The Meaning of Scarcity in the 21st Century: Drivers and Constraints to the Supply of Minerals Using Regional, National and Global Perspectives

Volume IV

Sociocultural and Institutional Drivers and Constraints to Mineral Supply

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The § indicates that the source is an Internet site, the citation for which is located in the sub-section “Selected Internet References” within the sections “Selected References”.

Abstract

The sociocultural dimensions of mineral supply at the outset of the 21st century are making the supply process increasingly complex. The dimensions encompass legal, financial, environmental, cultural, and global implications of mining, and are driving unprecedented change in the way minerals supply will be accomplished in the future. Minerals scarcity on a global scale is subordinate to other societal issues about mineral resources and reserves estimated to meet society's demands for decades to centuries in the future.

This report reviews historical and present-day sociocultural drivers of change, and reactions of the minerals industry to these drivers. It is reflective primarily of conditions in the United States, but also uses examples from other countries. It expresses viewpoints on sociocultural drivers as seen by constituents of the minerals industry and several other communities of interest including Aboriginal peoples, non-government organizations; labor; mining-dependent communities; mining-affected communities; researchers; and government (federal, state/provincial, and local). It provides overviews of the demand for minerals in the United States, and the status of land available for mining. The report uses a case study of a metals mining project in Wisconsin to illustrate specific sociocultural drivers and constraints to minerals supply, and how these influence the minerals industry.

Over the past 150 years, a progression of sociocultural movements under the headings of conservationism, environmentalism, and sustainable development have nurtured societal values that have come to influence the mineral supply process in important ways. These movements reflect a continuing tension between the demand for minerals and other resources, and the simultaneous demand for aesthetic, spiritual, ecological, cultural, and other attributes of the land. The tension is an important element in current international debates about the meaning and future of sustainable development. This report focuses on some of the social challenges to the minerals industry to supply minerals, while at the same time providing environmental protection, economic growth, and sociocultural acceptance. All these issues fall under the rubric of sustainable development. It also describes current industry responses to sustainability, including the Global Mining Initiative (2001a§), an attempt to introduce major changes in global industry practices to begin the 21st century. This report complements other documents in the series on physical supply, technological advancement, and economic and policy drivers (Wilburn and others, 2001§).

Introduction to the Series by Eric E. Rodenburg

The possibility of future mineral scarcity is an important concern of environmental activists, those desiring to limit population growth, and those concerned with wealth distribution between industrialized and developing countries. Through the years, observers from Thomas Malthus (1798) to the 1972 Club of Rome (Meadows and others, 1972), for example, predicted exhaustion of resources at various dates, most of which have come and gone without the dire consequences of societal collapse they envisioned.

The static model from which these predictions came continues to inform many who choose to believe that mineral production cannot meet the material aspirations of a rapidly growing world population if consumption of some resources continues to increase. The perception of future scarcity, for example, motivated the Factor Ten Club, a group of resource economists, to issue the Carnoules Declaration in 1994 and 1995. The Declaration called for a swift 10-fold increase in material efficiency among industrialized countries to free materials for people in developing countries (Factor 10 Club, 1995).

The concerns of future scarcity may in part be caused by misinterpretation and (or) the misuse of published mineral reserve estimates for non-fuel mineral commodities. A reserve is that part of an in-place demonstrated resource that can be economically extracted or produced at the time of estimation (U.S. Bureau of Mines and U.S. Geological Survey, 1980). Some misinterpret the term "reserve" as an estimate of all that is left of a resource.

Mineral supply starts with the physical existence of materials, and can be no greater than its occurrence in the Earth's crust. The amount of material actually supplied to society (economic supply) is that which is called forth by demand (willingness-to-pay), as moderated by the cost of production, which is influenced by physical realities, technology, politics, and social concerns.

In fact, many of the minerals that the Earth's population demands exist in nearly inexhaustible amounts. Additionally, there is an enormous stock of resources in materials in-use (machinery, buildings, and roads) and in unutilized waste (landfills). There is, however, a growing understanding that physical scarcity is not the only, or even the most, important issue. Industrial activities extract and transform resources into products people use. In many cases, these activities come with direct or accumulative environmental consequences that can pose serious threats to ecosystems and human health. Thus, the important issue of scarcity may be the capacity of Earth's geologic, hydrologic, and atmospheric systems to assimilate the wastes (Meadows and others, 1972).

This series, "Scarcity in the 21st Century", addresses resource constraints and opportunities, and the effects of their interactions on resource supply. Assessing potential supply requires a whole systems approach, both in physical terms by looking at the flows of materials through the economy, and in human terms by integrating the interactive domains of economics, environment, policy, technology, and societal values.

In 1929, D.F. Hewett, of the United States Geological Survey (USGS), reflecting on the effects of war on metal production, identified four factors he deemed most important in influencing metal production (Hewett, 1929).

1. Geology

"First, there are the geological factors, which are concerned with the minerals present; their number and kind, which determine whether the problem of recovery is simple or complex; the degree of their concentration or dissemination; their border relations; the shape and extent of the recognizable masses."

2. Technology

"Second, there are the technical factors of mining, treatment and refining. A review of these leaves a vivid impression of the labor involved in their improvement but they necessarily yield cumulative benefits."

3. Economics

"The third group of factors that affects rates of production are economic, and among these factors cost and selling price are outstanding... Since 1800 the trend of prices for the common metals, measured not only by monetary units but by the cost in human effort, has been almost steadily downward…"

4. Politics

"The fourth group of factors that affect metal-production curves are political or lie between politics and economics."

The four factors do not operate separately, but rather as parts of an integrated system, which also includes social constraints and drivers such as environmental issues and the structure of the mining industry.

“Scarcity in the 21st Century” is composed of six chapters to be published in a series of USGS Open File Reports and then compiled as a USGS Circular.

Chapter 1: “The Supply of Materials” examines the physical supply of minerals on the planet, in the ground and products-in-use, waste streams, and waste deposits (landfills). Current and future potential for recycling of products-in-use and landfill materials are examined.

Chapter 2: “Economic Drivers of Mineral Supply” explores price, investment, costs, and productivity, and their relevance to supply.

Chapter 3: “Technological Advancements – A Factor in Increasing Resource Use” investigates the impact of technological change on mineral extraction, processing, use and substitution.

Chapter 4: “Sociocultural and Institutional Drivers and Constraints to Mineral Supply” addresses social realities that affect mineral supply, nationally and globally, and the sociocultural trends that promise to have an impact on future supplies.

Chapter 5: “Policy – A Factor Determining the Parameters of Minerals Supply and Demand” examines the effect of government policies that either promote or restrain mineral development, some of which include: access, title, regulation, rent, royalty, and tax fees, and direct and indirect subsidies. This volume also discusses the affects of corporate policies on mineral supply.

Chapter 6: “Overview of Minerals Supply” presents an overall view of these parameters of supply to show their synergy in supply and ultimately production.

Each chapter contains ample reference to historical information about one or more commodities to illustrate the concepts.

Introduction to This Volume: The Scope of Social Realities

Sociocultural trends at the beginning of the 21st century are making the concept of mineral supply increasingly more complex. Whereas technological advances in mining and processing mineral materials continue to expand the services of minerals to meet human demands, competing sociocultural forces are having powerful influences on the processes of supplying minerals to meet these demands. Typical issues facing mineral suppliers throughout the world comprise numerous social and environmental concerns that tend to alter or inhibit the manner in which exploration and mining have been traditionally conducted.

Balkau and Parsons (1999, p. 1) offer examples of major issues facing mining (p. 10, this volume). The commentary suggests that there is a fast-moving environmental agenda driving attention to the issues, and that the agenda is a composite of environmental, technical, and socioeconomic trends that are global in scope. The spirit of this agenda is partly encapsulated in the idea of sustainable development, originally designed as a policy option of the United Nations (World Commission on Environment and Development, 1987), and debated, expanded and refined throughout the world since that time. Because the idea of sustainable development is now so widespread among governments, international organizations, nongovernment organizations (NGOs) and others, it has come to be a major factor that could affect mineral production.

AN OVERVIEW OF THE INTERNATIONAL ENVIRONMENTAL AGENDA FOR MINING

Not only is the environmental agenda moving, but it is also moving fast. The following list includes the major environmental issues for mining as seen in 1999 by the United Nations Environment Programme:

- ***Destruction of habitat and biodiversity at the mine site***
- ***Ecosystem/habitat/biodiversity protection in adjacent land***
- ***Landscape/visual impact/loss of land-use***
- ***Site stabilization and rehabilitation***
- ***Mine waste/tailings disposal***
- ***Sudden failure of tailings facilities***
- ***Abandoned equipment, solid waste, sewage***
- ***Air emissions***
- ***Dust***
- ***Climate change***
- ***Energy consumption***
- ***Siltation and changes in river regimes***
- ***Effluent discharges and acid drainage***
- ***Groundwater alteration or contamination***
- ***Hazardous wastes and chemical residues***
- ***Hazardous chemicals handling, safety, workplace exposure***
- ***Noise***
- ***Radiation***
- ***Workplace health and safety***
- ***The impact of metals toxicity on the marketing of metals***
- ***Cultural and archaeological values***
- ***Public health and urban settlement issues around mines***

-- Balkau and Parsons (1999, p. 1).

Major sociocultural trends affecting mineral supplies include increasing access to global communications and transportation for a vast number of people, and a proliferation of nongovernmental organizations (NGOs) that effectively shape public opinion. The recent and worldwide ascendancy of NGOs that are critical of mining, together with the communications resources provided by the Internet, allows global monitoring of mining and rapid distribution of potentially negative information. This means that far greater numbers of even the less attentive public now visit, read about, or view today's mining activities (or the consequences of mining tens to thousands of years ago) and form immediate opinions about mining. Mining at the outset of the 21st century, to an extent unprecedented in human history, is seldom isolated from public scrutiny and more open than ever to public perceptions that are often negative.

Sociocultural drivers reside in human beliefs and values that often take precedence over the physical facts of mineral supplies and demands that include, for example, the quantities of materials in the Earth's crust and the water-quality and other physical expressions of mining. This discussion attempts to examine mineral supply in a way that goes well beyond its physical and economic dimensions. Here the focus is on social realities, both nationally and globally, that have influenced mineral supply in the past, and some sociocultural trends that promise to have an impact on future supplies. This is no simple task, as sociocultural issues are both rapidly changeable and virtually boundless. Additionally, the discussion surrounds differences between individuals and organizations in communicating about sustainable development and environmental issues connected with mineral supplies. The worlds of geology, mining, and mineral economics, for example, come with concepts and vocabularies that are typically unfamiliar to, and easily misinterpreted by groups like NGOs, policymakers, indigenous peoples, and the general public. The worlds of ecology, preservation, and sustainable development also come with domains and expressions that can be alien to these same groups as well as to members of the mining and minerals community.

Other reports in this series discuss nonfuel minerals, and exclude, for example, coal, oil, and gas. However, for thoroughness and perspective, this volume goes beyond distinctions about types of minerals and even about the specific activity of mining. Sociocultural perspectives on mining commonly do not distinguish among practices used to mine different kinds of minerals, and often focus on activities ancillary to mining itself. For many people, disrupting the land surface for minerals extraction in many cases is not appreciably different from actions taken in other types of extractive and industrial practices. Critics of these practices focus on the negative aspects of noisy machinery, roadbuilding, removing surface vegetation and soil, excavating and displacing bedrock, creating impervious surfaces, altering local hydrologic systems, generating wastes and pollution, fragmenting or obliterating the pre-existing ecosystem, and potentially transforming the local social and cultural tapestry. Case studies on the Crandon Project in Wisconsin (Appendix A.) and aggregate supply and demand in the mid-Atlantic United States (Robinson and Brown, 2002§) serve to illustrate how these aspects are viewed and how they influence the complex sociocultural dimensions of obtaining and ensuring mineral supplies.

Debates about mineral supplies also have many parallels to debates about scarcity or abundance of other renewable and nonrenewable natural resources. For example, significant findings (Rock, 2000; U.S. Geological Survey, 1998) about water use, water scarcity, and the intensity of water use as economic development proceeds could provide valuable insights into understanding similar issues about minerals and other resources. In addition, the discussion in this document occasionally touches on issues of resource extraction for materials like wood and water, particularly where these issues help illuminate the reasons why people accept or resist mineral extraction.

Given a wide diversity of opinion and political action, not all lands rich in resources are available for mining, logging, and similar activities. Thus, investigators cannot afford to look at resource supply and environmental quality in isolation from the physical and social systems of which they are a part. This report draws from many sources to examine aspects of the changing nature of minerals supply, competing sociocultural views about supply and demand, and commentaries on the ethics, aesthetics, theology and other facets of obtaining the minerals demanded by modern society.

This report briefly reviews conservation and environmental movements in the United States and elsewhere to provide background about social values that potentially affect mineral supply. It treats the evolution of ideas about creating a transition to sustainable development, and refers to practices such as industrial ecology and cultural phenomena like globalization that potentially influence the role of minerals in sustainable development. It reviews current and projected minerals demand in the United States, and assesses the status of land available for mining. It examines the mining industry's response to the sustainability transition, and offers case studies to help illustrate what society is asking of the industry in terms of mineral supplies, environmental protection, and social values, and what the industry is requiring of itself at the outset of the 21st century.

Conservation and Environmentalism: 150 Years of Changing Values

The concepts of conservationism and environmentalism have evolved over many years (Kovarik, 2000§) to have important impacts on national and global social policy at the outset of the 21st century. Particularly, values arising from conservationism and environmentalism have strongly influenced both the policies applied to resource extraction and the practices of those who supply the resources society demands. These values have changed over time from minor public skepticism about the effects of garnering resources to widespread disapproval over any actual or imagined harmful impact on the environment (Marcus, 1997, p. 35). The results, particularly by the later years of the 20th century, have manifested themselves as entrenched differences of opinion throughout society about the nature of activities (mining, logging, fishing, manufacturing, agriculture) that provide the fundamental materials and sustenance that humans either require or would like to have. Much of the conflict arises because beliefs about what constitutes conservation or environmental protection are elusive. Moreover, the full dimension of the human relationship with the environment remains under intensive scientific scrutiny, and has yet to be fully understood in terms of such contemporary issues as greenhouse gases, biodiversity, and the capacity of the environment to assimilate anthropogenic wastes.

The environmental movement of the 1960s to the 1990s arose from a conservation movement manifested in the United States in the latter half of the 19th century (The Library of Congress, 2001§; Kovarik, 2002§). Hague (1977§) suggests: "If the first phase of American history, in which a dominant theme was the advance of the frontier, ran from 1607 to 1890, the second phase began with the emergence of the conservation movement which would lead to the alteration of fundamental attitudes toward the land nurtured during the first phase." Those fundamental attitudes included the assumption by frontiersmen that the American West contained inexhaustible resources. Hague (1977§) refers to two factions of the conservation movement. One was a refinement of the frontier view of exploitation described as promoting "utilitarian conservation" that "…advocated the careful use of finite resources, without rejecting the basic assumption that the resources were there to be exploited." The other faction, described as advocating "aesthetic conservation," argued for preservation of natural land for its own sake and for public enjoyment. This group's activities led to measuring environmental values in other than strictly economic terms, and to the establishment of national and state parks, monuments, and wilderness areas. The full expression of a conservation movement, attributable to the powers of persuasion of leaders over the years like George Perkins Marsh, John Muir, Gifford Pinchot, and John Wesley Powell (Marcus, 1997, p. 12) set the stage for land-use policy conflicts that have remained on the nation's political agenda throughout the past 100 years. A subsequent section of this report (p. 47, this volume)

reviews some of the conflicts that have evolved since the onset of the conservation movement regarding the purpose and use of national lands, and what these portend for future mineral supplies on such lands.

The changes in human and social values engendered by conservationism and environmentalism over the past 150 years are pronounced. Trends in changing values are exemplified by the eras defined for the evolution of the U.S. Forest Service that include 1905 through 1945 as the "Forest Protection Era," 1946 through 1969 as the "Managed Forest & Multiple Use Era," and 1970 through 2001 as the "Environmental & Ecological Era" (USDA Forest Service, 2001§). Concepts that once seemed extraordinary, such as environmental protection, are now commonplace in societal institutions. New concepts such as responsible consumerism, environmental justice, intra- and inter-generational equity, and sustainability are now prominent in international debate. Shabecoff (2000, p. 5) noted for the United States: "Public concern for the environment became a flood that could not be contained…(on Earth Day, April 22, 1970) environmentalism emerged for the first time on the national stage as an unmistakable mass movement." Particularly during the years since 1970, the strength and evolution of environmental values has fueled the growth of environmental protection policies throughout the world. These policies are evidence that at least some form of environmentalism is now strongly imbedded in many parts of global culture. In the United States, for example, most Americans consider themselves to be environmentally aware, and attention to environmental issues is unprecedented (Danni, 1997, p. 719). As humanity enters the 21st century, the right to a healthful environment is becoming more and more central to global values.

Environmental concerns can be important drivers of national and global economies as well as international diplomacy. In many cases, environmental drivers of international relations have come to be as influential as the traditionally dominant activities, such as diplomacy related to military security issues (Brown and others, 2000, p. 28). For such reasons, environmentalism continues to grow and change as part of broader unifying visions (such as sustainable development) to confront global challenges (p. 22, this volume). Shabecoff (2000, p. 10) asserts:

> "In the 20th century, environmentalism provided an intellectual and ethical context that enabled Americans, and people in much of the rest of the world, to see the harm that human activity was inflicting on the natural world. It established a legal and institutional infrastructure to help them come to grips with these ills and enlisted an army of activists, governmental and nongovernmental, at the local,

> national, and international levels, to work on solutions. An esoteric enthusiasm for a small elite at the beginning of the century, environmentalism had been transformed into a planet-wide value by its end."

One of the appeals of environmental values lies in the idea that the environment cannot be viewed as some sort of medium that is separate from human life. As John Muir (1869) wrote, "When we try to pick out anything by itself, we find that it is bound fast by a thousand invisible cords that cannot be broken to everything in the universe." Shutkin (2000, p. 126-141) uses the term "civic environmentalism" to describe the emerging model of social and environmental activism for the 21st century. Whereas environmentalism of the past few decades has concentrated on specific media or pollutants, civic environmentalism treats overall health and quality of life in a combination of social, economic, and environmental terms. The vision is one of sustaining – and increasing – the health and quality of life of communities over time. Civic environmentalism tends to imply that communities and society in general will come to understand and appreciate the demand for resources together with the consequences of extracting resources. In concert, extractive industries will engage society using ecological thinking while offering a more holistic approach to their work and its impacts. Shutkin (2000) describes a model that encompasses six principles described as a framework for moving towards sustainability (p. 16, this volume).

Civic Environmentalism: A Framework for Moving Towards Sustainability

"Environmentalism is evolving from an essentially elitist movement accompanied by a complex system of laws and policies fixated on preserving undeveloped land and resources and controlling pollution from major sources to a more democratic call for healthy, sustainable communities across geographic, economic and cultural lines. Instead of merely reacting to environmental changes and decrying the pollution and waste generated by our liberal capitalist economy, an expanding environmental constituency is devising alternatives to traditional approaches to economic development and environmental protection. One need only look at the host of environmental initiatives launched in the 1990s, and the emergence of a new field of design and engineering called industrial ecology to see the transformation. In their best light, these and other initiatives are aimed at not only cleaning up the nation's air, water, and soil, but making American communities more livable and the economy more sustainable."

"I call this new approach civic environmentalism because it marries a concern for the physical health of communities with an understanding that part and parcel of environmental quality is overall civic health."

"***At the heart of civic environmentalism are six core concepts that provide a solid theoretical framework: 1) Democratic process – engaging a critical mass of stakeholders united by place and time in the project of rebuilding and communities' social, economic and physical fabric; 2) Community and regional planning – integrating law, science, fiscal policy, governance mechanisms, and civic will in systems-oriented environmental strategies; 3) Education – building greater awareness among citizens of the environmental and social costs of their actions ('environmental literacy') and enlisting them in the process of identifying and remedying environmental harms; 4) Environmental justice – embedding in all environmental strategies a concern for lower-income people and communities of color, who have been disproportionately burdened by environmental harms in the past and must be directly engaged in environmental decisionmaking; 5) Industrial ecology – the principles of pollution prevention and sustainability as applied to the design and production methods of firms and to economic development generally and the theoretical framework for what ecoarchitect Bill McDonough (1992§, 1998§) and others are calling the next industrial revolution; and 6) Place – the physical and emotional space we occupy that inspires civic action." (Shutkin, 2000).***

In another view of evolving environmentalism, Mol and Sonnenfeld (2000) describe five clusters of roles of social and institutional transformations as superior to physical improvements in ecological modernization. They see science and technology valued for their actual and potential role in curing and preventing environmental problems. Here, science and technology move beyond traditional remediation measures to preventive socio-technological approaches that incorporate environmental considerations from the design stage of projects. They emphasize the increasing importance of market dynamics and economic agents (such as producers, customers, consumers, credit institutions, insurance companies and others) as carriers of ecological restructuring and reform. They foresee transformations in the role of the nation-state wherein less centralized, more flexible and consensual styles of governance emerge, with less top-down, national command-and-control environmental regulation. This allows the private sector and nongovernmental entities to assume traditional administrative, regulatory, managerial, corporate, and mediating functions of nation-states in environmental matters. Here, there is an opportunity for supra-national institutions such as global mining companies to take on a major role in environmental reform. Mol and Sonnenfeld (2000) also acknowledge the power of social movements that sway public and private decisionmaking institutions regarding environmental reforms. Whereas environmental movements once were limited to the periphery or the outside of such institutions 20 to 30 years ago, they are embedded in these institutions at the outset of the 21st century. Moreover, environmental movements continue to change their own ideologies and strategies as they themselves influence and are influenced by the societies they occupy. Finally, Mol and Sonnenfeld (2000) argue that complete neglect of the environment and the fundamental counterpositioning of economic and environmental interests are no longer accepted as legitimate positions. Instead, they claim that intergenerational solidarity in dealing with the sustenance base has emerged as an undisputed core principle.

The United Nations Environment Programme (UNEP) acknowledges that strong environmental laws and institutions have been developed over the past few years in almost all countries (UNEP, 1999a). The most prominent policy instrument is command-and-control policy using direct regulation (Oates, 1999). UNEP (1999a) states:

> "In most regions, such policies are still organized by sector but environmental planning and environmental impact assessment are becoming increasingly common everywhere. While most regions are now trying to strengthen their institutions and regulations, some are shifting towards deregulation, increased use of economic instruments and subsidy reform, reliance on voluntary action by the private sector, and more public and NGO participation. This development is fed by the increasing complexity of environmental regulation and high control costs as well as demands from the private sector for more flexibility, self-regulation and cost-effectiveness."

Elements such as community-based efforts, deregulation, self-regulation by the private sector, and increasing public and NGO participation in environmental management suggest continuing efforts toward balancing human demands and environmental quality. However, these elements also can increase the complexity of environmental requirements at the local level, and sustain continuing shifts in government strategies toward environmental protection. Steelman (in press) notes the proliferation of expanded community influence on environmental management in the United States in the last 10-20 years "…against a backdrop of changing societal perceptions of the environment, mounting frustration with traditional environmental regulatory approaches and increasing favor for decentralized policy solutions." Steelman questions whether such efforts offer advantages over traditional command-and-control regulation, whether they offer clear improvements in environmental quality, and whether they undermine the statutory framework under which environmental gains have been made. Part of the problem arises from communities taking into consideration a wide variety of values, and failing to prioritize one value above all others in terms of a decision, for example, to mine or not to mine an ore deposit (Appendix A.). Thus, when mining companies involve local citizens and NGOs in mine planning and permitting, the process could be as difficult and the outcomes as uncertain as those obtained engaging a state or national regulatory situation. Further, the global trend in adopting permitting procedures through environmental laws, regulations, voluntary standards, and engagements with local communities and NGOs is similar to the practices applicable to mining operations in the United States (Marcus, 1997, p. 6). This trend reflects an ongoing move toward global environmental standards that are likely to be the focus of those concerned with mineral supplies for the foreseeable future.

Trends in societal values regarding conservation and the natural and human environment have progressively influenced the manner in which extractive industries supply the materials people demand. In the United States, especially from the mid-1800s to the present day, these trends have spawned a succession of national policies born of concerns for the environment, human health, and safety (Goonan, in press). These policies generally are intended to preserve natural and cultural features, and place restrictions on the use or contamination of land, water, and air. They range, for example, from setting aside forest reserves in 1891 (USDA Forest Service, 2001§) to establishing liability for adverse impacts to the environment from development projects in 1980 (CERCLA, 2000§). Concomitant with the objectives of preservation and protection are prohibitions on a variety of land uses, including extractive activities and other development on certain lands such as national parks and monuments (p. 49, this volume).

Throughout the course of implementing these policies, extractive industries have been required to implement pollution control and other environmental protection practices, sometimes at significant financial cost. Murray (1997) argues that, for the mining industry, the direct and indirect costs of environmental compliance have resulted in smaller mining companies being forced out of business, larger companies increasing operations in other countries, and the United States becoming more dependent upon foreign sources of minerals. For mining within the United States, local entities are gaining substantial control over resource development, and mining companies must involve local citizens to a greater extent to develop mineral resources (Marcus, 1997, p. 6).

Whereas these problems do not necessarily curtail minerals supply, they could impose greater costs on the industry that in turn could be passed on to society at large.

Environmentalism, despite a constantly changing agenda and much uncertainty in interpreting environmental information, continues to reflect a strong and influential set of values. In addition, these values continue to have important influences on political and economic power because they have become imbedded in the sustainable development movement of the early 21st century.

Trends and Resolutions for Environmental Issues in Mining

"These (environmental issues for mining) do not appear from nowhere. The environmental agenda cannot be seen in isolation from technical and socio-economic trends. There are many stakeholders involved in defining the agenda, including business, NGOs (in response to community concerns, and also for their own political power), governments (as disinterested authorities, but also for political reasons), and intergovernmental organizations (again for a variety of motives). It is tempting to place the blame for what some see as unwanted interference in national or commercial affairs at the feet of the United Nations and similar bodies, but these organizations are seldom the initiators of international trends and issues. The evolution of environmental issues, and the way in which they can be resolved, will be influenced by a number of general trends such as:

- ***Improvements in technologies which make lower grade ores profitable, but with implications for waste disposal and energy consumption;***
- ***Political and population pressures to open some areas to mining that were previously unavailable, including areas of environmental and cultural sensitivity;***
- ***Refusal to allow access to land from, in particular, native people, who often have very different values systems to Western-owned mining companies;***
- ***Increased pressure for artisanal mining, with impacts on environmental values;***
- ***International media and easy communication which give pollution incidents at mining operations higher visibility;***
- ***Privatization policies that disengage governments from operations, and refocus their role on application of policy instruments, and enforcement of regulations;***
- ***A sharp rise in foreign direct investment from companies, accompanied by a drop in official development assistance from governments;***
- ***Growth in the power of multinational companies, allowing them to influence or even dictate environmental and other national policies;***
- ***An associated increasing public distrust in big corporations, resulting in calls for controls on their activities and, in extreme cases, campaigns to boycott their products;***
- ***Greater scientific knowledge of health and ecological impacts leading to more stringent protection standards for environment and health; and***
- ***Sophisticated environmental management tools requiring a more systematic and professional approach to environment protection programs.***

These trends will make environmental issues increasingly complex and interactive and ensure that they will remain a management challenge to governments and companies in the foreseeable future."

-- Balkau and Parsons (1999, p. 2)

The Sustainability Transition: A World Full of Hope and Promise

In an essay on the Earth as transformed by human action over the past 300 years, Kates, Turner and Clark (1990, p. 14) state: "It is difficult to be in the midst of change and to understand it: to separate the deep structures from the shallow constructions, the long rhythms from time's embellishments, or the profound understandings from the current enthusiasms. And we are very much in the midst of change." Certainly, at the outset of the 1990s there began an enthusiasm about the idea of sustainable development. As we enter the 21st century, the concept of sustainability has permeated societies around the globe, and one might argue that we are immersed in a sustainability transition. The transition can be seen as having evolved at least in part from the conservation and environmental movements, in concert with simultaneous improvements in the human condition and developing economies.

What is Sustainable Development?

In 1987 the Prime Minister of Norway, Gro Harlem Brundtland, chaired a committee that generated a report on the state of the environment for the United Nations (UN) World Commission on Environment and Development (WCED). The report, entitled "Our Common Future," came to be known as the Brundtland Report (World Commission on Environment and Development, 1987). While the concept of sustainable development was not new at that time, the common use of the term today can be attributed to the Brundtland Report. The Brundtland Commission states:

> "Humanity has the ability to make development sustainable, to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs."

Whereas this definition encourages everyone to have a different conception of sustainable development, and allows many groups to champion their vision of "sustainable development," the definition did not produce criteria for a successful combination of economic growth and environmental protection.

Sustainable development policy evolved from concepts of environmental management and development reported at the UN Conference on the Human Environment in Stockholm, Sweden in 1972. The term sustainable development was introduced in 1980 by the International Union for the Conservation of Nature (Allen and Scott, 1980). The UN incorporated the idea of maintaining sustainable productivity of ecosystems and organisms into its World Charter for Nature in 1982 (p. 23, this volume). However, the term sustainable development was not fully developed into a policy option until the 1987 Brundtland Report was published. In the report, the WCED called upon each country of the world to adopt the goal of sustainable development. In the absence of specific recommendations, however, it has been difficult for the developing countries to embrace the lofty goal of not compromising the needs of future generations.

Resources Scarcity: An Impetus for Maintaining Sustainable Productivity of Ecosystems

The General Assembly, reaffirming the fundamental purposes of the United Nations, in particular the maintenance of international peace and security, the development of friendly relations among nations and the achievement of international cooperation in solving international problems of an economic, social, cultural, technical, intellectual or humanitarian character,

Aware that:

(a) Mankind is a part of nature and life depends on the uninterrupted functioning of natural systems which ensure the supply of energy and nutrients,

(b) Civilization is rooted in nature, which has shaped human culture and influenced all artistic and scientific achievements, and living in harmony with nature gives man the best opportunities for the development of his creativity, and for rest and recreation,

Convinced that:

(a) Every form of life is unique, warranting respect regardless of its worth to man, and, to accord other organisms such recognition, man must be guided by a moral code of action,

(b) Man can alter nature and exhaust natural resources by his action or its consequences and, therefore, must fully recognize the urgency of maintaining the stability and quality of nature and of conserving natural resources,

Persuaded that:

(a) Lasting benefits from nature depend upon the maintenance of essential ecological processes and life support systems, and upon the diversity of life forms, which are jeopardized through excessive exploitation and habitat destruction by man,

(b) The degradation of natural systems owing to excessive consumption and misuse of natural resources, as well as to failure to establish an appropriate economic order among peoples and among States, leads to the breakdown of the economic, social and political framework of civilization,

(c) Competition for scarce resources creates conflicts, whereas the conservation of nature and natural resources contributes to justice and the maintenance of peace and cannot be achieved until mankind learns to live in peace and to forsake war and armaments,

Reaffirming that man must acquire the knowledge to maintain and enhance his ability to use natural resources in a manner which ensures the preservation of the species and ecosystems for the benefit of present and future generations,

Firmly convinced of the need for appropriate measures, at the national and international, individual and collective, and private and public levels, to protect nature and promote international co-operation in this field,

Adopts, to these ends, the present World Charter for Nature, which proclaims … principles of conservation by which all human conduct affecting nature is to be guided and judged.

(United Nations General Assembly, 1982§)

In 1992, world leaders met for the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil. The United Nations convened the "Rio Earth Summit" to address urgent problems of environmental protection and socioeconomic development. The assembled leaders signed the Framework Convention on Climate Change and the Convention on Biological Diversity; endorsed the Rio Declaration and the Forest Principles; and adopted Agenda 21, a 300-page plan for achieving sustainable development in the 21st century (United Nations Conference on Environment and Development, 1992). The conference produced a document that could offer achievable, concrete goals with enough flexibility that each individual country could tailor it to meet its own needs. More importantly, it offered a descriptive definition of sustainable development. Agenda 21 includes in-depth analysis of the scope of the problems of both environmental degradation and third world poverty and prescriptions to solve the problem. In its Preamble, Agenda 21 describes sustainable development in terms of integrating environment and development concerns and paying greater attention to them. Such actions "…will lead to the fulfillment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future." Agenda 21 labels itself a "global partnership for sustainable development" which "reflects a global consensus and political commitment at the highest level on development and environment cooperation." The key to sustainable development, according to Agenda 21, is that it must seek the mutual goals of economic development and environmental protection for the purpose of fulfilling basic needs for all. Economic development therefore need not be classified as development to the point of highly developed nations like the United States. Instead, countries could successfully achieve sustainable development (and economic development) when basic needs such as food, clothing, and shelter were made available to all, which is not an unattainable goal for impoverished nations.

Because the ideas within sustainable development are now widespread among international organizations, governmental and nongovernmental organizations, and firms, they have the potential to instill values that could affect supply. Sustainable development embraces values across the "Triple Bottom Line" of economic growth, sociocultural acceptance, and environmental protection (McDonald, 2001, p. 69; Hodge, 2001). It attempts to articulate and emphasize the values of stewardship for the Earth, intergenerational and intragenerational equity regarding the resource base, and economic development. By design, sustainable development is not an easy concept to define or measure. The Brundtland Commission's definition of sustainable development in 1987 was deliberately vague so it could appeal to all groups of people, and urge them to create a more substantive interpretation of the term. At the outset of the 21st century, for example, the definition of sustainable development has expanded to include aspects of environmental integrity, economic security, social equity, and prospects for advances well beyond maintaining the world as it is in 2002.

Seeking a Definition of Sustainable Development

Sustainable development is an intervention that allows us to simultaneously consider the multiple issues related to health of the environment, survival of all life, and the socio-economic well being of humans. Actually, these are the exact things that sustainable development tries to harmoniously improve. Sustainability is the ability of humans to coexist in a manner that maintains wildlife, wildlands, and decent environments simultaneously with economic well-being and equality, today and for future generations (Five E's Unlimited, 2002§).

Sustainable development is a metaphor for opportunity and progress as well as a reminder of obligations and uncertainty. It requires a step-change improvement in performance. Merely doing better what we are already doing is not sufficient to meet the needs and aspirations of a growing world population with dignity (Brown, Brenner, and Halweil, 2000).

It is impossible to know whether humankind has entered a genuine ecological crisis. It is clear enough that our current ways are ecologically unsustainable, but we cannot know for how long we may yet sustain them, or what might happen if we do. In any case, human history since the dawn of agriculture is replete with unsustainable societies, some of which vanished but many of which changed their ways and survived. They changed not to sustainability but to some new and different kind of unsustainability. Perhaps we can, as it were, pile one unsustainable regime upon another indefinitely, making adjustments large and small but avoiding collapse, as China did during its "3,000 years of unsustainable development" (Elvin, 1993§).

Imperial China, for all its apparent conservatism, was more rat than shark, adopting new food crops, new technologies, shifting its trade relations with its neighbors, constantly adapting – and surviving several crises. However, unsustainable society on the global scale may be yet another matter entirely, and what China did for millennia the whole world perhaps cannot do for long. If so, then collapse looms, as prophets of the ecological apocalypse so often warn. Perhaps the transition from our current unsustainable regime to another would be horribly wrenching and a fate to be avoided – or at least delayed – at all costs, as beneficiaries of the status quo so regularly claim. We cannot know for sure, and by the time we do know, it will be far too late to do anything about it (McNeil, 2000, p. 358).

Many definitions of sustainability debated around the world may represent only the delicate line between degradation and enhancement. Because of this, the concept, as presently perceived, may be somewhat impoverished. Our precept imagines that we should be able to enjoy far brighter prospects than mere maintenance. This is, therefore, not an "efficiency" agenda; it does not ask us to imagine we are presently guilty of waste which we must reduce in order to feel better. Instead it asks us to imagine a world full of hope and promise, to measure our positive progress and celebrate the fecundity of our creative imaginations. As designers signaling our intentions in a world perceived to be reaching its critical limits we are asking not how few songbirds we will leave in the world for our children to enjoy, but how many (McDonough, 1992§).

Societal Perceptions About Mining

The environmental ethic applied to mining has been evolving over a surprisingly long period of time but still lacks full definition. In the industrial world minor public skepticism, which has been around for centuries, slowly evolved into increased apprehensions, beginning during the mid-to-late part of the 19th century. Lately, this feeling has turned to much more widespread disapproval over any actual or even imagined harmful impact of mining on the environment. In the United States a strong negative attitude first appeared during the era of hydraulic mining for gold in California. From that period to the present, anti-mining feelings, fueled by a series of sporadic episodes, have been gathering accelerated widespread momentum which crystallized to the point where seemingly the United States mining industry can now expect major new comprehensive regulations in the very near future (Marcus, 1997, p. 35).

In concert with specific economic benefits, the detriments of developing mineral resources throughout human history have been high, and mining activity has often proceeded as if unaware or in disregard of the environmental, social, and other costs of its activities (Marcus, 1997, p. 8.). Particularly during the 19th and early 20th century, mining activity proceeded in many areas of the world in concert with European colonialism, a mindset of manifest destiny, and significance absence of government regulation. Under these and similar conditions, mining activities left behind distinctive legacies of physical and social transformations that have colored and formed enduring and highly negative perceptions of mining. For example, throughout the American West lie the tailings piles, open pits, aggraded rivers, mountain remnants, and other landscapes transformed by mining. The bulk of activity there began with the California gold rush in the mid-1800s, and has continued since under a variety of societal transformations.

In Nigeria, extensive surface mining of tin, gold, lead, columbite, and gravel began under British colonial rule in the late 1800s (Udo and others, 1990). The mining left permanent scars on the landscape, and led to broad-scale deforestation of the Jos Plateau because of a large increase in demand for firewood and charcoal to support the mining communities. The negative impacts of deforestation, and consequent transformations of social and settlement patterns, are projected to remain especially with the Sudan-Sahel zone of northern Nigeria well into the 21st century (Udo and others, 1990, p. 594-597). In the Amazon River basin in South America, the discovery of gold in 1980 led to developing the Serra Pelada mine, producing significant riches and a nearby city of 100,000 people (Salati, and others, 1990). Tin mining has also become a major industry, exemplified by the Carajas Mine that has grown from a modest iron mine into a multi-billion dollar mining complex with sophisticated equipment for handling several other minerals (Almeida, 1986). However, Salati and others (1990, p. 487) indicate that most mining operations in the Amazon region are poorly controlled and do great harm to the environment despite existing legislation. For example, they estimate that more than 91 metric tons (100 tons) of mercury were spilled into the Maderia River during gold processing. Additionally, they observe that a significant quantity of the Amazon's mineral wealth is smuggled abroad, yielding little economic and social benefit to the region.

One of the most vivid mineral extraction legacies in the United States is hydraulic mining that ravaged rivers in the Sierra Nevada of California and led to extensive sedimentation of San Francisco Bay (Gilbert, 1917). Hydraulic mining for gold in the foothills of the Sierra Nevada began in 1853, and involved washing vegetation, soil, and rocks from mountainsides using high-powered jets of water. The nozzles ranged up to about 5 meters (16 to 18 feet) in length and were capable of blasting a stream of water about 120 to 150 meters (400 to 500 feet). The sediment was then run through sluices lined with mercury that captured particles of gold. The remaining debris was washed into nearby streams and rivers, causing massive aggradation of major river channels and destruction of farmland in the Sacramento Valley. Farther downstream, the debris began to fill San Francisco Bay. Cappiella and others (1999) estimate that hydraulic mining removed more than 1 billion cubic meters (1.3 billion cubic yards) of sediment from the foothills of the Sierra Nevada, and that about 9,100 metric tons (10,000 tons) of liquid mercury was distributed throughout the river systems downstream from the sluices and the sediments in San Francisco Bay.

Because of the devastation and damage to farms and towns caused by debris accumulation in river channels, and effects such as impeded navigation and increased flooding, hydraulic mining was banned in 1884. Mining debris nonetheless remained in river channels and continued to be transported into San Francisco Bay well into the 20th century (Cappiella and others 1999). Dams constructed for water supply and flood control in the early to mid twentieth century ultimately had the effect of trapping sediment and reducing the peak river flows capable of transporting sediment into San Francisco Bay (Cappiella and others 1999). By the mid to late 20th century, the San Pablo and Suisun components of the San Francisco Bay system were erosional, losing sediment and deepening in the absence of inputs of hydraulic mining debris. However, the eroding materials are likely contaminated with mercury, posing problems for 21st century society (Jaffe and others, 1998; Cappiella and others, 1999). Additionally, the mined areas of the Sierra Nevada foothills and river channels upstream from modern reservoirs retain the scars and debris of hydraulic mining. Thus, the thirty-one year era of hydraulic mining produced effects that persisted for more than 100 years, and which will continue in the form of natural and anthropogenic reclamation of mined lands and river courses, and treatment of mercury contamination problems.

Current (2002), large-scale mining practices in the United States are characterized by massive open-pit and underground operations excavated with a variety of giant machinery and explosives. These operations have grown in the past century to produce increasingly larger amounts of waste rock, tailings, and land-surface disruption. Technology has allowed the mining of rock containing increasingly lower concentrations of metals, for example, with resulting increases in the quantities of waste materials (Hitzman, 2002). In the case of coal and aggregate mining, automation and technology at mine sites and efficient transportation methods have lowered the cost of moving larger and larger amounts of rock. In most cases, operators attempt to contain the rock, water, and potentially toxic materials generated by the mining processes in order to avoid the type of wide dispersion of large-volume waste that characterized historical hydraulic mining. Also, modern regulations generally require operators to attempt various forms of reclamation of mined land depending upon the type of operation. Reclamation in the case of large open-pit metal mines in the United States and elsewhere typically is not performed with the intent of restoring the original landscape. (Restoration implies returning mined land to an approximation of its original contour, use, or condition.) Reclamation for large open-pit features generally is associated with stabilizing tailings piles rather than refilling open pits because the costs of the latter could be prohibitive. Moreover, the tailings and other debris could be mined again in the future, given technological advances sufficient to extract the gold and other metals that remain in small concentrations. Atencio (2001) provides one overview of the debate over modern reclamation issues associated with open-pit mining, and the wide range of estimates for cleanup costs. Humphries and Vincent (2000, p. CRS–11§) discuss reclamation and bonding regulations enacted in 2001 by the United States Federal Government to govern the surface impacts of hardrock mining on federal lands.

In contrast, modern reclamation associated with open-pit nonmetal mines (for example, for coal in Wyoming and West Virginia, or phosphate in Idaho) generally can restore landforms and vegetation to an approximation of original conditions because excavations are filled while mining proceeds. In these cases, operators remove vegetation, soil, and overburden to expose the coal or other resource. After miners extract the resource, they replace and grade the overburden and cover it with soil and vegetation. The entire mining operation is scheduled so that as one area is being mined, another is being reclaimed. Within a few seasons following high-quality reclamation practices, the reclaimed strip-mined lands may show little evidence of having been mined (Arch Coal, Inc., 2001§).

Underground mining typically results in far less waste being placed on the land surface than does open-pit mining. In general, underground mining is most appropriate for ores at depth and large concentrations of other minerals such as coal, and of course oil and natural gas. In recent years, it is generally ore depth that dictates underground mining rather than ore grade. High-grade material exposed at the surface is typically mined by open-pit methods. However, the grade of an ore that can be recovered economically can be influenced by social, environmental, and other conditions that could favor underground mining over open-pit mining in some situations. Although potentially having impacts on groundwater and surface water such as that discharged through adits (shafts), underground mining in many cases may have less obvious impacts on the land surface than open-pit mining. In the example above for Nigeria (p. 26, this volume), coal mining in the southeastern part of the country has not devastated the land surface like other types of mining on the Jos Plateau because the coal is obtained from adits driven into the hillsides (Udo and others, 1990, p. 596). Underground mining has been widely popularized through literature, film, song, and other media with frequent reports about mining accidents and heroic rescue efforts displaying mining as a predominantly underground activity (Marcus, 1997, p. 9).

The impacts of modern hardrock mining are readily demonstrated in the enormous excavations (open pits) and massive piles of rock debris (tailings, waste, and stockpiles) at numerous gold mines throughout the Carlin Trend in Nevada. There, excavation and earthmoving on a massive scale continues as part of modern society's relentless demand and search for gold. Individually, the open pits can be greater than 1.6 kilometers (one mile) across and perhaps 300 meters (1000 feet) deep. The total area affected by an individual mine including the area of groundwater drawdown and contamination, plus tailings disposal piles and other surficial features can extend over a few tens of square kilometers. In general, rock debris is contained at the site as engineered features such as fills, heap-leach pads, and tailings reservoirs. Groundwater is pumped out of the local environment to keep the deepening pits from filling with water, and in the case of the Carlin Trend mines, is discharged mainly as surface water to the Humboldt River. After open-pit excavation ceases, water accumulates to form pit lakes with varying degrees of water quality depending upon a variety of chemical and hydrologic factors (National Research Council, 1999, p. 156; 198-199). The National Research Council (1999, p. 150-152) also notes that the regional concentration of a large number of gold mines along the Carlin Trend in

Nevada and of copper mines in the Miami and Globe area of Arizona, for example, pose questions of cumulative environmental impacts that are not yet fully understood by the scientific community. Additionally, scientists cannot predict the full extent and duration of environmental problems at modern mine sites until better information becomes available (Moran, 2000). In some cases, environmental problems may not be sufficiently acute to warrant further treatment under current (2002) standards, and the mine sites may be left untreated. Finally, the concepts of reclamation applied to operations such as those along the Carlin Trend leave many unanswered questions with respect to future uses of the pits, disposal areas, pit lakes, and the regional groundwater table. Thus, impacts from open-pit gold and other hardrock mining operations currently underway in the United States and elsewhere will be a legacy of mining for centuries to come, given the scale of land and water disruption possible using modern technology.

The examples discussed above are intended to illustrate the conflicted nature of mining that includes the rapid creation of wealth, dramatic societal transformations, and long-term social and environmental costs. These examples are part of the more vivid legacy of mining practices that have occurred around the world, and represent an enduring face of mining most apparent to the public.

"The extent of damage to the environment caused by some mining operations was only understood after they had shut down, and many of the original owners have long since disappeared from the scene. Notwithstanding, serious environmental problems of yesteryear are still with us, such as abandoned radioactive tailings piles, mercury and other toxic heavy (base) metals entering the food chain, leakages and failures of tailings dams, invasion and depletion of aquifers, surface land subsidence and caving, acid mine drainage affecting wide areas, and abandoned mines requiring remediation. In some cases, environmental damage from mining is ongoing at existing or recently mined sites, such as Summitville, in Colorado." – Marcus (1997, p. 8).

Despite the mining industry's essential role as the main source of society's raw materials and energy, a major player in global economics, and contributor to international security, most people have limited exposure to mining and its consequences. Marcus (1997, p. 9), Danni (1997, p. 719), and Born (1997, p. 721), in trying to assess public awareness of the mining industry, made several observations about public perceptions that offer a starting point for understanding how people think about the mining industry. They conclude that people strongly associate mining with underground methods, believe aboveground methods scar the land, believe mining harms the environment, and believe mining to be inherently destructive; that it serves no real purpose, and that it cannot be environmentally sound. Nor do people distinguish between large-scale and small-scale or artisanal mining. To the broader public, it is all "mining" (Balkau and Parsons, 1999, p. 9). The public believes the industry to be isolationist, perhaps because its activities generally take place in remote areas, or because of the somewhat secretive nature of minerals exploration and development. The public believes that the mining industry exploits its workers. The public believes the industry to be very conservative and unwilling to change its practices appreciably. The public is commonly unaware of the benefits of mining to daily life, and they are unaware of the mining industry's reclamation efforts. They are unaware of the global moves in the mining industry in recent years towards environmental awareness and performance. Additionally, the public mistrusts large companies in general, and that level of mistrust has grown substantially during the past three decades (MORI, 1999§).

Many people form an opinion of resource extraction on the basis of economic, environmental, esthetic, or religious grounds. For example, people in highly developed countries tend to favor environmental quality over resource extraction (Pfister and Messerli, 1990, p. 650-651), apparently with the view that the resources they increasingly demand can be obtained elsewhere. People in developing countries, seeing resources exploitation as an avenue to economic growth, may offer tax incentives to support mining, and hold environmental and other regulations to a minimum. In contrast, other developing countries demand environmental protection and a variety of other conditions before they will provide minerals and other materials to the global market.

People and societies tend to be strongly conflicted over religious beliefs and practical assessments about natural resources available for society's ends. Since the arrival of European peoples, the North American continent has been a battleground over religious values about the land, not only between European and Native American societies, but also among the European immigrants and their descendants. American artist Thomas Cole (1836§) expressed the dilemma of watching beautiful landscapes passing away before logging, mining, and other elements of human endeavor while acknowledging the contribution of these activities to human progress. Perry Miller (1956) explored the religious dimension of this dilemma in detail, tracing the issue from the Puritan settlers to the America that arose from World War II. He argued that American settlers went forward with a view of the landscape as a holy object, with its beauty, richness, and bounty providing evidence of God's love. Nonetheless, this same land was given by God to provide the materials the settlers wanted to build farmlands, cities, transportation corridors, and all else society could envision. Miller (1956, p. 205-216) presents the continuing dilemma of "…the American theme, of nature versus civilization," wherein there is a profound conflict between the religious belief in unlimited resources provided by a bountiful God and the practical matters of exploiting these resources to construct the vast American civilization.

"The belief in the inexhaustibility of western resources was superimposed on an attitude toward the land that Americans had inherited from generations past. In the Judeo-Christian view, God created the world for man. Man was the master of nature rather than a part of it. The resources of the earth – soil, water, plants, animals, insects, rocks, fish, birds, air – were there for his use, and his proper role was to dominate. It was natural then for God's children to harvest the rich garden provided for them by their Creator. They went into the West to do God's bidding, to use the land as he willed, to fulfill a destiny.

This attitude of man-over-nature was not universal. Like most primitive cultures throughout history, it was not held by the American Indian. The Indian saw himself as a part of nature, not its master. He felt a close kinship with the earth and all living things. Black Elk, a holy man of the Oglala Sioux, for example, believed that all living things were the children of the sky, their father, and the earth, their mother. He had a special reverence for 'the earth, from whence we came and at whose breast we suck as babies all our lives, along with the animals and birds and trees and grasses.' Creation legends of many tribes illustrate the Indian's familial attachment to the earth and his symbiotic relationship with other forms of life. The land to the Indians was more than merely a means of livelihood for the current generation. It belonged not only to them, the living, but to all generations of their people, those who came before and those who would come after. They could not separate themselves from the land." – (Hague, 1977§).

As described in the Crandon Mine example (Appendix A.), many people oppose or support resource development because of its varied impacts on the quality of their lives. Some embrace resource extraction as an economic means to a better life. Others do not want the changes imposed by resource extraction, and offer strong resistance to intrusion. People typically find strong reasons to oppose or support resource development based on the location of the resource with respect to their immediate environment. In addition, people will oppose or support resource development in locations they have never seen or might never visit because of their beliefs about effects on the common good.

An example of this phenomenon involves opposition to the proposal by Crown Butte Resources, Ltd. to develop the New World gold mine near Yellowstone National Park in Montana, USA (Humphries, 1996a,b§). The proposed mining location was about 3 miles (4.8 kilometers) from the northeastern corner of the park. People and organizations including U.S. President William J. Clinton and the United Nations World Heritage Committee applied political pressure at the state, federal and even international level to stop the project. The broad opposition to the project, based primarily on fears that mining operations might cause damage to parkland resources and recreational assets, convinced Crown Butte Resources, Ltd. to abandon the project. In August

1998, the U.S. Government paid Crown Butte Resources. Ltd. $65 million, of which $22.5 million would be allocated for cleaning up the abandoned mine site (Randolph, 1998).

People have a powerful sense of place and attachment to specific places. The sense of place accumulates over generations and invests people with significant (and often unappreciated) knowledge of their local environment (Sagoff, 2000, p. 140; Kemmis, 1990). People and cultures belonging to a place (aboriginal people, as an important modern example) tend to have unique insights into their local environment that may be unappreciated by those wishing to exploit that environment (Pasco-Font, 1997§; The Mining, Minerals and Sustainable Development Project, 2002, p. 200). These cultures commonly claim not only legal rights, but also moral and spiritual rights to the land they occupy. In addition, cultures with a strong sense of place are likely to have unique perspectives on what is important, and are likely to be driven by different sets of values than intruders (Pasco-Font, 1997§; Steelman, in press). In the United States, for example, the successful campaign to limit and eventually close a sand, gravel, and pumice mine was based on the sacred reputation of the San Francisco Peaks in Arizona to many local Native American tribes (McLeod, 2000; USDA Forest Service, 2000§). Thus, indigenous peoples commonly maintain religious and social values that contradict the interests, wishes, and reasoning of mining companies, government authorities, or other entities that attempt to introduce significant change (Ostensson, 2001, p. 3-15 – 3-17). Modern attention to the values of indigenous peoples, however, has produced a trend in recent years for the public, extractive industries, and others to recognize the special claim of indigenous people to the land they occupy.

The examples in Appendix A and Robinson and Brown (2002) suggest that people directly affected by mining would like to be compensated fairly for the disruption of their lives. They want to be consulted well in advance of any activity that could disrupt their lives (The Mining, Minerals and Sustainable Development Project, 2002, p. 198). They have a very different perspective on time than mining industry representatives. For example, even a 30-year lifetime of a mining operation from opening to reclamation spans the bulk of human adult life, and people tend to be more interested in sustaining their communities than in sustaining mining at the expense of their communities (Appendix A). They commonly see their existing economy and cultural situation as self-sustaining and independent; they want independence from the imposition of governance by the mining community or other outside entities; they want truth, openness, information, and clear explanations about what is happening to them; they want to be heard (The Mining, Minerals and Sustainable Development Project, 2002, p. 198-201). If they are accepting of mining in their community, they want their skills used in the mining operation. People want trust, transparency, access and openness (International Institute for Environment and Development, 2002c, p. 198-202§; Appendix A.). People want scenarios that allow them to identify and understand the times and places to take action. They have legitimate, esthetic reasons to object to landscape alterations. They want the industry to take responsibility for cleaning up what it has desecrated in the past. They want continuity and a greater stability than that provided by a "boom and bust" economy (Task 2 Work Group, MMSD North America, p. 19).

In contrast to communities that resist or place great restrictions on the minerals industry, there are those communities that embrace its presence. Fairbanks, Alaska is an example of a community with a foundation in mining and continuity of growth during the past century. The city was founded in 1902 during the Klondike gold rush, and owes its existence to the gold mining industry (Kinross Gold Corporation, 2001a§). In 2001, Fairbanks had a population of about 80,000 people, and was the second largest community in Alaska. The local economy is broadly based, providing services for the interior of Alaska, and having significant military and government sectors. The Fort Knox gold mine, developed in 1995-96, and the True North deposit, developed in 2001, together provide a work force of about 1,700 people in the Fairbanks area. Kinross Gold Corporation (2001a§) estimates the total economic impact of Fort Knox and True North to be approximately $132 million over the lives of the mines. As a "good neighbor" to Fairbanks, Kinross operates under a comprehensive environmental management system that describes standards for all activities throughout the mining cycle, and has won awards for its reclamation and other environmentally conscious practices. Kinross Gold Corporation (2001b§) believes: "…outstanding environmental performance is simply good business, and makes an environmental commitment extending from exploration to reclamation, and to all operations, wherever located." During 2000, Kinross spent $9.6 million on reclamation and site closure activities at the True North project, and reclaimed about 500 hectares (1235 acres) of mined lands. In addition, Kinross participates in a global initiative coordinated by the United Nations Environment Programme and the International Council on Mining and Metals (p. 74-75, this volume) to develop voluntary codes of practice for cyanide management (United Nations Environment Programme, 2001c).

Despite modern reclamation and other activities such as those near Fairbanks, the industry is generally not prominent enough in the public eye to enjoy widespread acceptance of its practices. Today, as throughout history, the numbers of people affected by mining are far greater than the numbers employed by the industry.

Snow and Juhas (2002, p. 7) show that mining employment in the United States (including employment in finished mineral products to the point of first sale) dropped from 1,200,000 people in 1920 to fewer than 500,000 people at the turn of the 21st century. Thus, the mining work force has dropped from about 4.2 percent to 0.4 percent of the population of the United States, a trend seen by Snow and Juhas (2002) as significantly reducing the influence of the industry on public opinion. Far greater numbers of even the less attentive public now look across, read about, or view on television or computer screens land that is being mined today or was mined tens to thousands of years ago, and form immediate opinions of mining. Under this reality, mining at the outset of the 21st century, to an extent unprecedented in human history, is seldom isolated from public scrutiny.

The scrutiny has become more intense because people around the globe increasingly believe a healthful environment is a basic human right (Pfister and Messerli, 1990, p. 650-651). As Shabecoff (2000, p. 25) observes, "Many governments now acknowledge that the ecological health of the planet is essential to national and collective security. Few countries are without some kind of environmental protection agency." However, people tend not to recognize the environmental consequences of demanding specific quantities and qualities of aluminum, copper, lead, sulfur, and other materials. They are strongly focused on their immediate environments, and are not highly motivated to decrease their demands (Shabecoff, 2000, p. 26; Pfister and Messerli, 1990, p. 650-651). For the United States, for example, Shabecoff (2000, p. 26) remarks: "Although the great majority of Americans support environmental goals, that support may be shallow among many or most of them. Many people seem to have only a loose grasp of the dimensions of the problems and show little willingness to make any but the slightest changes in lifestyle." Marcus (1997, p. 35) corroborates this impression, stating particularly with respect to mining that "…most Americans want some, as yet to be defined, positive action to be undertaken in order to at least protect if not better the environment, but without causing too much self-interference and 'pain'." Pfister and Messerli (1990, p. 650-651) state for Switzerland that "Discussion in the media and popular votes suggest that a profound change in values is underway. The ethic to do no harm to the biosphere is widely shared. Concern for nature has reached the top of the political agenda; hence the readiness to invest in new technologies (such as the catalytic converter) to improve the quality of the environment. On the other hand, the values are not strong enough yet to bring about changes in the way of life – unlimited mobility by automobile has become a fundamental right – or to check the market system in those domains in which it obviously promotes environmental degradation." Nonetheless, there are increasing expectations for products that consume less energy and whose production results in less environmental harm, as well as products that have been produced with less energy and lower emissions of toxic substances (Balkau and Parsons, 1999, p. 10).

According to Ropiek (2000), people hold large measures of uncertainty and misunderstanding that drive their beliefs about resource supplies. Ropiek (2000) further states that people commonly believe they lack personal control over the resources they demand, which contributes to uncertainty. They are typically more afraid of immediate problems with resources availability (for example, gasoline supplies) than with chronic problems that demand their attention over the long term (for example, greenhouse gases). They accept natural dangers, but fear the dangers created by human technology (Ropiek, 2000). The more they perceive a benefit from using a resource, the less they fear the risks associated with that use, whether to themselves or the larger society (Ropiek, 2000). They tend to resist barriers to resource use that are imposed upon them, and prefer to set their own standards of voluntary compliance with others' guidelines (Ropiek, 2000).

According to MORI (1999§) and Edelman Public Relations Worldwide (2000§), average citizens have increasingly developed a limited belief in the findings of experts over the past several decades. Much of this probably comes from uncertainty created through divergent expert opinions on the same issue. There is a tendency in modern media and politics to attempt to provide strongly opposite rather than central or consensus views on almost every subject, with the potential effect of leading people to disregard experts who cannot agree. People then look within their own spheres towards those they think they can trust, and place a stronger belief, for example, in representatives of quasi-governmental or non-governmental organizations (NGOs) than in corporations or national governments (Ostensson, 2000, p. 3-17 -- 3-18). There is also a trend over the past several decades towards increasing distrust in corporate and governmental experts. For example, according to MORI (1999§), the British public is increasingly cynical about big business despite rising expectations of the corporate world, specifically with regard to social and environmental responsibility. According to Edelman Public Relations Worldwide (2000§), NGOs are trusted nearly two to one to "do what is right" compared to government, media, or corporations. Nearly two-thirds of respondents say that corporations care only about profits, while well over half say that NGOs "represent values I believe in." As a result, NGOs such as the Mineral Policy Center and the Sierra Club, and similar community or civil society groups have become increasingly well established and organized in many countries since the early 1990s. These groups succeed by addressing issues that matter to the individual, whether at the local level or within the framework of the individual's worldview. Edelman Public Relations Worldwide (2000§) has found that NGOs such as Amnesty

International, Greenpeace, Sierra Club, and World Wildlife Fund have greater credibility than such corporations as Exxon, Ford, Microsoft, Monsanto, and Nike. Edelman Public Relations Worldwide (2000§) also states, "Eighty percent of United States respondents view Greenpeace as highly effective and 78 percent see Amnesty International as highly effective," and "Only 11 percent of United States respondents see government or companies as 'making the world a better place'." NGOs now form influential lobby groups in many national and international arenas, and they command a wide range of activities related to environment, land use, and other aspects of resources development. The outlook at the outset of the 21st century is that NGOs and related groups have the foundation and potential to become more important and more influential with respect to corporate and governmental policy worldwide (Ostensson, 2001, p. 3-17).

All together these trends imply important challenges for the mining and other resources extraction industries in the 21st century. The commentary for the United Nations Pacific Economic Co-operation Committee Minerals Forum by Balkau and Parsons (p. 20, this volume) exemplifies these challenges. Mainly, the call is for attending to a host of issues, actors, and trends that will make resources extraction more complicated for the foreseeable future (Table 1.). The extractive industries together with society at large are being charged with somehow overcoming the built-in antagonism between environmental quality and economic growth (Shabecoff, 2000, p. 22). The industries most likely will be pushed in the direction of more environmentally benign extractive activities, while the rest of society will be pressed towards some agreeable level of coexistence with extractive industries.

Table 1. – Issues and stakeholders in a hypothetical mining project (Ostensson, 2001, p. 3-25).

	Stakeholders						
Issues	Company	National government	Local/ provincial government	Local community	Indigenous peoples	Local NGOs	National/ international NGOs
Economic return of project	XXX	XXX	X	X			
Direct employment	XX	X	XXX	XXX	XX	XX	
Indirect employment	X	X	XXX	XXX	XX	XX	
Land ownership and land use	X	X	XX	XXX	XXX	XX	X
Social and cultural impacts	X	X	XX	XXX	XXX	XX	XX
Environmental compliance	XXX	XXX	XXX	XX	X	XX	XX
Environmental impact	X	X	XX	XXX	XXX	XXX	XXX
Impacts on biodiversity	X	XX	X	XX	XXX	XX	XXX

Ostensson (2001) suggests that the number of Xs show how important a particular issue is to the stakeholder. The table is a generalization, and the interests of individual stakeholders may differ considerably from the stakeholder represented in the table. The table does not show whether interests converge or diverge. Thus, the existence of three Xs for a particular issue for two stakeholders may imply that this issue is a "deal breaker" or that it offers an opportunity for two groups of stakeholders to form an alliance.

The Demand for Minerals

Each year the Mineral Information Institute, Inc. (MII) of Golden, Colorado estimates the mineral demands of American people. These demands are defined as the quantity of mineral resources required "…to provide the products and services that sustain the American way of life." The MII derives the estimates from data published by the U.S. Geological Survey (2001) and the U.S. Energy Information Administration (2000), and analyses by the National Mining Association. MII bases the estimates on projections of average life expectancy at birth for Americans born during the indicated year. Projected over a life span of about 77 years, the MII (2000) estimates it could take more than 1.7 million kilograms (3.7 million pounds) of minerals, metals, and energy fuels to support the lifestyle and demands of the average American during his or her lifetime. Part of this material, however, could be used by future generations through reuse and recycling. Examples include power generating plants and electrical grids, dams, buildings, roads, and other long-lasting constructions.

The MII uses the data to create the per capita quantities of minerals, metals and energy fuels used for the United States population. In 1999, for example, the share for each of the 272.8 million people in the United States was about 21,972 kilograms (48,427 pounds) of these materials. The MII further states that this figure represents newly mined minerals and metals, with aggregates (sand, gravel and stone) and fuels (petroleum, natural gas, and coal) accounting for the overwhelming bulk of demand.

These demands can be readily demonstrated, for example, by the quantities of materials and energy associated with new houses, other buildings, roads and bridges. In 1999, builders constructed about 1.7 million houses across the United States, and these contained an average of about 113,400 kilograms (250,000 pounds) of minerals and metals per house (Minerals Information Institute, 2000). Infrastructure associated with each house such as access roads, water and sewer systems, and gas and electric utility lines also require minerals and metals. In addition to the fuels employed to process and transport materials to build the houses, each house will assume fuels and materials uses associated with the demands of its occupants for furnishings, appliances, heating, cooling, lighting, and other services.

Aggregates and metals commonly are primary components of buildings (concrete foundations, concrete and steel beams, and other metals), roads (road base and surfaces), and bridges (concrete and steel). The road and bridge system of the United States comprised about 6.3 million kilometers (3.9 million miles) in 1999, and provides a continuing demand for fuel and aggregates used for expansion, maintenance, and repairs (Minerals

Information Institute, 2000). For a more detailed example, Robinson and Brown (2002) provide information about the demand for aggregates for the Mid-Atlantic region of the United States.

Agriculture uses large amounts of mined materials, such as potash and phosphate for fertilizers to grow crops for human and animal feed. In the United States, these materials are applied at an annual rate of approximately 7.7 million metric tons (8.5 million tons) (Searls, oral commun., 2001) and about 12.7 million metric tons (14 million tons) (Jasinski, oral commun., 2001) respectively, or about 32 kilograms (70 pounds) of potash and 52 kilograms (115 pounds) of phosphate rock per American per year. The amount used for feeding Americans is actually less because the United States is a major net exporter of grains and other agricultural products.

The figures in the previous discussion represent estimated demand for newly mined minerals at the beginning of the 21st century, and the context of the MII summary – projections over roughly 8 decades of a human lifetime – implies continuing demand at these and perhaps greater levels throughout most of the century. Population projections for the United States suggest increases to between 500 and 600 million people by 2100 (Riche, 2000). Using these numbers, and conservatively holding demand at 2000 levels, the 21st century could experience an increase of mining into the range of about 11 to 14 billion metric tons (12 to 16 billion tons) per year for minerals and fuels for the United States. While this simple exercise in projection cannot take into account the events likely to change society and its material demands over the next several decades, it does illustrate what could occur at business as usual.

For the United States, "business as usual" for the 20th century is illustrated in figure 1. Matos and Wagner (1998) estimate that the quantity of new materials entering the U.S. economy in 1900 was 146 million metric tons (161 million tons). In 1998, about 2,900 million metric tons (3,200 million tons) of new materials entered the U.S. economy. Of all the materials used during the 20th century in the United States, more than half were used in the last 25 years. Matos and Wagner (1998) note further that on a percentage basis, the use of metals by weight declined slightly relative to other materials. Their reasons include the demand for lighter-weight materials (such as aluminum), the introduction of high-strength steel in vehicles, and the availability of substitute materials such as plastics. Figure 1 also shows recycled materials, reflecting the growth of recycling of metals and industrial mineral commodities such as concrete. Although recycling occurred before the 1960s, recycled metals prior to that time were included in the total metal values used to compile the graph. Matos and Wagner note that recycled metals accounted for 37 percent of metals use in 1998 even as total metals use has increased. Recycling rates in 2000 for products containing steel, for example, were 84.1 percent for appliances, 95.0 percent for automobiles, and 58.4 percent for steel cans (Steel Recycling Institute, 2001§).

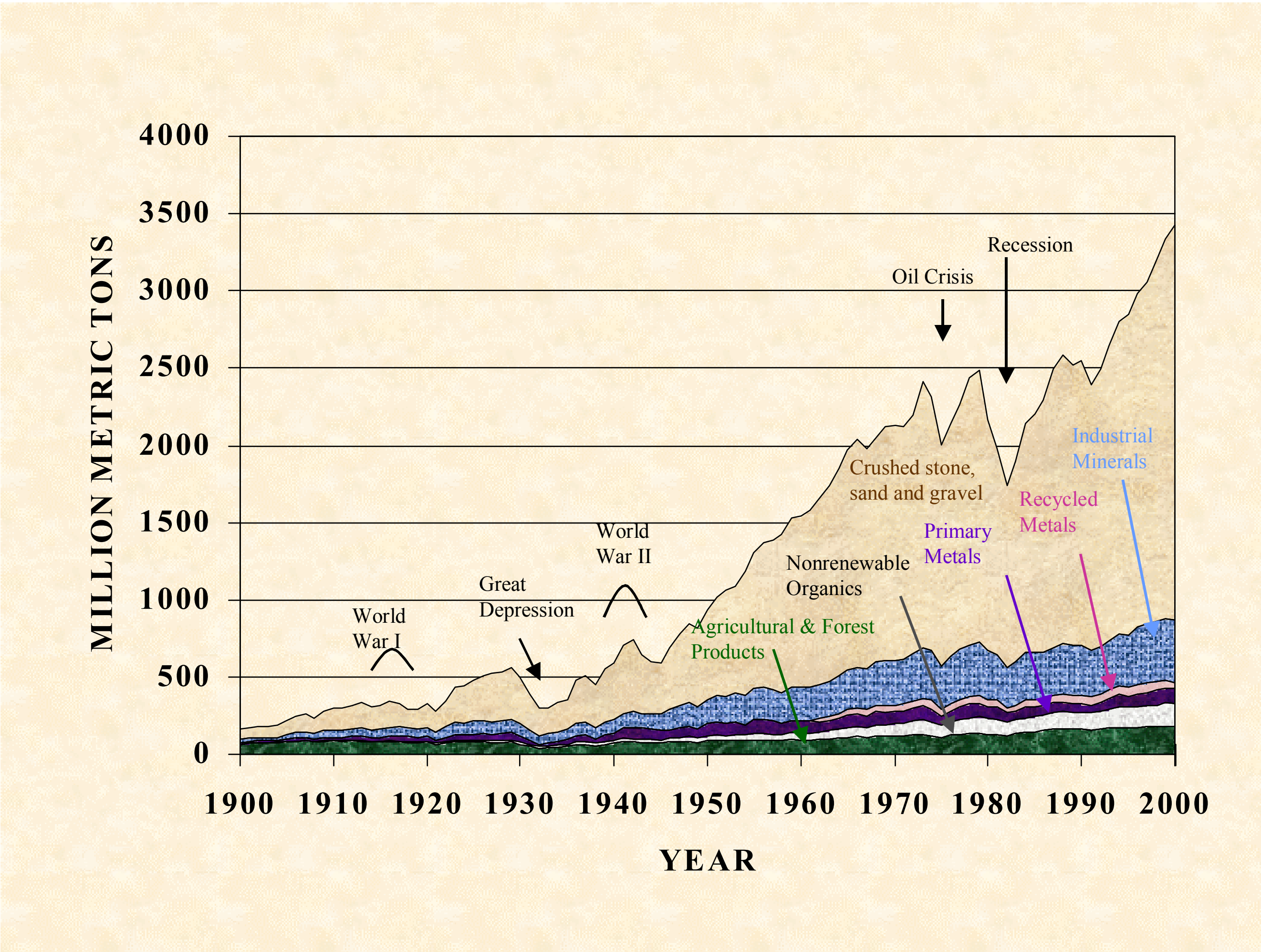

Figure 1. U.S. flow of raw materials by weight, 1900-98. Modified from Matos and Wagner (1998, fig. 3).

Trends that could counter linear increases in demand include decreased intensity of use of materials despite increases in population. Recent findings about the changing demands for water in the United States (Brown III and others, 2000, p. 46; U.S. Geological Survey, 1998) and other countries (Rock, 2000), suggest trends and potential for decreasing per capita use while maintaining economic growth. The construct of a transition from water-supply management to water-demand management is part of the effort to encourage more efficient use of water, and is a construct similar to that of "dematerialization" with respect to the use of minerals (Cleveland and Ruth, 1998). "Dematerialization" is the absolute or relative reduction in the quantity of materials used and (or) the quantity of waste generated in the production of a unit of economic output, and encompasses recycling, technical improvements, substitution, and other factors (Brown III and others, 2000, p. 21). Investigators of population growth also suggest declining rates of growth or even a decline in world population during the 21st century that could dramatically change the picture of the demand for resources (Lutz, and others, 2000).

Evolving technological and economic conditions show promise for expanding global transport of oil, coal, and aggregates in bulk, and greater amounts of these materials could come from foreign sources (Robinson and Brown, 2002; Holmes, D.A., oral communication, 2002). Based on current trends, many other minerals could be mined in relatively smaller and fewer areas in the United States (Hitzman, M.W., oral communication, 1999). In the current global economy, many of the minerals once mined extensively in the United States increasingly are imported from those countries that maintain significant economic advantages for mining and exporting minerals.

Worldwide reserves include materials that can or could be mined profitably. For most commodities, such as aggregates, aluminum ore (bauxite), iron ore, phosphate rock, potash, natural gas, and coal, reserves are also very large. Reserve estimates in table 2 for 1999 illustrate a general sense of the adequacy of materials that are economically profitable to extract at current prices and technologies. Reserve estimates are dynamic and can increase or decrease dramatically with new discoveries, changes in costs and technology of extraction, commodity price, and other factors. The data in table 2 suggest that reserves estimated in 1999 are sufficient to meet demand from about 30 to more than 60 years for many commodities, and about 50 to more than 200 years for some others given selected growth rates. Reserves, based on historical observations, could remain adequate for many decades to centuries as long as there is market demand. In general, reserves increase as demand increases as a result of higher prices or lower costs. As an example, aggregate resources are known to be plentiful. However, exploiting new aggregate deposits will depend primarily on the willingness of the consumer to accept the costs of mining and transporting aggregates from the mine sites to the places where they will be used (Robinson and Brown, 2002). Mineral resources in the world are vast, but all known resources are not currently developed. They remain undeveloped because market conditions or extraction technologies do not permit them to be produced at a profit or as a result of other socioeconomic and political factors. As economic and other conditions become more favorable, mining of these resources could likely occur. Thus, these resources could become part of the world's reserves.

Table 2. The ratio of current world reserves [a] to annual production for selected mineral commodities.

Mineral Commodity[b]	1999 reserve estimates[c]	1997-1999 average annual production[c]	Ratio, 1999 reserve estimates to 1997-1999 average annual production [d]	Average annual growth in world production, 1975-1999 (percent)
Coal	990×10^9	4560×10^6	216	1.1
Crude Oil	1000×10^9	23.7×10^9	44	0.8
Natural Gas	5100×10^{12}	80.5×10^{12}	64	2.9
Bauxite	25×10^9	124×10^6	202	2.9
Copper	340×10^6	12.1×10^6	28	3.4
Iron	71×10^9	560×10^6	132	0.5
Lead	64×10^6	3070×10^3	21	- 0.5
Nickel	49×10^6	1130×10^3	41	1.6
Phosphate	12×10^9	141×10^6	85	1.2
Potash	8400×10^6	25.5×10^6	330	0.2
Silver	280×10^3	16.1×10^3	17	3.0
Sulfur	1400×10^6	57×10^6	27	0.6
Tin	9.6×10^6	208×10^3	37	- 0.5
Zinc	190×10^6	7750×10^3	25	1.9

Sources:
Tilton, 2001, p. III-21, adapted from U.S. Bureau of Mines (1977), U.S. Geological Survey (2000a); U.S. Geological Survey (2000b); American Petroleum Institute (2000); BP Amoco (2000§); International Energy Agency (2000).

Notes:
[a]Reserves can best be understood as a "working inventory." They are defined as that part of the resource base which is characterized in sufficient detail to be considered available and can be economically extracted or produced at the time of determination. The term reserves need not signify that extraction facilities are in place and operative. Reserves include only recoverable materials; thus, terms such as "extractable reserves" and "recoverable reserves" are redundant and are not a part of the classification system used by the U.S. Geological Survey (U.S. Geological Survey, 1980, p. 2).
Reserve estimates are dynamic and can increase or decrease dramatically with new discoveries, changes in costs and technology of extraction, commodity price, and other factors. Additional

resources are known, but are either sub-economic or are not sufficiently characterized to be identified as reserves.

[b]For the metal ores, except bauxite, reserves are measured in terms of metal content. For bauxite, an ore of aluminum, reserves are measured in terms of bauxite ore rather than aluminum content.

[c]Reserves are measured in metric tons except for crude oil, measured in barrels, and natural gas, measured in cubic feet.

[d]Ratios were calculated before reserve and average production data were rounded.

The Land Available for Mining

Mined Land in the United States

In the United States, mining as a specific land-use activity in the 1990s constituted less than 6 million acres (2.4 million hectares) or about 0.2 percent of the approximately 2.27 billion acres (918 million hectares) of total land area (Minerals Information Institute, 2000). For comparison, the MII estimates that cities and towns occupy about 78 million acres (32 million hectares), and that about 32 million acres (13 million hectares) are given over to highways, for a total of about 110 million acres (45 million hectares). Private agricultural lands occupy about 983 million acres (398 million hectares), and about 50 million acres (20 million hectares) are covered with water bodies. Note that all these land-use categories may include areas of mining, including aggregate mining within highway right-of-ways before, during, and after highway construction. The discussion beginning on page 49 (this volume) provides details about Federal lands that comprise about 700 million acres (283 million hectares) of National Parks and Forests, fish and wildlife conservation areas, Indian trust lands, and the Federal estate available for mineral and energy development.

The overwhelming acreage used for mining produces nonmetals (aggregates, for example) and coal. Mining for metals, by comparison, uses less than 10 percent of the land used for mining nonmetals and fuels (Minerals Information Institute, 2000). The figures refer to the approximate area of mined land, and do not include, for example, transportation corridors to and from mined lands, and other uses (transportation, processing, and manufacturing) essential to converting mined materials into various products. Nor does mined area include the sphere of influence of mined lands having impacts on the surrounding air, land, and water (p. 29, this volume). Mining activities can impact large areas of the surrounding environment as occurs, for example, through groundwater drawdown surrounding large open-pit mines (Federal Register, 2000, p. 70045§), building transportation and utility corridors, riverine or oceanic dumping of tailings and tailings dam failures (United Nations Environment Programme, 2001a; WISE Uranium Project, 2001§; Plumlee, and others, 2000), combined with other activities. Nonetheless, the figures for mined land show that the bulk of mineral demand in the United States is being met using a relatively small percentage of the nation's land and imports from other parts of the world.

Perceptions of the Sphere of Influence of Mining

"However, it should be noted that impacts from mining operations and many other activities on public lands cannot be confined exclusively to the area of direct surface disturbance. Impacts to many resources transcend the direct disturbance boundary due to the nature of the effect. Visual impacts can often be seen for miles. Noise from operations can be heard a good distance from the project area. Wildlife may be displaced. Impacts to such resources as water and air will extend beyond the immediate disturbance due to the establishment of compliance points and mixing zones by other regulatory agencies. Due to the nature of mining, these situations will occur even with model operations that are in compliance with all applicable laws and regulations." -- Federal Register (2000, p. 70045§).

The amount of land classified as being actively mined in the United States probably will not increase at a rapid rate primarily because of modern land reclamation requirements that seek to have mined lands transformed for other uses (Table 3). Thus, land classification will reflect a new category of use following reclamation. Modern coal mining, for example, typically demonstrates a continuous process of mining and land reclamation, with about 75 percent of lands mined for coal having been restored for other potential uses during the 20th century. The perspective for lands used for aggregate mining is similar, with mined areas being reclaimed for a variety of uses after materials are extracted (Dunphy, 1998; Robinson and Brown, 2002). In the case of aggregate mining, the industry has been producing more crushed stone from rock quarries than sand and gravel from glaciofluvial deposits since 1974 (Tepordei, 2001, p. 13). Because rock quarries produce large amounts of aggregates from significantly smaller areas than alluvial deposits, there is a trend toward reducing the total area of the United States being actively mined for aggregates. This is a significant trend because aggregate mining accounts for more than one-half of all mining in the United States on the basis of either weight or volume (Tepordei, 2001, p. 13).

Reclamation Trends for Aggregate Quarries

Residential developments, parks, commercial sites and landfills have all been traditional end uses for mined out aggregate quarries. Golf courses are being planned and developed in mine sites. Quarries converted into ponds and lakes can become productive wildlife habitat and provide a favorable setting for residential developments. Quarry pits are also used as groundwater recharge basins. In some cases, mining companies forego depleting the entire reserves of an aggregate quarry in favor of reserving land for future and more profitable valued real estate development (Dunphy, 1998, p. 28).

Table 3. Land Used and Reclaimed by the Mining Industry in the United States, 1930-2000. Adapted from Mineral Information Institute, Inc. (2000).

Commodity	Acres Used	Acres Reclaimed	Percent reclaimed	Acreage being actively mined in 2000*
Metals	508,000	41,000	8.1	467,000
Nonmetals	2,353,000	635,000	27.0	1,717,400
Coal and peat	2,818,000	2,053,000	72.9	765,000
Total	5,700,000	2,700,000	47.4	2,949,000

* The Office of Surface Mining (OSM) indicated in 1992 that the amount of public and private land permitted for coal mining between 1978 and 1991 in the United States totaled 4,228,334 acres, with 1,292,227 being reclaimed and released from bond. The net acreage used for coal mining would then total 2,936,107 acres. However, not all of this land is being mined. Some land has been reclaimed, but not released from bond. Some land has not yet been mined, and some will never be mined because it is used as a buffer between mining operations and other types of land use.

The Federal Estate Available for Energy and Minerals Development

According to Gorte and Vincent (2001§), the Federal government owns about 655 million acres (265 million hectares) of land, or about 28 percent of the total land area of the United States. Lands under American Indian and Alaska Native sovereignty (Indian trust lands) comprise about 56 million acres (23 million hectares). These and other lands (because of the disposition of mineral rights on Indian trust lands) compose the Federal estate of greater than 700 million acres (283 million hectares) that are potentially available for mineral development.

Federal Land Management in the United States, 1995

The Bureau of Land Management (BLM) in the U.S. Department of the Interior (DOI) and the U.S. Forest Service (USFS) in the U.S. Department of Agriculture (USDA) together manage 456 million acres (185 million hectares) of land, or 70 percent of that owned by the federal government. Other agencies, notably the U.S. National Park Service (NPS) and the U.S. Fish and Wildlife Service (FWS) of DOI manage, respectively, 78 million acres (32 million hectares) in National Parks and about 88 million acres (36 million hectares) for the conservation and protection of fish and wildlife (Cody, 1995§). BLM itself manages 264 million acres (107 million hectares) of land, predominantly in Alaska and 11 western states, of which about 150 million acres (61 million hectares) is managed for grazing. The USFS administers 192 million acres (78 million hectares) of federal land, also concentrated in the American West (Gorte and Vincent, 2000§; Cody 1995§).

According to Cody (1995§):

"The BLM administers the mineral resources of the onshore Federal estate available for development, regardless of surface and subsurface management jurisdiction. The entire surface and subsurface Federal estate subject to mineral development totals 732 million acres (296.2 million hectares). [Other sources, including BLM, claim BLM's jurisdiction over mineral development to cover 700 million acres (283.3 million hectares) in 2001 (U.S. Bureau of Land Management, 2001a).] Some minerals are available for development under the mining laws; others are developed through a leasing system. Authorities for disposition of mineral lands and resources are primarily found in the General Mining Law (Mining Act of 1872§), the Mineral Leasing Act of 1920§, the Mineral Leasing Act for Acquired Lands of 1947§, and the Materials Disposal Act of 1947§. Activities governed by these laws include the location and patenting of mining claims for hard rock minerals, competitive and noncompetitive leasing of lands for leaseable minerals (oil, gas, coal, potash, geothermal energy, and certain other minerals), and the sale or free disposal of common mineral materials not subject to the mining or leasing laws. Authorities for mining, leasing, and royalties may differ for public domain and acquired lands."

Current (2000) Mining Activity on Federal Lands under the 1872 Mining Law

Most of the current mining activity and mineral claims under the 1872 Mining Law (Mining Act of 1872§) are in Nevada, Arizona, California, Montana, and Wyoming. Of a total of 235,948 mining claims as of the end of FY2000, approximately 45% were in Nevada alone and another nearly 35% are in those other four states. According to the Bureau of Land Management (BLM), the number of claims declined from about 1.2 million claims in FY1989 to 294,678 for FY1993. Many claims were dropped as a result of provisions of law charging a $100 per-claim annual maintenance fee to hold a claim. The number of claims subsequently rose to 324,651 in FY1997, reflecting the relative strength of the gold and copper industries. The number of claims has fallen to a low of 235,948 for FY2000, reflecting a decline in the gold and copper industries and, according to the BLM, changes in public land policy that significantly lengthened the time it takes in practice to get permission to mine.

Only a small percentage of claims are ever patented, totaling about 3.3 million acres (1.3 million hectares) from 1867 through 2000. This represents approximately 1.5% of all public lands patented; most public lands have been patented under homestead entries, statehood grants, railroad grants, and other non-mineral public land laws. It is not required to patent a claim to mine a deposit, and a great deal of mining activity is currently taking place on unpatented claims. However, patenting a claim gives the holder legal title to both the surface and the minerals.

-- Humphries and Vincent (2001§).

At one time, BLM also had responsibility for Outer Continental Shelf (OCS) leasing. In 1982, a Department of the Interior reorganization placed the Minerals Management Service (MMS) in charge of all OCS leasing.

Now, BLM is responsible for administering all onshore energy and mineral resources, while MMS is responsible for all OCS leasing and also management of revenues derived from onshore and OCS leasing."

Federal Land Withdrawals

Federal land withdrawals are actions that restrict the use or disposition of public lands. For example, Federal land, such as that in National Monuments or National Forests, can be and has been withdrawn from mineral development, generally to study or protect certain natural and cultural resources (USDA Forest Service, 1999§). Although the discussion on pages 47-51 suggests a vast Federal estate available for minerals and energy development, there are significant legal, political, economic, and temporal barriers to access this estate by the extractive industries. As the figures above show, about 166 million acres (67.2 million hectares) of Federal lands are managed as National Parks and National Wildlife Refuges. National Parks are generally inaccessible for minerals exploitation, although mining such as gravel mining for road construction and maintenance does occur in these preserves. As of the year 2000, approximately 4,000 abandoned mines and 150 active mine sites existed within National Parks (Arbogast and others, 2000, p. 5). In National Wildlife Refuges, restrictions on access and practices by the minerals industry commonly inhibit economic mining activity. Wilderness and roadless area designations on other Federal lands similarly may preclude ready access to mineral resources. In some cases land is reserved for specific uses such as existing development or military operations, and these uses may rule out locating mining claims and granting leases.

Partly because of the tension between environmental protection and resource exploitation, extractive industries face increasingly protracted processes for developing projects on public lands. In some cases, although access to public lands is expressly allowed, the time and effort to complete a permitting process can jeopardize the economic viability of the project. As indicated by Strusacker (1997, p. 359) "…the nature of regulatory and political atmosphere with respect to mining is the most influential factor in determining whether permitting a project will be relatively straightforward and easy, or complex and difficult." Thus, accessing land available for mining becomes complicated by investing in managing political issues surrounding the proposed work, and the costs of producing a suite of technical and environmental studies.

According to the BLM, of the approximately 700 million acres (283 million hectares) of federal subsurface minerals under the agency's jurisdiction in 2000, approximately 165 million acres (67 million hectares) or about 24 percent have been withdrawn from mineral entry, leasing, and sale, subject to valid existing rights. Lands in the National Park System (except National Recreation Areas), Wilderness Preservation System, and the Arctic National Wildlife Refuge (ANWR) are among those that are statutorily withdrawn. Also, mineral development on another 182 million acres (74 million hectares) of this 700 million acres (283 million hectares) is subject to the approval of the surface management agency, and must conform to land designations and plans. National Wildlife Refuges (except ANWR), wilderness study areas, and roadless areas, among others, fall in this category.

Wilderness Designations and Mineral Rights

Wilderness designations are often controversial because wilderness areas have strict management and use limitations. Wilderness is "undeveloped Federal land ... without permanent improvements," and is to be managed to protect and preserve the natural conditions. Permanent improvements, such as roads and buildings, and activities which alter existing natural conditions, such as timber harvesting, are prohibited in wilderness areas. The Wilderness Act provided one temporary exception to the management restrictions: mineral exploration and leasing was allowed in wilderness areas for 20 years, until December 31, 1983. In addition, Congress specifically directed that livestock grazing be continued and that valid existing mineral rights be pursued under reasonable regulations to permit development while preserving wilderness characteristics (Cody, 1995§).

According to Humphries and Vincent (2001§), the Federal Land Policy Management Act of 1976 (FLPMA) mandated review of public land withdrawals in 11 Western states to determine whether, and for how long, existing withdrawals should be continued. BLM continues to review approximately 70 million withdrawn acres (28 million hectares), giving priority to about 26 million acres (11 million hectares) that are expected to be returned by another agency to BLM, or, in the case of BLM withdrawals, made available for one or more uses. As of November 2000, BLM has completed review of approximately 7 million withdrawn acres (3 million hectares), mostly BLM and Bureau of Reclamation land, and the withdrawals on more than 6 million of these acres (2 million hectares) have been revoked. According to the BLM Manual, retention of a withdrawal requires a compelling show of need, and an agency manager "recommending that lands not be opened to multiple use, particularly mining and mineral leasing, must convince the BLM Directory, Secretary, and watchful segments of the public, that there is no reasonable alternative to continued withdrawal or classification." The review process is likely to continue over the next several years, in part because the withdrawals must be considered in BLM's planning process and be supported by documentation under the National Environmental Policy Act of 1969 (NEPA)§.

Mineral industry representatives maintain that federal withdrawals inhibit mineral exploration and limit the reserve base even when conditions are favorable for production. Mineral reserves are not renewable. Thus, they argue that whether minerals are in the public or private sector, without new reserves or technological advancements, mineral production costs may rise. As a result, according to the industry, exploration on foreign soil has increased (Hitzman, 2002), raising the risk to investors and boosting import dependence. In this view, governmental policies that increase costs to the mineral industry may result in increased costs to society (Murray, 1997, p. 635). Mining industry supporters also assert that too much land has been unnecessarily withdrawn from mining, through administrative actions, in order to pursue preservation goals (Humphries and Vincent, 2002, p. CRS-9§).

Critics of access to public lands by the mineral industry (particularly under the Mining Act of 1872§) believe that in many cases there is no way to protect other land values and uses short of withdrawal of lands from development under the law (Humphries and Vincent, 2002, p. CRS-9§). For example, they point to areas that have been mined for hardrock minerals in the past, leaving open pits, tailings piles, toxic discharges, and other features that were abandoned without being treated or reclaimed. They show examples of problems with mining wastes that have gone untreated for centuries, and those that will require maintenance for centuries in the future. They cite cases where the sphere of influence of mining (for example, noise, dust and other emissions to the atmosphere, groundwater drawdown, transportation access, and a host of other effects) extends onto adjacent public lands well beyond the boundaries set aside for mining (Federal Register, 2000, p. 70045§). They also cite instances where minerals development has in the past or could in the future spoil scenic, historic, cultural, and other resources on public land.

Socio-economic Changes and Federal Lands

"The population of many of the western mining states is increasing rapidly, often with people who come from regions where hardrock mining has not been a common activity. Consequently, new residents may have values and interests that differ substantially from those of other residents who depend on mining for jobs and opportunities. In addition, the U.S. population today generally expects more from its federal lands – more recreational opportunities, more wildlife and habitat protection, more watershed protection, more timber and forage production, more historic and cultural preservation, more sensitivity to tribal concerns, as well as more mineral activities. It is likely to become increasingly difficult to find sites that will not stimulate some opposition from groups with competing values and interests in the same lands." (National Research Council, 1999, p. 34)

As of 2002, the controversy over public lands continues. The mining industry and its adherents are attempting to overturn or modify legislation promulgated in 2000 that allows the BLM to deny expansion of existing mines or begin new ones if the plan suggests "unnecessary or undue degradation" of the land in question (Resources Publishing Company, 2001§). Detailed discussions about "unnecessary or undue degradation" are included in questions to and responses by the Bureau of Land Management published in the Federal Register (2000, p. 69997-70046§) including definition of the phrase on pages 70015-70018, and frequent discussion of the concept throughout. Despite any distribution of lands -- public or private, readily accessible or mandated to be off limits to development -- the mining industry has a major stake in gaining access to areas where the resources can be most economically extracted, and other parties have strong interests in prohibiting mining. As many past and current situations illustrate, the demands of mining routinely come into conflict with other uses of the land (National Research Council, 1999, p. 87-88).

Federal Land Use Trends and Mining

Between 1785 and 2000, the United States Federal government transferred approximately 1.1 billion acres (445 million hectares) of Federal land to state, local and private ownership (U.S. Bureau of Land Management, 2001b). If current trends continue, the Federal government will probably continue to transfer lands out of its ownership in the 21st century as it adjusts for changing demands for mineral development and other uses. The pace of transfer and the size of parcels the government transfers could be reduced from similar activities of the past two centuries. Additionally, the Federal government is likely to continue the process of withdrawing land for studies of alternative uses, reviewing withdrawals, and revoking withdrawals in favor of minerals and other development (p. 52, this volume). The land withdrawal process can be seen as embodying societal values about the use of public lands in the United States as reflected in the actions of the U.S. Congress.

Gorte and Vincent (2001§) describe continuing issues for the United States Congress with respect to Federal lands. The issues typically surround reconciling different perspectives on lands the Federal government should own. Questions include:

- How much land should be acquired from or conveyed to state, local, or private ownership, and under what circumstances?
- Should the non-federal role in managing Federal lands be expanded?

- How should land acquisition be funded, and what are the concerns about acquiring private land?
- How effective are Federal land exchange programs?
- Should funds be appropriated to reduce the backlog in maintaining Federal lands as an alternative to new acquisitions?
- How should the congress balance multiple uses of public lands in terms of resource extraction, preservation, and wildlife protection?
- To what extent should Congress support traditional commodity uses, primarily mining, oil and gas production, livestock grazing, and timber harvesting?
- Historically, Federal resources have supported local economies; however, how does the Congress treat the more recent trend toward non-development values?

Gorte and Vincent (2001§) further note that, at the outset of the 21st century, the United States Congress continues debating issues related to land and resource protection, such as designating national monuments and other protected areas, funding for wildfire protection, and regulatory changes for mining and roadless areas (National Research Council, 1999; Resources Publishing Company, 2001§). Other issues relate to setting fees, for such uses as rights of way and livestock grazing; collecting revenues, for example, by imposing royalties on mining; and regulating the environmental effects of land uses. The effect of these efforts on land uses and the role of Congress, states, and the public in determining use and protection are among the controversies. All of these issues relate to the relative ease or difficulty of obtaining mineral supplies from Federal lands, and illustrate the complexity and persistence of issues affecting supply. Currently (2002), there are about 3,100 protected areas on public lands in the United States comprising nearly 13 percent of the U.S. land area (World Resources Institute, 2000a).

Non-federal Lands Available for Mining

As indicated previously (p. 47, this volume), cities, towns and highways occupy about 110 million acres (45 million hectares) of land, private agricultural lands occupy about 983 million acres (398 million hectares), and about 50 million acres (20 million hectares) are covered with water bodies in the United States. Mining activities of various types occur within all these categories. For example, aggregate mining is common within and near cities, towns, and highways. In many coastal areas of the United States, sand is mined in the offshore environment for beach replenishment and other uses. Oil and gas drilling take place on private agricultural lands and in water bodies. Accessing mineral resources on these lands is conditioned on factors such as the cost of purchasing or leasing the land for mining, obtaining permits, complying with zoning regulations, changing zoning through a political process, overcoming political resistance to mining, and other related factors. In many cases, the mining industry has access to resources through subsurface mineral rights that are superior to the rights of the surface landowner.

Urban and suburban expansions, including highways and other transportation corridors, tend to preclude both new mining for resources covered by development and additional mining after new development takes place. In the extreme, the land occupied by cities and towns at the beginning of the 21st century could be considered off limits to new mining. However, urban and suburban land use is dynamic, and access to subsurface resources comes and goes with physical and political changes at the surface. Land-use zoning can be changed from agricultural or residential to allow industrial activities such as aggregate mining (Robinson and Brown, 2002). Large swaths of land can be condemned, particularly for highways and water resources development, thus freeing the land particularly for aggregate mining to support that development. If surface mining is impossible because of the presence of buildings, mining in favorable cases can proceed beneath the buildings via surface entry at some distance from the development.

There are approximately 281 million people in the United States at the outset of the 21st century (Kent and others, 2001§). Projections for population growth suggest that the number of people will increase to about 413 million people by 2050, and roughly double the 2000 population by the end of this century (Population Reference Bureau, 2001§). The expected addition of another 250 to 300 million to the United States population during the 2100s could result in major new cities evolving from smaller towns or evolving in places that do not yet have significant development. Assuming the current ratio of people to built-up areas in 2000, and estimating the population of the United States at about 550 million people by 2100, one scenario could be a doubling of the land demanded for new cities, towns and highways. (Other scenarios might argue for more or less than a one-to-one ratio between population and developed land). This means an additional 70 to 80 million acres (28 to 32 million hectares) of land could be converted to urban and suburban regions during the next 100 years, and up to 30 million acres (12 million hectares) converted to highways in the absence of major changes in transportation technology. The bulk of this land conversion would probably occur in the vicinity of existing major metropolitan cores (Mitchell, 2001), and could be accommodated primarily by transforming rural lands and private agricultural lands into cities, towns, and transportation corridors. This implies diminishing opportunities with time to exploit the mineral resources on these lands while permanent to semi-permanent development proceeds at the surface. There are many scenarios for the sources of land for new urban and suburban development, but trends indicate that the greater part this land will likely come from private ownership and particularly from agricultural lands in the vicinity of existing, major metropolitan regions. The composite image of the United States shown in Mitchell (2001, p. 56-57) illustrates the strong trend for new and rapid development in the immediate vicinity of major urban areas for 1993-2001.

Possibilities also exist for lesser increases in urban-suburban development per capita during the 2000 – 2100. A modern analysis of land transformations to accommodate population growth for the Albuquerque, New Mexico region indicate trends toward in-fill development in existing urban areas, and modest decreases in urbanized area per capita in existing cities (Table 4.). Further work is needed to determine whether the Albuquerque scenario could be representative of other growing metropolitan areas, and whether this portends a diminishing per capita demand during the 2100s for the materials used to construct cities, towns, and transportation corridors.

Table 4. The Spread of Urban and Suburban Land in Albuquerque, New Mexico, 1886 – 2050 (Projected).

Year	Albuquerque Urban Area in Acres	Rate of Growth, Acres/Year
1886	2,000	
1935	4,400	49
1951	15,400	688
1973	49,700	1559
1991	84,900	1956
2050 (projected)	124,600	673
1886 – 2050 (projected)	Total 124,600	Average 748

Growth of the Albuquerque urban area 1991 – 2050 is based on observations and projections of in-fill development and physiographic, legislative, and regulatory constraining factors. Physiographic constraints include the Sandia Mountain Range abutting the Albuquerque urban area on the east. Lands exempted from growth at the beginning of the 21st century because of legislative and regulatory constraints include the Cibola National Forest to the east, Petroglyphs National Monument to the west, and Sandia Indian Pueblo lands to the south. (Data and explanations courtesy of David J. Hester, U.S. Geological Survey, Rocky Mountain Mapping Center, Denver, CO, March, 2001).

Uncertainties Influencing Mineral Exploration

The ease of managing political issues and gaining acceptance of technical and environmental studies for mineral exploration varies from place to place. In the United States at the turn of the 21st century, California, Montana, Oregon, Washington, and Wisconsin (Appendix A.) are particularly difficult places in which to permit a mining project, whereas Nevada, Arizona, Utah and Alaska pose fewer obstacles. On a more global scale in the year 2000, the South and Central American countries of Argentina, Brazil, Chile, Mexico, and Peru generally posed significantly less investment risk in terms of developing projects than Indonesia, Papua New Guinea, and western Canada (Fredricksen and Jones, 2001). However, for additional reasons, including lower prices and decreased demand for copper, Fredricksen and Jones (2001) note that mining companies are tending to decrease their rate of investment for exploration in Chile and Peru despite the significant mineral endowments and comparative ease of permitting mining operations in those countries.

Some Uncertainties That Influence Exploration Investment by Mining Companies

- ***Uncertainty concerning the administration/interpretation/enforcement of existing regulations***
- ***Environmental regulations***
- ***Regulatory duplication and inconsistencies***
- ***Uncertainty concerning native land claims***
- ***Uncertainty concerning what areas will be protected as wilderness or parks***
- ***Infrastructure***
- ***Labour regulation/employment agreements***
- ***Socio-economic agreements/community development conditions***
- ***Taxation regime***
- ***Mineral potential, assuming CURRENT regulation/land use policies***
- ***Mineral potential, assuming NO land use restrictions in place, and further assuming that any mine would operate to industry best practice standards***

-- Fredricksen and Jones (2000, p.10).

Exploration investment trends by mining companies at the turn of the 21st century give a somewhat clearer picture of the distribution of areas favorable to mining around the globe. According to Fredricksen and Jones (2001, p. 44), mining companies are generally decreasing the proportion of their exploration budgets they spend in Indonesia, Chile, Peru, and the USA. They are increasing the proportion of their exploration budgets they spend in Australia, Mexico, Brazil, and South America as a whole. Thirty-five percent of companies indicated an increase in the proportion of their exploration budgets they spend in Canada, while another 35 percent reported a decrease. In the USA, 53 percent of companies reported a decrease in the proportion of their exploration expenditures, while 30 percent indicated an increase.

Wilburn (2001, p. 41) reports worldwide exploration budgets for 2000 for 656 companies totaling $2.34 billion. About 28.3 percent of budgeted exploration expenditures for nonfuel minerals were targeted for Latin America, followed by 17.3 percent for Australia, 14.9 percent for Canada, 12.6 percent for Africa, 10.0 percent for the United States, 8.5 percent for the Pacific Region, and 8.4 percent for the rest of the World. Wilburn indicates that the world exploration budget increased steadily from 1994 through 1997, but declined substantially between 1997 and 2000. He attributes the decrease to changing exchange rates, continued low commodity prices, investor wariness for funding exploration activities, and tighter company budgets.

Analysis of Exploration Activity

From 1994 to 1997, exploration activity shifted away from Australia, Canada, and the United States (highly industrialized areas with extensive past mineral exploration) toward Africa, Latin America, the Pacific and other regions (largely developing regions with under-explored areas). During the years 1998-2000, however, this trend apparently reversed. This was because low commodity prices, regional unrest (central Africa), financial turmoil (Asia-Pacific) and post-Busang investor trauma all seemed to focus investor interest toward areas with established mineral potential and away from areas with more potential risk.

-- adapted from Wilburn (2001, p. 44).

For the United States, Wilburn (2001, p. 43-44) notes that new exploration activities generally require deeper and more expensive drilling. Stringent permitting standards in many states also add to the exploration cost. Investor interest in exploration in the United States varies considerably depending upon state regulatory practices. The policy climates in Nevada and Alaska are the highest rated in terms of favoring investment in mining, and Wisconsin (Appendix A.), California, Montana, and Washington are among the lowest rated.

The exploration patterns described above can be seen to reflect forward-looking decisions by the minerals industry that weigh and integrate the factors shown on page 60 (this volume), and include these factors with a spectrum of other issues such as prices and demand. In summary, the overview reinforces the existence of a highly complicated mix of sociocultural drivers and constraints that influence minerals exploration investment and consequent mineral supply.

Parks and Protected Areas Around The Globe

In 1970, North America (Canada, United States, and Mexico) contained about 800 protected areas. By 1980, that number had increased to about 1,300, and by 2002 it had increased to 2,800 (Commission for Environmental Cooperation, 2002, p. 40). These 2,800 parks and protected areas comprised about 300 million hectares (741 million acres) in 2002, or about 15 percent of the continent's land area. Note that protected areas do not necessarily preclude mining, forestry, and other uses. However, such uses could likely face greater restrictions on protected lands than on other lands. The Commission for Environmental Cooperation (2002, p. 41) further states, "There is enormous variety in the levels of protection afforded to these areas, however, both among and within the three countries, depending on their designation. Some areas that are deemed 'protected' actually encourage development activities that put biodiversity at great risk." Areas fully protected are those in which extractive activities are prohibited, and such areas account for about 5.7 percent of North America's landmass.

There are an estimated 44,000 parks and protected areas globally, covering about 10 percent of the world's land surface (World Conservation Monitoring Centre and IUCN World Commission for Protected Areas, 1998). About 42 percent of areas designated for protection are found in developing countries. Because of population and development demands projected for the 21st century, the demand for additional protected areas beyond those that currently exist may be difficult to meet. Areas of pristine lands considered desirable for parks and protection continue to disappear rapidly due to development, whether in highly industrialized or developing countries (World Conservation Monitoring Centre and IUCN World Commission for Protected Areas, 1998). Additionally, any increases in protected areas could be nullified through neglect, inadequate funding, lack of enforcement, political transformations, and other countervailing forces that revert protected areas to developed or disturbed status (World Conservation Monitoring Centre and IUCN World Commission for Protected Areas, 1998). The result is an outlook suggesting 85 to 90 percent of global land area could continue to be available for other uses, with mineral and other development continuing to be allowed, generally with major restrictions, on some parts of the remaining 10 to 15 percent in the "protected" category.

Global Parks and Protected Areas

IUCN - the World Conservation Union, defines a protected area as: "an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means."

IUCN categorizes protected areas by size (1000 hectares or larger) and management objective, and has identified six distinct categories of protected areas:

I. Strict Nature Reserve/Wilderness Area: protected area managed mainly for science of wilderness protection;

II. National Park: protected area managed mainly for ecosystem protection and recreation;

III. Natural Monument: protected area managed mainly for conservation of specific natural features;

IV. Habitat/Species Management Area: protected area managed mainly for conservation through management intervention;

V. Protected Landscape/Seascape: protected area managed mainly for landscape/seascape protection and recreation; and

VI. Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems.

Protected areas face many challenges, such as external threats associated with pollution and climate change, irresponsible tourism, infrastructure development and ever increasing demands for land and water resources. Moreover, many protected areas lack political support and have inadequate financial and other resources.

-- World Conservation Monitoring Centre and IUCN World Commission for Protected Areas (1998).

Resolving Societal Issues: The Mining Industry's Response to Sustainability

"In theory, sustainable development translates into extracting and consuming natural resources at a rate that leaves something for future generations. Each and every new mineral deposit would not be developed immediately, and we would not mine merely for the sake of mining. This is a difficult concept for the mining industry to embrace. It is contrary to the time-tested manner in which mining is conducted. In the public's mind, sustainable development to the mining industry means exploiting each deposit as quickly as possible to maintain cash flow and increase investor returns. But sustainable development can also mean improving the quality of life in an emerging nation by providing jobs, education, health care, and basic infrastructure. We must live with the issue of producing more than we need, and in the process occasionally generating costly and unnecessary environmental damage." – Mudder (2001)

Analysts including Mudder (2001) and Marcus (1997) have discussed modern, negative public perceptions of the mining industry pointing out that mining companies do not necessarily mine for mining's sake alone, but to meet or create society's demands for materials. The focus is primarily to understand the negative perceptions in order to prescribe new directions for meeting the demand for minerals while enhancing or renewing the industry's image. Mudder's definition of sustainable development and mining is only one of many possible interpretations, but he does recognize that negative perceptions are not likely to change quickly, and advocates several ideas for creating a more positive image of mining. For example, he encourages a renewed focus on local communities that possess mineral resources, and engaging local people respectfully and repeatedly through identifying their cultural needs and desires. Importantly, he also calls for the mining industry to reestablish the connection between its products and the people who use them through comprehensive public outreach.

In reviewing the American mining industry, Marcus (1997, p. 8) describes the industry and its professionals at a "significant crossroads" during the first half of the 1990s, noting especially the changes in public perception and degree of acceptance of mining since the 1960s and 1970s. These changes effectively overturned accepted wisdom about mining, and rapidly placed mining professionals (mining and metallurgical engineers and geologists) in defensive positions about their role in society. The result was an industry-wide trend toward new types of mining professionals who participate in resources extraction, but with the maximum amount of care (Marcus 1997, p. 10). Marcus (1997, p. 10) predicted: "The next decade should see the complete change from the old to the new style mining industry professional."

At the outset of the 21st century, the "new style mining industry professional" is becoming a prominent actor in the global business of mining. The ascendant themes for the business are many, but revolve around several key principles and activities repeated throughout the literature about the industry and the documents the industry prepares for its stockholders and the public. Typically, the industry expects to be judged by its shareholders and members of the communities wherein it operates not only based on its financial performance, but also on its safety and environmental performance. Many companies now prepare sustainability and environmental reports in addition to financial reports (BHP Billiton, published annually§; Homestake Mining Company, published annually§; Placer Dome, Inc., published annually§). Since March 2000, the bimonthly journal Mining Environmental Management has offered descriptions of publicly available mining company reports on sustainability and environmental performance, revealing a proliferation of these documents since the latter half of the 1990s. These documents devote considerable space to activities and guidelines for protecting employees, members of the public, and the environment from adverse consequences of mining; sustainability policies; and policies for reducing greenhouse gases. Recurrent themes include: developing openness and transparency with local communities about the company's intentions and practices; understanding rights appurtenant to aboriginal lands and resources; building alliances among stakeholders, establishing community wide emergency preparedness strategies; and correcting past practices that have created environmental or health problems. In general, to accommodate the sociocultural complexities of extracting minerals, the mining industry is moving well beyond common practices of most of the 20th century toward a more all-embracing commitment to social, environmental and economic goals.

Social Challenges in Central America and South America

Pasco-Font (1997§) describes several key social challenges for mining in Central America and South America. He advocates that the industry provide linkages with other economic sectors of each country in which it operates. This will ensure that part of the wealth generated by mining supports future economic growth after the mine closes, thereby diversifying the economy and promoting sustainability. He asks that the industry investigate infrastructure development in the mining region to determine the relative costs and benefits of social and cultural dislocations. The industry cannot presuppose that mining induced migration is either beneficial or detrimental for a community because the impact will likely differ from case to case. He cautions the industry about problems associated with changing local cultural patterns that are quite different from a "market oriented Occidential culture." Mining companies can have positive effects on culture, for example, by providing local people with training in skills they can market elsewhere in the economy. However, companies need to recognize how mining can overturn the local economy, whether in its effects on traditional land use or in shifting power from traditional authority to the people connected with mining.

Pasco-Font (1997§) further asks the industry to recognize that indigenous people and even communities located in isolated areas usually have customs that are more important than the laws of the state. The local customs and the state laws could even conflict on paper. Given the low levels of state enforcement typical in remote areas, local customs are by default the prevailing and valid laws in terms of land use and property rights. Ignoring this construct (and a long history of disagreement about land titling in the region) in favor of state laws has been a source of persistent conflict for the mining industry in the past. Moreover, informal or artisanal mining prompts frequent disputes throughout the region between legitimate companies and individuals or small groups who have occupied ore deposits. Modern practice recommends substantial sociocultural research by foreign investors and companies to determine courses of action and agreements that might succeed in each unique situation.

Canada's Whitehorse Mining Initiative

"Our vision is of a socially, economically and environmentally sustainable, and prosperous mining industry, underpinned by political and community consensus." – Whitehorse Mining Initiative (1994, p. 1§).

The Canadian mining industry, recognizing that it faced major challenges for its future, decided in 1992 to take convincing action to ensure its viability in the 21st century. On behalf of the mining industry, the Mining Association of Canada proposed a cooperative approach to problem solving at a special meeting of mines ministers of all provincial governments in Whitehorse, Yukon Territory, Canada in September 1992. The approach, developed within a non-adversarial framework, garnered support from the mining industry, provincial governments, labor unions, aboriginal peoples, and the environmental community. These groups engaged in facilitated discussions for 18 months, and developed the accord known as the Whitehorse Mining Initiative (Natural Resources Canada, 1999§). The accord resulted from a process considered to be "…a remarkable achievement in the history of mining in Canada. It was so novel that it attracted international attention among mining industry officials, governments, and other stakeholders in Australia, the United States, and other mining countries…" (Whitehorse Mining Initiative, 1994, p. 4§).

The Whitehorse Mining Initiative (WMI) specifically calls for:

- Improving the investment climate for investors
- Streamlining and harmonizing regulatory and tax regimes
- Ensuring the participation of Aboriginal peoples in all aspects of mining
- Adopting sound environmental practices
- Establishing an ecologically based system of protected areas
- Providing workers with healthy and safe environments and a continued high standard of living
- Recognition and respect for Aboriginal treaty rights
- Settling Aboriginal land claims
- Guaranteeing stakeholder participation where the public interest is affected
- Creating a climate for innovative and effective responses to change

The accord illustrates the complexities of the sociocultural environment surrounding the mining industry in Canada. For example, the accord is based on 16 fundamental principles from which the stakeholders derived 70 specific goals. The principles and goals treat business climate, financing, taxation, overlap and duplications, government services, environmental protection, planning and environmental assessment, use of information and science in environmental decisionmaking, land use and land access, protected areas, certainty of mineral tenure, attracting and retaining skilled workers, maximizing community benefits from mining, Aboriginal lands and resources, Aboriginal involvement in the mining industry, and an open decisionmaking process.

The WMI is based on a strategic vision for a healthy mining industry that acknowledges concepts of sustainability, healthy and diverse ecosystems, constructive relationships among stakeholders, and sharing opportunities among stakeholders with special emphasis on Aboriginal cultures. The WMI is evolutionary, promising implementation of its principles and goals at the national and regional levels, and convening participants from time to time for progress checks and advancing the agenda.

Results in the late 1990s specifically attributable to the WMI include communications initiatives, multi-stakeholder forums, partnerships and agreements, general legislative and political initiatives, voluntary actions in the spirit of the WMI, and initiatives on land and land access, protected areas, and labor force development (Whitehorse Mining Initiative, 1996§). Mining industry and environmental organizations have been actively presenting WMI Accord principles to a variety of audiences. Mining companies have been honored for their environmental records. Stakeholders have partnered to develop new skills needed in the mining industry, to advance cost-effective and cooperative environmental impact assessments, to treat mining-related issues with Aboriginal peoples, to reach prescribed and voluntary agreements on major reductions in toxic releases, and to fund research on regional environmental and socioeconomic issues. Legislators have begun to create new legislation incorporating the principles of the WMI, and to update and streamline existing legislation on the environmental regulation aspects of mining. Many new political initiatives on mining in several Canadian provinces are couched in the framework of sustainability or sustainable development (Whitehorse Mining Initiative, 1996, p. 7§). Canadian provinces and mining companies have begun to reach agreements on issues such as relinquishing prospecting rights in favor of establishing parkland in some areas while improving land access and securing tenure for mining in other places. Additionally, industry representatives are working with environmental NGOs to establish criteria for selecting areas for mine development and conservation. A few Canadian provincial governments also are creating initiatives for tax incentives favoring the mining industry, and for meeting the industry's workforce demands. Other work in progress includes crafting sustainable development strategies for Aboriginal lands throughout Canada, creating information systems that incorporate forestry, fish, wildlife, ownership, and other information in mineral resource management, reviewing community consultation and involvement in the mining industry, and drafting new minerals policies based on sustainable development as guided by the principles of the WMI.

The WMI was not as successful as its proponents had hoped it might be, primarily because there was no governing body specifically mandated to carry the initiative forward. However, the WMI had great influence in Canada in modifying the way people viewed the conflicts surrounding mining. The WMI was successful in setting a tone for collaboration, and remains an object lesson and a model for directions being taken by the Mining, Minerals and Sustainable Development Project of the Global Mining Initiative (p. 72-75, this volume).

The Business Implications of Sustainable Development: Rio Tinto Borax

Rio Tinto Borax, with operations in the United States, Argentina, Spain, France, and The Netherlands, evolved from Borax, a company that was established in California in 1872 and joined Rio Tinto in 1966. The company rapidly built a global market for its products in the late 1800s, and has been considered the world leader in borate production and technology. In 2001, Rio Tinto Borax completed a study to translate ideals about the company's commitments to social, economic and environmental responsibility into standards and measurements. The company published initial results in its 2000 Social and Environment Report (Rio Tinto Borax, 2001§). The company acknowledged a need to resolve inconsistencies between its business strategy and sustainable development priorities, and offered the report as a milestone in transitioning sustainable development from a research project to a business imperative (Global Mining Initiative, 2001, p. 1§). The study builds on sustainable development principles, and develops five objectives for which the company defines indicators, or units that can be used to measure progress towards the objectives through specific metrics. Within each objective are several targets, or levels of performance sought within a defined timeframe. Table 5 provides an example of the company's objective of enhancing the human potential and well being of its employees and the communities in which it works.

Table 5. – Indicators, metrics and targets set by Rio Tinto Borax to meet the objective of enhancing the human potential and well-being of communities and employees (Rio Tinto Borax, 2001, p. 11§).

INDICATOR	METRIC	TARGET
Consultation and mutual understanding	Number of consultations with representative groups in the community Number of targeted perception surveys with appropriate follow-up	Minimum two meetings per year* Minimum one every two years for employees and the community
Strategic alliances supporting the principles of sustainable development (SD)	Percentage of site closure plans addressing SD priorities Percentage of sites with partnership criteria defined and utilized	100% by 2004 100% by 2001
Transferable skills development	Percentage of employees giving time to training or mentoring in the community Percentage of employees trained in transferable occupational skills Percentage of sites working with the community to establish criteria for educational initiatives consistent with SD principles	10% by end of 2001 100% by end of 2002 100% by end of 2002

*Consultation with community groups will be subjected to more rigorous parameters in 2001. In 2000, site-reported consultation could have included community relations or charitable activities. These consultations are now defined as meaningful discussions with stakeholders on how Borax contributes to – or detracts from – the health and well-being of neighboring communities.

The report also includes objectives for health and safety, balancing environmental and economic concerns, optimizing economic contribution to society, and enhancing a product stewardship policy and program. The report links all objectives to sustainability through a set of guidelines for sustainable partnerships (Rio Tinto Borax, 2001, p. 15§).

The report treats the following areas of performance:

- Addressing effects of mining companies' operations on employees and the neighboring communities not only during the life of the mine, but also beyond its closure
- Seeking global opinions on the tenets of sustainable development through surveys of customers, community leaders, scientists, regulators, political leaders, and news media
- Increasing efficiencies in fuel and water use by creating more direct haul routes and recycling waste water; increasing plant recovery rates (the percent of ore that is manufactured into salable products); improving packaging and distribution efficiency; switching to fuel-efficient modes of transportation; and reducing carbon dioxide emissions
- Leveraging education and skills in the local community to reduce dependence on the mining operation and create an acceptable standard of living after mineral resources are depleted
- Establishing cash, time, and in-kind donations to local economies based on a specific percentage of pre-tax revenues
- Establishing how mineral products (boron and borate compounds) can better contribute to sustainable development's environmental and economic principles
- Performing life-cycle assessments and using these to establish product stewardship guidelines for all employees, distributors, and customers

Life Cycle Assessment, Borate-Treated Lumber

"Life Cycle Assessments (LCAs) are an effective tool for evaluating environmental performance in how products are made and used, as well as for helping consumers choose environmentally friendly options. An independent LCA on borate-treated lumber conducted in 2000 measured how borate preservation systems extend the life of structures, reduce the need for replacement wood, and serve as an environmentally sound substitute for other systems. This cradle-to-grave assessment measured the entire system – from extracting ore to wood disposal – to quantify the environmental impacts associated with this application."-- (Rio Tinto Borax, 2001, p. 17§).

Rio Tinto Borax sees these and related concepts as critical to future success, and intends to weave sustainable development practices into the full spectrum of its business. In a process similar to that of the Whitehorse Mining Initiative, the company developed its sustainable development project in concert with experts from environmental NGOs and local governments in the communities and regions where it operates.

The Global Mining Initiative: Mineral Supplies and Sustainable Development

The Global Mining Initiative (GMI) began in late 1998 as a leadership and change exercise by the Chairmen or CEOs of ten of the world's leading mining and metals companies. These principals sought a new course for the mining industry for the 21st century by working through and taking leadership on the issues arising from society's expectations of sustainable development. They were concerned about the fragmented manner in which the industry represented itself to society, and the quality of the industry's relationships with the people affected by its broad scope of operations. They believed there was a strong business case for responsible management of the full range of sustainable development issues, and that this should be part of their engagement with stakeholders such as employees, shareholders, financial institutions, local communities, customers, suppliers, joint venture partners, regulators, the media and NGOs. The GMI sought to independently analyze the challenges the industry must meet to contribute to sustainable development; to organize a major global conference in 2002 on the future of mining, metals and sustainable development; and to create organizational structures to implement change and carry forward the sustainable development agenda (Global Mining Initiative, 2001a§). The GMI tasked the Mining, Minerals and Sustainable Development Project (MMSD, p. 75, this volume) with performing the independent analysis during 1999-2002.

The Global Mining Initiative's 10 sponsoring companies are members of the World Business Council for Sustainable Development (WBCSD).

Anglo American
BHP Ltd.
Billiton
Codelco
Newmont
Noranda
Phelps Dodge
Placer Dome
Rio Tinto
WMC Ltd.

The GMI attempts an holistic approach to mining and minerals. It concerns itself with the mineral life cycle that includes exploration through project development and mine operations to closure, and from processing materials to use, recycling, and ultimate disposal. The GMI also seeks to provide pathways and options for industry and stakeholder action on a wide range of issues such as disposal of industry wastes, environmental performance, fair distribution of economic benefits, community consultation and human rights, and product stewardship. At the same time, the companies want to help raise the debate from the current exchanges on individual issues to a fuller, shared understanding of the overall picture of mining and minerals. As well as posing some tough challenges for the industry, the debate asks searching questions about how governments, international organizations and other representatives of civil society can play a constructive role. From the outset, the companies have been clear that the GMI is about performance and not simply a public relations effort. They recognize that the conclusions of the work might point to the need to change some aspects of what they do. Development of pathways and options to meet the challenges the industry faces is a shared responsibility of the industry and all its stakeholders, including its critics. It will succeed only if it leads to clear and significant changes in the behaviors of both the industry and its stakeholders (Global Mining Initiative, 2001a§).

A Full Range of Issues for the Mining Industry

"Although the name of the initiative focuses on mining, and although it cannot cover all questions to the same degree of detail, the GMI is concerned with the full range of issues in both the mining, minerals and metals cycles, including: access to land and resources; exploration; project development and secondary development impacts; governance of mining projects, their place in social and economic development, and issues of capacity building; rent capture and distribution; mining operations; stewardship of resources such as water and bio-diversity; energy use; management of waste; social and environmental aspects of mine closure; primary and subsequent stages of processing; the trade in materials produced by mining; and how those materials are used, their consumption, recycling and disposal." (Global Mining Initiative, 2001a§).

The mining, minerals and metals industries face a series of common challenges in a world seen as increasingly committed to globalization. With globalization has come the rapid transfer of information, impacts and regulatory developments across jurisdictions and an increasing need for decisions based on sound science. There has also been a significant increase in the internationalization and global activity of NGOs and others who drive agendas concerning the industry, and a significant expansion in the political and regulatory response to these agendas through intergovernmental agencies. To meet the challenges posed by such agendas, the GMI sought a global organization that attends to sustainable development, international trade, industry taxation and resource rent, occupational health and safety, economic studies, and industry data. GMI looked for greater involvement in and ownership of national and commodity associations in global issues. It hoped to create a critical mass of scientific resources and maximum collaboration on issues common to the industry through integrating policy-oriented science into the global body.

In 2002, the GMI reviewed industry associations worldwide noting that "…these are the industry's natural vehicles to deliver the most effective follow-up and leverage for the outcomes of the program." The GMI was concerned that fragmentation and duplication of industry representation and the associated costs could hamper the industry's abilities to carry forward the outcomes of the program. Thus, the GMI developed a new structure of industry associations at a global level designed to advance the outcomes of the shared analysis, reinforce the industry's social and environmental performance, and engage more effectively with public policy makers. The GMI proposed that the International Council on Metals and the Environment (ICME) become the nucleus of a new global mining association. The board of the ICME voted in May 2001 to broaden its mandate and transform itself into the International

Council on Mining and Metals (ICMM), the global representative body to provide leadership in meeting the challenges of sustainable development (Global Mining Initiative, 2001, p. 1§).

The GMI described itself as a change agent; it had no formal institutional structure and was not intended to become a permanent body. The GMI lasted until the first half of 2002, leading up to the World Summit on Sustainable Development held in South Africa in September 2002 to mark the tenth anniversary of the Rio Earth Summit (United Nations Conference on Environment and Development, 1992). The GMI formally concluded with a major global conference, Resourcing the Future, held in Toronto, Ontario, Canada in May 2002. The conference was intended to be the platform for the industry to present its sustainable development case to others, and to articulate and define its response to the independent MMSD analysis (p. 75-79). The conference set the stage for implementing changed behaviors within the industry, cementing relationships created through the MMSD analysis, and creating a more effective external representative structure for the mining industry to relate to the wider world. The GMI expected strong participation by the industry, its suppliers and customers. Conference planning provided for sponsorship from various quarters to ensure that local communities, indigenous groups, NGOs and developing country representatives were able to participate and give the event greater balance.

The Mining, Minerals and Sustainable Development Project

The Mining, Minerals and Sustainable Development Project (MMSD) was an independent two-year project of participatory analysis seeking to understand how the mining and minerals sector could contribute to the global transition to sustainable development (International Institute for Environment and Development, 2002a§). MMSD was a project of the International Institute for Environment and Development (IIED) commissioned by the World Business Council for Sustainable Development (WBCSD). The Global Mining Initiative's 10 sponsoring companies are members of the WBCSD. MMSD came into being because of the GMI, but it was not responsible to the GMI. MMSD also had non-mining sponsors (Table 6) and was supported by other stakeholders. It enjoyed a governance structure that underpinned its independence, although all communities of interest did not hold this perception. For example, environmental NGOs refused to participate in MMSD North America because of the governance structure (International Institute for Sustainable Development and Morris K. Wosk

Centre for Dialogue, 2002). Mining industry sponsors contributed substantially to fund the MMSD's analysis with no conditions other than to be kept informed and consulted about the project together with other stakeholders. MMSD independently created the process, selected the issues for analysis, selected principals to be consulted, and determined how the final report was prepared.

The WBCSD convened a Sponsors Group to support and finance the MMSD. The Project sought to strike a balance of commercial and non-commercial sponsorship to lend credibility to the partnership approach it is taking. By mid-2001, a total of 31 companies and 8 non-commercial organizations (Table 6) had committed approximately US $5 million to the project. Non-commercial sponsors included the Rockefeller Foundation, the Government of Australia, the United Nations Environment Programme (UNEP) and the World Bank. The WBCSD also approached and received strong expressions of interest from other entities such as the European Bank for Reconstruction and Development (EBRD), Conservation International and the IUCN-The World Conservation Union, and other national governments.

Table 6. -- The MMSD by mid-2001 had attracted 31 commercial and 8 non-commercial sponsors. As the project evolved, the WBCSD continued to seek sponsorship from other organizations (International Institute for Environment and Development, 2002a§).

Commerical Sponsors	**Non-Commercial Sponsors**
Alcan	Chilean Copper Commission
Alcoa	Colorado School of Mines
Anglo-American	Government of Australia
Anglovaal	Mackay School of Mines
Barrick Gold Corporation	PriceWaterhouseCoopers
BHP	The Rockefeller Foundation
Billiton	United Nations Environment Programme
Codelco	The World Bank
Cominco	
De Beers	
Freeport-McMoRan	
Gold Fields	
Lonmin	
M.I.M. Holdings	
Mitsubishi Materials / Mitusbishi Corporation	
Mitsui Mining and Smelting	
Newmont	
Nippon Mining & Metals	
Noranda	
Normandy	
Norsk Hydro ASA	
Pasminco	
Phelps Dodge	
Placer Dome	
Rio Tinto	
Sibirsky Aluminium Group	
Somincor	
Sumitomo Metal Mining	
Teck Corporation	
Western Mining	

The MMSD Project began in April 2000 and was designed both to produce a series of working papers and a final report (The Mining, Minerals and Sustainable Development Project, 2002). It also established a process that provided for creating an ongoing dialogue among stakeholders. Principals responsible for the project recognize that the mining and minerals sector is subject to a number of powerful trends that are poised to shape the business environment in which the industry operates in the 21st century. Perhaps none of these is more challenging than the call for a global transition to sustainable development, a vision based on achieving a better quality of life for the world population today, while preserving and increasing the ability of future generations to achieve a higher quality of life for themselves. Many initiatives addressing elements of the mining, minerals and sustainable development agenda are underway, but critical bottlenecks such as lack of trust among companies, governments and civil society, and the absence of the necessary skills, resources and institutional capacity to deliver are slowing progress. MMSD encouraged a greater coherence in the initiatives to increase their collective impact while overcoming barriers to collaboration. To achieve this it drew together a wide range of actors to develop a comprehensive agenda around which global stakeholders can create change.

The MMSD Project was designed to assess global mining and minerals use in terms of the transition to sustainable development. The project reviewed the history of the industry and its current contribution to and detraction from economic prosperity, human well being, ecosystem health and accountable decision-making. It identified if and how the services provided by the minerals system can be delivered in accordance with sustainable development in the future. It proposed actions for improvement in the minerals system, and it built a platform of analysis and engagement for ongoing cooperation and networking among all stakeholders. The project recognized that it could not solve or even address all issues that will ever be faced by the mining and minerals industries. However, it provided a start at identifying different concerns, and getting processes underway, which in the long run could move the industry closer to solutions.

In early 2001, after several months of dialog and research, the MMSD project identified eight key questions facing the global mining and minerals sector. These questions do not reflect all the problems affecting the sector, but they cut across most of the key challenges to mineral suppliers in a sustainable society.

1. Can the industry assure its own long-run sustainability?
2. To what extent can the industry drive development of national economies?
3. How can the industry best contribute to broad economic and social development at the community level?
4. How can the industry improve its environmental record?
5. What are the ground rules for land: its management, access, control and use?
6. How can the industry ensure that future markets and consumption patterns are compatible with a sustainable world?
7. How can the industry keep pace with the information revolution and ensure meaningful access to information for all stakeholders?
8. What should be the administrative relationships, roles, responsibilities and performed standards of the key actors in a more sustainable future?

MMSD sought to combine an equitable and transparent process of stakeholder engagement with high standards of analytical rigor, and to produce outcomes that were useful to a wide range of stakeholders from the global to the local level. Project activities were decentralized and managed by regional partners based in some of the principal mineral producing and consuming regions of the world. The activities included research on long-run minerals availability, baseline assessment of current corporate practice, management of large volume waste, abandoned mines, policy and other aspects of mine closure, life cycle analysis, managing mineral wealth, mining and biodiversity, mining and indigenous peoples, small scale mining, mining financial institutions, public participation, stakeholder engagement, information and communication, and planning for outcomes (Greene and others, 2001§; International Institute for Sustainable Development, 2002c).

Summary

A long list of social and environmental issues faces mining and minerals suppliers at the beginning of the 21st century. The agenda driving attention to the issues has evolved over many years to drive a composite of socioeconomic, environmental and technological trends that are global in scope and continually changing. These trends continue to provide the momentum behind the global debate over sustainability. Whereas current data on mineral reserves and resources indicate that global society is far from depleting its mineral assets, there are concerns, particularly within the mining industry, about the efficiency with which supplies can be maintained under the constructs of sustainability.

Societal trends that could impact the efficiency of minerals extraction and the immediacy of supplies have their origins in the legacy of mining. This legacy is most apparent where mining activities have left behind certain physical and social transformations that caused enduring, highly negative perceptions in the court of public opinion. The physical transformations include massive landform alterations, creation of persistent sources of toxic or other undesirable materials, and lingering effects of contaminants that last decades to centuries. Negative social transformations induced by mining include launching “boom and bust” economic cycles; intruding on the lands of indigenous peoples; creating local problems (waste, noise, dust, community disruption) with benefits (wealth, production) dispersed elsewhere; and practices conflicting with recreational opportunities, wildlife and habitat protection, watershed protection, and cultural preservation.

Divergent views on the quality and meaning of reclamation illustrate the conflicted global perception of mining as an enterprise that involves rapid creation of wealth, dramatic societal transformation, and long-term social and environmental cost. Land-use data and modern practices suggest increasing attention by the industry to some form of reclamation of mined lands, particularly in the United States, but also in many other parts of the world. Modern coal mining in the United States, for example, commonly involves a continuous process of coupled mining and land reclamation, with about 75 percent of lands mined for coal having been transformed for other potential uses during the 20th century. The attention to lands used for aggregate mining is similar, with mined areas being transformed for a variety of non-mining uses after materials are extracted. A long-range outlook based on current trends and regulations is for mining in concert with or followed by some form of reclamation, rather than rapidly increasing the total area devoted exclusively to mining. In some cases, within a few seasons of high-quality reclamation, mined lands may show little evidence of past mineral extraction.

Though reclamation commonly implies restoring mined land to original contour, use, or condition, reclamation in the case of the larger modern open-pit mines in the United States and elsewhere may not approach restoring the original landscape. Concepts of reclamation applied to massive open-pit operations around the globe leave many unanswered questions, for example, with respect to future uses of the pits, disposal of large-volume wastes, quality and viability of pit lakes, and the regional groundwater system. Thus, impacts from open-pit and similar mining operations where landform restoration is impractical could be a legacy of mining for centuries to come, given the scale of land and water disruption possible using modern equipment and technology.

The mining industry has an essential role as a source of society's raw materials and energy. It is a major player in global economics and facets of international security. Nonetheless, most members of society have limited exposure to mining and its consequences. Most people associate mining with underground methods, and believe aboveground methods scar the land. They believe mining to be inherently destructive, and that it cannot be environmentally sound. In general, people do not distinguish between large-scale and small-scale mining, nor do they differentiate among mining for metals, industrial minerals, or mineral fuels. To the broader public, it is all "mining." They believe the industry to be isolationist, perhaps because its activities generally take place in remote areas, or because of the somewhat secretive nature of minerals exploration and development. They believe the industry to be very conservative and unwilling to change its practices appreciably. They are unaware of the benefits of mining to daily life, and they are unaware of the mining industry's reclamation efforts. They are unaware of the global moves in the mining industry in recent years towards environmental awareness and performance. Additionally, the public mistrusts large companies in general, and the level of mistrust has grown substantially in recent years.

Particularly in highly developed countries, people tend to have values and interests that favor environmental protection over resource exploitation, apparently with the view that the resources they demand can be obtained elsewhere. Additionally, people and societies tend to be strongly conflicted regarding religious beliefs and practical assessments about natural resources available for society's aspirations. Indigenous peoples in particular characteristically maintain religious and social values that contradict the interests and reasoning of mining companies, government authorities, or other entities that attempt to introduce significant change. Only in recent years has there been significant attention to the values of indigenous peoples, and to recognizing the special claim of indigenous people to the land they occupy.

From 1920 to 2000, the mining work force in the United States dropped from about 1,200,000 to 500,000 employees, or from about 4.0 percent to 0.4 percent of the population. Industry observers see this trend as significantly reducing the influence of the industry on public opinion. Simultaneously, far greater numbers of even the uninterested public now are exposed to mining issues and form immediate and commonly negative opinions of mining. Under these conditions, broad political support for mining as it has traditionally been practiced is eroding and requires unprecedented attention and nurturing on the part of the industry.

A public that has little knowledge of the geology and geography of mineral supplies, or the ways in which minerals are processed and transported typically confronts extractive industries around the globe. The public also has a growing belief that a healthful environment is a basic human right; that extractive industries interfere with this right; and that there must be environmentally benign ways to extract resources from the Earth. The modern public commonly does not associate the consequences of demanding specific quantities and qualities of copper, aluminum, lead, sulfur, and other materials with the necessary activities of the extractive industries. Additionally, the members of this public tend to be strongly focused on their immediate environments. They also support broader environmental protection beyond those environments, yet they tend not to be highly motivated to decrease their demands. As well, they hold large measures of fear and ignorance that drive beliefs about resource supplies. They tend to assuage their uncertainties by looking towards those they think they can trust, and tend to place a stronger belief, for example, in representatives of quasi-governmental or non-governmental organizations (NGOs) than in corporations or national governments. Especially over the latter half of the 20th century, the public has exhibited a declining trust in corporate and governmental experts. In this situation, NGOs have ascended rapidly in political power, using the ease and speed of the Internet and targeting specific issues for effective political action at all levels of society. Few NGOs have a positive or even neutral attitude toward mining and other extractive industries, and thereby create serious impediments for industrialists who attempt new projects almost anywhere in the world.

Based on projections made in the year 2000, the average citizen of the United States could use more than 1.7 million kilograms (3.7 million pounds) of minerals, metals, and energy fuels during his or her lifetime. This figure represents newly mined minerals and metals, with aggregates and fuels accounting for about 75 percent of demand. Most of this demand could be met by continued mining within the United States, and could be derived from a relatively small percentage of the total land area of the nation. However, finding land suitable for mining specific minerals and obtaining the permits to mine remain major challenges to the mining industry. Partly because of the tension between environmental protection and resource exploitation, extractive industries face increasingly protracted processes for developing projects on either private or public lands in the United States.

In 2001, United States cities, towns and highways occupied about 110 million acres (44.5 million hectares) of land, private agricultural lands occupied about 983 million acres (397.8 million hectares), and about 50 million acres (20.2 million hectares) were covered with water bodies. Public lands comprised about 700 million acres (283.3 million hectares). About 300 million acres (121.4 million hectares) were considered protected areas such as National Parks, wilderness areas, and fish and wildlife refuges. Unresolved issues for the United States Congress with respect to Federal lands surround reconciling different perspectives on which land the Federal government should own, and management alternatives for the land it does own. Practices during the 20th century suggest that the Federal government is likely to continue a process of withdrawing public lands for studies of alternative uses, reviewing withdrawals, and revoking withdrawals from time to time in favor of minerals and other development.

Mineral industry representatives maintain that federal withdrawals inhibit mineral exploration and limit the reserve base even when conditions are favorable for production. They argue that whether minerals are in the public or private sector, without new reserves or technological advancements, mineral production costs may rise. As a result, according to the industry, exploration on foreign soil may increase, raising the risk to investors and boosting import dependence. In this view, governmental policies that increase costs to the mineral industry may result in increased costs to society. Mining industry supporters also assert that too much land has been unnecessarily withdrawn from mining, through administrative actions, in order to pursue preservation goals. Critics of access to public lands by the mineral industry (particularly under the Mining Act of 1872§) believe that in many cases there is no way to protect other land values and uses short of withdrawal of lands from development under the law. Despite any distribution of lands -- public or private, readily accessible or mandated to be off limits to development -- the mining industry has a major stake in gaining access to areas where the resources can be most economically extracted, and other parties have strong interests in prohibiting mining. As many past and current situations illustrate, the demands of mining routinely come into conflict with other uses of the land. Nonetheless, the land available for mining within United States borders is extensive, as are aggregate and most fuel resources (excluding oil) that United States citizens might demand over the coming century. The conflicts over land use reinforce the existence of a highly complicated mix of sociocultural drivers and constraints that influence minerals exploration investment and consequent mineral supply. The extractive industries together with society at large are being charged with somehow overcoming the built-in antagonism between environmental quality and economic growth. The industries most likely will be pushed in the direction of more environmentally benign extractive activities, while the rest of society could be pressed towards some agreeable level of coexistence with extractive industries.

In an increasingly globalized economy, current technology and economic conditions portend increasing global transport of oil, coal, and aggregates in bulk, and increasing amounts of these materials could come to the United States from foreign sources. Based on current trends, many other minerals, particularly metals, could be mined in relatively smaller quantities and areas in the United States. In the current global economy, many of the metals once mined extensively in the United States could be imported from those countries that maintain significant economic advantages for mining and exporting metallic minerals.

For the world in 2001, there were an estimated 44,000 parks and protected areas covering about 10 percent of the world's land surface. About 42 percent of areas designated for protection were found in developing countries. Even with substantial increases in protected areas, the outlook for at least the next several decades suggests about 85 to 90 percent of global land area is likely to remain in present uses, to experience continuing development, and to be available for uses other than protection. Mineral and other development probably will continue to be allowed, albeit with major restrictions, on some parts of the remaining 10 to 15 percent in the protected category. Whereas land-use restrictions typically affect mineral supply locally and in the short term, there is abundant land around the globe available for mining to potentially circumvent issues of scarcity of the materials society is projected to demand.

For mineral suppliers, a major challenge is adapting to modern concepts of environmental management and sustainable development. Industry analysts, for example, urge a renewed focus on local communities where mineral resources are located. The goal is to reduce conflict over societal and environmental issues through engaging local people respectfully and repeatedly, and identifying their cultural needs and desires through all stages of the mineral extraction process. Furthermore, mineral suppliers are being called upon to reestablish and publicize widely the connection between mineral products and the people who use them. The ascendant themes for the business are many, but revolve around several key principles and activities repeated throughout the literature about the industry and the documents the industry prepares for its stockholders and the public. Typically, goals within the industry include being judged by shareholders and members of the communities wherein it operates not only on financial performance, but also on safety and environmental performance. In general, to accommodate the sociocultural complexities of extracting minerals, the mining industry is being pushed to move well beyond common practices of most of the 20th century toward a more all-embracing commitment to social, environmental and economic goals.

Examples from developing countries show that mining companies can have positive effects on local culture by providing local people with training in skills they can market elsewhere in the economy. The industry could provide linkages with other economic sectors of the country in which it operates to ensure that part of the wealth generated by mining supports future economic growth after the mine closes. Such action holds promise for diversifying the economy and promoting sustainability. Analysts caution companies, however, to recognize how mining can overturn the local economy, whether in its effects on traditional land use or in shifting power from traditional authority to the people connected with mining. In developing countries, indigenous people and communities located in isolated areas can have customs that conflict with and are more important than the laws of the state. Commonly, local customs are by default the prevailing and valid laws in terms of land use and property rights. Ignoring this fact in favor of state laws has been a source of persistent conflict for the mining industry in the past. Moreover, informal or artisanal mining prompts frequent disputes between legitimate companies and individuals or small groups who have exploited ore deposits. Modern practice recommends substantial sociocultural research by foreign investors and companies to determine courses of action and agreements that might succeed in each unique situation.

Canada's Whitehorse Mining Initiative (WMI) accord is an attempt to cope with the complexities of the sociocultural environment surrounding the mining industry. The principles and goals of the WMI treat a wide range of interrelated business, environmental, and societal issues, and call for a transparent process of open decisionmaking. The WMI was based on a strategic vision for a healthy mining industry that acknowledges concepts of sustainability, healthy and diverse ecosystems, constructive relationships among stakeholders, and sharing opportunities among stakeholders with special emphasis on Aboriginal cultures. Whereas the application of the WMI to Canadian mining practices is yet to be fully defined, the process by which the WMI came to be is illustrative of efforts within the industry to change the face of mining to attend to concepts of sustainability.

Many individual companies are weaving sustainable development practices into the full spectrum of their business. Rio Tinto Borax, through a process similar to that used in creating the Whitehorse Mining Initiative, developed its sustainable development project with the advice of experts from environmental NGOs and local governments in the communities and regions where it operates.

The Global Mining Initiative (GMI), sponsored by the world's leading mining and minerals companies, is an unprecedented attempt to seek a new course for the mining industry. Under the GMI, the global industry is attempting to work through and take leadership on the issues arising from society's expectations of sustainable development. The GMI operates on the principle that there is a strong business case for responsible management of the full range of sustainable development issues. This case could well be the driving force behind industry's engagement with all its existing and potential stakeholders. The GMI through 2001 has been analyzing the challenges the industry must meet to contribute to sustainable development; and organizing a major global conference on the future of mining, metals and sustainable development. In 2001, the GMI created the International Council on Mining and Metals to be the industry's global representative body for providing leadership in meeting the challenges of sustainable development.

The GMI also sponsored the Mining, Minerals and Sustainable Development Project (MMSD) during 1999-2002. The MMSD Project was designed to assess global mining and minerals use through the transition to sustainable development. The project reviews the history of the industry and its current contribution to and detraction from economic prosperity, human well being, ecosystem health and accountable decisionmaking. It identifies ways in which services provided by the minerals system can be delivered in accordance with sustainable development in the future. It proposes actions for improvement in the minerals system, and it builds a platform of analysis and engagement for ongoing cooperation and networking among all stakeholders. The project provides a start at identifying different concerns of the industry and its stakeholders, and an impetus for moving the industry closer to solutions in the long run. The results of the MMSD Project were synthesized by the GMI for presentation to world leaders at the World Summit on Sustainable Development to be held in South Africa in late 2002.

The examples in this report reveal the suite and complexity of sociocultural issues impinging upon mineral supply that affect mining companies, governments, and other entities around the globe. The mining industry's attention to these issues, as evidenced by change initiatives and companies' reports on environmental and sustainability practices, proclaims reforms to maintain economic viability and to present a better public image. In particular, the industry seeks to improve its community relations programs and environmental management systems. This requires not only building professional staffs with expertise in these areas, but also establishing new kinds of partnerships with organizations traditionally seen as adversaries. The Global Mining Initiative together with the Mining, Minerals and Sustainable Development Project seek to set the course for the industry for long-term and global attention to meeting the challenges of a sustainability transition while ensuring mineral supplies.

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Appendix A. – The Crandon Mining Project, Wisconsin

Twenty-Six Years of Debate and Changing Values

In July 1975, Exxon Coal and Minerals Company of Houston, Texas (Exxon) discovered a mineral deposit in Forest County in northern Wisconsin that was later determined to be the tenth largest zinc deposit in North America. Named for a nearby town, the Crandon mineral deposit, or orebody, contains an estimated 50 million metric tons (55 million tons) of ore, primarily zinc and copper, but also lead, silver, and gold. The deposit contains an estimated 0.93 grams (0.03 troy ounces) of gold for every ton of ore, or an estimated 51.3 million grams (1.65 million ounces) of gold. The orebody is about 1,500 meters (4,900 feet) long from east to west and about 30 meters (100 feet) wide from north to south. It begins about 60 meters (200 feet) below the surface and extends to a depth of about 670 meters (2,200 feet). About 5 percent of the material to be mined has value, and 95 percent would need to be treated as waste. The current (2001) owner, Nicolet Minerals Company (NMC), plans to extract 27 million metric tons (30 million tons) of zinc and about 23 million metric tons (25 million tons) of copper.

The mineral deposit rests at the headwaters of the Wolf River watershed, a large drainage basin that encompasses nearly all of northeastern Wisconsin. The Wolf River runs through eight counties and several Native American reservations, and its basin is known for its pristine lakes and streams, wetlands, trout fishery, and wild rice beds, among other natural and cultural amenities. Because of potential threats to the Wolf River environment, and for a host of other reasons, individuals and local, regional, national and international entities have debated the issue of whether to mine the Crandon orebody for a full quarter century. As of mid-2001, a decision on permitting for mining the Crandon orebody is still at least months in the future (Decker, 2001a§), and any permitting decision for or against mining will almost certainly be challenged. The Wisconsin Department of Natural Resources (WDNR) will release the Draft Environmental Impact Statement (EIS) on the Crandon project as soon as groundwater flow and contaminant transport models are completed. The EIS was still being reviewed in late 2002, and the WDNR schedule indicates that the sequence of events following release of the EIS will take about 22 months to complete the permitting process (Wisconsin Department of Natural Resources, 2000a§; 2002§). The Crandon mine will receive a permit only when it is proven to meet six criteria specified in Wisconsin state law. The criteria are: to comply with all state and federal environmental regulations; to protect public health, safety and welfare; to safeguard lands with unique features, critical ecological importance or historical value; to have a net positive socioeconomic impact; to comply with local zoning laws; and to include suitable plans for reclamation (Nicolet Minerals Company, 2000§).

According to the Wisconsin Review Commission (1995§) and Naparalla (2001§), after discovering the deposit, Exxon faced a decade of strong opposition to mining compounded by falling mineral prices. Although on the verge of obtaining permits to mine, Exxon withdrew from the project in 1986. In August 1992, Exxon partnered with Phelps Dodge Mining Company of Phoenix, Arizona (Phelps Dodge) to reopen the Crandon project, but Phelps Dodge withdrew within four months. Exxon then partnered with Rio Algom Limited of Toronto, Ontario, Canada (Rio Algom) in September 1993 to create the Crandon Mining Company. In January 1998, Rio Algom purchased Exxon's share of the project and created Nicolet Minerals Company to handle the Crandon project. On December 15, 2000 Rio Algom announced that it would transfer the Nicolet exploration project near Crandon, Wisconsin to Billiton PLC of London, U.K. (Rio Algom Limited, 2000§). Rio Algom was integrated into Billiton PLC in 2001. On June 19, 2001 the directors of BHP Limited of Melbourne, Australia and Billiton PLC announced the merger creating BHP Billiton (BHP Limited and Billiton PLC, 2001§). The new company is headquartered in Melbourne, Australia, with a corporate management center in London, United Kingdom. BHP Billiton is positioning itself to serve the mineral commodity requirements of a diverse customer base across six continents (BHP Limited, 2001, p. 2-3§), with predominance in Asia (29 percent of customers), Australia (24 percent), Europe (20 percent), and North America (17 percent).

Through purchases and leases by the succession of owners since the Exxon discovery in 1975, NMC owns and controls almost 5,000 acres of land. The mining plan indicates that mine buildings, tailings, and roads will disturb about 500 acres. The tailings management area and facilities construction will require clearing about 282 of the 500 acres. To meet regulatory requirements, industry standards, and the challenges of mining opponents, NMC's mining plan must include, for example: complying with the provisions of Wisconsin's Mining Moratorium Law (p. 106, this volume) and managing political relationships and contracts with various federal, state, regional, and local entities. Specific requirements include, for example, managing tailings; treating pyrite and other mining residues to control acidic drainage; storing sulfide waste underground; modeling groundwater flow during and after mining operations; treating wastewater; treating or avoiding impacts on surface waters and wetlands; developing grouting technology to control groundwater flow; handling, storing, and transporting toxic materials, including twelve million gallons of cyanide to be used for heap leaching; reclaiming (restoring) the site during and after mining operations; and ensuring performance of the reclamation or restoration effort in perpetuity (Decker, 2001b§; Nicolet Minerals Company, 2000§; Wisconsin Stewardship Network, 2000§; Wisconsin Department of Natural Resources, 1997a§,b§). As a part of the permitting process, and in preparing a draft environmental impact study, NMC is proposing and implementing a variety of expensive, high technology engineering solutions to these problems.

Reclaiming and Restoring Mined Land in Wisconsin: Responsibility for Long Term Care Does Not End

"***Successful reclamation means the restoration of all areas disturbed by mining activities including aspects of the mine itself, waste disposal areas, buildings, roads and utility corridors. It is the product of thorough planning and execution of a well conceived reclamation plan. Restoration means returning of the site to a condition that minimizes erosion and sedimentation, supports productive and diverse plant and animal communities and allows for the desired post-mining land use."***

"Many mining operations would include mining waste disposal facilities. The operator/owner of mining waste disposal facilities is required to provide and maintain proof of financial responsibility (such as a bond or other financial security) for long term care of the waste facility. Following closure, the operator/owner is required to maintain the waste facility and periodically monitor the site as well as the local environment to assure that no problems are developing. The monitoring plan, approved during the permitting process, would identify the types of monitoring required from before mining started, during operations and throughout the long-term care period. After a minimum of 40 years following closure, the owner may petition the Department to terminate the owner's obligation to maintain proof of financial responsibility. However, the landowner's responsibility for long term care activities at the mine waste disposal facility does not end." – Wisconsin Department of Natural Resources (1997a§).

Wisconsin's Mining Moratorium Law and the Crandon Project

The mining industry and others consider Wisconsin's mining regulations to be among the strictest in the nation. Currently (2001), a mining project needs more than 40 Federal, state, and local permits before construction can begin. As a part of obtaining these permits, the Crandon Project must comply with Wisconsin's Mining Moratorium Law that took effect on May 7, 1998. The law evolved during a three-year legislative process into a series of evidentiary determinations that the Wisconsin Department of Natural Resources (WDNR) must make before it issues a mining permit for the mining of a sulfide ore body. The purpose of these determinations is to verify that one or more sulfide mining operations have been undertaken elsewhere in the United States or Canada in full compliance with pertinent environmental laws, and without causing any significant environmental pollution.

The law contains five key requirements that refer to geologic criteria, ten-year operating criteria, ten-year closure criteria, responsible parties, and environmental pollution for the selected, comparative mining operations. Under the law, each candidate mine must have operated in a sulfide ore body that, together with the host rock, has a net acid generating potential. The underlying intent of this provision is to ensure that the focus of the moratorium inquiry is on mines that are capable of producing environmentally damaging levels of acid mine waste, regardless of whether the acid waste comes from mine drainage or acid generated in waste rock piles or from tailings disposal sites. At least one of the candidate mines must have operated for at least 10 years without the pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals. At least one of the candidate mines must have been closed for at least 10 years without the pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals. A candidate mine is excluded from consideration under the new statute if either of the following criteria apply: It has been listed on the national priorities list under the Superfund Law (42 United States Code Section 9605§), or it is a mining operation for which the operator is no longer in business and has no successor that may be liable for any contamination from the mining operation and for which there are no other persons that may be liable for any contamination from the mining operation (a so-called "orphan mine"). Finally, the law provides that the WDNR may not base its determination on a mining operation unless the WDNR determines, based on relevant data from groundwater or surface water monitoring, that the mining operation has not caused significant environmental pollution from acid drainage at the tailings site or at the mine site or from the release of heavy metals.

NMC believes that the law's underlying concern is the desire for proof and reassurance that a modern sulfide mine can be operated and reclaimed in a sensitive environment, meet stringent environmental safeguards, and that the industry can be a good long-term citizen and neighbor.

The law was enacted about four years into the permitting process for the Crandon project, suggesting that evolution of the law was heavily influenced by that and possible future mining projects in Wisconsin. Critics of mining believe that the law was passed despite strong opposition by the mining industry, and that the WDNR developed rules to implement the law that favored the mining industry's designs. Currently (2001), mining critics are investigating the mining operations in California, Arizona, and Northwest Territories, Canada, selected by NMC to attend to requirements of the law.

– adapted from Nicolet Minerals Company (2000§), Wisconsin Statutes (2001), Wisconsin Department of Natural Resources (2000b§), and Wisconsin Stewardship Network (2000b§).

Mining and the Sociocultural Environment in Wisconsin: Inextricably Bound and Changed

"But above all, the extraction of 55 million tons of copper and zinc ore would become an everyday presence for the 28 years the mine is projected to operate. In essence, it would become a marriage between the communities and Nicolet: For better or for worse, they would be inextricably bound and changed." (Naparalla, 2000a§)

The issues surrounding the Crandon project run the gamut from local, personal, and simple to global, impersonal and complex. The issues are also colored by the passage of time. Over the course of the years since 1975, modern society has changed greatly in many ways, both technologically and socially. Accompanying these changes are major shifts in not only the types of people who are engaged in the debate over mining in general and the Crandon project in particular, but also the types of values they pursue.

In general, the public does not fully understand the structure and practices of the mining industry (p. 31-39, this volume). The extent of misunderstandings together with changing values can open or reinforce a mutual lack of trust between industry representatives and local opinion leaders. In the sociocultural environment surrounding the Crandon project, levels of trust and agreement among the parties have fluctuated considerably over time. The debate has encompassed consensus on some issues and has led to polarized entrenchment about others. With broader attention being given to the project over time, the quality of the debate has shifted dramatically as different principals – local, regional, national and international –associate or disassociate themselves with the state of affairs.

Table A-1. -- What's at Stake in Crandon? A Thumbnail Sketch of the Major Issues (Naparalla, 2000b, p. 4§).

Key Issues	Proponents say	Opponents say
JOBS	The mine will employ 2,200 people in its construction and another 350 in its 30-year planned operation. Payroll may reach $23 million annually.	Most construction jobs will be held by non-local workers. All jobs will last only as long as the mine operates, causing a boom-and-bust economy.
NEED	There is a national and international shortage of copper and zinc, necessary for such key staples as electrical wiring and computer circuitry.	There may be a scarcity of the metals now, but this is artificially caused by withholding ore until prices rise. The real need is unproven.
EFFECT ON WATER	New technologies in cleaning and recycling water means the mine will have little effect on ground water supply or the receiving waters.	The mine will suck up 3 million gallons of water a day, drawing from nearby rivers and lakes, as well as pollute receiving waters.
EFFECT ON LAND	The mine is being built in a remote, unused area. The local plants and wildlife are abundant throughout the region, and no species are endangered.	The location of the mine provides prime habitat for migrating waterfowl and the area is a favorite spot for camping, fishing, and wildlife-watching.
EFFECT ON TAXES	About $320,000 a year will go into local county and township tax coffers. The state will receive an estimated $1.5 million annually in new taxes.	The taxes raised locally will be insufficient to pay for additional school, utilities and municipal services the mine and its workers will require.
EFFECT ON PEOPLE	The Crandon area is economically depressed and relies mainly on seasonal forestry work for jobs. The mine will diversify and stabilize the area.	Residents will lose their secluded beauty and the tourism trade that has buoyed them. When the mine closes in 30 years, they'll have nothing.

An overview of the Crandon situation in 2001 (Naparalla, 2000a§); suggests that people in the region almost certainly understand an economic boom is possible if money generated by mining stays in the area and if local people become a part of the industry. There are comparisons, for example, with the recent performance of the nearby but substantially smaller Flambeau mining project near Ladysmith, Wisconsin (Wisconsin Department of Natural Resources, 2000c§) with respect to permitting, operations, closure, reclamation, and socioeconomic impacts on the community. Kennecott Mineral Corporation and Rio Tinto Zinc, the parent companies of Flambeau Mining Company, hired 33 people locally, and mined the 1.9-million ton deposit, with an estimate value of $750 million, for four years (Naparalla, 2000e§). The Crandon orebody is about 30 times larger than the Flambeau orebody, and would be mined over about 28 years. There are concerns about how the project is valued beyond estimates for the prices and quantities of copper and zinc, prompting calls for more transparency by the industry about valuing the gold or silver to be extracted along with the copper and zinc (Wisconsin Stewardship Network, 2000a§).

The Flambeau Project: Mining Under Modern Regulations

"While there are other examples of successfully operated and reclaimed metal mines in Wisconsin, the Flambeau Mine near Ladysmith in Rusk County is the only example of a metallic mineral mine that was opened, operated, and reclaimed under the State's existing regulatory framework. The Department has gained valuable experience in its review and oversight of the Flambeau Mine and will continue to acquire additional knowledge as monitoring of the reclaimed site continues for the next several decades."

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"Over the course of the mining operation, about 1.9 million tons of ore containing about 8.9% copper and 0.10 ounces of gold per ton were mined and shipped from the site. The mine produced about 178,000 tons of marketable copper and 328,000 ounces of contained gold."

-- Wisconsin Department of Natural Resources (2000c§).

People have difficulty preparing for the 'boom-and-bust' cycles that result from vagaries of the global minerals marketplace and consequent mine openings and closures. They probably are not aware of the spectrum of driving forces behind the shifting values of the minerals being extracted. It is not clear whether people in the region appreciate the international aspects of the mining industry as they affect the Crandon project. They do not tend to equate local mining issues with larger issues of global minerals supply and demand, sustainable development, and their personal contributions to these ends.

People do not grasp the uncertainties in computer models that project groundwater and other conditions for thousands of years into the future. They want assurances that there is funding to clean up contamination resulting from both worst case and reasonably probable mine emissions scenarios. Local people are concerned about the inability of current and previous owners of the Crandon orebody to demonstrate the ability to operate a mine safely or to gain state and federal approvals to mine in the last 26 years. Some perceive that WDNR supports the metallic mining industry, whereas the WDNR is a regulatory agency with no position in favor of or against mining. The WDNR maintains that the Wisconsin State Legislature made the policy decision on the acceptability of mining, stating: "Mining is an essential industrial activity that must be conducted in an environmentally acceptable manner." (Wisconsin Department of Natural Resources, 2000b§.) Others are fearful about the resources of the mining industry and how it uses money, public relations, attorneys, and other advantages that might overwhelm local people and their organizations (Duane, 1997; Wise, 2001§).

From a point of view based on dimensions of the orebody and the basic requirements for mining it, local people in concert with the mining companies and the WDNR have an early opportunity to understand descriptions of the land area to be impacted by mining. In the case of the Crandon project, this land area is mostly local, with direct impacts mainly in Forest County and on the towns of Crandon, Lincoln, and Nashville, for example. NMC provides a project description that includes transportation and utilities requirements in addition to proposed mine site facilities, tailings management areas, water management and treatment systems, and other constructions (Nicolet Minerals Company, 2000§). In Wisconsin, local communities are required to enter into contracts with mining companies through a Local Agreement law (p. 112, this volume). In general, these local contracts can specify a variety of obligations to benefit the community and the mining company. These include zoning changes and variances, rearrangements of tax structures, compensations for loss of property values, leasing arrangements, dimensions of local hiring and training, support for new and expanded schools, additions to fire and police protection, and funding for social services, highways, and water supply or wastewater treatment facilities, among other possibilities. Local communities can negotiate such contracts at any time, subject to final approval in local public meetings. Local communities also have the option of waiting for WDNR to provide a final EIS, for example, before entering into a contract with the mining company. In the case of the Crandon project, local communities signed agreements early in the permitting process. Because the process has become so protracted, communities are reconsidering certain individual contracts and the local agreements process in other areas of potential mining activity (Fantle, 2000§, Wilson, 2000§, Naparalla, 2000c§).

Wisconsin's Local Agreement Law and Recent Local Actions

Wisconsin law requires Local Agreements, or contracts between mining companies and local municipalities that outline mutual responsibilities and obligations. In 1996, officials of the Town of Nashville approved a Local Agreement with Nicolet Minerals Company (NMC) about the terms and conditions of mining and access to the Crandon orebody in the vicinity of the town. The people of Nashville later reacted strongly to the Local Agreement by voting out of office the officials who negotiated the contract, and electing new members to the town board. The new town board rescinded the contract in 1998, indicating that NMC would not renegotiate the contract despite changes made to the proposed mining plan since the contract was signed. NMC sued the town to maintain the 1996 contract, and was successful in its efforts through a judge's decision of March 8, 2000 to reject the town's cancellation of the mining agreement. Currently (2001), lawyers and officials for the town are reconsidering their options and the possibility of appealing the ruling.

Perhaps influenced by the Nashville situation, and active leasing by Kennecott Copper in the late 1990's, the County Board of Jackson County, Wisconsin passed a new mining ordinance on March 28, 2000. The new ordinance draws from many sample ordinances in place elsewhere in Wisconsin, and applies to all entities in the county that require zoning. In part, the ordinance forbids any community to sign a Local Agreement with a mining company before the WDNR has issued a final Environmental Impact Statement on the project.

The Town of Lincoln that sits atop the Crandon orebody seems to have accepted its fate of being dominated by mining activity. Nashville, meanwhile, is seeking alternatives to bolstering its economy in ways that will eliminate the demand for a mine in the area. The town recently obtained a $2.5 million community empowerment grant from the U.S. Department of Agriculture to enhance its economy. The chairman of the Nashville Town Board is calling for bringing in environmentally safe industry, and using that industry to take away the lever of jobs promised by NMC.

-- adapted from Fantle (2000§), Wilson (2000§), and Naparalla (2000c§).

Beyond the physical dimensions of the mine and its supporting infrastructure, there are larger, regional considerations. The boundaries of environmental impact potentially extend far beyond local jurisdictions. For example, because the proposed mining is in the headwaters of the Wolf River basin, any impacts on the river itself could extend far downstream. Other impacts arising from mine site or mine transportation activities could also extend beyond local control. In general, local communities must assume that federal and state laws will protect the larger environment and therefore may not engage broader environmental considerations in contract negotiations with a mining company. Thus, environmental impact of a mining operation becomes the domain of the federal and state governments, and perhaps a host of local, regional, national and even international voices with an array of agendas about mining, the environment, governmental process, and related issues. In addition, mining can be seen as a more than a simply local issue because what happens concerning ventures like the Crandon project will set precedents for other mining activities in the region and elsewhere in the future.

Responsibilities to Generations in the Future

"We hold a spiritual, religious, ancestral connection with the earth, water and air. If we cut it, then we're reliant on grocery stores and purified water. Then we've failed our responsibility given to us by our creator to ensure the seven generations down the road have a way of life as we enjoyed and our ancestors enjoyed 1,000, 2,000, 8,000 years ago." – Ken Fish, Treaty Rights and Mining Impacts Director, Menominee Tribe.

***"From an environmental point of view, the water of Wisconsin is liquid gold. It's more valuable as a resource and a tourist attraction 100 years from now than any mine."* -- Doug LaFollette, Wisconsin Secretary of State <u>in</u> Naparalla (2000d§).**

In Wisconsin, one regional voice is that of Native Americans. Native American people in Wisconsin and elsewhere tend to support an environmental and temporal overview that is commonly significantly different from that of the other modern Americans descended from later arrivals. Their people are said to retain long connections over time among themselves and their ancestors and descendants using an oral tradition. The Menominee people affected by proximity to the Crandon project believe they have a responsibility for their descendants for the next 10,000 years. Because of restrictions based on federal treaties, they cannot lease or sell their land and move to a different area with the same ease available to other landowners. In many cases, leasing or selling their land or their water or mineral rights is simply non-negotiable because of their beliefs. As with many other Native Americans throughout North American, the tribes in Wisconsin use territory that they do not own, but by treaty has been guaranteed for hunting, fishing and gathering rights. Presence on both the reservation lands and rights on other lands in the vicinity of the Crandon project engage the nearby tribes in the regional picture of permitting the mining operation.

The nearby Mole Lake Sokagon Chippewa, for example, will not negotiate the quality of their water with the state of Wisconsin or with NMC. Alberts and Grasmick (2000, p. 20) observe that the Sokagon Chippewa successfully resisted a lawsuit by the state of Wisconsin contending that the state, not Tribes, holds authority over submerged lands and water bodies on tribal lands. Whereas Wisconsin is appealing the case to a higher court, NMC made the decision to opt for complying with the more stringent water-quality standards set by the Tribe rather than try to fight the validity of two sets of standards in court. NMC was concerned not only with the cost in time and money for a court fight, but also the even greater cost of an amicable relationship with the Sokagon Chippewa. NMC's course of action was to strive to comply with any reasonable application of the Sokagon water-quality standards, even though the standards were narrative and not quantitative in nature (Alberts and Grasmick, 2000, p. 20).

Another regional issue is that of cumulative mining impacts. Local people and mining industry critics fear that resolutions about the Crandon project will pave the way for significant, additional mining in northern Wisconsin (Wisconsin Department of Natural Resources, 1997b§). Currently, there are four known mineral deposits with commercial value in the region, including the Crandon, Flambeau, Noranda and Bend orebodies. The Flambeau deposit, relatively small at 1.9 million tons and composed of rich ore, was mined between 1993 and 1997. Reclamation of the Flambeau site beginning with mine closure in June 1997 is almost complete in 2001. Significant permitting activities related to the Bend and Noranda deposits currently (2001) await further progress on permitting the Crandon project. According to the WDNR (1997b), concurrent mining of the Crandon, Bend and Noranda deposits would result in activities no closer than 30 miles apart. Additionally, new discoveries even in 2001 would not result in mining for a minimum of seven to ten years, so there is minor concern by WDNR about a large number of concurrent mining projects having cumulative, regional environmental and socioeconomic impacts. The list of impacts includes: mining becoming the dominant economic activity throughout northern Wisconsin; the total acreage potentially disturbed by mining development; the total natural resources impacts with emphasis on water resources; transportation, tourism and net proceeds tax collection by the state; and precedent for other mines to be permitted in rapid succession (Wisconsin Department of Natural Resources, 1997b§).

The socioeconomic concerns most directly related to mining have to do with unpredictable changes in demand and prices for metals. If many mines were operating simultaneously, large numbers of employees – and mining benefits to local communities – would be vulnerable to fluctuations in the minerals economy. Local communities voice concerns about migrants who are lured by mining, then stay in the community and add to the unemployment rate and social burden if the mines shut down. The WDNR states that, in this regard, mining is little different than auto manufacturing, the steel industry, defense contracting, or wood products manufacturing. Industrial stability is not one of the criteria available to the WDNR in regulating mining. For an EIS, each mining project could evaluate potential socioeconomic concerns within its own sphere of influence, but could not be expected to provide a regional socioeconomic overview.

At the outset of the 21st century, virtually no mining operation anywhere on Earth is concealed from scrutiny by an array of governmental and nongovernmental entities (Khanna, 2000). In Wisconsin, critics of the mining industry have engaged global financial and other support by way of the Internet for fighting their legal and political battles at the local and regional levels. The proliferation of almost instantaneous electronic communications, especially via the Internet, has created surprising and powerful connections that come to bear on virtually all activities like the Crandon project, and should continue to influence mining in the foreseeable future. Additionally, mining for metals and many other commodities is clearly a global enterprise. As indicated previously (p. 105, this volume), most of the metals to be mined from the Crandon project by an international corporation are destined for markets outside the United States. The conjunction of global enterprise with surveillance by people engaged in global environmental and natural resources policymaking serves to call into question whether the Crandon project and others like it can ever be considered as being under purely local jurisdiction.

Wisconsin as an Example for the World

"However, we will certainly have forestalled the immediate threat of irresponsible exploitation, avoided the worst disasters associated with sulfide metallic mining, substantially raised the regulatory bar and done much to protect Wisconsin's pristine environment and, hopefully, by example, improved the standards for mining activities the world over." (Wisconsin Stewardship Network, 2000§)

Mining, no matter how well planned, regulated or executed faces intense inspection, comparisons, and accountability around the globe. As stated by Naparalla (2000§), despite records of improved performance, "The industry's past is replete with negatives, especially as it affects its physical surroundings." The environmental record of mining (p. 26-39, this volume) is one of past and present insults ranging from minor contaminations to major environmental crimes at locations around the globe (Danielson and Lagos, 2001§). Almost any mining operation, whether in Wisconsin, Papua New Guinea, Peru, or Romania will attract immediate attention when anything goes wrong, and the consequences will be quickly broadcast globally and used as examples of what could go wrong at almost any other mine in any other place (Mudder, 2001; Natori, 2000). Currently (2001), problems with cyanide contamination of local and regional environments in mining operations elsewhere in the world are being brought to bear on attempts to create new legislation banning the use of cyanide in mining operations in Wisconsin. Mining Environmental Management (2001) provides a modern, international overview of the history of cyanide use, cyanide problems, and cyanide management in mining. The United Nations Environment Programme (2001c), in cooperation with mining companies, is attempting to develop an international cyanide management code (p. 35, this volume).

Nicolet Minerals Company adopted the philosophy that the most effective way to control environmental damage during and following its Crandon project is to prevent it in the first place. NMC, in addition to complying with all local, state and federal laws and regulations assures that its corporate policy and management practices dictate even more stringent controls than are required by law (Nicolet Minerals Company, 2000§). The company also presents a face of openness and accessibility, using several mechanisms and venues for attending to local concerns and explaining designs and progress. NMC claims to have embarked upon a new social and technical approach to the project, relying upon listening to people and working with them rather than trying to convince them that technology will overcome the adverse impacts of mining (Alberts and Grasmick, 2000, p. 20). NMC seeks to achieve shared social, economic and environmental goals within the framework of exploiting the Crandon orebody, but clearly faces many obstacles during the next few years in obtaining a permit and beginning mining.

The struggles for and against mining in northern Wisconsin, perhaps more so than in most other regions of the world, illuminate a sociocultural complexity that was either absent from consideration or treated very differently by the mining industry as recently as ten to fifteen years ago. The Crandon situation serves to inform both the industry and its critics that there must be new ways of thinking about their relationships. It brings to light common obstacles to their respective ends, and helps clarify the manner in which they are inextricably bound and changed in ensuring sustainable mineral supplies, environmental quality, and promising socioeconomic futures for all concerned.

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