHRP SUPER PAVE HMAC* specs and some of the other SHRP asphalt and asphalt concrete research activities should help us resolve some of those issues.
- Aggregate coatings are always a problem.
- Finally, aggregate effects on asphalt concrete rutting. AC rutting remains a major consideration. It is a principal factor in AC mixture design.

In closing, we have many R&D needs. *QUALITY* is everybody's responsibility! It starts with the aggregate producer and ends with the successful placement of the material (natural aggregate or "bound material") into the finished construction. The process may include a ready-mix operator or asphalt concrete producer supplying materials to a paving contractor, etc. But, it is a total closed loop. Everyone must fulfill their role in a responsible manner if *QUALITY* is to be obtained.

The public's perception is based on the performance of the "final product" in the pavement or structure. If a pavement fails prematurely, the whole industry gets a black eye (or a white eye in the case of portland cement concrete). *QUALITY* is a joint responsibility! We all have a role to play, and it takes a cooperative effort. I encourage everyone to adopt the philosophy:

*We all will work effectively and harmoniously toward providing quality products whether it is a black, white, pink, or purple pavement.*

"Market share" considerations will always be with us! Let us try to keep it in perspective, though. There is a limit to how far you can use "Market share" motives for the sake of "selling a product." Technology and understanding should drive our decisions, not politics and pressure.

If a bureaucrat is in a position where a "hard call" has to be made, he/she will not go far out on a limb without a solid basis for the decision. Many times, that solid basis for doing something is derived from R&D results. We need to vigorously increase our R&D activities if we hope to see more aggressive and innovative decision making concerning aggregate applications in construction!

#### PARTICIPANTS DISCUSSION AND COMMENTS

- I would like to ask how widespread this alkali-silica reactivity thing is, and also how low would you feel the alkali content of cement would have to be in order to alleviate the problem?

Reply: The SHRP ASR research program was conducted by David Stark at the Construction Technology Lab (the research arm of PCA). Early in that study, they put out a summary of a survey which indicated which states had ASR distress. Maybe 60 percent or so of the states reported an ASR problem. As a result of that early activity, a SHRP Handbook was published Handbook For the Identification of ASR in Highway Structures. It includes a simple field test procedure for identifying ASR problems. Since the Handbook hit the streets, there have been a number of states that have said, "Oh, wow, I didn't think I had this kind of a problem; but it now appears that I do have some ASR distress." I would say that the number is creeping up. It is a very large percentage of the states. Originally, we thought, "Well, if you've got limestone-dolomite aggregates, you don't have a problem." In reality, at times these aggregate types do seem to show ASR problems. It seems that we are coming up with cases where ASR originally was not

perceived to be a significant problem, and now it has reared its ugly head.

Some additional points: 1) We have very stringent skid number requirements for surface courses in highway and airfield pavements. That means certain aggregate sources are not suitable for surface courses; 2) if we have D-Cracking problems, other aggregate sources are eliminated; 3) if we get into ASR problems, some other sources go "down the tube." After a while the available sources are very limited or not available.

Geoff Harris' chart indicated we have less aggregate production sites and fewer aggregate producers. That also exacerbates the problem. Pretty soon, we are going to be shipping aggregates a long distance to meet all of these requirements. These are legitimate requirements, and I am not downplaying their importance. We may ultimately be in a position where we have to better utilize these "off-standard" materials. For example, consider aggregate polishing in a pavement surface course. If some polishing and skid number reduction occurs, you can easily rotomill 1-inch from the surface, place a thin AC overlay (an overnight operation), and have "a new pavement" (as far as the public is concerned) by the next morning.

We may have to think about how to live with some of these limitations and better adapt to the lack of availability of the premium aggregates we traditionally have utilized. They may not always be there to meet all of our demands!

- What is that alkali content?

Reply: The 0.6 percent maximum value that shows up in PCA and ASTM has traditionally been considered a reasonable level for alkali content in portland cement. The problem is that in some cases ASR reactions occur with cement that has less than 0.6 percent alkali. In other aggregates, the alkali content may be as much as 0.8 percent and 0.9 percent without any ASR distress. Leslie Struble's major thrust is to develop improved procedures and criteria so that we can better specify cement relative to mitigating/alleviating the ASR problem. If you watch the ASTM magazine, "Standards Research News," you will probably find some continuing updates on her project.

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

By Ernest K. Lehmann

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All of you are familiar with the acronym NIMBY -- "Not In My Back Yard" -- as a characterization of a person who, while perhaps giving lip service to the social need for a product or service, opposes the project at the proposed location because it might impinge on his, the Nimby's, "space". Commonly, however, when analyzed, the opposition is much broader and deeper. It is opposition to any project at any location; in other words a doctrine of Not In Anybody's Back Yard: NAMBY, rather than NIMBY.

Most of us honestly, but in some cases only secretly, would have to admit to ourselves being on occasion a NIMBY, in the narrow sense. Even I will admit that on some occasions, in various contexts -- as a member of a village planning commission, as an activist in Minneapolis neighborhood politics, as a property owner in a small bucolic rural community -- I could be characterized as such.

Let he or she who is without NIMBYism cast the first stone!

Inherent in the conflict between project proponents and the opponents, whether they are NIMBYs in the narrow sense or NAMBYs in the broad sense, are two opposing views of what constitutes environmentalism. One possible definition of environmentalism is synonymous with another, older word "conservation," that is, the wise use of our natural resources for the benefit of human kind. This is a humanistic view of man's relation to nature that has its origins at least as early as the 18th Century Enlightenment. Those who ascribe to this definition of environmentalism generally also believe that only with economic development and the creation of an affluence, can society afford the level of environmental protection that we would like to see. Clearly, NIMBYism, in its most basic and often selfish terms, may not always be consistent with this definition of environmentalism.

A second school of thought, the NAMBY school, defines environmentalism in more "radical" terms. It values any sort of "nature" -- good, bad, or

indifferent -- at a value higher than any human achievement. This, in the extreme, is an ethic that places non-human values above human values. This appears to be the position of at least some of the radical environmental groups. It is a non-humanistic view whose foundations are perhaps originally in animist religions and that manifests itself in the periodic back-to-nature movements of the 19th and 20th Century.

NIMBYism and the broader NAMBY school of thought, whatever their origins or degree of legitimacy, are not without costs to society. Those costs also directly affect the mineral industry.

Most of us who are active in the mineral industry subscribe to the first view of environmentalism. We believe in responsible stewardship of natural resources and their development for the common good. The fact that we also seek to make a profit ("doing well by doing good" as the 19th Century missionaries put it) does not detract from the societal benefit of a project that supplies needed raw materials for the community. However, increasingly, we are in conflict with the NIMBY and the radical environmentalists who, empowered by increasing affluence, by the emphasis on public participation in decision-making and by a cyclical prevalence of the back-to-nature movements, seek to block almost any and all development projects, especially extractive mineral development, for reasons good and bad.

One way to examine and understand the conflicts inherent in the underlying issue of development versus NIMBYism and radical environmentalism is to look at it in terms of Game Theory.<sup>2</sup>

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<sup>2</sup>In this discussion of Game Theory, I draw heavily on William Poundstone's "Prisoner's Dilemma" (Doubleday, New York, 1992) and am also indebted to Paul Vatter's all too brief instruction on related topics at the Harvard Business School in 1984.

Poundstone defines Game Theory as "a study of conflict between thoughtful and potentially deceitful opponents." Because the assumption in Game Theory is that the players are totally rational, the outcomes should be subject to precise analysis. Rationality implies self interest. One man's self interest may appear to another as greed.

Thus, keep in mind in our analysis that both the developer, in this case a mineral developer, and the NIMBY are assumed to be perfectly rational, potentially deceitful, and self interested.

Next, let us distinguish between "zero-sum games" and "non-zero-sum games." The simplest form of a zero-sum game is two children dividing a piece of cake. There is only so much cake available. The age-old solution is to have one child cut the cake, and the other to have the first choice of which piece to take. Not much of a problem here. The first child cuts the cake, the second child gets first pick. It is in the interest of the first child to divide the cake as evenly as possible so that the second child will be indifferent as to which piece it chooses. This simple set of circumstances rarely applies to environmental decisions -- unfortunately, because this introduces profound complexities into decision making; fortunately, because environmental decisions may potentially be plus-sum rather than zero-sum games.

The second, and more relevant category of games are non-zero-sum games. The outcome may increase or decrease the "total" cake available. The classic non-zero-sum game is the "Prisoners' Dilemma."

Consider the following situation: The Sheriff arrests Joe and Sam, members of a despicable gang of armed robbers. Immediately, each prisoner is placed in solitary confinement, unable to communicate with the other. The Sheriff admits that he does not have sufficient evidence to convict either of the pair for armed robbery, but each is carrying a weapon without a permit. Armed robbery is punishable by up to 8 years imprisonment, while carrying a weapon without a permit is punishable by one year. The Sheriff separately tells Sam and Joe that if neither confesses, they will be sentenced on the weapons charge -- one year for each. If one confesses and turns state's evidence and the other does not, the one who confesses will go free and the other will get the maximum sentence, 8 years. However, if both confess, there is no need for either to give evidence and the deal is off, but each will

be treated slightly more leniently and sentenced to 5 years.

Diagrammatically, the game looks like this:

	<u>Joe Refuses</u>	<u>Joe Confesses</u>
Sam Refuses	Sam: 1 year Joe: <u>1 year</u> 2 years	Sam: 8 years Joe: <u>0</u> 8 years
Sam Confesses	Sam: 0 Joe: <u>8 years</u> 8 years	Sam: 5 years Joe: <u>5 years</u> 10 years

Now, it is clearly in the interest of both parties to "cooperate" with each other (even though they cannot communicate) and for neither to confess since then the sum of their sentences -- the adverse consequence -- would be two years, the joint minimum. However, Sam reasons that if he confesses and Joe does not, he will minimize his adverse consequence to zero and Joe will get 8 years. Sam gains, Joe loses. Sam further reasons that if he cooperates and does not confess, Joe will probably defect and confess in which case Joe wins and Sam loses. For Joe, the converse is true.

What is typically the result? Both confess and both lose by being sentenced to five years or a total for the pair of ten years. Thus, although cooperation (in this case, refusal to confess) would minimize the loss to each party, greed and rational analysis result in mutually adverse consequences. Together, the parties maximize their total loss. It is reported that in experiments of repeated "plays" of the game, the typical outcome is non-cooperation and maximizing the loss.

There are many and complex variations of this basic game, but I just want to make the point that even in a potentially plus-sum game, rational players do not necessarily cooperate and maximize gain or minimize loss; rather, they act deceitfully and greedily as well as rationally, frequently maximizing loss or minimizing gain.

You do not believe non-zero-sum games exist in the world of mineral development? I suggest that they do. Let's get down to geology and mineral resources. The Twin Cities metro area is a growing market for crushed stone -- mainly as construction aggregate and sand and gravel. The freight on board (f.o.b.)-mine value of the sand and gravel produced in the seven-county metropolitan area in 1990 was \$33,120,000, or

\$2.36 per ton. The value of crushed stone produced for 1989 in the metro area was \$15,570,000, or \$3.46 per ton. As to crushed stone, in 1989, about half of the quantity and half the value of crushed stone mined in the state were mined in the metro area. As to sand and gravel, in 1988, the last year for which data are available, about one-third of the quantity and 40 percent of the value of sand and gravel were produced within the metro area. In addition to the production from the seven counties, the metro area also imported significant additional amounts of stone and sand and gravel from out-state.

Remember, the values reported above are the f.o.b. mine value. Because of transportation costs, the value delivered at the job site is much higher.

Now, let us set up our "game". We will assume that we have a deposit of high-quality gravel in an as-yet-undeveloped tract in the suburban Twin Cities area. The tract is purchased by a quarry operator who wishes to develop it. There are nearby housing developments. Typically, the operator must obtain rezoning and probably a special-use permit from the local government. To do this, he hires engineers to design the pit and the reclamation plan, landscape architects and planning consultants to design the buffer and assist with the rezoning, and the inevitable lawyers to shepherd the process.

Let us set out some basic physical and economic parameters. The minable part of our deposit is 40 acres, and the deposit is 40 feet thick. The operator proposes to put a 150-foot-wide buffer around it. Thus, the total land used is 60 acres, and the quantity of gravel to be extracted over 5 years is 3,485,000 tons, that is 697,000 tons per year, about 5 percent of the metro area's production and a smaller part of the metro area's consumption.

The f.o.b. mine value is \$2.36 per ton, and the average haul is 15 miles at 12 cents per mile, or \$1.80 per ton, for a delivered price of \$4.16 per ton.

The nearby neighborhood objects to the project. The major issues are incompatibility of land uses, traffic, noise, and potential air and water pollution.

Planning commission and then city council approvals need to be obtained. All of these require public hearings. At the hearings, specters are raised

about diminished property values, safety of children in the streets, dust on the laundry, and even worse: increased lead or hydrocarbon emissions from truck traffic, contamination of ground water from fuel spills, and, more imaginatively, radon or asbestos releases.

There is also the possibility of appeal by opponents to the State Environmental Quality Board for an environmental impact statement. There may be air and water quality and storm drainage discharge permits to be obtained from the state Pollution Control Agency -- a process which in itself can take more than a year. And in the end, there is the possibility of court challenges on any number of procedural or technical grounds. A process that technically could take as little as six weeks can stretch out to several years.

If the community decides not to allow the operation, the operator will move to another location, or another supplier will fill this market from another location. Thus, the average haulage distance is going to be greatly increased, say by 25 miles, an additional direct cost of \$3.00. To the operator, this increase is possibly offset by a lower land cost at the alternate location, which may in part compensate him for the additional haul. But this in turn is offset by the fact that he would have had a higher residual land value after completion of mining at the close-in site as opposed to a more rural site. Most critical to him will be his decreased competitive position relative to others in the market who may have a lower delivered cost than he will, if he is forced to add 25 miles to his haul distance.

Now, look at the potential cost to the community at large, which may be imposed by the group of neighbors who seek to deny the operator the permit. The incremental cost to the community is the same as that of the operator. It is the cost of the additional 25 miles of haul, or \$3.00 per ton. The delivered cost for gravel needed for road construction, building, and other everyday uses is going to be increased to \$7.15, or about three times the f.o.b. mine value of the gravel. A total of about \$4.80 is going to be spent on trucks, tires, fuel, and drivers.

Thus, the cost to the community for not mining the forty acres is \$2,090,880 per year for 5 years, or, discounted to a net present value at a 12% discount rate, \$7,537,000. This is equal to \$125,600 per acre for the 60-acre tract, only two-thirds of which will actually be mined.

If we go back to our game -- the Prisoner's Dilemma -- what is likely to happen? The two rational, or self interested (or greedy), and potentially deceitful parties are likely to make the choice that is wrong in overall terms. Instead of developing the property, which will indeed cost the community something, at least in the short term, and the operator something in somewhat increased operating and reclamation costs, the most likely outcome is that the community will block development, therefore costing itself more than \$7 million, or \$125,000 per acre. In the present climate, the operator in turn is likely to take the easy way out, to move out, thereby potentially sacrificing market share for the sake of cheaper land costs and lower operating cost and less "hassle," but higher delivered cost. He will try to pass the cost on to the consumer. Everybody loses.

Is there a way to turn this into a win-win situation? Unfortunately, solutions appear to be few.

One could be the creation of what is called in Greek tragedy a "deus ex machina": an all-knowing, all-wise authority that makes the decisions and resolves the conflict. Perhaps this wisdom and authority already exists in the form of our Metro Council or similar institutions in other urban areas. Has such a mechanism been successful in resource decisions? Are land-use planning agencies sufficiently knowledgeable about the resources that exist and the market forces that affect them? Some of us are skeptical.

Can education help? Certainly, public knowledge of resource needs and availability will help. Understanding of the real, as opposed to imagined, effects of the project and of the costs of alternative solutions will also help if the operator, the public, and the decision makers will listen.

Are there market forces that can be brought to bear? Certainly market forces will bear heavily on the operator. However, the individual NIMBY will probably take a narrow and parochial view of the market and his personal benefit as contrasted to the overall societal good. Reliance on only market forces will probably not get us out of the Prisoners' Dilemma.

Given the present circumstances, I am not optimistic about our ability to make optimal decisions.

Under the present circumstances of almost unlimited public input on individual project decisions, as contrasted with process-related decisions, the best I can conjure up for our escape from this trap is a combination of allowing the market to work while striving to educate the players as to the advantages of cooperation, perhaps nudging this process along by government at all levels acting more as a teacher and arbitrator than as a planner and director. That is, unless we change the rules of the game -- something that may be politically too difficult to contemplate.

If we want to change the rules, I would suggest that we must rethink our attitude towards how we make natural resource decisions. We need to recognize the place-value and place-dependency of natural resources. In the case of minerals, we must also recognize the fact that we cannot easily anticipate their existence and location, except in a most general way, until considerable work and high-risk expenditure has been undertaken.

Under an alternate system, we might propose to give mineral resource development primacy over other resources. This would recognize mineral resource extraction as a temporary use of the land, which, except where specifically outlawed in very restricted areas, could be developed anywhere subject to a predetermined, economically and physically realistic set of rules. Appropriate reclamation of the land for later use would be included. The object would be to establish a regulatory framework with a minimum of discretionary decision-making or delay by government or impedance by NIMBYs.

In this brave new world, the preliminary regional decisions as to overall land-use plans and the establishment of a goal-oriented overall permitting process would still be subject to public input and would be predetermined. These broad objectives would be fully resolved before any site-specific decisions were made. Thereafter, as long as the operator adhered to these rules, he could proceed without further debate and endless delays. However, this is the real world, and the likelihood of our achieving such a system and avoiding the Prisoners' Dilemma seems remote.

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## PRODUCTION, DISTRIBUTION, AND MARKETING OF INDUSTRIAL MINERALS

By Haydn H. Murray

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### INTRODUCTION

Industrial minerals, also commonly referred to as non-metallic minerals, are critical to a country's economic well being and are a key to having a high standard of living. According to figures from the U.S. Bureau of Mines, the value of industrial minerals in the United States in 1991 was \$19.6 billion and for metals was \$11.2 billion. As a generality, it can be said that in those countries where the value of industrial minerals exceeds the value of metallic minerals, a high standard of living will exist.

In the United States, industrial minerals are generally readily available to those industries that utilize them, are of good quality, and can be delivered to the consumer at economically attractive prices. There are few industrial minerals that must be imported into the U.S. Fortunately, the reserves and resources of our industrial minerals are adequate to supply our industrial needs well into the next century. However, the United States must protect these resources from unnecessary regulations, yet provide proper regulation that will continue to allow producers to mine and process these minerals where they are geographically located. The producers of these industrial minerals must also develop sound practices that make them good neighbors and sound environmentalists.

### INDUSTRIAL MINERAL TYPES AND USES

Most people do not realize that practically everything they use in their daily routines contains one or more industrial minerals. In fact, industrial minerals are critical components in the products made in a number of industries. In by far the majority of uses, industrial minerals are functional in that they contribute necessary physical and(or) chemical properties to the products. Also, just as important as their functionality is that they also must be cost effective. Industrial minerals are not just inert fillers that are low in cost as many people seem to perceive.

Industrial minerals are critical components in the construction industry. Examples are mineral aggregates

used in concrete, gypsum used in wallboard, limestone and clays as necessary ingredients in cement, and dimension stone such as granite, marble, limestone, and others used as building stone or as decorative materials. In agriculture, phosphate fertilizers, ag lime, potash, and sorptive clays as carriers for pesticides and insecticides are all critical and important. In the chemical industry, sulfur, phosphate, brines rich in lithium, potassium, magnesium, iodine, and sodium are utilized extensively. In the petroleum industry, bentonite clays are a necessary component of drilling muds, and kaolin clays are used as an ingredient in cracking catalysts. The glass industry is dependent upon high purity silica sand as the major ingredient. In ceramics, common clays, ball clays, kaolins, flint clays, feldspar, nepheline syenite, high-silica sand, and kyanite are important industrial minerals. In the paper industry, kaolins and calcium carbonates are used as fillers in the interstices of the sheet and as coating materials on the surface of the sheet to improve printability. Kaolin and calcium carbonate are functional extenders used in the paint industry and are also functional fillers in several types of plastics. Kaolins are used extensively in non-black rubber compounds as functional fillers. In the foundry industry, silica sand and bentonite are prime ingredients in making the molds into which the hot metals are poured. Many more examples could be cited, but the above examples illustrate the importance of industrial minerals to many industries.

Industrial minerals are difficult to classify because they are so diverse in their occurrence, physical and chemical properties, and their utilization and value. A simple classification in which industrial minerals are classified into three economic groups is:

- (1) Low price - high volume;
- (2) Medium price - moderate to high volume;
- and
- (3) High price - low volume.

Examples of low price - high volume industrial minerals are sand and gravel and mineral aggregates for the construction industry. These materials sell for a few

dollars per ton, and the volume is in the hundreds of million tons annually. Examples of medium price and moderate to high volume industrial minerals are kaolin, which sells at prices ranging from \$40 to \$130 per ton with an annual volume of about ten million tons; pigment grade calcium carbonate, which sells for about \$90 per ton in annual volumes of about a million tons; sorbent clays (Fuller's earth), which sell in a range of \$50 to \$200 per ton at volumes of about two to three million tons; and bentonite clays, which sell in a range of \$35 to \$100 per ton with an annual volume of about three million tons. Examples of high price - low volume industrial minerals are talc, which sells in a range of \$90 to \$250 per ton in annual volumes of about 800,000 tons, and mica, which sells in the range of \$400 to \$600 per ton in volumes of a few thousand tons annually.

Low priced, high volume materials generally are not transported far because of cost, and therefore the mining operations must be located near major use centers, which are normally large cities. Medium priced, moderate to high volume materials and high priced, low volume materials can be shipped great distances and in some instances are exported around the world.

#### PRODUCTION AND DISTRIBUTION COSTS

The cost of an industrial mineral to the user is based upon several factors such as geographic location, the geologic complexity of the deposit, type of mining, the complexity of production, and transportation. Geographic location is an important factor in cost because of distance to the markets, the infrastructures available in the area of the deposit, and the climate. Sand and gravel and mineral aggregates are generally available in most areas of the country so geography is not as important as for most other industrial minerals. However, these construction materials are limited by land-use conflicts, zoning regulations, and urban growth, all of which forces locating the operations further from the markets, which significantly increases transportation costs.

Geologic factors that affect costs are: overburden type and thickness; position of the water table; the thickness, uniformity, and inclination of the deposit being mined; and the mineral content and particle size of the deposit. If the overburden is soft and friable, it is generally much less costly to remove than if it is hard and dense and must be blasted or ripped before it can be

removed. Overburden thickness is also a limiting factor for most open-pit mining operations. For low priced industrial minerals, the overburden thickness must be relatively small or at least have a low overburden thickness to deposit thickness ratio. The position of the water table is also important in most industrial mineral mining operations because of the necessity to keep the mine as dry as possible. The thickness and uniformity of the deposit is important because a relatively thick and uniform deposit can be mined much more economically than a thin, variable deposit. Also, a relatively flat lying deposit is much easier to mine than a steeply dipping deposit. The purity of the deposit and the particle size of the industrial mineral being mined are also important cost factors. A deposit which must be beneficiated using sophisticated processes is a high cost operation because certain deleterious minerals must be removed. Also, fine particle materials are more difficult to process than coarser particle materials.

The type of mining, whether open pit or underground, certainly affects the cost. In general, open-pit mining which can use relatively large mining equipment is the least costly mining operation. Reclamation costs are also a necessary added cost.

Processing costs for beneficiating industrial minerals are dependent upon several factors such as: 1) whether the process is wet or dry; 2) rates of production; 3) type of beneficiation processes required; 4) manpower requirements; 5) energy requirements and costs; 6) clean air and water regulations; and 7) health and safety requirements.

In general, if an industrial mineral can be processed dry, the cost is much lower than if the process is wet. For example, kaolin is processed using a dry process for some applications, but must be processed wet for most applications. The cost of dry processing, which includes drying and grinding, is about \$15 per ton, whereas for wet processing, which includes centrifugation, leaching, magnetic separation, dewatering, and drying, the cost is more than \$40 per ton. The production rate also affects the costs in that high rates of production using large pieces of equipment is less costly than producing low tonnages through smaller pieces of equipment. If the industrial mineral contains deleterious minerals that must be removed, then the cost can be relatively high, particularly if flotation or selective flocculation is required. Labor is a high cost so that automation and reduced manpower is



always a goal. The cost of energy affects the production cost because almost all industrial minerals require drying, which is one of the highest cost operations. Federal and state regulations for air quality, water quality, and health and safety requirements are additional costs that are passed on to the customer. Packaging is another costly operation, particularly if the product must be placed in 50 pound bags. This cost is also passed directly on to the consumer.

Transportation costs of industrial minerals are a significant part of the delivered cost. In many instances, the transportation cost is higher than the freight on board (FOB) price of the industrial mineral. The type of transport affects the cost, and the rate is dependent upon whether the material moves by truck, rail, or water. In general, water transport is cheaper than transport by truck or rail. Therefore, deposits that are located near major waterways can have a distinct transportation cost advantage.

#### MARKETING

Marketing costs for industrial minerals vary as much as the processing costs. Some industrial minerals almost sell themselves, and salesmen are not necessary. An example is sulfur, a most important and necessary industrial mineral in many industries, including the chemical and paper industries. The marketing costs for sulfur are relatively small in contrast to the marketing costs of kaolin. Several salesmen located in various parts of the country are required to market kaolin to the paper, paint, plastics, ceramic, and rubber industries. Thus, the marketing costs for industrial minerals cannot be generalized because the costs for each industrial mineral are unique to that particular mineral. The marketing costs for sand and gravel and sulfur are exceedingly low, whereas the marketing costs for kaolins and sorbent minerals are relatively high.

#### FUTURE PROBLEMS

Most industrial minerals in the United States are known to have adequate reserves for the next century

(Brobst and Pratt, 1973). However, a few such as fluorspar, barite, talc, pyrophyllite, and manganese have inadequate reserves to sustain their increased use beyond the next ten years. Another problem is the availability and cost of fuel. Some industrial minerals require extensive drying and calcining. If fuel costs increase substantially, some industrial minerals may be forced out of some competitive markets. Ever increasing costs of transportation are going to force the substitution of less desirable materials. Chemical costs are another risk in that chemicals are required for processing and dispersion. Rising costs may force the substitution of less desirable and efficient chemicals. Increasing government regulations and restrictions and increasing taxes are certainly a major problem for the future.

#### SUMMARY

The delivered costs of industrial minerals are continually increasing. Federal, state, and local government regulations are more stringent and more costly. The small entrepreneurial producer is disappearing. However, with public and government understanding, the domestic industrial mineral industry can continue to flourish and maintain its world leadership position.

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

By Anthony M. Bauer

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## BACKGROUND

It does not take much of an imagination to trace aggregate mining back to the Stone Age when humans were looking for the "right rock" to defend themselves, to hunt, and to create tools. Aggregate resources have always been an integral part of civilization and are, literally, the foundation of urban environments. The importance of these resources continued to increase as cities evolved into concrete and steel metropolises and as networks of roads and bridges spread across the nation. Aggregate mining exists today, as an urban use, for the benefit of the urban community.

In 1990, the national annual consumption of aggregates was approximately 8.5 tons per capita (Tepordei, 1992a). Each year more than two billion tons of stone and sand and gravel are mined to provide resources for the maintenance and expansion of urban environments and the nation's infrastructure. It is a ubiquitous resource that is mined in every state of the Union. However, in an increasing number of communities aggregate shortages are anticipated in spite of the fact that extensive deposits exist within or near the communities. It is a resource that is being depleted by means other than mining, at a rate considerably faster than it is being mined.

## SUPPLY-DEMAND STUDIES

Concerns for the future availability of aggregate resources were raised in the early 1960s: a period of urban expansion and increased public participation in land planning and environmental issues. In 1961, the Inter-County Regional Planning Commission in Denver reported that of an estimated original reserve of 925,000,000 tons located within a 15 mile radius of downtown Denver, 58 percent was considered inaccessible and only 26 percent, or 244,000,000 tons, were available for mining. The remainder had been mined-out (Inter-County Regional Planning Commission, 1961). A more recent study of aggregate reserves in a six county area surrounding the Denver metropolitan area (an area more than ten times that of the 1961 study) indicated that only between a 16- and

25-year supply of aggregate (343,632,000 tons) exists in the study area, depending on population growth and consumption rates (Nasser, 1987). The State of California, in 1973, estimated that between the years 1970 and 2000 as much as \$17 billion worth of minerals would be lost to urban growth (Alfors, 1973). Seventy percent of the aggregate reserves in the Washington D.C. area have been preempted. Around Baltimore, more than 85 percent of the reserves have been lost (Thomas, 1982). In 1979, a study was conducted to determine the impact of eliminating aggregate mining in the Santa Clara River Valley, Ventura County, California. The economic impact, based on 1979 dollars, of extracting sand and gravel resources from other sources in the region was estimated to be as follows:

Average Cost Increase:	102%
Increased cost per ton:	\$5.00
Increase in total private residential costs:	\$8,500,000/year
Total private non-residential costs:	\$6,250,000/year
Public works and engineering:	\$8,000,000/year

The study also estimated that the increase in trucking mileage would be 21,622 miles per day (Envicom, 1979). These estimates do not take into account the impact on highway maintenance, safety, and air quality issues.

While the demand for these resources will continue at approximately the current rate of consumption, the rate of resource sterilization can be expected to increase, substantially increasing the potential for depriving communities access to an inexpensive source of aggregates.

## WHY THE LOSS OF AGGREGATE RESOURCES?

Arguably, the ground work for increasing loss of reserves was set in the 1960s and 1970s: a period of considerable development activity and corresponding increase in citizen participation and environmental awareness at the local level. A centerpiece of this

concern for the environment was the mining industry itself: more specifically, the coal industry in Appalachia and the Midwest. It did not make a difference that little similarity existed between coal and aggregate mining. To the general public, mining is mining! By an extension of this view, it was assumed that aggregate mining is not a suitable use within an urban environment or, in the minds of some people, within any environment.

Aggregate reserves are being lost, within this pull and tug atmosphere between urban expansion and environmental concern, for three fundamental reasons. The first reason lies squarely on the shoulders of the aggregate industry. It relates to the industry's historic and current practices, its negative image, and the public's lack of understanding of and(or) indifference toward the role that aggregate mining plays in society.

In spite of striking achievements, in terms of beautification, reclamation, and end-use development, by a few aggregate mining companies, the industry as a whole has not come to grips with the reality that it is operating within an increasingly urban environment. For every company that establishes a formal and effective program of beautification, reclamation, and end-use development, many more companies either ignore or pay lip service to these activities. For example, I cannot identify a single operator in Lansing, Michigan, or in my hometown west of Milwaukee who has successfully and effectively addressed these three issues. The industry cannot change its negative image by talking about it, by making half-hearted attempts at becoming more acceptable urban land users, or by having just a few of its members undertake serious efforts to become "better neighbors". It cannot become an acceptable urban land user without a concerted effort to improve the quality of the environment within which it operates, both during and after mining activities. It is its visual legacy of scarred landscapes, past and present, that represent the most damning argument against continuation of aggregate mining in urban environments. Educational and public relations programs, no matter how well conceived, can be effective only if *all* aggregate producers have corresponding well-conceived beautification and reclamation programs completed or underway.

The second reason for the increasing loss of aggregate resources is public opposition. In this case, mining is not alone in receiving this unwanted attention. Daycare centers, shopping malls, housing

projects, highways, etc., become rallying cries for "not in my back yard". One of the problems is that the opposition simply does not care about the consequences of eliminating mining from the urban environment. Based upon their own experiences and perceptions of the industry and upon a general opposition to change, they do not want to be associated with a mining operation in any shape or form. Increasingly, the industry and community become involved in protracted debates with limited opportunities for serious discussion and compromise: thus proceeding down the path that leads to the courts.

The third and probably the most serious reason for loss of resources is the fact that aggregates are not recognized in the community comprehensive planning process as a resource of community value. A review of local planning documents clearly supports this point. Comprehensive planning documents include inventories of vegetation, soils, archeological sites, endangered species, visual features, drainage patterns, wetlands, flood plains, and wildlife habitats, but seldom aggregate resources. Communities simply do not know where the aggregate resources are located. The activities of the industry are heavily regulated; while the resource itself is seldom protected from urban encroachment. Typically, aggregate mining is allowed as a secondary use (by way of a special use permit) in other use districts such as agricultural or industrial districts, whether or not aggregate deposits exist in that district (Bauer, 1991a).

In summary, aggregates are essential to the maintenance and expansion of urban environments. Communities benefit economically when the aggregate industry gains access to those reserves closest to the market place. On the other hand, the negative image of the aggregate industry, reinforced by past and many current practices, continues to give opponents reasons for objecting to any form of mining in or near populated areas. This issue is exacerbated by the fact that mineral resource management and protection policies are absent from most community comprehensive planning documents, and by the fact that most communities remain silent (or uninformed) about the role this industry plays in society. The public does not want the industry; the industry has not adjusted well to operating in the urban landscape; and communities fail to address the issue of assuring that low cost aggregate resources will continue to be available to future generations. We seem to be at an impasse; or are we? If everyone continues to view this issue from a

negative and confrontational viewpoint, the future indeed looks bleak. If, on the other hand, we rise above the din of the opponents, reservations of the industry, and the silence of the community leaders, some very positive, challenging, and creative opportunities lie before those of us that are concerned about this issue. At that point, the creative possibilities of mining in an urban environment become unlimited.

The questions then raised are: Can aggregate mining be a compatible part of an urban environment? Can mining companies be good neighbors? Can mine sites be shaped into productive environments and end uses? Can resources be managed through the comprehensive planning process in a way that compliments the long range development of the community? The answer to all these questions is an unqualified yes. And there are ample examples to support this argument.

#### MINING COMPANIES CAN BE GOOD NEIGHBORS

The potential for the aggregate mining industry to be a positive and compatible use activity in an urban setting is real. Its ability to create new, attractive, and productive landscapes is unlimited (Bauer, 1991b). To fully appreciate these possibilities, two distinct aspects of the industry must be addressed. The first aspect is the character and quality of the mine landscape throughout the life of the operation. What does that mine operation look like from adjacent roads and properties? How compatible is it with the present land uses and with future land uses? The second aspect is the ultimate form and character of the mined-out deposit. Will the site be usable and attractive?

In conducting operations that are compatible with adjacent lands, the mining companies commonly are guided by a tried and true adage, "Out of site, out of mind." Numerous examples exist where the mining companies were successful in blending their operation areas into the landscape by taking advantage of the natural terrain and existing vegetation in siting their processing plant and mining activity. When natural visual barriers do not exist, earth mounds and vegetation, along with proper siting of facilities and activities can do the job.

But total screening is not always possible or necessary. A combination of site design, landscape

planting, and maintenance can result in mine operating areas competing with home grounds and corporate offices for outstanding community landscape design awards. In some cases, the interior parts of the operation area, as well as the exterior, were landscaped for the benefit of employees and customers. While the landscapes may range from the more elaborate to the simple, the one common ingredient in all successful site design projects is an effective and continuous maintenance program that keeps all structures in good repair and the grounds groomed and free of debris.

Some mining companies have proven that they can be compatible with surrounding areas through a program involving site design, landscaping, and maintenance. What happens when mining is terminated? What uses can be considered for mined-out pits and quarries? That's the wrong way to phrase the question. The proper question is, what uses cannot be considered for a depleted deposit? The answer is, only another mine operation. There is no use that cannot be considered. As a matter of fact, through proper planning of the earth moving activities and utilization of deposit features, some very unique end uses can be developed.

The end-use options for pits and quarries are unlimited. Pits and quarries have been developed as recreation sites, agricultural lands, office parks, arboretums, amphitheaters, gardens, housing areas of all types, and golf courses. These developments can be integrated into the existing and proposed land-use patterns of any long-range community plan. In addition, they offer communities opportunities to create unique, attractive, and otherwise unavailable landscapes that compliment the natural and built environments.

These end-use examples are not isolated projects. They exist throughout the United States, and clearly demonstrate that mining companies can be good neighbors. Reclaimed projects also demonstrate that productive and attractive uses of all types can be developed in mine sites. The issue is not whether or not aggregate mining can be a compatible urban land use. The issues are whether or not the industry, in general, is willing to make a stronger commitment to becoming a good neighbor; whether or not communities can be more effective in enforcing that commitment; and having done so, whether or not communities will protect existing aggregate reserves from urban encroachment.

## AGGREGATE RESOURCE MANAGEMENT POLICIES

Recognizing the continuing long range need for aggregates, the increasing loss of these aggregates to urban encroachment, and the impending shortages of these resources, the State of California and the Province of Ontario enacted State and Provincial aggregate resource management policies. The Surface Mining and Reclamation Act of 1975 (SMARA) was adopted by California and is under the direction of the Department of Mines and Geology Board (DMG). In 1983, Ontario adopted the Mineral Aggregate Resources Planning Policy Statement (MARPP), followed in 1989, by the Aggregate Resources Act. Within the respective systems of government both acts and policies address three common themes:

- maintain local autonomy in land-use planning issues;
- continue mineral resource availability by requiring local planning agencies to recognize aggregate resources in their comprehensive planning documents; and
- combine this policy with State or Provincial reclamation acts.

Two consequences of these programs are evident. The first is that the State and Provincial governments have committed to and have initiated major aggregate resource inventories in the most critical resource demand areas of their jurisdictions. This information is made available to the local agencies for land-use planning decisions. The second consequence is that for the first time, in addition to regulating the mining activity in the form of reclamation requirements, local agencies are required to incorporate into their planning process data about long term aggregate resource needs on a regional basis, available (permitted) reserves, and the location, quantity, and characteristics of existing aggregate resources. They are required to consider protection of these resources from urban encroachment within the context of their land-use planning decisions.

### USING AGGREGATE MINING IN THE COMPREHENSIVE PLANNING PROCESS

While these programs assure consideration of aggregate resources in the community planning process, there are strong reservations at the local level in using mining as a positive and creative activity in the development of a long range community master plan.

This reluctance is understandable, given the nature of the industry and the possible public wrath it might bring on the planning agency and local politicians. But, this is not an original idea! Numerous examples of public agencies working together with mining companies to achieve common land-use goals exist throughout the United States.

For example, the Parks Department in Racine, Wisconsin, contracted with a mining company, after the community obtained a quarry, to mine an additional portion of the site in order to create a swimming area. In Illinois, the Lake County Forest Preserve District purchased a mined-out sand and gravel pit, along with some adjacent land, and contracted with a mining company to extract sand and gravel, according to a land shaping plan, to create suitable environments for fish, shape a beach, and create a wetlands. In Dayton, Ohio, a mining company worked with the Montgomery County Parks and Recreation Department to reshape and develop the Madison Lakes County Park. The park was opened in 1975. Mining continues to this day in a coordinated effort to extract a valuable resource and shape and expand a more valuable community asset.

Each of these efforts were opportunistic arrangements. But imagine, for a moment, what creative possibilities lie ahead if these ideas were integrated into the long range community planning process. Imagine incorporating the many types of attractive landscapes and uses already existing in pits and quarries into the long range planning process. Imagine the idea of using mining as a creative earth moving process in shaping predetermined landscapes. Communities would have, within their grasps, opportunities to secure low cost aggregate resources for future generations, influence the pattern of growth and land development, and create specific, predetermined, and sometimes unique environments for whatever uses they determined appropriate. The legislation enacted in California and Ontario allows for such possibilities.

This idea can be illustrated by setting up a hypothetical situation of a broad river valley with gravel terraces on one side of the river and limestone formations defining the opposite side. It is located at the far reaches of an urbanizing area that, to the concern of many people, will spill into, up, and across this attractive valley. The geologic report indicates a potential 100 year supply of limestone, sand, and gravel resources in the valley floor, the gravel terraces, and the limestone formations. Significant wetlands, natural

features, and agricultural areas are located within this valley environment.

After considerable discussion and debate, the community established a program for the long range development of this important environment. The centerpiece of this program was the continuation of a strong open-space character throughout the valley. The goals of this community were to:

- sustain the open-space character of the valley floor and selected "edges" of the valley through the continuation of a variety of compatible uses, e.g., farming, parks, and mining;
- protect those designated unique natural areas and cultural features from urban encroachment and destruction;
- protect designated 75 year supply of aggregates from urban encroachment;
- develop a generalized land-use plan that guides the reshaping and development of mined-out aggregate deposits in accordance with the long range plan of the valley;
- develop guidelines for the visual integration of the mining operations in the valley landscape; **and**
- utilize the unique and special physical characteristics of the aggregate deposits in shaping new environments.

This hypothetical situation represents an embellishment of a real situation in the San Joaquin Valley north of Fresno, CA. This valley received the designation as a significant resource area for Fresno from the Department of Mines and Geology. Active mining has been underway for many years. Recently, a proposal for a residential development was presented. Local open-space advocates used the aggregate resource protection legislation as one of their reasons for opposing the residential project, arguing that the reserves needed to be protected and that mining, along with the reclamation process, was a land use compatible with their concepts of open space and controlled growth in the valley.

There is precedent for this hypothetical case. So let us carry this concept of using aggregate mining as a positive element in shaping urban landscapes one step further.

What is necessary in making sound decisions related to mining, resource protection, and long range

planning? There are six basic steps that should be followed.

1. *Conduct a geologic survey of the area:* From a land-use planning standpoint, it is not enough to simply identify and quantify the resource. A general knowledge of the geologic formation containing the resource, along with supporting data from well records, road cuts, and existing mining operations, is useful in understanding the extent, quality, and distribution of these resources. This information can be useful in setting priorities for resource protection areas and in predicting the general character of future landscapes, such as water landscapes, sharp sloped landscapes, or landscape with special features, such as rock outcroppings and terraced terrain.

2. *Evaluate the spatial relationship between the primary resource locations and other significant natural areas and cultural features.* This step allows the community to make determinations within the resource protection area as to which use or feature deserves protection. For example, in one case, mining might be allowed in a high quality resource area containing an important woodlot, but prohibited in an area where a special scenic feature exists.

3. *Evaluate the aggregate market.* It is important to determine the demand for the aggregate resource in order to understand, from a land-use planning standpoint, the rate of resource depletion within the resource protection area. While this information is general, at best, it is useful in anticipating the transition from one use to another over the period of the long range plan.

4. *Evaluate the physical consequences of mining within the resource protection area.* While resource protection areas provide some assurance to mining companies of reasonable access to the resource, there should be no lessening of requirements for the company to maintain an attractive operational environment during the life of its mining operation. Standards and guidelines should be established to minimize the visual impact of the processing plant area as well as the extraction area.

5. *Establish a comprehensive land-use and landscape character plan of the resource protection area.* This plan should take into consideration, in addition to normal land planning criteria, the geological structure of the aggregate-bearing lands, the nature of the mining

operations, and the potential for creating specific types of landscapes.

6. *Develop sequential mining and reclamation guidelines directed at implementing the long range plan.* All companies should reclaim lands during their mining activity. That is the time when earth materials are being moved and that is the time when the proper earth moving equipment is on site and available for shaping the predetermined landforms. It results in more efficient use of earth materials and equipment and minimizes the amount of disturbed land at any given time during the operation.

In conclusion, aggregate mining is an urban land use with the potential for creating attractive and productive landscapes as an integral part of its operation. Close access to the market is beneficial to both the industry and the community in terms of keeping the cost of these constructions low. In addition, through proper planning, the community has an opportunity to use the mining activity to influence the character and quality of future landscapes.

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## CASE STUDIES -- PROMISES AND PITFALLS

By H. Lynwood Bourne, Moderator

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The Society for Mining, Metallurgy, and Exploration used to be known as the Society of Mining Engineers (SME). About a year and a half ago, the Society formed a foundation for public information and education. The goals of the foundation are the collection and dissemination of information relative to the mining industry. We do not produce any information; there are a number of people who are good at that and who have already done that. We want to be able to collect what is available and through the membership distribute this information. On the collection side, we have done very well. We have accumulated a number of videos and have a video lending library from the office in Denver. There are 20 or 30 videos on that list that are available, which illustrate various aspects of the mining industry. Some are oriented toward coal, some are on mining in general, and some are on iron mining. Most of these videos are well done. A couple of videos are available for sale through SME headquarters. In addition, we have accumulated some teacher information packets. The University of Minnesota has developed a teaching tool computer program for demonstrating which minerals are available within the State of Arizona. We hope to modify that so it would be available on a state-by-state basis. Within the dissemination aspect of our goal, we have also done well, and our audience is children through adults. In the adult sector, we want to reach the general public either through speaking to Kiwanis or

Rotary or Chambers of Commerce. We want to be able to reach the media, we want to be able to reach the policy makers and some of the political figures. With respect to the children, we are active with state teachers organizations and are trying to provide information to teachers about the importance of mining. One of the Nevada SME sections has a clever project. They used chocolate chip cookies, and the chocolate chips became the ore, and the rest of the cookie became the waste. The children were encouraged to work with toothpicks to get some idea of what is involved in winning the ore and minimizing the waste. The Carolina SME section last year went to the State Science Teachers Convention and had information available. They were one of the busiest booths at the convention, and they were sufficiently encouraged that they have taken on the Southeast National Science Teachers Association Convention that will be held in Charlotte, North Carolina, in December, 1992. They expect 5,000 science teachers, and they will have a booth to pass out rock samples and information about mining. The feedback that we get is that the teachers are excited about this. So, we are encouraged by the response that we have had to the SME Foundation, even though it is only a year and a half old. If anyone wants more information, please contact me, and I will make sure that you get some information about the SME Foundation.

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## PLANNING FOR MINERAL EXTRACTION: PITS AND PITFALLS

By Randall Graves

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Maple Grove, Minnesota, is a developing community which has grown from 6,000 people in 1970 to 20,000 in 1980 and 39,000 in 1990. The growth continues unabated by anything except market forces. The latest estimated population of the community is 42,300. Commercial growth has lagged behind the population; however, it is showing signs of imminent explosion, with national firms expressing an

interest in locating a regional shopping facility in the community.

Office/industrial development has long been located in the community, but has evolved from the early land intensive uses normally found in the urban fringe to the office and other labor intensive uses found in more densely populated areas. The existence of



excellent transportation amenities makes Maple Grove a likely recipient of major business developments in the future. Some of that development is underway at present, with the commencement of a one-half million square foot, 5,000 employee corporate campus.

The area of Maple Grove is roughly 36 square miles (see fig. 32). It is a township with a small bite removed for part of an old town of 2,000 people. Of that 36 square miles, about half has been developed. The anticipated population at full buildout is 80,000 people, and the business community is much less than half completed.

Gravel mining pre-dated suburbanization by nearly half a century. The first mining operation began in the 1920s and continued on a small scale through the depression and war years. Large scale operations began in the 1950s, and peak mining activity occurred during the 1960s and 1970s as gravel sources closer to the center of the Minneapolis region were depleted. While mining activity has slowed, a considerable resource is still left and is in an accessible location.

The land surrounding the gravel mining area is developed with a variety of uses, with freeways abutting two sides of the area. The mining area is completely surrounded by development. Much of the development is non-residential, which is fortunate but not entirely unplanned.

The gravel mining area of Maple Grove has been withheld from development primarily at the wish of the land owners, most of whom are still mining their land. There is also pressure to exploit the gravel resource for the benefit of the metropolitan region. While there is disagreement between Maple Grove and our regional planning agency over who is responsible for determining when development can take place, there is unanimity in the goal of allowing the resource to be depleted prior to reclaiming the land for urbanization.

The aggregate mining in Maple Grove does provide a benefit to the entire region by providing a relatively close in source for these materials. Many of the region's highways are a transplanted piece of Maple Grove, as are the parking garages at the newly opened Mall of America.

This regional benefit does not come without a price. The gravel mining area of Maple Grove encompasses 2,100 acres, or nearly 10 percent of the

entire area of the city. An area this large cannot be undeveloped without disrupting city services. The gravel mining land is zoned for rural-type development which is, in reality, a holding zone. City water and sanitary sewers are not extended into the 2,100 acres and are not expected to serve all of the area for many years to come. This means that water and sewer lines have gone around the gravel mining area at a greater cost than if a more direct route had been used.

An additional area of concern is the gravel deposit itself. Maple Grove gets its water supply from an aquifer located in the glacial drift, which is the source of the gravel deposits. In places, the gravel has been removed as much as 60 feet below the water table, creating ground water ponds of considerable extent. In some states, they would be called lakes. This places our drinking water at the surface and makes it susceptible to surface-borne pollution.

The city contracted to have a Gravel Mining Area Plan prepared in 1985. This plan sets some physical guidelines for the area and sets the scene for the eventual reuse of the land for more conventional purposes. An overall grading and stormwater drainage plan was prepared as was a transportation plan. Utility service is also provided for, and a ground water protection plan is in place. Obviously, all of these things interrelate. The grading plan calls for certain amounts of overburden above the water level. The amount of ground water pond area is limited, and surface drainage is directed away from those ponds.

Transportation corridors are identified so that road beds can be planned for and even built as a part of reclamation. Presently the roads are privately owned, but they do allow through traffic, though in a circuitous manner.

Among the problems occasioned by gravel mining is the issue of associated uses. Maple Grove permits the gravel miners to use their products as well as extract them. Asphalt plants, rock crushers, asphalt and concrete recycling, and the manufacture of concrete products such as concrete block and concrete beams are considered a reasonable extension of the mining business. The potential problems will arise when the aggregate runs out, and the users are expected to move their facilities elsewhere. There is also a concern with the amount of recyclable material on a site and with unexpected uses of facilities such as the use of asphalt plants for the treatment of contaminated soils.

The additional time and money spent in regulating mineral extraction can be partially recompensed with taxes, but the real payback is in the opportunity to plan the development of a large area of the city after development has taken place around it. One of the most difficult aspects of urban planning in rapidly growing areas is the tendency to not wait until development is ready, but instead to develop the first thing that is profitable. This tendency often leads to residential development occupying land best used for other purposes and sometimes not suited to residential uses. The problem is that business uses of all kinds generally seek areas with stable populations or areas where large numbers of people live.

The gravel mining area will be among the last areas of Maple Grove to be built upon. This means that urbanization will be less of a necessity than in areas where urban services need to be provided. The planned city could prove to be a reality in this part of Maple Grove.

The mining industry will continue to be a part of the Maple Grove landscape for many years to come. A guesstimate would say that there are 15 to 20 years of mining left. In the past, people have assumed that we would mine frantically, and then all activity would cease at once. That is of course not the way it will happen. We are already seeing areas mined out and becoming ready for development. It would appear that the land on the edges of the area will be reclaimed and redeveloped until we work our way to the middle and gravel mining diminishes. If this is the proper scenario, advance land-use planning is a necessity and an imminent one.

#### PARTICIPANTS DISCUSSION AND COMMENTS

- Couple of questions. First of all, you mentioned a 7 percent tax levied by the county. I'm wondering if that's a severance tax, if that's based on the amount removed, or if that's based on the amount estimated in the ground. The second question is at what point in time was this area set aside as a distinct gravel mining area?

Reply: The tax itself is based on the material that is taken out, and it is a 7 cent per ton tax. That tax is extracted by the county. They return 30 percent to the communities in the county who have gravel mining operations, in this case, Hennepin County. Maple Grove received 90 percent of that tax because we have

90 percent of the gravel mining activity in Hennepin County.

The other question: it was set aside as an official special area with the adoption of the Gravel Mining Area Plan of 1985. It was an unofficial set-aside prior to that.

- I'm curious to know if you ever did a cost-benefit study of the value to the community, to Maple Grove, of this as a mining area versus residential, or other kinds of development. Clearly, you're getting a lot of money from this now.

Reply: I would probably disagree with that. I don't think we're really getting anything from it now. The \$150,000 a year doesn't even pay the staff time and the upkeep of the people who are involved in gravel mining. We do get property taxes, but they are no more nor less than we would get from the land had it been developed for other uses. So, we really haven't done a cost-benefit analysis; we don't think, at this point, we have a measurable benefit. We think that we will have a city planning benefit and a potential benefit in the future, but cost-benefit analysis is "what you get back is what you put into it", and I would be hard pressed to say what it is going to be worth in the future.

- How many operators are there in the gravel mining area, and how long is the plan expected to be in place before the full area is mined out and everything is fully reclaimed?

Reply: I believe there are six major operators in the area. We're not sure exactly how long mining is going to last. We get estimates of 15 to 20 years; that will depend, of course, on the demand for the product. We suspect that the demand for the land will be increasing fairly rapidly over, particularly, the next 20 years. So, in general, we expect mining to continue for about 20 years.

- You've been operating here fairly heavily since the 1960s, although it's been longer than that I understand. Why hasn't there been any sequential or phased reclamation underway over this period of time?

Reply: There has been some. Perhaps not sequential, but some reclamation, and there have been properties that have been mined out and have been reclaimed and reused for other purposes. The gravel

mining is not taking place sequentially. Since there are several operators, the mining is not in just one place that we can finish off and then reclaim. We have the problem now, that the property lines of the different mining operators have encroached into areas of extensive trees. We have one active woman who owns a fairly large piece of land that has mined gravel deposits, and who doesn't want to sell it. She has already sold enough gravel that she doesn't need the money, and she has a forest that she wants to keep. Well, that will stay there, and it's right in the middle of all the gravel mining, so mining is not occurring sequentially. Our effort will be to try to make sure that the land will be so valuable in the future that it is in the best interests of the operators to sell it. The last piece that we heard of in the area sold for about \$3 per square foot for 50 acres, so there is a considerable amount of money to be made by selling the land.

One thing I did forget to mention is that some of the problems that we have been having are not really related to the extraction industry, but instead are related to the peripheral things that they also do. For example, there is a concrete block plant that is used to recycle

concrete and asphalt; people use the rock crushers that are in the mining areas to take the concrete and make aggregates of it. Also, the county owns a site which they decided to use for leaf recycling and composting. Frankly, the gravel mining was a piece of cake next to the smell that came out of the leaf recycling facility. And the county also had a gravel pit where they got material for their projects. They converted the pit into an elm tree burning site and then later into a leaf composting site. Now there's a tree chipping site there. So, we're not having so much problem with gravel mining as we are with all of the things that go along with it. The latest flap had to do with using one of the asphalt plants for the purpose of taking petroleum polluted soils and burning out the pollutant. A good deal of equipment had to be added to the asphalt plant to allow them to do this. The operator does have a state permit, but a resident in the community, who is also in that business feels that the operation in the asphalt plant is inappropriate. So, the city is caught between the state agency, who says it is, and a private citizen, who says it isn't. Staff time for that problem alone probably cost \$150,000 in one year.

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## MINERAL EXTRACTION MEETS PLANNING AND ZONING

By Mark A. Wyckoff

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### INTRODUCTION

The glaciated terranes of the upper Midwest are rich in aggregates. Other mineral resources are also plentiful. There is a great and growing need for mineral resources. Yet, the resources are not always where the need is. Fortunately, we have a good and diverse transportation system. There are spot reports of shortages and some importation from outside the region, but no documented widespread shortages (at least in Michigan).

So what is the problem? The **apparent problems** include the following:

- It is becoming more difficult for mineral operators to extract minerals because of increasing environmental and local regulations;

- The prospects for the future are not much better because of the lack of planning to identify and protect valuable resources long before they are needed and in the face of rising population density in rural areas. We heard yesterday, and you will hear a lot more today, about the fact that extraction activities are not considered to be "*good neighbors*" -- particularly to residential land uses. Yet, it is difficult to argue that there are not solid public reasons for most of the federal and state regulations that apply to mining activities. Where disagreement seems to exist is the extent, if any (in the eyes of some), and the nature of appropriate **local regulations**, especially over sand and gravel extraction activities.

My purpose today is to explore the following:

- Why local regulations are enacted;
- The scope of typical local regulations over aggregates;
- The principal techniques being used;
- The pros and cons of these techniques;
- The common unintended effects of these techniques;
- Court responses to local regulations; and
- Some conclusions and recommendations for real improvements.

### MICHIGAN FOCUS

I will be speaking particularly about the situation in Michigan. It is perhaps the most complex in the Midwest due to the extremely large number of local governments with planning and zoning authority and the large number of extraction operations. Michigan is a state with about 9.3 million persons. There are 1,243 townships in Michigan, all with local planning and zoning authority; about 950 are exercising that authority. In addition, there are about 530 cities and villages.

### EXTENT OF EXTRACTION ACTIVITY

There is an unknown number of ongoing sand and gravel extraction operations of widely varying sizes scattered across the state. Based on a range of poor sources, there are somewhere in excess of 5,000 pits presently in Michigan. By no means are they all active. They generate millions of tons of aggregate per year. The following three graphs (figs. 23, 24, and 25) illustrate the tonnage and value of these aggregates over the last decade.

These facts were put together by the staff at the Geological Survey Division, Michigan Department of Natural Resources. I particularly want to thank Paul Sundeen for providing me with the specific information used to make these graphs.

Michigan ranked fifth nationally in 1989 in the value of nonfuel mineral production at about \$1.6 billion; that is about 5 percent of the U.S. total. It was the 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. It was

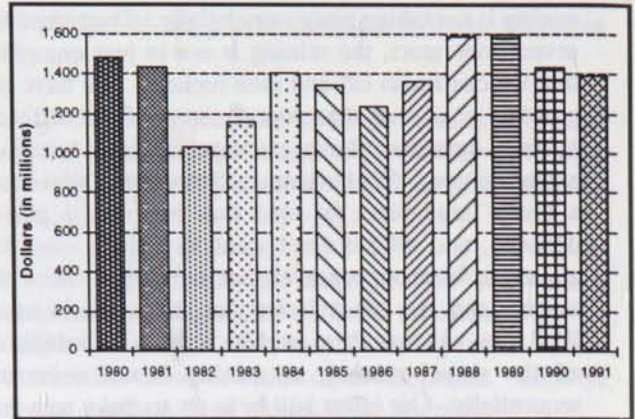


Figure 23. Total value of all industrial minerals in Michigan, 1980-1991.

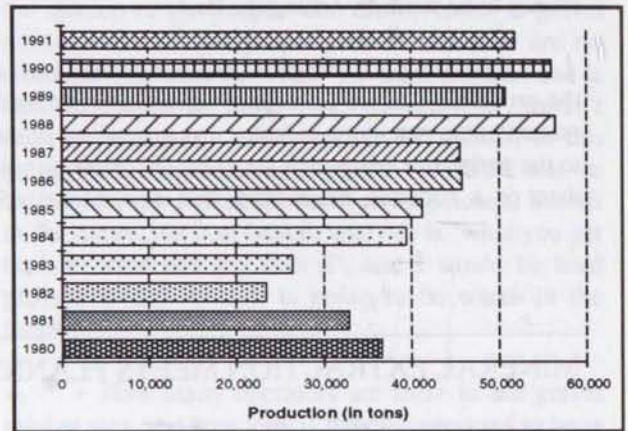


Figure 24. Tonnage of construction and industrial sand and gravel in Michigan, 1980-1991.

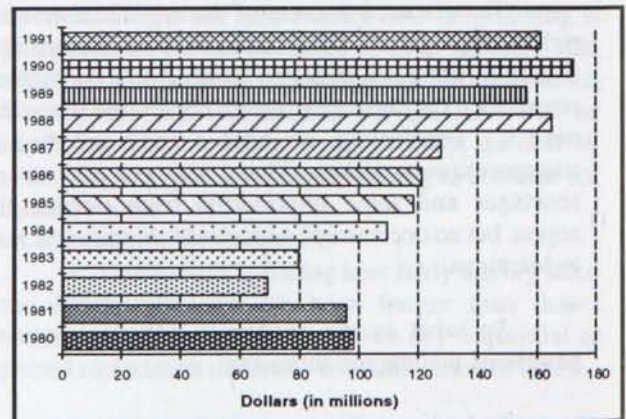


Figure 25. Value of construction and industrial sand and gravel in Michigan, 1980-1991.

the third leading producer of gypsum, and the fourth leading producer of masonry, portland cement, and potash.

If one studies figures 23, 24, and 25, a wide variation (between 23,000 and 57,000) can be seen in tonnage produced between 1980 and 1991. These graphs might just as well be a graph of the national economy. In the years 1981 to 1983, sand and gravel production was low, which corresponds to the peak of Michigan's depression, also the national recession. Production improved by the end of the decade. But note it began to fall again in the last few years; again consistent with what has happened economically in Michigan and nationally. While the value of the products also followed the same economic trends, over the course of 10 years they did manage to triple in value.

Statewide mining employment, in 1989, was about 10,500 persons; it is lower than that right now. At the local level, in terms of frequency of controversy, the real issue is just sand and gravel, not other types of mining activities.

#### STATE PLANNING STRUCTURE

In terms of the state planning structure, Michigan is *not* one of the 12 states in the country with coordinated, integrated state land-use legislation. There is not an established statewide goal in Michigan to protect mineral resources. There is not a statewide or even regional inventory of mineral resources. Without a mandate to even inventory what is there, every prospective new mine or mining activity must be examined on a case-by-case basis. Most mineral resources do not receive public policy attention, because they are "*out of sight*" and therefore "*out of mind*".

As a state, we in Michigan know quite precisely what land-use activities and land cover exists on the land surface. Michigan is one of those few states with a comprehensive Geographic Information System. We have complete statewide inventory of land cover and use for every county in Michigan built into a centralized data base in the Michigan Department of Natural Resources. It is known as MIRIS and is accurate to the 1 acre scale. It is a detailed inventory. It is available for use by private parties and local governments as well as state agencies. However, while we know what is on the ground, we do not have any uniform data associated with surface activities beyond the fact that it is there.

Worse, we do not have mapped subsurface information related to sand and gravel deposits.

#### STATE REGULATORY STRUCTURE

There are specific state regulations that apply to large scale metallic mineral operations (we have, for example, a Mine Reclamation Act). However, there are not any specific sand and gravel extraction regulations except for comprehensive regulations over extraction in designated sand dune areas. Michigan is internationally known for its thousands of miles of Great Lakes shoreline. Less well known is the fact that hundreds of those miles, particularly along the Lake Michigan shore, are the home of the largest assembly of fresh water sand dunes in the world.

Michigan also has a myriad of special purpose environmental regulations, not unlike many other states. They include wetland regulations, inland lakes and streams regulations, soil erosion and sedimentation regulations, and so on. Some of you who work or do business in Michigan are probably familiar with the book that lists more than 100 pages of permits that are administered by the Michigan Department of Natural Resources for a wide variety of activities. They are not unique to extraction operations, but many do apply.

#### LOCAL REGULATORY STRUCTURE

Until about 20 years ago, there was little local regulation of extraction activities, and even today, I estimate less than half of the local units of government in Michigan have any regulations over extraction activities. Yet, there are 1,800 units of local government, that is cities, villages, townships, and counties with the authority to adopt plans and zoning regulations; about 1,400 of those have planning and zoning in place. Now for comparison purposes, an average state has only 300 to 500 jurisdictions, and we have more than 1,800 units of government in Michigan. The multiplicity of local units of government, each with its own planning and zoning power without any kind of coordinated, mandated, regional, or state planning, means that certain issues of greater than local concern, such as protecting mineral resources, simply does not get done.

We have seven local planning and zoning enabling acts. They are based on models prepared and promoted nationally in the 1920s and 1930s. These are included in a publication, now in its fourth edition,

called **Michigan Laws Relating to Planning**. When the first edition came out 25 years ago, it was 300 pages. It included all the basic planning laws, zoning laws, subdivision regulations, housing laws, economic development laws, and all the existing environmental regulations at that time. The current edition is two volumes, each more than 600 pages. We had to take out all of the housing laws and economic development statutes and put them in a separate volume due to a lot of legislative activity in this area. While there has obviously been a proliferation of planning related legislation over a 25-year period, the only new mineral-related legislation is the Sand Dune Protection and Management Act and the Peat Mining Act. The basic planning and zoning legislation has not changed since its enactment in the 1920s and 1930s.

There is one phrase in all three of the Zoning Enabling Acts which authorizes the use of local zoning to *"meet the needs of the states citizens for"* and then there is a long list of things. Mining is not specifically mentioned, but the last part of the phrase says *"other natural resources,"* presumably that is where mining comes in. There is a phrase in the Township Planning Act which says a plan may be prepared in which the *"use of resources"* is planned *"in accordance with the character and adaptability of the area."* That is the closest there is to anything that recognizes surface mining as an activity which should be considered relative to local planning.

In addition, the Township and County Zoning Enabling Acts prohibit the application of local zoning to oil and gas facilities at the site of the wellhead. That authority resides with the Supervisor of Wells (who is the Director of the Michigan Department of Natural Resources). There is also a provision in all three of the zoning enabling acts which makes it unlawful for a municipality to exclude any lawful land use. So, a community cannot just pass a regulation related to any land use, mining or otherwise, that says *"such and such a land use is prohibited in our community"*. This prohibition was a response by the Michigan Legislature to widespread local exclusion of mobile homes.

#### IMPACTS OF UNREGULATED ACTIVITY

Michigan is littered with abandoned, unreclaimed gravel pits that predominantly were created during a period of virtually no regulation by both public and private entities operating at the state, county, or local

level. This blight serves as a constant reminder of what communities do not want. Every year several children, and sometimes adults, drown in abandoned gravel pits. Each time it happens, there is considerable negative attention focused on the industry. A newspaper article says that 15 to 20 persons drown in gravel pits every year in Michigan. When this happens, there is commonly a call for legislative action to require some kind of fencing regulation of sand and gravel operations. Everyone gets *"hot to trot"* until they begin to find out that there are probably 4 or 5 thousand pits around Michigan, many of which are no longer active, and it is just not feasible to undertake safety measures. Nevertheless, it does draw negative attention to the entire industry.

#### LACK OF KNOWLEDGE OF THE BENEFITS OF GOOD RECLAMATION

There is an incredible lack of knowledge of the benefits of good reclamation. I do not mean just on the part of the general public, but also on the part of local officials in the planning and zoning arena (especially of elected officials). More unfortunately, there is a tremendous lack of knowledge in the industry itself -- especially among small operators. I am always amazed to see Tony Bauer's slides on reclamation, because I rarely get to see the positive side of the industry. The calls that I get and the circumstances that I get involved in almost never include good reclamation. I usually get called into controversies where reclamation has not even been a consideration right from the beginning, or the issue is what can be done after the fact to clean up a terrible situation. Oftentimes, operators talk to me as if reclamation is something that is a concept they have never even heard about. Yet, there are certainly lots of good examples of reclamation.

The Emerald Lakes subdivision is about 25 years old. There are a whole series of small turquoise ponds throughout this entire subdivision. I had an interesting experience there. I had stopped between two homes to get some pictures of the lake; this is difficult because there are so many homes that it is hard to get any views of the water from the road (everyone has a nice view from their backyard). One resident came out and asked me what I was doing. I said I was taking pictures of this old gravel pit. She got very, very upset because she did not know that it had been an old gravel pit -- she practically threw me out of there.

## RURAL POPULATIONS ARE INCREASING

Rural populations are increasing significantly throughout the Midwest, and especially in Michigan. There has been a huge rise in the number of rural homes that are being constructed, and generally these homes do not have any relation to the resource value of the land. They are not there because they are the farmer's home, they are not there because they are the home of a forest manager or gravel pit operator. These are predominantly homes for people who are either retiring in the area, second homes, or bedroom community homes. As the population in rural areas rises, so do the impacts of extraction activities.

The following map (fig. 26) shows the population change in Michigan between 1980 and 1990. The areas in hachure fill have the largest population change in terms of increases, and the areas in black have the greatest losses. Note that the greatest losses were not just in the older urban areas, but also in the thumb, which is a heavily agricultural area, and in the upper peninsula which is very, very rural. The largest increases were in the areas in the northern part of the lower peninsula and also in the growing suburban communities around Grand Rapids and the Detroit metro area.

Figure 27 shows population density in Michigan. The black areas have the largest population density. One can easily pick out the Detroit metropolitan area, Ann Arbor (A), Jackson (J), Battle Creek (B), Kalamazoo (K), Benton Harbor (BH), Muskegon (Mkg), Grand Rapids (GR), Lansing (L), Flint (F), Saginaw (S), Bay City (BCy), and Midland (M). The density decreases as the patterns change from black to white. The white areas depict the lowest population density. As one could probably guess, the greatest amount of controversy over extraction activities are going to be in those areas where the population density is rising the fastest and where there is extractable, marketable minerals and the need for those mineral resources. This happens to be in the suburban areas.

## PROTECTION OF RURAL CHARACTER IS OF GROWING IMPORTANCE TO CITIZENS

A central issue in suburbanizing rural areas is protection of rural character. Rural communities are commonly not primarily resource-based economies. They are becoming tourist centers, retirement areas,

bedroom communities, and second home areas. The undeveloped natural character of the area is what attracts people there. Local plans and zoning regulations are increasingly recognizing the strong citizen desires to protect the rural character of the area over resource management objectives. It only takes a small population increase to outvote the indigenous population, and that is when changes in local policies occur.

A number of surveys identify what elements of rural character are valued. Increasingly, no matter what part of Michigan we are in, we get the same results. People want to retain, or view as elements of rural character, wooded areas, natural streams and river banks, ravines, bluffs and hillsides, wetlands, tree-lined roads, parks and recreation areas, farms, non-farm residences on large lots, the absence of commercial development, orchards, lakes, and small towns and villages. Now, if you think back to Tony Bauer's presentation yesterday, a large number of those characteristics can be a part of properly reclaimed sand and gravel operations. He showed you excellent slides illustrating how that can be done. Making sure that after the extraction activity is finished the new land use is compatible with the community is more than half of the battle going in, because the presumption on the part of the citizenry is that a gravel operation is going to be totally contrary to the desired rural character of the community.

## COURT DECISIONS

Michigan is one of those states that has a dubious distinction of having a large amount of zoning litigation -- which is in no small measure related to the fact that we have so many jurisdictions. We have had more than 600 appellate court decisions on zoning, which puts us in the top ten in the country, not particularly a desirable place to be. There have been an incredibly large number of cases related to mining activities.

The Michigan Supreme Court in the 1920s set down a rule as it related to mining that communities could not preclude mining activities unless there would be "*very serious consequences.*" Now, of course, they did not define what that was, other than to say that they would decide it on a case-by-case basis. The rule has been infrequently invoked, until about seven or eight years ago. Yet, if you look at all of the cases, most local efforts to *prohibit* mining activity have been

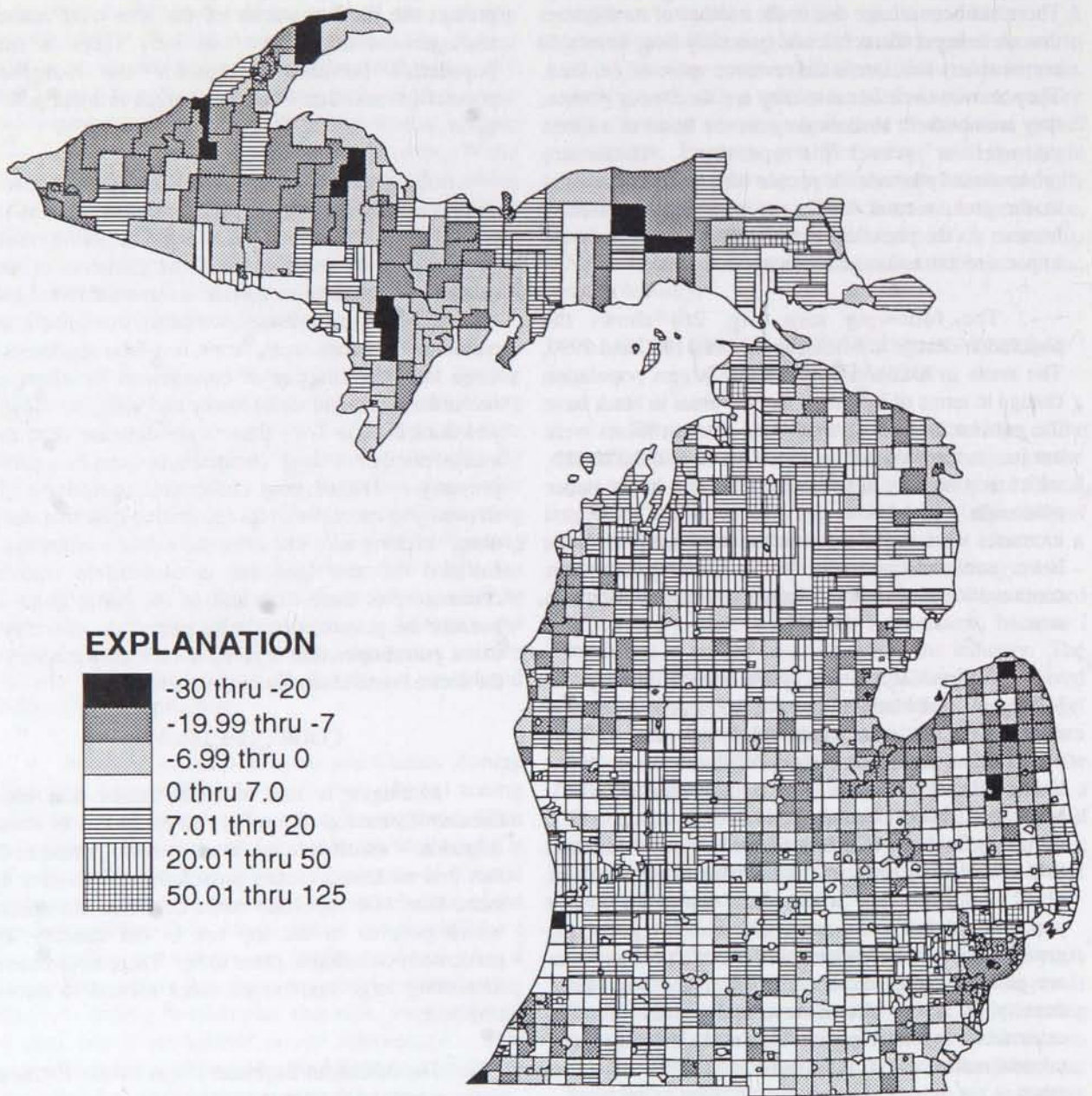


Figure 26. Percent change in population in Michigan by unit of government, 1980-1990. The Saginaw Bay region and older urban areas around Detroit, Jackson, Benton Harbor, and Flint had population losses, while areas around Grand Rapids, northwest Michigan, and the Houghton/Higgins Lake area experienced population gains. More communities in the Upper Peninsula lost population than gained it. Data source: Michigan Information Center, Department of Management and Budget. Adapted from Tim McCauley, *Planning and Zoning News*, 1991, *Planner's Book of Lists III, Census Data*, v. 10, no. 2, p. 17.



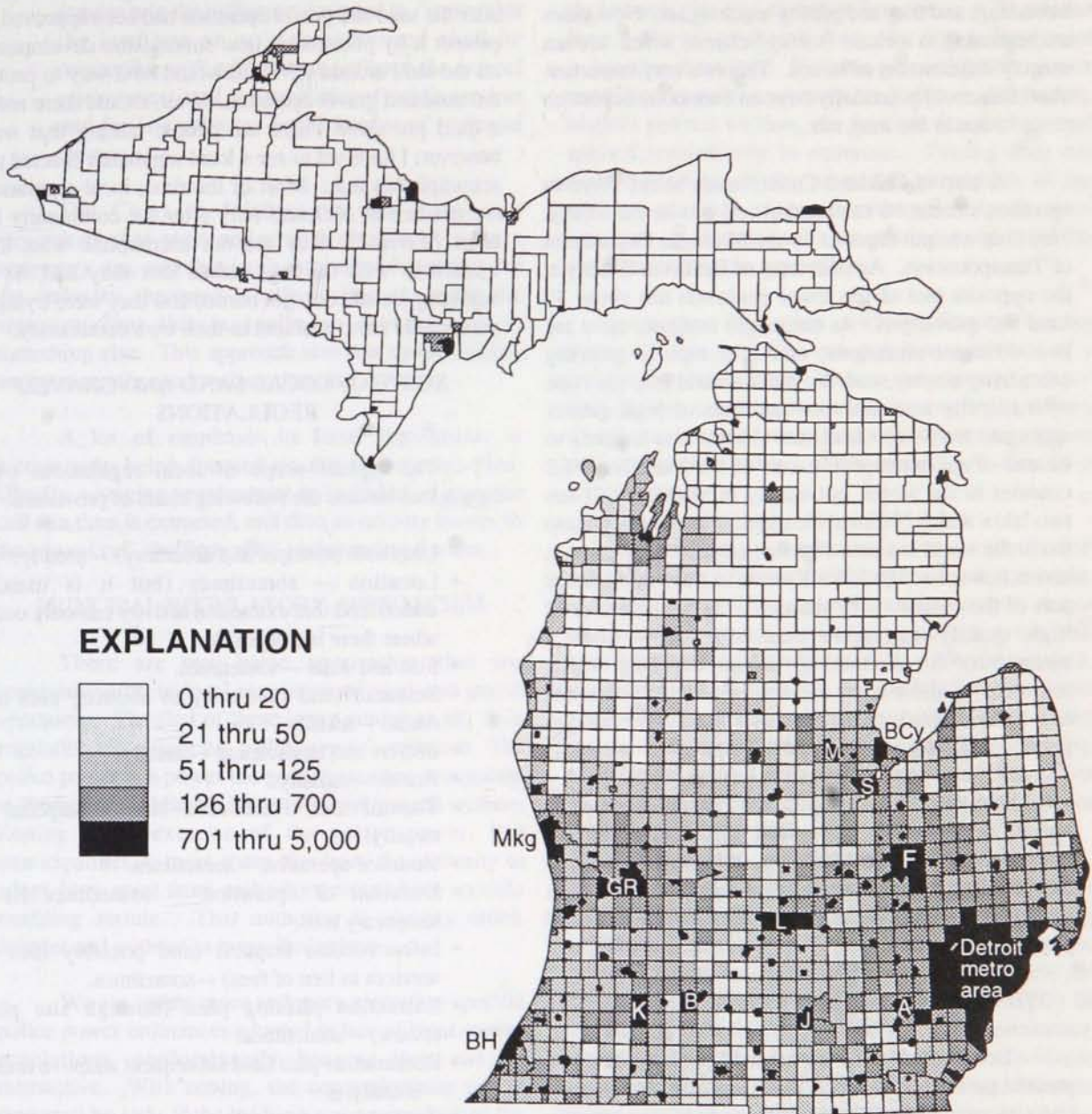


Figure 27. Persons per square mile by community in Michigan, 1990. Michigan's cities have the highest densities (persons per square mile). The gradual decline in density around central cities appears as rings. The gradual increase in the density of outer rings can be equated with the shift of people to suburban or rural areas -- sprawl. Data source: 1990 Census. Adapted from Tim McCauley, *Planning and Zoning News*, 1991, *Planner's Book of Lists III*, *Census Data*, v. 10, no. 2, p. 24.

thwarted, whereas most local efforts to *regulate* mining activity have been sustained.

The number and type of conflicts seem to be increasing, and they are getting much uglier. New cases are beginning to include "*taking*" claims, which are an entirely different set of issues. This is a very important trend that could potentially have an enormous impact on these issues in the long run.

A map of Oakland County made about 20 years ago shows about 98 sand and gravel pits in the county. This map was put together by the Michigan Department of Transportation. Another map of Leelanau County at the opposite end of the lower peninsula has about 35 sand and gravel pits. As one might imagine, these are two different situations; one is a rapidly growing urbanizing county, and the other a rural one (but one with literally tons and tons and tons of high quality aggregate material). Leelanau County also happens to be one of the most scenic, one of the most beautiful counties in the world, not simply in Michigan. It has two lakes which National Geographic has put in the top ten in the world in terms of their quality and appearance, and it has townships, like Kasson in the south central part of the county, with practically 36 square miles of high quality aggregate material. How does a community (or a state) go about deciding which resources to allow to be extracted and which ones not to? In Michigan's case it does not happen by rational planning, so we have "*litigation central*".

Moore (1991, *Planning and Zoning News*, v. 9, no. 6, p. 7-9, 11), addressed local regulation of extraction activities in Michigan. It included a table of the primary cases surrounding sand and gravel and related mining activities in Michigan over the last 50 years.

#### WHY LOCAL REGULATIONS ARE ENACTED

Local regulations are enacted predominantly to prevent permanent scars on the landscape, to minimize impacts on abutting properties (which are usually residential), and in some cases to exclude sand and gravel operations. Of course, the enabling legislation that Michigan communities operate under does not permit exclusion of a lawful land use, and sand and gravel operations are a lawful land use (the only unlawful land uses are houses of prostitution and gambling facilities in Michigan).

Rarely are local regulations enacted to protect sand and gravel deposits for future use or operators from encroachment by new subdivisions or residences. When was the last time you saw a local regulation enacted after the sand and gravel operation had been approved, to protect it by prohibiting new subdivision development on the land around it? That would be a way to protect the sand and gravel operation. Well, should there not be a quid pro quo? There are people talking that way; however, I have yet to see a local regulation enacted that accomplishes that. Most of the time, local regulations are enacted or stiffened only after the community has been "*burned*"; they did not accomplish what they wanted to with the regulations that they had, or an adjoining jurisdiction got burned and they were trying to prevent the same problem in their own community.

#### SCOPE OF LOCAL SAND AND GRAVEL REGULATIONS

The typical scope of local regulations over aggregates include the following kinds of provisions:

- Use (both principal and accessory) -- usually.
- Location -- sometimes (but it is usually understood that extraction activity can only occur where there is a deposit).
- Size and scale -- sometimes.
- Setbacks (and proximity to abutting uses and roads) -- usually.
- Buffers and landscaping -- usually.
- Access -- usually.
- Topsoil and overburden storage/disposal -- usually.
- Hours of operation -- sometimes.
- Duration of operation -- sometimes (is a temporary use).
- Infrastructure impacts (and possibly fees or services in lieu of fees) -- sometimes.
- Extraction phasing plan (through site plan review) -- sometimes.
- Reclamation plan (and subsequent adaptive reuse) -- usually.
- Conformance with state regulations -- usually at two levels -- first, does the operator have the necessary permits, then it is an "*eyes and ears*" function.
- Financial performance guarantee -- usually.
- Liability insurance requirements -- usually.
- Nuisance impact standards (noise, dust, vibrations) -- usually.

- Groundwater protection (water level, flow, and water quality) -- increasingly.
- Conditions may be imposed (based on broad enabling authority) but there must be specific standards in the ordinance designed to "insure that the land use or activity authorized shall be compatible with adjacent uses of land, the natural environment, and the capacities of public services and facilities affected by the land use." -- almost always.

The Court in Michigan a few years ago recognized that sand and gravel operations were a temporary use, and that is an important distinction for the industry, because it allows one to make the argument that this is really an interim step to something else. This approach also sets up the critical importance of a good reclamation plan.

A lot of emphasis in local regulations is increasingly being focused on the reclamation plan. Usually a staging requirement is included so that one cell at a time is extracted, and then as activity moves to the second cell, the first cell is reclaimed, and so on.

#### PRINCIPAL REGULATORY APPROACHES

There are two basic approaches that are commonly used in local regulation of sand and gravel operations. The first of these is not zoning at all. It is regulation via a separate "police power" ordinance. The police power is a power the government has to regulate to protect the public health, safety, and general welfare. Zoning is an exercise of the police power. But municipalities in most states also have the authority to adopt laws apart from authority granted by a specific enabling statute. This authority is usually much broader and without as many limitations.

We are seeing more and more extraction-specific police power ordinances adopted in lieu of local zoning regulations, predominantly because they can be retroactive. With zoning, the nonconforming use is protected by law. If the land use was present before the regulation went into effect, then the new regulation cannot apply to it. With a police power ordinance, everything (old or new) has to comply.

From an analogy standpoint, think back to the early 1970s when we had the energy crisis. Congress enacted significant speed limit reductions on the federal highways. Limits went from 70 miles an hour to 55.

Imagine that you were driving and a state policeman stopped you for speeding and was going to write you a ticket, but you say, "Officer, you can't write me a ticket, I'm a nonconforming driver. I was here before the law was changed, therefore I can drive at 70 miles an hour." No way, that will not work. The police power is broader than that. Under a general police power regulation in order to protect the public health, safety, and(or) general welfare, the law can be changed and applied immediately to everyone. Zoning does not work that way. If the extraction provisions in the zoning ordinance change tomorrow, only the new operators or the new cells in existing operations can come under the new regulations.

Another limitation with traditional zoning approaches is that they can put new operators at a competitive disadvantage because they have to comply with the new regulations whereas the existing operators do not. As a result, many communities are moving to police power extraction regulations that apply equally to all operators.

However, one limitation to a specific police power ordinance is the legal risk that arises because the ordinance looks like a zoning ordinance but is not enacted as one. A reviewing court may use the principle that "it looks like a duck, walks like a duck, and talks like a duck, then it is a duck." So, if sand and gravel regulations look like they ought to be zoning regulations, and they are not enacted as zoning regulations, a court may invalidate them. So, either way a community is taking a risk; it is a tough line for many to walk.

More common than specific police power ordinances are extraction regulations in the zoning ordinance. Three approaches are widely used. The first is regulation by means of a *separate district* where the community establishes a separate zone that is largely (if not wholly) devoted to extraction and related processing operations. The situation we just heard about in Maple Grove is a perfect candidate for this approach. There is a large contiguous area with common characteristics; uniform regulations could easily be applied there.

A second approach, called an "overlay zone", is increasingly being used. An overlay zone establishes regulations that apply in addition to those of an underlying zone. In the case of extraction activities, the overlay zone exists on the zoning map and is tied to a lot of special ordinance regulations, but until a parcel

within the overlay zone is proposed to be used for extraction activities, none of the overlay regulations apply.

The third, most common approach, at least in Michigan, is to permit sand and gravel extraction activities as a "conditional use" or "special land use" in specific zones. These are uses of land which have characteristics with nuisance-like impacts on adjoining uses of lands. There are specific standards established in the ordinance for the particular land use which has to be conformed with. This is an approach which is not only common but also effective. Michigan's zoning enabling legislation clearly authorizes this approach, provided the standards required for approval are clearly spelled out in the ordinance (some states do not authorize this approach). The idea is that the specific characteristics of the use require careful review prior to approval to ensure compatibility with adjoining uses of land. Decisions are particular to the physical features and related facts surrounding a particular location. Final approval is discretionary based on conformance or nonconformance with ordinance standards. The decision is administrative rather than legislative and could be made by either the legislative body or the planning/zoning commission (in some states a decision could only be made by a Board of Zoning Appeals as a special exception use). Some communities are also experimenting with Public Utility District (PUD) approaches using special land-use procedures and standards.

The benefits of zoning (as opposed to separate police power ordinances) include the fact that it is a traditional accepted place for land-use regulations, it is a tool familiar to the court, and it is easily linked to other related regulations and administrative procedures. But, again, it cannot be applied retroactively, and that may result in different regulations being applied to new operations that do not apply to existing operations.

In all three of the common zoning approaches, site plan review would also be employed. This means the applicant would have to submit a detailed site plan for the phasing and reclamation of the proposed extraction activity, and there would be a lot of documents and drawings associated with it. Site plan review is what we call the only WYSIWYG zoning function there is; those of you who are computer experts know that WYSIWYG is an acronym that means "what you see is what you get." The site plan then becomes a critical tool that the local government

uses to ensure that the operation is conducted in a manner consistent with an approved site plan.

#### COMMON UNINTENDED EFFECTS OF THESE TECHNIQUES

There are some common unintended effects of these techniques. The first of which we heard a lot about yesterday. These special review and approval processes promote NIMBYism through the public hearing process. This in turn may result in litigation, delays, and significant cost problems for the extraction owner. It can result in approvals in some places and denials in others based on popular opposition rather than noncompliance with ordinance standards. It often results in dissimilar operations within a single community and between adjacent communities with different regulations. It can create a competitive disadvantage or advantage, depending on which operator you are, which will have an impact on top of market conditions. It can result in higher costs of aggregates to buyers as well as in a loss of valuable deposits. It can also result in great reluctance to plan for and protect known deposits because of a fear that the contention associated with review of a single site will multiply when many sites are at issue all at once. Nevertheless, both zoning and more specific police power approaches tend to result in better attention to broad long term public interests and abutting property owner interests than the laissez faire or "hit and miss" regulatory approaches of the past.

#### COURT RESPONSES TO LOCAL REGULATIONS

With those sorts of unintended effects, it should not be a surprise that there has been a lot of litigation. The court recognizes, at least in Michigan, that unlike other land uses which could in many instances be located anywhere, an extraction operation can only exist where there are extractable minerals. That is a significant limitation on the local zoning authority. Mineral rights are also a recognized property right that are oftentimes given deference over surface rights. But the court also recognizes that extraction operations can have a significant impact on adjoining land uses. That point is usually the basis for most of the disputes. We have another court rule in Michigan that says that any administrative standards have to be "as reasonably precise as the subject matter requires or permits." Communities cannot just say that there shall be a reclamation plan. To meet this court rule, the community has to say that there shall be a reclamation

plan with the following characteristics, and then detail those. Likewise, they cannot "make up" regulations, they have to be a part of the ordinance.

I mentioned earlier the "very serious consequences rule" of the Michigan Supreme Court. This rule is now being applied quite regularly. In fact, on August 24th in Michigan a case involving *Sandman vs. Oxford Township* was decided. Lyn Bourne was an expert witness on that case. The court determined that "very serious consequences" were not going to result from the proposed extraction activity. The court recognized that the proposed extraction operation in this case was a temporary use, where the final use was going to be residential. A detailed reclamation plan to accomplish this had been submitted by the operator. The case occurred in a township which is locally billed as the township with more sand and gravel operations than anywhere in the country. About 23 to 25 percent of the land in the township is zoned for extraction activities, and for residents of the township, the issue is "how much is too much?" The court made a point of saying that while "very serious consequences" would not occur from this particular project, the impact of extraction operations in general had become so significant that the next one might be the one that tips the scale. This is an unusual sort of court warning.

The major local issues usually involve impacts on abutting land uses and where the haul routes are going to be. These issues are usually raised as noise, dust, groundwater, and safety issues. Obviously, the higher the population density, the more impact there is going to be.

"Taking" issues are also being raised. There is a lot of uncertainty here. We thought that there would be some direction from a case decided a few months ago in South Carolina. The case turned out not to provide the direction that we expected. In *Lucas v. South Carolina Coastal Commission*, the U.S. Supreme Court merely reiterated the rule they set down four years ago in *First Lutheran* that when local zoning regulations or other police power regulations have the effect of removing all economically viable use from property, then a taking occurs. Obviously, that could be a big issue if in the application of the rule to a sand and gravel mining case they concluded that a taking had occurred. However, as long as there is a surface use to the property which provided for a positive economic return, then it is unlikely that there would be any taking.

## CONCLUSIONS AND RECOMMENDATIONS

I want to share with you some conclusions and some recommendations.

1. There is no comprehensive, coordinated effort to protect quality aggregate resource deposits for the future, at least not in Michigan. I feel that there should be, and it should be initiated at the state policy level with most of the implementation at the local level according to state goals and broad standards. Sand and gravel extraction is an issue of greater than local concern. The need for it extends beyond the jurisdiction, but local residents bear the brunt of the impact, so local governments should have the authority to regulate extraction activities within broad parameters established at either a state or a regional level.

2. Sprawl, in the form of rural residential development, continues unabated, putting more pressure on the resource. It should be stopped with a combination of state and local efforts focused on renewable and mineral resource protection policies and strict infrastructure management. This is where the industry has been incredibly silent in Michigan. There have been two major initiatives over the last 20 years to establish legislation that would significantly slow sprawl and limit land fragmentation (which is actually one of the bigger long-term problems facing the sand and gravel industry). The industry was totally silent during the years of legislative debate on these issues.

3. Conflicts will continue to escalate, and litigation will become even more common. In other words, the court will increasingly become a "superzoning commission" deciding where and when mineral extraction activities will be allowed. More court involvement could be decreased if the first two recommendations were implemented. Most of the communities that I work with do not want the court to be making their zoning decisions. They do not feel that the court has enough knowledge or understanding to do it fairly on a consistent basis, and, unfortunately, the record in Michigan shows that they are probably right. Norman Williams, Jr., retired Professor of Law at Rutgers University, the author of one of the five national legal treatises on zoning, and the only one to look at zoning on a state-by-state basis, described zoning law in 49 of the 50 states before coming to Michigan. In the first paragraph of the last chapter he writes, "And then there's Michigan, the most erratic of all."

4. Shortages will eventually become evident in the Midwest, again, unless points number 1 and 2 occur. I do not expect much in the way of shortages in Michigan. We just have so much sand and gravel, our problem is going to be how far it has to be hauled and thus what the price will be.

5. As long as sprawl continues, more people will be impacted as extraction activities are approved. The solution is protecting resource based activities (in other words, we have got to identify the resources in advance and protect them), and tightly managing infrastructure. This is a two-edged sword for the industry. Aggregates are very much a part of infrastructure development, and yet where that infrastructure is built, particularly at public expense, is going to dictate to a great extent what happens to new development in the area. So if you manage infrastructure tightly so that it is not just constructed willy-nilly all over the landscape, then you are going to reduce the amount of aggregates in demand, but on the other hand, you are going to be able to extract them because you do not have sprawl (people) all over the landscape.

6. The lack of a strong state role in identifying mineral resources by type and quality and in establishing the public interests in protecting resource deposits for the future is a key factor in the current and future dilemma. It is probably the central factor and should be changed per recommendation number one.

7. The lack of uniformity in local planning and regulation of mineral extraction activities results in "*hit or miss*" policy and puts some operators at a significant competitive disadvantage in some regional markets. It will continue unless number one is implemented or courts get more aggressive.

8. The longer it takes to act, the more difficult it will become to act because of increased land fragmentation and higher population densities -- more people will be impacted. See number five.

9. A coalition of industry, state, and local governments, environmental groups, and aggregate users will likely need to be formed to deal with the above issues, as many interests are affected and any independent effort will be viewed with suspicion. Such a coalition cannot begin forming soon enough.

10. Local government officials and citizens need to be better informed of the need to protect mineral resources and the benefits of well designed reclamation plans. Specific education initiatives should begin soon with sponsorship by the coalition formed in number nine.

11. The local role as it relates to planning and zoning should remain strong, within established broad state parameters, in order to prevent unnecessary new state bureaucracy, or another set of regulations without anyone to administer them, and to deal with local impacts. See number one and number two. Also, a source of local financing, either in the form of a tipping fee, or other impact fee, may be necessary to deal with specific common impacts such as road impacts, which many local governments do not have the wherewithal to deal with, particularly in the rural areas.

12. The disparity in competitiveness created by significant differences in local regulations should be corrected. Model local regulations consistent with state goals and standards should be developed and actively promoted by the coalition created under number nine to achieve greater uniformity.

Those are my conclusions and recommendations. I will be glad to respond to any questions. Thank you for your kind attention and best wishes in your own efforts to bring greater rationality to state and local decisions regarding sand and gravel extraction operations.

#### PARTICIPANTS DISCUSSION AND COMMENTS

- As Mark pointed out, in Michigan, a lot of the jurisdictions zoning decisions are done at the township level. I don't know if there are very many states that have it at that low a level.

Reply: Only six.

- Only six? Well, for a mining company and anybody who represents them it gets to be pretty scary when it gets to the hearing stage, because the citizens are in an emotional state relative to "don't mine"; I mean NIMBYism is very strong, and sometimes you wonder if you're going to come out with your hide. The other aspect of that is that between the initial application for permit and possibly winning that permit, usually through the courts; rarely at the township level will you win. That's a very lengthy and

very expensive process. Usually years and hundreds of thousands of dollars are involved. And contrary to what you said, I think sometimes the local officials and the zoning boards may recognize the rationality of the proposal by the mining company, but they're fearful of siding with or voting in favor of the permit; and if it's taken out of their hands and decided in the court, they don't feel the pressure that they would if they say "well, this is a good proposal," and they've got all of the reclamation plans and done all of their homework. But I don't know if it becomes a more rational process when it's done at a county level. Can you comment on that?

Reply: Okay, a couple of things: In a lot of jurisdictions, there is a reluctance to decide in the face of all the opposition; they say, "well, if we turn it down, they'll just sue us and go to court. Then let the court decide, and it won't be our problem." I have seen that happen before, although I don't think it happens as much in planning commissions as it does in governing bodies, because planning commissions are more willing to make that decision if they have the authority to make it, and in a lot of the jurisdictions, the final decisions are made by the governing body. They're elected, and they're more likely to not be willing to do that. There are exceptions to that. There are three cases that have been consolidated in Kasson Township in Leelanau County, Michigan, where three different operators requested such a use permit for sand and gravel extraction. They ultimately got approval for the rezoning to allow that to take place, a special use permit from the jurisdiction. After a year of very contentious debate and analysis, the governing body finally approved it. Then immediately, a referendum was initiated by the property owners. It went to a vote. All three rezonings went down by referendum. The operators then went to court separately against the municipality, and the circuit court, in a very bold move, overturned all three referenda based on very sound law, and concluded as well that a taking had occurred. Okay, that's all the land was reasonably suited for in that particular instance. Those cases are not likely to go to a higher court because the township just doesn't have any money, and it's a very, very rural township with not a lot of people. But there is the other side of it where the local officials did decide and did the right thing but then still lost because the citizens were so upset and the referendum power was available to them.

• Mark, that was an admirably clear and comprehensive presentation. I would like to address and

ask a question regarding something I think is a bit more fundamental. In the case of zoning, it seems to me that it will be unsuccessful unless the appropriate resource data is there, and in case after case, I see counties that don't have the data. In Michigan, from your experience, do you think this is a fundamental lacking? And how would you recommend, along with those conclusions, that those data be made available?

Reply: It is an absolutely fundamental problem. As a community planner who has also assisted communities to prepare comprehensive plans, and who has attempted to build in resource considerations in the planning process and been thwarted because information on where the resources are didn't exist, yes, that's a fundamental problem. We've got to have it. I think that the only solution that you can get is by the coalition that I recommended. If you get a coalition together that involves a large number of interest groups which together decide that that's one of the key issues, you then have a means to approach the legislature about a solution; but if the industry independently attempts to do that, I don't think they're going to get anywhere. There isn't enough understanding among the legislature that this is an issue or problem of any consequence. It's going to have to be done via a coalition. And there is a potential to do that right now, in Michigan at least. Michigan is one of several dozen states that have just completed what's called a risk assessment process, to identify key risks to the environment and to the health and safety of people. It shocked most people who are involved that a report of this nature came out of a very conservative Republican administration, in Michigan. One of the most critical problems addressing the environment in the state on a long-term basis is the lack of resource-based planning and the impacts of sprawl and unmanaged infrastructure investment on the future of the state. There's been all kinds of legislative activity in just the months since that report was released. Well, what does that mean? What are the implications of that? How come we haven't been talking about that? We haven't had a bill dealing with those issues in so long, and I suspect that you're going to see the time is right, at least in Michigan, to do that. Most of the states are going through that process right now because EPA finished the process on that nationally about two years ago, and then each of the EPA regions in the country have separately done reports. So, many states are doing their own as a result of that, and your own state may have the opportunity to piggyback on that effort.

- To what extent are these issues being brought to the attention of the planning professionals through the planning organizations? Some of this kind of material needs to be presented to them.

Reply: That's a good point. Formally, not at all. I mean there's no formal process underway to do that. I have not seen mineral and extraction issues on either a state chapter of the American Planning Association program or the Michigan Society of Planning Officials training program, for at least 10 years. I have not heard of nor am I familiar with any efforts underway to change this. To the extent that anything has been done, it's been done through articles that we've run in Planning and Zoning News, such as articles that Tony Bauer wrote, and other ones that we've done to just generally acquaint people with some of these problems. But that's not at all a concerted effort. It's very much a hit or miss thing. Perhaps the issue that keeps it in front of people more than anything else is the zoning litigation. Because there's been so much of that, and we report all of it, and it is reported in other places as well. But, that's not solutions based. At that point, it's just news.

- One of your slides in the presentation, your very comprehensive presentation, could be misleading, and I think it needs some explanation or clarification. The one slide that shows 90 some gravel pits in one county could be misleading. I'm very well acquainted with situations like that in Illinois and in some areas in Michigan. The economics of our industry do not allow 97 pits in one county. The slide creates an implication of an industry run amok. I think in that case you would find, as we find in some rural areas in Illinois, one, is

your definition of the term "active." Quite a few of these gravel pits in Michigan, I'm sure you'll find are owned by the county or the township. Quite a few are owned by industry. What happens is the economics of the industry, particularly in rural areas, township and county monies for funding of road repair and county and township infrastructure projects is so slim that by having several sources where the aggregate is bountiful, as it is in Michigan in most places, by having several pits that you can use, you minimize cartage, and cartage is probably 60 percent of the cost of our delivered product. Therefore, I didn't want people to have the impression that our industry has run amok in that county. That was not Wayne County, was it?

Reply: That was Oakland County, but there's more than a million people within Oakland County. That's a very good point, but it raises another one. Please don't assume that any of the comments that I made about reclamation plans and so on should apply only to private operations. I believe that they should apply equally to any public extraction activities as well, county road commission sites, and so on. And, that's going to be a tougher nut to crack than applying them by a long shot to the private sites. But I believe that they should be applied equally to public and private sites.

- Incidentally, for those numbers in Oakland County, that publication, as Mark said, is about 20 years old. There are probably only about 30 to 40 percent of those gravel pits that are still left.

Reply: Thank you.

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## COUNTY PLANNING, PRESERVATION, RECLAMATION, AND REGULATION

By Ed Sieben

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I am Building and Zoning Division Director of the Kane County, Illinois, Development Department. I have been with the County almost 6 years. I have just moved over to Building and Zoning; I had been in the Planning Division for the last 5 years, and one of the things that I have been working on this year has been to update our comprehensive plan, so I would like to touch

on some issues of our new plan as it relates to mining activity.

Our Development Department in Kane County deals with just the unincorporated portions of the county, but that totals about 420 square miles. We deal with zoning, building, subdivision review, and different



planning activities. Therefore, I would like to talk today about our experiences in Kane County with land-use planning as it relates to mineral resource preservation, and then, some of the regulations related to mineral resource extraction and reclamation.

First, just a little background on our county. We are part of the Chicago metropolitan area. We are located about 45 miles due west of downtown Chicago. Some fingers of development spread westward from Chicago toward the eastern property line of our county, about 40 miles west of downtown Chicago. Along the eastern edge is the Fox River; older urban communities go up and down the river. Elgin is our larger community on the north, with Aurora to the south.

The majority (about 89 percent) of our population is located along the eastern border of our county. We have two tollways that feed into the county. I-90, the northwest tollway, feeds out from the O'Hare Airport area to the east, and I-88, the east-west tollway that extends westward from Du Page County. The suburbs of Naperville and Oak Brook, to the east, have a lot of office development. In fact, Sears has moved out of the Sears Tower in downtown Chicago and is going into a site about 2 miles to the east of our border. So, there is a lot of population pressure pushing in from the east. The fastest growing county in the state, Du Page County, which borders our eastern side, grew at a rate of about 25 percent over the past decade. Kane County itself has doubled in population since 1950, and during the 1980s increased 14 percent; a gain of about 40,000 people. We currently have about 325,000 people. While we gained 40,000 people in the 1980s, the whole state of Illinois only gained 4,000 people. If you look at the six counties of the Chicago metropolitan region, they gained 157,000 people during the 1980s; downstate Illinois, therefore, lost about 153,000. All the growth is occurring in the northern parts of Illinois, near Chicago.

The two tollways in the county, I-90 and I-88, have helped to fuel different aspects of our growth. What we are trying to do is to concentrate our development along the eastern edge, where there is current infrastructure, that is, roads and sewers in place, and prevent rapid sprawl into the prime farmland to the west.

The largest suburb of Chicago is the city of Aurora; its population is 100,000. It was settled in the 1830s and became a city around 1857. It is an older,

typical blue-collar urban area; it is getting a new housing development along its outer edges. In fact, last year Aurora was number one among all Chicago suburbs for single-family building activity. It is a little bit gritty in spots. The rail yards of the Burlington-Northern Railroad have since been redeveloped and become a transportation center, and new building activity is taking place downtown.

Elgin, our second largest city, has a population of about 77,000; it also is located on the Fox River. Appropriately, one of our smaller communities is named Big Rock; it is an unincorporated rural community of about 300 or 400 people in the southwest part of Kane County. Kane County varies from a city of 100,000 people to small hamlets of about 200 people. We have quite a diversity in the county.

The Fox River is one of our most valuable resources, and we try to preserve its quality and use for the public's benefit. For example, bike trails have been built along most of the bank along the stretch of the Fox River through Kane County. (We have about 65 miles of trails in Kane County.) Also we are putting in some trails through downtown Aurora, and the city is doing some riverwalk improvements to try to improve some of the blighted areas in town.

Natural resources also are a big aspect of our land-use plan, as are creeks and wetlands. Approximately 65 percent of Kane County is still in agricultural production. This includes about 83 percent of the unincorporated portions of the county over which we have jurisdiction. Farming accounts for more than \$80 million worth of agricultural products sold, and that figure is increasing. We have had a lot of new nurseries expanding into some parts of the central areas of the county, and the value of those products is generally a lot higher than that of corn and soybeans, which are the main crops.

In addition to preserving prime farmland, we are also preserving possible future extractable mineral resources underneath this land; so, it is important that we know where these resources are for future extraction. Due to the development pressure from the Chicago area, plus the relatively cheaper prices for land in Kane County, it is essential that we try to steer development away from areas where potential resources occur. Among the converted uses of the farmland in the county just to the west of the urban Fox River corridor, are

golf course communities; in fact, within the past 6 months the County Board has approved two 700-plus-acre golf course residential developments. Another 700-plus-acre golf course development is in the planning stages, and a 1,400-acre development just to the west of the cities in the middle of the county on the Fox River is in the conceptual stage now.

Residential development is expanding into areas that were farmland. Building activity in Kane County, within the unincorporated portions, is mostly single-family development on one to two acre lots; they require wells and septic tanks inasmuch as the county does not operate sewer systems in the center of the county. We had a peak in 1987 of just under 800 building permits, and we dropped to about 330 last year. So one can see the effects of the recession. The average price of a single-family home is about \$250,000. So that market -- that \$250,000-plus market -- has declined under the recession. However, the cities along the Fox River have not slowed down at all in their building activity, which is taking place primarily on their western border, extending into farmland. These cities have had very steady development; most of their homes start at about \$120,000, but that market is a little bit stronger than the market we have in unincorporated Kane County.

Some of the different stone products that have been mined in Kane County have been used for some of our older homes, such as a home that has become a historic property in downtown St. Charles. Stone also has been used for some of our institutional buildings, churches and commercial buildings, such as in the village of Batavia.

Kane County has historically for about the past couple of decades been the number two producer of sand and gravel among the counties in Illinois. Number one has generally been McHenry County, which is on our northern border. The sand, gravel, and stone represent an existing or potential economic resource. It is often said that the strength of any nation, or in this case county, is based in large part on its mineral wealth and water resources. Therefore, it is important that through the planning process the distribution of important mineral resources be documented and preserved for future use and buffered from incompatible land uses. This has become more imperative as Kane County becomes more developed, thus jeopardizing mineral resource extraction, while at the same time increasing the demand for the resource as construction activity increases.

Currently 23 active pits and quarries exist in Kane County. The majority of these involve sand and gravel; perhaps three of the operations produce stone. Judging from older USGS topographic maps, which have pit symbols on them, there are about 100 inactive pits in Kane County. A photographic and an on-site analysis of many of these 100 inactive pits showed that at least three-fourths of them are 2 to 3 acre sites, which were on a private farm field; probably the farmer dug out a little sand and gravel for his own purposes and sold a little bit on the side. Therefore, land-use planning and geologic information are the key ingredients required for future mineral resource extraction.

A map was prepared in 1980 showing the existing land use in Kane County. In 1980, agriculture accounted for about 73 percent of land use in the county; currently it accounts for about 65-66 percent. Urban residential areas are concentrated in the cities along the Fox River corridor. We have some small towns also, such as Sugar Grove, Elburn, and Hampshire, some of which developed into rural agricultural centers that have some residential activity. The larger lot single-family developments that are being built out west in the vicinity of St. Charles, are generally hilly, wooded areas. People like to live in such an area, so we are trying to concentrate growth in areas such as this. We are calling it our critical growth area, because it is the one area in the county that is experiencing the most development pressure. We want to save this area for future agriculture and any possible mineral resource extraction.

Our current land use plan was done in 1982. It shows a concentration of development taking place along the urban corridor where the infrastructure is, and it shows that rural residential one-acre-type lots are being concentrated in areas that are not prime farmland. We have some expanded development proposed around some of these rural villages.

A more recent update to the existing land-use map shows areas that have greater than 20 persons per square mile. It shows how sprawl is coming out from the Chicago area. It would be extremely difficult to open up any new mining activities within this area, because once people start to come out here, it is going to be difficult to get any mining activity started there. So it is important to try to control this, try to keep the line in check, and document possible mineral resources in these areas.

I would now like to state some of our policies for mineral resource extraction. Policies in our current update plan are to: 1) discourage development on or adjacent to minable mineral deposits that might eventually interfere with mineral extraction or recharge of shallow aquifers; 2) allow well-controlled expansion of existing sand and gravel pits and quarries when consistent with adjacent land uses; 3) encourage the opening of new mineral resource areas for extraction considering the county and regional growth forecast and market conditions; 4) require land reclamation plans before extraction is permitted and require adequate buffer and landscaping between mining operations and potentially incompatible land uses; 5) encourage research by county or other agencies of improved mining and reclamation techniques; and, finally, 6) which we have been doing for about the past five or six years, cooperate with the Illinois State Geological Survey and any other state or federal agencies in identifying and more precisely mapping areas of minerals deposits.

We have a contract with the Illinois State Geological Survey to do the geology needed for the planning study for Kane County. This all began in about 1986 or 1987, when the Superconducting Super Collider (SSC) was proposed by the Department of Energy. The Fermi National Accelerator Laboratory, which is currently the largest accelerator in the United States, is on our eastern border. The plan was to tie this new SSC ring to the existing ring at Fermi Lab. The state did a lot of preliminary planning studies within Kane County, and because a lot of that information was available, we proceeded from there to put together a formal geologic framework for planning. Our county is probably one of the most well researched of all for geologic information.

A map of the earth material in Kane County, one of the main maps of this process, delineates potential areas, from low to high, for development of sand and gravel resources. There is a high potential along the Fox River. Some areas in the still agricultural parts of the county, in the northwest and in the west-central parts, have a high potential for future sand and gravel resources. We definitely want to protect these areas for the future in conjunction with keeping the land in agriculture use.

Also marked on the map are some of the active pits and quarries, many of which are located in the central part of the county. There are not many pits in

the western part of the county; the aggregate taken from these pits and quarries is being used mainly in eastern Kane County and Du Page County to the east. There also are some existing pits and quarries along the urban area; these have mostly been around for a number of years, and accordingly they were there before the people, so they are fairly well buffered for any future expansion.

Other products that came out of the geologic study include a map of aquifers having a potential for development of public water supplies; these are shallow aquifers. Kane County has had a bit of a problem with the state EPA because of the amount of radium in the deep aquifers, which supply most of the municipal water. So, some of the cities now are mixing Fox River water with the deep aquifer water, and a number of them are also going to mix the water with that from the shallow aquifers. That is another reason that we want to protect some areas in central Kane County.

Another map shows soil drainage characteristics in the county -- well drained to moderately drained to poorly drained. About 32 percent of Kane County's soils are hydric, many of them being former wetlands that were drained for farm production.

Other maps include a slope map of the county, showing different slopes; the distribution and thickness of the Tipton till in the county; a map showing drift thickness; a bedrock topographic map; and, finally, a stack unit map of the features of Kane County.

I now want to briefly discuss some of the regulations and reclamation that Kane County does. Our experience in the county shows that regulation and reclamation plans must be reasonable. Through our zoning ordinance, mining is allowed by the granting of a special use within the farming district. A mining operation license that is good for five years and can be renewed after that five-year period is also required. An approved reclamation plan is required as part of the licensing process; this started in the last few years. Previously, those mines, pits, and quarries that existed were not required to have reclamation plans. We now require that any new pits and quarries and any of the existing ones that want to expand into areas where special use zoning exists submit a reclamation plan for approval.

Semi-annual on-site inspections are made to determine the status of the reclamation plans to the area already mined; if reclamation is not up to standards, the

license may be revoked. Performance guarantee in the form of a letter of credit is also required, and the county can default if the reclamation is not done right. In the past, reclamation plans have not been required, and there have not been any requirements regarding soil erosion. As an example, an existing stone quarry that had been operating for a number of years -- which is along and just above the Fox River -- created a lot of erosion into the Fox River. We required them to do some terracing work to stave off some of the erosion into the Fox River. Previously, a lot of the sediment went directly into the river. Some of these things are relatively simple, but they help preserve the environment.

Finally, we also require landscaping; it does not have to be lavish, but people driving by should not see an appalling sight. The quarry pit operators are willing to cooperate with this because they want a good image with the public.

We have had very good experiences with mining activity within the county. We have not had a great deal of opposition to expansion of any of the pits. An exception is a pit located in the central part of the county which is adjacent to an older, 10 to 12-lot subdivision. They were expanding to within about an eighth of a mile of the subdivision, which was approved about 20 years ago before we had our first land-use plan in 1976. Kane County has become the NIMBY capital of northeast Illinois. In the five years that I have been with the county, we have had 10 or 12 different NIMBY groups with cute little acronyms rallying against anything of environmental concern such as possible bridge crossings of the Fox River. We had a proposed scenic parkway just west of the Fox River, and people formed a group against that. There has been a NIMBY group formed against nearly everything in the county, but yet fortunately, we are doing our job, and there has been good cooperation between ourselves and the operators of the pits. We have not had any NIMBY groups formed against any of these mining operations.

In conclusion, I would like to add that Kane County is well aware that there are reasonable limits to the level and amount of regulations. We realize it is important to provide reasonably priced construction materials for future development. Over-regulation and reclamation may make extraction unprofitable. On the other hand, a lack of regulation is also bad, because it may lead to state preemption of local control. In our opinion, this would likely lead to poor land-use planning, at least with regard to the State of Illinois.

There must be a balance, then, between no regulation and too much regulation, which requires cooperation between the state, counties, and owners and operators. We all must realize the need to plan wisely for the future extraction of mineral resources.

To sum up, our strategy is the two p's, Plan and Preserve, and the 2 r's Reasonably Regulate and Reclaim.

## PARTICIPANTS DISCUSSION AND COMMENTS

- Ed, you illustrated the population growth in one slide and in another series of slides you demonstrated that you have a pretty good geologic data base. Have you superimposed those to delineate the areas that are best suited for preservation of future mineral resources, and do you have the authority to make it stick if you have or will do that?

Reply: Yes, we have done that on one of our study maps. Although we are an urban-suburban community, most of the growth has been concentrated along the eastern edge, and our county board has done a good job of following our land-use plans. We do not have a lot of scattered spot subdivisions in the western part of the county. We have a few, but these were established more than 20 years ago, before our plan went into effect. Our strategy and the county board's strategy has been to use agricultural preservation as our rallying point, and through preserving agricultural areas we can also preserve the mineral resources. Our study maps provide us with information on the location of future possible mineral resources. We have had one new sand and gravel pit opened in the eastern part of the county. It was approved in an unincorporated area, even though it was about a quarter of a mile from one municipality. However, it was in an area that was designated on the county plan and the municipality's plan for future industrial use. It was along the railroad, and there was no residential development anywhere in the vicinity; so, there were no objections from the municipality. Incidentally, the company had a reclamation plan that showed a future mixed-use development that was satisfactory to the municipality. But, in general, if any new pits or quarries are to be developed in the county, they will be in the central and western part of the county.

- You might have answered that question, but I would like to press a little more. I noticed on one map that you said it was a quick study, where you had the

sharp edge, where you would like to control development. I also noticed, if I read it right, on your geologic map that right to the east of that edge was one of the primary gravel resource areas; have you just simply written that off? Or is it, from your point of view, impossible to address that issue?

Reply: Well, it is possible. Fortunately the area that was shown as a high potential for sand and gravel is in the south-central part of the county. I just said in general that that central part is our critical growth area. We're showing much of that for future development.

There are some variances to that line, and I didn't show it. We're still working on that, but the area is Blackberry Township, which is in that south-central area; it's an area that has not been intruded by residential development and is a prime agricultural area also. It's very flat and has a large agricultural development with high productivity. We will show that to remain in agricultural production, and it does coincide with the high potential for resources. In fact, that township does have the highest amount of acreage of current pits and quarries in the county. So, we will preserve for agriculture and at the same time for mineral resources.

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## LAND USE CLASSIFICATION AND CONFLICT

By Todd A. Thompson, Paul N. Irwin, Curtis H. Ault, and Steve J. Baedke

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### INTRODUCTION

Wetland regulations and pending changes to wetland policies have generated considerable concern from 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 next to areas of mining. Surface mining operations are most affected by wetland regulations. This is especially true for the sand and gravel industries, which commonly produce from riverine areas that contain numerous wetlands. Little information is available regarding the number of industrial mineral producers that are affected by wetland regulations and the amount of industrial minerals that cannot be extracted at present under current regulatory policies. A further complicating factor is that the regulatory definition of a wetland is not well established. Anticipated changes to the definition require reassessment of the wetland-regulation impact on the industry.

Information on the distribution of mineral resources and the number of producers is commonly kept by state geological surveys. These data in combination with wetland-distribution data can be used to estimate the impact of wetland policies on mineral extraction. The best source for digital data about wetland-distribution is the U.S. Fish and Wildlife Service National Wetland Inventory (NWI). Geographic Information System (GIS) software is most suitable for

handling the large volume of spatial information contained in the mineral resource and wetland databases. In addition, GIS processing yields 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.

The purpose of this paper is to examine the interrelationships among potential mineral resources, wetlands, and industrial mineral producers in Hamilton County, Indiana. The goal of this study is to better quantify the impact of nearby wetlands on mineral extraction and to examine the usefulness of a GIS to address this problem. However, this study is hampered by the scope of the wetland data. The NWI contains wetlands that may not fall under the regulatory policies of the Clean Water Act of 1977, and therefore some of the wetlands used to calculate potential mineral resource loss may not be regulated. In this study, we focus on all non-man-made wetlands within the NWI. We do not attempt to extract from the NWI only wetlands that would be regulated.

### STUDY AREA

Hamilton County is located in north-central Indiana (fig. 28), and is an important source of sand and gravel and crushed stone for the metropolitan area of Indianapolis. Urban growth north of Indianapolis has pushed into southern Hamilton County and has

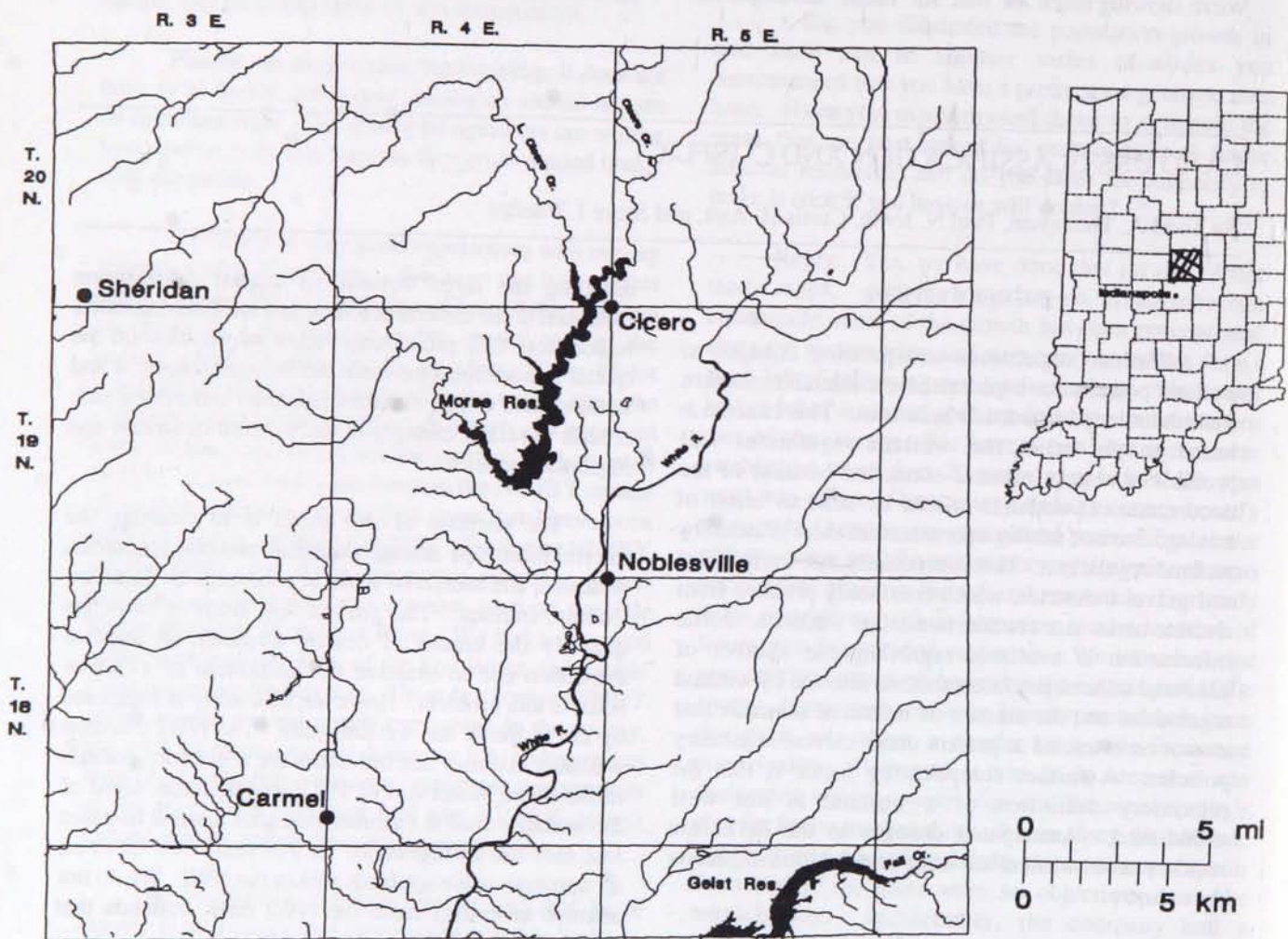


Figure 28. Map of Hamilton County, Indiana, showing drainages and major communities.

expanded the need for industrial minerals within the county while reducing the available resources. Currently, five sand and gravel and three crushed-stone producers operate within the county.

### GENERAL GEOLOGY

Hamilton County is within the Tipton Till Plain physiographic province (Schneider, 1966). Upland areas are underlain by till of the Trafalgar Formation (Wayne, 1963). Sand and gravel resources are primarily located along the drainage valleys of and tributaries to the White River, Cicero Creek, and Fall Creek (fig. 29) and consist of alluvial, valley-train, and tunnel-valley deposits of the Martinsville Formation (Wayne, 1963). The thickest and most economically suitable deposits occur in the southern part of the county in the drainage valley of the White River. Generally, the sand and gravel deposits in the tributaries have a reticulate pattern that suggests that they accumulated in channels that were cut beneath ice, following fracture patterns within the ice. Other sand and gravel sediments occur as kames. These deposits form topographic highs and are variable in grain size and composition. Currently, all sand and gravel production in Hamilton County is within the valley-train and kame sediments.

Three open-pit quarries in the county produce crushed stone aggregate from the Silurian limestone and dolomite that is at or near the bedrock surface in the southeastern third of the county. Two underground mines with adits in faces of the American Aggregates Corp. 96th Street Quarry on the north side of Indianapolis produce from the Salina Group and Salamonie Dolomite of Silurian age. Limestone and dolomite of the upper part of the Salina Group in Hamilton County generally contain considerable chert or clay minerals that make them unsuitable for many uses of crushed stone. However, much of the underlying Silurian rocks are sources of high-quality crushed stone. Two open-pit quarries near McCordsville and Noblesville also produce from the Salina and the Salamonie, and a fourth quarry and possible future underground mine is being developed in Silurian carbonate rocks near Noblesville.

Silurian limestone and dolomite more than 250 feet thick locally are at depths of less than 50 feet along the White River in the east-central part of the county (fig. 29). These potential areas for surface mines are near the expanding markets for crushed stone in the Indianapolis and Noblesville areas. Where

unconsolidated materials overlying the bedrock are more than 50 feet thick in parts of northern and western Hamilton County, Silurian and Devonian limestone and dolomite are potential sources of crushed stone that could be mined underground, although thick overburden in parts of northwestern Hamilton County would make opening an underground mine very expensive.

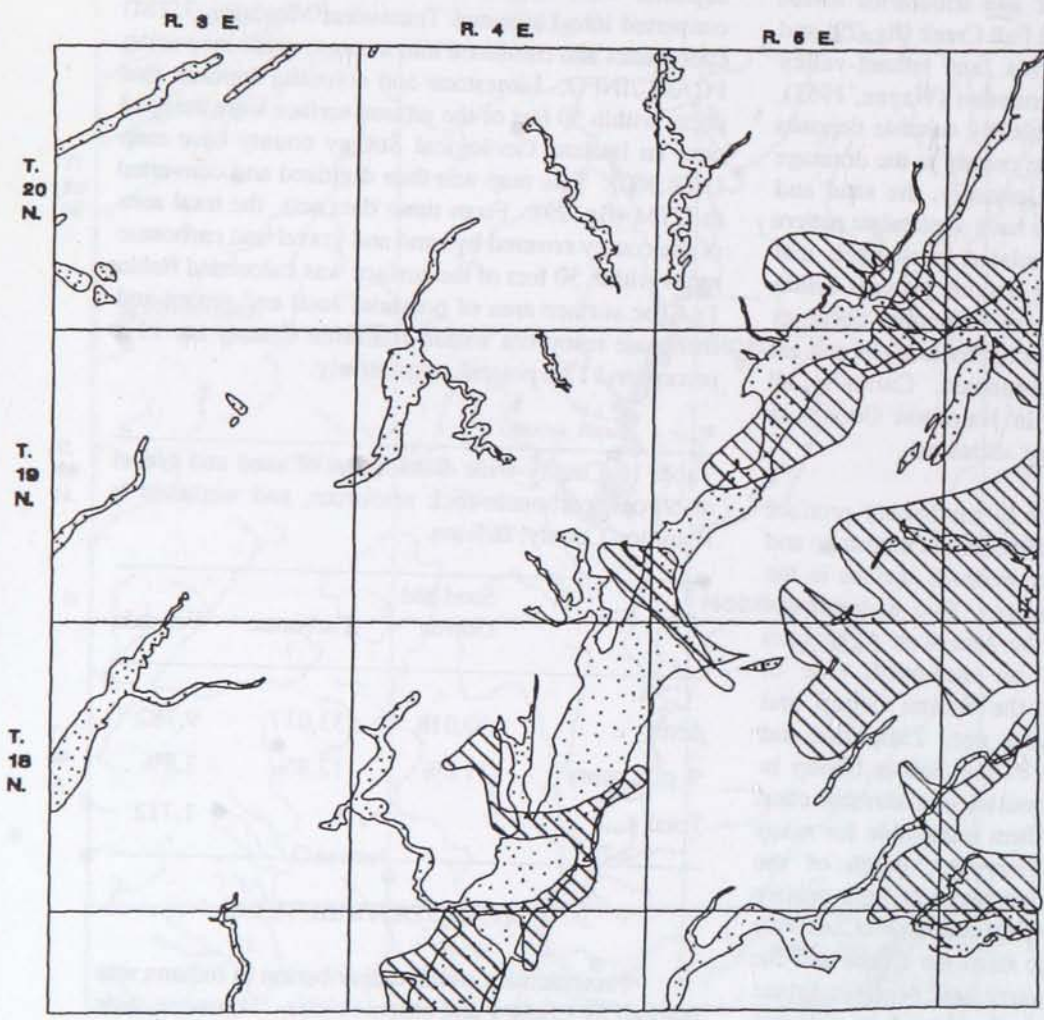
For this study, the sand and gravel deposits were mapped onto U.S. Geological Survey topographic quadrangles (1:24,000 scale), and the borders of the deposits were digitized. The digitized data were converted into Universal Transverse Mercator (UTM) coordinates and combined into a county-wide map using PCARC/INFO. Limestone and dolomite deposits that occur within 50 feet of the ground surface were mapped onto an Indiana Geological Survey county base map (1:63,360). This map was then digitized and converted to UTM (fig. 29). From these data sets, the total area of the county covered by sand and gravel and carbonate rocks within 50 feet of the surface was calculated (table 1). The surface area of potential sand and gravel and carbonate resources within Hamilton County are 11.8 percent and 12.8 percent, respectively.

Table 1. County-wide distribution of sand and gravel resources, carbonate-rock resources, and wetlands in Hamilton County, Indiana.



	Sand and Gravel	Carbonate	Wetlands
Acres	30,018	33,017	9,782
% of County	11.8%	12.8%	3.8%
Total #			1,712

### WETLAND DISTRIBUTION

Presettlement wetland distribution in Indiana was mapped by Lindsey and others (1965). However, their study does not distinguish individual wetlands and cannot be used to define wetland distribution in Hamilton County. A more recent source of information is the U.S. Fish and Wildlife Service National Wetland Inventory (NWI) for Indiana. For the NWI, aerial photographs at scales ranging from 1:60,000 to 1:130,000 are the primary sources of data, with color-infrared photographs at a scale of 1:60,000 used to



**EXPLANATION**

-  Sand and Gravel
-  Carbonate Rock

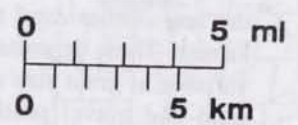


Figure 29. Map of Hamilton County, Indiana, showing the distribution of potential sand and gravel and carbonate-rock resources.



interpret plant and soil occurrences and the frequency of flooding (Mitsch and Gosselink, 1986). Based upon these interpretations, the NWI uses the hierarchical classification scheme of Cowardin and others (1979), comprised of systems, subsystems, dominance types, and other modifiers, to define the wetlands more precisely. When completed, the wetland inventory for an area is summarized on U.S. Geological Survey topographic quadrangles (1:24,000). Digital versions of the NWI quadrangles for Hamilton County were obtained from the Management Information Systems Division of the Indiana Department of Natural Resources and processed into a county-wide coverage using PCARC/INFO (fig. 30). It should be noted that the NWI contains many wetlands that may not fall under current and future wetland regulations. In that light, the wetlands presented in this study overestimate the number of regulated wetlands that occur in Hamilton County.

The wetland inventory for Hamilton County contains 1,712 individual wetland entries, which cover 3.8 percent of the county's entire surface area (table 1). Major wetland types are lacustrine, palustrine, and riverine wetlands (table 2). Palustrine wetlands are the dominant type (69.9 percent), having more than 1,600 occurrences. The NWI considers these wetlands to be

Table 2. Wetland types in the National Wetland Inventory for Hamilton County, Indiana.

	Lacustrine	Palustrine	Riverine
Acres	2395	6841	546
% of Wetlands	24.5%	69.9%	5.6%
Total #	15	1682	15
% of County	0.9%	2.7%	0.2%

"[a]ll nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens.... It also includes wetlands lacking such vegetation, but with all of the following characteristics: 1) area less than 8 hectares (20 acres); 2) active waveformed or bedrock shoreline features lacking; 3) water depth in the deepest part of (the) basin less than 2 m (6.6 feet) at low water ..." (Mitsch and Gosselink, 1986, p. 462). In Hamilton County, these wetlands are typically forested swamps and marshes between farmlands in the upland areas.

They make up 2.7 percent of the county's surface area. The second most common type of wetland is lacustrine (24.5 percent; table 2). These wetlands are considered to be "... habitats with all of the following characteristics: 1) situated in a topographic depression or a dammed river channel; 2) lacking trees, shrubs, persistent emergents, emergent mosses, or lichens with greater than 30% areal coverage; and 3) total area exceeds 8 ha (20 acres). Similar wetland and deepwater habitats that total less than 8 ha are also included ... if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the depth in the deepest part of the basin exceeds 2 m (6.6 feet) at low water" (Mitsch and Gosselink, 1986, p. 460). There are only 15 lacustrine wetlands in the county. They are dominated by the Geist and Morse Reservoirs. Other lacustrine wetlands were produced by sand and gravel excavation into the water table. In all, lacustrine wetlands make up less than 1 percent of the county's surface area. The final type of wetland in Hamilton County is the riverine wetlands, which includes "... habitats contained within a channel with (the following exception): 1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens ..." (Mitsch and Gosselink, 1986, p. 460). The riverine wetlands are dominated by the White River, Fall Creek, and their tributaries. However, the riverine wetlands total only 0.2 percent of the surface area of the county (table 2).

#### WETLAND AND MINERAL RESOURCE OCCURRENCES

Although many wetlands are present in Hamilton County, they make up a small percentage of the county's surface area. From these data, it would appear that wetlands should have little or no influence on the operation of mineral extraction industries. However, tabulated surface distributions of mineral resources do not show the spatial interrelationships between the industries and the wetlands. This is especially true for the sand and gravel producers in Hamilton County that produce from riverine areas that contain many wetlands or create new wetlands through their extraction of sand and gravel. To address this conflict, the surface area of wetland areas that overlie potential resources must be determined. The digitized maps, imported into a GIS, allow the easy calculation of the potential loss of mineral resources. The surface distribution of wetlands overlying sand and gravel and carbonate resources was calculated using PCARC/INFO (table 3).

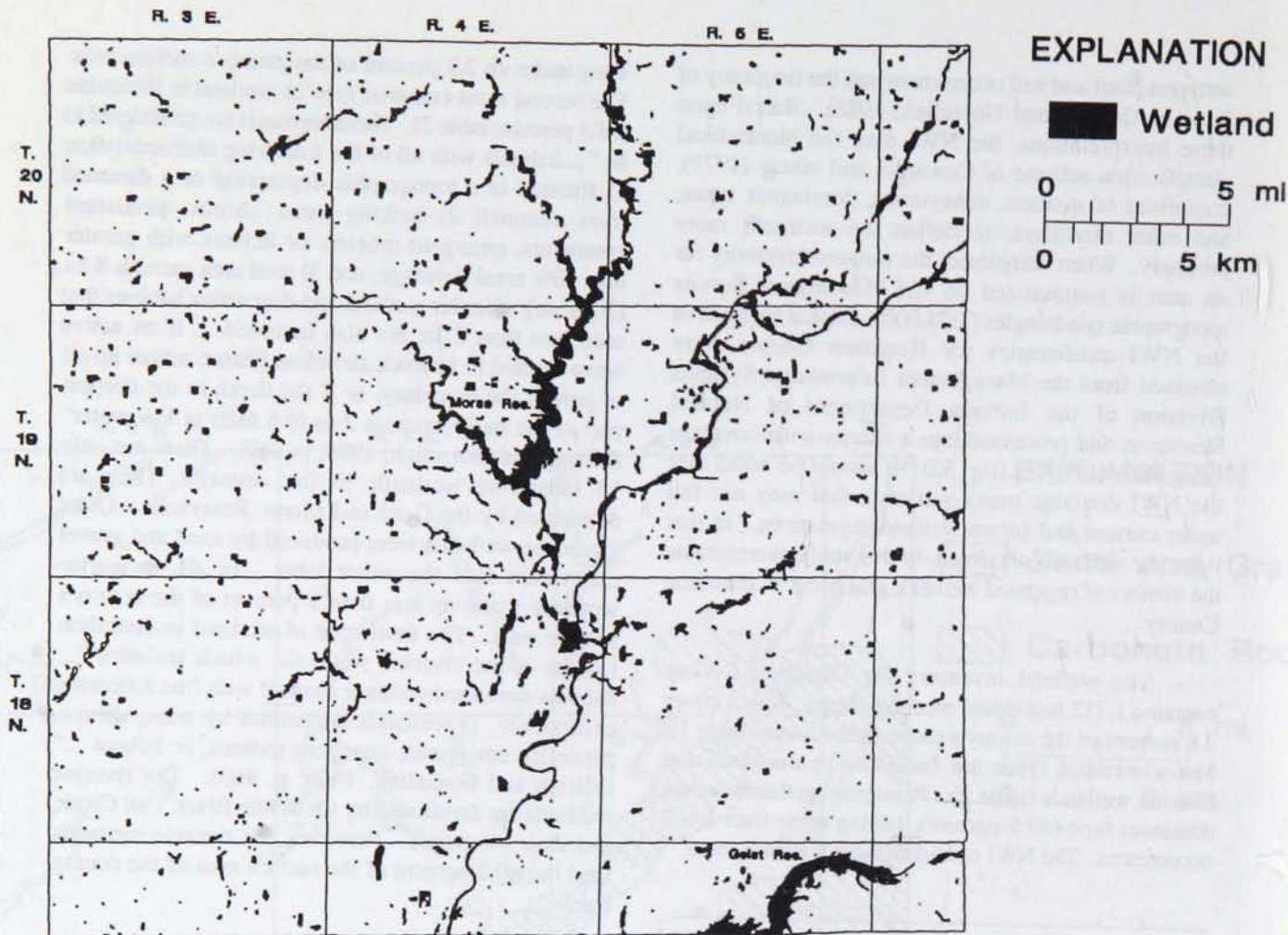


Figure 30. Map of Hamilton County, Indiana, showing the distribution of wetlands.

Table 3. Wetlands overlying sand and gravel and carbonate resources in Hamilton County, Indiana.

	All Wetlands		Minus Man-Made or Disturbed Wetlands	
	Overlying Sand and Gravel	Overlying Carbonates	Overlying Sand and Gravel	Overlying Carbonates
Acres	3,740	1,096	2,761	727
% of Resource	12.5%	3.3%	9.2%	2.2%

Wetlands in Hamilton County overlie 12.5 percent and 3.3 percent of the potential sand and gravel and carbonate-rock resources, respectively. Extracting the reservoirs and excavated wetlands from the remaining natural wetlands, these analyses yield values of 9.2 percent sand and gravel loss and 2.2 percent carbonate rock loss. Both values from a county-wide viewpoint are relatively small compared with the net loss of mineral resources from urbanization and zoning restrictions. However, from an individual producer's standpoint adjacent wetlands can preclude future development of a site or alter an existing mining plan.

To examine the spatial interaction of wetlands and sand and gravel producers, a quarter mile, a half mile, and one mile buffers were drawn around four sand and gravel producers in south central Hamilton County (fig. 31). The acreage of sand and gravel overlain by wetlands was calculated for the three buffer zones (table 4). On an average, four natural wetlands occur within a quarter of a mile of each of the four producers. This value expands to 12 natural wetlands per pit at a distance of one mile.

Because of the numerous small wetlands in Hamilton County (fig. 30), any areas considered for new open-pit quarries are likely to contain some wetlands, especially in those areas along the White River in eastern Hamilton County, where sand and gravel and carbonate rock could be co-produced. A large amount of surface space is also required for storage and processing of stone from underground mines, and wetland legislation presents significant economic and geographic restrictions. New mining ventures in Hamilton County, as in many areas in the Midwestern U.S., face many economic, zoning, and other obstacles. Land acquisition and development for such ventures will

Table 4. Wetlands overlying potential sand and gravel resources near four producers in southern Hamilton County.

	Distance from Operations		
	1/4 mi	1/2 mi	1 mi
<u>All Wetlands</u>			
Number (Per Pit)	65 (9)	116 (17)	169 (24)
Acres Overlying Area of Sand and Gravel	927	1417	1936
<u>Natural Wetlands</u>			
Number (Per Pit)	27 (4)	57 (8)	86 (12)
Acres Overlying Area of Sand and Gravel	327	604	1022

become more expensive and more difficult if wetlands are present.

#### CONCLUSIONS

Numerous small wetlands occur throughout Hamilton County, Indiana, and make up about 4 percent of the total surface area of the county. The natural wetlands overlie about 9 percent of potential sand and gravel and 2 percent of potential carbonate-rock resources. Although these numbers are small compared with the loss of potential mineral resources due to urbanization and zoning, wetlands are common near most of the current producers. Expansion for several of the producers may be limited because of the presence of an average of 12 nearby wetlands per pit within a radius of one mile.

The trend during the last decade to open new underground limestone and dolomite mines in central Indiana, all situated in present sand and gravel operations and open-pit quarries, is clear. Part of and perhaps much of the reason for this trend has been the expense and difficulty of obtaining land and zoning clearances for new mineral operations. In addition, although stone reserves for both surface and underground mining are abundant in Hamilton County, *available* reserves are much less because of intense surface use of land and the difficulty of obtaining zoning approval for mineral extraction. Additional restrictions imposed upon aggregate producers to protect wetlands, even though environmentally and ecologically desirable, will make land acquisition for mineral extraction that much

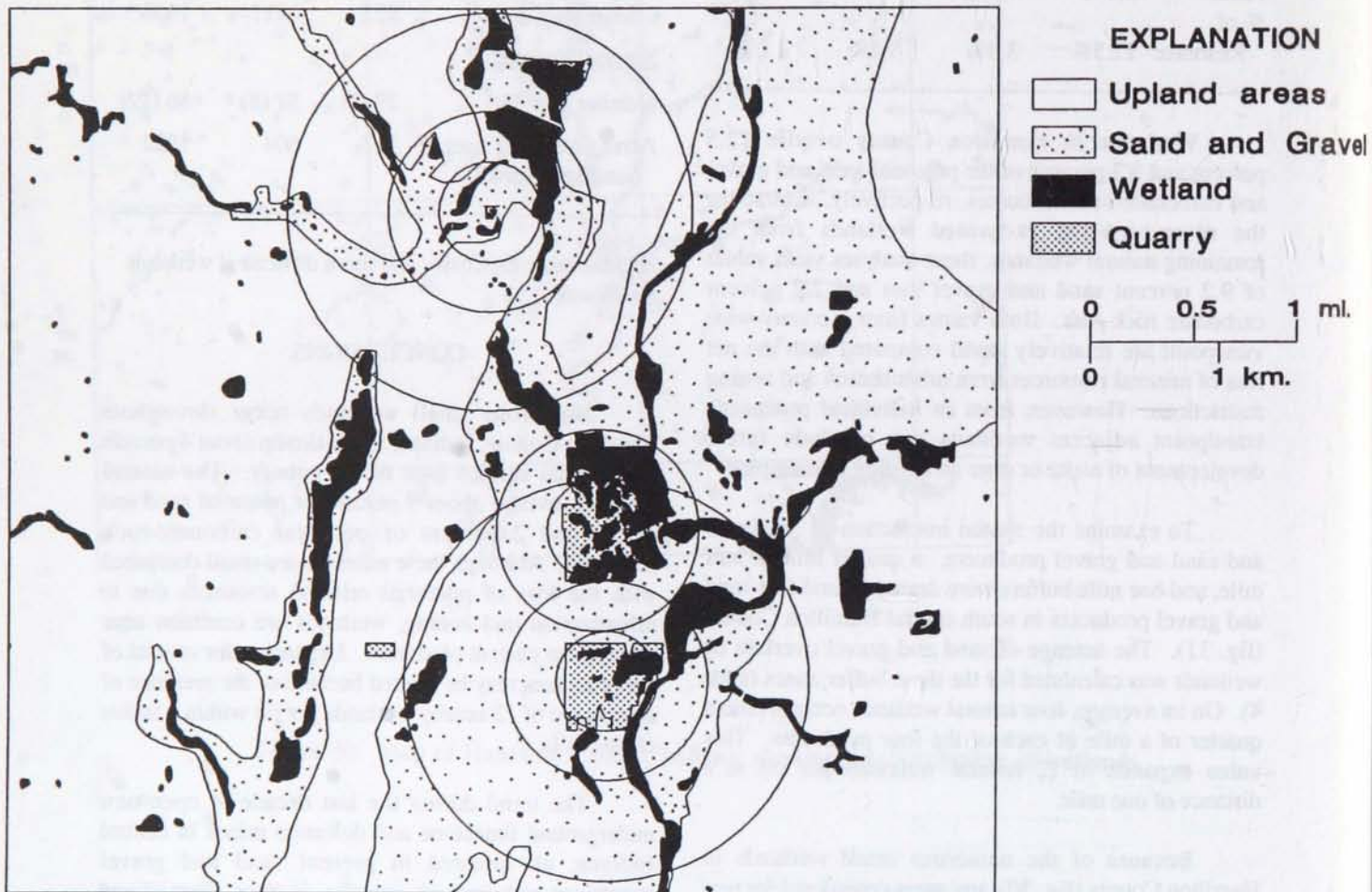


Figure 31. Map showing the occurrence of wetlands within 1/4, 1/2, and 1 miles of four producing sand and gravel operations in southern Hamilton County, Indiana.

more difficult. Sequential use of the land, allowing restoration of wetlands and other environmentally favorable renovations, both during mining and after abandonment of the extraction sites, is a partial solution.

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#### PARTICIPANTS DISCUSSION AND COMMENTS

- How many times are lands classified as wetlands based on a perched water table?

Reply: I'm sorry I really don't know. I haven't gotten into all those details, I don't have all those numbers.

- I don't know if that's a realistic classification, to say the perched water table.

Reply: Those were many of the concerns that were brought up to the EPA, and part of the reason that the EPA was attempting to change their manual, for situations like that.

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## A REGIONAL APPROACH TO EVALUATING AGGREGATE NEEDS

By Carl J. Schenk

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### INTRODUCTION

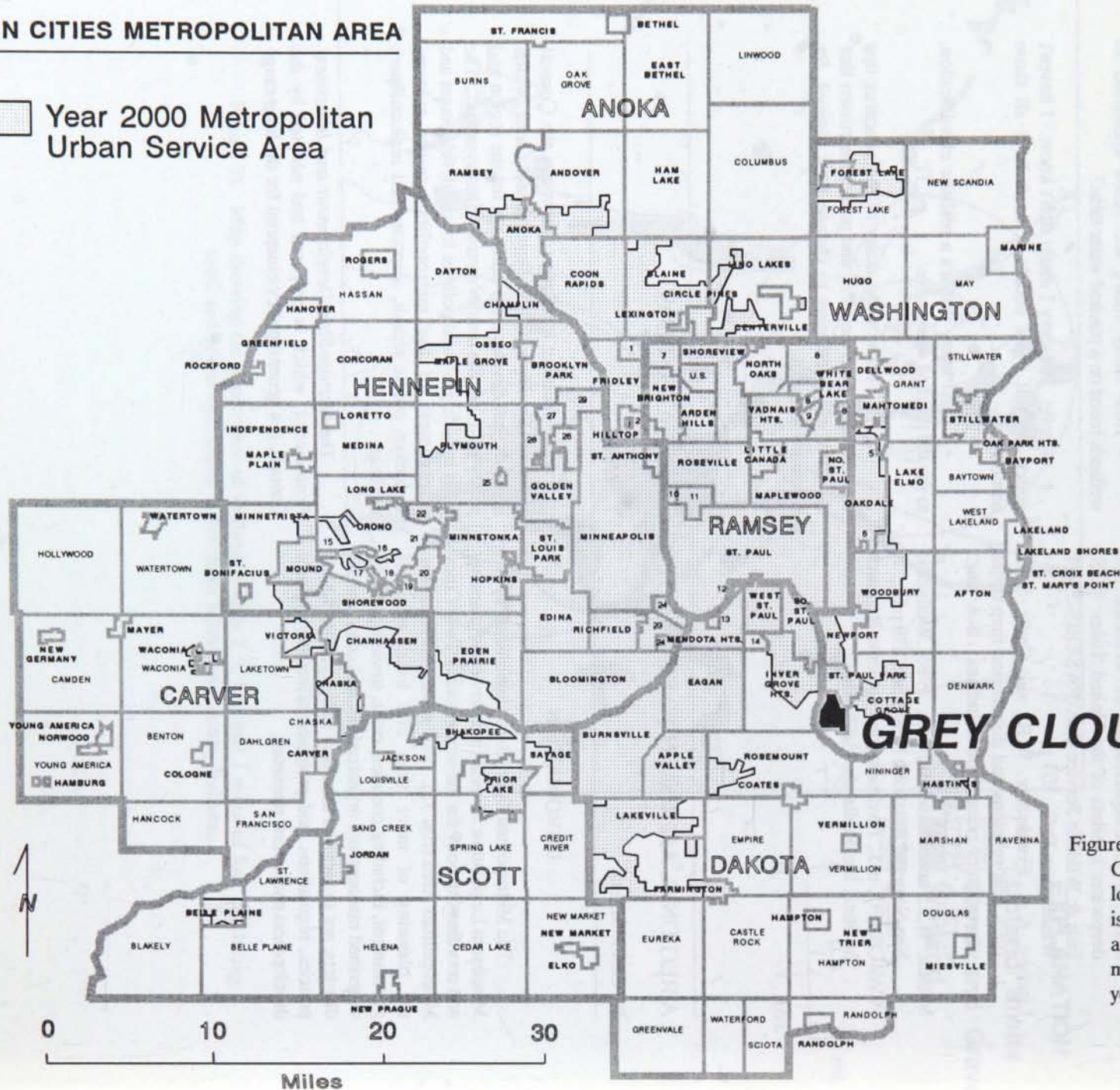
The Metropolitan Council was established by the Minnesota Legislature 25 years ago to be the planning and coordinating body for the seven-county Twin Cities Metropolitan Area (fig. 32). This means coordinating the planning of more than 200 local units of government, including counties, cities, townships, local watershed management organizations, and other special districts, not to mention the many state agencies whose policies, regulations, and programs affect the region's development and natural resources.

The enabling legislation authorizes the Council to prepare the *Metropolitan Development Guide*, which is the overall development blueprint for the region and policy plans for the major "metropolitan systems." The plans include goals and policies for the development and management of the metropolitan sewer system, highways, public transit, airports, and regional park facilities.

The *Metropolitan Development and Investment Framework*, which is prepared and adopted by the Council, is a general policy blueprint for the long-range

**TWIN CITIES METROPOLITAN AREA**

 Year 2000 Metropolitan Urban Service Area



**GREY CLOUD TWP.**

Figure 32. The seven-county Twin Cities Metropolitan Area. The location of Grey Cloud Township is shown in black, and the planned area of urban development and metropolitan services through the year 2000 is stippled.

development of the region. The framework contains goals, policies, and standards for orderly development, including the physical, social, and economic needs of the region. The framework delineates the areas planned for urban development and metropolitan services through the year 2000 and the areas for rural development (fig. 33).

To ensure that local comprehensive plans are consistent with metropolitan plans and policies, the legislature passed the Metropolitan Land Planning Act in 1976. The act requires all governments to prepare comprehensive plans, including:

- objectives, policies and standards for development;
- a land use plan (intensity and extent of land uses); and
- a public facilities plan (sewers, parks, and transportation)

Local comprehensive plans are to be consistent with metropolitan system plans. The Council reviews each plan and subsequent amendments to determine their consistency. If the local plan is inconsistent, the Council may require the local government to modify it. For example, if the local plan requires the unplanned expansion of a metropolitan sewer or wastewater treatment plant, the Council could require the local government to amend its plan to bring its plans for growth in line with the sewer service available.

It should be noted at this point that aggregate resources are not a metropolitan system. Natural resources have not been designated to date as a metropolitan system. Currently, all the metropolitan systems are "engineered" or built systems.

#### NEED FOR A REGIONAL ASSESSMENT

In 1980, the Council reviewed the proposed comprehensive plan of Grey Cloud Township, a rural community located at the southeastern edge of the urbanized portion of the region. A major crushed rock mining operation had been active in the community for many years. The company had tried for some time to have the township zone an adjoining 200-acre parcel owned by the company for future mining, and the town had resisted. The township's proposed comprehensive plan designated the land for low density, rural residential

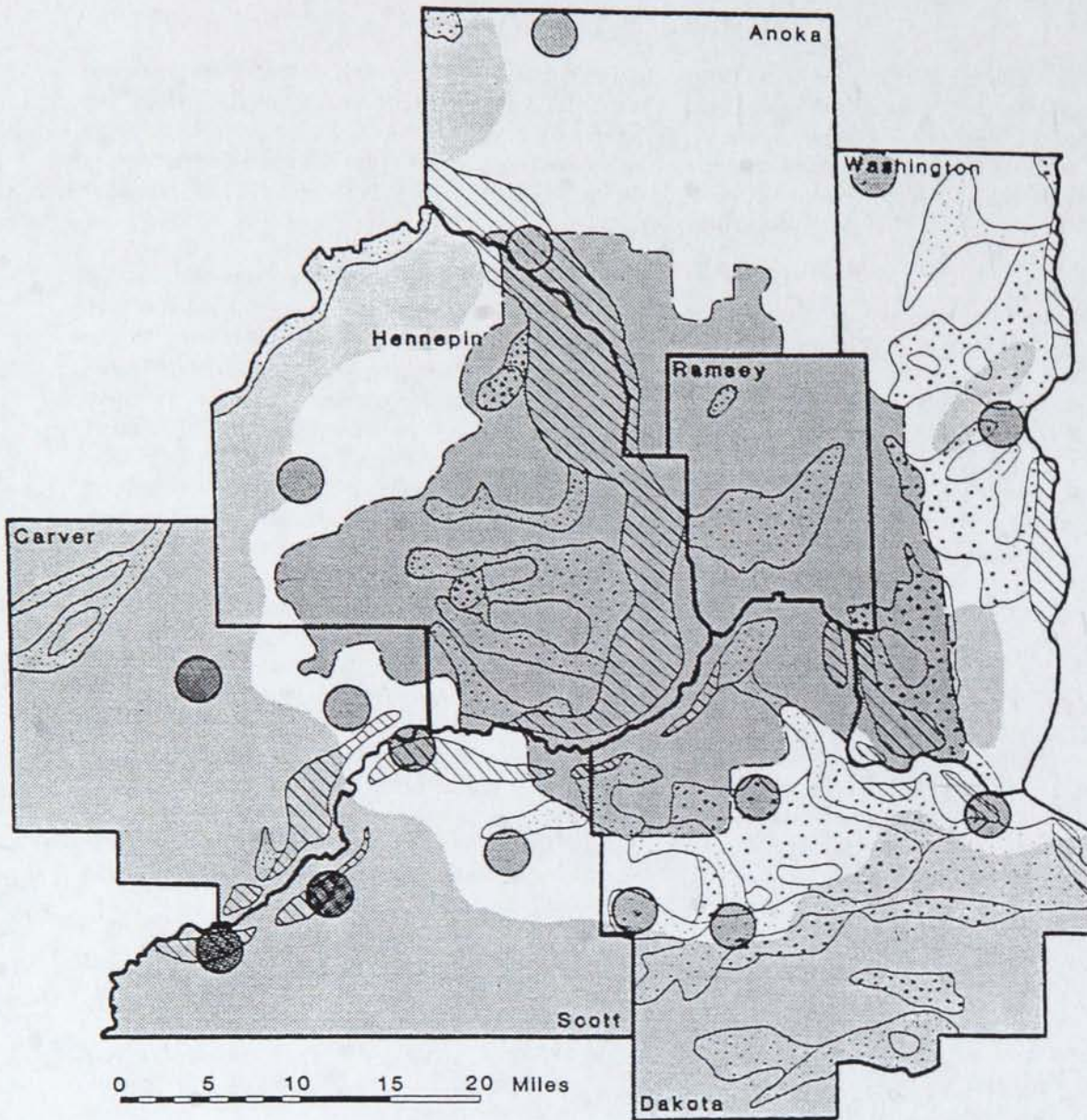
development and included in it is a regional park search area. The Council's Recreation Open-Space Plan had previously designated the area as a potential regional park facility, but a master plan had not been prepared for the facility that delineated its boundary or proposed uses.

The company pressured the Council during its review of the township plan to require the township to modify its plan to allow the future mining of the 200-acre area. The company argued that the deposit was significant to the region because of the scarcity of the resource and its close proximity to urban development and transportation. Because the deposit was located adjacent to the Mississippi River, the company shipped the crushed rock efficiently by barge to river terminals at several locations throughout the urban area.

The Council determined that it did not have sufficient information on the availability of the resource to require a change in the plan or allow the mining of the rock prior to developing the regional park. As part of its response to this issue, the Council decided to undertake a comprehensive evaluation of identified and potential aggregate resources in the region. (The Council had attempted a more limited study of permitted reserves in 1974, but it had been unable to secure the information from the producers.) The objectives of the study were:

- define the general location, extent, quality, and quantity of resources;
- identify uses and future uses of aggregates;
- evaluate constraints on availability (transportation, economics, urban development, and public policy); and
- develop appropriate public policies to assure future availability.

To assist in preparing the study, a technical advisory group was formed to advise the Council staff. It consisted of representatives of the mining industry, local governments, environmental groups, local government planners, and representatives of the Minnesota Departments of Natural Resources and Transportation. The committee assisted with technical tasks such as developing the criteria for classifying potential resources as well as reviewing drafts of the study.



METROPOLITAN DEVELOPMENT FRAMEWORK PLAN  
AND POTENTIAL SAND AND GRAVEL RESOURCES







-  1990 Urban Service Area
-  Freestanding Growth Centers
-  Commercial Agricultural Region
-  Terrace Sand and Gravel (mixture of northeast and northwest source areas)
-  Des Moines Lobe and Grantsburg Sublobe Sand and Gravel (northwest source area, mixed with variable amounts from northeast source area)
-  Superior Lobe Sand and Gravel (northeast source area)

Figure 33. Map of the Metropolitan Development Framework Plan delineating areas of urban development, commercial agriculture regions, and potential sand and gravel resources.



## EVALUATION OF QUANTITY AND QUALITY OF THE RESOURCE

Two types of aggregate resources present in the region are sand and gravel or natural aggregates, which are of glacial origin, and bedrock or crushed rock consisting of limestone (Platteville Formation) and dolomite (Prairie du Chien Formation).

To prepare the inventory of potential aggregate resources, the Council contracted with the Minnesota Geological Survey. The responsibility of the Survey was to evaluate the quality and quantity of identified and potential aggregate resources in the seven-county region. The Survey used existing engineering and geologic data such as well logs and test holes to determine the quality and depth of deposits and county soil surveys and U.S. Geological Survey topographic maps to map and evaluate the extent of deposits. Original drilling or testing was not done. The maps indicate generalized potential aggregate resources and not proven reserves.

Potential aggregate resources were classified and mapped on the basis of several criteria as to their potential value. Sand and gravel deposits were classified on the basis of the following:

- proportion of gravel (generally 35 percent or more retained on a #10 sieve);
- thickness (20 feet or more);
- amount of overburden (10 feet or less);
- depth to water table (generally less than 20 feet);
- size of the deposit; and
- relative amount of data available.

Bedrock deposits were classified by the following criteria:

- formation type (Platteville or Prairie du Chien Formations);
- thickness of the deposit (generally 10-30 feet or more);
- amount of overburden; and
- reliability of information.

Each deposit was described according to its origin, location, general quality, and estimated quantity. Deposits are classified as "potential" when data points are scarce or "significant" when more information is available.

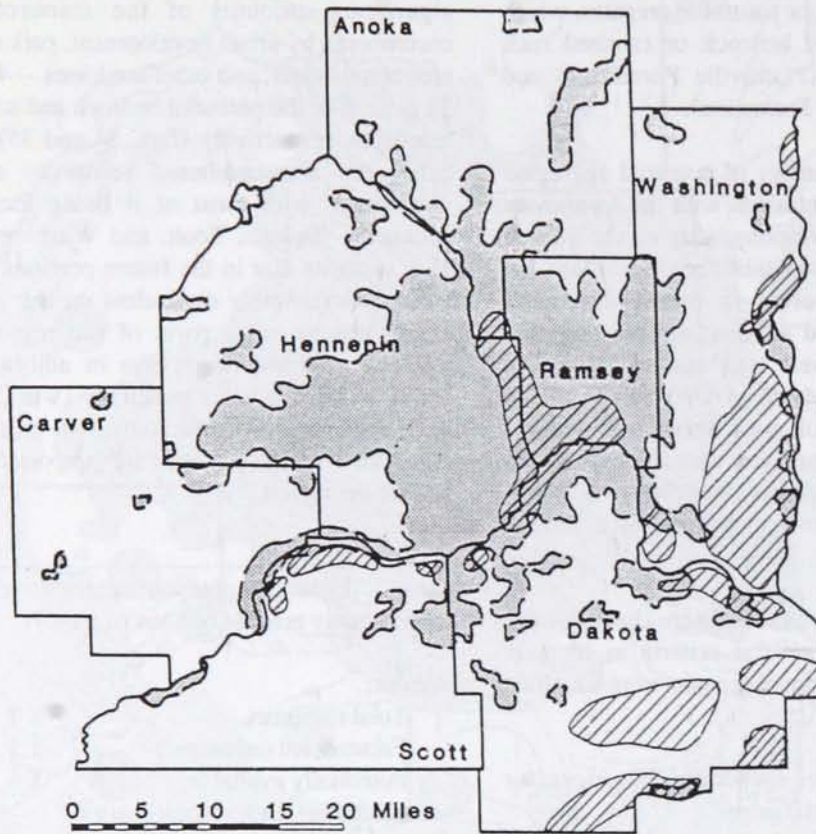
According to the Survey's inventory, there are an estimated 3.0 billion tons of sand and gravel and 1.6 billion tons of crushed rock potentially available in the region (table 5). The Survey also estimated that significant amounts of the resources had been encumbered by urban development, park and recreation area acquisitions, and other land uses -- 41 percent and 32 percent of the potential bedrock and sand and gravel resources, respectively (figs. 34 and 35). Geographically, the unencumbered resources are unevenly distributed, with most of it being located in three counties -- Dakota, Scott, and Washington (table 6). This suggests that in the future portions of the region will be increasingly dependent on the availability of aggregates in other parts of the region. Potential resources outside the region in adjoining counties, which are already being mined for Twin Cities' markets, were not evaluated in the study. An estimated average of 0.8 million tons per year are "imported" from mines outside the region.

Table 5. Estimated potential aggregate resources in the seven-county area, in billions of tons.

Bedrock:		
Total resources	3.7	
Encumbered (urbanized)	1.5	(41%)
Potentially available (excluding 25% percent waste)	1.6	
Sand and Gravel:		
Total resources	8.4	
Encumbered (urbanized)	2.4	(32%)
Potentially available (excluding 50 percent waste)	3.0	

Table 6. Distribution of potential aggregate resources, in millions of tons, in the seven-county area.

<u>County</u>	<u>Resource</u>
Anoka	40.0
Carver	124.0
Dakota	2,471.0
Hennepin	37.0
Ramsey	22.0
Scott	2,740.0
Washington	3,715.0



**GENERALIZED DISTRIBUTION OF BEDROCK AGGREGATE  
SUBREGIONS IN THE TWIN CITIES METROPOLITAN AREA**



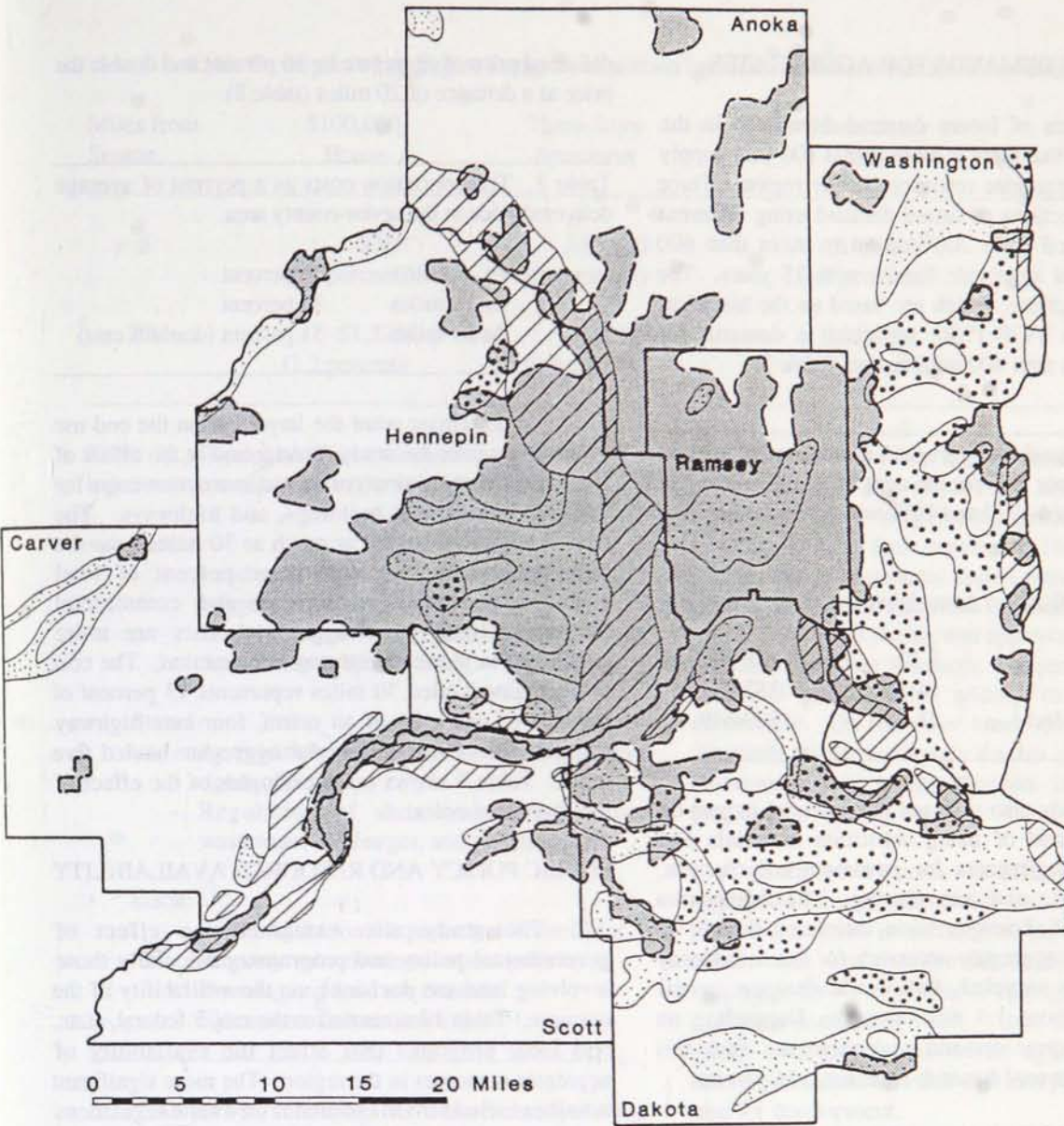
-  Generalized Urban Land 1978  
(Including approved public open space)
-  Generalized Bedrock Aggregate Subregions

Figure 34. Generalized distribution of bedrock aggregate subregions in the Twin Cities Metropolitan Area, as defined in study.



**GENERALIZED DISTRIBUTION OF MAJOR SAND AND GRAVEL DEPOSITS  
IN THE TWIN CITIES METROPOLITAN AREA**





-  Terrace Sand and Gravel (mixture of northwest and northeast source areas)
-  Des Moines Lobe and Grantsburg Sublobe Sand and Gravel (northwest source area, mixed with variable amounts from northeast source area)
-  Superior Lobe Sand and Gravel (northeast source area)
-  Generalized Urban Land, 1978 (Including approved public open space)

Figure 35. Generalized distribution of major sand and gravel deposits in the Twin Cities Metropolitan Area, as defined in study.

## FUTURE DEMANDS FOR AGGREGATES

Estimates of future demand developed in the study indicate that there is more than a 100-year supply of potential aggregate resources in the region. Three different projections of future demand using different methods ranged from 200 million to more than 600 million tons of aggregate for the next 25 years. The medium projections, which are based on the historical demand from 1970-1980, indicated a demand for somewhat less than 400 million tons (table 7).

Table 7. Demand for aggregate, in millions of tons, in the seven-county area for the next 25 years. Historical demand between 1970 and 1980 was 12-16 million tons per year.

<u>Projection Method</u>	<u>Annual Average</u>	<u>Total</u>
1) Sector	8-12	208-307
2) Historical	14-15	352-372
3) National Model	21-26	519-649

The study also assessed the potential impact on regional demand of using substitute materials and recycling of aggregates for pavement construction, reconstruction, and resurfacing. The Minnesota Department of Transportation estimated that if 60 percent of the aggregate necessary for future highway programs was recycled, this would dampen annual demand by about 1.6 million tons. Depending on which of the three demand projections are used, this would reduce annual demands from six to 16 percent.

### IMPACT OF TRANSPORTATION COSTS

Historically, as urban development expanded outward in the region, mines also opened further from cities. This results in longer transportation distances to markets and increased costs for the material. Because aggregate is a relatively inexpensive commodity, approximately \$2 per ton at the mine in 1983, trucking costs could have a significant impact on the cost of aggregate at the construction site. Based on a survey of mining companies, the Council's study confirmed that transportation (trucking) costs are significant. At a distance of 10 miles, transportation costs increase the

delivered price of aggregate by 36 percent and double the price at a distance of 20 miles (table 8).

Table 8. Transportation costs as a percent of average delivered price in the seven-county area.

-	At 5 miles	25 percent
-	At 10 miles	36 percent
-	At 20 miles	51 percent (doubles cost)

To determine what the impact is on the end use of the aggregate, the study also looked at the effect of increased transportation costs on construction costs for housing, commercial buildings, and highways. The cost of aggregate hauled as much as 30 miles from the mine represents less than three percent of total construction costs for housing and commercial buildings (table 9). Aggregate costs are more significant in terms of highway construction. The cost of aggregate hauled 30 miles represents 13 percent of the cost of one mile of an urban, four-lane highway compared to seven percent for aggregate hauled five miles. Table 9 shows other examples of the effect of transportation costs.

### PUBLIC POLICY AND RESOURCE AVAILABILITY

The study also examined the effect of governmental policy and programs, particularly those involving land-use decisions, on the availability of the resource. Table 10 summarizes the major federal, state, and local programs that affect the availability of aggregate resources in the region. The more significant activities include environmental reviews and regulations and the acquisition of federal, state, and local parks and recreation areas. There is typically no assessment of the impact on the availability of aggregate resources when these programs or projects are established.

The primary responsibility for land-use decisions that affect the availability of aggregate lies with local government. As in other metropolitan areas, cities, townships, and counties have the responsibility for adopting comprehensive plans and land-use controls such as zoning that will determine the use for any parcel.

Table 9. Impact of aggregate transportation costs on construction costs in the seven-county area.

Miles from Source	\$100,000 House	Three-Story Apartment	Seven-Story Office	Four-Lane Highway
5	\$780 (0.8 percent)	\$13,000 (0.6 percent)	\$195,000 (1.0 percent)	\$275,000 (7.3%)
20	\$1,221 (1.2 percent)	\$19,000 (0.9 percent)	\$250,000 (1.3 percent)	\$442,000 (11.3%)

Table 10. Summary of governmental programs affecting resource availability in the seven-county area.

- Federal:
  - Land acquisition for national recreation and refuge area
  - Environmental laws/regulations (e.g., Clean Air and Clean Water Acts)
- State:
  - Acquisition of parks, trails, highway rights-of-way
  - Regulation of shorelands, floodplains, wastewater discharges, and air emissions
- Local:
  - Land acquisition for parks, public facilities
  - Property valuation/assessment policies
  - Planning and land use controls
  - Extension of urban services

As part of its study, the Council analyzed the land-use controls of the local governments in the potential aggregate resource areas to evaluate the overall effect on aggregate availability. Local land-use controls emphasized the regulation of mining operations and reclamation rather than protection of the resource. Most local ordinances allow mining. Only three prohibited it outright. Most local governments allow mining as a conditional use, special use, or under an extraction permit. Few establish temporary districts where mining is a permitted use.

The conditional or special permit procedure typically requires the company or operator to meet certain conditions to obtain a permit. These vary from community to community and may be very general or specific. The conditions frequently lack specific

standards for operations and reclamation. The permit application will also require the holding of a public hearing to allow neighboring property owners and residents to raise their concerns. The conditional use process and requirements do not provide any certainty for the applicant and allow for a great deal of local subjectivity in reviewing and approving or denying the proposal. In some instances, the permit must also be reviewed periodically, adding to the applicant's uncertainty. On the other hand, the lack of specific standards in an ordinance do not provide the local community any surety that its interests will be protected.

Local governments also affect the availability of aggregates through their taxing and special assessment policies. If land is assessed at its market value for commercial and residential development, it may encourage the development of aggregate resource lands for other conflicting uses. Also, the assessment of utility costs (sewer and water) against property and extension of these services will also pressure the sale of land for development.

There is not a regional policy or program to protect aggregates or to coordinate local planning and land-use controls to encourage protection. The Council's *1973 Protection Open Space Policy* encouraged local governments to include policies for the "interim use, development and reuse of mineral deposit areas and concurrent reclamation." However, there was a lack of information on the location of the resource, and the Council did not have authority to implement these policies. These policies have been dropped by the Council since the completion of the study. The Council's *Metropolitan Development and Investment Framework* support continued urban development in areas where substantial potential resources are located.

Local government comprehensive plans reinforce the regional policies.

## MAJOR FINDINGS

The major findings of the study were as follows:

- the region has more than a 100-year potential of aggregates. Potential resources are 3.0 billion tons of sand and gravel and 1.6 billion tons of crushed rock. The projected use over the next 25 years based on historical trends is 375 million tons;
- better data is needed to delineate actual reserves;
- potential resources/reserves in three counties are close to or exceeded by future demands, but the potential resources in the other counties will meet the long-term needs of the entire region;
- costs of longer transportation hauls do not have a significant impact on residential and commercial construction costs. The impact on highway costs is more significant;
- local land-use controls are the key factor in protecting aggregate resources for future needs;
- local land-use controls do not recognize aggregate protection or mining as a primary land use;
- local governments and citizens are concerned primarily with the side effects of mining and reclamation rather than long-term protection; and
- lack of overall coordinating framework to ensure availability of aggregate for the region. Each local government decides what is best for the region.

## CONCLUSIONS

Some major conclusions of the study were:

- aggregate resources are important to the economic development of the region;
- while the region's potential aggregate resources are adequate for long-term needs, there is a need to determine the actual reserves based on the volume, quality, and commercial viability of the deposit;
- the region needs a mechanism to protect the future supply. There is no need to protect all potential resource areas, but large areas will continue to be lost because of urban and rural development;

- the public and local officials need a better understanding of the importance of aggregate resources and the need for mining as a land use; and
- to increase the acceptability of protection and mining, local officials and residents need assurances that the industry and local mining and reclamation controls will minimize the side effects on the community, the environment, and other local development objectives.

## AGGREGATE PROTECTION LEGISLATION

In 1984, the aggregate industry and selected others lobbied the legislature to pass a law providing stronger state wide protection of aggregate (Minn. Laws 1984, Ch. 605, Section 2). The law required the Department of Natural Resources and the Minnesota Geological Survey with the assistance of other state agencies to identify and classify potentially valuable aggregate lands. This information is to be given to the appropriate local planning authority and county engineer. The local planning authority is to consider the protection of identified and important aggregate resources in their land-use decisions.

In the Metropolitan Area, because of the potentially large supply of aggregates available, a compromise in the legislation was reached with the bill's author. The Metropolitan Council was directed to appoint an advisory committee to look at the need to protect the resource in the region. The committee was to be comprised of representatives from industry, local governments, and the Minnesota Departments of Natural Resources and Transportation. The charge to the advisory committee was to:

- identify whether existing information is adequate to determine whether local plans and land-use controls should protect the resource;
- recommend a procedure for identifying the degree of protection; and
- recommend methods of protection.

The committee evaluated the information, findings, and conclusions of the Council's study. The committee also examined the ability of the industry to secure local permits for new and expanded mining. The committee determined that while the permitting process is full of uncertainties for the industry, the issuance of

permits in recent years has maintained a 10-year supply of reserves. The committee also found that the private market and aggregate mining industry have been generally successful in the past in identifying, securing access, and developing commercially viable reserves to meet the region's demand and have the capacity to do so in the foreseeable future. Some of the major conclusions of the committee were:

- the existing information is adequate to determine the need to protect the resource. Existing site-specific data is inadequate for protecting specific deposits, but the necessary surveys to provide the data are expensive and should be done by the industry in selecting deposits for mining;
- there is no need to legislate local protection of the resource. There is potentially a 200-year supply of unencumbered resources based on known consumption and supply estimates;
- the aggregate mining industry historically has been successful in identifying and developing commercially viable resources to meet the region's needs;
- the diversity and lack of specific standards in local mining controls is a problem for the industry and communities; and
- the long-term protection of resources not owned by the industry would be uncertain and costly. Protection by zoning is uncertain due to the property rights of landowners.

One of the committee's recommendations was that the legislature review the possible need for preservation periodically, for example every 10 years. The committee also recommended that the legislature establish a committee of technical experts and representatives of local communities and the industry to recommend standards for mining and reclamation to be administered by local governments. These would be used in reviewing permits and setting conditions for permits. If the legislature adopted the standards, they would be mandated. Communities could adopt less stringent standards but not more restrictive.

#### PARTICIPANTS DISCUSSION AND COMMENTS

• To finish your story on, historically, the township ...

Reply: Oh, the Grey Cloud. I was going to mention that. It was a political issue to begin with, and it was resolved politically. The town board changed

in its composition. I think there were three board members, and one or two of those changed. They basically got tired of fighting with the company, in a way. The land-use zoning designation was changed to allow the expansion of the mining in that area. We did secure some kind of setback of about 100 feet so that they would not mine very close to the river. It was right along the Mississippi River, a very scenic, beautiful area, so the mining would only extend to a certain number of feet from the river, and the issue of the park is still up in the air. The county has not prepared a master plan for that park. It is still in our open-space system plan, but it is one of those things that will be resolved at some point. The Mississippi River has been designated as a National Recreation Area. The Park Service is developing a plan, and it will be interesting to see what that plan says about that particular area and whether that whole issue is going to bubble up again or not.

• It just strikes me as odd that you're changing your first conclusion from a 100 year supply to a 200 year supply. I'm assuming since the reserves are finite, using the criteria you set up, that really the variable you have for change is the rate of growth; is that the major factor that changed in massaging these numbers?

Reply: I can't tell you the details of that. I believe our first conclusion was far more than a 100 year supply, and I think they looked a little more closely at the numbers and maybe used our medium forecast and came up with a 200 year number. You know, hundreds, those are nice catchy numbers, so 200 sounds a little better than 100. I think 100 is good enough for me. I don't think I'll be around when that comes up.

• The problem of the fallacy in the Council's analysis as to the burden on the community is that, when you look at a \$100,000 house, the increase in cost is minimal, but if you look at the burden on the community, that is, if you move those aggregate producers 10 miles, which is about a buck-twenty a ton times 16 million tons a year, you've added a burden to the community of close to \$20 million that you don't need to add.

• If I followed your logic of coming up with your estimates anywhere from 100 to 200 year supplies, that is taking into account the current urbanized area. Did you do any kind of projection of growth of what area these potential resources will be covered in the

future, 25, 50, 100 years? If not, I suggest that those estimates of 100 to 200 year supplies are much too optimistic. In fact, today, much of those resources delineated in Dakota County are already encumbered by development.

Reply: Are you talking about demand side or you talking about loss of potential?

- The loss of potential resources.

Reply: We did look at that at the time, and I couldn't find any numbers on that. The local plans and the comparable growth plans for the metropolitan area do show substantial growth into Dakota County. There's no doubt about that, and there will be loss of reserves.

- I think that needs to be considered when you're suggesting that we have this 100 to 200 years' supply.

Reply: I don't; as I remember, it didn't affect it all that much, because we still came out with 200 years. That's a conservative estimate of what is out there, I really think.

- I work with Burlington-Northern on aggregates, from Minneapolis to Seattle and Missouri. I'd like to strengthen what was just said; that is, in studies of other areas, what are quoted as reserves, or resources usually work out to about one quarter that figure when you're talking reserves. So from a standpoint of having done a number of studies, you're looking at 25, maybe 30 years maximum reserves in the metropolitan area here; you're not looking at 200 years or 100 years.

Reply: Are you talking about reserves, or are you talking about potential? We're not talking about reserves.

- When you're talking resources, you're talking broad picture. When you get down to true reserves of drill materials, material you can permit, etc., usually it shrinks down to, as I say, about a quarter.

Reply: I don't know how you'd ever project what you're going to be able to permit or not. That's just an impossible task. I think the numbers are fairly conservative. We used 10 feet of overburden, and, for the level of study that we're doing, a general planning study, I think we all felt comfortable with that. This

was done by the Minnesota Geological Survey; the technical advisory group looked at the criteria.

- Reserves have a tendency to be a very shrunken version of resources. Right?

Reply: I agree with you there. Yes.

- What you just said I think maybe is the key. It seems to me that what you can permit is the bottom line. If you can't permit it, it's gone. It's the bottom line.

Reply: I don't think you're going to be able to protect what you think you'd like to protect. Unless the companies are willing to buy all that supply out there, you have to allow some reasonable use of land, and that's a tough issue. Property owners are going to say, "Oh, you're not going to mine my land for 100 years?" I wouldn't want to sit on my land that long. So, that's a very difficult issue to protect. If the company is willing to go out there and buy parcels, that's more readily done. It's still going to be a tough battle, no doubt about it, but you've got agriculture out there, you've got low density residential out there, even at one unit per acre, or more in some areas. There has to be some use of the property, so, we've got some good ideas on how to protect a lot of it; in some of our close-in suburbs, they're looking at development of their community. Now, if you're going to say you have to take 1,000 acres out of your community and protect that, and it's right for residential, commercial, and industrial development, how are we going to protect that? It's a very difficult issue. You'll be in court all the time on that sort of an issue.

- Yeah, I know of at least one company in the Chicago metropolitan area that bought reserves. They did the whole thing; it was drilled, they had reserves proven up, they couldn't get it permitted, and had to sell it.

Reply: I agree with you. That is a different issue, but to go out into some community, what do industries look at? Do they look at it in terms of something like a 100 year supply?

- Maybe we should just forget about all of our surface aggregate resources and go underground, mine it all 500 feet below ground, and go after the top grade rock and just forget all this surface stuff.



Reply: Maybe it's going that way. I don't know.

- I would suggest you take a look when you ask a question about how you protect those resources. You protect the resources in the same way you protect residential areas by designating areas as a residential zone, or an agricultural zone, or as a natural resource zone. That doesn't preclude all other uses. It just precludes the uses that are not compatible. In the California situation where they have designated areas, the communities who adopted these areas have given the mining, the resource protection area, the right to mine. And then the other uses come in, in the context of the mining. It doesn't prohibit other uses. It just says mining is the primary use. And it's no different than being designated as any other type of a land-use zone. It just recognizes that this is a critical resource in this area, and it's a transitory resource, but a transitory resource in that context over a period of 50 or 100 years or in your case, if the supplies are concentrated, 200 years. So you can protect them in the same way that you can protect other types of land uses.

Reply: I think you can do that if the industry owns the land, but if you've got a property owner out there who wants the shopping center plus the housing, and the city wants the housing, etc., you're working against some strong forces there.

- Same way if you had an agricultural piece of land, and now mining is permitted in agricultural lands, mining companies can go in there, negotiate with that landowner, and then go get a special use permit to mine it. You can reverse that for the other kinds of uses, but mining becomes a primary use as agriculture is now, and then it still does not prohibit that developer or that landowner from selling the use to some other type of development, to have to go through a special exception.

Reply: I think that works in the short run, but, again, I say you have to have the right situation, and you're talking about locking up land for 100 years; that gets to be very difficult for a landowner. I think that for a short run that's workable, particularly where a company is interested in buying the land or does own the land now, but when you're talking about longer range than that ...

- Let me address that a little further. We're talking about locking up land for environmental purposes worldwide for our grandchildren for an infinite

period of time. I'd like to come back to that. David Holmes pointed out that not more than 30 percent of the maximum resources will be available for actual mining. I would like to indicate an example that certainly substantiates that. In the coal industry, another resource of which we seemingly have great amounts -- more extensive than sand and gravel -- studies throughout the eastern United States indicate that only 25 to 30 percent of that coal is available. We have looked at seemingly infinite resources of coal in our basins and are finding out that only a small portion of that is available, largely due to urban and other infrastructure expansions. Coming back to availability, we are talking about a finite resource here, not an infinite resource. We have to legislate, if necessary, to make sure that's available, or we won't have it. If we're standing here today thinking only about 30 years, whether we're politicians or we're from industry, we're being very short-sighted. We cannot count on industry to solve availability problems, so it comes down to zoning, and it comes down to being willing to make decisions that are the right decisions for far greater periods of time than 25 or 30 years.

- I'm an aggregate geologist, and I think that what we need is to definitely start this all up again and start a study right now and go through the whole thing. I see a lot of questions and problems with this study right here, and there's been so many changes very quickly, that it's definitely time to start another one.

Reply: Won't bother me.

- And not just the Twin Cities area - it should be statewide.

Reply: Yeah, there are regions in the state that are hurting because of the scarcity issue. I did see one map of Stearns County which adjoins us. By the way, we already receive extensive amounts of aggregate from the adjoining county of Stearns, to replace that which soon will be worked out in Maple Grove. We've pretty much developed everything else in Hennepin.

- I would like to preface my comment with, I'm sure nobody intends to jump on you.

Reply: No, I'm not taking it that way. These issues are more complex.

- Along the same line as the last several comments about reserve versus resource and multiple

100 year projections, I'd like to give one example from the State of Ohio which has not had specific studies done on it. But, the city of Cleveland, which for all intents and purposes is the entire county, Cuyahoga County, has extensive sand and gravel deposits, primarily sand, in buried valleys throughout the county. The surrounding counties have a fair amount of glacial outwash. Cuyahoga County is essentially out of sand. It's further complicated by the fact that there are not any carbonate rocks within the general vicinity of the southern Lake Erie shore. Because of urban sprawl, lack of planning, and designation of mineral resource areas, aggregate, fine aggregate in the southern Lake Erie shore in Ohio is anywhere from \$8 to \$12 a ton. They're bringing in both carbonate and slag across Lake Erie. They're trucking carbonate sand 100 plus miles from western Ohio; this fine aggregate is worth \$8 to \$12 a ton in the city of Cleveland. Here in Minnesota you're looking at \$2.36 a ton and saying you got 200 year supplies. I'll just repeat what other people have said, when you look at a 200 year projection and you look at where you are now, look at where this city was 20 years ago and look at where it might be 20 years from now, and think again as to how much you might have that's not built over.

Reply: Very good discussion going here. Too bad it's time for lunch.

• I'm a geologist, so I hesitate to make this suggestion, because the planners will probably start jumping on me. But there are a couple techniques that I understand work, in answer to your question "how do you lock up land"? Two of them that I don't think have

been mentioned are land banking and the transfer of development rights. I take the easier one first. The transfer of development rights. You can make tradeoffs with developers to allow a higher intensity of development in one area to forgo intensity in another. That might be one that would work. The land banking can either be where a government, if you're in a county with a sufficient tax base, that is, a highly populated county, the government can purchase the land or they can purchase the rights to develop or to mine the land in the future, similar to a scenic easement, where they don't really buy the land from the person, but they buy the right to keep that land in its present state. Both of those have been effective elsewhere, so maybe something like that could work.

Reply: There are some tools, there's no doubt about it, but when you talk about buying, there has to be money, and as we all know, in Minnesota right now there isn't a lot of money around to do much of anything new that we'd like to do. So, there are tools, yes. There are constraints, there are problems that have to be dealt with. Property rights, etc., etc., money, whatever. I sure appreciate the discussion. It was good.

Lyn Bourne, moderator: One of the common complaints of those of us in the mining industry is that we end up preaching to the choir. This last interaction is a little digression from that, and if there are future meetings like this, maybe we can get more diversity in the audience, and get some people from the media. I know you tried, but we need to understand each other's point of view, and I think the discussion that we had was good.

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

By James R. Dunn, Moderator

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The problem that we have been presented with here is to say things that haven't been said before, and we have had a very thorough discussion of quite a few different things. The previous talks have been excellent, with good descriptions of some of the problems which most of us here see. We have had some excellent suggestions for approaches for ways of handling some of these problems. So, our problem

here is how do we talk about things but not be repetitious.

The approach to pursuing the subject of this panel will be this: we will try to fill in gaps in the previous discussions. I will touch on a couple of them briefly myself. Additionally, we will try to stress the kinds of things which can be done to solve problems.

We have been discussing the long term anticipated shortage of aggregates. I've been to quite a few meetings where such things have been discussed, but most of the meetings have been short on answers. We will discuss some shortages, something about the shortages, something about the implications, and we'll explore some of the specifics about what kinds of things should be done and by whom. Additionally, some environmental implications will be discussed. I hope, however, that we will not have to go back and prove certain things to this audience. For instance, most of us probably assume that roads and transportation infrastructure are needed and must be kept in good condition. Some people may not accept that, but I think the people who are here do. We will also assume that in order to do this, a supply of minerals is required, and we will also assume that in order to do that, mining is necessary.

First, I must say that I have no idea what the panel members are going to talk about, whether they agree or disagree with each other or agree or disagree with previous speakers.

First, I'll just discuss a few things in the way of filling in a few holes. I will give examples of some of the manifestations or symptoms of shortages. Most of us know what most of them are, but one thing which hasn't been mentioned here is that we are now seeing radical changes in transportation patterns. For example, aggregate is sent from Scotland to Houston, Texas, and to points on the Atlantic Coast. This is possible because of the shortages of certain types of aggregate in the eastern and Gulf Coast regions. It is also facilitated because in this particular case it's possible to backhaul [Editor's note: Backhaul means that the ship comes to the United States from Scotland and returns to Scotland carrying cargo in both directions] certain commodities. Without the backhaul, it may be that such a haul may not be economical. But other operations where backhauls are not possible are shipping aggregate long distance to the east coast and Gulf Coast. Aggregate is now shipped from Newfoundland and Mulgrave, Nova Scotia, to various ports on the east coast. Limestone aggregate and oolitic material are also shipped from the Bahamas to the east coast. Finally, aggregate is shipped from the Yucatan Peninsula from a new facility between Cancun and Tulum, Mexico, to Gulf Coast ports. All of these changes are relatively recent, most of them within the last four or five years, some of them within the last year. These changes indicate a shortage of aggregate on the whole eastern and Gulf seaboard.

As for the Midwest, what's happening here? Dunn Corporation did a survey of the Detroit area, and we concluded that the aggregates in the Detroit area will be depleted by around the year 2000, at current demand. If the anticipated infrastructure work occurs, the depletion may be considerably before 2000, if additional resources are not developed.

Sand and gravel is produced from areas northwest and west of Detroit. Limestone is produced from areas southwest of Detroit. Slag comes from the Detroit area itself as a result of steel and iron manufacture. In addition, some 4 million tons of limestone come by water into the Detroit market from other areas, such as the Presque Isle-Rogers City area in northern Michigan, a little bit, I understand even from Canada, and some limestone is shipped from Marblehead, Ohio. About 65 percent of that stone is for aggregates; the rest of it is for the manufacture of steel and iron.

Once local sand and gravel is gone, the major sources of aggregate will be wholly limestone, largely imported by barge and shipped from considerable distances. This means double handling, it has to be dropped somewhere at a pier, has to be picked up again, and trucked to some other place. The extra cost of this is about \$30 million a year for the southeast Michigan area.

I would like to give one example of costs and how a particular conflict, potentially, could have been very expensive for a small town. The town is Saratoga, New York, where two quarries are adjacent to each other. One of them is very close to a well exposed ledge of cryptozoan fossils, which has become a tourist attraction. Some people claimed that blasting would damage the cryptozoan ledge. A citizen's group tried to close the quarry. Now, keep in mind that these two quarries are adjacent and are highly competitive with each other. Although such competition is good for the city of Saratoga, both operations hate it. Each one would just love to be there by itself. We showed that if one quarry closed, the other quarry stood to make a lot of money because the nearest operation that was competitive with it was about 40 to 50 miles away. Therefore, if one was shut down, the remaining operation could add the equivalent of the haul cost of the other aggregate into Saratoga to its price. The potential cost to the city of Saratoga of closing down this one operation would have been about \$3 million a year. Three million dollars a year, if you discount it at 10 percent for 20 years would be about \$22 million. In all

probability it would have been cheaper for the city of Saratoga to have bought all the nearby homes and then release or sell them rather than close one operation down.

There are additional costs which occur when aggregates are depicted, for example, wear and tear on highways. When you force aggregate operations further from the market than they need to be, the wear on highways increases. Additionally, from the conservation point of view, it requires more energy to bring the aggregates into the point of use. And, of course, any of the dangers associated with trucking are increased. It's not good conservation, and it's not good from the point of view of people who are driving on highways.

Now, I would like to make just a couple more points. I would like to talk briefly about some of the up side of aggregate production. When I fly west out of Chicago, I see many lakes. Most of those lakes were formed by aggregate operations. In fact, many of the lakes and ponds throughout the Midwest, in general, have resulted from the mining of sand and gravel or the quarrying of stone. The combination of the farm ponds and of the lakes and ponds which are created as a result of aggregate operations is responsible for most surface-stored water in large areas of the United States, a major conservation plus.

Such impoundments are scenic resources, and most are stocked with fish. Finally, the ponds attract ducks and geese. The result of this is that the ducks and geese and waterfowl in general have been expanding in the United States over the past 30 to 40 years. You can find these statistics in the United States Department of Interior's Nesting Bird Survey.

In a survey this past year of 10 different duck populations by the New York State Department of Environmental Conservation, for instance, all but two were increasing their population, and they have been for years. The two which were not increasing their populations were decreasing for reasons which had nothing to do with people. The most astounding thing is the change in the population of New York's Canadian geese. Since the first survey in the 1940s, the population has grown 2,600 percent. The people who produce aggregates and leave ponds and lakes bear no small responsibility for this.

Now, I would like to make one point which is of a technologic nature. We heard some discussion yesterday of technology. The impression I got is that the tendency is for technology to diminish the availability of aggregate resources. This is because as specifications become tighter, and we learn more and more about the bad things that can happen when aggregate is put in concrete, specifications tend to get tighter, and the tendency then is to reduce the aggregate resource.

I'm going to talk about something which is the opposite. Some years ago, my company decided to do some experimental work and see if we could improve aggregate quality by treating it chemically. We used some concepts which we developed 30 years ago to the effect that if you can protect aggregate from salt, you can improve its performance in highways. We reasoned that if you can put a semi-permeable membrane around the outside of the aggregate particles so it would let water in and keep salt out, you can improve the quality of that aggregate. We worked with General Electric Company, and after a few years, we came up with something that appeared to work, a group of polyelectrolytes. As an example, aggregate treated with 20 percent polyalkylene polyamine 9E-100 has magnesium sulfate soundness test losses of about 0.6 percent in comparison to losses of 88.1 percent for untreated aggregate. The State of New York laid some asphaltic concrete test strips for us on a highway, Route 38B, near Binghamton. Some test strips contained E-100 treated aggregate and some test strips had untreated aggregate. The aggregate that we used was a graywacke with an average test loss of about 90 percent. It was the worst quarried rock we could find. It was typical graywacke from the Catskill delta sediments that occur all the way from the Catskills of New York almost to Erie, Pennsylvania. After 10 years now, the asphaltic concrete which had the treated aggregate is as good as new. The individual particles of aggregate are overwhelmingly either convex upward or they're flat. The highway where the aggregate was not treated is very badly deteriorated; the aggregate is pitted, with many aggregate particles simply lost. The bottom line is that the stuff works. I don't want to give the impression that we're any kind of geniuses, because there was a luck factor there. We still don't know why it continues to work after the particles are worn down.

The potential effect of this bit of technology is to enormously increase the available aggregate reserves in southern New York and northern and western Pennsylvania. Suddenly trillions of tons of Catskill delta graywackes are potentially economic as aggregates for certain uses. We now suspect that any aggregate which has a high sulfate soundness test loss would be similarly improved.

The final thing which I will mention is that there are more and more underground mining operations in the United States, and such mining rock for aggregate should continue to increase. In some places where we can't open up surface operations, underground operations, properly hidden, properly landscaped, I think

are possible. An underground operation near a market is competitive with a more distance operation if the increased cost of mining is less than the haul cost difference to get to the market center from the more distant source. I think planners should be aware of this option because in more and more places it is very difficult to open up a new quarry. Underground operations not only are less visible, less noisy, and less dusty, they are also good conservation. Such operations create usable space which is inexpensive to heat, inexpensive to cool, and cheap to maintain; and the surface is still available for other uses. The act of mining has created enormous values for the community in addition to making aggregate more readily available near the points of use.

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## THE PERSPECTIVE OF AN AGGREGATE ASSOCIATION

By George Dirkes

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A State Aggregate Association can have a significant affect on the aggregate business in its state. That, quite simply, is the purpose of a State Aggregate Association. The challenge is for the Aggregate Association to do what it can to provide a business environment in which the aggregate producer can operate profitably in a highly regulated and competitive industry.

In order to accomplish this, the Association Director, with or without committees, must get involved, on a first name basis, with all the various state agencies that have or may have an impact on the industry. This includes not only the regulatory agencies, but also other agencies and departments that provide part of the market for aggregate products. Liaison must be maintained between such diverse groups as Department of Transportation, Bureau of Economic Development, Abandoned Mined Land Reclamation Council, the Capital Development Board, the Department of Water Resources, the Department of Agriculture, and the Governor's Office, which oversees special programs relating to infrastructure. Good liaison is important because all of these offices and agencies have construction budgets.

On the regulatory side, in addition to the usual environmental agencies, close contact must be maintained with another diverse group of state agencies and offices such as Department of Conservation, Department of Mines and Minerals, the State Commerce Commission, the Attorney General's Office, and the Department of Revenue, to name a few.

Somewhere in between these two groups that affect our markets and regulate our industry lies the State Legislature, which must be continually apprised of the conditions of the aggregate industry. To a large degree, the well-being of the aggregate industry rests in the hands of the State Legislature. The State Legislature can perform in a manner that will increase or decrease a great share of the markets for aggregates. Similarly, the State Legislature can and does exercise control over the regulatory conditions we operate within.

Lastly, the State Aggregate Association must get involved with a mixed bag of regulators and market outlets such as regional commissions, multi-state agencies, the Corps of Engineers, educational and information sources, and the State Geological Survey.

The State Geological Survey should really be mentioned separately and emphasized because the well being of the Survey and the Association's rapport with it is of the utmost importance to the welfare of the industry.

The aforementioned laundry list of the various groups that a State Aggregate Association gets involved with is only, unfortunately, a partial list. Our rule of thumb is that if a group can affect the well-being of our industry, we want to know them, and we want them to know us.

Finally, to conclude the listing, I would be remiss if I did not add the Federal Government, which has a great affect on our industry with its trickle-down regulations.

The end result is: if the State Association works effectively with these groups, it is usually given the opportunity to participate in the design of programs; programs that may be either regulatory or of such a nature that they will create markets for aggregate products.

You may have noticed that I made no mention of the Association's involvement with the County or local governments. Quite frankly, we cannot afford to get involved with the counties because we have 102 counties in Illinois. The Association just does not have enough manpower to go around. However, from time to time, our Association does get involved at the county level in certain situations. The moderator of this panel asked me, for example, if our Association gets involved in helping its members obtain zoning.

We respectfully decline when our members ask for help in obtaining zoning for a new operation. We decline because that is usually a no-win situation. Invariably, some other Association member is already servicing that market; therefore, our efforts to help one member would be to the detriment of another member.

However, our Association does get involved at the county level in two situations. The first is if the county is creating or changing zoning or ordinances that will have an impact upon our producers in that county - and only if we are invited to participate. The second situation is if the county is making changes in its zoning or ordinances that will impact our producers, and these changes could result in a ripple or domino affect throughout the State. If the actions of the county are

detrimental to the industry, and the Association's Board of Directors feels that such action by the county has a high probability of being emulated by other counties, our Association gets involved.

We are involved in such a situation right now. For the past several years, our Association, several of its members, and a particular county in Illinois have been embroiled in a wild free-for-all. I would like to think that the Association, its producers, and the county officials are conducting themselves in a gentlemanly businesslike manner. And, by and large, most of the times we are. However, from time to time a certain adversary group gets involved and turns it into a free-for-all. The problems manifest in this county encompass all of the negatives mentioned in the past two days of these meetings. Quite commonly, the real issues become totally obscured.

The factors involved in this situation are financial, political, and environmental, in that order. The financial problem is this. In my opinion, through bad fiscal management policies, the county has painted itself into a corner. It is now in dire need of funding. The county's financial woes have been compounded by the imposition of unfunded Federal mandates. The financial problems caused at the county level by the Federal mandates is not unique to this county. It is felt by every county and parish throughout the country. Unfortunately, the problem will not abate, but will, in fact, worsen. It is anticipated that by the turn of the century, the counties in this country will be suffering from a 300 percent increase in the number of Federal mandates they must comply with. In order to alleviate its financial problems, the county is attempting to impose real estate tax increases on our industry in the magnitude of hundreds of percents and, in some cases, increases of thousands of percents in one year's time.

The political problem in this county, in my opinion, is that a radical political group wants to take control of the county government. They have disguised themselves as an environmental group. They take environmental issues, distort facts and figures, and blow them out of proportion. With the witting or unwitting aid of the news media, they use these alarmist tactics to create within the citizenry discontent in the county government. Coincidentally, this group of political zealots gets particularly active shortly before every primary and fall election. Currently, in that county our industry is the environmental scapegoat this group is using. Before we became their vehicle to get

sensational exposure in the press, they effectively used a garbage and landfill issue in the same manner for more than five years.

The group's current contention in the press is that our industry is destroying the environment, lowering land values, and is undertaxed. Industry contends that this radical political group was successful in brow beating the county into attempting to radically increase our real estate taxes.

The environmental problems are the normal environmental problems faced by our industry anywhere in the country. Our industry is not perfect. We are not without fault. However, in this particular county, in almost every case where the environmental zealots made a claim of wrongdoing on our part, the industry was exonerated upon examination of the facts. However, at that point, the exoneration usually means nothing because the false information in the press has already been absorbed by the average citizen. Quite often the aggregate mining industry is blamed for something grandpa did. Precisely what I mean is that we are often judged today by present-day laws for something we did

yesterday when such laws were not in existence. And that is the pity of it all. Changing rules and regulations make every industry vulnerable to such an attack and false charges by unscrupulous groups.

I will conclude by saying that the aggregate mining industry operates under the scrutiny of many agencies and departments at all levels of government. In addition to that, we are always operating under the scrutiny of the general public. I do not think that the horror story I just mentioned, unfortunately, is unique. This scenario can and does happen wherever a group of zealots is determined to eliminate our industry. By misusing existing rules and regulations, they confound the issue. However, the story usually, but not always, has a happy ending, and industry is allowed to continue operation. Unfortunately, the happy ending is not achieved without a great expenditure of time and money.

The question posed to this panel was, "how will we meet the next century's demand for aggregates?" The answer is ... easily. We can do it with one hand tied behind our back. The real question is, will we be allowed to do so?

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## RE-CREATING URBAN WETLANDS

By Donald L. Hey

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My role on this panel is to defend the environment against profit-minded geologists and overly ambitious planners who have addressed this group. It is not an easy role to play. In fact, if you would look at my academic training you might wonder why I was cast for this part; I am a product of an engineering education that certainly did not teach me to believe that Mother Nature could take care of herself. However, I have become convinced that if we look to Mother Nature more often and more carefully, we could find more effective and efficient solutions to this country's substantial environmental problems.

Based on my 25 years of experience in the field of water resources, I would like to offer a perspective on why many of our environmental problems arose from attempts to engineer solutions without a complete understanding of the natural environmental conditions.

I then would like to go forward with suggestions on how the aggregate industry might help achieve a better environment, a better world in which to live.

It took only about 150 years for the European settlers to change this continent's landscape to such an extent that today it is hardly recognizable from what it once was. Of the 2.2 billion acres of land in the U.S., about one-half of that — 1 billion acres — is under agricultural production. We achieved this by clear-cutting forests, plowing under prairies, and draining wetlands. For example, we drained 118 million acres of wetlands out of 221 million acres that once existed in the contiguous 48 states (Dahl, 1990). In the Mississippi Valley, those changes were even more dramatic: we drained the water from 80 percent of the wetlands, destroying some 60 million acres of wetland, or a land area equivalent to the states of

Illinois, Indiana, and Ohio (Dahl, 1990). Then, we sat back and marveled at the floodwaters that came pouring down the Ohio and Mississippi Rivers.

Every time it floods in Chicago, the engineer, the politician, the newspaper editor all seem perplexed. Yet, an early settler in Chicago noted that in the spring you could canoe in any direction from Fort Dearborn. There was not a real defined drainage system. Water was everywhere.

Ridding the land of standing water was a top priority for early European settlers in the 1800s. To do this, our ancestors constructed enough drainage ditches to span the United States seven times (Wooten and Jones, 1955). They constructed many times that distance in tile lines. As a result, groundwater on this continent was lowered by two to three feet. Since the climate has not changed much, we continue to have rain showers and storms and, inevitably, flooding.

We have spent billions of dollars trying to solve our flood problems while considering all kinds of excuses for why we have them. Yet today, we suffer greater flood damage than we did in 1935 when we passed the Flood Control Act. Without first examining the underlying cause-effect relationships, we passed this act with the expressed intention of reducing, if not eliminating, flood disasters.

Today, our flood losses continue to grow. Only a few months ago, despite billions of dollars spent on Deep Tunnel, one of the premier flood control projects in the United States, Chicago's business district flooded. More than one billion dollars of flood damages resulted. The engineers responded by saying, "Oh, well, that kind of flood wasn't taken into consideration when we did our flood planning." Well, no, it was not. It was another kind of flood — the kind that short-sighted thinking did not contemplate. Unfortunately, that sort of thinking is not unique to Chicago, rather, it has been applied to flood control planning and engineering across this country. For example, we have constructed levees around 50 percent of the floodplain belonging to the Illinois River. No longer can floodwaters be stored there. These waters are now forced downstream to flood St. Louis and other points south.

We have exercised similar short-sightedness in regard to water quality planning in the United States. In 1972, we passed the Clean Water Act with the goal of making our streams and rivers "fishable and swimmable." We were going to repair the physical, chemical, and biological integrity of our nation's waters. We spent more than \$200 billion in the next 15 years building wastewater treatment plants so that our streams presumably would be clear. Today, our streams do have less raw industrial and domestic wastes entering them. However, from a biological standpoint, they are hardly improved. Twelve years after passage of the Clean Water Act, the Illinois Environmental Protection Agency (1984) found that only 10 percent of formerly contaminated stream reaches were suitable for native fauna and flora. This was accomplished at a cost of \$13 million per mile.

At the same time, we have burned up countless tons of coal to drive steam turbines to produce electrical energy to drive the equipment needed to purge wastewater of its contaminants. In doing so, we have put more than two tons of carbon into the atmosphere for every ton of carbon we have pulled out of the water. Our presumed solution has only created greater environmental losses — air pollution. The short-sightedness of my engineering profession has not considered the larger environmental picture. The bottom line is that we have spent billions of dollars on flood control, and billions of dollars on pollution control, but we do not have much to show for it.

The regulations controlling the aggregate industry — or any land-use development activity for that matter — do not get us much further. Based on faulty science and engineering, most regulations become overly ambitious in trying to contain perceived environmental problems. After sitting on a committee to review proposed state laws affecting the development of wetlands in Illinois, I concluded that it would cost more to regulate those few wetlands that were to be protected than the wetlands were worth. Conversely, with the money we were going to spend on regulation we could re-create more wetlands than we were proposing to regulate.



## FINDING SOLUTIONS IN NATIVE LANDSCAPES

Let me take you back to the 1600s when the French arrived on this continent. Four hundred million beaver were living in what is now North America — more beaver than there are people today (Spencer, 1985). There were beaver dams and dens every thousand feet or so along all streams and rivers, except in desert areas and in southern Florida. In two hundred years, the beaver was almost driven to extinction. By the mid-1800s, for example, there were not any beaver left in Illinois (Spencer, 1985). What few beavers were left by the trappers were eradicated by the early settlers. Their dams very quickly decomposed and were washed downstream, as settlers channelized the streams and rivers. By that mere act, European man changed the hydrology and the hydraulics of our streams and rivers and set into motion the flood problems that we face today. Behind those beaver dams were trapped and stored all the sediments, nitrogen, phosphorus, and other chemicals that we are now trying to remove from our streams. In the upper Mississippi River Basin, those beaver dams, if redistributed, would provide more flood control storage than current Army Corps of Engineers' dams.

Clearly, we cannot bring back 400 million beaver, but we can use the beaver dam as a model for effective water treatment and storage. Based on research that we have done at the Des Plaines River Wetlands Demonstration Project near Chicago, we know that we could achieve a high degree of water quality from a beaver-type impoundment. For example, after two years of research we have observed that our four constructed marshes on the average trap more than 90 percent of the total suspended solids and 85 percent of the total phosphorus found in the Des Plaines River (Hey, Kenimer, and Barrett 1992).

To use constructed wetlands such as these to improve the water quality of an entire watershed would require converting only 2 to 4 percent of the land area to this kind of use (Hey, Barrett, and Biegen, 1992). That 2 to 4 percent is the same amount of land that western settlers reserved for education when they set aside the 16th section of every township. (One section is about 2.7 percent of a township.) We were smart enough to know that we needed to finance our educational programs, but we were not smart enough to realize that we also needed to underwrite a healthy environment.

Today, we know that we need the benefits of native landscapes if we are to achieve an economically efficient and productive environment. We also know that landscape restoration is possible. Just as we arrived at the current, pathetic environmental state by draining wetlands acre by acre, and beaver ponds dam by dam, we can work back the other way acre by acre. We can start with those 20,000 acres of surface water that the aggregate industry produces each year. The ponds that you leave behind can store floodwaters, improve water quality, and provide wildlife habitat, but only if you landscape these areas properly. You cannot leave a hole in the ground and expect waterfowl to use it. You must create the right physical condition, the right water depths, the right vegetation. You must connect that pond to other waters. Fundamentally, you must give some forethought to the long-term landscape.

When you develop your next sand and gravel pit, think about how it can be connected to a stream and, after all the mineral resources extracted, converted to a structure like a beaver pond to serve a vital environmental purpose. In doing so, you will be part of the process of re-creating our nation's riverine wetlands. This process may take a long time, but it will produce important benefits. Not the least of these will be demonstrating to other industries and the public what can be accomplished by some long-term thinking.

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## THE NEED FOR EARTH SCIENCE EDUCATION

By LeRoy Lee

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The Wisconsin Academy of Science, Arts and Letters is a broad-based membership organization. We have a gallery, publish books and journals, conduct conferences, and are involved in science, mathematics, and technology education. The Wisconsin Academy's Center for the Advancement of Science, Mathematics, and Technology Education (CASE) has documented what we consider serious problems in K-12th grade science education. Presently, we are conducting several major projects in Wisconsin with funding from the National Science Foundation relating to needs we have identified. Additionally, Wisconsin Academy staff has been active in national efforts of the National Science Teachers Association (NSTA), the American Association for the Advancement of Science (AAAS) Project 2061, and the American Geological Institute (AGI) initiatives. My remarks today will be based on this background.

We know there is a problem in education. We know there is a national desire for scientific literacy for everyone. Scientific literacy can be defined many ways, but most definitions include problem solving that involves identifying the problem, issue clarification, and looking at multiple solutions. We have heard other speakers advance the idea of multiple solutions already today. There is not a single answer to a problem: you need to look at and evaluate different solutions. Other attributes of scientific literacy are critical thinking, the ability and the desire to ask questions, and a knowledge base. I believe most of you would agree that decisions regarding science should be based on scientific literacy.

At the national level there are educational standards in the process of being developed for science, just as they have been for mathematics. The standards will be published in about two years, and they probably will be followed by national assessments. The thrust of the national standards will be decision making.

When you look at decisions people make, such as the location of a pond or digging of a pit, there are usually several things involved. There is an aesthetic component in decisions. As I look at the multitude of ties in the audience, I can guess your decision to wear one was based on culture, but the style and color was

based on your sense of esthetics. Decisions are also made based on self interest, usually relating to money. Decisions may also be based on territoriality. Several people during this conference have mentioned the phrase, "don't put it here, put it over there." There is also a sense of ethics that people use in making decisions. Decisions in the real world are thus made based on our beliefs, which are the sum total of experiences, as well as knowledge.

When we talk about decisions we need to talk about the total experience that gives us our beliefs upon which we make decisions. As a personal example, my father cleared a farm of trees and farmed it for 60 years. When I purchased it and turned it into a tree farm, he could not understand or accept that decision. From my perspective, it had to do with taxes and money; from his perspective, a waste of land. We have heard other speakers talking about "encumbered land". If your belief is the social good, I believe a developer could argue forcefully with facts and figures that development is for the common good. I have seen many farmers very concerned about lands being encumbered for other things, such as development. And, of course, you as aggregate suppliers, also have a different perspective.

What people call knowledge is many times just information presented from their perspective based on experience. However, there is another part of knowledge and that is the content base of scientific literacy. It is content that teachers spend most of the time on when working with students.

With that in mind, I would just like to briefly give you from my perspective the present status of education in general and, more specifically, of earth science education. At the elementary level, a majority of teachers have never had a course even in high school called earth science. The science they teach tends to be descriptive. It tends to be from a textbook, and it tends to be read-about science rather than doing science. In the fourth grade in Wisconsin, and I am not sure which grade it is in other states, they study the state. I have asked many fourth grade teachers to "tell me about mining in Wisconsin." Invariably, they tell me about the lead industry from a historical perspective, or they

talk about iron. Never have they mentioned the non-metallic mineral production that Tom Evans of the Wisconsin Geological Survey indicated was a \$20 million a year industry in Wisconsin. That is not mining to elementary teachers. Elementary teachers tend to have a life-science background of six to 12 credits. The classes they teach typically have an environmental thrust and a preservationist approach.

The middle school in many states consists of the 6th to 8th grades. A class called earth science is usually taught in one of the grades. There are a large number of teachers teaching a middle school course called earth science from an earth science textbook. Many of them are elementary teachers with a life-science background who have been placed into a middle school. Again, there is a tendency to be descriptive.

High school teachers are typically well qualified. Those teaching a course called earth science will usually have at least a bachelor's degree in earth science or an earth science area. It is not unusual to find geology majors. Many of the earth science teachers will have masters' degrees, typically in education. The earth science course in the high school has, unfortunately, a reputation for being what is called a "dummy course". Students that may have trouble in biology, chemistry, or physics make up the majority of students taking this course. The typical curriculum is determined by the textbook, and the figures that are typically quoted indicate that 90 percent of the teachers use a textbook 95 percent of the time.

Coverage of the text is considered important to many teachers. The earth science instructional time is about 3.7 hours per week of actual contact time. If a teacher is text "coverage" driven it means a chapter a week. To give you a feel for this, in one week from a typical text chapter you would cover the Mesozoic and Cenozoic eras. The second week the rock record, and still another week would cover the Precambrian to Paleozoic. What kids call "dirt science" also includes other topics so other weeks would include climate and climate change, atmospheric pressure and winds, air masses, fronts, planets, solar systems, oceans, glaciers, plate tectonics, storms and weather, etc. My point is simply that the earth science curriculum is crowded.

If you look specifically at where you would expect to find something dealing with the metals and non-metals in a text, there will be a portion of one chapter devoted to them. In a typical earth science text

that is widely used across the United States, you will find the entire non-metallic aggregate industry covered in 210 words. In the 210 words, they tell you that salt is plentiful all over, and that sand, gravel, and crushed stone come from quarries. A quarry is defined as a "small open pit mine where these materials occur naturally" and that "The United States has enough of these construction materials". As you can see, that concept of the non-metals is not really covered. That is not the way teachers are trained.

It was entirely possible a few years ago to take a course called chemistry or a course called physics and never have the course relate to the everyday world of people. A modern trend in science education is to put people back into science. The approach is called science, technology, and society; STS for short. An STS approach attempts to show that science and technology relate to society, and how they interact. It is a strong movement. Teachers have not been trained and, as expected, the majority do not use it.

A question was asked, "do teachers understand the need for mining". I believe that if teachers would stop and think about this, they would say "yes". However, most do not stop to think about it more than most of us think about where electricity comes from when we turn on a switch. I have had the opportunity to work with teachers in projects for the last several years. One project, Field Experiences for Science Teachers, involves taking teachers out in the field and trying to give them a sense of the real world rather than the textbook. Every once in a while someone will make a statement that you say, "I knew that all along, but I never thought of it that way." I vividly remember that happening to a group of twenty teachers as we were standing at the Homestake mine open pit in the Black Hills and having a geologist say, "remember, everything you're wearing today came from farming or mining." That is a profound thought that most people do not think about, but after that experience virtually every participant mentioned it to me over the next year. Tom Evans from the Wisconsin Geological and Natural History Survey talked to teachers in one of my projects about mining in Wisconsin. Because he was able to relate to their world he gave them more background about what is happening in Wisconsin and provided them with new perspectives than they would have received from reading or from their formal education. It is encounters such as this that you as a profession can provide to help teachers gain a better understanding of their world.

Attitudes of teachers can be changed. It is not a question of indoctrination. It is a process of exposing them to new experiences and new ways of thinking. One group of teachers with whom I worked held a preservationist perspective. They were against mining because they had always been against mining. I had the chance to take them to a gypsum mine and an open pit coal mine in Wyoming. They had a chance to look at the mines and express "look at how terrible that is". But they also met with mine engineers and looked at reclamation standards and process. I still remember their look as they studied the landscape which had been

reconstructed back to the original and how favorably it compared to the overpastured range land that had grown into sage that they had believed was pristine. The teachers came away from that experience with a different impression about mining.

The final question of "how can science education be helped" can be answered by you. You can help. Everyone in this conference can make a difference. Do not preach to students, do not preach to teachers. Help them see the connection between the 210 words in the earth science text book and the real world.

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## AN AGGREGATE PRODUCER'S POINT OF VIEW ON ZONING

By Robert Meskimen

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Mark Wyckoff talked this morning about zoning of sand and gravel, and a lot of the commentary the last couple of days has been aimed toward sand and gravel. But if you go into a zoning hearing and throw in some high explosives and talk about opening up a quarry, you've really got your hands full. It is a whole different world out there. I am pleased to hear about the things that are happening or starting to happen in the field of education -- what LeRoy Lee just talked about, what the SME's work is doing with some science educators around the country. Maybe what we need as an industry is basically our own junior achievement program, to where we can get into the schools and spend some time. It is a heck of a financial commitment to be made, maybe it is something that we can be doing on the state and national levels as far as associations are concerned.

I come from a little different background. I cover a five-state area, including Iowa, Missouri, Nebraska, Kansas, and a little bit of Wisconsin. Carl Schenk talked this morning about the 180 plus governmental units in the 7-county area around Minneapolis. If you would spread those out over five states, we deal with about that many different governmental units. You can imagine the difference in zoning regulations and permitting laws that we run into. It takes a pretty good staff of people just to read and understand them and keep up with those things and do the planning necessary to open a new location. I would like to say at the outset that I do believe wholeheartedly in the free enterprise

system of good competition. But what we in this country have done, to what we have termed here in the last couple of days, "mom and pop" operations, is probably not very good. The cost for those people to keep up with the amount of regulations that have come down in just the last 20 years is devastating. They do not have the capital to keep up with those things, do not have the staff that we have available, being with a large company. We need those people, they are good operators, they are good, honest people. We need to find ways to help keep those people in business, believe me. To keep up with storm water runoff is the latest thing to hit. They do not understand it, we do not understand it. But I just approved a check for over \$30,000 just for permits. That is the first round. Where does it end?

That whole list of 24 permits that we saw listed on the screen this morning is difficult for some of those small operators to deal with. We as a larger company have the availability of having some resources and some people to throw at planning and zoning issues. We have learned some hard lessons in the past. We had one county in Iowa where we went for zoning, we knew things were not going well. We made some mistakes, and, Mike [Preston], forgive me, but what we did not need at that meeting was somebody in a \$600 suit trying to explain our situation to a board of supervisors where in one instance the meeting was postponed or delayed for a few minutes until one of the supervisors

got off his combine and got to the courthouse. We needed somebody who was out there that could "roll cobs" with those people and talk to them one on one. We knew we were going to have problems as it came down to the vote; they agreed to let us videotape the entire session which lasted about 4 hours. It was a great learning experience for us. We were turned down, but we learned a lot of things from going back and examining and reviewing that tape. You need to do your homework. You need to know exactly what all the different variances are in these zoning laws from location to location and create your own due diligence list of things that have to be done prior to even making an application. One of those things is working one on one with the local landowners around that operation. We work in an awful lot of rural areas in the five-state area. We do work in Des Moines, Kansas City, Wichita, Omaha, and a few other large metropolitan areas, but you need somebody out there that can sit down and reason and talk with these people. A lot of times, what it takes is just an understanding of the person you are talking to and trying to match up personalities -- people from our company with that individual to where they feel comfortable with one another, can sit down and talk, interchange ideas, and allay some of the fears that they have from the past or things that they have heard about quarry operations and sand and gravel operations. We have run into some instances where the local governmental unit did not understand the zoning ordinances that they had on the books. We ran into one small town that had a zoning ordinance that was about two inches thick. They were attached to a rather large metropolitan area, and once you started looking at the zoning ordinance it had their name on the front, but once you flipped into the title page, it still had the name of the city that it was really designed for on the inside. They adopted it many years ahead of that, did not understand it, so sometimes it does make things very difficult.

There was a comment made just before lunch and Jim Dunn made it again, about underground operations. We actually operate nine underground operations within Martin Marietta. We do it for various reasons. One has to do with the amount of overburden. You cannot go underground and mine everything. You need to have some kind of a suitable rock structure over your head that you can leave so that you can get in and safely mine. But it does lend itself to doing more underground mining in major metropolitan areas. We see more of that happening. Somewhere down the road, it may be economically feasible to do a vertical shaft mine where

you are bringing things out with a bucket elevator rather than with 50 ton trucks. It can be done. It depends on the way specifications change and rule out some of the local aggregate or readily available aggregates, and you may have to go down 200, 300, 400 feet with a vertical shaft mine. It has been done. It does lead to some other alternative uses, once you are done. The Kansas City area is full of underground warehouses. Lamar Hunt who owns the Kansas City Chiefs made some of his fortune in the aggregate business in Kansas City. Leasing out these underground operations once they are worked out, you can go in and paint them white, hang up strip lights, you can section parcels of them off and put in freezers, a lot of food storage underground is a huge business. They are large enough that you can put rail lines right in there, take cars in, unload them, load them, move goods in and out. You will see more and more underground mining, I am sure, in the future.

As an industry, we have really done a very poor job of telling our story, and maybe this is another place for our associations to maybe change some of their focus, some of their direction. It goes back to education. We need to help the educators. There has been a lot of talk about where we are headed trying to head off the drug problem in the United States. A lot of people have said they have given up on our generation. Now they are after the second graders, the first graders, the third graders, they are hitting them right away when they get in school. They have given up on the rest of us, but they are getting that education. We have not gotten our story out either and in 210 words, there just is not enough being said. A big part of the whole economic structure of our country is based on the mining industry, the ability to move goods from place to place. You name it.

Martin Marietta has a philosophy of being a good neighbor. We enter the Iowa Limestone Quarry Beautification Contest every year. There are many different categories you can be in whether it is screening or scale house or pit development or stripping or reclamation. The National Stone Association has several different categories for About-Face awards that they present every year. It takes time, it takes money, it takes a lot of effort on many people's part. A lot of it you do not even have to do yourself. If you have got an old junk pile you can invite a junk dealer in, he will cut it up and pay you for the steel he is hauling out. You do not have to touch it. Problem is, people think

that is all worth something. Well, it is not worth a thing unless it is in somebody else's hands.

Tony Bauer's idea about zoning a mineral resource district as a prime use is kind of interesting, and I think maybe what we need is probably more brainstorming sessions with a few less speakers. The availability or the ability to get more people involved to sit down may be what is needed. We need to get on programs of planning and zoning administrators when they have their meetings to tell our story. It would certainly help.

I would like to leave you with a couple of questions. One of them came up at our dinner table last night, -- "could the interstate system be built in today's environment?" It would probably never get off the ground with the things that have happened in the last 35 years. Things have become much, much more complicated since the 1950s when we started on that

program. The other question I would like you to consider is whether or not we should set aside land for the future for mineral resources. Can we afford to wait? Probably not. High quality aggregates are being zoned out, they are being built over the top of, maybe it is going to take some underground mines. Transportation is a huge factor in our industry, just because of the volume of material that gets moved. We move material by rail into Wichita, Kansas, from about 80 miles away. Some of it gets trucked in. A lot of it comes by rail from southern Oklahoma into Wichita. They do not have good quality aggregate reserves. We move a lot of material into Des Moines. We haul rock by truck from quarries that are 20 miles away, 40 miles away, and 60 miles away. Varying qualities come from these locations. We also ship in a lot of aggregate by rail from 100 miles away. It all adds up. Do not push the aggregate producers out of town if there is a way you can make room for them.

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## THE PERSPECTIVE OF A LAWYER

By Charles M. Preston

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Of course, lawyer bashing is nothing new. It goes back a long way ... Shakespeare talks about it ... even in biblical times there were references. Given the level that lawyer bashing has risen to in this 1992 presidential election year, I would hope that everyone in this room appreciates the courage that it takes for me to come here in a relatively confined area ... especially considering the fact that most of the people in this room are non-lawyers and are also not only familiar with, but presumably have reasonably free or easy access to, stones. Of course, this workshop was scheduled before the present tumult in the campaign arose. I can only say that I have learned to duck over the years, and all I ask is a fair chance ... some small warning so I can take off in some reasonable direction.

Let me tell you, I am from a place called Carroll County, Maryland, which is in northern-central Maryland. Our county seat, Westminster, is in the center of the county and about 35 miles northwest of the City of Baltimore. Our county's northern boundary sits about 10 miles south of Gettysburg, which is a town I assume everybody has heard of, at least, if not familiar with.

What I tell people is that I am a country lawyer. People always say, "Well now, what do you specialize in?" (Of course, I "specialize" in whatever comes in the door and pays). But, if being a "country lawyer" does not satisfy the curious inquiries, I guess predominantly, I could say ... and this is what I tell people, "Well, I do a lot of zoning and development work representing developers ... and then I also have a pretty healthy practice in criminal defense trials." Many people seem to see a similarity between these types of work. Indeed, I have had a few clients who have managed to bridge that gap with very, very little difficulty whatsoever.

I would tell you, first off, that I do not know anything about aggregates and so on. I would not know limestone from quartzite, and I do not even know if there is a difference, to be quite honest, except for the way that the words are spelled and that I have a map here on which they are shown in different colors. I do recognize gold, sometimes, when I see it in court orders and decisions of juries, but other than that, I really do not know much about minerals at all.

On the other hand, I know a little bit about zoning. And from my experience from working in Carroll County on a Mineral Resource Ordinance and working with mining companies, and sometimes, frankly, from the few things I have heard since I have been here, I get the feeling that at least some of the people involved in the mineral extraction field know very, very little about zoning. I hear stories about the litigation that goes on and on and involves years and hundreds of thousands of dollars in lawyer's fees ... and I can tell you that my salivary glands start to work up to a fever pitch. Jim Dunn and I were involved in an exercise in my county which, in fact, has graduated past stage one now, but which, in evolution, took about 16 years. That exercise I am going to talk about briefly.

First off, in Carroll County our principal mineral resource is limestone. Now, I guess I do know a little bit about limestone. I should tell you at the outset that I am directing my remarks toward "how-to" stuff, sort of nuts and bolts from a lawyer's standpoint, and there may be a few pearls that I can throw out here. Maybe they are not pearls, but I have got a hunch that if there are any lawyers in here, I might be in as much trouble with them as I may be in with the geologists by the time I get finished. In my county, we had zoning go into effect in 1965. It is what would be called by some "classical Euclidean zoning". That means that areas of the entire county are broken down into a number of districts. Some are residential, some commercial, and others are industrial. Uses are either "permitted" by specific reference (which means you can do it, period), or are "conditional uses" (which are also called "special exceptions" in some jurisdictions) which require Board of Zoning Appeals' approval, which, in turn, means public hearings after advertising. Everything else which is not thus specifically mentioned is prohibited. Now, the mining companies in our county had some influence when the zoning ordinance was adopted and managed to get sort of a "sub-district" designation (which nobody apparently understood and which never has been legally defined by any court) called "agricultural extractive" or "AE". So the mining company property was in an agricultural zone, but they were also designated "AE". The problem was that the AE designation still required the operator or the mining company to go back before the Board of Zoning Appeals because it remained a conditional use. So you can see we were never really sure what was the effect of the AE designation in the first place. The problem came to light very early in the game when the then current limestone pits either got down too far, held too much water, ran out of stone, or

whatever else may have happened, and they needed to expand. When they wanted to expand, some governmental administrator who did not know anything about mining, looked at the Zoning Ordinance and said, "You can't do that without going to the Board of Zoning Appeals". The first round was about three weeks of public hearings over one application for a minor expansion on land owned by a mining company and designated Agricultural Extractive. No one was killed, but it was close. As the public hearing ended, there were busloads of people coming in to protest. There had never really been any major zoning cases in our county up to that point in time. That was in 1972. Over a period of three years, there were a half dozen hotly contested cases. I ended up being hired by the County Commissioners to represent the county in a couple of those cases, and it became very evident, early on, that things were not working well and that we needed to get into this in detail. Quarry owners, of course, keep telling us that they are going to "run out of stone", and "it's going to cost so much more to bring stone in from other counties", and "we're a growing area and we need roads" and all these related problems. Fortunately, the county was sufficiently rural at that point, and there were not really that many organized groups that had political influence. So, what we did was we changed the Zoning Ordinance. We rewrote it. We were involved in a major case which had been in the appellate courts twice; and in the course of that litigation, we just changed the text of the Zoning Ordinance, which change was advertised in the newspaper, but, of course, no letters to affected property owners went out because you do not send letters to the whole county. And what we said was "mining's permitted in the AE designation"... *BINGO*. Right in the middle of the second appellate case and, as we approached the Bench for argument after a couple of years of litigation, one of the judges looked down and said, "Isn't this moot?" and we smiled and said "Yes." And, in that particular instance, the company got the "go ahead". Now, that was a short-term bandaid, because, of course, there were not that many lands that this "designation" applied to, and the mining companies soon wanted to go to lands beyond those so designated. So what we set to work on doing was changing the Zoning Ordinance. That was when the Director of Planning for the county and I, as special counsel, met with Jim Dunn, got his company involved, and started to put together what, I believe, Dr. Bauer was referencing when he was talking about the "inventory" or the "data base". We went to work with the Maryland Geological Survey, developed a quadrangle map which

showed every known and suspected mineral resource in the county and developed what became known as an "overlay zone". Frankly, the inspiration for an overlay back in 1976 or 1977 came from the idea of "flood plain zoning" which is superimposed, very often, over existing zoning. The rationale behind that approach was that it would be more difficult to just pick out a piece of the county and say, "Okay, this is a mining zone henceforth," because you have immediately got problems of "unconstitutional taking" with the people that own the land who were not miners, and you have probably got some political problems as well. But if you did an overlay zone which, when it goes into effect and is designated on an area, permits certain uses that are permitted in the underlying zone further restricting some of them, and prohibiting certain others, you can make a much better argument for the fact that you have not wiped out any reasonable use of the land as the Supreme Court defines it, i.e. viable, economic use.

So we went to that "overlay" concept; and, ultimately, that is what the county has enacted. One gentleman this morning talked about "banking" land. Frankly, that is a terrific idea; but, particularly in economic hard times, it becomes unreasonable to expect the county to buy the land. We now have in our Zoning Ordinance "transferable development rights (TDR)". TDR basically says that if you find yourself in one of these overlay zones, and you are not a miner (and therefore presumably somewhat unhappy), if your land extends beyond the area affected, then you can figure out what development rights you would have had applying the density standard (living units per acre) as if the overlay zone was not there, and we (the County) will give development density to you on a "clustered" or denser basis. In other words, the county gives higher density, lower land acreage requirements and set-back requirements on your remaining land that sits outside the overlay. Alternatively, if you cannot do that for any number of various reasons (including the fact that maybe all of your land is within the mineral overlay), then you can sell your development rights. You can sell them to people outside the overlay zone, and you can sell them for whatever the market will bear. You can believe that in a growing area changing from rural to suburban, there are developers around who are "chafing at the bit" to get a higher density. TDR also fits somewhat hand-in-glove with the idea of trying to direct growth around the cities where you have or will have water and sewer available rather than with the private well and septic systems found in rural areas.

Litigation is probably imminent because our new law has gone into effect only recently, and the first round of fighting over the overlay designation and the applications for mining permits is just starting to cook up. One advantage of that, if you can think about it, is that, obviously, once that permit is granted (and it will be) the burden of going forward and fighting this new law at this stage of the game is going to shift from the mining company to those people who oppose mining. In the law, there is a presumption given to legislative actions that they are constitutional, that they are valid, and that they are going to be interpreted in a reasonable manner. That is a big plus from the standpoint of trying to win in a zoning case, and, of course, it is a tremendous advantage if you get the benefit of that statute running with you at the outset rather than having it construed against you.

From an analytical standpoint, I have broken it down into a couple of points, and said, "Is there a problem?" (I heard this morning that in Minnesota there was 200 years worth of stone around. I do not know anything about stone, so I am not being critical, but, I do not know why we are here, if it is that good. Apparently Minnesota is a lot better off than Maryland.) Anyway, if the answer is "Yes", then it seems to me that next it is a question of what approach to use. One thing you can do is "tough it out." That means legal battles, higher costs, lawyers in \$600 tailored suits, \$200,000 legal bills, and competition which probably will become cutthroat. Another option that you can take is the route of lobbying, influence peddling, and bribery. I do not recommend it, in fact, I am going to be on record that I do not recommend it. And if you think you have to deal with lawyers now, in the words of Al Jolson, "You ain't seen nothin' yet."

A third possibility, besides toughing it out and criminal activity, is "regulation". Regulation can work for you as well as against you. I believe that those who have spoken for the proposition that "regulation" will probably remain at the local level are correct. I believe they are correct, not because I know anything about stone, but because I have been involved in some pretty long-term litigation over sludge storage, waste dumps, and sanitary landfills. I have seen that type of regulation resisted on a state regulatory level. In fact, if anything, the state tries to ignore it. They want to push it down on a local level. I have seen it happen with sludge. It is unbelievable, I mean they barely regulate it. Basically, what regulators do is they just



say, "Get it out of here, ... we don't care, ... we don't want to hear about it, ... here's your permit, go." So any kind of regulation in that area comes about, usually, on a local level. We had a train full of sludge out of Baltimore not too long ago, ... they put the stuff on a ship and tried to send it to Texas and get it back on another railroad down there because the states around Maryland would not let us run the train through their territory, believing that we were trying to dump it on them when we were really going to send it to a state beyond them.

I have also seen the local regulation prevail over state regulation in the case of waste landfills or dumps. I represented a company that is a big East Coast hauler of trash, and what we wanted to do was set up an incinerator and a private dump behind the Black and Decker plant. The Black and Decker main plant is in Maryland (just happens to be in my county) and we wanted to use the dump to dump the ash from the incinerator at Black and Decker. We had a contract for Black and Decker work and also could use the dump for possibly other trash from outside of our county because the county landfills would not let us dump out-of-county waste. (Of course, we did not tell the local government about that aspect). The point was, we got so much resistance at the Board of Zoning Appeals level in the public hearing that it was unbelievable. We even went so far (and this is the difference between state and local regulations) as to consider what landfill uses the state regulates. Where does the state regulate? Well, one of the places Maryland regulates when it comes to dumps is low-level nuclear waste dumps. So, it did not take a quantum leap, or mental giant, to figure out that maybe one of the ways to get around this local resistance is to apply for a low-level nuclear waste, but because on a state level we do not have to worry as much about the impact of the local people turning against us. We will just get the state to approve it since the state is looking desperately for a low-level nuclear waste dump site. When our opponents hear that we have applied for a low-level nuclear waste dump, they will give us the regular dump ... Did not work. But we tried.

The better way is to try to persuade the state government or the local government to work with you. I do not know whether you should do that individually or as a group of individuals when you have a couple of mining companies in the same jurisdiction, or comprehensively through your industry agencies or associations. But I suggest that a comprehensive effort

is always better. That requires a bit of a team approach. Very quickly, I think that in a team package this is Rule Number One: No prostitutes and no card tricks. Mark Wyckoff earlier said that in Michigan there were only two activities that were prohibited ... prostitution and gambling. Well, that prohibition also should apply to your game plan when you are going before a zoning board or before a board of county commissioners, or a local legislative body. You do not want people who will give expert opinions depending on which way the wind is blowing that day. And you do not want to try to use mirrors to get your proposal past people because in this day and age too many people are educated well enough and have enough resources that they will find out where the trick is. They will "show the lie", so to speak. I think the other elements or rules are these: You need a miner because you need the practical experience of knowing what you need to do to effectively run your operation. You need a geologist, obviously. You need a planner. I think you need a political adviser. Without question, you need a political adviser, because you have to know the quirks of the people you are dealing with. If you are talking to farmers, believe me, you have got to know that. Limestone is the principal resource in my county, for example. Maybe all of you know this, but we have a problem with sinkholes. Well, if one of the county commissioners happens to be the head of the Farm Bureau where one of the members of the Farm Bureau Board just lost 60 head of milk cows that went right down a sinkhole, and you go in and say "We want to open a new pit", you have got a problem. You have to know that sort of thing up front. So, you need somebody who knows their politics and knows who the players are. And of course, you need a lawyer. I could not miss that. You need the lawyer mostly for constitutional questions which will most certainly be dragged into your effort, and you need a lawyer for drafting purposes.

Given the fact that you need a politician and a lawyer, you also need patience and money.

I would suggest that the most important thing in your plan (and the first step) is establishing an inventory or data base. Another essential element is to persuade the government to work with you. It is better if you get the government to work with you because, among other things, when the real sparks start to fly, the government will be defending you, which may be cheaper, as a practical matter. Cheaper because they have got their own lawyers, and they are on salary.

The other thing that you should work into the process as much as possible (as we did) is to get the approval aspect away from zoning boards and into, what I heard William Buckley call once, the institutional framework. That is to say, if you institutionalize the approval process and put it through planning commissions and whatnot, you get away from zoning notices going out by mail. At best, there is a little ad on the back page of the paper, "The planning commission will meet on such and such a day and consider such and such". In our county, they do not even say what they are going to consider. They just tell them that they are going to meet. Nobody comes. Nobody. If you can do that, and if it is legal, you have eliminated your greatest stumbling block. You still have to have plenty of protection (for example: setbacks that people will go for) because you have to get the law passed first. But if the public thinks that there are protections, and they think that there are ways to guard against abuse, that is to say that the system is going to guard against abuses, then you can get the planning commission to approve the use without big advertisement, and you have got a course of action that might work.

Now, I am an advocate. I do not know whether what I just proposed to you is right or wrong. I am certainly not a judge, and I would not try to make that judgment. But I would suggest to you that it, at least, illustrates that there are things that you can do that can work within the system and which, with a little bit of luck, may turn out to be both good for the industry and for society itself. The final judgment on that, I guess, is way off in the future. I have to worry about paying overhead, so, I'll leave that to you.

James R. Dunn, Moderator. I think the procedure now is to open this to discussion. I think you have had quite a range of ideas and opinions and perspectives, and there must be a lot of things to talk about. The main consideration is we are here to talk about problems that we have and that most of us, I think, see pretty clearly, and we are now open to discussions, questions.

#### PARTICIPANTS DISCUSSION AND COMMENTS

- It seems that we can write off the NIABY's, the "not in anybody's backyard" people, but with the people who are more directly affected by these kinds of activities, those of you on the panel, are there any ways that you can practically turn those people into stake

holders in the project and perhaps convert them to your side? I would be interested in hearing some comment.

Response, Donald Hey: I'll try. Certainly there's no question you can convert them. You have to find out what they're really interested in to begin with. If they're interested simply in stopping the mine, and in having no mining activity, or whatever the development activity, and they don't want it in their backyard, then you're going to have somebody who's going to take you to the mat or will be around for the entire process until you finally subdue them. But, if there are other interests, environmental interests are the ones, of course, I'm most familiar with, and if you can find out what specific environmental interests are, I think you can convert them.

There was about an 800-acre development in Chicago recently involving the movement of Sears from their downtown corporate headquarters to a suburban office park, and it was a very large piece of land; to the north is a very exclusive suburb, the Barrington, and several communities, including large estate properties; there was a lot of opposition to the Sears project. Sears, through a number of different actions, converted that more typical development into something that built on native landscaping. The development maintains a quarter right smack through the middle of it, about 70 acres, through which people can traverse the property; there will be trails, wildlife can continue to move, and it ends up linking two Cook County forest preserve district holdings. Through those actions they won over every conservation group that I know of that originally opposed their project. Yet you have to find, though, what it is those people are most interested in, what they're most concerned about. I think you can win them over.

Response, Robert C. Meskimen: We in one instance had some opposition to opening up a new location, and the question of water wells came up. Presumably, we were going to diminish the capacity of their wells. We told them we would do some testing on the capacity as well as the quality of the water. Two families found out that the quality of the water they had been using was absolutely horrible. Their young kids had problems with illnesses over a number of years. They had new wells drilled. They were very appreciative of the fact that somebody eventually found out what was wrong; so, it was really an aside to what we were trying to point out to them.

- Away from the issues of specific site permitting and over to the issue of rezoning or modifications on local zoning ordinances. I am interested in hearing some discussion on the kinds of information and the form of information that you or we need to present to the decision makers that persuade them of the need for protecting and recognizing the resource. Simply noting the fact that resources are being diminished or transportation costs are going to increase is not necessarily persuasive to somebody that the resource needs to be protected in their own jurisdiction. I think the kind of information that Carl Schenk showed this morning as far as the incremental cost on different kinds of development is the direction in which we need to be looking in order to get people's attention -- when we can show them that it's going to cost dollars, if such and such is not done -- you can probably get their attention, rather than suggesting that the sky is falling because we're running out of rock.

Response, James R. Dunn: I'll make a small comment. I'm not sure that I fully understand what your question is, but I think that, in all cases, when we're dealing with zoning we have two publics; we have the public which is in the immediate vicinity of an operation and which is directly impacted. Then, we have a general public which is not immediately impacted, but may be enormously impacted in the long run because it may cost them a great deal of money. This is what we're talking about, I mean multi-millions of dollars, as in the case, for instance, of Detroit, the southeastern Michigan area, we're talking about a huge amount of money which I don't believe that they can afford. When the local public objects to something, the general public, to my knowledge, is rarely represented in these discussions. So there's no mechanism for showing the overall cost of something of this sort, and even in litigation the judges, I think, generally insist on talking about the local conditions, local environmental impacts, and so on, and don't go beyond that and talk about the general impact on the general public. Most of the public is not even aware, to my knowledge, of the degree to which they are impacted. Those impacts can be enormous. That's what I used to call at one time "dispersed benefit riddle," the problem of what happens in a local area, the local fight, of the local gain, of the local benefit. Benefits are measured one way, but the overall public may be impacted adversely or positively in a much, much greater way.

One example I have used was coal and all the strip mining of coal. It impacted about a million acres.

On the other hand, if we hadn't mined that coal, we wouldn't have some 50 million acres of new forests in the eastern United States, because we were using wood for fuel. When you suddenly are able to use coal for fuel, then you can start to grow trees back. So, the gain there was a 50 to 1 ratio, 1 million acres versus a 50 million acre gain. Well, this is the kind, but that gain is a subtle gain. I see it now. I see it every day of my life because I live in the woods, all the game and wildlife around me is all new. I doubt whether 50 years ago or 100 years ago, a person sitting where I was sitting would have realized the kinds of tradeoffs which were occurring, tradeoffs are invisible.

I'm not sure whether this answers your question, but we're always dealing with two publics; the general public is much more impacted in a lot of ways, and the costs are much greater than for the local publics which generally object to things.

- The general public won't recognize a need until it is put into economic terms.

Response, James R. Dunn: Well, then you come down to the problem of who does this and how do you get the word out for the schools, you write about this in newspapers and magazines, but what do you say and to whom, and who does the saying? That's not very simple. I tell you, I've tried to say some of these things myself through a lot of years, and it's not very easy to get that to the general public.

Response, Donald Hey: In Illinois, the Endangered Species Act usually gets involved; you get involved with the Endangered Species Act when you try for rezoning, which means that your property has to be surveyed. It means that you have to provide information on not only breeding but foraging of wildlife on your property and the presence or absence thereof of endangered and threatened plants. So when you go into a rezoning, I think, at least in many jurisdictions, you open a whole new arena of investigation and inquiry.

- I'm going to make the comment that Harry Tourtelot anticipated. Randall Graves this morning mentioned, when he was asked about the benefit to Maple Grove, that he felt that the benefit to cost ratio was probably negative, looking at the amount of taxes that were available and the cost in monitoring the particular area set aside for aggregates. When Carl Schenk spoke, he started giving us figures as to what

the benefit might be to the entire Minneapolis area. Clearly, a benefit to cost study of the Maple Grove situation for the entire region would give you a different benefit-cost ratio, and I would anticipate it would be positive.

The Illinois State Geological Survey did a benefit-cost ratio of geologic mapping for Boone and Winnebago Counties on the Wisconsin border west of the city of Chicago. We started that study for the purpose of demonstrating utility of this fundamental information, whether it be for resources, groundwater, waste disposal, or any geologically related purpose. In doing that study, we found that the best data available were geologic maps in disposing of wastes. The gentlemen who did it are principally Subhash Baghwat and Dick Berg. But, we documented, in what is now published, that the cost for avoiding clean-up sites alone as compared to the cost of geologically mapping those two counties at a cost in the 1980s of some \$300,000, had a benefit-cost ratio depending upon a number of premises from 5 to 20, and extrapolated to the State of Illinois, it was even greater. If you started working in things like aggregates or the cost of taking care of groundwater or other purposes, the benefit to cost ratio would be even more.

The State Geological Survey did this for the purpose of demonstrating the utility of geologic mapping in anticipation of the National Geologic Mapping Act. The National Geologic Mapping Act has now been passed. It was signed by President Bush a couple of months ago. The appropriations are anticipated. Part of the appropriations call for an increasing amount over a period of four years of as much as \$35 million to provide matching monies for the states to carry out geologic mapping. I think the message here is if the aggregate industry needs data, and I can hear from a number of talks today, and I think Mike Preston just alluded to it a few minutes ago, that the data are needed. You talk about inventories. Well, now is the time to get that geologic inventory. The aggregate industry can speak up on behalf of their state organizations, which could carry out that mapping whether it be the state geological surveys or a university, but the monies that are raised will be matched by Federal dollars, and I think that I can guarantee that the benefit-cost ratio will be positive. That's one way of looking at this situation and getting the data that are needed, because, regardless of how we're going to solve the problem with zoning, if the data on

which the zoning will be based are not available, I think the process will fail.

Response, Charles M. Preston: I might say I couldn't agree more. We use the Maryland Geological Survey and the USGS information in our effort. These data were the backbone as far as the justification for what we were doing. I don't think there's any doubt that there's an opportunity if that kind of information is available, it might catch on like wildfire. That is to say, if you could get people to recognize in a couple of jurisdictions that this is the way to go, it will build upon itself and will establish a precedent for other areas to do it. Then you've got a reasonable basis for enacting legislation.

- I would like your advice on how to get it going. In Champaign County, Illinois, there was a landfill on which \$600,000 was spent; afterwards, they came to the Geological Survey and found out this was an inappropriate site, and then a \$40,000 study was done to find out where an appropriate site existed. There is something like 330,000 oil wells and water wells in the Geological Survey's geologic data base, which is a tremendous backlog to fall back on to solve any geologic problem, but my second question would be "how do you get somebody to use it?" We've gone to counties; we don't get an ear. And the problem is they don't come to us until there's a problem. Is there a way to get that message across?

Response, Charles M. Preston: Well, I think that probably the best carrier pigeon for that is the mining companies. I mean if you try to figure out whose ox is necessarily maybe going to get gored here, it seems to me that the public expense, the ultimate public expense, is too far in the future for anybody to realize or appreciate. With all due respect, I think the economic argument will work with the political body, but as far as Joe Q. Public is concerned, it isn't going to matter. So who's going to make that nexus if the industry doesn't? I don't know who would, frankly.

- I teach a short course on industrial minerals, and I teach my students that everything hinges on markets, and the word I just don't hear today in all the discussions on things is "marketing". So I'm going to delve into that.

The industrial minerals sector, especially aggregates, isn't concerned with local demands, they're

not concerned with regional demands, they're not concerned about reliability of future supply; they're concerned with markets. They respond to local markets, they respond to regional markets and the surety of market demand, and having access to both markets and raw materials, and to making profits. If a local or regional market becomes unprofitable, or onerously choked with regulatory restrictions and irrational oppositions it will gradually shut down or move elsewhere and ship in stuff, 100 or 200 miles from outside. Or, you'll see a pattern of imports, say from Canada, or if it's down on the Gulf Coast, from Mexico gradually develop.

Now this may be a detriment to a local or regional market, in two ways, either through higher prices or, at times of dislocation in markets, through availability. All of us are old enough to have been through the oil crunch, and I remember that during that crunch and at other times, shortages and high prices develop in oil, natural gas, sulfur, titanium, barite, bentonite, and such commodities. And, where there are such restrictions, such onerous situations where you cannot operate, then it is the market itself that suffers. So, remember, whatever transpires at local or regional regulatory and government fronts, industrial minerals industries will respond only as market-scene participants. Future reliable supply requires understanding by government bodies, local, regional, planning people, whomever, to guarantee that the future supply will not be by import only.

- I have a comment and then a question. The comment relates to an earlier question of who should be initiating the work for the geologic testing. How do we get that started? You suggested that the aggregate people ought to be one of the key people. I don't disagree with that, but I think that response is too narrow, because I think urban geology is a bigger problem than just aggregates. I think that one of the key agencies or people you ought to be looking at are the planners, the American Planning Association, because these are the people that are making and carrying this message.

The question I would like to direct is at Don Hey. He's made some strong statements with regard to what happens when you try to regulate or develop legislation to solve specific problems, and we seem to have a tunnel vision in doing that. What advice would you give with regard to the mining industry as to how we might best approach the current legislation that's

coming down with regard to wetlands? In context to the comment you made about legislation.

Response, Donald Hey: In one word, restoration. Beyond that, there are a lot of mechanisms for initiating and extending restoration throughout the country. You heard a little bit earlier about mitigation banks; it's an idea that's come that I think we'll see developed in the next 10 years. I think the aggregate mining industry is in an excellent position to do that. In fact, in northeastern Illinois, there have been several sand and gravel operations that have already offered their property. On our research site along the Des Plaines River, we have three abandoned mines, typical mines that were mined out, and the owner just walked away and left them. There is little in the way of redeeming wildlife benefit to these mines as they are now situated, but with a very minor amount of investment they can be converted and restored, and that's actually what we're doing research on. I will say, however, that the cost of retrofitting these old abandoned pits is far more costly than a little forethought and the judicious disposal of overburden in the right locations during the mining operation. That gets back to my long-term thinking. I think that if the aggregate mining industry acts as a good neighbor and is concerned about the environmental resources, and especially the wildlife resources of the region, and provides a meaningful end-use plan, that will save yourself all kinds of problems. I have seen this in case after case where a developer comes forward, tries to stonewall it, tries to draw that bottom line a little higher than he probably should, and he runs into no end of grief from the public. If that developer were to come back, and oftentimes is forced to come back, with a little more meaningful environmental end-use or environmental plan associated with his/her project, it would go much more smoothly.

- I have a question for LeRoy Lee, and it concerns education. You made the comment that all of us can do something to help in the schools, and I appreciate that. I work with an Alliance for Science and volunteer my time four or more times a year doing science experiments, and I go into my son's classroom and give a talk. But that's on volunteer time; that's not part of my job, although it could be, but it's on my work hours that I'm doing that. My question is what can we do to educate educators and help them teach science better, so that all of us aren't spending our time doing it, because they're spending four years in college learning to teach? Please address that.

Response, LeRoy Lee: Very good question. As a parent of a son who is now in 6th grade, I have watched him go through 6 years of a science education that by my standard is absolutely horrible. My wife is also a teacher, and it is very difficult for two teachers to come in and talk to another teacher. Very difficult. The answer in my estimation is twofold: one, is that you have to work at a higher level than at that teacher. You have to work at the level of the school board. You have to make demands at that level. The other is, working through other means. I'll use a very specific example. We've heard about \$30,000 for permits. Well, if I had that same amount of money over 10 years, I could directly influence and could guarantee a change in attitude in 60 teachers, which would represent in ten years 60,000 kids. There are people all across the states that can do those types of things, that have those types of programs in place. But there is a danger; I would like to use a specific example. A danger that a good friend of mine, who is the president of Playcon Corporation and whose son is now in the second grade, had is the teacher wants him to come in and help, and he has a tremendous ethical problem. He says, "If I go in that classroom and help, give some money, and do some things with that classroom, I'm perpetuating what's there. If I don't, I'm hurting my son."

- It's been very interesting to be here for a day and a half, and it's only in the last hour or so that we've had mention of geology. Yet, we must, and we have to ask, "what can geology do for you?", and the industry has to ask "what can we do with you?" We are forgetting that this whole session was sponsored by the Minnesota Geological Survey, the U.S. Bureau of Mines, and the U.S. Geological Survey, and with the cooperation of other state geological surveys in this northern midcontinent region. There is a lot that geology can do. Ken Weaver, former State Geologist of Maryland, was one of the first to point out the erosion of resources by zoning and the way that good geology can explain this to people so they understand and can accept some action that may be necessary. So, geology wants to work in this area. Geologists want to work in this area. It is a very site-specific kind of activity, so that state geological surveys certainly are playing a preeminent role in the application of geology to these problems. But larger groups, such as the U.S. Geological Survey and the Bureau of Mines certainly recognize that there is a national component in this problem, and that we want to assist in whatever way we can, too.

- I have a comment, and it's not good news. About 20 years ago, the state legislature in Colorado mandated the state Geological Survey to map the aggregate resources in the eight most populous counties. The idea was that the county planning officials would have this information and would take this into account for future development. Colorado is as tough a place as there is to win a mining permit, at least in the Front Range area. There have been a number of companies that have taken a very expensive run at this and have come away with a dry hole. I think what's happened is that the importance of mining which we recognize is lost on a lot of people who don't think mining is important. An anti-mining feeling has taken place, which has evolved over decades. I think LeRoy Lee has hit the nail on the head. I think that it's going to be a long, slow education process. I know that you gentlemen have spoken to a number of groups, you've written a number of articles, and they were well done, but still we're not reaching the public. I think we have to start with the children, let them know how important mining is to their lives. I don't say that we should abandon our efforts because we can't do that, but I think that we are going to have to come up with some ways to work on this for a long, long period of time.

Response, James R. Dunn: Of course, I couldn't agree more; all of us have been preaching to the choir for a long period of time, and I've been to many meetings where these kinds of subjects have come up and, of course, we are always talking to our own people. Most of the people in the audience agree with what we're saying. We have to reach people such as the educators. We have to get to the general public in some way, talk about dispersed benefits from mining. Mining has a problem at a local level; many activities have enormous benefits for a much larger segment of the public, and these things almost never come out. We have to talk to the major media, if it's possible, and that's very difficult; I've tried that and have not had much success. I bet a lot of you other people have, too. Get to the schools, and I think you have to get right back into the textbooks. You have to get to the school boards. That's a very difficult thing. I don't think we should stop writing articles, but it's tough to educate the public.

- I would like to make a little follow-up to your recent remarks and those of the previous questioner, and take any comments that the panel might have. I'm so used to workshops and conferences where industry

representatives, and especially the government agencies that are most favorably disposed to the aggregates industry or to mining in general, put their major emphasis on questions of mineralogy and economics and on statistics to show the economic impact of not mining in certain areas. Of course, we in our own audience recognize how important that is, and I think we recognize how tough a sell it is for the politician and the zoning officials, etc., to make their judgments based solely on economic grounds.

It seems to me, as in California, that one of the most important things that the industry can start to do is to talk about the environmental impacts of not mining in a certain area, balancing that with the economic aspects. As we all know, commonly there are environmentally better places to mine or not to mine. And there are negative impacts to the environment in coming up with alternatives that are far away. In some ways, Mr. Hey responded to try to focus the issue on environmental as well as economic terms, and I wonder if you think that this might be part of the answer to our problem?

Response, James R. Dunn: I certainly agree. As you know, we should focus a lot more on environmental impacts of not mining and regional environmental impacts. I've talked quite frequently about the environmental impact of being poor. Most of you have travelled in poor nations, and you recognize at a glance -- it takes about 5 seconds for a geologist who is knowledgeable about landscape -- what the devil they're doing with their land. You look around our landscapes and you don't see those things. They're here, but they're not so obvious; so, we also have to point out the environmental importance of having money. In other words, we have to be careful about not crippling our financial machine. There are a whole lot of things that interplay here, but it takes a long time to get those things out.

Response, Donald Hey: Let me just respond further. There is another side to this. I think we've probably all been thinking about the negative side, the negative environmental impact, but there are environmental opportunities associated with mining as well. There's a case, again, in Chicago, where a sand and gravel mine had been abandoned, for more than 30 to 40 years. It was done with a mining technique, a rill and trench technique, and it left behind a habitat that actually harbors a threatened bird species now in Illinois, the veery, and provided foraging ground for the

coopershawk. So, there is a positive benefit. Now another group came along and said they wanted to develop this mine, this derelict land, for another purpose, and they have had to spend a great deal of time and money working out an environmental plan to offset the benefits the abandoned land provided. It's a little bit of a reach, perhaps, but I think you ought to look at the environmental opportunities associated with each mining activity, whether it's flood control, water quality treatment, or wildlife habitat; the benefits are there, and they ought to be brought forward.

- I would just like to call attention to some of these subjects which have been considered in previous workshops in Arizona, California, and in Utah and which were written up in USGS Bulletins. The Nevada Division of Mines, Bureau of Minerals, instituted a program of education of teachers in Nevada, which has been highly successful; they provide the teachers with educational instruction at the University of Nevada, take them out to the field and set up a curriculum for them; all this is paid for by a mining company. In the area of influencing people, the Nevada Mining Association has an active program trying to promote some legislation, and they got a public relations firm to help them put the story of mining across; the bill was passed. So it can be done. I commend those three bulletins to you, USGS Bulletins 1905, 1958, and 2013.

- This afternoon's discussion primarily focussed on metropolitan areas and major companies, and associated problems. I was going to give you some background on South Dakota, where I live, but in order not to delay things, I would like to ask what you would advise states that lack metropolitan areas to do in anticipation of dealing with things in the future?

Response, Robert C. Meskimen: Do you have a reclamation law, currently?

- No.

Response, Robert C. Meskimen: That would be a good step. We've got the problem in Nebraska and Kansas. They don't have adequate reclamation laws, and that's the one thing that can help turn our industry around.

Response, James R. Dunn: Reclamation laws are funny. I personally think that if we had no laws at all, a lot of good things would still happen. But people don't think good things are going to happen, and they

certainly would take longer to happen without the laws, so, I agree; I think that the laws are important because they bring things along in a more systematic way, and people know there's going to be an end in sight, and things are going to get better. But I think, for instance, as I mentioned earlier, about all of the lakes west of Chicago that were formed by the aggregate industry. I think most of those lakes were never really formally reclaimed, not by the mining companies. So, good things happen even though we didn't plan them. But I

think that planning helps; it certainly accelerates the good things. I think that's a benefit.

Response, George Dirkes: One quick response to the comment. Aesop's Fable -- everybody sees a different part of the elephant or does not see. I interpret the question differently. What you do is covet and cherish your aggregate mining industry, because without aggregates there is no construction; without construction, there is no progress, and you'll never have a big city.

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## INTRODUCTION OF KEYNOTE SPEAKER

By Gary B. Sidder

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It is my pleasure to introduce our keynote speaker today. His name is Louis R. Guzzo. He is currently a television and radio commentator and analyst for KIRO-TV and Radio in Seattle, Washington, for which he received the Associated Press' Commentator of the Year award in 1986. He has a long history with the media as well as in government. Lou worked as a reporter, columnist, and editor for major metropolitan newspapers in Cleveland and Seattle for more than 30

years. He served as policy adviser to Governor Dixy Lee Ray and as Washington State Historic Preservation Officer from 1977 to 1981. Lou is also co-author with Dixy Lee Ray of two important books, *Trashing the Planet* and *Environmental Overkill*. It is my pleasure to introduce to you commentator, newspaperman, author, editor, actor, musician, and our keynote speaker Lou Guzzo.

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## WHATEVER HAPPENED TO COMMON SENSE?

By Lou Guzzo

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Because I have learned a great deal from you today, I am changing my talk considerably to reflect your specific concerns. First, let me say that I am impressed with all of you here today and what you do. You are all builders, creators, people who deal in the future, not the past. And you are worried about not being able to do your job in the best way -- to benefit others, to benefit communities and keep building and repairing America in the most advantageous methods without sacrificing environmental and other requirements.

I have heard about your problems as you have explained them at this important conference. Let me offer you some suggestions from my own experience in the private sector of the news media and in government, as well.

Many of your speakers have mentioned the NIMBY syndrome as a major hurdle. It has become a national lament in every community, large or small. For years I have been promoting an idea in newspaper columns, editorials, and in TV/Radio commentaries,



which I still cannot sell in Seattle and Washington State because of political self-interests and governmental stagnation. It is this: Local taxing districts should have the authority to award tax incentives to those neighborhoods or communities willing to accept an otherwise "undesirable" function -- such as: 1) jails and prisons; 2) waste-disposal stations; 3) incinerators; 4) rendering plants and other similar facilities; and 5) mineral resources sites.

I bet you that homeowners and landowners in such communities would suddenly switch from negative to positive citizens if they knew their property and road taxes were going to be cut 10 or 20 percent as a result! And why not? This has been my argument: The LID, or Local Improvement District, principle has been operating well throughout the U.S. for years. If a new road or a repaired or widened road is in your community, you probably will be assessed for it on a ratio basis, even though your house is not on the road, but in a nearby area. You use it, and you pay for it. We already accept this practice.

Now, why can't we reverse that process with, say, an LUD -- a Local "Unimprovement" District -- to give you a tax reduction if you say "OK" to a jail, an incinerator, or a mineral resource site? Let's just call it a *DISASSESSMENT!*

Can government be that creative? Of course it can -- if only it would try.

Let me throw another idea your way. When I left the news media to serve Governor Dixy Lee Ray as policy adviser, one of my many tasks was as the state's historic preservation officer. I think the best thing I did in that office was to create a system of transparent plastic overlays to the map of the state. They were all color-coded, and you could tell instantly where a strategic spot was -- one you had to watch out for before planning anything in it or near it. One overlay indicated all archeological sites. Another contained geological sites and natural treasures. Still another included aquifers, mining sites, federal and state security installations (such as nuclear plants), key farmlands, and resource sites. Other overlays bore major roadways, historic sites, bridges, and so on. There were 12 overlays in all.

Copies of the overlays were transmitted to all departments of state government, county government, and cities and towns. They were intended to say to all concerned: "Hey, look! Don't touch! These are out of

bounds to residential or other development -- and to urban sprawl, as well. These will also protect urgently needed mineral and metal resources, and even old-growth forests."

Unfortunately, my successor found the job too much for him, and he let it drop by the wayside. Too bad. But I highly recommend the overlay approach to you, if you do not already have one in place. It is an idea whose time is long overdue -- an idea that will dispel many disputes and headaches before they start.

Incidentally, other speakers have spent a lot of time on the reclamation issue concerning mining sites. The LUD tax-incentive idea and the overlays would go a long way toward making ultimate reclamation a much more attractive factor in winning over communities.

But I should get on with my main topic here today. Mark Wyckoff included in his impressive list of recommendations a "coalition of industry, state and local governments, *environmental groups*, and aggregate users" to deal with resource and other issues.

I would say that is a fine idea -- provided the environmentalists are reasonable, well-schooled -- *AND NOT REPRESENTATIVES OF THE RADICAL ENVIRONMENTAL FRINGE!*

As a chronicler of events all my life, I have watched the U.S. move gradually from a free-wheeling, freedom-loving capitalist nation -- with all the advantages and disadvantages that implies -- to one that is careening dangerously to the other extreme: too strong a federal government, regulations and restraints that are gradually squeezing the life out of a once virile nation, and, worst of all, an unwillingness to find compromise, to talk about our problems, to consider all points of view, whether we are talking about developing urgently needed new communities or protecting green belts, forests, or wetlands.

What has happened? For the first time in our history, a political movement has come along that has sweet-talked the news media and a majority of politicians into parroting its cause. That is a deadly lineup, one that could bring us to total state socialism and render us a third-class power. I am not talking about the Democrats or Republicans or even the Socialist and Communist Parties. The movement I am talking about is the Environmental Movement run by more than a dozen militant groups with big treasuries

and lots of gullible, dues-paying members who are not really aware of the monster they are supporting.

I must tell you a personal story that illustrates exactly what it is I am talking about -- and the danger we are in from cultivating too much of a good thing. You may find this hard to believe, but way back in the early 1950s, my colleague, Dr. Dixy Lee Ray, and I pioneered the environmental movement in Washington State -- she as a distinguished marine biologist, and I as a reporter and later the managing editor of the morning paper in Seattle.

As beginning "revolutionaries" of sorts, we crusaded on behalf of clean water supplies, cleaner air, and the protection of lakes, rivers, and old forests of historic value. Her report to the Legislature saved the Nisqually River Valley -- the last remaining untouched river in the state -- from industrial and commercial incursions that could just as easily be situated elsewhere. I led a newspaper investigation that uncovered and blocked a surreptitious scheme to degrade the banks of Washington's Hood Canal, a prime resort area.

We did not do it as part of a movement. We thought it was the right thing to do -- and we still do. But we had no idea of where it would all lead. Others took up the cause in the 1950s and 1960s, and many good things started happening in the Puget Sound area as a result -- including the cleanup of dying lakes such as Lake Washington and Green Lake, a new metropolitan system of sewage treatment, controlling the pollution of rivers and lakes, and the establishment of green belts in rural Washington. Almost overnight, government and the people started caring for their environment.

Then in the 1970s, a good thing went to pot as the movement turned political and the uncompromising militants took over. From the logic of environmental action, we saw a sudden switch to extremism and wild-eyed devotion that turned to a war against industry, against science, against technology, and even against people and in favor of animals and birds. Dixy and I left the new movement, which had now been taken over by urban cowboys who were more interested in risky adventure, political gain, and scary headlines than in honest environmentalism.

Today, Dixy and I are still environmentalists in the original sense of the term, but we are doing all we

can to alert the nation to the grave danger posed by the many shrill, well-oiled organizations that want to return us to a pristine world in which the human race is considered a danger and a pest.

Thanks to them and their cohorts across the nation, we are being strangled by the greatest amount of federal and local regulatory laws, agencies, and rules in our history -- regulation which, if it goes unchecked, will soon turn America into a socialist state run by the Environmental Party and not a staff agency like the Environmental Protection Agency, but a Department of Environmentalism.

The political environmentalists are quick to mock what they have labeled Big Industry, Big Oil, Big Business, and even Big Labor in their constant barbs against the free-enterprise system. But it is quite obvious that what we have now is, in fact, Big Environmentalism -- to go along with what I am afraid has become the Big Press, thanks to all the daily mergers.

You know all too well the organizations I am talking about that do not want a new America -- unless they can run it, that is. They include Friends of the Earth, Earth First!, Greenpeace, Zero Population Growth, the Environmental Defense Fund, the Wilderness Society, the Sierra Club, and so many, many more. All of them have multi-million-dollar treasuries that permit them to mount massive campaigns in all the news media and in our schools to spout their half-truths and unsubstantiated fears about wetlands, agriculture, pesticides, global warming, ozone "holes," and other assorted fairy tales.

Sadly, the largest proportion of those who have been taken in to the militant environmental movement are the young generations -- and when I say "taken in," I use the right term. I love their enthusiasm and love of adventure, but their inexperience concerns me. They remind me of that old story about the arrogant young know-it-all who made a tour of farms after graduation from agricultural college.

He said flippantly to old Farmer Jones: "I'm surprised by your old-fashioned methods. If you got a pound of apples from that tree, I'd be absolutely amazed."

Farmer Jones replied: "I'd be amazed, too, young man, because it's a pear tree."

Another tragedy concerns the news media -- the Big Press, as I like to call it. The younger generations I mentioned are also very much in command of the news media, and they are willing patsies for the militant environmentalists. So are many of the columnists and TV and radio commentators. They buy the environmentalists' warnings of doom and gloom because they are geared to accept sensational stories -- often without checking them for accuracy.

I have been a TV commentator for eight years, and it is still tough to get one of the young phenoms who produce the news programs to make time for me to insult a spotted owl or to suggest that salmon are for eating, not worshipping.

Ah, television, the super-medium! Do you know what TV is? It is the punishment for people who stay home from work when they're not really sick. Or, as one wag said: "It's like a steak -- a medium that's rarely well done." The comedian Bob Orben called TV a device that acquaints you with all the things going on in the world that you could be a part of -- if you were not sitting on your duff at home watching TV."

This may sound strange coming from a man who has devoted most of his working life to the press, TV, and radio, but the news media in general and TV in particular are failing America at a time America needs the truth about environmental matters more than ever. Editors, news directors, reporters, and producers pander to what they consider popular sentiment and to the environmental extremists. They prefer to run the driveline pumped out constantly by the Paul Ehrlichs, Ralph Naders, Barry Commoners, and other self-appointed experts.

Why? Because these ersatz experts and publicity hounds are always available. They are in everybody's Rolodex. They have trained themselves to speak in headlines. Not the truth, mind you -- just the sensational headlines that make the top of the 6 o'clock news and page 1. They have perfected the hit-and-run technique, and too many editors and reporters fall for it every time.

It goes this way, and I am sure you will recognize it: make a spectacular charge. It doesn't matter that there is little or no truth in it. Make it outlandish enough -- like Alar in apples threatening kids with cancer -- and let the gullible media do the rest. By the time the legitimate scientists and responsible people

are able to recover and disprove the wild charges, it is too late. The public has lost interest and so have the media people. Besides, the honest response, when it is finally considered, appears back with the classified ads of the newspaper and right after the public service announcements on TV at 2 in the morning after the late-late movie. And you wondered why the bonafide scientists are seldom heard from ...!

I would guess that the Upper Midwest states are much like our Pacific Northwest corner of the world, which has probably the most radical environmental community in the nation. The Seattle newspapers particularly preach the environmentalist gospel daily. Environmental activists need only sneeze and the region's news media rush forward to say "Bless you!" before the bacteria hit the ground!

Their one-sided coverage of the spotted owl lunacy is proof enough of that.

Dr. Ray loses her cool when she hears or reads about those computerized models that government agencies and others use to make their flawed predictions about global warming and imagined "holes" in the ozone layer. I like to quote her directly:

"These bunglers," she says, "are picking unreliable factors out of the air to create computer models and other criteria to make wild guesses about global warming, the greenhouse effect, and ozone holes. They also presume to tell us what stratospheric, atmospheric, and weather conditions will be two years from now, five years from now, even 10, 20, or 30 years from now! Holy Toledo! Our trained weather people can't even give us a reliable five-day forecast!"

Another favorite device of the practitioners who use computer models to guess at global warming mythology is to deal with "averages" or "average persons," instead of precise measurements. Do you know what an "average person" is? According to Dixy, a computer would probably tell you that an average human being is a person with one breast and one testicle.

Now, who are some of the militant gurus the media people listen to -- gurus who have made your lives miserable and frustrating and who butcher scientific fact to bring you the global warming mythology and other fairy tales? Here are a few examples:

*Paul Watson, founder of Greenpeace:* "I got the impression that instead of going out to shoot birds, I should go out and shoot the kids who shoot birds." Nice fellow, no?

*Paul Ehrlich, Stanford biologist and darling of the environmental camp, whose forecast of world famine in the 1970s was discredited long ago:* "We've already had too much economic growth in the United States. Economic growth in rich countries like ours is the disease, not the cure."

Wouldn't he make a terrific CEO? How would you like to have him help you solve the serious problems you face in halting the deterioration of our cities, roads, and rural communities?

*David Brower, founder of Earth First!:* "We must reclaim the roads and the plowed land, halt dam construction, tear down existing dams, free shackled rivers, and return to wilderness millions and tens of millions of acres of presently settled land."

*John Shuttlesworth, who wrote the Friends of the Earth manual:* "The only really good technology is no technology at all. Technology is taxation without representation, imposed by our elitist species (man) upon the rest of the natural world."

If he had a ruptured appendix, I wonder whom he would call to remove it?

And, speaking of global warming's prime advocates, here is what *Stephen Schneider, leader of the "hole in the ozone" cult*, had to say: "We need to get some broad-based support to capture the public's imagination. That, of course, entails getting loads of media coverage. So we have to offer up scary scenarios, make simplified, dramatic statements, and make little mention of any doubts we may have. Each of us has to decide what the right balance is between being effective and being honest."

Would you believe you are paying his salary with your tax money? He is with the National Center for Atmospheric Research! I want my money back.

Here is a revealing quotation from the goddess of the environmental movement, *Helen Caldicott, Australia's gift to the misguided, head-in-the-sand Union of Concerned Scientists:* "Free enterprise really means

rich people get richer. And they have the freedom to exploit and psychologically rape their fellow human beings in the process ... Capitalism is destroying the earth. Cuba is a wonderful country. What Castro has done is superb."

Speaking of misguided, head-in-the-sandism, listen to *Prince Philip of Britain, leader of the World Wildlife Fund:* "If I were to be reincarnated, I would wish to return as a killer virus to lower human population levels."

Thank goodness he never made King!

I could go on and on with such quotes, but I am sure you already get the point. Now that I have painted a somber picture of the media's role in promoting the myths of environmental extremism, I owe it to you to suggest what you can do about it.

I have known many publishers, station owners, editors-in-chief, and station managers. Believe me, with just a few exceptions (like CNN's Ted Turner), they are all on your side. But either they do not care, do not know, or are not willing to look into their news operations because they are not aware that their reporters, anchors, and editors are managing the news to suit their prejudices. Or, worse yet, they do not think YOU care.

Your job is to make them aware and let them know you do care and that honest government, free enterprise, and the advance of science need help. It is your hand that feeds them, that keeps this country free, and that guarantees that the press remains free.

Go to them directly when your side of the story is ignored or manhandled. Do not depend on a high-priced public relations firm or press agent. Go yourself -- and I mean right to the boss, the publisher, the station owner, not the receptionist in the newsroom. Do not do it secretly or surreptitiously. Do it out in the open, and let the public and all your associates and employees know you are doing it. I think you will be surprised to find out your side of the story will get a fair hearing. Let the militants howl all they want about Big Corporations, Big Industry, Big Utilities, or other Bigs.

You can and should howl back. Remember, every time well-heeled Big Environmentalism goes on the attack and gets a lot of press, it adds hundreds more

to its membership and thousands more to its treasury. And many, many more headaches for you.

Do you believe in abiding by the law? Of course you do. Do you believe in the American judicial system, with all its wrinkles and tangents? Of course you do. Then why do you not use it? The Big Environmentalist organizations have used the courts to great advantage. You should, too. Maybe then we will get some of those compromises we need so urgently to bring environmental issues down to earth so they can be resolved sensibly.

Whatever happened to common sense?

If you do not fight back with scientific facts and some courage, you will, in fact, be indicting yourself and virtually acknowledging that the Green Mafia has indeed taken over America. If you learn to fight back with logic and truth on your side, you will show all the news media, government administrators, and the public that they should follow suit.

It is not just a biblical admonition. "The truth *WILL* set you free." Thank you.

## APPENDIX

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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

By Eidel, J.J., Baxter, J.W., Berg, R.C., Nelson, W.J., Hughes, R.E., Masters, J.M., Pool, R.R., Smith, L.R., Stiff, B.J., Anderson, W., Dever, G., Jr., Olive, W.W., McFarland, M., Rueff, A., Hayes, T.S., and Berg, R.B.

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#### ABSTRACT

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 1987 as a cooperative effort of the USGS, the Illinois State Geological Survey, and the Geological Surveys 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 primary 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 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 show areas of high, medium, and low potential for each of the nine industrial minerals.

#### INTRODUCTION

The Conterminous U.S. Mineral Assessment Program (CUSMAP) of the U.S. Geological Survey (USGS) provides detailed geological, geochemical, and geophysical studies in regions known to contain or have potential for mineral deposits. The purpose of CUSMAP is to acquire basic information required to evaluate the likelihood of finding new mineral resources or extensions of known deposits and to facilitate

exploration activities. The mid-continent program began in southeastern Missouri in 1965 with the Rolla 1°x2° sheet and was continued westward for the adjacent Springfield, Harrison, and Joplin quadrangles. The CUSMAP study of the Paducah 1°x2° sheet (1:250,000, 1 inch = 4 miles) was begun by the USGS in 1987 as a cooperative effort with the Illinois State Geological Survey, the Kentucky Geological Survey, the Missouri

## GEOLOGY AND BASIC MAP COMPILATIONS

Division of Geology and Land Survey, and the Indiana Geological Survey. The Paducah quadrangle, 37°-38°N latitude and 88°-90°E longitude, was chosen for study because of the significant mineral resources that had been produced from the quadrangle (fluorspar, lead, zinc, barite, tripoli, oil and gas, coal, clay, limestone and dolomite, and sand and gravel) and the potential for future discovery and production of a variety of metallic and non-metallic mineral commodities. Figure 36 shows the location of the quadrangle, known mineral districts, the limit of oil production, and the extent of Pennsylvanian (coal-bearing) strata in the quadrangle.

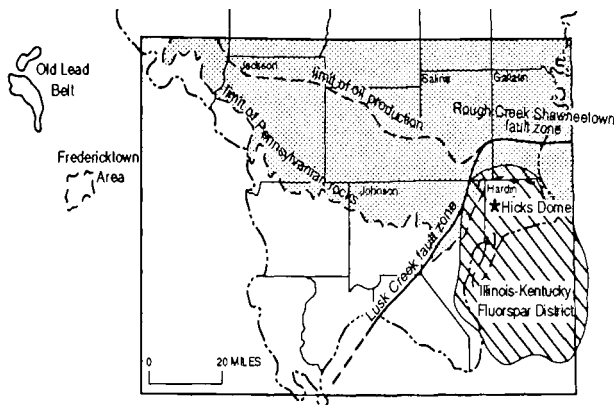


Figure 36. The Paducah quadrangle and related mineral production areas.

The results of the Paducah CUSMAP resource evaluation and related topical studies were presented at a meeting in St. Louis, MO, in January, 1992. Extended abstracts were published as USGS Open-File Report 92-1. This report presents a general overview of the methods and criteria utilized in assessing the economic potential for several of the industrial rocks and minerals.

Production of industrial minerals within the Paducah quadrangle, consisting of sand and gravel, limestone and dolomite, clays, and tripoli (microcrystalline silica), has been, and continues to be, widespread. The CUSMAP assessment, using the Illinois Geographic Information System (IGIS), shows areas of economic interest and promising exploration targets for industrial rocks and minerals. Although historical records of industrial mineral activity are incomplete, it is certain that the cumulative production of industrial minerals from the Paducah quadrangle exceeds hundreds of millions of tons.

The Paducah quadrangle encompasses three distinct structural/sedimentary provinces: the eastern portion of the Ozark Uplift (Ordovician through Devonian bedrock), the southern portion of the Illinois Basin (Mississippian through Lower Permian bedrock), and the northern extremity of the Mississippi Embayment (Cretaceous through Eocene strata). It straddles the northern part of the Reelfoot Rift and its confluence with the western part of the Rough Creek Graben (Nelson, 1992). As an initial part of the CUSMAP project, bedrock and surficial geologic maps of the area were prepared and potential field data (magnetic and gravity) also were compiled and interpreted.

### Bedrock map

The bedrock geology of the Paducah quadrangle was compiled and digitized at a scale of 1:100,000 from photographically reduced quadrangle maps. These included: 1:24,000 quadrangles (69), 1:62,500 quadrangles (6), and other maps at various scales (10). The 7.5-minute geological quadrangles covering all of the Kentucky portion of the Paducah quadrangle and much of the Fluorspar mining district in Illinois, mostly published in the 1960s, were utilized, as were other maps produced more recently. Additional 7.5-minute quadrangles (15), covering the southern portion of the Pennsylvanian rocks in Illinois, have been mapped under the USGS Cooperative Geological Mapping Program (COGEMAP) and have been, or soon will be, published. In Missouri, 7.5-minute quadrangles (29) have been completed in recent years. Mapping at this scale is continuing in both Missouri and Illinois.

### Surficial map

Surficial materials maps provide information on the distribution of near-surface resources such as sand and gravel and some clay deposits, and on the extent and thickness of overburden that must be removed prior to mining resources in bedrock. The surficial deposit maps were prepared in a format adapted from the stack-unit map of Illinois (1:250,000; Berg and Kempton, 1988). A stack-unit map depicts the distribution of surficial and/or bedrock materials in their order of occurrence to a specific depth.

The Paducah stack-unit map (1:100,000) portrays detailed three-dimensional, lithostratigraphy to a depth of 15 meters (about 50 feet) using an array of colors with line and dot patterns (Berg and others, 1992). A total of 132 sequences of materials were differentiated from 14 glacial and semilithified materials and 12 bedrock units. The continuity of major color groups illustrates regional geological provinces within which individual map areas are differentiated. Each color shade group, when combined with a line or dot pattern, represents a unique sequence of surficial geological materials.

## INDUSTRIAL MINERAL ASSESSMENT

Assessment of the potential for the discovery and production of new sources of mineral commodities was made using a digital cartographic technique developed specifically for the Paducah project (Johnson and others, 1992). Industrial minerals geologists from Illinois, Missouri, and Kentucky prepared descriptive models for nine industrial minerals commodities: high-calcium limestone, limestone and dolomite for aggregate, carbonate building stone, common clay, absorbent clay, ball clay, sand and gravel, chert gravel, and tripoli. From the descriptive models, diagnostic criteria for the existence of a deposit were established for each industrial mineral deposit type known or anticipated to be present in the geologic formations of the quadrangle. Some of the criteria chosen for models were directly amenable to conversion to digital map polygons, i.e. they could be areally defined. Other criteria represented point source data that could, by use of buffers, also be areally defined for graphic presentation. The criteria chosen for each commodity were weighted in proportion to their relative importance as indicators of potential, i.e. their suitability to be used to predict the existence of mineral deposit of the specified type. Diagnostic criteria, weights, and buffer zones used in the assessment procedure for high-purity limestone resources are shown in table 11 as an example.

In general, the most important criterion for each model was assigned a maximum weight 10; other less important criteria were assigned lesser values. Buffer zones, representing the possible areas of influence, were chosen for both areally defined and point source criteria and also were assigned lesser values. The resultant mixture of buffered point-source and polygonal diagnostic criteria were then weighted with respect to the significance of each diagnostic criterion.

After digitizing the basic data, GIS techniques were used to provide buffer zones, attribute previously chosen numerical values, and, for each model, to produce the criteria-based data layers that were summed to produce the final assessment model. Three or more layers of buffered and weighted data were summed with the GIS system to produce two dimensional, color-coded mineral potential maps for each commodity. These maps are available from the Illinois State Geological Survey in preliminary form as electrostatic plotter prints.

## Limestone and dolomite

Large quantities of limestone and dolomite suitable for construction, agricultural, and industrial uses are present in rocks of Mississippian, Devonian, Silurian and Ordovician age in the Paducah quadrangle (Baxter and others, 1992). Raw materials currently produced from the Paducah CUSMAP region that were assessed include: 1) high-purity limestone; 2) high-specification aggregate; and 3) lower specification aggregate and commercial limestone and dolomite. There has also been production in the past of rough building stone, dimension stone, and commercial "marble" (polished stone); therefore, the potential for these commodities also was assessed. Present production of crushed stone in the quadrangle is largely for aggregate and cement production.

For the appraisal, a general limestone and dolomite resource map showing the areal distribution of formations composed predominantly of limestone and/or dolomite was prepared and digitized at the scale of 1:100,000. The mapped geologic units were grouped into use categories based on the known or potential suitability of the unit for specific commercial applications. The use category for each unit was determined by past and present performance records of material from that unit, published laboratory tests and similarity to other rock units with a history of extraction and use in or near the Paducah quadrangle. Three separate models were constructed to assess the potential for limestone and dolomite products: high-purity limestone, construction aggregate, and building stone. Diagnostic criteria used for the GIS assessment of the potential for the production of all carbonate rock products in the Paducah quadrangle included: 1) presence of favorable bedrock formations; 2) history of use and production; 3) occurrences



Table 11. Diagnostic Criteria, Weights, and Buffers for High-Purity Limestone Model.  
Age and formation name abbreviations in parentheses.

HIGH PURITY LIMESTONE MODEL		
Diagnostic Criteria	Wt.	Buffer
Favorable stratigraphic units (areally defined)		
Kimmswick (Ok), Salem (Msw), Ste. Genevieve (Msg), Warsaw (Mw), Ullin (Mu)	10 or	
Backbone (Dbb)	8 or	
Glen Dean (Mgd), Golconda (Mg)	4 or	
Okaw (Mok)	2	
	MAX 10	
Occurrences (point locations)		
Quarry site from which high calcium is being produced	5 or	3 miles along strike
Quarry site from which high calcium has been produced in the past.	3 or	3 miles along strike
Quarry site working favorable formation from which high calcium has not been produced	1	3 miles along strike
	MAX 5	
Overburden thickness (areally defined)		
0-20 feet	5	
20-50 feet	3	
>50 feet	1	
	MAX 5	
Explanation M = Mississippian D = Devonian O = Ordovician	TOTAL MAX = 20	

(locations of active and inactive quarries); and 4) thickness of unconsolidated overburden (0-20, 20-50, and greater than 50 feet).

#### High-purity limestone

High-purity limestones are those that, at some places, contain a quarriable/minable section of limestone with a minimum  $\text{CaCO}_3$  content of 95 percent. This criterion is met by at least seven formations with a history of production in or near the Paducah quadrangle. In addition, there are other formations that *may* contain a section of limestone containing a minimum of 95 percent  $\text{CaCO}_3$ .

Potential for high-purity limestone exists in some specific areas, particularly those underlain by the Kimmswick Limestone, the Harrodsburg Member of the Ullin Limestone, and the Ste. Genevieve Limestone. The highest potential for the Kimmswick Limestone is along the Mississippi River, near Cape Girardeau, Missouri, and Thebes, Illinois; for the Harrodsburg Member, in portions of the outcrop belt in Union and Alexander Counties; and for the Ste. Genevieve Limestone, in Hardin County, Illinois, and the adjacent portion of Kentucky.

#### Aggregate resources

The Paducah quadrangle contains resources for the production of concrete or bituminous aggregate material. Quality testing for material to be used in highway construction is generally carried out on a stock pile by stock pile basis and specifications may vary from state to state.

High-specification aggregate in this assessment is a category used to designate stone that generally meets local quality specifications for use in portland cement concrete. Some formations are not thought to be prospective for high-specification aggregate, but are considered to be potential resources in terms of the probability that they contain stone capable of meeting less stringent requirements for lower specification aggregate and for other commercial uses.

The greatest potential for production of construction aggregate in Missouri, especially for the high-specification category, occurs within the outcrop belts of the Platin, Pecatonica, and Joachim

Formations that extend south of the Ste. Genevieve fault zone. In Illinois, primary targets will most likely be restricted to the Ste. Genevieve and Kinkaid Limestones. In Kentucky, the principal sources will continue to be the Ste. Genevieve, Warsaw, Kinkaid, and Salem Limestones and, for uses where a high-silica content is desirable or not detrimental, the Fort Payne Formation.

#### Carbonate building stone

The Paducah quadrangle contains limestone resources suitable for use as building stone, although there is no present production and apparently no well-developed market. Available resources are placed in this category because of past production or their similarity to units outside the quadrangle having a history of use as building stone. Rough-shaped blocks quarried from units of this category have been used in building construction, for flagging, or as rubble.

The Harrodsburg Member of the Ullin Limestone in Union County, Illinois, has been quarried for building stone, utilized as raw material for cut stone and dimension stone, and has been polished and marketed commercially as "marble". Stone from other formations has been demonstrated to take a polish and may also have a place under this category of use.

There are not, at present, any viable markets for production of roughly shaped carbonate building stone nor production of dimension or polished stone. However, extensive areas in Missouri underlain by Ordovician dolomite, and areas in Illinois underlain by Mississippian carbonate bedrock, can provide roughly shaped materials for local use or for restoration of historic structures. The greatest potential for production of dimension stone and polished limestone (commercial marble) lies within the Harrodsburg Member of the Ullin Limestone in Union and Pulaski Counties in Illinois. Limestone, mapped as Warsaw Limestone in fault blocks in the southeast corner of the quadrangle, is lithologically similar to the Harrodsburg Member, but may have fractures and other discontinuities detrimental to use. Portions of the Salem Limestone in southeast Illinois that are nearly black in color, and parts of the Silurian in southwest Illinois that display shades of red, have potential as sources of chips for use in terrazzo floors. Reddish stone from the Silurian has been utilized commercially for this purpose on a small scale.

## Sand and gravel

Sand and gravel deposits suitable for use as certain types of construction aggregate or as a source of quartz sand are locally abundant within the boundaries of the Paducah quadrangle (Masters and others, 1992). Sand and gravel aggregate products are relatively low unit-cost commodities, and markets close to the point of extraction are required to provide profitability and minimize transportation costs. Production is closely tied to the needs of the small population in the area, and, therefore, is correspondingly low. Only high quality sand dredged from the three major rivers is likely to be shipped out of the area to other markets due to easy access to low-cost barge transportation.

The assessment of sand and gravel involves only the location of deposits and their potential. It does not consider legal requirements or current land-use restrictions that may limit or prevent the development of some areas where sand and gravel deposits exist. The sand and gravel resource map, on which the assessments are based, was derived from the surficial deposits map (stack-unit map) and the bedrock geology map prepared for the mineral resource assessment of the Paducah 1°x2° quadrangle. However, the resource map incorporates refinements and revisions based on: 1) the authors' knowledge of the geology of the area; 2) unpublished field notes, reports, and maps; 3) engineering tests, water wells, and other drilling records; 4) modern soil maps and publications by the Soil Conservation Service of the U.S. Department of Agriculture; and 5) published reports and maps of the Kentucky, Illinois, Missouri, and U.S. Geological Surveys.

Diagnostic criteria used in the GIS assessment of potential for chert gravel include: 1) presence and topographic position of potential sources; 2) overburden thickness; 3) thickness of source formation; 4) variation in particle size; and 5) pits and other occurrences. For construction sand and gravel from Pleistocene-Holocene deposits, the diagnostic criteria used are: 1) presence and relative position of source formation with respect to the water table; 2) overburden thickness; 3) deposit thickness; 4) location of pits and other occurrences; and 5) the occurrences of special depositional features affecting quality.

The various types of sedimentary deposits that may contain sand and gravel resources include:

Cretaceous near-shore marine to fluvial-deltaic sand (McNairy Formation) and alluvial-fan chert-gravel (Tuscaloosa Formation); Eocene fluvial deposits (Wilcox and Claiborne Formations); Pliocene-Pleistocene alluvial-fan chert-gravel deposits (Mounds Gravel of Illinois = "Lafayette" Formation of Missouri = "continental deposits" of Kentucky); Pleistocene fluvial sand and gravel (Mackinaw Member of the Henry Formation), lacustrine slack-water deposits (Carmi Member of the Equality Formation), and wind-blown deposits (Peoria Loess); and Holocene fluvial sediments (Cahokia Alluvium).

Within the area of the Paducah quadrangle, Cretaceous and Eocene sands are only known to have been mined for use as fill material. Cretaceous chert gravel was formerly used for railroad ballast, on secondary roads, and for fill. The more widespread Pliocene-Pleistocene chert gravel is commonly used for base construction of paved highways, as secondary road surfacing, and as fill material. None of the gravel in the area meets current specifications for use as aggregate in concrete. On the other hand, sand from Pleistocene-Holocene deposits, especially in-channel sand from the Mississippi, Ohio, and Wabash Rivers, usually does meet specifications for use in concrete. Eolian sand is used as blend-sand in bituminous-based concrete and as fill. Chert gravel in certain creek beds adjacent to areas of chert bedrock is used on secondary roads and as fill.

## Clay and shale

Currently, absorbent clay produced from the Porters Creek Formation for use in pet litter products is the major clay resource within the Paducah quadrangle and has the greatest potential for increased development (Hughes and others, 1992). This clay could be used more extensively in the pet litter markets and in agriculture, as a feed pelletizer and an agrichemical carrier. The Porters Creek Formation and other clays with a high content of expandable minerals (montmorillonite, mixed-layered illite/smectite, or vermiculite) could also be used for covers and barriers in waste disposal or as solidifying absorbents in waste cleanup. Potential resources of high-expandable clays include some Quaternary lacustrine deposits, Quaternary accretion gleys, some clays in the McNairy Formation, and gley-type underclays (mostly below the Herrin and Springfield Coal Members of the Carbondale Formation).

Surficial materials such as loess and noncalcareous lacustrine deposits, ball clays in the Claiborne, Wilcox, and McNairy Formations, Pennsylvanian underclays and shales, pre-Pennsylvanian shales, coal cleaning wastes, Anna ball clays, and hydrothermal clays such as those at the Clay Diggings, Illinois, site can be used for various fired-clay products. The quality and value of fired products ranges from very low for surficial materials to moderately high for ball clays, kaolinitic Pennsylvanian underclays, and coal cleaning wastes. The kaolinitic underclays are mostly found below the Colchester Coal Member of the Carbondale Formation. Most of the clays with potential for fired-clay products could also be used for flux in cement making and some would be kaolinitic enough to produce high-strength cement.

The need for materials to impound wastes is growing. This market growth should add to the value of fine-grained materials in lacustrine deposits, expandable-clay-rich facies of the McNairy Formation, and gley-type underclays, but the overall prospects for new clay products industries in southern Illinois is low, partly because of the relatively low-grade resources and partly due to market factors such as distance from major cities, lack of low-cost fuel, and competition from the nearby Kentucky ball clay district. Mitigating factors favoring development of clay resources in the Paducah quadrangle include low land and labor costs, potential for use of coal and captive natural gas to fire kilns and calciners, and transportation savings to some nearby metropolitan markets.

Waste materials represent possible byproduct market opportunities. For example, moderately large tonnages of clay in the Porters Creek Formation are left unmined due either to color considerations or to unacceptably low absorbent properties. Also, most coal cleaning plants in the region reject kaolinite-rich waste. In addition to the conventional products that could be made from these two wastes, they might also be chemically modified to produce a fine absorbent clay for pelletizing animal feed and/or synthetic zeolites for several markets.

Assessments were produced for four models: 1) absorbent clay; 2) ball clay; 3) underclays and shales; and 4) lacustrine clays. The diagnostic features utilized for each of the four clay models are: 1) distribution of potential sources (host rock); 2) locations of mines, prospects, and informational outcrops and drill holes; and 3) overburden thickness.

## Tripoli (microcrystalline silica)

Tripoli, or microcrystalline silica, has been mined for 80 years in Illinois. More than 2.2 million tons were produced between 1913 and 1989. There are currently two active surface mines and one underground mine in Illinois. Microcrystalline silica products from Illinois are used as fillers or extenders, as abrasives, and in the manufacture of cement. In Missouri, more than 5 million tons were produced as railroad ballast and road metal between 1903 and 1924. Much smaller tonnages were produced through the 1950s, primarily for road metal, with small amounts consumed for ceramics and silica brick. There are not currently any active tripoli mines in Missouri.

Tripoli occurs in two districts in southern Illinois, the Elco district in Alexander and southern Union Counties, and the smaller Wolf Lake district in northern Union County. Tripoli also occurs in Perry and Cape Girardeau Counties, Missouri.

Limestone and dolomite of the Clear Creek Chert of the New Harmony Group (Lower Devonian) has been leached and extensively silicified to form dense to friable microcrystalline silica. Lamar (1953) described the deposits and documented the replacement of a carbonate precursor by silica. Weller and Ekblaw (1940) called upon deep weathering to explain the removal of carbonate, but Berg and Masters (in press) have documented fluid inclusion homogenization temperatures of about 200°C from silica overgrowths of quartz crystals. They also noted that the deposits are spatially related to positive magnetic anomalies and concluded that the silicification and removal of the carbonate may be hydrothermal.

The tripoli, or microcrystalline silica, ore deposit model is comprised of three diagnostic criteria: 1) occurrence of tripoli or microcrystalline silica; 2) favorable host rock, i.e., the Clear Creek Chert; and 3) post-Precambrian magnetic anomalies representing igneous (alkalic?) plutons (Eidel and others, 1992).

The occurrence of tripoli, or microcrystalline silica, is a direct indicator of tripoli mineralization and was accorded the highest weight. Favorable host rocks were given less weight and the indirect spatial relationship of positive magnetic anomalies the least weight. Tripoli occurrences were buffered with a one mile radius.

The resultant model defines discrete areas in which to conduct further exploration for tripoli. The three diagnostic criteria result in seven combinations, ranked in order of increasing exploration potential, with tripoli occurrence plus favorable host rock plus positive magnetic anomaly being the highest and positive magnetic anomalies alone being the lowest. The model, which utilizes only three diagnostic criteria, provides a simple example for demonstrating the utility of the GIS system in analyzing more complex hydrothermal ore deposit models.

Future exploration for tripoli should focus on prospecting for tripoli both within these districts and in areas of prospective host rock that overlie positive magnetic anomalies. Special attention should be paid to massive chert beds such as those at the top of the Clear Creek Chert; such beds may be in part siliceous sinter and near-surface silica replacement and, thus, represent previously unrecognized hydrothermal activity.

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## DEFINING INDUSTRIAL MINERAL RESERVES: COMMON AND SUBTLE PROBLEMS<sup>1</sup>

By David A. Holmes and David M. Abbott, Jr.<sup>2</sup>

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Industrial minerals are market driven rather than price driven. Thus, the approach taken in evaluating or verifying reserve information on industrial mineral deposits differs from the approach usually taken with most metal deposits where market issues are not usually a problem. In defining reserves of industrial mineral deposits, consideration of marketability and related factors is generally more important initially than determining tonnage, grade, cost, and commodity price. Unlike metals ventures, industrial mineral deposits with favorable size, grade, and extraction costs may be valueless for lack of appropriate market, existence of an established competitor, or other, sometimes subtle, reasons.

Evaluation of an industrial mineral deposit should be approached more as a fatal flaw study than as a verification exercise. One fatal flaw or weak link will doom a deposit's economic viability regardless of the favorability of all other data and considerations. Most potential problems related to reserve calculation in industrial minerals are caused by sampling errors, geological errors, modelling errors, mining or process engineering errors, and/or market evaluation errors. Industrial mineral deposits with multiple "ore" minerals pose particular problems in reserve definition, as do deposits in which the same mineral is used for a wide variety of applications (*e.g.*, kaolin and limestone). The effect of contaminants as well as confusion of quality and grade are common problems.

The U.S. Securities and Exchange Commission defines reserves as, "That portion of a mineral deposit which could be economically and legally extracted at the time of determination." Also, the SEC recognizes only the "proven" and "probable" reserve categories, disallowing the "possible" category as too speculative; a policy following formal industry definitions. More important than the wording of particular definitions is the data required to support the conclusion that reserves exist. Statements that reserves exist on a particular property must be supported by appropriate geologic, mining, processing, economic, and other studies, collectively known as the feasibility study, which demonstrate with a reasonable degree of assurance that the deposit(s) can be profitably mined.

Different groups with differing responsibilities require reserve, exploration, or in-place tonnage data for varying reasons related to their roles in developing or evaluating deposits. Operating personnel in different departments, business managers, financial analysts and lenders, and tax and regulatory agencies have differing needs for information based on a common geological and engineering data base. The needs and knowledge level of these various user groups should be considered during evaluation and reporting of industrial mineral deposits.

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<sup>1</sup> This abstract was presented as a poster display at the conference in Minneapolis. The abstract was received too late to include in the Program with Abstracts volume, U.S. Geological Survey Open-File Report 92-514.

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<sup>2</sup> Mr. Abbott's views are his own and do not necessarily reflect the views of the U.S. Securities and Exchange Commission or other members of its staff.

**ILLINOIS**  
**INDUSTRIAL MINERAL INFORMATION AND REGULATION**

compiled by

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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    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: Donald F. Oltz  
(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

John M. Masters (Statewide)  
(217) 244-2516

Fluorspar and Related Minerals

John M. Masters  
(217) 244-2516

**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 West Jefferson Street  
Suite 300, P.O. Box 10137  
Springfield, IL 62791-1137  
(217) 782-6791

**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 East 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. Department 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. Department of Labor  
Mine Safety and Health Administration  
Metals and Nonmetals  
Illinois Valley Office  
2200 Marquette Road  
Peru, IL 61354  
815-223-0697  
(office covers the area for northwest Indiana)

Tom Anderson  
U.S. Department of Labor  
Mine Safety and Health Administration  
Metals and Nonmetals  
Federal Building, Room 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, 109D	Assignment 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 West Main Street, 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 Department 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  
P.O. Box 59  
Louisville, KY 40201  
Attention: ORLOP-FP  
(502) 582-6461  
(southern two-thirds of Indiana)

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

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

Wetlands (see addresses above)

U.S. Army Corps of Engineers  
Indiana Department of Environmental 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 Department of Natural Resources  
Division of Oil and Gas  
309 West Washington Street, Suite 601  
Indianapolis, IN 46204  
(317) 232-4055

Transportation/road construction:

Indiana Dept. of Transportation  
Permit Section  
State Office Building, Room 1108  
100 North Senate Avenue  
Indianapolis, IN 46204  
(317) 232-5436

Building Codes:

Indiana Department of Fire and Building Services  
Attention: Plan Review  
1099 North Meriden Street, Suite 900  
Indianapolis, IN 46204  
(317) 232-6385

Internal Revenue Service:

Indiana Department of Revenue  
Central Registration Section  
208 State Office Building  
100 North Senate Avenue  
Indianapolis, IN 46204  
(317) 232-2240

**INDIANA**  
**INDUSTRIAL MINERAL REFERENCE LIST**

1. List of Publications:

Publications Section  
Indiana Geological Survey  
611 North Walnut Grove Avenue  
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 North Walnut Grove Avenue  
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  
government activities

Kevin Geier  
Indiana Department of Natural Resources  
Division of Reclamation  
201 West Main Street, 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 North Walnut Grove Avenue  
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 West Main Street, 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 South 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 Department of Natural Resources  
Division of Water  
2475 Directors Row  
Indianapolis, IN 46241  
317-232-4160

## 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  
P.O. 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 South Harrison Road  
East Lansing, MI 48823  
(517) 337-6701  
(to obtain county soil survey maps and reports)

Planning and Zoning Center, Inc.  
302 South 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.

## 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  
P.O. 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)

**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 East Boulevard Avenue  
Bismarck, ND 58505-0840  
(Tel. 701-224-4109)

Contact: John P. Bluemle, State Geologist

North Dakota Soil Conservation Committee  
608 East Boulevard Avenue, 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 East Boulevard Avenue  
Bismarck, ND 58505-0187  
(Tel. 701-224-2752)

U.S. Army Corp of Engineers  
North Dakota 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:

North Dakota Department of Health  
and Consolidated Laboratories  
1200 Missouri Avenue  
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 East Divide Avenue  
**mailing address**  
600 East 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 East 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 East Boulevard Avenue  
Bismarck, ND 58505-0187  
(Tel. 224-2752)

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

## 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 determined 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 fig. 37):

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

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

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

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

Ohio EPA  
Southwest District Office  
40 South Main Street  
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.

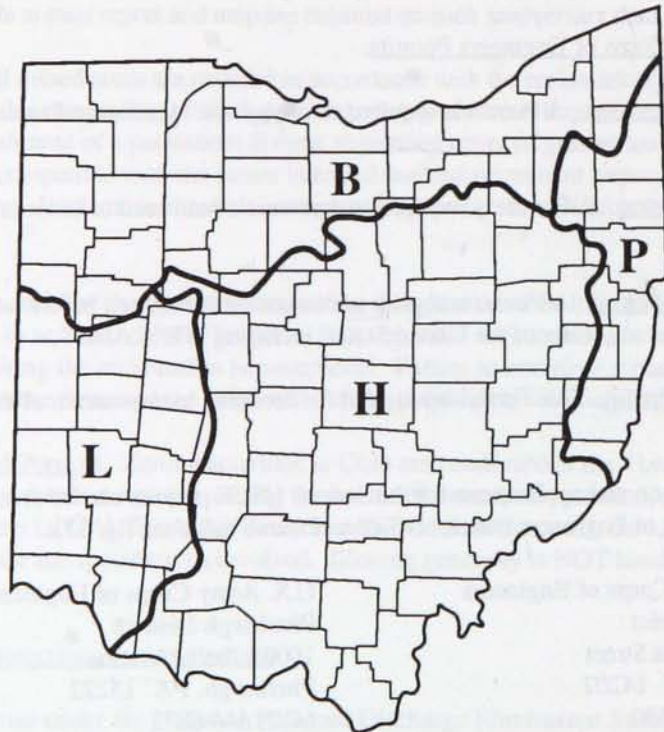
Information on and applications for the various USCE permits can be obtained from the appropriate U.S. Army Corps of Engineers District Office as follows (also see fig. 37):

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

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



**Ohio EPA Districts**



**U. S. Corps of Engineers Districts**

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

Figure 37. EPA and U.S. Corps of Engineers Districts in Ohio.

U.S. Army Corps of Engineers  
Louisville District  
Attention: 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 Street  
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, Building 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, Building 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 and Health Administration  
Metal and Non-Metal Section  
2035 Reddington Road  
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 Avenue  
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:

<u>Commodity</u>	<u>¢/ton</u>
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  
Attention: Excise Tax and Assessment Unit  
P.O. Box 530  
Columbus, OH 43266-0030  
(614) 466-7026

## OHIO

### INDUSTRIAL MINERAL 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 Drive  
P.O. Box 1049  
Columbus, OH 43266  
(614) 644-3020

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

Ohio Department of Taxation  
Attention: 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 Street  
Columbus, OH 43266-0334  
(614) 644-7054

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

**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 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 mine site.
- 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 mine site.

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

Office of Minerals and Mining  
South Dakota 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  
P.O. 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

**WISCONSIN**  
**INDUSTRIAL MINERAL INFORMATION AND REGULATION**

compiled by

Bruce A. Brown and Thomas J. Evans  
Wisconsin Geological and Natural History Survey

Pertinent legislation and permitting procedures in Wisconsin.

**1. Responsible State Agencies:**

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

Department of Industry,  
Labor, and Human Relations  
Division of Mine Safety  
201 East 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, Wisconsin Statutes, 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 activities 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, Wisconsin 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, Wisconsin Administration 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 MINERAL REFERENCE LIST

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 West Washington Avenue  
Madison, WI 53703  
608-266-1018

Wisconsin Manufacturers and Commerce (Private)  
501 East 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 South Webster Street  
Madison, WI 53703  
608-267-3579

## **SOLID-MINERAL LEASES ON INDIAN LANDS**

By Richard Wilson<sup>3</sup>

### **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.

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<sup>3</sup> Bureau of Indian Affairs, Division of Energy and Mineral Resources 730 Simms, Room 239, Golden, CO 80401, (303) 231-5070, FAX (303) 231-5085.

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.









