POLICY, ECONOMICS, AND THE REGULATORY FRAMEWORK

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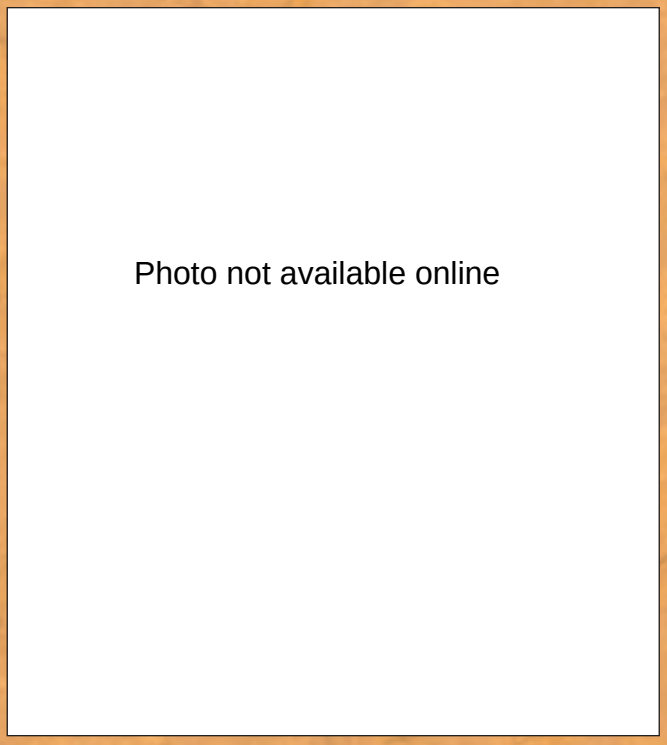
FIELD CONFERENCE 2005
Taos Region



Tailings ponds west of Questa, October 2002.

An Industry Perspective on Mining in New Mexico

Patrick S. Freeman, *St. Cloud Mining Company*

The extraction of natural resources has been a historical and cultural way of life in New Mexico and, including income from the Permanent Fund, contributes as much as 35 percent of the state's annual budget. Oil and gas make the biggest contribution to the Permanent Fund, but all extractive industries, including metal mining, industrial minerals, and sand and gravel, pay severance and resource taxes, which accumulate in the Permanent Fund and finance education. Most people understand that mineral production in various forms is necessary to maintain our standard of living and provide the raw materials necessary to sustain the quality of life we all enjoy. On the other hand, participants in the reform process include groups who, on one side, believe that no extractive industry whatsoever is acceptable and, on the other, believe that there should be no regulatory constraints of any kind. The reasonable objective should be to assure that environmental concerns are met in a manner that encourages sustainable mineral development. With regulatory oversight and modern reclamation technology, mining and environmental responsibility do not have to be mutually exclusive.

The two laws that contain the most rigorous requirements on mining activities in the state are the Water Quality Act and the Mining Act. Ground water quality impacts at mining operations are regulated under the Water Quality Act, administered by the New Mexico Environment Department. The department requires mine closure plans, water treatment and contamination abatement where applicable, with financial assurance, for operations expected to impact ground water and surface water. For these operations, Environment Department requirements are usually the most challenging for mining operators to meet. This includes the largest operations in the state. For mines that do not have significant water issues, the Mining Act reclamation requirements are likely to be the most onerous. This category includes most medium-sized and small mines in the state.

THE NEW MEXICO MINING ACT OF 1993

The New Mexico Mining Act is a Governor Bruce King legacy and was carried by Gary King through an eleventh hour legislative process in 1993. Reform was long overdue, and many mining companies had failed to become proactive in their communities or were unable to address citizens' concerns. Although the New Mexico Environment Department had some authority over the most blatant abuses of air and water quality, for the most part, the hard rock mining industry had operated with virtual impunity from reclamation since Territorial times. Local groups were insisting on public oversight, and mining companies were an easy and popular target.

The poster child for mining reform was the Ortiz mine, an inactive gold operation near Cerrillos, with a scar visible from the state capitol and cyanide contamination reported in downstream ground water. Santa Fe County reacted with a mining ordinance that became a model for the state Mining Act ten years later. Elsewhere in New Mexico, environmental activists and citizens were concerned about public safety and were reacting to hazardous mine openings, abandoned mine sites, pollution, and the possible effect of some operations on general quality of life issues.

The resultant Mining Act of 1993 changed the way mining is done in New Mexico and continues to evolve administratively and through interpretation. The act was initially intended to assure reclamation of depleted or abandoned mines, but now it materially affects all phases of permitting from exploration through mine closure and beyond. Excluded from regulation under the act are sand and gravel operations, certain uranium processing, all of the coal and potash industries, copper smelters, and recreational prospecting. Some of these industry segments are regulated under other federal, state, and public land requirements. Included under the act are primarily mining and exploration activities for base and precious metals and a wide range of industrial mineral operations.

Existing mines in 1993 were allowed to continue operations if they were able to conform with the provisions of the act including achieving an approved post-mine land use and providing the state financial assurance in the form of bonds or other irrevocable security to assure future reclamation. The act holds mine operators responsible for public and private

lands and was retroactive for any mines operating for at least two years since 1970, which brought many inactive and abandoned mines sites under the state's control.

The regulatory process for bringing a new mining operation into production or for expanding an existing mine is much more restrictive and uncertain. Requirements include oversight from various regulatory agencies, environmental studies, public participation, and a lengthy process of hearings, options for appeals, and possible lawsuits, some of which the applicant pays for. A few companies have tried, but in the final analysis, there has not been a new large mine operation or a significant expansion of an existing mine since the act was promulgated in 1993. Organized exploration efforts for the regulated commodities, which is a precursor to future mineral development, is virtually non-existent in New Mexico and will not likely be resumed unless there is a reasonable certainty that a potential discovery can be developed. Mining companies evaluate cost and risk and will ultimately take the path of least resistance. For now, that path leads away from New Mexico. The mines already in production, when unable to expand or respond to changing conditions, are more vulnerable to competition, increased costs, and fluctuations in commodity prices.

In the decade before the Mining Act, ten or more operations were significantly expanded and new mines were brought on line. That decade saw the reopening of the Hurley copper smelter and the Continental mine, the SXEW investments at Chino and Tyrone and at a number of new, smaller base and precious metal mines, and exploration projects scattered across the state. Pinos Altos, Carrache Canyon, mines in the Lordsburg area, St. Cloud's silver mines, and exploration projects collectively provided economic development in many rural settings. By the mid-1990s the industry experienced a downturn in metal prices, and the added costs of the Mining Act and other regulatory impacts were too much to overcome. In 1999, for example, New Mexico lost 1,426 high paying jobs and another $52 million in annual payrolls from the copper industry alone. Many of these jobs, including the production equipment that supported the employment, were exported to neighboring states or foreign countries where higher-grade deposits, fewer regulatory constraints, and lower costs were being offered. At the time the New Mexico mines were being closed, Phelps Dodge, for example, acquired and operated new copper mines and a smelter in Arizona and invested heavily in South American projects. The three principal copper smelters that provided market outlets for much of New Mexico's mineral production, El Paso, Hurley, and Playas, collectively remain closed.

The impact of these mine closings on local governments' ability to provide essential human services has been particularly severe in small, rural communities such as Animas, Lordsburg, and Questa. Grants, Silver City, and other cities have been able to partially diversify their economic base beyond mining but are still adjusting to reduced tax revenue and unemployment.

In the area of financial assurance for post-mining reclamation, New Mexico's requirements are generally more onerous than those of other western states. As an example, there was a long and more than $10-million process of hearings, appeals, studies, and administrative review in determining Phelps Dodge's financial assurance requirements for its Silver City operations. At one point, environmental groups were suggesting $1,200 million of irrevocable reclamation security and, although the current assurance is approximately one-third of that amount, it represents a substantial expense and ties up collateral that would otherwise be available for investment. The recently reopened Robinson copper mine in northern Nevada is similar in size, scope, and legacy impact to Chino at Silver City. Its joint financial assurance obligation with the BLM and the state of Nevada is $18,100,000 or about one-twentieth the requirement for Chino. Sumitomo, a former partner at Chino, recently paid Phelps Dodge to acquire their interest and relieve them of environmental obligations in New Mexico.

Once financial assurance is in place, there is disincentive to incur the additional expense of the actual reclamation as this constitutes double jeopardy for the operator. Further, the process for release of the financial assurance, once reclamation is completed, is subject to additional regulatory scrutiny and public input and is by no means certain. For smaller operators the costs for maintaining financial assurance and complying with reporting obligations, coupled with the annual permit fees, can be more than the actual cost of completing the reclamation. The catch is, reclamation can't be completed until mining ceases.

As another example of the economic impact of the Mining Act on operators, St. Cloud mines zeolite, an inert absorbent material involving no chemical processing, at a small and remote site in southwestern New Mexico and is subject to the act. Essentially all of the reclamation that can be done, short of closing the mine, has been completed. Maintaining financial assurance, annual permit fees, and administrative

oversight for reporting constitutes a 4-6 percent burden over gross operating costs, not including the actual reclamation that is routinely done. St. Cloud's principal competitor in Texas has no annual fee or reclamation assurance obligations whatsoever. Although this could change, New Mexico operators are currently at a disadvantage.

Enforcement and administration of the Mining Act is under the Mining and Minerals Division (MMD) Reclamation Bureau, consisting of about ten employees. The bureau is responsive and professionally staffed. The act, however, was not funded by the legislature and derives its operating budget from the regulated operators in the form of permitting fees, annual assessments, and penalties. With a declining base of operators, as existing companies fall victim to depleting reserves and increasing costs, and as reclamation is completed and more inactive mines are released, the pool that funds the Reclamation Bureau is decreasing. The bureau's operating cost, on the other hand, has more than doubled since inception in 1993, and the remaining mines, bearing the brunt of these costs, find it increasingly expensive to remain open.

In cases such as San Pedro, Carrache Canyon, Little Rock, and others, MMD either issued permits or was unable to proceed with the permitting process because other state agencies, such as the Environment Department, or local ordinances, as in Santa Fe County, blocked or hindered the process. In other cases, as with Copper Flat near Hillsboro, citizens' groups filed appeals and demanded more and more studies until the operator succumbed to the process and withdrew from the state. In 1999 Chapman, Wood and Griswold, a consulting firm in Albuquerque, was asked to review opportunities for a possible wallboard and soil amendment operation that needed a gypsum resource and the availability of natural gas and transportation facilities, all of which are plentiful in New Mexico. The company envisioned a $60,000,000 project with employment for 60–100 workers. The consulting firm outlined several likely sites, and one in southeastern New Mexico was particularly attractive. When the New Mexico regulatory component was described, the company took its search to Utah and Nevada.

Without a doubt, many good things might not have otherwise been accomplished without the Mining Act. Commendable reclamation efforts under the act include clean-ups by companies who acquired properties with abandoned or inactive mines but were not actually responsible for the prior disturbances. Lac Minerals at the Ortiz operation near Cerrillos is a prime example, but others include Rio Tinto and other owners of uranium properties near Grants and Phelps Dodge, which completed work at Pinos Altos and Hanover near Silver City and at Tererro near Pecos. St. Cloud conducted similar reclamation at San Pedro in southern Santa Fe County and at Lordsburg, including clean-up of a cyanide heap-leach facility abandoned by a previous operator. Remaining operators are now held to a higher standard, and mines are safer, cleaner, and more responsive to citizen input than they have ever been.

A few existing mines were unable or unwilling to comply with the Mining Act or the general regulatory climate and closed. Agronics, a small humate operation near Cuba, and a garnet operation at San Pedro are examples. After spending millions, other promising exploration or development projects bogged down in the permitting process and remain inactive. The gold deposit at Carrache Canyon and copper deposits at Copper Flat near Hillsboro and at Little Rock near Tyrone are examples. Other operating mines have simply succumbed to increased compliance and operating costs, including a mica mine near Velarde, which later closed as well. The state of the hard rock mining industry in New Mexico is such that capital for development or expansion is difficult to obtain and reclamation bonding and liability insurance are beyond the reach of many operators, particularly the smaller ones.

Some extractive operators have turned to commodities not regulated under the Mining Act, such as sand and gravel, and continue to expand or add new operations. A new aggregate operation at Lordsburg for railroad ballast is an example. A call for increased regulatory control of these producers by state agencies and citizen's groups was initiated in 2000, and it will likely receive additional oversight in the future.

THE NEW MEXICO ENVIRONMENT DEPARTMENT

Throughout the evolution of the Mining Act, the New Mexico Environment Department has played a key role. The Environment Department, through its Ground Water, Surface Water, and Air Quality Bureaus, administers regulations under the Federal Environmental Protection Agency, continues to permit certain aspects of mining operations and fills in regulatory gaps in the Mining Act. The Environment Department uses its considerable technical resources, large staff, and “veto” power under the act to further assure that water and air standards are met and uses this authority to leverage operators to achieve standards that were not necessarily enforceable before the

promulgation of the act. For example, some closed mine operations had expired discharge plans with limited obligations for capping tailing impoundments and ground water monitoring. As a condition for approving closeout plans and financial assurance packages under the act, some operators were held to higher standards than were required under their original permits. Within the last decade the Environment Department has also begun requiring "closure plans" with full financial assurance that covers all elements of mine closure including reclamation, water treatment, and clean-up of any water contamination. Recently the Environment Department has also become much more aggressive in enforcing penalties and collecting increased fees to fund the department's expanding activities.

The Environment Department also oversees portions of the Federal Superfund program. Clean-up of the Cleveland mill tailings near Silver City and other work near Pecos, for example, was initiated by companies within Superfund guidelines. These two examples would not have been covered under the act (pre-1973), had identifiable, responsible ownership and were ineligible or too complex to be reclaimed under Abandoned Mine Land programs.

For the mining industry, the Environment Department, however, has become a cumbersome and sometimes conflicting and duplicitous impairment for environmental compliance. The Environment Department represents a bigger variable than MMD for permitting because of the more subjective rules, time and cost to process permit applications, and selective enforcement. The complexity of the permitting, reporting, and compliance process within the Environment Department requires much more expertise than a typical small operator can manage or afford.

OTHER REGULATORY OVERSIGHT AND SUPPORT

As elsewhere, the Mine Safety and Health Administration (MSHA) regulates worker safety, training, exposure limits, and related employment issues. The state Engineer's Office controls, approves, and monitors water consumption and allocation and the safety of water impoundments. There are emerging local regulatory groups, for purposes other than conventional zoning and land use. Bernalillo, Santa Fe, and Rio Arriba Counties and many tribal governments now have separate permitting and enforcement standards for extractive activities which, in general, are more restrictive or cover other operations, such as sand and gravel producers, that are not fully addressed under state authority. The Department of Game and Fish is also represented under the act and reviews endangered species, wildlife, and the revegetation aspects of mining in general before the issuance or modification of permits. The Office of Cultural Affairs reviews mining permits for possible impacts on historical or cultural sites, cemeteries, or related sensitive areas.

For the pre-1973 abandoned mining properties not covered by the Mining Act, the citizens of New Mexico are served by another group within MMD: the Abandoned Mine Land Bureau (AML). AML derives its funding from the federal Surface Mine Control and Reclamation Act (SMCRA) of 1977. Coal mine operators pay a reclamation fee of $0.35 per ton for surface mined coal and $0.15 per ton for underground mined coal, which is dispersed back to the states for worthy reclamation and safeguarding projects, including non-coal projects. The AML staff inventories, prioritizes projects, and contracts safeguarding and reclamation. To date, major projects completed by AML include abandoned and inactive coal mine sites at Sugarite Canyon, Carthage, Yankee, and Madrid and hard rock sites at Cerrillos, Oro Grande, Cochiti, Organ, Deming, and elsewhere. Additional projects funded by SMCRA are planned and include Lake Valley and additional work at Oro Grande and Sugarite Canyon. At least three of these restored sites, Sugarite Canyon, Cerrillos, and Lake Valley are, or will be, interpretive centers, parks, and nature conservatories with economic development impact through tourism.

This reclamation work may improve the public perception of mining, provide some sustainable income producing post-mine land uses, serve as a safety valve for the protection of historical and cultural sites relating to mining, and protect citizens from the hazards often found at abandoned sites.

The office of the State Mine Inspector, whose inspection duties were primarily relegated to support and accident investigations by MSHA, now provides training to new mine employees and continuing education for experienced miners. This is an especially beneficial program for smaller companies that may not have in-house training capabilities. It is not coincidental that mine safety has dramatically improved in New Mexico.

The New Mexico Bureau of Geology and Mineral Resources, a division of New Mexico Tech, has considerable professional and technical resources. It serves as repository of historical mining records, maps, and publications; provides support, information and assistance, particularly to smaller operators, regulatory agencies, and citizens' groups; and conducts research

in various forms to serve the state's needs. The bureau also helps companies interested in natural resource development in New Mexico compile previous exploration information and access the latest technology, and it provides support for analytical, metallurgical, and marketing services.

OPPORTUNITIES DELAYED

Exploration, development, and utilization of New Mexico's hard rock mineral resources have gone into hibernation since enactment of the Mining Act of 1993. Many companies have decided to work in less regulated states or to accept political risk in developing countries for the uncertainties of environmental and permitting risks in New Mexico. Known deposits await future development, and exploration potential remains to be tested. Many of the abandoned properties have been brought into compliance, and many of the environmental concerns at operating mines have been corrected. The act, with Environment Department oversight, has corrected many environmental problems at mine sites, but now it serves as an effective deterrent prohibiting expansion of existing operations and the development of new projects.

Recently copper and precious metal prices have improved, and Governor Bill Richardson's administration was able to complete a closeout plan and a financial assurance package for Phelps Dodge in Silver City. This is the first bright spot for mining in many years and has allowed a partial resumption of operations with some 150 workers being recalled.

Legislative revision of the Mining Act and Environment Department regulations, perhaps with broader provisions to encompass all extractive activities within New Mexico, will be necessary before a meaningful resumption of exploration and sustainable mineral development can resume.

Economic Impact of Mining on New Mexico

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The wealth of the world will be found in New Mexico and Arizona —Baron von Humboldt, 1803

It is difficult to overestimate the effect that mining has had on the history and development of New Mexico. The Cerrillos mining district located southwest of Santa Fe is the oldest European mining district in the United States. Activity there predates mining in the American colonies by at least one hundred years. The Spanish were mining in the area four hundred years ago, and local pueblos have been mining turquoise in the Cerrillos Hills for at least one thousand years. Mining was important even then because it was one of the few activities capable of producing a commodity valuable enough to pay the high cost of transport from remote Nuevo Mexico to Mexico City, more than 1,500 miles south. The promise of finding gold or silver deposits was one of the driving forces behind the Spanish colonization of New Mexico. Those expectations largely came to fruition during the nineteenth century and the first half of the twentieth. Since that time the trend has been decidedly down. Experts believe that there may be many factors responsible for this declining trend including world mineral economics, the lack of undeveloped high-grade deposits, globalization, and a complex regulatory environment.

Although it is clear that mining has been a major component of New Mexico's economy in the past, it is less clear what the economic impact of the mining industry in New Mexico is today. In 2003 there were 225 registered active, producing mining operations in New Mexico. This includes five coal mines, three potash mines/mills, one molybdenum mine, two major copper mines, forty industrial mineral operations, and 175 aggregate operations. Operations on Indian lands are not included, but it is known that one of the largest coal mines in the state, some industrial mineral, and many aggregate operations are located on Indian lands. Since 1998 the number of registered operations has increased by about sixty, almost all in the industrial mineral and aggregate categories.

According to the Bureau of Business and Economic Research at the University of New Mexico, there have been no comprehensive studies done to determine the total economic impact of mining to the state. However, a variety of data has been collected that highlights the relative importance of the mining sector. The data show that during the mid-1960s employment in the mining industry was about 3.5 percent of all employment (excluding agriculture) in New Mexico. (The mining category typically includes the oil and gas industry, but for purposes of this discussion, oil and gas numbers were omitted.) This percentage has been dropping ever since, with the exception of a one-year period beginning in mid-1979. In spite of the drop in the percentage of employees in the mining industry over the last forty years, the number of employees rose from approximately 9,000 in the mid-1960s to 16,500 in 1980, but has steadily declined to about 4,000 in recent years. Mining-related employment during the first half of 2004 represents about 1.8 percent of all non-farm employees statewide. Nationally, mining is less than one-half of one percent of all non-farm employment.

Wages in the mining industry are high when compared to other sectors. According to the New Mexico Mining Association, the average employee earns more than $53,000 a year, whereas the state average is less than $30,000. The New Mexico Department of Labor statistics indicate annual average mining industry wages for 2003 were $54,392. The total economic impact to the state, as determined by a 1999 study by a private consultant and based on 1998 data, is over $4.4 billion.

IMPACT OF NEW MEXICO'S BIG PLAYERS

Copper Copper was one of the first metals ever used. Because of its properties, including high ductility, malleability, and thermal and electrical conductivity, and its resistance to corrosion it is one of the most valuable metals. Copper metal is generally produced from a multistage process that includes mining, concentrating, smelting, and refining to produce a pure copper cathode. Copper is increasingly produced from acid leaching of ores.

New Mexico copper is used chiefly in the manufacture of electrical wire. Electrical uses of copper include power transmission and generation, building

wiring, telecommunication, and electrical and electronic products. Copper is readily recycled, which contributes significantly to the copper supply. China is now the world's largest consumer of copper. The price of copper has risen dramatically from $0.69 per pound in August 2002, to $0.83 per pound in August 2003, to $1.38 per pound in October 2004.

The world's second largest copper producer, Phelps Dodge Mining Company, produces copper and base metals principally in Grant County in southwest New Mexico and in Arizona. Collectively, Phelps Dodge's six mines in Arizona and New Mexico are capable of producing more than 2 billion pounds of copper annually and account for about 60 percent of total U.S. copper production. The two active Phelps Dodge operations in New Mexico are Chino and Tyrone.

In 2004 Chino Mines Company (Chino), a division of Phelps Dodge, reactivated the Ivanhoe concentrator that had been shut down since 2001. Chino reactivated mining in the Santa Rita open pit in 2003 after mining operations were idled in 2001. Production has continued at the Chino solvent extraction/electowinning (SXEW) plant throughout these periods. The Chino Smelter has been idle since 2002. With increasing copper prices in 2004 operations resumed and production increased at Chino. Employment rose at Chino from 380 employees at the end of 2003 and is expected to stabilize at slightly more than 600 employees by the first quarter of 2005.

SXEW production at Phelps Dodge Tyrone, Inc. (Tyrone) has remained steady during 2004, but the mining rate and employment have increased since the end of 2003. Employment at Tyrone has increased from 260 employees at the end of 2003 to about 380 employees currently, with about fifty of that number working part-time at Tyrone. Between Chino and Tyrone, approximately 400 employees will have been recalled or hired by early 2005.

Gold, silver, and molybdenum are produced as byproducts of copper processing from Phelps Dodge

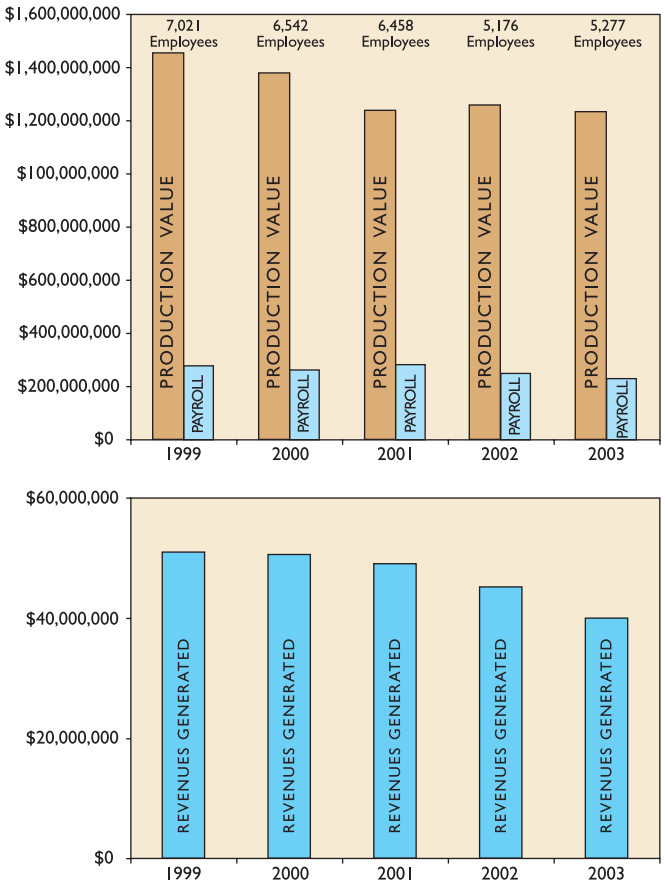
Jobs	6,000
Average salary	$53,000
State average all jobs	$29,000
Direct economic gain	$982,000,000
Direct personal income gain	$302,000,000
Direct in-state business income	$451,000,000
Direct out-of-state business income	$19,000,000
State & local gov. revenue	$208,000,000
Total impact on NM economy	**$4,415,000,000**

Source: New Mexico Mining Association and the National Mining Associaion

Economic impact of mining in New Mexico in 2002.

MINERAL	PRODUCTION RANK	PRODUCTION VALUE ($)	EMPLOYMENT	PAYROLL ($)	REVENUE GENERATED ($) STATE	FEDERAL
Coal	12	628,291,436	1,651	110,979,081	23,612,272	10,414,900
Copper	3	158,138,070	879	26,815,001	548,521	
Gold	-	-	-	-	3,900	
Industrial minerals	-	153,198,856	663	18,708,370	941,640	
Aggregates	-	77,848,579	1,063	17,190,991	703,926	
Molybdenum	5	15,800,000	165	7,000,000		
Potash	1	202,166,863	824	47,249,963	1,456,772	2,376,622
Silver	-	-	-	-	1,763	
Uranium		-	32	1,000,000	232	
Total		**1,235,443,804**	**5,277**	**228,943,406**	**27,269,026**	**12,791,522**

Summary of production rank, production value, employment, payroll, and revenue for mineral commodities in New Mexico in 2003. Rank is based on quantity produced. State revenue includes royalties/rentals from state trust land mineral leases; and severance, resources excise and energy conservation tax revenues. Federal revenue includes 50% state share of federal royalties (Onshore Collections in CY 2003). Source: Production rank from U.S. Geological Survey (http://minerals.er.usgs.gov/minerals) and DOE's Energy Information Administration (www.eia.doe.gov). Employment includes direct and contract employees. State revenue data from NM Tax and Revenue Department and the State Land Office; Federal data from Minerals Management Service.



Trend information associated with several of the commodity attributes 1999–2003 including data for coal, copper, gold, industrial minerals, aggregates, molybdenum, potash, silver, sulfuric acid, and uranium. Although the figure demonstrates that the trend over the five-year period is decidedly down, with increasing commodity prices the 2004 data will likely reverse this trend.

copper operations in Grant County. Production of these commodities was highest in the late 1980s and has declined ever since. No byproduct gold, silver, or molybdenum has been produced in the state over the past several years. However, with rising metal prices and the reactivation of the Ivanhoe concentrator, byproduct production resumed in 2004.

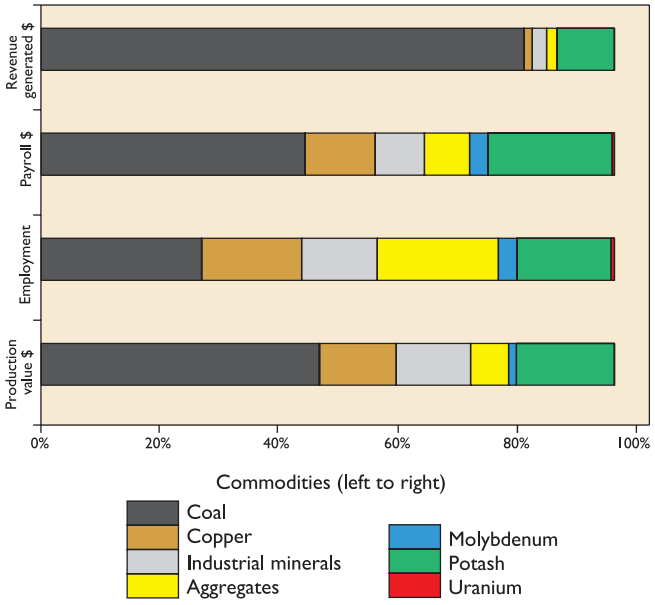
The economic impact of the copper industry to Grant County and New Mexico was examined in a paper commissioned by Phelps Dodge in 2002. According to that document the average wage of a Phelps Dodge employee is $50,734, more than twice the average wage per job in Grant County. Wages and salaries from Phelps Dodge represent almost 8 percent of the county's total personal income. Phelps Dodge purchased $43.6 million in goods and services from other Grant County businesses and an additional $3.3 million from businesses in New Mexico but outside the county. Phelps Dodge paid $6.7 million in state and local taxes including: property taxes ($1.94 million); gross receipts/compensating taxes ($3.1 million); severance taxes on copper production ($.16 million); and fees, operating permits, licenses, and other excise taxes ($1.5 million). Total direct impact to Grant County was estimated at $80.5 million with an additional $7.8 million to other counties in New Mexico. When indirect impacts are considered, the impact to Grant County is estimated to be over $100 million and the impact to the state of New Mexico is estimated at $144 million.

Molybdenum Molybdenum is a metallic element used principally as an alloying agent in steel and cast iron. It enhances hardness, strength, toughness, corrosion resistance, and wear. These properties are achieved by combining molybdenum with other metals including manganese, nickel, and tungsten. Molybdenum is also used in the development of catalysts, lubricants, and pigments.

The state's only primary molybdenum producer is Molycorp's Questa mine and mill in Taos County, which has operated sporadically since the early 1900s. Molybdenum is also produced as a byproduct of copper production at Phelps Dodge operations in Grant County. Additional workers were hired in 2004 at Questa to meet the demands of the current market. The mine currently employs over 150 personnel with the majority of the workforce from northern New Mexico. At least 50 percent of the work force reside in the village of Questa. The average Molycorp employee earns about $50,000 annually.

According to Molycorp the mine, on an annual basis, has purchased goods, materials, and services in Taos County in the amount of $7 million and in New Mexico (particularly in the northern part of the state) in excess of $11.3 million. The direct economic benefit on Taos County alone is calculated to be more than $32 million. Taxes paid by Molycorp to the state include $141,000 in property tax; $990,000 in sales tax; and $31,000 in severance tax. Molycorp intends to continue to be a direct participant in the economic stability of the local area, including assisting the village of Questa in its economic sustainability efforts.

Potash Potash is a mined salt containing water-soluble potassium. Potassium chloride (sylvite) and potassium/magnesium sulfate (langbeinite) are mined by underground methods in Eddy and Lea Counties near



Production value, employment, payroll, and revenue generated, shown by percentage, by commodity. This figure provides some gage of the relative importance of the commodities to each other, for a selected number of attributes.

Carlsbad. More than 75 percent of U.S. potash production comes from the Carlsbad potash district, where two companies operate three mines and employ approximately one thousand workers. New Mexico potash is used primarily as an agricultural fertilizer; most is sold domestically to companies in Texas, Oklahoma, Kansas, and Nebraska. The estimated potash reserves in the district are very large. Worldwide demand is strong, inventories are low, and supply is extremely tight. Pricing has increased to historically high levels. In recent years the industry estimates their annual economic impact to the state at $304 million: $80 million on materials, energy, and related taxes; $65 million for direct payroll; $150 million for indirect payroll; and $9 million for royalties, and property and sales taxes. More than 75 percent of the total ($231 million) goes to just Eddy County, where potash employs 12–15 percent of the available workforce.

Uranium Although the present economic impact is minimal, given rising prices and huge reserves, the potential impact is huge. Since production started in the late 1940s, the Grants uranium belt has been the most prolific producer of uranium in the U.S. The boom years in the district were 1953–1980, when approximately 350 million pounds of uranium oxide (yellowcake) were produced. Uranium recovery operations declined dramatically after 1980 because of the depressed uranium market that resulted from the liquidation of large government (cold war military) stockpiles. All uranium recovery in the state ceased in December 2002. Proposed operations in New Mexico include Hydro Resources, Inc. (HRI), which intends to mine uranium by in situ leaching at Church Rock and Crownpoint in the near future. Rio Grande Resources Co. is maintaining the closed facilities at the flooded Mt. Taylor underground mine in Cibola County.

According to HRI, interest in uranium production is returning because inventories have become depleted and market prices are rising to economic levels that reflect the cost of production. The price of yellowcake has risen from about $7 per pound in 1994 to about $20 per pound in fall of 2004. The New Mexico Bureau of Geology and Mineral Resources estimates that known resources could be as much as 600 million pounds. New Mexico is second only to Wyoming in uranium reserves. HRI estimates that nearly half of the known resources are recoverable using low-cost in-situ leaching methods. In situ leaching involves the circulation of ground water with a bubbled oxygen (club soda-like) mixture through a series of injection and extraction wells that removes the uranium ore from the sandstone orebody.

According to an Albuquerque Journal article (September 1, 2003) an international consortium wants to build a billion-dollar-plus Lea County facility to produce fuel for nuclear reactors. Louisiana Energy Services (LES) announced that the $1.2 billion uranium enrichment plant would be built off NM–176, 5 miles east of Eunice, near the Texas–New Mexico border. Construction could begin within three years if the permit process goes smoothly. LES proposed moving the operation to New Mexico after encountering community resistance in Hartsville, Tennessee, where it had proposed building the facility after meeting opposition in Louisiana, its first choice. The planned Lea County facility would provide uranium for the U.S. nuclear industry, with oversight from the Nuclear Regulatory Commission and the New Mexico Environment Department. The plant is expected to employ from 200 to 400 people during construction and about 250 during operation. The company said the annual payroll will be about $10 million, with an average salary of about $50,000.

Aggregate Aggregate mining provides the basic materials for constructing and maintaining the infrastructure of New Mexico. Over 14 million tons of aggregate are consumed each year in New Mexico, with 6.5 mil-

lion tons consumed in Albuquerque and Santa Fe alone. Every new home uses approximately 100 tons of aggregate, every school or hospital uses from 12,000 to 15,000 tons, and road construction requires around 8,000 tons of aggregate per mile of road. In addition to providing the basic building materials, the industry provides high paying jobs for skilled employment, funds for improving New Mexico's schools through the mining of state land, and thousands of dollars in taxes and permits. According to the National Stone, Sand & Gravel Association, every $1 million in aggregate sales creates nineteen and a half jobs, and every dollar of industry output returns $1.58 to the economy.

Construction sand and gravel is one of the most accessible natural resources and a major basic raw material. It is used mostly by the construction industry. Despite the low unit value of its basic product, the construction sand and gravel industry is a major contributor to and an indicator of the economic well-being of the state and the nation. According to the U.S. Geological Survey, New Mexico is a significant producer of construction sand and gravel and dimension stone.

Based upon preliminary U.S. Geological Survey data, New Mexico was twenty fifth in rank (twenty fourth in 2002) among the fifty states in total non-fuel mineral production value and accounted for nearly 1.5 percent of the U.S. total.

Can we expect the future to look like the past? How does economics of mining relate to sustainable development? Unfortunately, like many of life's questions, there are no clear answers. What is clear is that to date there has been no comprehensive, impartial assessments performed and, without them, economic impact is in the eye of the beholder. The highly paid mine worker or the profitable mine operator will have one view of economic impact, whereas the environmentalist, the resident living next to an aggregate operation, or the tourism-related businessman may have another.

With recent price increases there is reason to believe that the industry may make a comeback. Unfortunately, the boom and bust cycle of the mining industry offers no guarantees that the comeback will last. Our state is lucky in one regard: we possess and produce significant quantities of aggregate, particularly sand, gravel, and crushed rock. Despite the low

COMMODITY	WHERE LOCATED	USES	COMMENTS
Perlite	Rio Arriba, Socorro	Building construction products and horticultural aggregate	New Mexico is first in production. Most shipped to west coast. Greece is primary competitor.
Gypsum	Bernalillo, Sandoval	Wallboard (typical home contains more than 7 metric tons)	Centex is major player.
Pumice	North central NM	Building products	New Mexico is third in production.
Humate	Sandoval, McKinley	Soil conditioner	Significant reserves exist.
Salt	Eddy	Feedstock and highway deicing	
Zeolite	Sierra	Pet litter, animal feed, horticultural applications	New Mexico has largest zeolite mine in U.S.; first in production.
Mica	Rio Arriba, Taos	Joint compound, paint, roofing, drilling additives, rubber products	New Mexico is third in production
Limestone	Bernalillo	Cement	Tijeras plant.
Clay	Northern NM (common clay) Luna and Grant (fire clay)	Adobe brick, brick, roofing granules, and quarry tile	Fire clay is quarried for use in the copper smelter.
Iron ore	Magnetite tailings in Grant County	Used in steelmaking and to increase the strength of cement	New Mexico is third in usable iron ore production.
Sulfuric acid	Grant County	Copper recovery and a multitude of industrial processes	Produced as by-product of copper smelting.
Sand and gravel	Generally along Rio Grande corridor	Road and building construction	Represents 35% of all aggregate production.
Crushed stone	Generally in eastern and western New Mexico	Road and building construction	Represents 35% of all aggregate production.

Selected information on industrial minerals.

unit value of its basic products, New Mexico's aggregate industry is a major contributor to, and indeed an indicator of, the economic well-being of our state.

The economic and statistical information presented here was generated in both the government and industry sectors. Sources include the Mining and Minerals Division of the Energy, Minerals and Natural Resources Department, which collects and publishes statistical information related to the mining industry; the U.S. Geological Survey; several of the larger operators in the state; the Bureau of Business and Economic Research at UNM; and the New Mexico and National Mining Associations.

The Economic Anomaly of Mining—Great Wealth, High Wages, Declining Communities

Thomas Michael Power, *Department of Economics, University of Montana*

Mineral extraction activities pay among the highest wages available to blue collar workers, about twice the average. In New Mexico in 2000, mineral extraction jobs paid $50,000 per year whereas the average wage and salary job paid $28,000. Given these high wages, one would expect communities that rely heavily on mineral extraction to be unusually prosperous. That, in general, is not the case. Across the United States, mining communities, instead, are noted for high levels of unemployment, slow rates of growth of income and employment, high poverty rates, and stagnant or declining populations. In fact, our historic mining regions have become synonymous with persistent poverty, not prosperity: Appalachia (coal), the Ozarks (lead), and the Four Corners (coal) areas are the most prominent of these. Federal efforts have focused considerable resources at overcoming the poverty and unemployment found in these historic mining districts. In addition, the Iron Range in Minnesota, the copper towns of New Mexico, Michigan, Montana, and Arizona, the Silver Valley of Idaho, the gold mining towns of Lead and Deadwood, South Dakota, etc. are also not prosperous, vital communities. Over the last several decades some of these areas have begun to recover as a result of the immigration of new, relatively footloose residents and economic activities, but that recovery is entirely non-mining based.

The dramatic contrast between the wealth created and the high wages paid in mining and the poor economic performance of mining communities needs to be understood before expanded mineral extraction activities can be safely promoted as a local economic development strategy. This paper looks at the actual performance of mineral communities over the last quarter century and then turns to an explanation for that relatively poor performance.

CONTEMPORARY AMERICAN MINING COMMUNITIES

In order to explore the contemporary local impact of reliance on mining in the United States, we studied the economic performance of all U.S. counties where mining (excluding oil and gas extraction) was the source of 20 percent or more of labor earnings between 1970 and 2000. There are about one hundred such counties that could be identified out of the 3,100 counties in the U.S. Data disclosure problems prevented the identification of some mine-dependent counties.

The U.S. mining-dependent counties are spread out over half of the American states but are geographically clustered in the Appalachian (Pennsylvania, West Virginia, Tennessee, Kentucky, and Virginia) and Mountain West states. The century-old copper mines of Upper Michigan, Montana, Utah, Arizona, and New Mexico are included, as are the new gold mines in Nevada. The older coal mines in southern regions of the Great Lakes states (Illinois, Indiana, and Ohio) are included, as are the new open pit coal mines of Wyoming, Montana, Utah, Colorado, and New Mexico. The lead mines of the Ozarks in Missouri, the precious metal mines in the Black Hills of South Dakota and the Silver Valley of Idaho, and the iron fields of Minnesota are also included.

The question we sought to answer was whether this high degree of reliance on mining allowed these counties to outperform those counties that did not rely heavily on mining. For those counties that were dependent on mining in the 1970s, we looked at their economic performance in the following decades: 1980–1990, 1990–2000, as well as the two decade period, 1980–2000. For those counties that were dependent on mining in the 1980s, we looked at their economic performance in the 1990–2000 period. Economic performance was measured in terms of the growth in the aggregate labor earnings of residents of the county, per capita income, and population. In addition, the level of per capita income at the beginning and end of the periods was analyzed.

The decade of the 1980s was not a good one for mining-dependent counties. Labor earnings in those counties grew much more slowly than in other counties, almost 60 percent slower. During the 1990s earnings were still growing more slowly in mining-dependent counties, 25–30 percent slower. For the entire period 1980–2000, aggregate earnings in mining-dependent counties grew at only half the rate of other American counties.

Per capita income also grew more slowly during the 1980s in mining-dependent counties, about 30 percent slower. During the 1990s per capita income grew at about the same rate as in the rest of the nation, but for the entire period, 1980–2000, per capita income grew about 25 percent slower. The *level* of per capita income was also lower in the mining-dependent counties and, given that slower growth, the gap increased relative to the rest of the nation. In 2000 the income available to support each person in a mining-dependent county was about $9,500 per year below what was available, on average, in other counties.

Most mining operations are located in non-metropolitan areas where average incomes, in general, are lower. If the mining-dependent counties are compared only to other non-metropolitan areas, it is still true that the mining-dependent counties have lower per capita incomes and that they have lost ground relative to other non-metropolitan counties over the last three decades. This is also true for most mining regions even if the mining-dependent counties are compared only with the other non-metropolitan counties in the same state. Of the twenty five states with mining-dependent counties, only four (Montana, Minnesota, Michigan, and Georgia) had per capita incomes in the mining-dependent counties above the state's non-metropolitan average, and those incomes were only 3–11 percent higher. Of those twenty five states with mining-dependent counties, nineteen saw per capita income in the mining-dependent counties deteriorate relative to the state non-metropolitan average between 1980 and 2000.

Given this poor economic performance in U.S. mining-dependent counties, it is not surprising that population growth in these counties was negative during the 1980s and significantly slower than in the rest of the nation in the 1990s. For the 1980–2000 period, population growth in mining-dependent counties was only one-fourth to one-eighth of what was found on average in the other U.S. counties.

It is clear that over the last several decades, dependence on mining did not allow U.S. communities to perform better than other American communities. In fact, mining-dependent communities lagged signifi-

	LABOR EARNINGS			PER CAPITA INCOME		
	1980–1990	1990–2000	1980–2000	1980–90	1990–2000	1980–2000
Mining-dependent counties in 1970s	0.41	0.75	0.49	0.71	0.97	0.77
Mining-dependent counties in 1980s	0.41	0.69	0.46	0.72	0.95	0.76

Source: REIS CD-ROM; author's calculations

Growth in labor earnings and per capita income, mining-dependent relative to other U.S. counties.

	POPULATION GROWTH			LEVEL OF PER CAPITA INCOME		
	1980–90	1990–2000	1980–2000	1980	1990	2000
Non-mine-dependent counties	4.5%	11.2%	18.1%	$ 10,201	$ 19,622	$ 29,548
1970s mining-dependent	-3.0%	6.8%	4.6%	$ 8,362	$ 13,595	$ 19,893
1980s mining-dependent	-3.8%	5.5%	2.2%	$ 8,390	$ 13,754	$ 20,099
Difference: 1970 mining-dependent and other counties	-7.6%	-4.4%	-13.5%	$ (1,839)	$ (6,027)	$ (9,655)
Difference: 1980 mining-dependent and other counties	-8.3%	-5.6%	-15.8%	$ (1,813)	$ (5,874)	$ (9,457)

Source: REIS CD-ROM; author's calculations

Population growth and level of per capita income, mining-dependent and other U.S. counties.

cantly behind the average for the rest of the nation.

These are not new results. U.S. Department of Agriculture analyses have also pointed out the slower economic growth and lower per capita incomes in mining-dependent counties. In addition, a recent report by the U.S. Census Bureau providing *Profiles of Poor Counties* showed, when counties are classified by the type of industry that dominates the local area, mining counties had the highest poverty rates of any industrial group and that poverty rate increased systematically between 1989 and 1996.

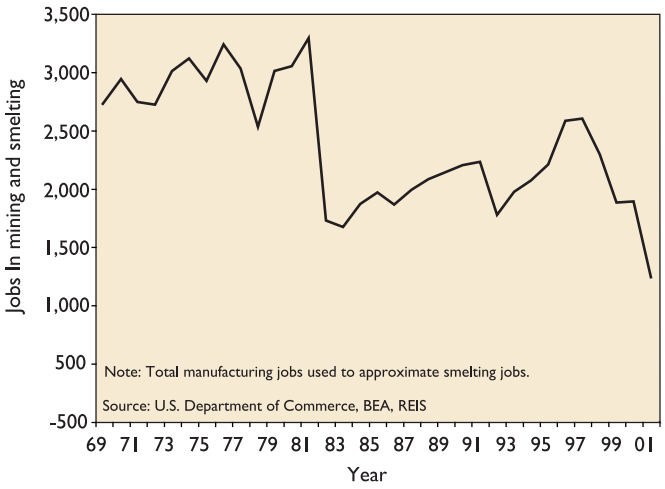
Alabama	1.05
Arizona	2.64
Colorado	1.31
Illinois	1.50
Indiana	1.38
Kentucky	1.64
Montana	1.76
New Mexico	1.38
North Dakota	1.82
Ohio	1.75
Pennsylvania	1.44
Texas	1.23
Utah	1.73
Virginia	2.95
West Virginia	1.27
Wyoming	1.02
All U.S. coal counties	**1.55**

Source: U.S. Department of Labor; author's calculations

Ratio of the unemployment rates in U.S. coal counties to the statewide average unemployment rate, 1990–2000.

Unemployment is also higher in mining-dependent counties in the U.S. For instance, unemployment rates in coal-mining counties are significantly above the average unemployment rate in the state where the county is located. Averaged over the 1990–2000 period and across all coal-mining counties, the unemployment rate in those counties was 55 percent above the state average rates. For some states, such as Arizona and Virginia, the coal county unemployment rates are two to three times higher than the state unemployment rates. Given the ongoing job losses in most coal mining counties due largely to labor-displacing technological change, these high unemployment rates might be expected. During the 1980s, for instance, the layoff rate in the mining industry was the highest of all the major industrial groups in the U.S., and the rate of job displacement in coal mining was much higher than in mining as a whole.

The important point to be drawn from all of these statistical results from an economic development perspective is that whatever might be said about the impact of mining on *national* economic development, in the U.S. these mining activities, in general, have not triggered sustained growth and development in the *local* regions were the mining took place. Closure of the mines often led to "ghost towns" and abandonment of the region. Where mining persisted over longer periods, it did not trigger a diversification of the economy. Instead, as labor-saving technologies reduced employment opportunities, the region around the mines became distressed with high unemployment and poverty rates. This was not just a historical problem associated with nineteenth-century mineral developments on the American frontier. Contemporary American counties that depend on mining continue to experience the same results, lagging the national economy.



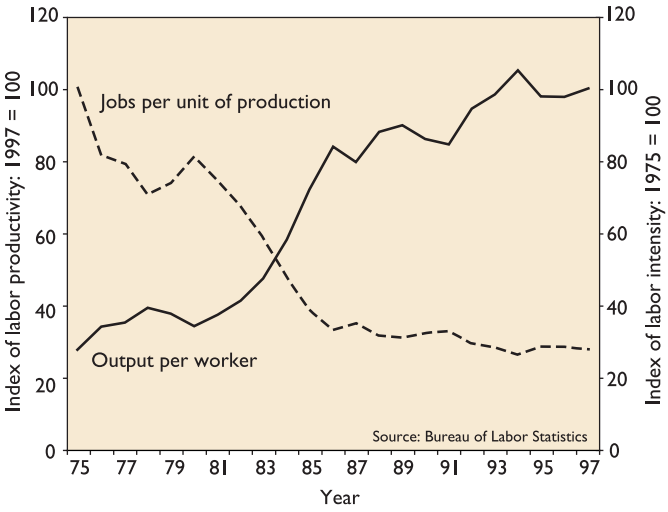
Mining and smelting employment, Grant County, New Mexico.

EXPLANATIONS FOR THE POOR ECONOMIC PERFORMANCE OF MINING COMMUNITIES

The explanation for this poor economic performance despite the local economy's specialization in a very high wage industry lies in the instability of employment and income associated with mineral development activity. As the experience of the Silver City area of Grant County, New Mexico, documents, mineral

development almost always has a boom-bust aspect to it that is tied to the wide fluctuations in world commodity prices. By 2001 almost two-thirds of the mining and smelting jobs that existed in 1981 in Grant County had disappeared. When mining-related jobs represent almost a third of all local jobs, such fluctuations in employment can have a devastating impact on the community.

In addition, technological change is continually reducing the number of jobs associated with any given level of mineral development. The productivity record, for instance, in copper mining over the last quarter century is indicative of the mining industry as a whole. In copper, output per worker has tripled.



Copper mining productivity and labor intensity.

This has helped copper mining companies control costs and remain competitive while processing lower and lower grade ores. The downside of this growth in labor productivity for workers and communities is that the labor required per unit of production has been cut to a third of what it otherwise would have been. Thus, even if production is stable, employment continues to fall. Only constantly expanding mineral development can maintain stable employment, and this is never possible over the long run. Another reason for declining employment and earnings in mining is that mineral deposits are always, ultimately, exhausted, and the industry has to shift to new geographic areas. In addition, because of the high profits that are often associated with extracting gifts of nature, there tends to be ongoing struggles between miners and mining companies over the sharing of those rents. This has led to often bitter and extended strikes and lockouts that have also taken their toll on local communities, adding still another source of economic instability. Finally, mineral extraction tends to be land-intensive, imposing a disruptive footprint on the natural landscape and contributing to significant environmental degradation. This makes mining-dependent areas less attractive places to live, work, and do business, depressing economic diversification and development.

These well-known explanations for economic instability in mineral-dependent economies lead investors to be very cautious about the investments they make in areas dependent on mineral production. Since workers, residents, businesses, and local governments do not know how long the employment and payrolls will last, they reduce their risk by avoiding fixed investments that may be lost if the mineral industry enters a period of decline. As a result, mineral workers commute long distances to jobs, maintaining residences at some distance from the mineral development. Businesses are hesitant to develop local commercial infrastructure, and local governments are hesitant to finance public infrastructure with debt. The result is a less fully developed local economy and more income leakage out of the local economy. In short, excess dependence on mineral development tends to constrain local economic development, leading to the depressed economic conditions that have come to characterize many mining-dependent areas.

The policy implications of this description of the problem are straightforward. Continued dependence on one industry is probably not a good economic development strategy. Diversification away from heavy dependence on mining can reduce the vulnerability of a community to the instability associated with mining. This is not to say that mining has to be abandoned. Rather, other sectors of the economy need to grow in relative terms to provide productive balance to mining. In addition, attention to reducing and then repairing the environmental damage associated with mineral extraction is important in making the community attractive to non-mineral economic activities and supporting such diversification. All of that, of course, is very easy to say but difficult to implement. Understanding the source of the problem, however, is the crucial first step in developing a solution.

Significant Metal Deposits in New Mexico—Resources and Reserves

Virginia T. McLemore, *New Mexico Bureau of Geology and Mineral Resources*

New Mexico is recognized for several economically significant and even world-class metal deposits. However, metals production in New Mexico has continued to decline since maximum annual minerals production was achieved in 1989. This decline is a result of many complex and interrelated factors, including fluctuating commodity prices worldwide and the quality and quantity of known ore in the state. Other factors that have hampered new mines from opening in the state include water rights issues, public perceptions, the state land moratorium, and the complexity, cost, and length of time required to complete the entire regulatory process in the U.S. at local, state, and federal levels. All of these factors add to the cost of mining, not only in New Mexico but throughout the world, and ultimately they determine if a deposit can be economically mined.

Metals deposits come in all types, shapes, and sizes and are based on geologic characteristics. The origin of metal deposits in New Mexico is the subject of a separate paper in this guidebook. The shape and size of metal deposits are defined by their spatial distribution in the ground, tonnage, and grade, and are the subject of this paper.

HOW DO WE DETERMINE THE GRADE OF METAL DEPOSITS?

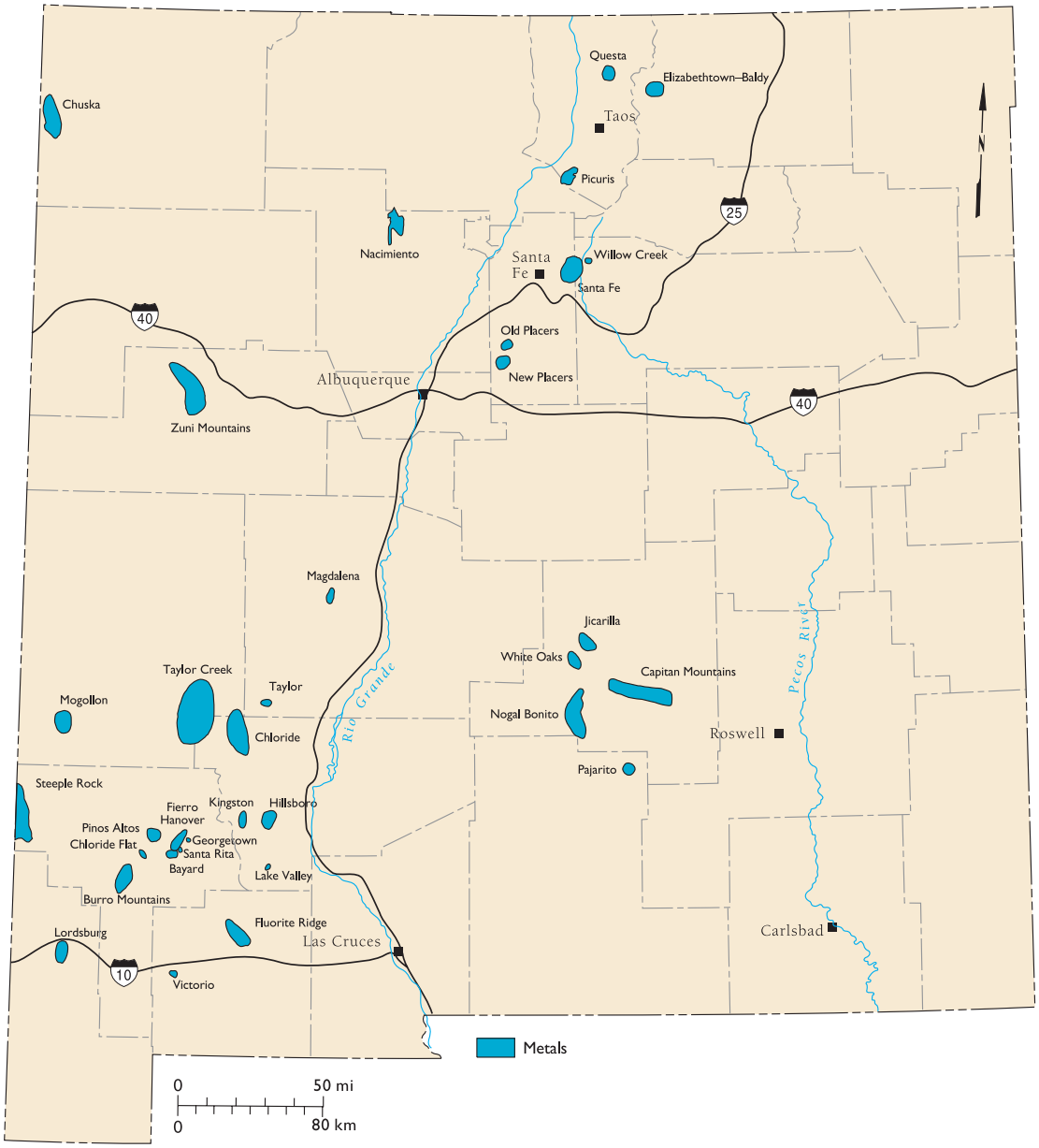
The term *mineral resources* refers to the assessed quantity of a commodity that is known to exist or can reasonably be inferred to exist from geologic criteria. *Reserves* are well-defined quantities of a commodity in the ground that can be economically extracted at a given time and cost. *Grade* is the term economic geologists and mining engineers use to define the average composition of the commodity in the deposit.

Resources and reserves are based on geologic characteristics, probabilities, and statistics. Geologists evaluate all available information to determine if they have adequate information to determine reserves or resources. Resources and reserves of metal deposits are nearly always determined by drilling and chemical analyses (assays) of the samples obtained from drilling. Statistics are applied to extrapolate the assays over a given distance based on the spatial distribution of drill holes, resulting in the grade of the deposit. If a given deposit covers approximately a quarter square mile, one hundred drill holes in that area is better than ten drill holes. However, the cost of drilling one hundred holes is approximately ten times the cost of a program with only ten holes. Reserves and resources are the basis for determining if a deposit can be economically mined.

Companies typically report their reserves of active operations and operations in development in annual reports to the shareholders. Reserves must constantly be re-evaluated as new information on the deposit becomes available, including subtraction of the annual production. It is important to remember that reserves are only estimates of the available ore in the ground and rarely equal the actual production, for three reasons: Recovery from the mill is less than 100 percent, statistical models fail to account for the natural heterogeneities of the ore deposit, and recovery during min-

ECONOMICS OF PRODUCTION (Increasing profitability ↑)	KNOWLEDGE OF RESOURCE OCCURRENCE (Increasing geologic certainty →)	
	Inferred	**Demonstrated**
Economic	Inferred resources	Demonstrated reserves
Marginally economic	Inferred marginal resources	Demonstrated marginal reserves
Sub-economic	Inferred sub-economic resources	Demonstrated sub-economic reserves

Classification of identified mineral resources. Undiscovered resources are considered as hypothetical or speculative, to reflect varying degrees of geologic certainty. The determination of whether or not a resource can be classified as a reserve depends upon the economics of production at a given time.



Mining districts in New Mexico with significant metal deposits.

ing is less than 100 percent.

Commodity prices fluctuate in the world economy. However, costs of exploration and mining typically increase every year. A company has to take this into account in determining if a deposit can be economically mined. Environmental and close-out costs are a major economic consideration in determining if a mine goes into production. Current predictions indicate that metal prices will continue to increase in the next decade or so as world demand for metals increases.

WORLD-CLASS AND SIGNIFICANT METAL DEPOSITS

Anomalous concentrations of copper, lead, zinc, gold, silver, and molybdenum are present to some extent in much of New Mexico and in many other places in the world. A *mineral deposit* is any occurrence of a valuable commodity or mineral of sufficient size and grade (concentration) to allow for economic development under past, present, or future favorable conditions. An *ore deposit* is a well-defined mineral deposit that has

been tested and found to be of sufficient size, grade, and accessibility to be extracted (i.e., mined) and processed at a profit at a specific time. Thus, the size and grade of an ore deposit changes as the economic conditions change. Mineral deposits and especially ore deposits are not found just anywhere in the world. Instead they are relatively rare and depend upon certain natural geologic conditions to form. The requirement that ore deposits must be extracted at a profit makes them even more rare.

Statistical studies have shown that less than 5 percent of the total number of a specific type of mineral deposit produces more than 90 percent of that commodity or group of related commodities. These deposits, so-called "world-class" deposits, are the largest of the known deposits in the world in terms of size and grade. In New Mexico the copper deposits at Chino and Tyrone are considered world class. The term *significant mineral deposit* includes world-class deposits and other large deposits of economic importance today. Significant metal deposits account for most of the world's production of a given commodity. Significant metal deposits are deposits of a size and grade that would yield more than $500 million in revenues using current average metal prices. Metallic mineral deposits are typically found in large belts or provinces, but only a few of those deposits are large enough to be significant. Significant metal deposits ensure that a company can continue mining economically during bust cycles when the price is low. A company requires large deposits to meet the increasing costs of mining, refining, reclaiming, close out, and continue to make a profit for the shareholders.

Units of Measure

Industry and government in different parts of the world sometimes use different units of measure. Just to clarify:

One ton (short ton)	**= 2,000 lbs**
One long ton	**= 2,240 lbs**
One metric ton (tonne)	**= 2,205 lbs (1,000 kg)**

Most mining companies today use short tons (tons), but government statistics both in the U.S. and abroad are given in metric tons. The term long ton is archaic and seldom used today.

Significant metal deposits in New Mexico, as defined by the U.S. Geological Survey National Mineral Resource Assessment Team, include deposits with at least:

- 2 short tons (58,333 ounces) gold
- 85 short tons (2,479,166 ounces) silver
- 50,000 short tons (100,000,000 pounds) copper
- 35,000 short tons (70,000,000 pounds) lead
- 50,000 short tons (100,000,000 pounds) zinc

Other significant deposits found in New Mexico include:

- 1,000 short tons molybdenum
- 100,000 short tons fluorite
- 100 short tons tin
- 1,000,000 long tons iron
- 100,000 short tons manganese
- 50 short tons tungsten
- 20,000 short tons titanium

SIGNIFICANT DEPOSITS IN NEW MEXICO

Many significant mineral deposits in New Mexico will continue to attract companies to the state to develop these known deposits and explore for new ones.

Figures for reserves are only available for six deposits in New Mexico; three of these deposits are currently inactive.

At current reserves, mine life at the Phelps Dodge copper mines at Chino and Tyrone is estimated to be 5–15 years, if copper prices remain high. Resources at Copper Flat were estimated in 1995 to be 50,210,000 million tons at 0.45 percent copper and 0.015 percent molybdenum for a mine life (if this deposit goes into production) of 10 years.

Molybdenum reserves and resources at Questa (as of November 1999) were as follows:

- Proven reserves: 16,344,898 tons of 0.343 percent molybdenum sulfide at a cutoff grade 0.25 percent molybdenum sulfide
- Probable reserves: 47,198,409 tons of 0.315 percent molybdenum sulfide
- Possible reserves: 3,223,000 tons of 0.369 percent molybdenum sulfide

At current proven and probable reserves, mine life at Questa is estimated to be 20–35 years.

DISTRICT	MINE OR DEPOSIT	YEAR OF INITIAL PRODUCTION	YEAR OF LAST PRODUCTION	ESTIMATED CUMULATIVE PRODUCTION	IS THERE FUTURE POTENTIAL?	SIGNIFICANT COMMODITIES
Mogollon		1875	1969	>$25,000,000	possible	gold, silver
*Steeple Rock	Carlisle, Center, Jim Crow, Summit	1880	1993	$10,000,000	yes	gold, silver
Elizabethtown-Baldy		1866	1968	$10,000,000	no	gold, silver
*Jicarilla	Jicarilla placers	1850	1957	$165,000	possible	gold
New Placers		1839	1968	$5,750,000	unlikely	gold
White Oaks		1850	1953	$3,100,000	possible	gold, silver
*Nogal-Bonito	Rialto, Vera Cruz	1865	1942	$300,000	possible	gold, silver, molybdenum
Chloride Flat	Boston Hill, Chloride Flat	1871	1946	$13,000,000	no	gold, manganese iron
Chloride	St. Cloud	1879	1988	$20,000,000	possible	silver
Georgetown		1866	1985	$3,500,000	no	silver
Kingston		1880	1957	$6,600,000	no	silver
Lake Valley		1878	1957	$5,400,000	no	silver
Bayard		1902	1969	>$60,000,000	no	gold, silver, copper, lead, zinc
*Burro Mountains	Tyrone, Little Rock, Niagra	1879	present	>$2,000,000,000	yes	gold, silver, copper, lead, fluorite
*Fierro-Hanover	Cobre, Hanover Mountain, Continental	1889	1980	>$2,000,000,000	yes	gold, zinc, copper, iron
*Pinos Altos	Piños Altos	1860	1997	>$11,000,000	yes	gold, silver, copper, lead, zinc
*Santa Rita	Chino	1801	present	>$2,000,000,000	yes	copper, gold, silver
*Lordsburg		1870	1999	>$60,000,000	yes	gold, silver, copper, lead
Willow Creek	Pecos	1927	1944	$40,000,000	no	gold, silver, copper, lead, zinc
Nacimiento	Nacimiento	1880	1975	$1,500,000	unlikely	gold, copper
*Old Placers	Cunningham Hill, Carache Canyon, Lukas Canyon, San Lazarus	1828	1986	>$4,000,000	yes	gold, copper
*Santa Fe	Jones Hill	1956	1957	$1,000	possible	gold, silver, copper, lead, zinc
*Hillsboro	Copper Flat, Mesa del Oro	1877	1982	$8,500,000	yes	copper, molybdenum, gold, silver
Magdalena		1866	1970	$25,045,999,616	no	gold, silver, copper, lead, zinc
*†Questa	Questa, Log Cabin	1918	present	>$100,000,000	yes	molybdenum
†Picuris	Harding, Champion, Spring Gulch	1902	1955	$3,000	unlikely	tantalum, beryllium, lithium, copper
Zuni Mountains		1905	present	$5,050,000	unlikely	fluorite
Fluorite Ridge		1909	1954	$2,790,000	unlikely	fluorite
*Capitan Mountains	Capitan Mountains	1960	2000	$500,000	yes	iron
*Victorio	Gulf Minerals	1880	1959	$2,330,700	possible	beryllium, molybdenum, tungsten
*Taylor	Apache Warm Springs			0	possible	beryllium
*Pajarito	Pajarito	1952	1952	$100	unlikely	yttrium, zirconium
*Chuska	Sanostee	1952	1982	$8,000,000	unlikely	uranium, iron, titanium, zirconium, thorium
*Taylor Creek		1919	1969	$7,500	no	tin

Significant metal deposits in New Mexico, by district, based on past production and known resources or reserves. Asterisk (*) denotes those districts whose significance is primarily based on known resources or reserves. Other economic factors must be considered before mining of most of these deposits can occur. Dagger (†) denotes districts in Taos County. Production from the Chuska district has been only from uranium deposits.

MINE	MILL RESERVES (million tons)	% COPPER	% MOLYBDENUM	LEACHING RESERVES (million tons)	% COPPER
Chino	182,100,000	0.61	.02	239,000,000	0.42
Tyrone	—	—	—	252,200,000	0.31
Niagra	—	—	—	500,000,000	0.29
Cobre	57,600,000	0.55	—	77,000,000	0.26

Molybdenum and copper deposits in New Mexico. *Mill reserves* are the ore that is sent to the mill for concentration; *leaching reserves* are the ore that is produced by solvent extraction electro-winning (SXEW) of the rock piles (also known as heap leaching).

Estimates of ore in the ground or resources have been reported for additional deposits in New Mexico during the exploration phase of those deposits. These figures are not considered reserves because they are based on insufficient or uncertain information or they have not been updated to reflect economic conditions in 2004. However, these resource figures serve as an approximation of what could be in the ground.

YEAR	COPPER ($ per pound)	MOLYBDENUM ($ per pound)
1989	1.25	3.40
1990	1.19	2.85
1991	1.05	2.30
1992	1.03	2.21
1993	0.85	2.32
1994	1.07	4.51
1995	1.35	8.08
1996	1.06	3.79
1997	1.04	4.31
1998	0.75	3.41
1999	0.72	2.65
2000	0.84	2.56
2001	0.73	2.36
2002	0.72	3.77
2003	0.81	5.32
2004	1.28	

Average copper (COMEX) and molybdenum (average Platts Metals Week) prices by year, through 2004.

An Overview of the Regulatory Framework for Mining in New Mexico

Douglas Bland, *New Mexico Bureau of Geology and Mineral Resources*

Early miners did not worry about environmental issues and were not subject to governmental regulation as we know it today. Their greatest concern was simply getting authorization to explore the land for minerals, and, if they were lucky enough to find a deposit of value, to open up a mine. The Mining Law of 1872 was the first major law that established requirements that would-be miners must follow to develop a mine in the U.S., even though these requirements addressed access rather than environmental protections.

Many years passed before significant concern was raised over mining's effects on the land and its people. This eventually led to modification of the 1872 Mining Law and the passage of other laws specifically targeting certain resources such as water and air. Additional requirements were established through federal and state land management agencies, including the U.S. Forest Service, the U.S. Bureau of Land Management, and the New Mexico State Land Office, which sought to address multiple land use needs on public lands. State laws were enacted to fill the gaps or tailor protections to the needs of our state. All of these efforts are designed to protect those who may be adversely affected by mining. Such adverse impacts can be caused by land disturbance, air and water contamination, surface and ground water use, noise, dust, blasting, truck traffic, and local infrastructure use, among others.

CURRENT REGULATORY FRAMEWORK

Today the regulatory framework that applies to mineral exploration, development, and mine closure is a complicated and often confusing web of requirements established by a wide variety of entities and agencies. Most are managed by federal, state, or local government bodies and are implemented as either land management or resource protection strategies. Further complicating this issue, almost all mining operations are different, creating different issues that trigger different sets of requirements. In some cases complex sites can require years for full authorization to begin mining.

Federal Requirements

There are three main types of federal government regulations: land management, resource protection, and citizen protection. Federal lands are subject to requirements designed to allow the land to be used for mining and then returned to the government for other uses. The exception to this is certain minerals that fall under the 1872 Mining Law, which allows transfer of federal land to private citizens through the patent process. Currently there is a moratorium on patenting lands, and no lands have been so transferred in more than a decade. Both federal land management agencies, the U.S. Department of Agriculture's Forest Service and the U.S. Department of the Interior's Bureau of Land Management have regulations addressing operational and reclamation requirements that must be met as a condition of approval to initiate mining. As land management agencies, these entities have a vested interest in how the land will be used during mining, and how it will be left after mining ceases and the land is available for other uses. These requirements are broad in scope and may cover many aspects of the operation. They are likely to be the most comprehensive requirements imposed by the federal government.

Minerals on federal lands are divided into three categories: salable, leasable, and locatable. Different procedures must be followed for each type of mineral. Salable minerals include most sand, gravel, and other aggregates, and sales contracts are established that allow extraction. Leasable minerals include coal and potash, where leases are obtained and royalties paid on commodities produced. Locatable minerals, also known as “hardrock” minerals, include gold, copper, mica, and other metallic and non-metallic minerals. For these commodities, the 1872 Mining Law allows access to federal lands by staking mining claims. Regardless of mineral type, almost all mines now must have detailed mine plans that specify how and where mining will be conducted, how contamination will be avoided, and how the site will be reclaimed after mining ceases. Bonding (also called financial assurance) is required for almost all operations and consists of financial resources being provided by the operator to

FEDERAL PERMIT REQUIREMENTS FOR MINING OPERATIONS IN NEW MEXICO

AGENCY	PERMIT NAME	DESCRIPTION
U.S. Forest Service, Southwest Region 505-842-3292, and Bureau of Land Mamagement 505-438-7400	Saleable minerals: sales contract, prospecting permit, or a free use permit	Saleable minerals include common varieties of sand, gravel, stone, pumice, pumicite, cinders, and clay, however certain uncommon varieties of these minerals are classified as locatable. Sales contracts contain operational and reclamation requirements, and the payment of a percentage of sales value.
U.S. Forest Service, Southwest Region 505-842-3292, and Bureau of Land Mamagement 505-438-7400	Leasable minerals: leases, prospecting permits and licenses	Leasable minerals include potash, sodium, native asphalt, solid and semi-solid bitumen, bituminous rock, phosphate, sulfur, and coal. Leases contain operational and reclamation requirements and payment of royalties.
U.S. Forest Service, Southwest Region 505-842-3292, and Bureau of Land Mamagement 505-438-7400	Locatable minerals: notice of intent, casual use (BLM) and plan of operations	Locatable minerals generally include metallic and nonmetallic minerals not listed above as either saleable or leasable. "Significant disturbance of surface resources" triggers requirements to minimize adverse environmental impacts where feasible, and reclamation with financial assurance (bonding) is required.
Nuclear Regulatory Commission 301-415-7000	Various permits and licenses	Required for uranium milling and processing facilities including in situ leaching operations.
Army Corps of Engineers, Albuquerque District 505-342-3282	Clean Water Act Section 404 permit	Required for any discharge of dredged or fill material into waters of the United States, including wetlands, most road construction involving water crossings, and dam construction.
Environmental Protection Agency Region 6 214-655-6444	Clean Water Act National Pollutant Discharge Elimination System permit (NPDES)	Required for any discharge of pollutants from a point source into waters of the United States. "Pollutants" are defined as any material that is added to water that changes the physical, chemical, and/or biological nature of the receiving water.
Department of Labor, Mine Safety and Health Administration South Central District 214-767-8401	Requirements for health and safety of miners	A variety of requirements designed to ensure safe working conditions for miners at mine sites and on-site processing facilities. Applies to all mine types.
Department of Justice Bureau of Alcohol, Tobacco, Firearms and Explosives 505-248-6544	Requirements for authorization to use explosives	Addresses safety issues and requirements related to explosives use and blasting on the mine site.

This table contains the most common federal permits and requirements, but is not intended to be a complete list of all that may be applicable to mining operations. Not all permits and requirements listed in this table will apply to all operations. Requirements will vary depending on circumstances. Agencies should be contacted for further details. Federal requirements that are managed by State agencies through primacy programs are not in included in this table, but are listed in the following table.

the federal government to cover reclamation costs should the operator be unable to perform the reclamation. The opportunity for public input is usually included.

Resource protection laws address one particular resource, such as water quality, air quality, or endangered species. These laws apply to a wide variety of industries that may trigger their provisions. In some cases individual states have passed their own laws addressing the same resource. If an individual federal law has a primacy clause, the state may take over administration of the law if the state passes a comparable law, and the federal government often provides funding to implement the program. Primacy clauses usually require that the state law must be at least as stringent as the federal counterpart. For example, the New Mexico legislature passed the Water Quality Act, and obtained primacy for managing certain ground

water quality programs covered by federal statutes.

Citizen protection laws address the health and safety of mine workers and other citizens. These include programs administered by the Mine Safety and Health Administration designed to ensure a safe work environment for miners. Another such entity is the Nuclear Regulatory Commission, which addresses issues associated with radioactive materials and radiation safety.

State Requirements

New Mexico has the same three main types of regulatory requirements as the federal government: land management, resource protection, and citizen protection. The State Land Office has land management requirements that must be followed in order to mine on state-owned lands. All minerals are managed through leases, although requirements differ depending on commodity, location, and site-specific issues. Reclamation plans are required on all leases.

The state has many resource and citizen protection laws, regulations, permits, and requirements managed by a variety of agencies. Regulated resources, materials, and facilities include surface and ground water quality and quantity, drinking water, air quality, hazardous waste, solid waste, storage tanks, cultural resources, endangered and threatened plant and animal species, and public utilities. Not all of these requirements will apply to each operation as conditions and circumstances vary widely. Some requirements are met through permits issued by an agency, such as a mining permit approved by the Mining and Minerals Division and a ground water discharge permit issued by the Environment Department. In other cases the operator must be aware of and in compliance with regulations even though permits are not issued, including cultural resource protection, worker safety, and certain endangered species requirements.

For many mining operations, the most comprehensive requirements will likely be found in the Mining Act of 1993, and if ground water is impacted, the Water Quality Act of 1967. The Mining Act focuses on what will happen to the mine property after mining ceases, and the permit outlines site-specific procedures to be followed that will establish a post-mine land use for each property. Financial assurance must be provided. The Water Quality Act requires ground water discharge permits to protect subsurface water resources. Discharge permits contain operational requirements to prevent ground water contamination during operations, and closure plans that are designed to ensure reclamation that also prevents contamination. Financial assurance may be required for this permit as well. Abatement plans may be required for existing contamination.

Local Requirements

Counties and cities also regulate certain aspects of mining operations. Many local jurisdictions have zoning laws that identify appropriate uses for specific locations, and such areas will have restrictions on certain activities. In addition, ordinances may apply that address certain activities. Controlled actions may include traffic, noise, times of operation, as well as prohibiting mining altogether in certain areas. Several New Mexico counties now have mining ordinances that specifically address if and how mining is authorized. Generally, local requirements are superseded by state and federal requirements if those requirements address the same specific areas of regulation, but local governments may "fill in the gaps" where no state or federal regulation exists.

Enforcement and Appeals

The agency responsible for implementing the regulations or establishing the permit is also responsible for enforcing them to ensure compliance. Methods for enforcement vary according to policies of the agency and the provisions outlined in the statutes and regulations. Notices of violation, fines, and corrective action plans are some of the methods used to address compliance problems.

Most decisions made by regulatory agencies can be appealed. Appeals may be made by the mining company involved or by citizens concerned with the operation. The venue for appeals varies widely, and may begin with an official within the agency itself, review by an overseeing body such as a commission or board, or it may go directly to court. Often, several additional levels of appeal are available including a State District Court, the Court of Appeals, and State Supreme Court. In some cases later appeals may be heard based on the hearing record developed at an earlier appeal; new testimony is not taken at these later appeals. If federal lands are involved, the decision may be appealed through the federal court system.

(Continues on page 110)

STATE PERMIT REQUIREMENTS FOR MINING OPERATIONS IN NEW MEXICO

AGENCY	PERMIT NAME	DESCRIPTION
ENERGY, MINERALS & NATURAL RESOURCES DEPARTMENT		
MINING AND MINERALS DIVISION		
Mining Act Reclamation Program 505-476-3400	Various mining and exploration permits	Comprehensive permits with closeout plans requiring reclamation, financial assurance and public participation. Includes minimal impact and regular permits for new and existing mines. Does not apply to aggregate and some industrial minerals.
Mine Registration, Reporting & Safeguarding 505-476-3400	Registration, reporting & safeguarding requirements	Forms required for initial registration, annual operations information, and safety methods used at closure. Applies to all commodities.
Coal Program 505-476-3400	Mining and exploration permits	Comprehensive operations and reclaimation permits for all coal operations requiring post-mine land use designation, bonding, and public participation.
FORESTRY DIVISION		
Environmental Resource Assessment Bureau 505-476-3325	Scientific studies & transplantation permits	Permits for protection of threatened or endangered plant species.
ENVIRONMENT DEPARTMENT		
WATER & WASTE MANAGEMENT DIVISION		
Ground Water Quality Bureau 505-827-2918	Ground water discharge permit	Comprehensive permits requiring protection of ground water quality through monitoring, prevention of contamination, reclamation, abatement, and remediation. Required for operations that may impact ground water quality.
Hazardous Waste Bureau 505-428-2500	Hazardous waste permit and handlers permit	Required for the transportation, treatment, storage, and disposal of hazardous waste.
FIELD OPERATIONS DIVISION		
Drinking Water Bureau 505-827-7536	Construction approval for new or modified public water supply systems	Approvals address maximum contaminant levels allowed, reporting, public notification, record-keeping and water supply construction.
Radiation Control Bureau 505-476-3081	Uranium and thorium ion exchange extraction license, radioactive material license	Addresses processing and handling of radioactive and nuclear material that is generally not covered by the federal Nuclear Regulatory Commission.
ENVIRONMENTAL PROTECTION DIVISION		
Air Quality Bureau 505-827-1494	Construction and operating permits	Ensure that air pollution sources meet applicable regulations and will not exceed ambient concentration standards for air pollutants. Does not apply to Bernalillo County, which has it's own program.
Solid Waste Bureau 505-827-2775	Registration, and Solid Waste Facility permit	Addresses transfer, processing, transformation, recycling, composting, or disposal of solid wastes.
Petroleum Storage Tank Bureau 505-984-1741	Tank registration, closure, investigation, reclamation	Addresses installation, operation, closure, investigation, and cleanup of sites with above-ground and underground storage tanks.
Occupational Health & Safety Bureau 505-827-4230	Miner health and safety requirements	Ensures a safe work environment in facilities not regulated by the federal Mine Safety and Health Administration. Generally applies to off-site mills and processing plants.

OFFICE OF STATE ENGINEER **WATER RIGHTS UNIT**		
Water Resource Allocation Program 505-827-6120	Permit to appropriate the public surface or underground waters of the State of New Mexico	Necessary for any person, firm, or corporation or any other entity that desires to use any of the surface or underground waters of the State of New Mexico (establish water rights). Underground permit needed only in OSE-declared water basins.
Water Resource Allocation Program 505-827-6120	Mine Dewatering permit	Ensures that mine dewatering does not impair existing water rights. Does not require or establish water rights.
Water Resource Allocation Program 505-827-6120	Approval of drill hole plugging	Approvals ensure that water encountered during drilling activities is confined to the aquifer in which it was encountered. Generally, no specific procedures have been established.
Water Resource Allocation Program 505-827-6120	License for water well drillers	Requires identification of equipment, permits for each well, record keeping, and filing of drilling log with OSE. Required for all wells drilled in declared water basins.
DEPARTMENT OF GAME AND FISH		
Conservation Services Division 505-476-8101	Scientific collection permit	Permit allows the taking of endangered wildlife for scientific and/or educational purposes.
STATE LAND OFFICE		
505-827-5750	Leases and permits for prospecting and exploration	Address operation, reclamation, and closure requirements, and includes fees and rentals. Applies to all commodities.
HISTORIC PRESERVATION OFFICE		
Office of Cultural Affairs 505-827-6320	Various permits for archaeological investigations on state-owned lands	Ensures the protection, preservation, and appropriate treatment of historic or prehistoric ruins and monuments, and any object of historical, archaeological, architectural, or scientific value. Human burial excavation permits apply to all land types.
PUBLIC REGULATION COMMISSION		
505-827-6942	Certificate of public convenience and necessity, and location permit	Required of all jurisdictional public utilities to operate, construct, or extend any plant or system, except for an extension within or to a territory already served by it.
NEW MEXICO BUREAU OF MINE INSPECTION		
505-835-5460	Underground mine diesel equipment permits, and certificates for coal miners	Various equipment and procedural requirements that must be followed to assure the health and safety of mine personnel.

Not all permits and requirements listed in this table will apply to all operations. Requirements will vary depending on circumstances. Agencies should be contacted for further details.

HOW DO I WORK WITHIN THIS MAZE OF REGULATIONS?

Miners

The first thing that must be done, no matter what your interest, is to become generally familiar with the basic requirements that apply to the activity in question and the agencies that implement them. If you are a mine operator or prospector, you will need to identify all the requirements that may apply to your proposed operation. If you are acquiring an existing operation, you should do the same thing. Permitting can be costly and time consuming. The Mining and Minerals Division offers a free publication titled *Permit Requirements for Energy and Minerals in New Mexico* that will help you get started.

Next, you should contact all agencies you believe could be involved with your project. Allow plenty of lead time, especially for those agencies that have extensive permitting or approval requirements. Discuss your particular operation with them so together you can plan a course of action to authorize mining and maintain compliance. If you suspect some of the requirements may be duplicated by another agency, ask how best to coordinate actions to minimize duplicative efforts, and ask the agencies if they can help you with this. Work hard to develop one comprehensive mining plan that meets the needs of all agencies, including those that may have overlapping requirements.

If you are aware of outside public interest in your project, meet with them early on to hear their concerns, and work with them to resolve the issues. Otherwise, you may become more familiar with regulations that deal with appeals than you might wish. Taking additional time up front to address public issues virtually always saves time in the long run, even if you don't end up in court. Above all, be patient, professional, responsive to requests for information, and question requests that you don't understand or seem out of line.

AGENCY	REQUIREMENT OR PERMIT
New Mexico Environment Department	
Ground Water Quality Bureau	Discharge permit-1055 for mine site
	Discharge permit-933 for tailings facility
	Discharge permit-132 for mine site sewage lagoons
	Community Right-to-Know requirements for chemical storage
Air Quality Bureau	702 Air Permit 201-M-1
Radiation Control Bureau	Radioactive Materials License GA139-13
Hazardous Waste Bureau	Hazardous Waste ID # NMD002899094
Drinking Water Bureau	Monitoring
Petroleum Storage Tank Bureau	Record keeping (underground fuel tanks)
New Mexico State Engineer Office	Tailings dams inspection & reporting
	Water consumption documenting, reporting and dam safety
New Mexico Mining & Minerals Division	Mining Act existing mine permit & closeout plan
	Registration & annual reporting
U.S. Environmental Protection Agency	NPDES permit # NM0022306 for discharges to Red River
	NPDES multi-sector storm water general permit # NMR05A913
U.S. Bureau of Alcohol, Tobacco, Firearms & Explosives	Explosives and blasting requirements

The above list of permits and compliance requirements for the Molycorp molybdenum mine, Questa, New Mexico, is an example of the permits that an individual mine must obtain to operate.

Citizens

If you are a member of the public that is concerned about an existing or proposed mining activity, many of the same recommendations listed above also should be followed. Know the regulations that apply. Develop a good working relationship with the mining company, if possible. Discuss concerns and how they might be addressed with the agency that regulates the activity in question, as agencies that do not have jurisdiction over your particular concern can do little in areas outside of their control. If it is determined the operation is in violation of certain requirements, you may want to stay involved in the remedy to ensure the problem is resolved to your satisfaction. Legal assistance, which can be costly, may be retained to help you determine the best way to work through these processes. If you wish to formally appeal certain actions, legal documents will usually need to be prepared and filed.

Regulators

If you are a regulator, most of the above recommendations should still be followed. It is helpful to know about requirements beyond those you administer, especially those that may overlap, duplicate, or be related to yours. For these, volunteer to work with the other agency to streamline the process. It is important to educate and assist those attempting to learn about or become involved in activities you regulate. Always maintain the goal of trying to resolve the issues to everyone's satisfaction, don't just focus on a solution that meets your own agency's requirements. Make sure you include all the appropriate parties when developing solutions.

Mining has been a fundamental part of life in New Mexico for a long time, and will continue to play a significant role for a long time to come. Even if most mining in the state ceases, we will be addressing environmental and reclamation issues associated with closed mine properties for many years. Regulation of these sites has steadily increased in the past few decades because of increased concerns over the effects mines have on our world. Although a stable and unchanging suite of regulations would help miners and concerned citizens alike to understand and work within the regulatory scheme, regulatory requirements will change in the future in response to changing needs and values of society, and changing mining and reclamation methods. We should consider how proposed regulatory changes fit into the existing scheme of requirements, and what effects the proposed changes will actually have on the industry, the environment, and the public. It is incumbent on all stakeholders to consider carefully what regulations are in the best interest of all of us, not just our own interest group, now and in the future.

The New Mexico Mining Act—A Primer

Bill Brancard, *Mining and Minerals Division, Energy, Minerals and Natural Resources Department*

New Mexico was among the last states in the West to adopt a non-coal mining regulatory law when the New Mexico Mining Act was enacted in 1993. While New Mexico was late in regulating hard rock mining, the New Mexico Mining Act of 1993 is a more comprehensive and detailed law than most states. The purposes of the Mining Act of 1993 include "promoting responsible utilization and reclamation of lands affected by exploration, mining or the extraction of minerals that are vital to the welfare of New Mexico." The act establishes requirements for a broad range of "hard rock" mines to obtain permits, meet certain standards, develop an approved reclamation plan, and post financial assurance to support the reclamation plan.

WHAT IS COVERED?

The act requires all mining operations to obtain permits and meet certain requirements. Whether you are or are not subject to the act depends largely on the definitions of *mining* and *minerals* in the act. *Mining* is defined as "the process of obtaining useful minerals from the earth's crust or from previously disposed or abandoned mining wastes, including exploration, open-cut mining and surface operation, the disposal of refuse from underground and in situ mining, mineral transportation, concentrating, milling, evaporation, leaching and other processing." *Minerals* are defined as "a nonliving commodity that is extracted from the earth for use or conversion into a saleable or usable product."

The following commodities and facilities are declared exempt from the act: "clays, adobe, flagstone, potash, sand, gravel, caliche, borrow dirt, quarry rock used as aggregate for construction, coal, surface water or subsurface water, geothermal resources, oil and natural gas together with other chemicals recovered with them, commodities, byproduct materials and wastes that are regulated by the nuclear regulatory commission" and hazardous waste. Some exemptions are designed to avoid duplicative regulation of a commodity or facility already regulated under a different federal or state law, such as coal, water, oil, gas, hazardous waste and NRC facilities. However, certain commodities, such as sand, gravel, and other construction materials, caliche and potash, are largely unregulated under state or federal law. In the end, the Mining Act covers most traditional hard rock and industrial minerals including gold, silver, copper, lead, molybdenum, perlite, zeolite, silica, and garnet.

The Mining Act applies not only to all mines operating when the act was passed and to all future mines, but it also covers some mines that were no longer operating at the time the act became law. The definition of "existing mining operation" includes any "operation that produced marketable minerals for a total of at least two years between January 1, 1970, and the effective date of the New Mexico Mining Act." Therefore, a mine that produced marketable minerals for two years in the 1970s but was shut by the time the act passed in 1993 is still covered.

WHO REGULATES?

Two government entities are at the center of the New Mexico Mining Act: the Mining Commission and the Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals and Natural Resources Department. The Mining Commission is charged with developing the rules necessary to implement the Mining Act and hearing appeals of permitting and enforcement actions by MMD. The Mining Commission consists of eleven members, four appointed by the Governor and seven *ex officio*. The seven *ex officio* members represent different government entities. The appointed members, consisting of two voting members and two alternates, "shall be chosen to represent and to balance environmental and mining interests."

The Mining and Minerals Division is charged with administering and enforcing the Mining Act and the Mining Commission's rules. The MMD director has broad authority under the act, including the obligation to decide on all permit applications and decide when to take enforcement action against someone violating the act or rules. The MMD director is required under the act to cooperate with other state and federal agencies that have responsibilities connected to min-

A Brief History of the New Mexico Mining Act

Gary King

In 1990 while serving as a state representative I was approached by constituents who were concerned by a new mining proposal in the Ortiz Mountains near Cerrillos. This proposal called for extraction of gold from low-grade ore via a large open-pit mine and cyanide heap leaching. Local residents were concerned about the impact this would have on their quality of life and environment. I found that New Mexico was one of only two states that did not regulate the reclamation of hard rock open pit mines. Therefore, it was virtually impossible to address the long-term impact of such mining operations through state action. This discovery led me to introduce legislation to address their concerns.

Traditionally, a bill in the legislature that impacts the environment will be referred to committees with widely differing views regarding the importance of environmental protection. Therefore, passage of the Mining Act required support from a broad range of interests and little or no stringent opposition from any major interest group.

From my perspective the primary goal of the legislation was to require hard rock miners to consider, from the inception of a project, the environmental impact of the operation on surrounding communities (primarily potential pollution of water resources with acid drainage or toxic materials) and to develop a reclamation plan to leave an economically or environmentally sound site when done. I also felt that mines that had been operating for many years might not be able to reclaim their sites to a "green field" status upon the completion, because when they were planned, they were not required to carry out their operations under such a regulatory scheme. I did not want regulations to stop mining as a viable industry within the state because of its economic importance. I also believe that reclamation of existing mine sites will generate positive economic activity in mining communities, and that industry has an obligation to protect people and the environment in areas where they are making a profit through mineral extraction.

The first piece of legislation I introduced regarding mine reclamation in 1991 was based on experience that the state had gained through the regulation of surface coal mines and from the regulation of landfills. Testimony was given at legislative hearings by experts and concerned citizens. In the final analysis, it was not possible to steer this first attempt successfully through the legislature. However, the concept was referred to an interim committee for detailed study between sessions, and a moratorium was placed on new operations within the state until the subject could be studied and a solution could be crafted.

During the summer all interested parties worked diligently trying to modify the language of the initial bill to meet our diverse needs. Hundreds of hours of work were contributed by representatives from industry and public interest groups to craft a compromise solution. We returned to the legislature, and the bill moved further through the process, but we were still unable to reach consensus with legislators. The bill failed, and everyone agreed to continue to work for another summer.

Perseverance is an important component in the recipe for success. During the 1993 legislative session virtually all of the interested parties made a commitment to find a viable solution. Our working group, which included legislators, industry representatives, and community activists, met on many evenings after the regular business of the legislature had ended. We would talk and negotiate and threaten until midnight or later. Then someone would declare that they had to get some sleep, and we would adjourn. Simultaneously, the bill was moving through the committee gauntlet, and after each hearing we would modify language to meet concerns expressed at the last hearing or to address concerns we knew would be raised by members of the next committee.

In every difficult endeavor, there is a seminal moment when success is finally achieved or calamity prevails. In our case this occurred near the end of the 1993 legislative session. Our group had reached agreement on virtually everything that was possible. Still there remained a few issues where compromise seemed impossible, primarily financial assurance. We were meeting late in the evening around the giant round conference table in the governor's office. I was surprised when Governor King came into the room and started to shake hands and slap backs of everyone in the room. He told us he appreciated all the hard work, then he left. Suddenly, he poked his head back through the door and said, "Oh yeah, one more thing, no one leaves this year until we have a bill!" That night we reached agreement on our final draft and appeared in the legislature as a unified group. Legislators appreciate having all major interest groups agree that a complex bill is acceptable, and the bill passed easily. Needless to say, the governor signed the bill too.

I have found that no complex piece of legislation can be implemented without some difficulty. One of the key provisions of the Mining Act provided flexibility to the Mining Commission to address issues such as financial assurance, considering actual conditions facing each operation. The membership of the commission is diverse, so all interested parties have a voice in the decision-making process. This flexibility has been beneficial to all concerned. The approach outlined in the Mining Act and enforced through current regulations has allowed for continuing reclamation at current sites, and we are making strides toward protection of our New Mexico communities.

ing facilities. In particular, the director must confer with the secretary of the New Mexico Environment Department on proposed rules and proposed closeout or reclamation plans for new or existing mines.

WHAT ARE THE REQUIREMENTS?

The requirements for a mining operation under the Mining Act depend on how the operation is classified. The major categories of operations are *existing mining operations*, *new mining operations*, and *exploration operations*. Within each of these categories, there is a subcategory of *minimal impact operations*. The act provides that reduced requirements should be applied to "operations that have minimal impact on the environment." Generally, minimal impact mining operations are 10 acres or less in size, and minimal impact exploration operations are 5 acres or less in size.

The Mining Act required all existing mining operations to submit a permit application by December 31, 1994, and then submit a "closeout plan" by December 31, 1995. The closeout plan is the core of the existing mine permit. The plan must demonstrate the work to be done to reclaim the permit area "to a condition that allows for the reestablishment of a self-sustaining ecosystem on the permit area following closure, appropriate for the life zone of the surrounding areas." This reclamation standard must be achieved unless the operator can show that it conflicts with an approved post-mining land use, or can demonstrate that reclamation of an open pit or waste unit "is not technically or economically feasible or is environmentally unsound." With the closeout plan, an operator must file financial assurance with the director sufficient to allow the state to hire a third party to complete the closure and reclamation requirements of the permit. An approved existing mine permit applies for the life of the operation.

The permit application process for a new mining operation is more complex. The application must contain considerable detail both on the nature and impacts of the proposed operation and on the background of the mine owners and operators. The applicant must collect at least twelve months of environmental baseline data on the permit area. The baseline investigation must provide information on (and the permit application must assure that) the operation and reclamation of the facility protect human health and safety, wildlife, cultural resources, and hydrologic balance. The Mining Commission rules require that a new mining operation employ best management practices, which include designing the operations to avoid or minimize acid drainage and other impacts to ground and surface water, to control erosion, and to use contemporaneous reclamation when practicable.

The director cannot issue a new mining permit unless he or she can find that the reclaimed operation will achieve "a self-sustaining ecosystem appropriate for the life zone of the surrounding areas" unless conflicting with a post-mining land use (no other waivers allowed), that the proposed reclamation is economically and technically feasible, and that all environmental requirements can be met without perpetual care. In addition, the operator or owners cannot fail any of the bad actor tests established under the act and the rules. A new mine permit has a maximum term of twenty years with ten-year renewal periods.

A permit for an exploration operation is the simplest to obtain. Exploration permits are valid for one year and may be renewed. Exploration operations must reclaim any disturbed areas within two years after completion of the operation.

WHAT IS THE ROLE OF THE PUBLIC?

The New Mexico Mining Act provides substantial opportunities for the public to participate in the major actions. Public notice is required on applications for the issuance, renewal, or revision of permits; for variance or standby requests; and for the release of financial assurance. The act requires that notice be provided in several manners, including mailing to all property owners within a half mile of the operation, to local governments, and to those citizens on lists maintained by MMD; posting in four conspicuous places including the facility entrance; and publishing a notice in a local newspaper. The notice provides citizens with an opportunity to comment on the proposed action and to request a public hearing.

Any person who is adversely affected by any order, penalty assessment or permit action taken by the MMD director can appeal to the Mining Commission. The commission will then conduct an evidentiary hearing on the appeal. The commission decision can be appealed to the District Court.

Finally, the Mining Act is unique among New Mexico environmental statutes in allowing a "citizen suit." A citizen with an adversely affected interest can sue any person who has allegedly violated any rule, order, or permit issued under the act, or sue the Energy, Minerals and Natural Resources Department (EMNRD), the Environment Department, or the Mining Commission for violating the act or for failing to perform any non-discretionary duty under the act.

A citizen suit cannot be commenced if the agencies have undertaken and are "diligently prosecuting" an enforcement action.

WHAT ARE SOME CURRENT MINING ACT ISSUES?

The implementation of the Mining Act over the past decade has triggered numerous disputes over the interpretation and impact of the act. Some disputes were ultimately resolved by agency actions and some by court decisions. What follows is a discussion of a few of the major issues that remain at the forefront today.

Agency Coordination

At the time the Mining Act was passed, mining operations were already subject to a number of regulatory regimes. These included water and air quality rules of the Environment Department and the federal Environmental Protection Agency (EPA), and, if the mine was on public land, the rules of land management agencies such as the Bureau of Land Management, the U.S. Forest Service, and the State Land Office. Both the environmental community and the mining community were concerned about the coordination of Mining Act requirements with those of other agencies. The environmental community feared that the various agencies would not interact and that serious concerns could fall into the cracks between regulatory programs. The mining community feared that the agencies would issue duplicative and conflicting requirements that would be costly and time consuming for the companies.

The Mining Act attempted to address the concerns of both groups. On the one hand, the Mining Act permits are treated as umbrella permits that require the operator to have obtained all other necessary permits and to obtain a determination from the Environment Department that the permitted mining activities will achieve compliance with environmental standards. On the other hand, the act also imposes requirements on all permitting agencies regulating mining operations to coordinate with each other and to avoid duplicative and conflicting requirements and permit administration.

The Mining and Minerals Division has made some strides in coordinating with other agencies. Agreements have been reached with the BLM and the U.S. Forest Service that establish processes for cooperation on mines on federal land. The State Land Office modified their rules to largely require their lessees to follow the Mining Act rules.

The greatest challenge in agency coordination has been the relationship between MMD and the Environment Department. As mentioned earlier, MMD must obtain a determination from the secretary of the Environment Department that a proposed closeout plan for a new or existing mine will achieve compliance with all applicable environmental standards. In particular, if a mining operation has potential groundwater contamination concerns, the Environment Department will require that the operator obtain a discharge permit with a "closure plan." The closure plan attempts to ensure a long-term solution to any ground water pollution concerns. Like the MMD closeout plan, the closure plan will establish reclamation requirements because in many cases the Environment Department has determined that the best way to prevent long-term water contamination is through reclamation.

While the closure and closeout plan requirements appear to establish duplicative and possibly conflicting mandates for the operators, the agencies and operators have managed to lessen the conflicts. Mine operators will often submit one plan to both agencies. The agencies will then negotiate with the operator, and amongst themselves, to establish one set of requirements for the reclamation of the facility. The agencies will also allow the operator to provide financial assurance that satisfies both permits. After the plans are approved, the agencies then continue to coordinate on the implementation and enforcement of the plans.

While the agencies have had success in avoiding duplicative and conflicting requirements, the process of agency coordination, both for state and federal agencies and for the operators, consumes considerable time and resources. The issue remains as to whether the work of the agencies can be streamlined further. Toward that end, there have been sporadic investigations into modifying the statutory framework, agency structure or staffing arrangements to combine, re-distribute or change these elements to simplify requirements and to reduce or eliminate duplication. These include combining MMD and Environment Department ground water regulatory programs, keeping them legally separate but housing them in the same location, or modifying the controlling statutes to eliminate duplicative requirements.

Financial Assurance

The Mining Act requires that each operator post, prior to obtaining a permit, financial assurance (FA) "suffi-

cient to assure the completion of the performance requirements of the permit, including closure and reclamation, if the work had to be performed by the director or a third party contractor." The act also prohibits the operator from using "any type or variety of self-guarantee or self-insurance." These strict requirements have resulted in some of the largest financial assurance amounts in the United States: The three largest mines in the state have FA obligations that each exceed $100,000,000.

Traditionally, mines have relied on surety bonds as the primary form of FA. However, changes in the insurance industry have made surety bonds very difficult and very expensive to obtain for mining companies. As a result, both the agencies and the operators have become more creative and flexible to meet FA requirements. The Mining Commission recently amended their rules to allow additional forms of FA, including trust funds, and to allow mechanisms such as "net present value." Recent large FA submittals have included a package of instruments, including trust funds, guarantees, collateral and letters of credit. Companies have also been more willing to accelerate their reclamation work to decrease their FA obligations.

Issues still remain about the use of certain FA mechanisms. Most notable are the concerns about whether certain types of guarantees, such as those provided by parent companies, violate the Mining Act's prohibition on self guarantees.

HAS THE MINING ACT BEEN A SUCCESS?

The legislature established a goal of promoting responsible utilization and reclamation of lands impacted by mining while also recognizing that mining is vital to New Mexico. Thus, success can be measured by seeing whether the state can require responsible mining and reclamation while not killing the hard rock mining industry in New Mexico.

For existing mines, the act has, up to this point, largely been a success. Reclamation plans have been approved and financial assurance has been provided at almost all of the state's existing mines. This is a remarkable feat considering that these mines were largely developed prior to the Mining Act without any plans for reclamation. At the same time, the state's largest mines remain operational and the act has not prevented the permitting of mine expansions. The recent increases in world commodity prices has resulted in significant increases in production and employment at existing mines, and facilitated the commencement of major reclamation projects.

For new mines, the impact of the Mining Act is harder to judge. A number of new mines have received permits under the act. However, the new mines have been fairly small, and no new large metal mine has been permitted under the act. New Mexico is not alone in this regard. Few new large metal mines have opened anywhere in the continental U.S. in recent years. Metals mining is now a global industry and, for the past few decades, companies have been looking to foreign jurisdictions with large untapped high grade deposits and lower costs.

Still, some in industry will argue that the increased requirements for new mines imposed by the Mining Act and by other agencies discourage perspective mine development in New Mexico. On the other hand, environmentalists might argue that if the act prevents marginal operations from coming to New Mexico, that may also explain why New Mexico has avoided the disasters such as Summitville, Zortman/Landusky, and other mine bankruptcies, which have left most western states with considerable exposure for reclamation and environmental cleanups.

A 2004 study by the Fraser Institute, a free market think tank in Canada, offers some evidence about how the mining industry views the attractiveness of New Mexico compared to other jurisdictions. Mining executives were surveyed concerning both the policy climate and the mineral potential of various jurisdictions around the world, and their responses were used to create several indices. The institute compared the executives' attitudes about the mineral potential of a jurisdiction, both with and without their current regulatory requirements, to create a "Room for Improvement" index. The four jurisdictions with the most room for improvement were U.S. states: Montana, California, Alaska and Colorado. By comparison, New Mexico was considered to have relatively little need for improvement, finishing eleventh of the fourteen U.S. states.

Planning for Mine Closure, Reclamation, and Self-Sustaining Ecosystems under the New Mexico Mining Act

Karen Garcia and Holland Shepherd, *Mining and Minerals Division*
Energy, Minerals and Natural Resources Department

The New Mexico Mining Act (Mining Act) was passed by the New Mexico legislature in 1993. New Mexico was one of the last states in the West to pass a mine reclamation act. The New Mexico legislature wanted to address environmental issues related to mining that are not specifically covered by other statutes and create legislation that would take into account the environmental health and productivity of lands impacted by mining long after mining had ceased. The intention was to ensure reclamation of disturbed lands to a condition that provides for a beneficial post-mining use. Three of the most important concepts embodied in the Mining Act are:

- The mine area will be reclaimed so that it is environmentally stable following closure
- The reclaimed mine will support a beneficial post-mine land use
- The establishment of a self-sustaining ecosystem

These three concepts are developed as requirements in the Mining Act and drive a mine operator's planning for eventual closure and reclamation of a mining operation. Knowing these requirements exist, a mine operator can plan ahead and design the mining operation in such a way as to facilitate closure and the establishment of a post-mine land use. Future planning then becomes an essential part of the mining operation and becomes a major economic driver in a mine operator's decision to proceed with mining. *Closure* is defined as the various steps to be taken to establish a beneficial post-mine land use, while *reclamation* can be defined as the steps to be taken to stabilize the site and mitigate the impacts of mining on the environment.

RECLAMATION TO AN ENVIRONMENTALLY STABLE CONDITION

Before receiving an approved permit, a mine operator must prove to the Environment Department that he has met all state and federal environmental laws related to air and water quality. The secretary of the Environment Department will then issue a determination stating that the permit applicant has demonstrated that the activities to be permitted or authorized are expected to achieve compliance with all applicable air, water quality, and other environmental standards if carried out as described in the closeout plan. This determination will address applicable standards for air, surface water, and ground water protection enforced by the Environment Department or for which the Environment Department is otherwise responsible. The operator must also prove to the Mining and Minerals Division (MMD) that the reclaimed operation will be stable from a mass stability and an erosional point of view. Where acid-producing materials are present, the operator must address these in a way that prevents or reduces impacts to the environment. Where wildlife habitat is to be the post-mine land use, potential hazards to wildlife must be mitigated at the site.

POST-MINE LAND USE

A *post-mine land use* is defined in the Mining Act Rules as a "beneficial use or multiple uses, which will be established on a permit area after completion of a mining project" and is required by law. It is to be selected by the mine operator, who must gain concurrence from the landowner, and approval from the Mining and Minerals Division director at the time that the reclamation plan is approved. The most common post-mine land use designations for New Mexico mines are wildlife habitat, livestock grazing, and commercial/industrial. Other post-mining land use categories include cropland, pastureland, forestry, residential, recreation or tourism, water management resources, and scientific or educational. Before release of financial assurance and from further responsibilities under the Mining Act, the operator must meet criteria or standards that demonstrate that the particular type of post-mine land use proposed will be achieved at the site.

SELF-SUSTAINING ECOSYSTEM

The Mining Act requires that a mine operator establish

The Las Conchas pumice mine in the Jemez Mountains east of Santa Fe. The mining operation did not include use of chemicals or mining below ground water and was therefore more conducive to easy reclamation.

The Las Conchas mine following reclamation. The site was contoured and seeded with native vegetation so that it blended in with the surrounding ecosystem after only a few years of average rainfall.

a post-mine condition that allows for a "self-sustaining ecosystem" unless it conflicts with another type of approved post-mine land use. A *self-sustaining ecosystem* is defined in the Mining Act as "reclaimed land that is self-renewing without the need for augmented seeding, soil amendments, or other assistance or maintenance, and which is capable of supporting communities of living organisms and their environment. A self-sustaining ecosystem includes hydrologic and nutrient cycles functioning at levels of productivity sufficient to support biological diversity." Many of the post-mine land uses commonly chosen by the mine operator, such as grazing land or wildlife habitat, are compatible with the requirement to establish a self-sustaining ecosystem. This is because once the mine operator has taken the initial steps toward reclamation, such as regrading, placement of soil cover, soil preparation, seeding, and mulching, the reclaimed property should be self maintaining. After reclamation, a period of monitoring the vegetation ensues to prove to the state that the reclamation goals established in the permit have been met.

As with many hard rock mining laws across the West, the goal is to require operators to return the land to some semblance of what it was, or to create some other beneficial use, and not simply leave it as an area that has been disturbed by mining. This does not involve "restoration," which requires putting it back the way it was. It does, however, mean "reclamation," which means that the area will be stable, self-sustaining, and environmentally sound. It is understood by regulators, as well as operators, that this task is often easier said than done. Creating a self-sustaining ecosystem out of disturbed mined land can be very costly as well as very challenging.

The science of reclaiming disturbed land (reclamation science) has been in existence for over twenty-five years. It has changed and evolved over time as results of scientific studies become available. In general, reclaiming a mine site involves grading or recontouring the disturbed land, employing erosion controls on recontoured slopes, placement of topsoil or cover material, and possibly adding soil amendments such as fertilizer or organic matter. The site is then seeded and sometimes planted with woody plant seedlings. The MMD requires the use of plant species that are adapted to the site. These are typically native species, but may include drought resistant non-native species as well. A mixture of grasses, herbaceous plants, shrubs, and trees may be required to ensure a self-sustaining and diverse plant community similar to adjacent plant communities. The MMD, in consultation with the operator, establishes what the vegetation standards and goals will be for successful revegetation. Numerical standards for a percent plant cover, diversity, and density values are written into the mine permit so that the operator knows what must be achieved to meet the Mining Act requirements for revegetation. The standards are designed to meet site-specific conditions of a particular mine site. After seeding, a period of monitoring follows to determine that the site is

self-sustaining. The Mining Act requires that a minimum of twelve years pass before final surveys are conducted to determine the success of the reclamation and whether the mine operator has met the permit requirements. If the post-mine land use is designated as wildlife habitat, MMD will require wildlife monitoring during the period following reclamation. The operator must demonstrate that wildlife is using the site and that there is nothing detrimental to wildlife remaining from the mining operation. To ensure the site is conducive for wildlife use, MMD encourages mine operators to leave features in place that wildlife species may use. This may include leaving a few power line poles for raptor perches and large boulder piles for small-mammal habitat.

PLANNING FOR CLOSURE

Once a post-mine land use has been chosen by the operator and approved by MMD, he can take steps that will help him achieve the post-mine land use even while the mining operation is underway. For example, if the approved post-mine land use allows for the establishment of a self-sustaining ecosystem, the mine operator must think about the best placement (location, size, and shape) and engineering design for open pits, waste dumps, leach pads, mine buildings, and infrastructure such as roads, rails, pipelines, and electrical facilities. If these mine units already exist, the operator must think about what the time frame will be for reclaiming them. Will it take one year or ten years? What units will be reclaimed first? What resources does the operator have to perform the reclamation, including man power, equipment, and financial resources? Planning ahead can save a significant amount of time and money in the long run and can increase chances of successful reclamation and eventual financial assurance release. A well-planned mining operation will involve some reclamation while the operation is still active. This is called concurrent reclamation, and it allows the operator to keep the financial assurance and overall reclamation costs to a minimum. If a mine operator waits until closure to start reclamation, it will increase the time required to obtain financial assurance release and can tie up financial resources for many years after closure.

The Chino copper mine, a portion of which is shown here, covers over 9,000 acres and exemplifies the monumental challenges for reclamation facing some mining companies.

Most mining operations require one or two years for reclamation. In New Mexico, however, some of the larger, more complex operations will take many years because of the immense size of the disturbance created by mining, often into the thousands of acres. The larger mines contain some of the most challenging environmental conditions and began operations long before the Mining Act was enacted. Often these sites require unusual or unique reclamation approaches because of steep terrain or acid-generating materials in the waste piles. In some cases acid drainage from these waste piles either is contaminating ground water or has the potential to contaminate ground water in the future. Some of these waste piles will require water treatment for many years after reclamation is complete.

While existing mines struggle to mitigate environmental impacts that occurred before the 1993 Mining Act, there are still opportunities to plan for closure, especially for new units and mine expansions. The operators should anticipate the conditions that new or expanded mine operations will create and take steps to mitigate environmental impacts before they occur.

For example, if a mine plans to locate a new waste pile or leaching facility on the mine site, it can construct the pile at the final reclamation slope angle that is conducive for plant establishment, eliminating costly double handling (regrading) of the material at a later time. This would involve designing and constructing new facilities, from the ground up, for future reclaimed slopes of 3:1 or less, instead of building slopes at angle of repose (approximately 1.3:1). Once operations at the facility are complete, the pile then would be covered with suitable growth medium and seeded. If acid drainage is expected to flow out from the pile, a liner that meets environmental standards should be placed

under the pile to ensure capture of the acidic drainage and protection of ground water. Before placement of the liner, topsoil salvage from the area can save costs associated with hauling soil cover from another source.

Many of the larger, complex mining operations are currently conducting scientific studies to determine the best way to reclaim steep slopes, acid-producing waste rock piles, acid or high-metal tailings ponds, or large open pits. The studies will be a valuable tool in determining the best approach for reclamation success. The reclamation plans for these sites are dynamic and can be changed as new information and new technology become available.

The increased awareness of modern society on environmental conservation, along with the impacts of modern mining techniques on the environment, have put new demands on the mining industry to "think outside of the pit," so to speak. Turning a mined landscape into one that will become a self-sustaining ecosystem, or other acceptable post-mine land use, takes not only a willingness to educate oneself on the science of ecology and reclamation but also a commitment to the concept of returning the land to a beneficial use once mining is complete.

Financial Assurance and Bonding: What Happens When Bankruptcy Hits

Warren McCullough, *Montana Department of Environmental Quality*

Legal mechanisms and safeguards for financial assurance should not be considered valid until actually tested and proven. As New Mexico decision makers consider the topic, it may be instructive to review the recent experience of another western mining state. Montana's plan for financial assurance before 1998, based on the conventional scientific and economic wisdom of the time and designed to shield Montana taxpayers from liabilities, received its first major test following a corporate bankruptcy, and the plan was found inadequate.

The Montana Department of Environmental Quality's (DEQ) Environmental Management Bureau (EMB) administers the state's Metal Mine Reclamation Act. Under this act, operating permits have been required for metal and stone mining operations in Montana since the state constitution was enacted in 1971. Operators are required to post performance bonds to guarantee reclamation of mine sites; reclamation standards and the language of the law have evolved over time, with the late 2004 version being:

> **82-4-338** *Performance bond. (1) An applicant for an exploration license or operating permit shall file with the department a bond payable to the state of Montana with surety satisfactory to the department in the sum to be determined by the department . . . . In lieu of a bond, the applicant may file with the department a cash deposit, an assignment of a certificate of deposit, an irrevocable letter of credit, or other surety acceptable to the department. The bond may not be less than the estimated cost to the state to ensure compliance with Title 75, chapters 2 [Air Quality] and 5 [Water Quality], this part, the rules, and the permit, including the potential cost of department management, operation, and maintenance of the site upon temporary or permanent operator insolvency or abandonment, until full bond liquidation can be effected.*

Performance bonds are typically submitted as surety policies, letters of credit, certificates of deposit, or cash. Please note that the act does not specifically mention corporate guarantees, and as a matter of policy, the state to date has not accepted any. From time to time until 1998, it was necessary for the state to forfeit bonds to use for reclamation of mine or exploration sites abandoned by operators, but these projects generally involved financial assurance ranging from a few hundred to a few hundred thousand dollars.

In the mid-1990s Pegasus Gold was a medium-sized gold producer, with mines in Idaho, Nevada, and Montana and a wide-ranging global exploration program. Pegasus had six mines in Montana, including four heap-leach gold operations at Beal Mountain, Basin Creek, Landusky, and Zortman, where the company had pioneered heap-leach technology in Montana starting in 1979. In 1997 the company suffered a series of financial setbacks from a steadily weakening gold price, diminished cash flow from the Montana operations due to exhaustion of permitted reserves, and, above all, disastrous losses from a new operation in Australia that failed to perform as expected. Pegasus went into Chapter 11 bankruptcy in mid-1997, booked a loss of more than $500 million for the year, and went into Chapter 7 bankruptcy in January 1998. Over the next few months, the mines that still had positive cash flow were spun off into a new subsidiary, Apollo Gold, and the state of Montana and its federal partners were handed the responsibility for reclaiming the four heap-leach properties. The insurance companies that had provided the bulk of the financial assurance for the properties in the form of surety policies had the option to carry out the work themselves, but declined. Each of the mines had unique problems.

BEAL MOUNTAIN

Beal Mountain was a 1,470-acre property with two open pits and a single 75-acre leach pad containing 15 million tons of rock at an elevation of 7,500 feet. At the time of the bankruptcy, mining operations were complete, but gold recovery was continuing. In 1997 the bond had been reduced from $11.9 million to $6.3 million in recognition of partial pit backfill and other reclamation work completed. The approved plan included treatment of the pad solution with hydrogen peroxide to break down residual cyanide, followed by land application of the treated water. After

negotiations with the surety company Safeco in May 1999, DEQ received a lump sum of $6.3 million as part of a settlement agreement, which stipulated that any unused funds would eventually be returned to Safeco. The money was immediately invested in a state-controlled interest-bearing account. Then, working with a court-appointed bankruptcy trustee and the U.S. Forest Service, DEQ began to implement the approved reclamation plan. It didn't work.

When the first batch of water from the pad was treated with hydrogen peroxide and land applied, all the plants in the test area died. After extensive analysis and greenhouse testing, DEQ learned that the pad water had evolved from a simple cyanide solution into 160 million gallons of water with 1,300 ppm thiocyanate, a potent herbicide resistant to conventional cyanide treatment. Over the next several years, a whole series of unanticipated events and developments followed:

- A $1 million biotreatment system based on an analogue in British Columbia was ultimately constructed to process the pad water to reduce thiocyanate and nitrate. The system worked reasonably well, but was very temperamental and prone to "crashing."
- The sensors designed to measure water level in the pad were not calibrated properly. Days after Beal was shut down for one winter to conserve costs, the heap overflowed, creating negative headlines for DEQ and forcing expensive year-round operation.
- The high-altitude, thin-soiled land application area at Beal was not suitable for the high water application rates necessary to empty the heap before it could evolve to a more acidic condition, leading to violations of surface water standards.
- The leach pad solution did continue to evolve geochemically; the thiocyanate level decreased to a trace, while ammonia and nitrate levels increased. The biotreatment plant crashed, and DEQ actually had to buy thiocyanate to jump start the treatment process.
- Mineralized rock in place and in surface dumps was found to contribute unacceptably high levels of selenium to a local stream with a recovering westslope cutthroat trout population.
- An environmental group filed suit against the U.S. Forest Service and DEQ over the violations and the department's issuance of a discharge permit to itself.
- The suit was rendered moot when the U.S. Forest Service took the site under CERCLA (Superfund) and assumed management responsibility.
- In spite of a synthetic cap and soil cover placed over the heap, the water level in the pad is rebounding, and the treatment plant must be started once again. Miscalculation of draindown has been a common problem.

To date, long-term water treatment issues linger at Beal after the expenditure of more than double the face amount of the bond. Additional funding for the site came from interest on the bond money, gold sales shared by the trustee, millions in supplemental funding from the U.S. Forest Service (USFS), and $2.5 million in reclamation bonds sold by DEQ under authority granted by the state legislature in 2001.

ZORTMAN/LANDUSKY

Permits for mining and heap leaching of oxide gold ores on private and Bureau of Land Management (BLM) land at Zortman and Landusky in the Little Rocky Mountains were issued in 1979. As mining continued until 1990 at Zortman and 1996 at Landusky, the pits were deepened into sulfide ores, and acid rock drainage was noted around 1992. A lawsuit over water quality violations led to a consent decree among DEQ, the Environmental Protection Agency, Pegasus Gold, and its sureties before the bankruptcy, requiring the company to buy zero-coupon bonds to create a trust fund to provide for long-term water treatment after 2017.

DEQ had calculated performance bonds for earth-moving work totaling about $30 million based on the projected condition of the mines at the end of a planned and approved expansion. The price of gold fell, however, and the expansion was canceled as uneconomic. A recalculation shortly after the bankruptcy projected a shortfall of about $8 million, but the agencies received only an additional $1.05 million from the bankruptcy court while the corporate officers responsible for the company's problems received $2 million in "golden parachutes." Zero-coupon bonds that had been purchased were insufficient to create the full trust fund, but there was no company left, and the sureties took advantage of an error in the consent decree language to stop any further payments. Full

funding of the trust would require an up-front investment now of more than $11 million, a sum that is simply not available to the state.

The consent decree also provided a yearly payment of $731,000 from the sureties for water treatment on site until 2017. A court-appointed site management contractor and bankruptcy trustee burned through the first year's budget in 3–4 months, leading to DEQ's dismissal of the contractor, who in turn filed a lawsuit against the agencies and a successor contractor. Six years of water treatment experience since then have shown the pitfalls of including calculations with line item amounts in agreements. Until the agreement was renegotiated in 2004, the sureties refused to pay more than the line item amount for any category in the calculation, even when other categories were underspent, and actual yearly costs ranged from $750,000 to $950,000. The total projected water treatment shortfall from the end of 2004 until 2017 is about $7.5 million.

The validity of the approved reclamation plans at the time of the bankruptcy was questioned almost immediately by tribes on the adjacent Fort Belknap Reservation and environmental groups, which ultimately led to a supplemental environmental impact statement paid for by the Environmental Protection Agency. The agencies' record of decision selected alternatives that could be largely paid for with the known funding, rather than the optimal alternatives identified. This led to another lawsuit, which lingers on, even though good engineering, additional funds from the BLM, and favorable bids from contractors have actually allowed the agencies to implement most of the optimal alternatives. In spite of reclamation to date, water quality in a drainage that flows onto the reservation continues to deteriorate. The BLM has taken Zortman/Landusky under their CERCLA authority, but there is yet another lawsuit over water quality issues to be contested.

The dirt work reclamation was largely completed by the end of 2004, but only about $2 million of the original bonds remained unspent. More than $6 million in supplemental funding has come from the BLM and state Resource Indemnity Trust grants, but significant projected long-term shortfalls remain, with no solution in sight.

LESSONS LEARNED

Lessons learned by state and federal regulators from six years of hands-on experience directing mine reclamation projects include the following:

- Site maintenance and water treatment costs continue in bankruptcy. Laws and financial assurance must be designed and written to allow regulatory agencies immediate access to funds.
- Insurance companies may prefer protracted negotiations or litigation to settlement of multi-million dollar claims.
- If reexamination of an approved reclamation plan after bankruptcy or site abandonment reveals previously unaddressed issues, the public may demand additional environmental analysis, even if there is no responsible party to pay for it.
- Financial assurance should be written to reflect involvement of federal partners.
- Financial assurance should be written to exclude line-item limitations on costs, and agencies should attempt to collect bond amounts as lump sums to be placed in interest-bearing accounts.
- It is extremely difficult in the current economic climate for even financially stable companies to obtain surety bonds. Agencies should be flexible, creative, and reasonably patient as companies try to establish acceptable guarantees for reclamation.
- Indirect costs (administrative overhead, engineering design, inflation, contingencies, etc.) are a much larger part of total reclamation costs than DEQ previously assumed.
- Real-world emergencies will continue to occur under agency management.
- The geochemistry of solutions in leach pads, tailings impoundments, and waste dumps may continue to evolve during reclamation, complicating treatment and increasing costs.
- When bond calculations include a component for long-term water treatment, DEQ runs the calculation out to one hundred years. Projected expenditures beyond one hundred years have little effect on a present-value figure.
- Bankruptcy trustees serve different masters and may sell equipment or facilities needed at the site for reclamation.
- Agencies must be creative when faced with financial assurance shortfalls. Grants or supplemental funding may be available from federal partners

(EPA, BLM, USFS). In 2002 Montana sold $2.5 million in state general obligation bonds to fund reclamation at Beal Mountain.

CORPORATE GUARANTEES

Two recent corporate histories involving prominent companies in Montana will help illustrate why the state does not wish to hold corporate guarantees for mine reclamation. For years, Montana Power Company (MPC) was a solid, secure, dividend-paying utility company. A few years ago the company divested itself of its traditional assets, including coal-fired and hydroelectric power units, transmission systems for electricity and natural gas, and oil and gas production. The proceeds of the divestitures were all plowed into telecommunications, particularly fiber optic transmission lines. That overbuilt market collapsed. The company went into bankruptcy, and the remaining assets were liquidated for pennies on the dollar. The company that purchased the transmission systems also went into Chapter 11 bankruptcy, although it has recently reorganized and emerged. A corporate guarantee from MPC for anything would have been worthless.

Stillwater Mining operates two platinum group metal mines on the JM reef, a world-class mineral deposit in Montana's Stillwater Complex. Although the stock traded in the upper $40 range only a few years ago, a free-fall drop in palladium prices and huge capital costs drove the stock down below $2.50 in early 2003. The company was widely believed to be on the verge of bankruptcy, which was averted only by a takeover and infusion of capital by Nor'ilsk Nickel, a major Russian mining company.

Such huge and sudden variations in overall value, especially in corporations perceived as solid, with substantial assets, have convinced Montana regulators of the need to avoid corporate guarantees. Had corporate guarantees been in place from Pegasus Gold, the state of Montana, with a limited industrial base and fewer than a million people, would have faced a total reclamation shortfall on the Pegasus properties alone of more than $75 million.

Financial Assurance for Hard Rock Mining in New Mexico

Ned Hall, *Phelps Dodge Corporation*

Hard rock mine operators face significant challenges in establishing financial assurance for New Mexico mining operations under the New Mexico Mining Act and the Water Quality Control Act. These challenges include obtaining approvals of the scope of work for future mine closure and reclamation from the two state agencies that administer these laws, developing and obtaining approval of cost estimates, determining the amount of financial assurance based upon the cost estimates, and establishing financial assurance mechanisms. The Chino and Tyrone mines, operated by Chino Mines Company and Phelps Dodge Tyrone, Inc., respectively, are the two largest hard rock mining operations in New Mexico, and their experiences are representative of these challenges.

CALCULATION OF FINANCIAL ASSURANCE AMOUNT

The Chino and Tyrone mines are "existing mining operations" as defined by the New Mexico Mining Act. These mines were developed, operated, and most of their current footprints in place decades before the Mining Act was enacted. Open pit mining began at Chino in 1910 and at Tyrone in the late 1960s. This long history results in special challenges, including environmental impacts that occurred before environmental regulations were established, and the application of new closure and reclamation requirements and performance objectives to facilities designed and constructed before these requirements were established. For example, these mines were designed with steep pit and stockpile slopes to minimize the footprint of the mine. Installation of soil covers as part of reclamation to reduce infiltration of precipitation and to establish vegetation requires that slopes be flattened by regrading at substantial cost.

Another major challenge is the Mining Act requirement to establish financial assurance based upon the "worst case" scenario. These worst case assumptions are that the mine operator will go bankrupt at the point in time when closure and reclamation costs are the highest, and that the state will have to hire a third-party contractor to conduct the work. Although providing maximum protection to the state, these assumptions result in financial assurance requirements that can substantially exceed the estimated cost for the operator to conduct closure and reclamation at the end of mine life.

Some mines are required to provide financial assurance for long-term water treatment. In the case of the Chino and Tyrone mines, as well as the Continental mine (final permit revision pending), the state has required financial assurance for water treatment for a period of a hundred years. It can be challenging to estimate the volume of water that will require treatment, the quality of that water, and treatment costs over such a long period. Long-term closure and reclamation plans take several years to implement and must be adjusted for cost inflation. Furthermore, the amount of financial assurance required is based upon "net present value." Initial financial assurance amounts may be reduced based upon an expectation of future growth of the principal amount over time through investment. This concept was specifically approved by the Mining Commission in changes to the Mining Act Rules made in late 2003.

For the largest mines in the state, the process of developing closure and reclamation plans, estimating the cost of conducting those plans, and determining the required amount of financial assurance took about ten years following the passage of the Mining Act. The total amount of financial assurance required of the two largest mines (Chino and Tyrone) combined exceeded $450 million. The next task was to establish financial assurance mechanisms for such large amounts.

COST AND AVAILABILITY OF FINANCIAL ASSURANCE MECHANISMS

The New Mexico Mining Act allows the use of a variety of financial assurance mechanisms, including surety bonds, letters of credit, cash certificates of deposit, trust funds, collateral, and third-party guarantees. Until the last few years, surety bonds were the mechanism of choice for many financial assurance requirements, particularly for larger operators. Surety bonds could be obtained in large face amounts by financially

healthy companies for relatively modest annual premiums. Beginning in 2001 the market for surety bonds for mine closure and reclamation changed dramatically, with many insurers withdrawing from the market entirely. Consequently, surety bonds became (and remain) difficult to obtain and, when available, are much more expensive. Insurers may also require surety bonds to be secured by pledges of specific assets.

Letters of credit issued by banks can be used as financial assurance. However, letters of credit usually are issued for terms of one year or less and command significant premiums, resulting in high carrying costs. They generally are not suited to large, long-term financial assurance obligations.

The New Mexico Mining Act allows "third-party" guarantees as financial assurance. Third-party guarantees may be accepted if they are issued by corporations that meet strict financial tests designed to ensure that sufficient assets will be available to cover closure and reclamation costs. However, following the Mining Commission's 2003 amendments to the Mining Act Rules, third party guarantees now may cover a maximum of 75 percent of the total financial assurance amount for a mine.

The loss of surety bonds as a viable financial assurance mechanism, coupled with the limits on the use of letters of credit and the limitation of third party guarantees, has resulted in the need for cash and other assets to be pledged for substantial portions of New Mexico financial assurance obligations. The Mining Act Rules, passed in 1994 as a requirement of the 1993 Mining Act, did not contemplate large amounts of financial assurance being covered by cash and limited cash mechanisms to certificates of deposit subject to the $100,000 FDIC-insured limit. To provide a more suitable mechanism for larger cash deposits, the Mining Commission amended the rules in 2003 to allow for trust funds. Following this amendment, Chino Mines Company established a trust fund for one-third of its financial assurance obligation, or about $64 million, and Tyrone is obligated to provide $27 million in cash funding to a trust fund.

The Mining Act also allows for collateral, including real property, as financial assurance, as long as the real property is not within the permit area of the mining operation. Mine operators who have lands outside the permit area may prefer to pledge those assets to cover a part of their financial assurance obligation rather than cash, because the use of cash to cover financial assurance obligations precludes the use of the pledged cash for other investments, including the expansion of mining operations. The pledge of real property for financial assurance, however, has proven to be time-consuming and costly. Transaction costs have included appraisals, appraisal reviews, environmental assessments, surveys, title insurance, and other costs typical of a large real-estate transaction. Tyrone's proposal to pledge collateral for a portion of its financial assurance obligation is still in process.

CONCLUSIONS

Establishing financial assurance for New Mexico's two largest mines has been a technical, procedural, and financial challenge. As long as this process has taken, it is not yet over. The permits for these mines require additional studies of the mines, including studies of the performance of various closure and reclamation techniques and the feasibility of alternative closure and reclamation measures. The plans must be re-evaluated and adjustments may be required after the studies are completed. In addition, closure and reclamation work is now underway on inactive portions of the mines. This will require adjustments in the approved cost estimates and financial assurance required, in order to reflect the work that has been performed.

Financial Assurance—The Requirements

Douglas Bland
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Financial assurance, also known as bonding, can be required for closure and reclamation of New Mexico non-coal mining operations by several state and federal agencies, depending on jurisdiction and potential environmental impact. State financial assurance requirements are established by the State Land Office for operations on state-owned land, by the Mining and Minerals Division (MMD) for obligations under the New Mexico Mining Act, and by the New Mexico Environment Department for addressing existing or potential ground water impacts. Federal financial assurance requirements are imposed by land management agencies if the mining operation is on land managed by either the U.S. Forest Service or the Bureau of Land Management.

FINANCIAL ASSURANCE TYPE	NUMBER OF MINES	TOTAL POSTED	JOINT AGENCY AGREEMENTS
Certificate of deposit	18	$448.701	6
Surety bond	23	$88,827,858	7
Cash account	5	$82,043,304	3
Letter of credit	11	$8,693,351	4
Collateral	2	$8,564,315	2
Corporate guarantee	5	$475,011,015	4

Financial assurance posted under the New Mexico Mining Act. Joint agency agreements may be between the New Mexico Environment Department, the U.S. Forest Service, the Bureau of Land Management, or a combination of these. Data from the New Mexico Energy, Mineral and Natural Resources Department.

The Mining Act requires that financial assurance be posted before any permit is approved for an exploration or mining operation. An exception is made for general permits and minimal impact exploration permits, mining operations that in general excavate less than 50 cubic yards of material per year, and exploration operations that disturb less than 5 acres of land. The financial assurance amount is based on third-party costs to perform the close-out or reclamation plan if the operator is unable or unwilling to perform these tasks. If the operator performs reclamation covered by the financial assurance, he may reduce the amount of financial assurance posted with MMD. Forms of financial assurance accepted by MMD include cash, surety bonds, letters of credit, collateral, trust funds, and third-party corporate guarantees.

The Environment Department may require financial assurance associated with ground water discharge permits issued under the Water Quality Act. Discharge permits are required for any operation that may have an impact on protected ground water resources, generally defined as those that contain less than 10,000 parts per million of total dissolved solids. The Environment Department generally accepts financial assurance instrument types similar to MMD. Most mining operations that are subject to financial assurance for a discharge permit are also required to submit financial assurance to MMD, even though they may be required for different aspects of reclamation because Environment Department requirements focus on water quality protection and Mining Act provisions ensure the re-establishment of a beneficial post-mine land use. These two agencies have agreements that allow one financial assurance package to be posted that meets the needs of both agencies, and they coordinate establishment of the amount, management of the financial assurance, and expenditure, if needed.

The State Land Office requires financial assurance for all types of mining conducted on state-owned lands. However, the state land office does not require duplicate financial assurance for mining activities covered by financial assurance posted with MMD.

The federal land management agencies, the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM), each have three categories of mining operations. They are salable, leasable, and locatable minerals. Federal financial assurance is required for salable and leasable minerals. Both the USFS and BLM have their own regulations that apply to locatable minerals, which are further subdivided into operations that require casual use, notice level, or plan of operations permits, depending on the amount of disturbance and environmental impact anticipated. All of these require financial assurance except casual use. Financial assurance instrument types allowed are similar to those accepted by MMD, except that corporate guarantees are not acceptable. A joint powers agreement between the USFS, BLM, and MMD has been adopted to address financial assurance requirements where there is overlap between them, but conflicting requirements have prevented coordination of joint instruments between the Environment Department and the federal agencies at this time. Fortunately, there are few instances where this has been an issue. To date, no mines have defaulted under the Mining Act or Water Quality Act requiring reclamation managed by the state using forfeited financial assurance.

Will There Be Water to Support Mining's Future in New Mexico?

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This paper explores some factors that influence the availability of water for future mining. Allocation of water is largely a legal matter, but my perspective is that of a geologist and an observer, not an attorney; nothing that follows should be thought of as legally authoritative, nor as legal advice.

Mining enterprises always require water. The uses vary widely: dust suppression, milling and processing, conveyance of tailings from mills, recovery of metals by leaching, dewatering of underground workings, and reclamation of mined lands. Apart from simple dewatering, most of these uses can lead to relatively high depletion—most of the water is lost to evaporation, rather than returned to the surface water or ground water system.

New Mexico's mining industry (which includes oil and gas extraction) has accounted for 1.5 to 2 percent of the state's total water use, in terms of depletions (water actually lost to evaporation) in recent decades. (Published state engineer statistics do not separate out oil and gas activities.) The value of water used in mining, in terms of share of the "gross state product," is relatively high. In 2000, for example, the gross state product in New Mexico from all economic activity amounted to an average of $20,000 per acre-foot of water depleted in all uses. The mining category contributed $103,000 per acre-foot; the corresponding figure for irrigated farms was about $347 per acre-foot of water depleted.

At first glance New Mexico's water law, evidently designed to regulate water in irrigation agriculture, seems to fit the mining industry poorly. Water rights are nominally perpetual, tied to specific lands and points of diversion (either surface water diversions or wells), as long as beneficial use is made of the water. But mining is almost by definition temporary in any particular place. The water use would presumably end when the ore, coal, or industrial-mineral deposit is exhausted and reclamation activities completed. On the other hand, long dormant periods governed by changing commodity prices are typical of mining. New mining activity is commonly initiated in established districts.

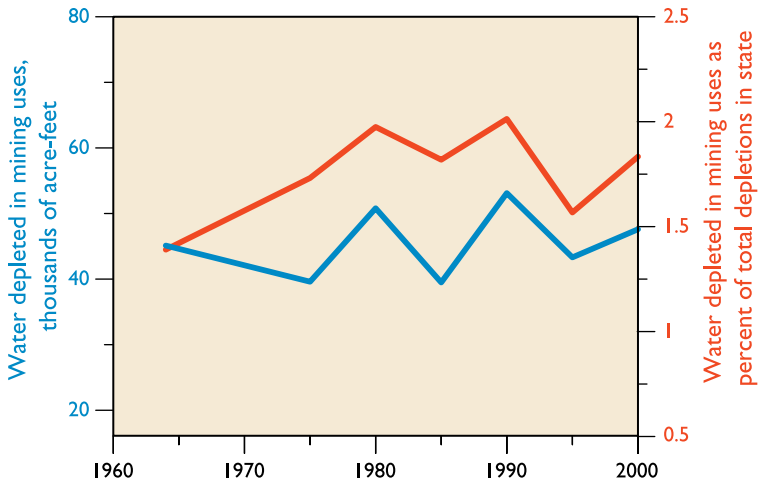
Water produced for uranium mining and milling increased from zero in 1950 to a peak that may have been near 20,000 acre-feet per year in about 1980, but was about 2,600 acre-feet in 2000 and has been negligible (except for reclamation activities) since 2002. The pumping was largely for milling and for dewatering underground workings, with the water discharged to the surface drainage. The uranium industry probably over-appropriated the Bluewater Basin for some period, in the sense that depletions were sufficient to cause significant lowering of ground water levels. All of this would be primarily of historical interest, except that other users are now considering the water rights established during the uranium era, whatever they may in fact be, and uranium production itself may emerge again as energy demands continue to rise.

Copper production in southwestern New Mexico has needed water for much longer, since about 1804. Water produced for the minerals industry in Grant and Hidalgo Counties was about 8,700 acre-feet in 1962, of which about 5,300 acre-feet were depleted. The corresponding figures for 2000 were 25,800 acre-feet and 21,300 acre-feet, but between 1962 and 2000 there were major changes in the patterns of pumping from surface water and ground water sources. In Taos County, molybdenum mining and milling has required diversions of as much as 9,400 acre-feet per year (in 1976), but water requirements have varied widely depending on the status of operations. In 2002 diversions were about 2,700 acre-feet, and they have not been above 6,000 acre-feet since 1991. These kinds of variations lead to complicated questions about the real meanings of the water rights involved.

The "use it or lose it" aspect of our water law would appear to mean that a mine operator, having once acquired a water right, must find a home for it in some other beneficial use when mining ceases, or risk losing the value it represents. In actuality, many other water uses share the impermanent character of mining. Water rights for agriculture are "not necessarily" forfeited during periods of non-use when irrigated farmlands are under the acreage reserve program or conservation program provided by the Soil Bank Act,

and, in general, "forfeiture shall not necessarily occur if circumstances beyond the control of the owner have caused non-use." This provision would appear to apply to mining, but there are few guidelines for its application.

Our water law does not distinguish among beneficial uses, regardless of their relative values to the community, and so would not particularly favor mining over some lesser-value use. On the other hand, high-value uses can justify the purchase of rights and the transaction costs relating to new appropriations or transfers of existing rights, whereas lower-value uses may not be able to. This may be an advantage for mining, but would not entirely offset the loss of value attributable to a long and uncertain administrative process.



Water depleted in mining uses (including oil and gas) in New Mexico.

The conventional permitting process of the state engineer can consume a great deal of time and seems to differ from environmental and land-use permits in that the outcome is less predictable. Compliance with regulations, however complex and burdensome, will lead to a permit from the Environment Department, but a state engineer permit may simply be denied if the applicant has failed to prove that no existing right would be impaired at some time in the future, or that the proposed project is not detrimental to the public welfare. It may not be as easy to demonstrate the future effects of ground water pumping as it is to assume an obligation to conduct an operation in some particular way. A trend toward a somewhat different policy seems to be emerging, in which the state engineer is willing to issue a permit, and somewhat more quickly than in the past, but sets conditions that represent a continuing obligation of the permittee to keep existing users whole.

Mining projects have commonly been controversial, and in some cases the state engineer administrative process, which must take the public welfare into account, has been the forum for presenting a case against a project even though the effects of its proposed water use have been small. The scope of public welfare issues is not defined, however, and may be very broad if opponents of a project are creative.

New Mexico has been engaged in regional water planning since 1987, and a statewide water plan is in the making. Unfortunately for mining, of course, as-yet undiscovered mineral deposits can't be represented in the plans, nor can the water plans anticipate price changes that would trigger reopening of former operations. One of the principal functions of the regional plans is to provide guidance to the state engineer as to each region's understanding of the public welfare. If potential mining is not specifically dealt with in a regional plan, is a new mining project at some disadvantage, simply because it could not be defined in advance and has not been examined through the public-welfare lens?

The state legislature in 1980 recognized that mining (uranium mining in particular) would better contribute to the economy if water could be pumped from underground workings, even though the water might not be put to any beneficial use (as required under a conventional water right), and instituted the Mine Dewatering Act. Mine dewatering was accepted as a beneficial non-use. The act actually went much further and provides for a sort of condemnation process in which any new user, not limited to mining, may take the water needed, as long as existing users' rights are kept whole through a "plan of replacement" approved by the state engineer. The Mine Dewatering Act is still in place but has been little used.

Mining commonly is distant from major streams, so that simply transferring irrigation rights upstream or downstream to serve them is less a consideration than the potential for "local impairment" in the form of increased drawdown in wells. In such a case, a plan of replacement under the Mine Dewatering Act might include providing water, or payment of the incremental increase in costs of pumping. Even though the mines themselves may be away from major streams,

depletions of water still influence the amounts of water available for delivery to Texas or Arizona under interstate stream compacts, and transfer of existing surface water rights is likely required to offset these effects.

Water rights acquired for mining, either by application for a permit to appropriate water and then perfecting the right by using water, or by simply declaring the existence of a right that had been established before the state engineer asserted jurisdiction over the particular ground water basin, have an important value on a mining company's balance sheet. However, such water rights may not be as fully defined as would be desired today. Are rights perfected under permits to appropriate from the state engineer of equal status with rights that have been adjudicated in court? Are rights automatically valid for post-mining closure and environmental reclamation needs, even if those uses were not specifically described in the original permit application, license, or declaration? Do such rights have the same status and value as irrigation rights (for example) when the mining-related uses are finally at an end? Policies or litigation may be necessary to answer these questions.

If beneficial use is "the basis, the measure and the limit" of a water right (in the words of the New Mexico Constitution), what proportion of a water right would remain valid for future transfer to another use if the water requirement in the mining use declines over time? What if a large part of a right is unused for many years more than the four-year statutory period, after which the state engineer may serve a notice warning of possible forfeiture? If a water right must continue to be available for post-mining environmental uses for a long time, but water is not actually put to beneficial use, would some part of the right be deemed abandoned? How long will a water right, established or acquired for mining, continue to be valid if the mining company chooses to hold it in anticipation of reopening of the mine? And how long will the right continue to be valid if not transferred to another use?

In the San Juan Basin, many applications to appropriate ground water were filed by uranium and coal companies decades ago; some were approved and permits issued, and some are still pending, but in many cases no water has been used for years. A number of rights, established by drilling of exploration wells, or by actual operation for some period, were declared by uranium and coal companies before the state engineer asserted jurisdiction but have not been exercised for many years. The current status of these permits and rights may be described differently by people in the mining industry and on the state engineer's staff. Probably in some cases the applicant corporations no longer exist. It seems likely that the energy resources of the basin will be of economic interest again, however, and resolution of these cases will be necessary.

Much of the new mining in New Mexico is likely to be in the form of sand-and-gravel or crushed-rock operations. These tend to be near urban areas, because markets are primarily in building and highway construction, and transportation is relatively expensive. Permits relating to zoning and land use are probably more of a concern than the availability of water. Water requirements are relatively short term, governed by a typical operation's reserve life of perhaps twenty years, and with little land-surface reclamation (and therefore irrigation) required, at least for now on private lands. Requirements for reclamation, and therefore for water, seem likely to increase in the future, even on non-public lands.