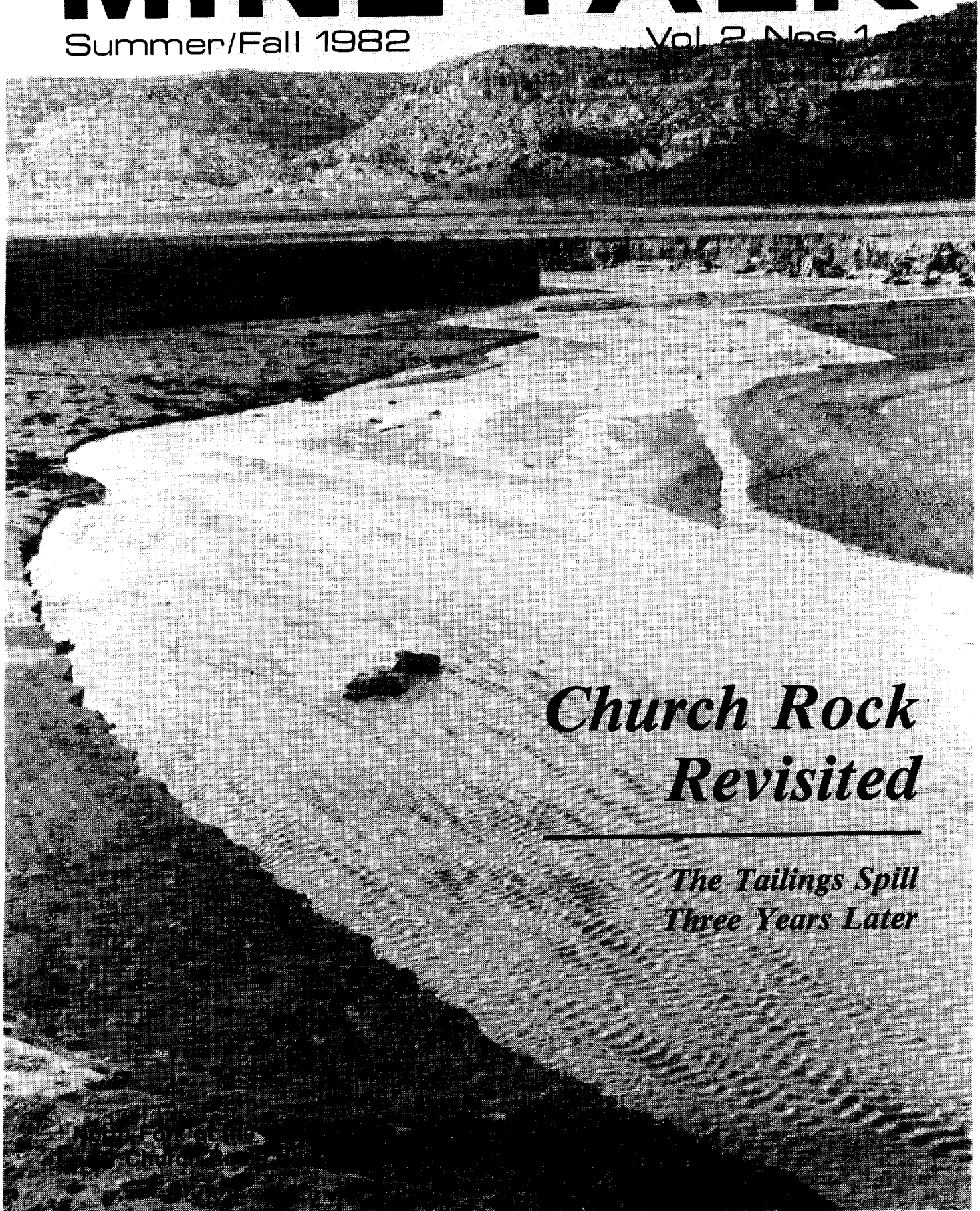


MINE TALK

Summer/Fall 1982

Vol. 2 Nos. 1



Church Rock Revisited

*The Tailings Spill
Three Years Later*

Photo: John G. ...
Church Rock

MINE TALK, published by Southwest Research and Information Center, is a quarterly newsmagazine for keeping track of mining development, especially in the West, and its impacts on the people, their environment, and their health. As the demand for energy fuels and strategic minerals increases, so will the threat of degradation of land, air and water — the basic resources of land-based communities throughout the U.S. and abroad. Protection of these vital resources and the life-

styles of the people who use them requires accurate information and timely coordination. **MINE TALK** attempts to facilitate local decision-making by bringing up-to-date facts and figures on existing and proposed mining operations and regulatory activities to the individuals and communities most likely to be adversely affected. In addition, it seeks to assist grassroots organizers and public interest groups in networking activities and the sharing of information so necessary for effective cit-

izen action. **MINE TALK's** goal is to provide the latest information on mining technology, analyses of social, economic and environmental impacts, and insights into mining politics nationally and internationally. More importantly, we hope **MINE TALK** will be a further incentive for people to communicate and work together to bring decision-making back to those who have only their most precious resources to preserve.

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To Our Readers:

This double issue of *Mine Talk* marks the beginning of our magazine's second year. Because we were late in publishing (*again*) and due to the tremendous amount of information we amassed on the aftermath of the Church Rock mill tailings spill, we decided to combine the Summer and Fall 1982 issues.

We have raised the unit cost of *Mine Talk* from \$3 a copy to \$4. This enabled us to reduce the yearly (four issues) subscription rate from \$18 to \$16. Those of you who paid \$18 for six issues will receive all six issues. All

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Cover Photo: As evidenced by sheep tracks in the river mud, animals still frequently use the Rio Puerco wash near Church Rock, N.M. This photo, by Chris Shuey, was taken about five miles downstream from the United Nuclear uranium mill in August 1982.

new subscription orders will be processed for four issues. For those of you who subscribed with our initial May/June 1981 issue, please be advised that your subscription has now expired. You'll be receiving renewal notices soon.

We hope you find this edition useful technically and as an educational tool. Many long hours went into the research effort to put together the latest information on the effects of the tailings spill. As always, we encourage feedback and criticism on the contents of these reports.

— *The Editors*

A Comment On...

Spying

It is apparently becoming dangerous for citizens to speak out for conservation and work against industry and government plans for energy development. Such exercise of First Amendment freedom of speech and assembly rights is under attack in New Mexico. While there previously have been various cases of surveillance and harassment of Chicano and Indian activists in the state, the New Mexico State Police have now apparently turned their attention to those who are opposing coal development in northwest New Mexico (see *Mine Talk*, Vol. 1, No. 4.)

That such illegal police activity is occurring is, at least, the allegation of a lawsuit filed Oct. 22, 1982, by four individuals and two citizens groups against the New Mexico State Police. In the lawsuit, filed in U.S. District Court in Albuquerque, the plaintiffs charge that the Police "have conducted a campaign of surveillance and harassment directed against them because of their support of environmental and conservation causes and because of their exercise of their First Amendment rights."

The complaint specifically alleges that Roger Payne, a State Police intelligence officer in Farmington, conducted an investigation against the plaintiffs and that the head of the Intelligence Division and the Chief of Police allowed such a campaign to be carried out against the plaintiffs.

The police investigation was reported on the front page of the *Albuquerque Journal* on June 15 under the headline, "Fears of Sabotage Raise Questions On Foes of Mine" — the "mine" being the Gateway facility operated by a subsidiary of Public Service Co. of New Mexico in the Bisti badlands area of the San Juan Basin.

However, none of the plaintiffs has ever advocated or engaged in any illegal activities. What they have done is researched the human and environmental impacts of the proposed massive energy development, educated the public on the lack of need for new powerplants and coal development, and participated actively in administrative proceedings related to that development.

To discourage such illegal police activities in the future, the suit asks for \$600,000 in actual damages and \$1 million in exemplary damages for the individuals. The organizations ask for a permanent injunction against such activities and expungement of all records resulting from the police campaign.

The plaintiffs are David Glowka, Mimi Lopez, Alison Monroe, Jonathan Teague, the Sierra Club and Southwest Research and Information Center. Additionally, the American Civil Liberties Union of New Mexico is cooperating in the lawsuit.

The State Police have filed a motion to dismiss the case. The plaintiffs have responded to it by showing that case law clearly supports their position. Thus, the plaintiffs feel that the Police are continuing to "stonewall" all questions on their investigation, making discovery and an ensuing trial all the more important for stopping such illegal surveillance.

— Don Hancock
Southwest Research and Information Center

Mine Talk erred on Spring Texas report

Mine Talk:

We at the Central Texas Lignite Watch were both pleased and disturbed when we found out that the Spring 1982 issue of *Mine Talk* included an article by CTLW. Pleased, in that we're glad that your magazine found Texas lignite development to be an issue of great importance. Disturbed, because, contrary to appearances, we did not write the article, nor were we consulted about its contents, and there are two very significant factual errors in it.

First, the U.S. Bureau of Land Management (BLM) *has not leased* the Camp Swift Military reservation in Bastrop County for lignite stripmining. BLM has accepted bids, but awarded no lease.

The agency received only a single, joint bid, offered by a consortium consisting of the Lower Colorado River Authority, the City of Austin, and the City Public Service Board of San Antonio. The U.S. Department of Justice has been reviewing this bid since the fall of 1981 in order to determine whether or not this single joint bid has violated federal anti-trust laws which require competitive bidding. Further action by the Justice Department is still pending.

Second, Texas lignite cannot be correctly characterized as a high-sulfur coal. It is more correctly termed moderate-sulfur coal, as it varies in sulfur content from about 0.5 to more than 3 percent. The average sulfur content of Texas lignite is within the range of 0.9 to 1.1 percent.

As for heating value, Texas lignite ranges from less than 4,000 to (rarely) more than 7,000 Btu/lb. In comparison, western coals fall in the 8,000 to 10,000 Btu/lb. range, and anthracite coal ranges up to 14,000 Btu/lb. A given quantity of western coal or anthracite will generate two to three times more electricity than a similar quantity of lignite.

Jane Anne Morris
Executive Committee
Central Texas Lignite Watch
Austin, Texas

The Boom-Bust Cycle

Exxon shocks the synfuels world: Colony pullout leaves workers, Western Colorado towns in haze

Exxon Corp., the world's largest energy company, dropped a bombshell on the world's hi-tech fuels picture — and a few fledgling western Colorado energy boomtowns — when it announced May 2 that it was withdrawing from the Colony oil shale project near Parachute, Colo.

The \$5 billion project, a joint venture with Tosco Corp. that Exxon undertook two years ago, was the largest commercial-scale oil shale operation in the U.S. and its demise left the American synthetic fuels program — once thought to be an answer to energy independence — with one remaining commercial oil shale operation and a less-than-rosy outlook for the future.

More important, however, the Exxon pullout left Parachute and Battlement Mesa, Colo. — the latter Exxon's 25,000-person planned community south of the Colony site — in a state of shock. Some 2,100 workers were immediately laid off after learning of the shutdown on television and radio late Sunday afternoon, May 2. Some workers arrived in Parachute

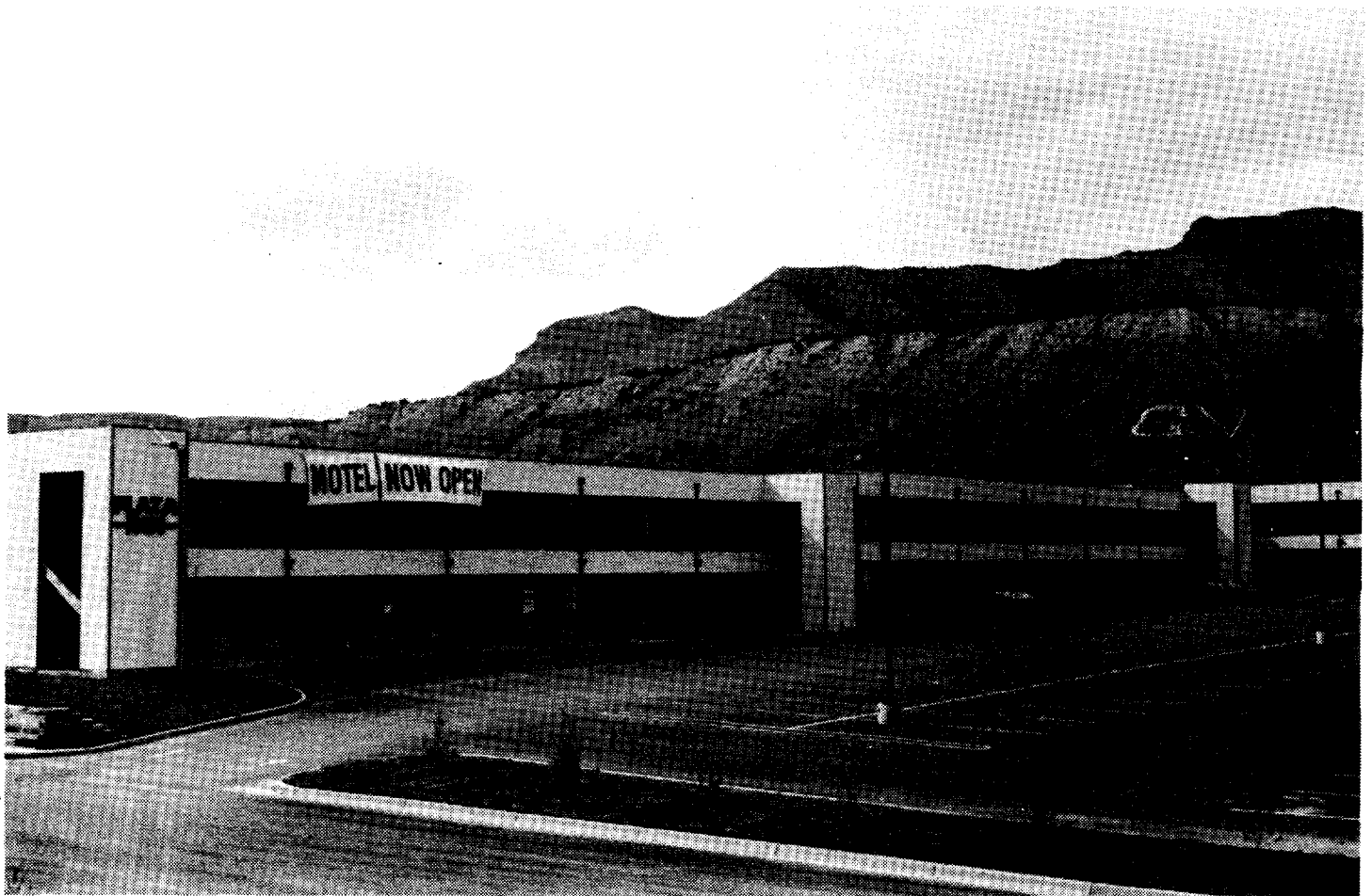
the following Monday and Tuesday to find they did not have the jobs they had been promised only two weeks earlier.

Exxon, 60-percent owner of the Colony project, said it based its decision to pull out on the probability that costs would continue to increase. Randall Meyer, president of Exxon Company U.S.A., said the company "believes the final cost would be more than twice as much as we thought it would be when we entered the project."

Colony initially was to have cost less than \$2 billion. Tosco had raised its own estimate to \$3.7 billion, and Exxon believed the cost would be between \$5 billion and \$6 billion. Exxon bought its share in Colony from Atlantic Richfield (ARCO) in 1980 and since then, it and Tosco have spent \$400 million on the project.

Counting the amount of money Exxon had agreed to pay Tosco if it pulled out and the cost of constructing Battlement Mesa, some estimates placed Exxon's loss at more than \$1 billion.

According to the *Christian Science Monitor*, the first reason Exxon gave for its action, before citing ballooning cost estimates, "involved economic conditions, particularly the softening of the world price of oil." The U.S. synfuels program, which the Carter administration made the cornerstone of an American thrust toward oil and energy self-sufficiency, has slowed under the Reagan administration, which de-emphasized federal aid and emphasized private endeavors. But as the *Los*



This motel in Parachute, Colo., opened shortly before Exxon shut down its Colony oil shale project.

Angeles Times reported, "As a pervasive worldwide oil glut has driven oil prices down . . . private industry has shown less willingness to shoulder the risk of building massive synthetic fuels projects that, in the view of many executives, may never prove profitable."

The entire synthetic fuels industry is seen as having been seriously eroded by Exxon's Colony action. Oil shale development plans in Colorado have been postponed by Occidental Petroleum Corp., Tenneco Inc., Gulf Oil Corp., and Standard Oil Co. (Indiana), Mobil Corp. and Standard Oil Co. of California are proceeding more slowly than planned. Only Union Oil Co. continues Colorado shale oil development, with a 10,000-barrel-a-day project. The *Wall Street Journal* reported that Fred Hartley, Union's president, believes Union will succeed where others failed because its technology is the best in the business. Of three Synthetic Fuels Corp. (SFC) pilot projects, only two remain, the small Union Oil shale project and a coal gasification project in North Dakota.

It was Exxon's Colony project that was the centerpiece of the U.S. synthetic fuels effort. The project was scheduled to produce 47,000 barrels of upgraded crude per day by 1986. Using a process developed by Tosco ("The Oil Shale Corporation"), oil-bearing rock was to be mined, crushed, cooked in retorts, and partially refined before shipment. The number of workers employed was to go far beyond the force of 2,100 working to construct the project when the shutdown occurred.

When news of the shutdown came, a mood of anger, bitterness, and uncertainty prevailed in Parachute, a town about 15 miles from the Colony site which has grown from 360 to more than 1,200 in two years, and in Battlement Mesa, the incomplete planned community. Tension in Battlement Mesa following the announcement prompted Exxon and local police to close the liquor store there, and off-duty and reserve deputies were called in doubling the usual nighttime force to 20.

Many who moved to Parachute to work on the Colony project expected to settle down and make western Colorado home for themselves and their families. Some bought houses. One discouraged former employee who thought he made a good investment when he sank most of his life savings into a new \$72,000 house told a reporter for the *New York Times*, "In six months, this is all going to be a ghost town . . . With Exxon in it, and with oil prices as they are, I just thought this project would be more stable than most. I guess I was wrong."

Battlement Mesa at shutdown had 1,900 residents, and about 10 percent of its houses and 50 percent of its streets and public facilities were complete. Exxon was carving the city out of a bluff near Parachute, spending \$1 million per day by Exxon estimate on a community of 3,000 acres that planned 8,000 dwellings, 10 churches, eight schools, an 18-hole golf course, and a huge recreation center. Such plans, along with the magnitude of the oil shale project itself, banished skepticism about the permanence of the Colony project. As one resident described it to the *Washington Post*, "There was a lot of dirt being moved. It was like they were building the pyramids up there."

The *New York Times* reported that following the shutdown order, "all work on the oil shale facility itself, as well as the new homes, schools, shops and apartments under construction at Battlement Mesa, stopped dead in its tracks." Some workers packed to leave immediately. One of those, a man who had gone to Parachute after failing to find work in the Pacific Northwest, believed he had "no choice but to hit the road again." Colony's \$16-per-hour wage attracted workers nationwide. Another worker who had picked up his last check

looked at the \$35,000 house he had bought in March and said, "I raised seven kids in my lifetime and saved enough to buy a house, and goddamn it, in 30 days I lost it. Sell it? Who to?"

Mayor Floyd McDaniel told the *Times* he worried about "all these merchants who have borrowed money and put additions on their shops in anticipation of this becoming someday an economically viable community." A new motel had its opening the day of the shutdown; a new car dealership opened the week before was awaiting delivery of its first inventory.

The *Washington Post* wrote, "A week ago, huge earth-movers were at work at the Colony site 15 miles up the creek from Parachute. Now they are being hauled down the mountain on long trucks, a grinding procession of broken dreams. Behind them on Parachute's dusty streets come the moving vans and RVs and cars pulling U-Hauls, filled with the possessions of families wondering how their fortunes could have changed so quickly." Mayor McDaniel told the *New York Times*, "I don't know what this is going to do to the town. But this isn't the first time. Our hopes have been tied to the oil shale industry for so long that folks here say the one thing this town can't afford is another oil shale boom, because it will surely be followed by another bust."

In the view of Friends of the Earth, an environmental group, "The collapse of the Colony oil shale project in western Colorado confirms the repeated warnings from Friends of the Earth and other environmental groups that mindless reliance on synthetic fuels to solve our energy problems were destined for failure . . . Every extractive industry in western Colorado has been highly cyclical. The environmental community has consistently asked how oil shale communities would handle busts, but no one would honestly confront the possibility or how to plan for it in advance. Now we face an abandoned new town (Battlement Mesa), dashed hopes, and a large unemployed workforce. We can only hope that Exxon, which has already swallowed a bitter \$1.2 billion loss, will be able and willing to accommodate the relatively small additional cost necessary to ease the pain for Rifle, Parachute, Battlement Mesa and other affected communities. Also, we trust that the 1,500-acre construction site will be appropriately reclaimed." (See the Colorado report for more on reclamation of the Colony site.)

The human cost of the Colony project shutdown waits to be counted, as does the cost to Colorado, which is left to hope for complete reclamation of land sacrificed to what Friends of the Earth called "the synthetic fuels white elephant."

Federal energy impact assistance programs sliced under Reagan, General Accounting Office says

Communities and regions expecting to be directly affected by the current emphasis on development of U.S. energy resources have new cause for worry about their ability to control the impacts of such development. The Reagan administration has lopped off funds for the only two federal programs specifically designed to assist energy-impacted communities.

The programs were far from generously funded (23 states received amounts ranging from \$113,000 to \$6 million in 1980), but energy-impacted communities must now seek to replace allocations with funds from states hard hit by New Federalism or from a possibly reluctant industrial sector.

A report by the U.S. General Accounting Office (GAO)

sets forth in some detail the socioeconomic impacts of energy development already felt by three areas likely to see a continuation: the Rocky Mountain states, Appalachia and the coastal zones. These diverse areas meet their problems in different ways, but the problems are the same for all: how to provide an "infrastructure" (housing, schools, police and fire protection, hospitals, recreation, social services, highways, docks, water supply, waste collection and treatment) for the new workers and their families who pour into the area and how to pay for it when the local tax base is small.

In the Rocky Mountain region, where a large percentage of the nation's energy resources is found, the Department of Energy (DOE) now lists 325 communities in the six states (Colorado, Montana, North and South Dakota, Utah and Wyoming) as potentially impacted from energy development, up from 131 in 1975. Many of these predominantly widely spaced small towns and cities have had problems absorbing large population in-migration. Green River, Wyo., multiply impacted by coal, oil, gas and trona development, grew 164 percent, from a small town of 4,196 to a city of 11,119, from 1970 to 1978, and Carbondale, Colo., with coal development, grew 214 percent during the same years. Such rapid growth severely strained housing and public facilities and services, typical in energy-impacted areas. Citing the DOE report, GAO said more than one-fourth of the 325 communities lack central sewage treatment systems and 10 percent do not have municipal water service. Most schools appear to be operating at capacity. Continued population growth from energy development can only worsen the situation and heighten the need to build expensive new municipal systems.

The Appalachian states have yet to experience significant effects of recent energy development, but their day may come if they are successful in bringing synthetic fuels operations to the area to take advantage of still plentiful coal resources. Appalachia, too, would be severely strained by large population growth. Its facilities are old and inadequate, reflecting the depressed condition from which it has not recovered since the days prior to WW II when its coal was exported without adequate financial return to the area. In order to bring the region some energy-related prosperity, development there is being actively sought, in contrast to the Rocky Mountain region, where the concern is to control the potential for runaway growth.

Among areas in the coastal zone (states bordering the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes, and Hawaii), Louisiana resembles Appalachia in encouraging energy development — it, too, has long been energy-impacted and has aging facilities whose modernization might be financed by energy development — while California is attempting to protect its environmental wealth through a variety of restrictions on both onshore and offshore oil development.

With no federal money to help communities mitigate the multiple impacts of energy development, GAO recommended that communities go with their hands out to state governments and to industry. Possible sources of revenue for state financing of badly needed assistance (beginning, ideally, with planning, so that communities are not simply overtaken by the host of problems Green River found itself unable to deal with) are under the control of state governments — severance tax money and revenues paid to states for mineral leases on their federal lands. Depending on the state tax rate, the price of energy, the level of production, and other variables, revenue from these sources can be enormous. For example, in Wyoming, severance

tax receipts for coal, oil, gas, and uranium more than doubled from \$44.7 million in 1977 to \$100.1 million in 1980 and are projected to increase fourfold to \$411.6 million in 1985. Not all states are in line for such wealth, but some states might be encouraged to allocate larger percentages of their severance tax receipts to mitigate the impacts of energy development. Rocky Mountain states allocate varying amounts to energy-impacted areas, often returning severance tax receipts to counties of origin; Utah is alone in assigning all severance tax receipts to its general fund. Similar variations occur in the distribution of federal mineral leasing revenues in the Rocky Mountain region.

Communities can begin to demand more of industry as a prerequisite for permitting energy development within their boundaries. Colorado, with its remote energy producing locations, has perhaps been responsible for making industry realize that it is good business practice, and in some cases a matter of economic necessity, to provide for housing and other needs of its employees. Industry has begun to realize that to recruit and retain workers for facilities in out-of-the-way places it has to shoulder some of the burden of providing a community where the workers and their families can live in agreeable surroundings. According to the GAO, "communities must realize the options available to them to encourage industry participation in mitigating socioeconomic impacts"

As for whether and when the federal government should resume its participation, the GAO recommends that "all variables should be considered in determining the proper Federal role in energy impact mitigation The willingness of State and local governments to use their existing sources of revenues such as severance tax and Federal mineral leasing receipts . . . should be factored into decisions on the extent of Federal assistance," as should the extent of industry assistance, whether given voluntarily or under some state or local law or regulation.

The GAO appears to believe the federal government should resume its role, calling it "integral to this issue because of policies affecting the pace of energy development and programs providing impact mitigation assistance. In addition, there are differences in the ability and willingness of States and communities to address the impacts."

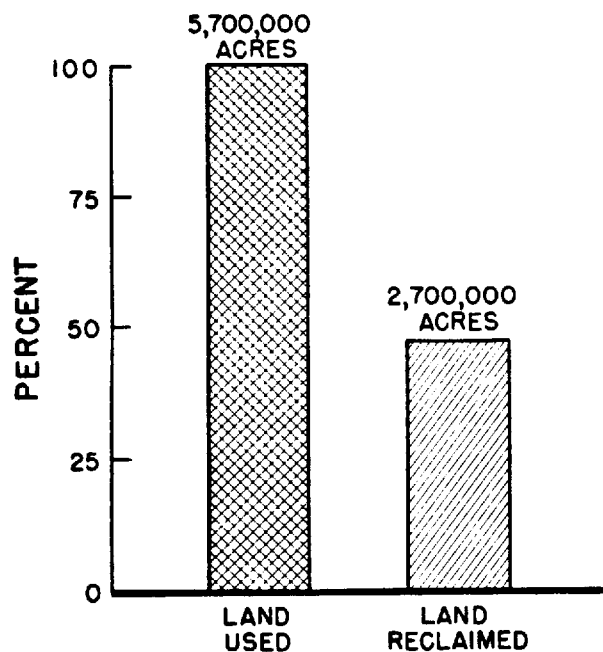
Persons interested in obtaining a copy of this report, titled "Mitigating Socioeconomic Impacts of Energy Development" (EMD-82-13, Mar. 2, 1982), should write GAO in care of the agency's Document Handling and Information Services Facility, P.O. Box 6015, Gaithersburg, MD 20760. Include the report number and date of publication with your request. Up to five copies can be obtained free.

— Julie Jacoby

Mining used 5.7 million acres in U.S. in last 50 years and reclaimed 47 percent, Bureau of Mines says

Land used for the mining industry for mineral extraction and processing from 1930 through 1980 amounted to 5.7 million acres, or 0.25 percent of the U.S. land mass, according to a recently released U.S. Bureau of Mines report. Land reclaimed by the industry during the same period was 47 percent of the land used.

The 10 leading states in total land used for mining over the 51 years were, in descending order, Pennsylvania, Kentucky, Ohio, Illinois, West Virginia, Florida, Indiana, California,



Total land used and reclaimed in the mining industry, 1930-1980.

Alabama, and Missouri. Seven minerals that account for 92 percent of mine land use are, in descending order, bituminous coal, sand and gravel, stone, phosphate rock, clay, copper, and iron ore, all predominantly surface mined. Bituminous coal operations used half of all land devoted to mining, and every state had mining operations of some sort during the period studied.

Comparative figures contained in the report show that the amount of land used for mining contrasts with 70 percent for agriculture, 3.9 percent for wildlife refuges, 3.4 percent for national parks, 3.0 percent for urban areas, 1.3 percent for transportation networks (e.g., highways, railroads, airports), and 1.1 percent for Forest Service wilderness.

The percentage of reclaimed mining land appears to have increased since a 1965 Interior Department report which identified 3.2 million acres of land affected by surface mining, "2 million acres of which were in need of varying degrees of treatment," and a 1971 Bureau of Mines survey covering 1930-71 which showed that 3.65 million acres had been used for mining and 1.46 million acres, or 40 percent, had been reclaimed.

Bituminous coal accounted for most of the acreage reclaimed, with 75 percent. That compares with 8 and 27 percent respectively for metal and nonmetal mining. According to the bureau, the lower percentages for those operations are due to several factors, including absence of regulatory history. The chief factor is in the nature of such operations, since they typically consist of large open pits or quarries that disturb relatively small surface areas while removing large quantities of ore over a period of many years.

The report said conclusions cannot be drawn about the amount of mining land that remains in abandoned condition, presumably 53 percent if 47 percent is reported as reclaimed. While none of the 53 percent was reclaimed by industry, some of it, the bureau said, has been reclaimed by nature and cannot be identified for reclamation purposes. Nor can reclaimed land be accounted for if industry voluntarily reclaimed it before the existence of federal and state regulations and the land is now used for other purposes. Still other mining lands have been

taken over by other industries or put to use for highways or housing.

Future reclamation should be high in coal mining areas because of requirements of state and federal laws. Reclamation of lands used for non-fuel minerals mining will probably increase, the bureau said, but at a slower rate than coal lands.

Seabed treaty signed, but U.S. mining firms move to protect exploration activities for ocean floor minerals

A flurry of activity developed this spring over deep seabed mining. On April 30, the United Nations Conference on Law of the Sea (UNCLOS) agreed to an international treaty covering, among many other areas, deep seabed mining. The June 25 *Federal Register* announced exploration license applications by the four U.S.-based international mining consortia under the U.S. Deep Seabed Mining Act, which is somewhat contrary to the provisions of the treaty.

Several mining companies are looking greedily at the ocean as a new source for minerals and profits. They persuaded Congress to pass a Deep Seabed Mining Act in 1980 (Public Law 96-283) and are now applying for permits to protect their exploration activities in the Northeastern Equatorial Pacific Ocean. The companies have formed international consortia to take advantage of favorable national tax and mining laws and to give them maximum flexibility of operation. They also will be able to take advantage of favorable trade and import laws through the consortia.

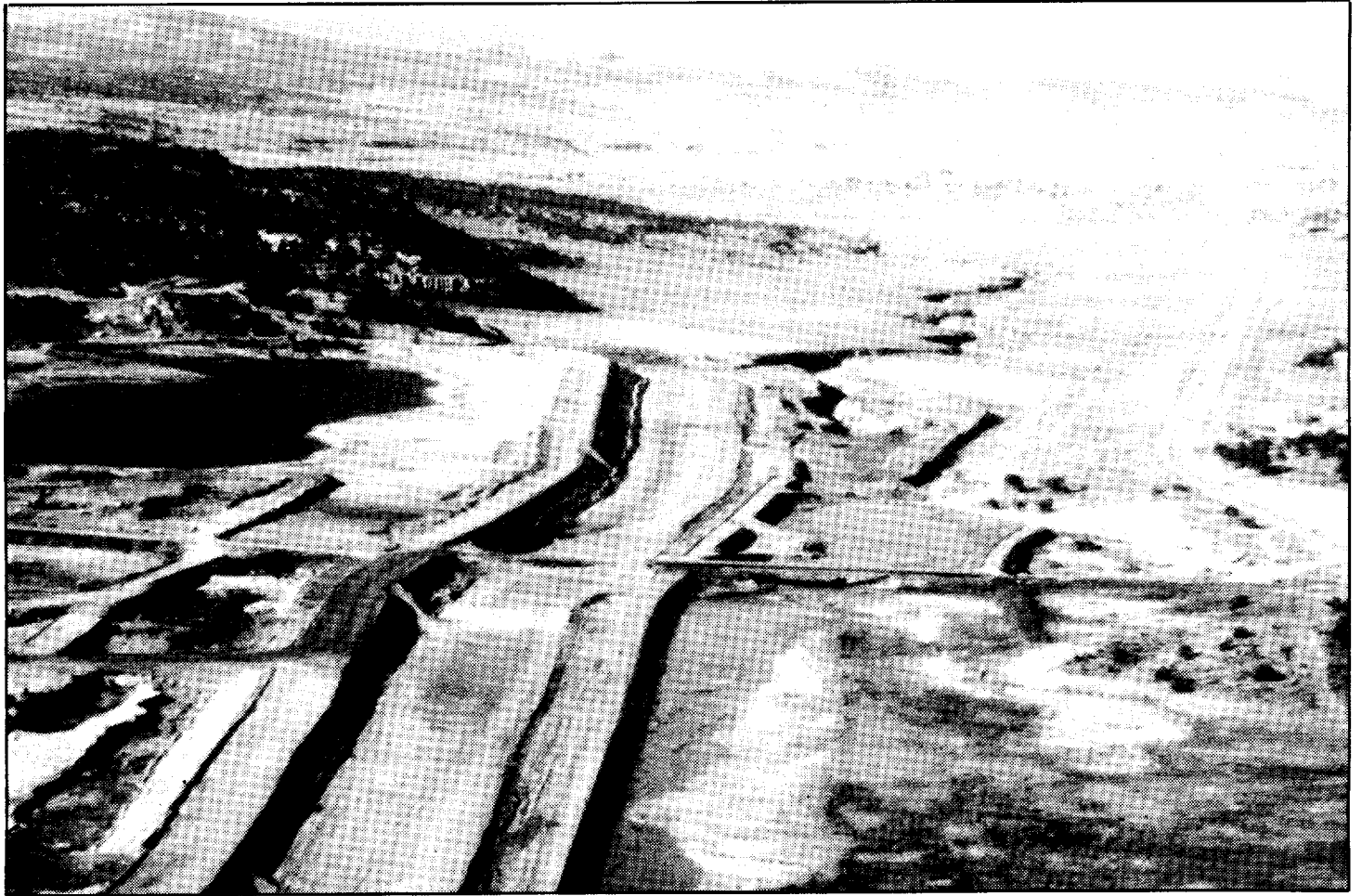
The four major consortia are Kennecott (which also includes British Petroleum, Rio Tinto Zinc, Noranda, Mitsubishi and Consolidated Gold Fields), Ocean Minerals Company (Lockheed, Standard Oil of Indiana, Royal Dutch/Shell and other Dutch companies), Ocean Mining Associations (U.S. Steel, Union Miniere, Sun Oil, Tenneco and Italian companies included), and Ocean Management Inc. (International Nickel, SEDCO and Japanese and West German companies).

Because of opposition from some of the U.S. mining industry, the U.S. government was one of only four nations in the world (of the 151 voting states) which did not agree to the UNCLOS Convention. (The other three nations were Turkey, Israel and Venezuela.) The companies want to be able to use both the provisions of the treaty that they like — international recognition of mining claims and participation in the regulatory agencies — while also being able to take advantage of U.S. law, which they hope will ensure U.S. government protection for their activities, since the Reagan Administration refuses to even consider ratifying the treaty when it is formally approved later this year.

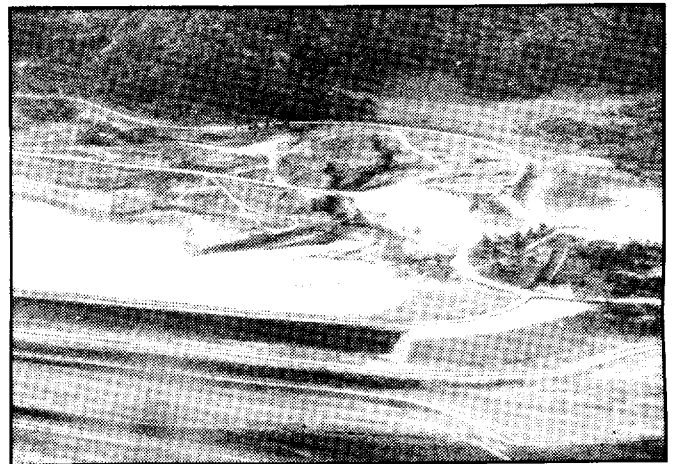
The manganese nodules on the seabed floor, containing copper, cobalt, nickel and manganese, offer significant mineral resources to the world and could well have a major impact on the world market for at least some of those minerals within the next 15 years. How well the international regime functions and how much the U.S. mining system clashes with the internationally agreed upon system will also have profound international political implications.

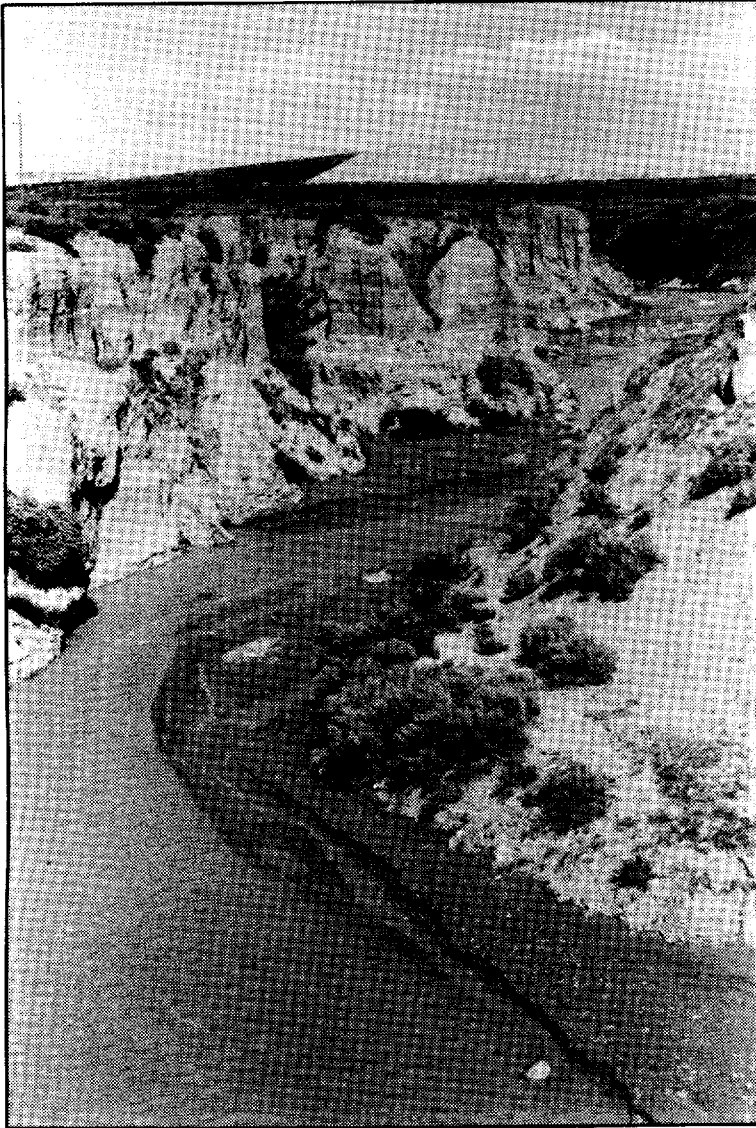
The next issue of *Mine Talk* will include an article about the mining consortia and how the new U.S. and international seabed mining law will affect the domestic and international mining industry.

Church Rock Revisited



Clockwise from above: The United Nuclear tailings dam looking south toward the Puerco valley — this photo, by Wm. Paul Robinson, was taken before the spill and shows the south evaporation pond (far left) to be full; the Pipeline Arroyo about 300 yards south of the breach area which is the light colored embankment in the upper right corner of the picture (photo by Chris Shuey); the breach itself one day after the spill; and an aerial view of the breach cap (photos by Wm. Paul Robinson).



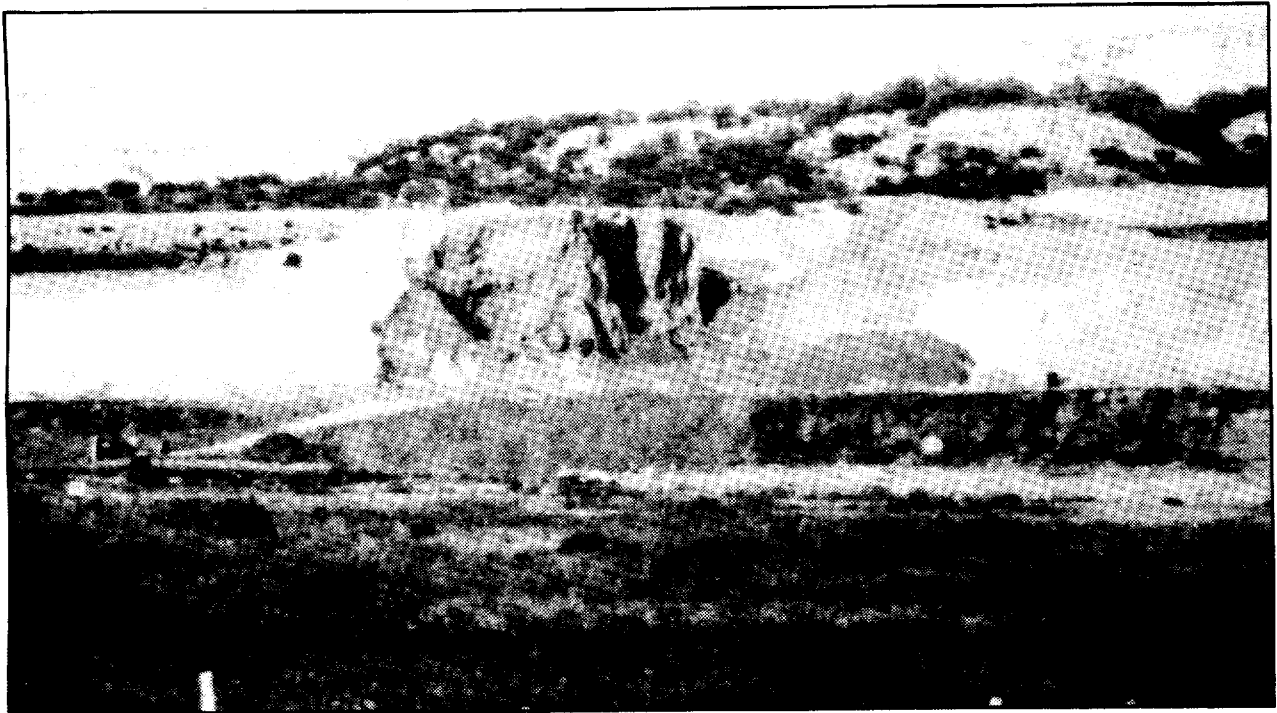


The Tailings Spill Three Years Later

The July 16, 1979 failure of a uranium mill tailings dam at the United Nuclear Corp. uranium mill near Church Rock, N.M., has left Navajo users of the Rio Puerco wash wondering if the health of their children and livestock was irreparably damaged by an accident they still cannot explain.

To them, it seems, the incident has been forgotten — washed down the 'Perky' with the yellowish waters they now know were the toxic wastes of uranium processing.

The articles which appear on the following pages attempt to keep the effects of the Church Rock tailings spill very much in the minds of legislators, government regulators and the industry. We want to make certain that the consequences of the largest release of radioactive wastes ever in the U.S. are not soon forgotten.



Accident Left Long-Term Contamination of Rio Puerco, But Seepage Problem Consumes New Mexico's Response

Chris Shuey

Environmental monitoring data collected and analyzed since the July 16, 1979, Church Rock uranium mill tailings spill show that the accident left severe and lasting contamination in an ephemeral stream which had served the livestock watering needs of downstream Navajos for decades.

The investigation into the incident at the United Nuclear Corp. uranium mill complex 20 miles northeast of Gallup, N.M., also led to the discovery of an environmental pollution problem at least as severe as the tailings spill: contamination of Indian groundwater from the seepage of acidic tailings wastewater from unlined evaporation ponds in the UNC mill tailings impoundment.

While the dam break that led to the tailings spill had only a minimal relationship to the causes of leakage from UNC's tailings ponds, the two events collectively demonstrated the need for fundamental changes in New Mexico's uranium regulatory apparatus.

The post-spill investigation produced a considerable amount of environmental data and pointed to the need for collecting quality "baseline" or background information before uranium facilities are licensed and permitted to operate. But it did not resolve basic questions about the effectiveness of state-ordered river cleanup programs conducted by UNC and whether contaminants released in the

spill really have dissipated to background concentrations or simply have been transported deeper into soils below the surface of the Rio Puerco wash.

The north fork of the Rio Puerco received the brunt of the 95 million gallons of wastewater and 1,100 tons of contaminated sediments that poured through a 20-foot hole in the southern portion of the UNC tailings dam. The liquids eventually traveled more than 115 miles downstream, temporarily altering the chemical quality of surface waters of the Little Colorado River near Holbrook, Ariz. (Figure 1). The spill remains ranked as the largest one-time release of radioactive wastes ever in the U.S.

Ironically, the seepage problem — and not the tailings spill itself — has dominated the state's regulatory oversight of United Nuclear in the past three-and-a-half years. UNC's numerous attempts to stop the outward movement of contaminants from its tailings ponds have repeatedly frustrated New Mexico environmental authorities.

Seepage of tailings fluids to usable groundwaters afflicts all five of the licensed and active uranium tailings facilities in New Mexico, but the condition is most severe at the United Nuclear operation. An estimated 15,000 to 80,000 gallons of raw tailings "raffinate" high in radioactivity and toxic metals and process chemicals seep daily from the UNC evaporation ponds into underlying aquifers, state officials say. Contamination is evident in site monitoring wells at depths up to 240 feet below the surface, according to the company's own information.

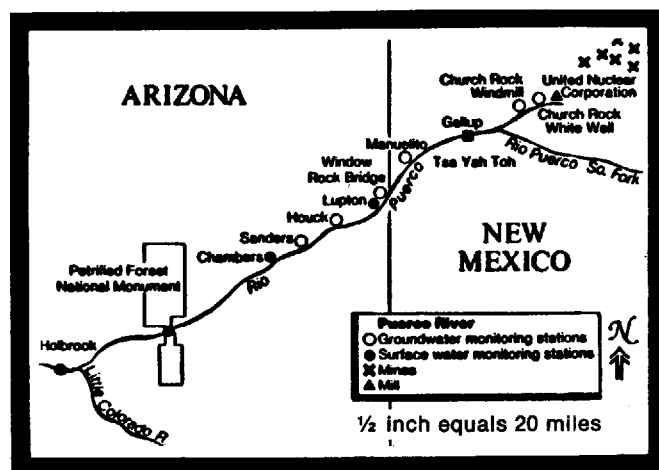
Prodded by an Albuquerque environmental group seeking restoration of polluted Indian groundwater, the state now is faced with putting together an enforcement program which not only requires UNC to restore the quality of groundwater it has degraded, but also is legally consistent with the provisions and jurisdiction of the state's groundwater and radiation protection regulations. The ability of the state's environmental agency to adopt such a program will be a major test of the effectiveness of uranium regulatory programs not only in New Mexico, but also in the U.S.'s other uranium producing states.

This article will discuss the technical and regulatory aspects of both the post-spill Rio Puerco cleanup program and the tailings impoundment seepage problem. Environmental monitoring data, geohydrologic concerns, and regulatory histories of both issues are reviewed.

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Figure 1

MAP OF RIO PUERCO AREAS, NEW MEXICO AND ARIZONA



The map above shows key sites along the Rio Puerco.

A regulatory enforcement scenario which requires restoration of contaminated groundwater is proposed. Technical approaches to restoring polluted groundwater, and the potential for success of such methods at United Nuclear's Church Rock facility, also are discussed. A companion article reviews UNC's corporate plans to de-emphasize domestic uranium production, and the company's views toward the spill and its consequences are presented in a question-answer interview with UNC officials.

Rio Puerco Contamination

Evidence that the tailings spill left lasting contamination in sediments of the Rio Puerco and in groundwater near it is contained in environmental monitoring data collected since the spill and in correspondence between the New Mexico Environmental Improvement Division (NMEID) and UNC.

An analysis of the information shows that although radioactivity levels in stream bed soils have decreased as a function of time and distance downstream, *several portions of the river remain contaminated, and contaminant concentrations have yet to return to "background" levels for the vast majority of the stream bed.* The areas of substantially elevated radioactivity — called "hot spots" — are in side arroyos, backwashes and other segments of the stream bed outside of the channel cut by normal flows.

Contaminant levels in groundwater in areas immediately downstream from the mill site and at the New Mexico-Arizona border near Lupton, Ariz., at the end of 1981 were still elevated over "pre-spill" concentrations, according to state and federal monitoring data. Water quality in monitoring wells along the stream bank two to 12 miles downstream from the mill showed high variability in samples taken early in 1982, with some indication of spill-related effects, according to NMEID data. Concentrations of certain "indicator" contaminants, such as sulfates (SO₄), have remained well above federal water quality standards in the majority of samples taken during the past three years from an abandoned well near Lupton, according to U.S. Environmental Protection Agency (EPA) reports. EPA authorities also reported that radioactivity levels in surface water samples in Arizona violated the state's radiochemical quality standards.

Sediment contamination. A comparison of the stream sediment radioactivity levels reported by contractors to the U.S. Nuclear Regulatory Commission (NRC)¹ and by NMEID's Radiation Protection Bureau in an April 1982 draft report² with preliminary and final NMEID cleanup standards and reported background concentrations supports the notion that the Rio Puerco remains contaminated.

These data also suggest that *United Nuclear's cleanup efforts were misdirected.* Contaminants apparently moved

¹Weimer, W.C., R.R. Kinnison and J.H. Reeves. "Survey of Radionuclide Distributions Resulting from the Church Rock, New Mexico Mill Tailings Pond Failure." Pacific Northwest Laboratory (PNL-4122), prepared for the U.S. Nuclear Regulatory Commission (NUREG/CR-2449); December 1981.

²Millard, Jere, Thomas Buhl and Dave Baggett. "Radionuclide Concentrations and Doses Resulting from the United Nuclear Uranium Mill Tailings Spill at Church Rock, N.M." Draft Report, Surveillance and Field Operations Section, Radiation Protection Bureau, New Mexico Environmental Improvement Division; April 1982.

Table 1

NMEID RIO PUERCO CLEANUP CRITERIA (picoCuries per gram)

	Th230	Ra226	Pb210
Prelim. A	30	10	
Prelim. B	60	10	10
Final:			
individual samples	100	10	30
95 percent CI	75	10	20
50 percent CI	3	3	3

Prelim. - Preliminary; CI - confidence interval

several feet below the surface of the stream bed, transported possibly by the continuous release of water to the Puerco from dewatering of upstream underground uranium mines. UNC's river cleanup program, which was carried out using the NMEID cleanup standards, focused on removing only the top few inches of stream bed sediments.

Samples of stream sediments from the first two inches of the riverbed were taken after the spill in late July 1979 and again two months later in late September and early October. More than 2,400 samples from about 500 sampling locations from the mill site to Navajo, Ariz. (about 75 miles downstream) were taken during these periods (Figure 1).

Four-foot core samples, or cylinder-shaped soil specimens 4 feet deep, were taken during late July and early August and again Sept. 27-Oct. 5, 1979, when UNC employees collected sediment samples for analysis by scientists with Battelle Pacific Northwest Laboratory (BPNL), the NRC contractor. A resampling program was initiated in late 1980 for the New Mexico portion of the stream at the same locations sampled during the September-October period the year before; however, data for only one-half of those samples is available, NMEID said.

Table 1 shows the preliminary and final river cleanup standards adopted by NMEID. All three sets of standards were contained in orders handed down by former Division Director Thomas E. Baca. The final criteria were adopted April 22, 1980, and have remained in effect since.

Under the final standards for Th-230, a single sediment sample could not exceed 100 pCi/g (picoCuries per gram),³ 95 percent of all samples taken could not exceed 75 pCi/g and 50 percent of all samples could not exceed 3 pCi/g for all three critical radionuclides. According to NMEID, these standards and "confidence intervals" were based on the EPA's 40 CFR (*Code of Federal Regulations*) Part 190 radiation dose rate limit of 25 mrem/yr (millirems per year)⁴ to any human organ from all sources of ex-

³A picoCurie is one-trillionth of a Curie (Ci), which is a measurement of radioactivity based on the decay of 1 gram of radium-226. A picoCurie equals 10E-12 Ci, or 0.037 disintegrations per second (dps), or 3.7 x 10E-1 dps, or 1 disintegration every 2.2 minutes.

⁴A millirem is one-thousandth of a rem, which is a measure of the biological significance (dose) of a certain quantity of radioactivity. The expression "mrem/yr" is referred to as a dose rate."

Table 2

**MEAN 1979 RIO PUERCO SEDIMENT CONCENTRATIONS
COMPARED TO MEAN 1980 VALUES AND MEASURED BACKGROUND¹**

Year	Sample Type	Mean Radionuclide Concentrations (pCi/g)			
		U238	Th230	Ra226	Pb210
1979	Background	2.44	0.75	1.29	1.70
1979	Concentrated Areas	5.9	55	0.8	5.4
1979	Main Channel Terraces	3.2	27	0.5	2.8
1980	Main Channel Terraces ²	2.2	8.4	0.9	1.6
1980	Side Channel Terraces	1.8	8.7	0.9	1.6
1979	Maximum Individual Sample ³	27.6	270.0	20.2	59.0

¹Data from Table 2.6 (background concentrations) and Table 2.7 (sediment concentrations), Millard, et al., NMEID, April 1982. (Standard errors have been omitted for each concentration above.)

²1980 terrace concentrations from main and side channels for the first half of the stream bed only (roughly 20 miles).

³Maximum values from Weimer, et al., BPNL/USNRC, December 1981.

posure. The EPA limit was used because "it is currently considered the most stringent limit and is in agreement with the accepted health physics practice of limiting radiation doses to as low as reasonably achievable (ALARA)," NMEID's April report said.

Thorium concentrations in river sediments were important indicators of long-term contamination of the Rio Puerco. NMEID investigators said Th-230 was the most critical radioactive contaminant in the stream bed owing to its relative abundance in tailings wastewater and to its contribution to human doses through the inhalation pathway. A review of the quantitative information in the Battelle report shows the relatively large amount of thorium that still lingered in river soils in late 1979.

Of 1,189 samples for which concentrations were reported in the BPNL report to NRC, 94 — or approximately 8 percent of the samples — equaled or exceeded the final 75-pCi/g Th-230 limit for thorium concentrations in individual samples. The highest thorium concentration reported was 270 pCi/g. The 8-percent figure represents approximately 40 of the nearly 500 sampling locations from which sediments were taken during the late 1979 sampling period. Of the total number of samples reported, between 75 and 80 percent exceeded the 3-pCi/g background (50-percent confidence interval) limitation.

The final cleanup standards were less stringent than the two earlier sets of sediment radionuclide limitations (identified as Preliminary A and Preliminary B in Table 1). NMEID said the final standards not only corresponded to the EPA dose limit, but also were more practical for implementation by UNC in its cleanup activities. But a review of the data shows that a much larger percentage of sediment samples failed to meet the earlier cleanup standards. For example, 416 of the 1,189 samples — or about 35 percent — exceeded the Preliminary A 30-pCi/g Th-230 limit and 143 (about 12 percent) exceeded the Preliminary B 60-pCi/g thorium standard.

Table 2 compares 1979 mean sediment concentrations for all critical radionuclides with both mean 1980 concentrations and mean background levels. The background concentrations were derived from soil samples taken at

5,000-foot intervals on the banks above the stream bed.

Mean Th-230 concentrations for samples taken during the 1979 sampling period were 55 pCi/g for concentrated areas (backwashes, side arroyos and crystalline deposits) and 27 pCi/g for all river terraces, according to NMEID. The latter concentration is well below the 75-pCi/g final criterion and just under the earlier (Preliminary A) 30-pCi/g standard. However, it is more than 36 times greater than the measured mean thorium background concentration (0.75 pCi/g) and about 9 times greater than the 3-pCi/g background limit established by the cleanup criteria.

The NMEID report, prepared by Jere Millard, Tom Buhl (now with Los Alamos National Laboratory) and Dave Baggett, concluded that both Th-230 and Pb-210 levels for river terraces were "elevated statistically above background, while U-238 and Ra-226 were indistinguishable from background....In addition, all Th-230 and Pb-210 values were significantly above background as a function of downstream distance..."

Contamination would be expected to be higher during the 1979 sampling period because UNC did not end its river cleanup activities until the following May. However, NMEID Director Russell Rhoades informed UNC this past August that the late 1980 resampling program found four sampling locations exceeding the 95-percent confidence interval and individual sample criteria for both Th-230 and Pb-210. In an Aug. 27 letter, Rhoades instructed UNC Mining and Milling Division President Thomas Bailey to collect 25 surface samples at each of the four locations within a month and to submit the raw data to the division thereafter. Millard said UNC had not responded to the order by the end of October.

One of the four locations of elevated radioactivity in the river bed was near the small Navajo community of Pinedale, 4 miles downstream from the mill site, according to Millard, who is chief of the Surveillance and Field Operations Section of NMEID's Radiation Protection Bureau. The other three sites, he said, were 10 to 12 miles downstream in three side channels.

Effectiveness of the cleanup program. The Millard

report noted that mean Th-230 and Pb-210 concentrations for all sampling locations had decreased by 3 and 2 times respectively in the year between major sampling programs. These values are reflected in Table 2. NMEID attributed this decline to dilution of contaminated sediments by uncontaminated soils being transported downstream. UNC could argue that its cleanup efforts also contributed to the apparent cleansing of the riverbed. But an equally plausible explanation says that the slow-moving radionuclides have percolated into the stream bed beneath the top two inches of soil.

Data in the Battelle report support this theory. BPNL scientists noted that while sampling from the first two inches of soil represented the most accurate estimation of the "possible exposure to humans and animals using the arroyo," the surface inventory did not "represent all of the material lost at the break of the dam." In fact, they said, "the spill did soak into the arroyo."

Twelve of 49 core samples showed "evidence of a measurable downward migration of Th-230 with inventories for the first, second and third foot of sediments amounting to 18.7 Ci, 11.1 Ci, and 1.5 Ci respectively," the report said. By comparison, total thorium "load" in surface sediments (soils two inches deep) was estimated by BPNL at 4.9 Ci and total background thorium concentrations for the entire length of the stream to the Arizona border was estimated at 0.3 Ci. Thorium concentrations in the third foot of soil, therefore, were five times greater than what was predicted to be normal.

This apparent downward movement of radioactivity has important implications both for the effectiveness of the cleanup program and for protection of underlying and nearby groundwater resources.

UNC reported to the state that it had removed more than 360,000 cubic yards of sediments within an area 10 miles downstream from the tailings dam by the middle of May 1980. The figure represents a large amount of dirt — about 2,600 dump truck loads in all. But the cleanup effort was limited to a handful of workers scraping one to three inches of soil from the riverbed in spots suspected of containing concentrated patches of radioactivity. The Battelle data suggest that some unidentified process — perhaps the recharge of mine water flows — aided the transport of radionuclides into the first few feet of the riverbed. If this is the case, *the cleanup program may have missed a large part of the radiocontaminants buried below the bed of the Rio Puerco.*

Radionuclides are notoriously slow movers in sandy earth and usually are the last of the three categories of contaminants to reach groundwater. When attached to clay particles, however, they can be released slowly over long periods of time, causing persistent increases in radioactivity in groundwater. As discussed below, this process — which would have its roots in a misdirected cleanup program — may be the cause of elevated gross alpha radiation activity in Puerco monitoring wells within 12 miles of the mill site.

As for the other two categories of contaminants, process chemicals (sulfates, chlorides and other compounds associated with the milling process) generally move through porous media at a much faster rate because they do not readily attach to the sand and clay grains of the soils. They are called indicator contaminants because they are the first pollutants to show up in contaminated ground-

water. Heavy metals, such as arsenic, selenium, molybdenum and cadmium to name a few, move relatively faster than radionuclides but slower than process chemicals. Their rate of travel is determined by the chemistry of the groundwater and the mineral content of the host rocks.

Ground and Surface Water Contamination Along the Rio Puerco Wash in Two States

Long-term contamination of Church Rock-area groundwater near the Rio Puerco wash is evident from an analysis of the available monitoring data. Indicator contaminants in Puerco monitoring wells have been elevated over "pre-spill" conditions since the accident. Some data indicate that the metals are just beginning to appear. If, as the Battelle/NRC data suggest, contaminants are still moving downward through the riverbed, then *radioactivity still present below the surface of the stream may continue to be released to groundwater causing a long-term water pollution problem.*

Groundwater can be polluted by the seepage or "recharge" of contaminants in surface flows through porous stream bed soils. Soils which have been deposited as a result of stream flows are collectively called alluvium. Alluvium characteristically contains the widest range of grain sizes, from silts and clays to sands and gravels. In the case of the Rio Puerco and the effects on it from the UNC tailings spill, the evidence suggests that recharge occurred relatively rapidly in the stream bed within 12 miles of the mill site and more slowly downstream, especially in the Lupton-Houck area just inside the Arizona border.

Surface water. The tailings spill released liquids of extremely poor chemical quality and extremely high levels of radioactivity. According to NMEID water monitoring data, the maximum gross alpha⁵ concentration in stream water the day of the spill was 130,000 pCi/l, or roughly the equivalent of the raw tailings liquids in the UNC tailings ponds. Surface water measurements the day of the spill in Gallup, more than 20 miles downstream, showed gross alpha levels of 26,300, 45,400 and 40,200 pCi/l. Normal alpha activity in stream waters not influenced by discharges of mine effluent ranges from 0 to 20 pCi/l.

Concentrations of specific radionuclides also were high, again on the order of the levels found in raw tailings liquids. Th-230 hovered around 14,000 pCi/l in samples taken July 16 and 17, 1979, in portions of the Puerco east of Gallup. The maximum Pb-210 concentration in stream water the day of the spill was 4,200 pCi/l in the Pipeline Arroyo immediately below the dam breach area and 460 pCi/l 3 miles downstream. The Ra-226 content of the raw tailings water was about 1,300 pCi/l, according to UNC data. Radium concentrations in surface water samples were 550, 100 and 23 pCi/l at distances of less than 1 mile, 4.5 miles and 16 miles downstream the day of the spill.

Table 3 shows the maximum permissible concentrations (MPCs) of key radionuclides allowed in water (surface and groundwater) by the New Mexico Radiation Protection Regulations (Part 4, Appendix A, Table II, Column 2).

⁵Gross alpha radiation is a measurement of the total amount of radioactivity (excluding the contribution from uranium-238) originating from uranium-decay series radionuclides whose principal emissions are alpha particles. It is normally used as an indicator of mixed alpha radioactivity in liquids.

Table 3

**MAXIMUM PERMISSIBLE CONCENTRATIONS
OF KEY RADIONUCLIDES IN WATER
IN NEW MEXICO¹
(picoCuries per liter)**

Radionuclide	MPC, soluble form ²
Thorium-230	2,000
Lead-210	100
Polonium-210	700
Radium-226	30
Uranium-238	40,000

¹New Mexico Environmental Improvement Board. "Standards for the Protection Against Radiation," April 21, 1980, Rev. Nov. 8, 1981; Part 4, Appendix A, Table II, Column 2.

²A "soluble" form of a substance readily dissolves in liquids and is distinguished from its "insoluble" form which does not. The soluble classification imposes more stringent limits on the concentration of a given radionuclide in water.

Clearly, the regulations were violated by the excessive amounts of Th-230, Pb-210 and Ra-226 in liquids released in the tailings spill.

Total Dissolved Solids (TDS), a measurement of the amount of chemicals dissolved in, or part of, water, registered 18,811 and 22,218 mg/l (milligrams per liter or parts per million) in surface samples taken the day of the spill in Gallup. Sulfates also were high, with concentrations exceeding 6,100 mg/l in four surface samples taken in Gallup. Acidity, measured in pH units, was between 1 and 3 for the first two days of the spill east of Gallup. A pH

concentration below 7 indicates increasing levels of acidity, and a pH above 7 denotes increasing levels of alkalinity.

These extremely large values dissipated rapidly as the bulk of tailings liquids moved downstream and as water continued to be discharged to the Puerco from upstream mines, the latter diluting the tailings liquids still standing in the stream. For instance, gross alpha concentrations in stream water at Gallup had decreased to 35 pCi/l two days after the spill.

Downstream distance and time after the spill were important factors controlling the severity of spill contamination. But even though contaminant concentrations decreased with distance and time as a general rule, elevated levels of some pollutants continued for several months after the spill. Radioactivity remained high in surface water in the Arizona stretch of the Rio Puerco well into 1980; *gross alpha concentrations on several occasions during this period exceeded the 30-pCi/l gross alpha limit of Arizona's Radiochemical Water Quality Standards.*

Table 4 summarizes surface water quality in the Puerco in Arizona between July 17, 1979, and May 19, 1980. Most surface water monitoring was discontinued by EPA and the Arizona Department of Health Services (ADHS) after May 1980. Several sampling locations not only exceeded the Arizona radiochemical standards for gross alpha, but also exceeded EPA's "secondary" standard for sulfates and chlorides of 250 mg/l. (New Mexico's water quality limit for sulfates is 600 mg/l.)

Groundwater. Groundwater adjacent to or near the Rio Puerco responded to surface contamination within two months after the spill in the Church Rock area and within six months in the Lupton-Houck area, according to NMEID and EPA data.

NMEID had operated four alluvial monitoring wells,

Table 4

**SUMMARY OF SURFACE WATER QUALITY IN THE RIO PUERCO IN ARIZONA
(units as noted)**

Date	Location	Miles Downstream	Chlorides (mg/l)	Sulfates (mg/l)	Gross Alpha (pCi/l)
7/17/79	Lupton	40	N/A	N/A	38
	Sanders	61	N/A	N/A	99
7/25-26/79	Lupton	40	73	610	210
	Confluence w/ Little Colo. River	115	91	1,600	61
10/16-17/79	Lupton	40	72	640	200
	Chambers	67	45	280	18
10/25/79	Confluence w/ Little Colo. River	115	87	1,800	42
	Chambers No. 1	67	39	620	6,000
	Chambers No. 2	67	43	620	5,900
	Chambers No. 3	67	46	670	11,200
2/28/80	Lupton	40	29	330	100
	Chambers	67	18	120	90
4/8/80	Lupton	40	17	100	32
	Chambers	67	21	100	LT 3
5/19/80	Window Rock Bridge	37	110	490	380
	Chambers	67	42	160	LT 3
	Petrified Forest	85	1,000	3,600	78
	Confluence w/ Little Colo. River	115	47	250	33

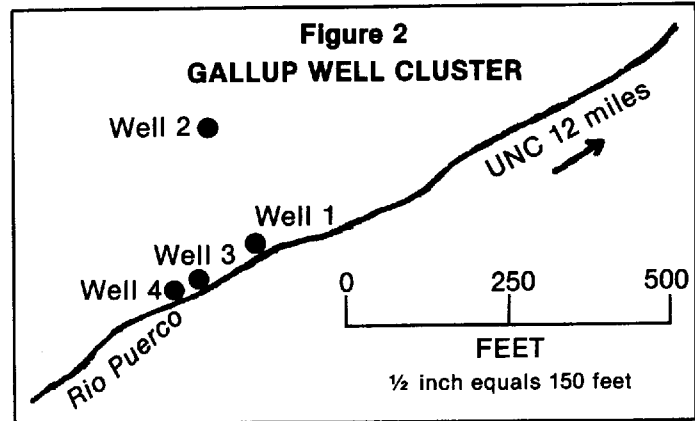
U.S. EPA data taken from water quality files, Arizona Department of Health Services, Phoenix. N/A: not available; LT: less than

called the Gallup Well Cluster, about 12 miles downstream from the mill site, since early 1978. Samples were taken from these wells on only four dates before the spill and constitute the only pre-spill groundwater chemical information available. Figure 2 is a diagram of the configuration of the well cluster.

Monitoring data show that Wells 3 and 1 responded rapidly to the infiltration of contaminants from the stream bed. Leading chemical parameters showed sharp increases in Well 3 within a month of the spill, with peak values registered toward the end of September 1979. Well 4 chemical quality remained relatively constant until spring 1980 when indicator contaminants increased rapidly over a nine-month period. The chemistry of these three wells has yet to return to pre-spill levels.

Understanding the significance of the locations of the wells, their depths and the rock formations in which they were drilled is important for an accurate interpretation of the chemical data. Water in wells located within a few feet of each other on the surface may have decidedly different chemical characteristics because the distance to the water table may be greater for one than for others, or because the water is being pumped from a rock formation whose mineralogy and porosity are substantially different.⁶ Well 2, for example, has shown no response to spill contamination because it is some 250 feet from the stream bank and is "screened" in a zone of less permeable clays.⁷

Although both Wells 1 and 3 have shown response, the extent of that response has been very different. Both wells are screened to 40 feet below the land surface, but Well 1 is

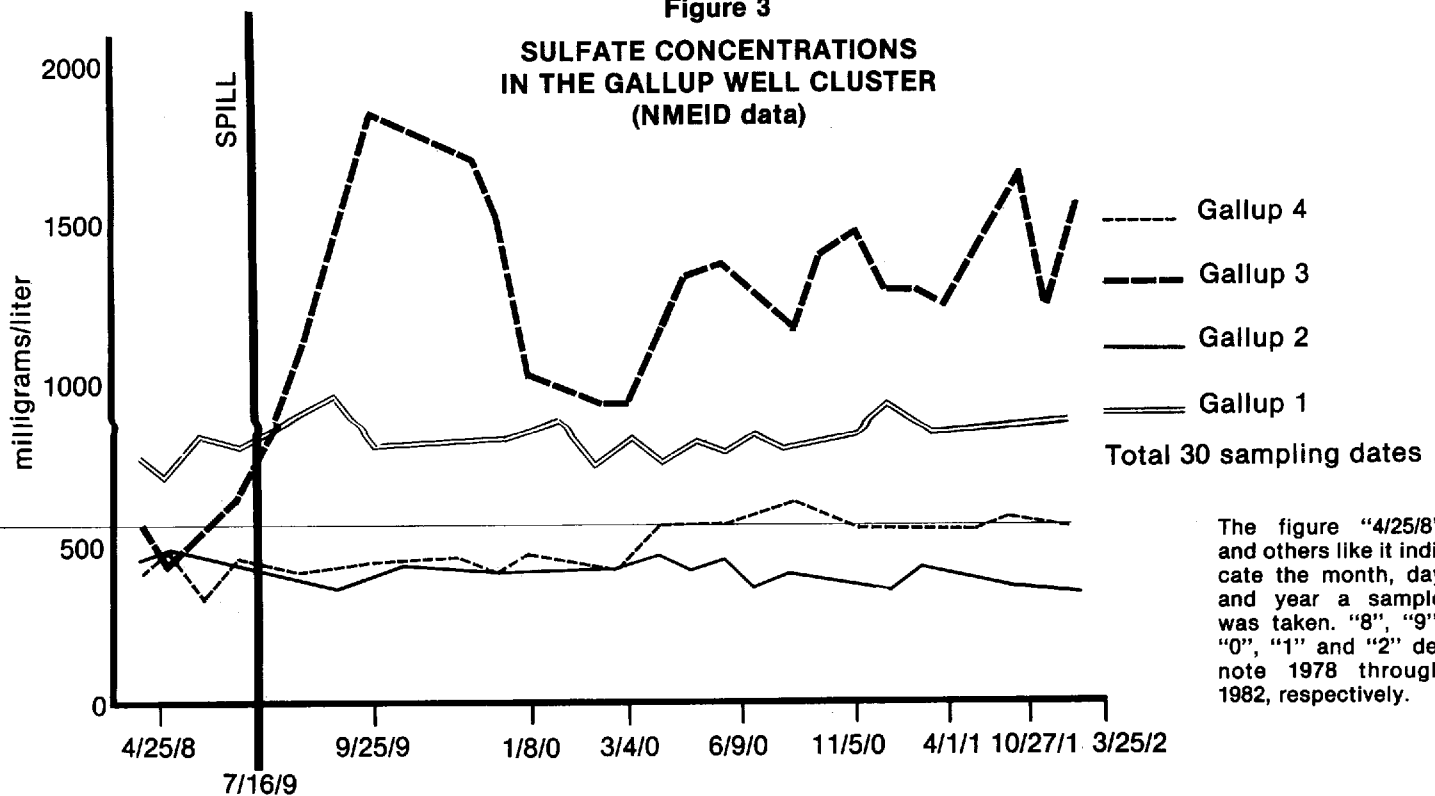


115 feet upstream from Well 3. NMEID information shows that the Well 1 screen is in less permeable alluvium and the Well 3 screen is in more gravelly stream bed soils with higher permeabilities.

Long-term contamination of an aquifer can be determined by observing trends in water quality. The chemical parameters of Well 3 have been extremely elevated since the spill. Bruce Gallaher, an NMEID hydrologist, agrees that Well 3 has been affected by seepage of spill liquids through the stream bed. The data suggest that Well 4 also has been affected, but to a lesser degree.

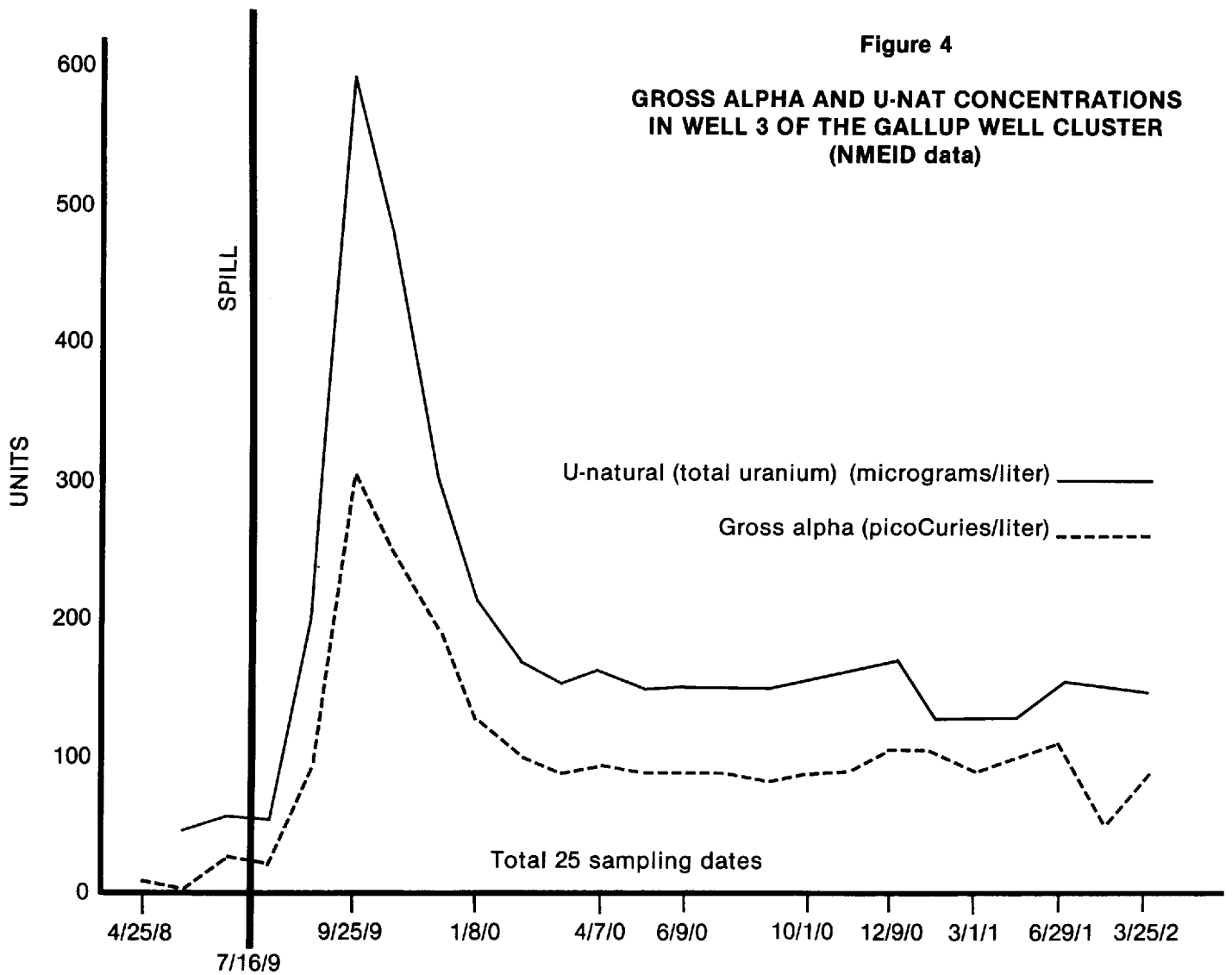
The screened interval of Well 4 is 30 to 40 feet deeper than that of Well 3 and is set in less permeable sands and clays, even though the wells are only 10 feet apart at the surface. The fact that the quality of water in Well 4

Figure 3
SULFATE CONCENTRATIONS
IN THE GALLUP WELL CLUSTER
(NMEID data)



⁶"Porosity" describes the amount of available pore space that can be filled with water in a rock formation. "Permeability" is the rate at which water moves through porous rock. Both terms describe a formation's ability to carry water.

⁷"Screened" or "screened interval" describes that part of a well which allows water to pass through the well casing. The screened interval of a groundwater monitoring well is typically 5 to 10 feet.



decreased dramatically in mid-1980 and has remained poor since then indicates that contaminants from the stream bed took six to nine months to move 30 to 40 feet through the gravelly zone of Well 3 and into the less permeable zone of Well 4.

Figure 3, a graph of sulfate concentrations in each of the four monitoring wells, shows the worsening of water quality in Wells 1, 3 and 4. The last data for each well show concentrations well above pre-spill levels. In fact, the third highest post-spill sulfate level in Well 3 was recorded in a June 29, 1981, sample and the fourth highest in a March 25, 1982, sample.

Figure 4, a graph of gross alpha activity and natural uranium concentrations in Well 3, shows that radioactivity has been elevated in Well 3 since the spill. Three pre-spill gross alpha concentrations averaged about 12 pCi/l while 21 post-spill samples averaged 112.6 pCi/l, or a tenfold increase. The highest gross alpha concentration (304 pCi/l) was recorded Sept. 25, 1979, the same date the highest post-spill sulfate level was reported. The concentrations are much higher than the average gross alpha levels of Wells 1, 2 and 4, which had not exceeded 20 pCi/l by the end of 1980, according to NMEID data.

The solid line of Figure 4 depicts concentrations of

natural uranium. Again, the data show a peak response two months after the spill and spring 1982 values three to six times greater than two samples taken prior to the spill. It should be noted that uranium is described in Figure 4 as a metal contaminant, and not as a radionuclide, and that the concentrations are expressed in ug/l (micrograms per liter).

The heavy load of radioactivity in the stream bed could be responsible for the continued elevated gross alpha values in Well 3. Certainly, the aquifer has not had time to be entirely cleansed, and Gallaher believes that some of the uranium which initially attached to clay particles and remained in a precipitate for many months is slowly being dissolved and released to groundwater. He said this would explain the consistency of recent gross alpha values elevated over pre-spill levels, although he does not discount the effects of mine water which despite pre-discharge treatment often are high in uranium.

Gallaher's theory corresponds with the Battelle findings that certain radionuclides have moved into soils several feet below the surface of the stream. *Uranium and its decay products, particularly Th-230, which has been shown to be elevated at depths beneath the surface, may be dislodging from clay particles in the subsurface soils and*

contributing to the consistency of abnormally high gross alpha activity in Well 3.

Other monitoring wells upstream from the original well cluster also have shown spill-related contamination, Gallaher said. High variation in gross alpha and TDS levels in wells 1.5 and 4 miles downstream from the confluence of the Puerco and Pipeline Arroyo "strongly suggests" lasting effects from the spill, he said. Gallaher cautioned, however, that selenium and arsenic concentrations 700 to 800 times the state standard for the two metals in these upstream monitoring wells could be the result of natural conditions. Elevated levels of Se and As are common in dry, alkaline soils, he said, adding that much of the alluvial water in the broad valley dissected by the north fork of the Rio Puerco is "naturally grungy."

Groundwater in Arizona. That monitoring wells along the Puerco east of Gallup would show response to the spill is not surprising. An EPA consultant in October 1979 identified the area as one of two regions along the course of the stream susceptible to groundwater recharge from stream flows.⁸ The other area was near Lupton and Houck, 40 to 43 miles downstream in Arizona. Not surprisingly, alluvial wells in this second area also have shown lasting spill-related contamination.

Sulfate concentrations in groundwater monitoring wells along the Puerco in Arizona remained elevated above the EPA's secondary standard through 1980. Monitoring was ended after 1980 at all but one, an unused livestock well near Lupton. Monitoring has continued at the Lupton well with sulfate concentrations ranging from 100 mg/l to nearly 1,600 mg/l. Figure 5 shows the high variability in sulfate and chloride levels in the Lupton well since the spill.

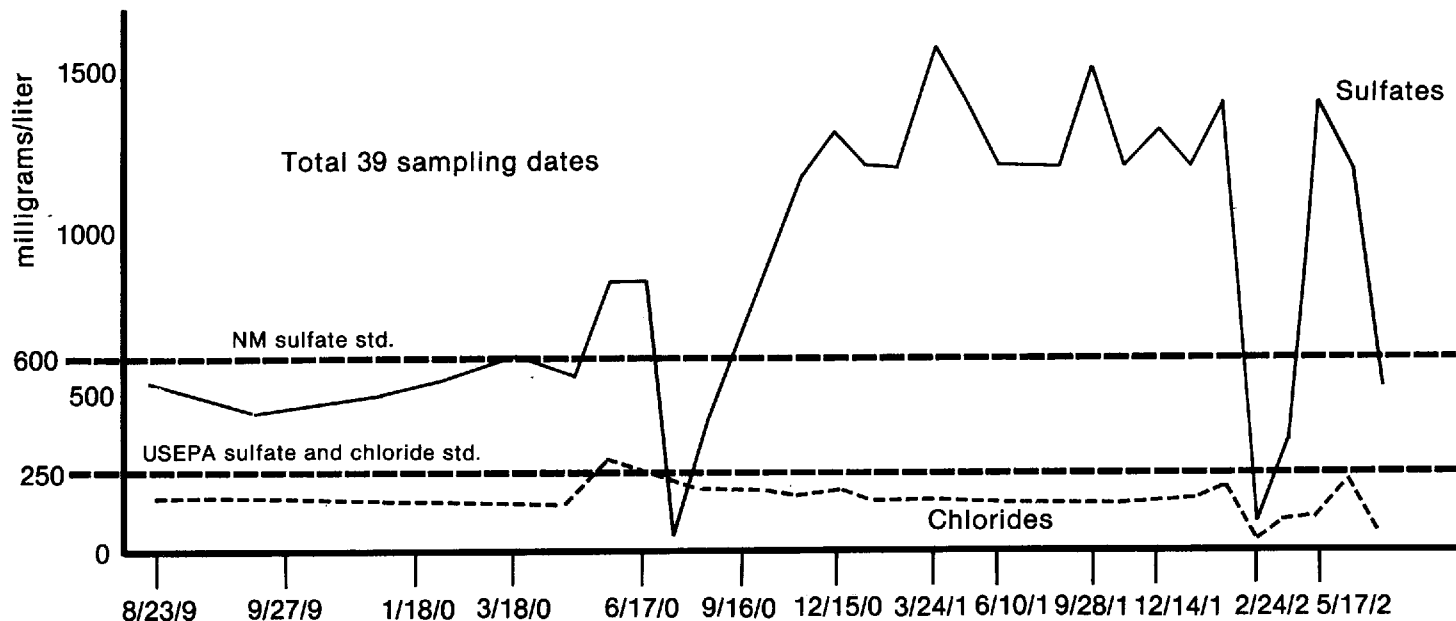
EPA said in a June 2, 1982, report on the monitoring program in the Arizona stretch of the Rio Puerco that the high sulfate concentrations in the Lupton well "possibly indicate spill contamination."⁹ Increases in sulfates and chlorides in the well may have been a result of their transport through the unsaturated zone above the water table and into the aquifer after upstream runoff percolated into the stream bed, the report said. It also noted that the chloride and sulfate concentrations were "in the correct proportion [to] the spill concentrations."

Even with this information, however, the agency's Region IX office in San Francisco may decide to terminate monitoring of the Lupton well after December. "Although we haven't decided and are awaiting results of the September sample, we'll probably drop sampling if there's no [sulfate] increase," said Laura Tom of the agency's Office of Technical and Scientific Assistance. Tom said she thought NMEID's continuing monitoring program along the Puerco in New Mexico would provide better information and that there was no need for duplication.

However, no sampling of surface or groundwater has been conducted along the Rio Puerco in Arizona outside of the Lupton well since December 1981 and NMEID has no jurisdiction to monitor groundwater outside of New Mexico. ADHS's Bureau of Water Quality Control, which aided EPA Region IX in conducting the Puerco monitoring program in Arizona, has all but wiped the program off its priority list and it is not anticipated that any new funds will be available, officials said. The lack of monitoring in Arizona raises a question of appropriate science and whether or not state and federal agencies want to find out if something remains wrong with groundwater along the Puerco in Arizona.

Figure 5

**SULFATE AND CHLORIDE CONCENTRATIONS
IN AN ALLUVIAL MONITORING WELL
LUPTON, ARIZONA**



⁸Aldis, Hussein. "United Nuclear Mine Tailings Spill Hydrologic Assessment." Ecology and Environment Inc., Cincinnati; prepared for U.S. EPA, Dallas; Oct. 9, 1979.

⁹"Rio Puerco Monitoring Program." Office of Technical and Scientific Assistance, U.S. Environmental Protection Agency, Region IX, San Francisco; June 2, 1982.

Table 5

**CHEMICAL PROPERTIES OF GROUND WATER
IN AND AROUND THE UNITED NUCLEAR
CHURCH ROCK TAILINGS IMPOUNDMENT¹**
(all units in milligrams/liter)

Parameter	Well 124	Well 304	Well 317	EPA stds ²	NMWQCC ³	NRC ⁴
Aluminum	1,600.0	0.8	2,180.0		5.0	2,000.0
Arsenic	3.65	0.08	5.2	0.05*	0.1*	0.02
Cadmium	0.17	0.03	0.11	0.01*	0.01*	0.02
Calcium	11.0	628.0	12.0			500.0
Chromium	1.0	0.03	0.94	0.05*	0.05*	
Cobalt	4.18	2.38	1.15		0.05	
Copper	2.17	0.02	2.6		1.0	50.0
Iron	2,185.0	0.19	1,417.5		1.0	1,000.0
Lead	0.09	0.06	0.13	0.05*	0.05*	7.0
Magnesium	1,030.0	1,070.0	635.0			
Manganese	115.0	42.0	60.0		0.2	500.0
Molybdenum	0.54	0.1	0.1		1.0	100.0
Nickel	3.86	0.32	1.83		0.2	
Potassium	25.0	14.0	6.8			
Selenium	0.008	0.047	0.032	0.01*	0.05*	20.0
Sodium	439.0	465.5	535.0			200.0
Vanadium	19.5	0.043	28.2			0.10
Zinc	24.05	0.159	12.8		10.0	80.0
Uranium-nat	8.15	0.09	4.97		5.0*	3,300.0
Chloride	272.3	274.7	301.9	250.0	250.0	300.0
Sulfate	19,128.9	4,100.0	15,165.3	250.0	600.0	30,000.0
TDS	31,179.2	7,538.8	31,860.0		1,000.0	35,000.0
pH	2.64	6.0	2.41		6-9	2.0

¹Data from United Nuclear Discharge Plan DP-152, Addendum 1, May 1981.

²USEPA. National Primary Drinking Water Regulations, EPA-570/9-76-003; 1976 (sulfates and chlorides are considered "secondary" standards and are not included in the "primary" regulations).

³New Mexico Water Quality Control Commission Regulations, Rev. Jan. 29, 1982.

⁴USNRC. Typical tailings solution concentrations for the "model" mill as reported in: Final Generic Environmental Impact Statement on Uranium Milling, NUREG-0706; September 1980; Table 5.3, p. 5-6.

Tailings Pond Seepage

The fact that tens of thousands of gallons of acidic tailings wastewater are leaking from United Nuclear's tailings ponds every day is not disputed — not even by the company itself. The problem is severe enough to have merited inclusion in the EPA's list of hazardous waste sites targeted for cleanup under the so-called Superfund program.

What is not agreed upon, however, is the extent and severity of the seepage problem, or a remedy for it. But a review of the data shows that *contaminants have left UNC's property and are degrading groundwater on Indian lands east of the tailings impoundment and on state lands north of the site*. Concentrations of these pollutants far exceed state groundwater standards for process chemicals and heavy metals; some monitoring wells also have detected radioactivity above the state's maximum permissible concentrations for thorium-230.

The New Mexico Water Quality Control Commission's (NMWQCC) regulations protect groundwaters of "present or reasonably foreseeable future use" and prohibit the discharge of contaminants into protected waters of the state (those of 10,000 mg/l TDS or less) beyond the numerical limits of Section 3-103, subsections A, B and C.

If discharge of contaminants beyond those limits occurs, the discharger is required to "take appropriate and necessary steps to contain and remove the damage caused by the discharge" (Section 1-203.A.2).

The water quality and geohydrologic data discussed in detail below show clearly that *United Nuclear's seepage is violating New Mexico's regulations which protect groundwater and is subject to the enforcement provisions of those regulations which require restoration of contaminated ground water*.

Chemistry of the seepage. Table 5 compares chemical parameters in three UNC groundwater monitoring wells with applicable EPA and New Mexico water quality standards and typical tailings fluid concentrations, as reported by the NRC.

The three wells are located in areas of some of the most severe groundwater contamination in and around the UNC tailings impoundment: northeast of the extreme northeast corner of the impoundment on state land (Well 124); on the eastern boundary of the impoundment abutting the Indian lands of adjacent Section 1 (Well 304); and on a cross dike separating two borrow pits in the heart of the impoundment (Well 317). The locations of these wells are noted on Figure 6, a plan view of the UNC tailings

impoundment.

The asterisks denote the health-based, or most stringent, standards of both the federal and state water quality regulations. All six of the chemical parameters in this category were equaled or exceeded in Well 124; five of the six were equaled or exceeded in Well 317, and four of the six were exceeded in Well 304 on the property boundary. The chemical values were reported in data supplied by UNC to NMEID in May 1981 and represent one-time samples taken in February and April 1981.

All three wells exceed the limits for the indicator contaminants TDS, sulfates and chlorides. The dissolved solids concentrations in Wells 124 and 317 (the screened intervals of which are approximately 70 feet deep and 200 feet deep respectively) approach the typical level in tailings solutions, suggesting quite pointedly that these and other UNC monitoring wells within the impoundment and just north of it are tapping "natural" groundwater influenced radically by tailings seepage.

The chemistry of the water also suggests that contaminants have moved vertically at least 200 feet into the underlying rock. As will be discussed in greater detail below, the gradient or "dip" of the underlying rock formations also suggests that seepage is moving horizontally toward groundwater of future use (Figures 7A and 7B).

As the data in Table 5 indicate, the seepage fluid contains large amounts of dissolved solids and sulfates and is low in pH — many monitoring wells show acidity levels between 1 and 3. A closer analysis of more recent information shows that the indicator contaminants are elevated in just about every monitoring well in or near the UNC tailings pile.

According to the company's license renewal application, which was filed with NMEID in December 1981, the average sulfate concentration in 140 monitoring wells for which data were reported was 4,548.2 mg/l, with values ranging from 140 mg/l to 24,520 mg/l. Average sulfate concentrations at or below the state standard of 600 mg/l were reported in only *eight* of the 140 wells. Only 15 of the 140 wells registered sulfate levels below 1,000 mg/l, which NMEID staff members say might be the "natural" sulfate concentration in shallow groundwater in the area of the UNC operation. (The NMWQCC regulations allow water quality standards to be set at higher levels if the "natural" or background concentration of any of the regulated contaminants is found to exceed the original standard.)

Average sulfate concentrations in 13 monitoring wells on the eastern boundary line was 4,143.7 mg/l, with levels ranging from 1,904 mg/l to 8,820 mg/l. The average concentration is about 6.2 times the standard, and the maximum concentration is about 14 times the sulfate limit.

Heavy metal contamination resulting from seepage also is evident. Data available for 43 of more than 200 monitoring wells show concentrations of arsenic, cadmium, chromium, lead, selenium and uranium in excess of applicable state health-based standards for groundwater.

UNC does not consider radioactivity to be a major constituent of the seepage, but concentrations of various radionuclides above those levels considered to be normal begin to appear in site monitoring wells in 1980 and 1981. Concentrations in excess of the Radiation Protection Regulations' Part 4 maximum permissible concentration of 2,000 pCi/l for Th-230 were evident in 10 of the 140 wells for which UNC provided data in its license renewal

application. The average thorium content of those wells was 6,428.2 pCi/l with concentrations ranging from 2,430 pCi/l to 14,058 pCi/l, according to UNC data.

None of these excessive thorium concentrations are in violation of the regulations because all 10 of the wells are within UNC's property, or "restricted area." The regulations apply only to contamination released to "unrestricted areas," which are lands, air and water outside of the properties controlled by mill operators.

However, NMEID staff members familiar with the UNC seepage problem said recent data show a Th-230 level of 40,000 pCi/l in monitoring well TWQ-124, which is the same Well 124 discussed above and is located in the unrestricted area north of the tailings pile. *Corroborating documentation was not available, but if the concentration is correct it would constitute a clear violation of the state's radiation regulations for thorium-230.*

Extent of the contaminant plume. The groundwater monitoring system describes a contaminant "plume" which appears to have spread in a northeasterly direction from the central cell and borrow pits of the tailings impoundment onto state land leased by Kerr-McGee for its mine complex a quarter-mile north of the UNC tailings pile, according to UNC and NMEID data. The same data also indicate that *a similar plume is spreading eastward onto Indian lands immediately east of the site* (Figure 6).

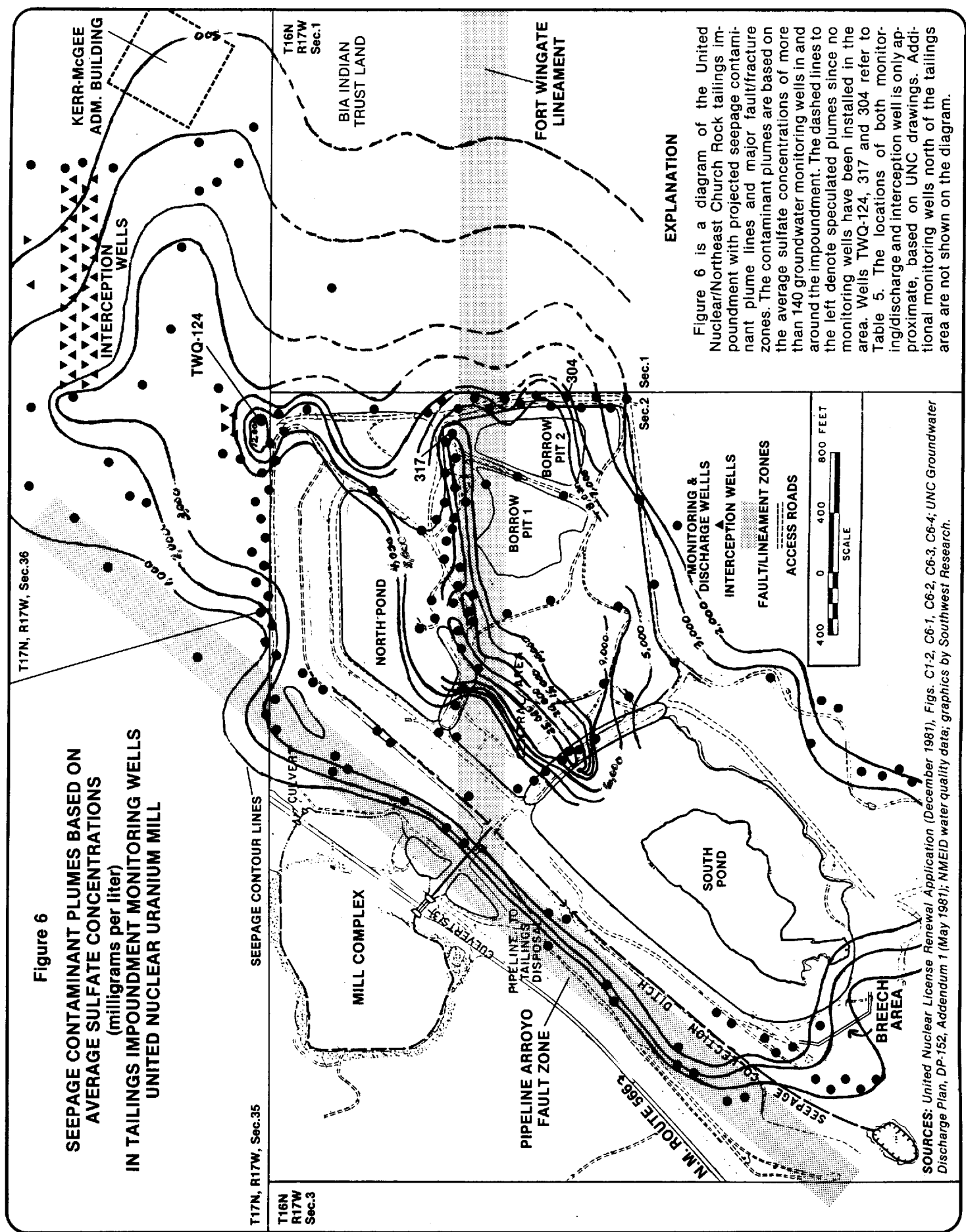
NMEID hydrologists and geochemists insist that there is little doubt that UNC's seepage has infiltrated and harmed the adjacent Indian waters. "There's definitely contamination in Section 1¹⁰ — those eastern perimeter wells show it," said Rick Raymondi of NMEID's Water Pollution Control Bureau. "It's there, and it's moving rapidly."

United Nuclear does not agree. While it acknowledges that the impoundment is leaking and that indicator contaminants have moved north, it contends that "the contaminant migration to date has not affected any groundwater users nor is it expected to in the future."

But the company has very little information to support that claim, and what data are available belie it. First, there is no information on groundwater chemistry east of the eastern property line and little information on groundwater use in neighboring Section 1. And second, what little information is available suggests that the aquifers receiving recharge of seepage fluids from the tailings impoundment are being used elsewhere in the immediate area and that the water that is being contaminated is of a natural quality that is usable at least for livestock watering.

UNC apparently has an aversion to obtaining water quality information on groundwater in Section 1. While the company has claimed in the past that it has had difficulty obtaining permission from Indian authorities to monitor groundwater east of its property, Indian officials offer another version of the story. According to Harold Tso, Navajo Environmental Protection Commission (NEPC) director, UNC has neither drilled monitoring wells in the neighboring Indian lands nor sought permis-

¹⁰UNC's mill and tailings complex is in Section 2 of Township 16 North, Range 17 West. A section is equal to 640 acres. Section 2 was purchased by UNC from the state of New Mexico in December 1968 for approximately \$30,000 — or about \$5 an acre, according to McKinley County Court records. Section 1, which is immediately east of Section 2, is federal Indian "trust" land administered by the U.S. Bureau of Indian Affairs and the Navajo Tribe. Individual Indian "allottees" possess the surface rights on these lands, while the government retains the mineral rights.



sion from the U.S. Bureau of Indian Affairs or the tribe to do so.

The company's license renewal application indicates that groundwater use in the area is minimal. The application lists only one well in Section 1. Described as a domestic and stock-watering source, the well is some 900 feet deep in the Dakota Sandstone, an aquifer several hundred feet beneath the two layers of the Upper Gallup Sandstone

which have received the brunt of seepage contamination. Tso said he thought this well was no longer used by local Navajos.

But other information in the application shows that water in the layers being affected by the seepage (Zones 3 and 1 of the Upper Gallup and the overlying Dilco Coal Member of the Cretaceous Crevasse Canyon Formation) is currently being used about two miles northwest of the mill

Figures 7A and 7B

CROSS-SECTION GEOLOGY OF THE UNITED NUCLEAR/CHURCH ROCK TAILINGS IMPOUNDMENT

Figure 7A — Stratigraphy between Wells 327 and 448

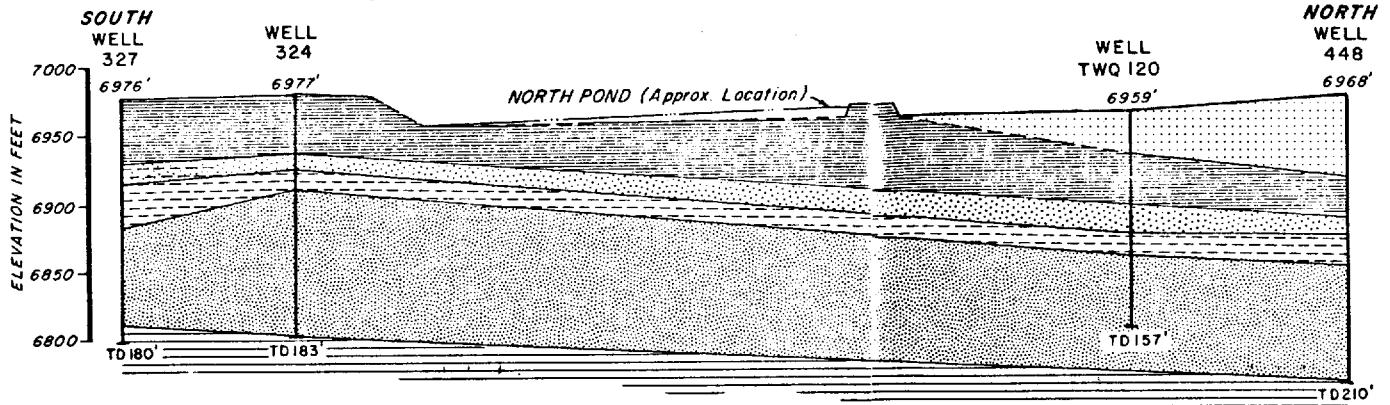
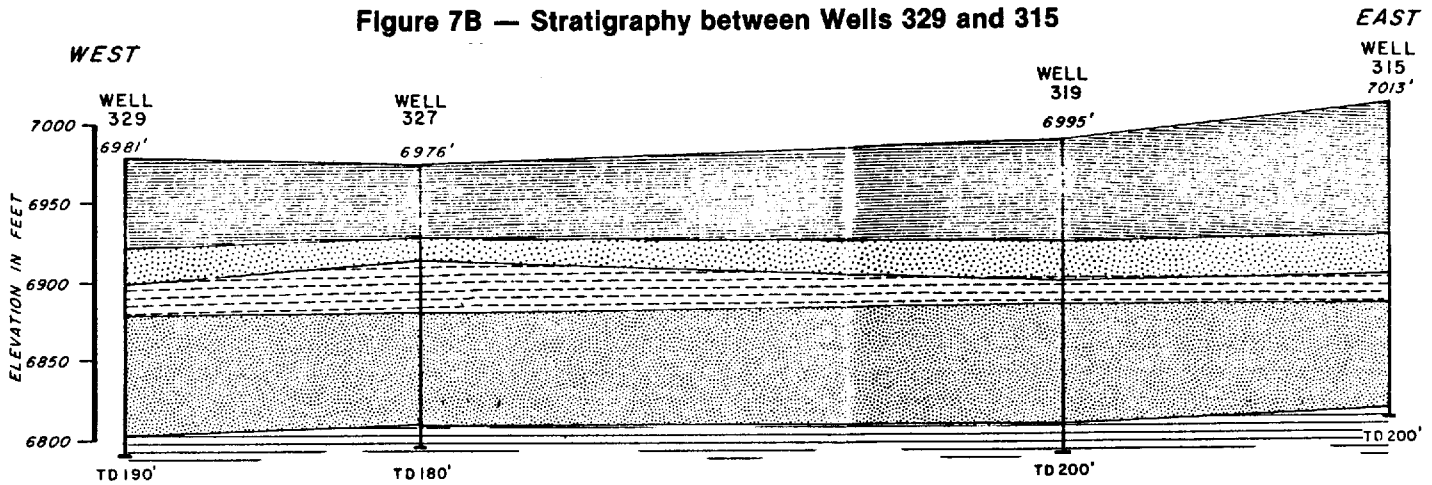


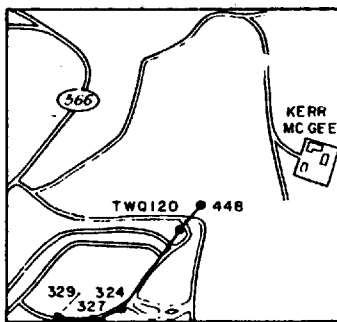
Figure 7B — Stratigraphy between Wells 329 and 315



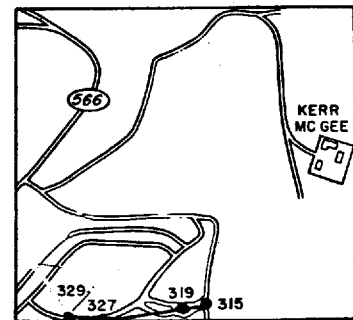
EXPLANATION

- ALLUVIUM
- CREVASSE CANYON FORMATION
DILCO COAL MEMBER
- UPPER GALLUP SANDSTONE
Coarse-grained sandstone (Zone 3)
- UPPER GALLUP SANDSTONE
Coal/Shale (Zone 2)
- UPPER GALLUP SANDSTONE
Fine-grained sandstone (Zone 1)
- UPPER D-CROSS TONGUE
OF THE MANCOS SHALE

Inset 7A



Inset 7B



SOURCES: UNC License Renewal Application, December 1981; Figs. B4-7A and B4-7B.

site within the boundaries of the Navajo Reservation. Additionally, since the "future use" of water is speculative and since surface flows in the area are limited, it seems just as likely — contrary to UNC's claims — that the local use of groundwater will *increase* as the local Indian population and its reliance on grazing and agriculture grow.

The lack of information on regional water use has not escaped NMEID. It prompted Kent Breese, the NMEID Radiation Protection Bureau officer reviewing the UNC application, to request in a March 1, 1982, letter to H. John Abbiss, UNC's vice president for environmental and safety services, that the company supply the agency with "the number of water supply wells currently within a four-mile radius of the mill site, and identify their locations and the uses of the water from those wells."

Subsurface geology. Groundwater movement is frequently influenced not only by the permeability and mineralogy of the aquifer, the chemical composition of the water, and the vertical and horizontal pressures exerted by the water as it moves through the rock, but also by the dip or slant of the formation. In the case of seepage at the Church Rock site, the fluid migration has been closely linked to both the dip of the underlying rocks and their "fracture permeability."

Figures 7A and 7B, which are taken from UNC's license renewal application, represent the subsurface geology at the tailings site. Figure 7A shows a general downward dip to the northeast on a line between monitoring Wells 327 and 448 (see inset for plan location), and Figure 7B shows a less obvious eastern gradient between Wells 329 and 315, the latter on the eastern property line.

The Dilco Coal Member comprises most of the surficial rock in the tailings impoundment. Stratigraphic columns in the license renewal application describe the Dilco as a coarse-grained sandstone with interbedded shales and coal. It grades into the coarse-grained sandstones of Zone 3 of the Upper Gallup.

Zone 3 is a highly porous rock layer ranging from 20 to 70 feet thick and is separated from Zone 1 by a thin, fractured layer of shales. Zone 1 is a thick layer (up to 120 feet deep) of fine-grained, silty sandstone and overlies the Upper D-Cross Member of the Mancos Shale.

According to UNC's groundwater monitoring data, water quality in Zone 1 is generally worse than that in Zone 3, suggesting that acidic tailings fluids have seeped through the Dilco and Zone 3 sandstones. NMEID consultants have said that this transport was influenced more by the fracturing of the shale between Zones 3 and 1 than by the porosity or fluid permeability of the shale.

NMEID and UNC acknowledge that the dip of the layers to the northeast has allowed seepage to flow in that direction. The piezometric surface (that is, the hypothetical "top" of the water table) of Zone 3 trends in an east-northeasterly direction from the central ponds and borrow pits, according to drawings in the UNC application.

But the transport mechanism which has allowed contaminants to move east onto the Indian lands is much more complex. Essentially, it involves the presence of a fracture zone which trends east from the Pipeline Arroyo through the borrow pits. This zone, called the Fort Wingate Lineament, is a regional tectonic feature named for the old Fort Wingate Army Depot 20 miles southeast of the mill site. (See Figure 6)

Jonathan Callender, an NMEID consultant and University of New Mexico geology professor, said in a July 4, 1981, letter to Raymondi that "fracturing may play a significant role [along the eastern perimeter of the impoundment], which lies on the northern extension of the Fort Wingate lineament..." Callender criticized UNC for failing to obtain "data on potential vertical fracture permeability" and said that seepage flow eastward from the eastern property line "could be a critical problem." He added that the problem was one he and NMEID had "noted previously...yet no new information on fractures" was presented in an addendum to UNC's seepage control discharge plan he was reviewing at the time.

Another consultant, Daniel Stephens, a professor of hydrogeology at New Mexico Tech at Socorro, also suggested in a series of letters to NMEID beginning in December 1980 that fracture permeability along the east-trending lineament was cause for concern. "My flow nets in the Gallup and Dilco suggest a direction of flow which is generally eastward and away from the [Pipeline] arroyo," Stephens said in a July 22, 1981, letter to Raymondi.

Raymondi says the monitoring data alone support the theory of seepage infiltration east of the eastern property line. Of the 13 eastern perimeter monitoring wells for which data are available, 11 are completed in Zone 1 of the Upper Gallup. The average sulfate concentration in these wells is more than 4,000 mg/l. Water from Zone 1 is more likely to be used in the future because the layer is thicker than any of the strata above it and because it is closer to the surface than other higher quality aquifers in the area which are encountered at depths ranging from 900 to 1,700 feet.

Raymondi, who along with NMEID geochemist Ron Conrad has been keeping track of the seepage since it was discovered in the post-spill investigation, is concerned about United Nuclear's efforts to stop the outward movement of contaminants since closing the mill May 3 for economic reasons.

Following a two-day field trip to the UNC facility in November, he noted that the company's seepage pump-back system now consists of a line of intercept wells north of the northern tailings dam and only five pumping wells in the same area. Of the five pumping wells, Raymondi said, three were producing only 1 gallon per minute (gpm) and the other two only 10 gpm at the time of his visit.

History of seepage detection. Raymondi's lament is beginning to sound like a broken record. He was expressing similar concerns two years ago when he and Conrad, in a Dec. 23, 1980, memo to then-Division Director Baca, accused UNC of a "trial and error approach to effect a plan to control seepage" and attacked the company's groundwater consultants as being at the "very beginning of the learning curve in the operation of a seepage control system."

On several occasions after UNC first proposed a groundwater pump-back system to collect seepage and return it to the tailings ponds in December 1980, consultants Callender and Stephens also questioned UNC's approach. In his July 4, 1981, letter to Raymondi, Callender said, "I sense, as I did in December, that the seepage control program is being carried out using intuition rather than knowledge of the site..."

In fact, *the potential for a large-scale seepage problem was known to NMEID and UNC in early 1976* and is one

Table 6

**CHRONOLOGY OF ACTIONS TAKEN BY NMEID
AND UNC TO CONTROL SEEPAGE
FROM CHURCH ROCK TAILINGS IMPOUNDMENT**

4/2/76	Former NMEID hydrologist John Dudley expresses concern about the potential for seepage from permeable areas in the tailings impoundment exposed during construction.		Baca's desire to close the mill pending a more detailed assessment of the seepage problem by UNC.
6/28/76	UNC official John Abbiss commits to installation of a seepage control system at any time in the future that contaminants begin reaching monitoring wells on site.		
10/31/79	NMEID Director Thomas Baca orders discharge plan to control seepage.		
1/14/80	UNC proposes seepage control system and says construction will commence 5/1/80.		
2/13/80	Tom Hill, UNC tailings manager, requests extension for filing of discharge plan to 7/31/80.		
2/27/80	Baca grants extension for completion of discharge plan to 7/31/80 provided that UNC's commitment to completing a task schedule by 3/15/80 and a seepage control plan by 5/1/80 are met.		
7/16/80	Hill requests another extension to 11/30/80.		
7/30/80	Baca says UNC must show "good cause" by 8/8/80 to be granted another extension.		
8/8/80	Baca grants extension to 11/30/80.		
10/15/80	UNC submits a discharge plan for construction of new lined evaporation ponds at the existing site.		
12/1/80	UNC submits a discharge plan for control and mitigation of seepage from its tailings impoundment.		
11/26/80 12/14/80 12/16/80	Baca confirms in three letters to UNC that an extension will be granted until 1/9/81 to allow NMEID technical staff to review the seepage control discharge plan.		
1/6/81	Gov. King calls an unscheduled public meeting to hear NMEID, UNC and others on the question of		
		1/9/81	King instructs Baca and HED Secretary George Goldstein to grant UNC a 60-day extension for completing the seepage control discharge plan and satisfying NMEID that its intentions are forthright.
		1/19/81	UNC submits to NMEID an outline of its seepage control plan in which the company's chief consultant reiterates his view that implementation and installation of a complete seepage control system will take a year to a year-and-a-half.
		3/6/81	Hill submits data from a pumping system showing that up to 20,000 gallons per day of contaminated liquids are being returned to the tailings impoundment. He also requests another extension.
		3/11/81	Baca finds there is "good cause" for ordering another extension and does so until 5/26/81. He also orders UNC to begin investigating neutralization of tailings as an alternative seepage control measure.
		5/26/81	Baca grants an indefinite extension for completion of the seepage control discharge plan and reiterates his desire that a neutralization program be studied and implemented.
		9/30/80	UNC informs NMEID it is abandoning construction of new lined evaporation ponds.
		1/1982	Neutralization of tailings begins.
		5/3/82	UNC announces it will temporarily close its Northeast Church Rock mill and tailings operation owing to continued poor market conditions for uranium.
		8/27/82	NMEID Director Russell Rhoades withdraws permission for UNC to continue to discharge tailings without an approved discharge plan and announces that a public hearing on the seepage problem will be held at some point in the future.

of the reasons why former Director Baca concluded in a May 26, 1981, letter to UNC that "the existing site is not suitable for long-term or permanent disposal of tailings."

Table 6 is a chronology of actions taken by NMEID to obtain an acceptable seepage control plan at UNC's Church Rock complex. Most of the actions were detailed in correspondence between NMEID and UNC or referenced in letters exchanged between the agency and interested members of the public, and in intragency memorandums.

As the table shows, NMEID water pollution officials first expressed concern about the potential for seepage from unlined evaporation ponds in April 1976, prior to the licensing of the facility 13 months later. Former NMEID hydrologist John Dudley, now a consultant in Santa Barbara, Calif., received a commitment from UNC's John Abbiss to install a seepage control system at any time in the future when contaminants began reaching site monitoring wells. That commitment — which came in June 1976 — was incorporated into UNC's license as a condition of

operation.

Dudley said in an interview this summer that the agency was powerless to require pond liners or other systems to prevent or mitigate seepage because the state's groundwater protection regulations were not in effect at the time UNC received its license to operate. Pat Donahoe, at the time one of only two uranium licensing officials on the NMEID staff, agreed, saying that the agency could require groundwater protection measures of licensees only if the licensees agreed in writing to meet such requirements. Donahoe said UNC was pressuring division staff to approve its new facility prior to the effective date of the new regulations. NMEID issued a radioactive materials license to UNC on May 7, 1977, and the regulations took effect later that month.

The practice of allowing construction of a uranium facility prior to the awarding of a license to its operator was permitted in the years before the adoption of the state's groundwater regulations — a practice which the NRC specifically did not allow in its licensing of uranium

operators in non-agreement states. Owing to that loophole, however, UNC was well into construction of what are now the southern and central evaporation ponds and central borrow pits in 1976 and had all but completed the main tailings dam and mill complex when licensed the following May.

These problems stood out like a sore thumb after the spill. Not only is construction during licensing now prohibited in New Mexico, but the groundwater rules (through their discharge limitation provisions) and the radiation regulations (through their design and siting criteria) virtually outlaw construction of a tailings impoundment in the middle of a flood plain — the exact location of the existing UNC pile. *Said Baca in an April 1981 interview, "The current site is probably the worst site that could ever be picked. If this were a new plan today, it certainly could not be approved."*

Seepage-control discharge plans. But despite his strong view about location of the company's tailings, Tom Baca was not so adamant when it came to correcting the seepage problem.

As Table 6 shows, the problem "officially" began in October 1979 and really has yet to be resolved. On six occasions between Oct. 31, 1979, and May 26, 1981, Baca granted United Nuclear extensions to complete an acceptable seepage control plan, and only a couple of times during that period can it be said that the company performed accordingly. Time and again the staff felt that UNC was stalling and did not deserve another extension. And time and again — often not by his own doing — did Baca grant another reprieve.

"You know, I've been there several times," he said in October 1981 when asked how many times UNC could push the agency to the brink of shutting down the company's Church Rock operations for failure to come up with an adequate plan to control seepage. "Each time they seem to act in good faith," he said, "they end up letting you down."

Acting on the recommendation of his staff (predominantly Conrad and Raymondi), Baca decided in December 1980 to order UNC to cease operations pending submittal of a more detailed seepage control plan. However, before issuing the order himself, he sought ad-

vice from his boss, Health and Environment Department Secretary Dr. George Goldstein. From there, it was a short jog to the governor's office where Bruce King three weeks later decided it was in the best "interests" of all concerned to grant the firm another extension. King's decision came after he held an unscheduled "public hearing" in his office at which UNC's attorney accused Raymondi and Conrad of "slandering" his client's consultants. Paul Robinson, environmental analyst at Southwest Research and Information Center (SRIC) in Albuquerque, attended the meeting and said of King's action, "He was left with little choice but to grant an extension — if only to appear reasonable."

The extension to March 11, 1981, was lengthened again to May 26 after both Baca and his staff agreed that the Division should permit UNC to continue obtaining data from its newly installed pump-back system, which consisted of a series of intercept wells north of the tailings impoundment. The theory was that pumping water from the contaminated aquifers would halt the further movement northward of the contaminant front.

"The extensions sound terrible, but in light of the situation, I don't think they are," Baca said that April. "The approach is now reasonable; they are sinking a series of wells that are going to intercept the most northern plume, stop it, and control the seepage. If May 26 comes and it's shown that the system doesn't work, we're going to have the operation ceased and have [UNC] devote all [its] efforts to stopping it."

While Raymondi had concurred in his boss's decision to grant UNC another extension, he was not convinced the system would work. "The doubt comes with the geologic and hydrologic nature of the system," he said at the time. "It's been difficult to get really effective pumping wells that could control the contamination. In other words, I have a little bit of doubt because it didn't work in the central area and might not work out north."

As it turned out, the system worked, but not completely. According to UNC's data, some 40,000 gallons per day of water of a pH between 1 and 3 were being returned to the tailings ponds in the spring of 1981. While the northward movement of the contaminant front appeared to be slowed, the seepage was not being stopped. Nevertheless, Baca granted UNC's sixth extension on May 26, 1981, this time for an indefinite period of time — a discretion given the Division director by the NMWQCC regulations.

United Nuclear had operated since the tailings spill without an approved discharge plan — a situation that the regulations were not *supposed* to permit — and continued operating in that manner until May 3, 1982, when economic conditions, not regulatory orders, forced the company to close its only U.S. uranium processing facility. Not until this past Aug. 27, however, did NMEID's new director, Russell Rhoades, withdraw permission "for UNC to discharge without an approved discharge plan."

In a letter to Tom Hill, UNC's manager of tailings operations, Rhoades said the action was taken "because UNC has failed to demonstrate that contamination will be contained on its property; has failed to adequately define the extent of contamination despite repeated EID requests for this information; and has failed to make adequate progress toward proposing specific measures and time frames for the ultimate solution of the groundwater contamination problem..." The prohibition, Rhoades said, was



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UNC/Northeast Church Rock mill complex.

limited to discharge of newly generated tailings and not to "efforts to prevent further movement of groundwater contamination off property and to reclaim the aquifer..." He added, "UNC remains responsible for the cleanup of contamination of the aquifer resulting from the company's activities at this site."

It should be noted at this point that Rhoades's letter, which was approved by Maxine Goad, head of the Division's Water Pollution Control Bureau, came just three weeks after SRIC forwarded to NMEID for comment and action a research report on unresolved issues relating to the tailings spill and continued operation of the United Nuclear facility.¹¹ The report discussed the seepage problem at length and recommended that "NMEID should not permit UNC to discharge tailings slurries into [the] tailings impoundment until a viable seepage control plan is approved by the agency. This requirement should become effective in the event UNC decides to reopen its mill in the near future."

Now that NMEID has taken the official step — albeit, with a little prodding — of prohibiting discharges until the seepage is cleaned up, UNC could not restart its mill even if the uranium market were to improve. UNC's aggressive corporate diversification program suggests that market improvements will have little bearing on any future decision by the firm to pull out of its Church Rock operation. That decision may already have been made, leaving the timing of abandonment of the site the only remaining question. What action, then, should NMEID take to ensure that the company does not leave Church Rock without, so to speak, taking out its garbage?

Regulatory Actions

NMEID has the regulatory authority to pursue a comprehensive administrative approach that requires United Nuclear to clean up its Church Rock tailings operation even if the company does not "officially" decide to abandon the site and opts to continue maintaining the facility in its current "temporary shutdown" mode. In fact, NMEID can adopt what amounts to a "schedule of compliance" to bring the facility into conformance with applicable regulations as a condition of granting a renewed radioactive materials license or as an order appended to UNC's current, but "expired" license.

An enforcement scenario which exhausts all administrative remedies will put the state in a better legal position in the event UNC fails to comply with Division orders. Going to court to resolve a problem that the state's regulations were supposed to deal with effectively will serve only to alienate the state's uranium operators (who have shown themselves to be a formidable lobby in New Mexico political affairs) and make the agency's performance that much more difficult in future cases similar to the present UNC situation. A lawsuit to settle the United Nuclear matter can be resorted to only after all administrative remedies have been exhausted.

The goals of such an approach to enforcement would be (1) to return groundwater harmed by discharge of contaminants from the UNC tailings ponds to its original con-

¹¹Shuey, Chris and Lynda S. Taylor. "Unresolved Issues and Recommendations for Resolution Concerning the Church Rock, New Mexico Uranium Tailings Dam Failure of July 16, 1979." Southwest Research and Information Center, Albuquerque August 1982.

SRIC Report Available

A report on unresolved issues three years after the United Nuclear/Church Rock uranium tailings spill is now available from Southwest Research and Information Center.

The August 1982 report, by SRIC staff members Chris Shuey and Lynda Taylor, reviews the most recent information on long-term contamination of the Rio Puerco wash resulting from the tailings spill, continued seepage from the UNC tailings ponds, the need for birth and cancer registries to monitor the health of individuals exposed to spill contaminants, and the need for expanded animal monitoring to determine doses to people who are eating animals exposed to contaminants from the spill and upstream mine dewatering.

The 45-page report with references and appendices can be purchased for \$5 by sending a check or money order to Southwest Research and Information Center, P.O. Box 4524, Albuquerque, N.M., 87106.

For an additional \$5, interested persons may obtain the report and all subsequent correspondence between SRIC and the New Mexico Environmental Improvement Division. The correspondence outlines what SRIC considers to be the appropriate regulatory approach for correcting the groundwater contamination problem at the UNC tailings impoundment.

All costs include postage.

dition (to the extent possible), (2) to eliminate the potential for further seepage of acidic wastewater by removing the several million tons of hazardous wastes from the existing, unsuitable tailings site, and (3) to conduct these cleanup activities at no cost to the state and its taxpayers.

The approach implies that the state will be required to invoke the surety provisions of its radiation protection regulations and all applicable rules of its groundwater regulations. A review of these regulations and how they came about will aid in understanding how an administrative approach to enforcement can be used successfully.

Use of surety arrangements. Division Director Rhoades said in a Nov. 16 letter to SRIC that UNC has submitted a self-insurance plan to pay for ultimate reclamation of the Church Rock site in accordance with the "surety" requirements of Part 3-315 of the state's radiation protection regulations and the long-term disposal objectives of the federal Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978.

The surety provisions of the regulations require all existing licensees, including United Nuclear, to have submitted to NMEID "an acceptable surety arrangement" equal to \$25,000 per acre of uranium tailings. An acceptable arrangement includes a variety of bonding and insurance scenarios, including self-insurance. Part 3-315.E.1-9 of the regulations sets out the requirements needed to qualify for self-insurance, including the provision that a "licensee's current assets exceed current liabilities by at least two and one-half times the amount of financial assurances determined to be necessary to meet the stabilization re-

quirements of these regulations.”

Rhoades said Anaconda was the only one of five licensed and active uranium processors in New Mexico to have posted a bond to cover reclamation; the others, including UNC, had submitted self-insurance plans. Whether United Nuclear qualifies for self-insurance, however, is a difficult question. UNC Resources's first quarter 1982 financial report listed a current assets to current liabilities ratio of 2.34 to 1 through Dec. 31, 1981. (UNC Resources is the parent company of United Nuclear Mining and Milling which operates the Church Rock facility.) The ratio is less than required by the regulations, but nonetheless fairly close.

NMEID's regulations-setting panel, the Environmental Improvement Board (EIB), opted to allow self-insurance by uranium companies when amending its regulations in mid-1981 to comply with the requirements of UMTRCA. The legislation required states which were delegated authority by the NRC under the Atomic Energy Act of 1954 to regulate "byproduct material" (the legal term for tailings) to upgrade their regulatory programs by November 1981. Whereas NRC specifically denied self-insurance to its licensees, New Mexico chose to allow such surety arrangements because, according to EIB, self-insurance is more practicable for New Mexico conditions.

NRC has not approved New Mexico's amended radiation protection program because of disagreements such as this. But, NRC really has no authority to revoke an "agreement state's" program for failure to comply with federal mill licensing requirements because of late-1981 congressional action which prohibited NRC from implementing or enforcing those rules. As such, New Mexico must live with its surety provisions, making their application to UNC's situation a major test of their effectiveness and the first test of agreement-state surety requirements in the nation.

The regulations provide for the use of a licensee's surety arrangements to pay for the cost of site reclamation at the time of "inactivation" of the site. As noted above, UNC has not officially announced an intention to abandon or "inactivate" its Church Rock facility, but all indications are that it will. (See accompanying article.) Regardless of UNC's intent, however, the surety provisions allow for use of surety funds to pay for phased reclamation during the course of operations. Groundwater restoration and some interim site cleanup activities clearly constitute "reclamation," or at least parts of a phased reclamation program.

Other regulatory requirements. Part 3-300.I of the radiation regulations requires licensees to comply with "all laws and regulations enforceable by the Division including the regulations of the New Mexico Water Quality Control Commission." Various provisions in Part 4 of the regulations prohibit release of radionuclides outside a licensee's "restricted area," which generally is the land it occupies for the milling of uranium ore and the disposal of the associated wastes.

Sec. 3-101 of the Water Quality Control Commission's groundwater regulations protects all groundwater in New Mexico of a chemical quality not exceeding 10,000 mg/l total dissolved solids. Sec. 3-103 sets standards for groundwater which cannot be exceeded by discharges. Where discharges into waters of "present or future use" (Sec. 3-109.C.2) exceed those standards, the discharger is required to "take appropriate and necessary steps to contain

and remove or mitigate the damage caused..." by those discharges (Sec. 1-203.A.2).

The Division has the discretion to allow discharge of contaminants exceeding the standards provided the discharger has been granted an approved "assurance of discontinuance or schedule of compliance" by the Division or the Commission (Sec. 1-203.B.2). Such a schedule is not now in place for United Nuclear at Church Rock.

Scenario of enforcement. It is within the context of this latter requirement that NMEID can act to require UNC to restore groundwater and clean up its tailings. The Division director, or the Commission, can order the company to conform to a schedule of compliance whereby technical remedies can be used to meet the requirements of an order.

NMEID should list all violations which have occurred as a result of UNC's operations and cite the regulations that have been violated. The duration and severity of each violation should be spelled out clearly. Violations upon which NMEID could base its enforcement action and for which the technical evidence is substantial include:

- Seepage of acidic tailings fluids from the impoundment has infiltrated waters of future use outside the company's restricted area;
- The concentrations of these contaminants exceed the numerical standards of the state's groundwater rules;
- The thorium-230 concentration in at least one monitoring well outside the company's restricted area exceeds the maximum permissible concentration limit of Part 4 of the radiation regulations;
- These violations have persisted at least since October 1979, and efforts to correct them have not been fruitful. In some cases, remedial actions taken by UNC to control seepage have not, in the opinion of the Division's technical staff, been commensurate with the severity of the contamination.

NMEID also can cite United Nuclear's recent performance as further justification for requiring a comprehensive schedule of compliance. UNC had not responded by the first of November to the Division's initial set of comments and questions relating to its license renewal application. Those comments and questions were contained in the March 1 letter from NMEID's Kent Breese to UNC's John Abbiss. This behavior suggests that the company is not actively pursuing Division approval of the application and builds on a pattern of past noncompliance and violation.

The schedule should clearly set out what the Division considers the appropriate methods for bringing the Church Rock operation into compliance with applicable water and radiation protection regulations. It would continue a process initiated, but not completed, in late 1979 when NMEID required UNC to submit a "task schedule" which analyzed relocation of the tailings, tailings neutralization and seepage control. Should UNC fail to comply with provisions of the schedule, NMEID or the EIB could at that point seek a court order requiring compliance.

Groundwater restoration. NMEID's Rick Raymondi is not optimistic about the success of a groundwater restoration program at the UNC facility. Returning contaminated groundwater to its original condition may be virtually impossible, he said. "I don't think you'll ever see a total restoration of water out there because the rock has been destroyed."

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UNC Officials Speak Out

The following interview with Thomas Bailey, president of United Nuclear Mining and Milling, and Tom Hill, manager of tailings operations for UNC's Church Rock operation, was conducted by Mine Talk managing editor Chris Shuey on April 23, 1981. It is one of the last interviews given by top UNC executives who in recent months have declined to publicly discuss the tailings spill because of pending litigation.

Bailey was named president of the UNC Resources Inc. mining unit in early 1980, succeeding most of the top officials of the company's Church Rock facility who were in charge at the time of the July 16, 1979, dam failure. In the interview, Bailey and Hill refrain from speaking about the causes of the breach, but discuss in some detail the continuing seepage problem and the firm's efforts to deal with it. Here are excerpts:

Construction of the tailings impoundment began before the license was issued, and one of the major changes resulting from the spill was that that is no longer allowed.

Bailey: I think that is true. It used to be perfectly acceptable to begin construction before actual licensing approval with a tacit understanding between the regulatory people and the company that the site was acceptable. Now that is not possible anymore; all licenses have to be in place prior to sticking the shovel in the ground.

Actually, you're talking about something that [occurred] prior to 1976 [when] none of the scientific brains or the environmental brains of this country really thought there was anything seriously wrong with uranium mill tailings.

As I understand it, several consulting firms looked into the conditions of the site geologically and questioned whether it was adequate for a tailings impoundment, and that this was about 1976. What knowledge did the company have of the poor site conditions and why wasn't action taken to find another more suitable site?

Bailey: I believe that the company, operating under the rules and regulations of that time, felt that this was an acceptable site. I have never seen or read any of these reports of consulting people that said it wasn't a suitable site. There wasn't a lot of land available to us. This was the best site we could find. I would suppose that under existing regulation and the attitudes of the people, both scientific people and the public, about uranium tailings, that starting again, we probably wouldn't be at this site.

But there were questions by the Kaiser [Engineering] people and SHB [Sergent, Hauskins & Beckwith, an Albuquerque geotechnical consulting firm and UNC contractor] about the geologic disharmony at the southern end of the tailings area where the dam eventually broke. There was a concern that there would be a need to raise the height of the dam to counter what would eventually become a settling problem, and according to your conclusions, the conclusions of EID [New Mexico Environmental Improvement Division] and the State Engineer, the major cause of the accident was the settling of one part of the dam over the alluvium and the other part over the bedrock.

Bailey: You know, I don't think it's proper of me or any of us, frankly, with ongoing insurance claims and one thing or another, to speculate on what caused that dam to break. I don't know what caused the dam to fail, and I'm not sure anyone knows for sure what caused it to fail -- it certainly is a matter of debate. It's a matter of debate between we and our insurance companies and it's a matter of debate between us and the regulatory people.

My job was to get the mill running and to protect the environment, and that's what I've undertaken to do and I didn't worry about anything else. This is what I was dealt, so let's play the cards and not worry about what caused it. I can't speak from knowledge and I'm not going to speculate.

In regard to the breach, you should read what the Nuclear Regulatory Commission said. Now I told you I didn't want to talk about the causes of the spill, but I firmly believe that

nobody was harmed by it. The only danger anybody would have had was if they were in the bottom of the wash when the damn thing broke -- and then they'd probably have drowned. The Nuclear Regulatory Commission said the danger to the livestock was for about 24 hours, and if they'd drank any of the water, it was so acidic it'd have burned their tongues. In the first place, the animals are smarter than that, and they'll stick their tongue in once and that'd be the end of it.

So you think the regulatory and public outcry has been too stringent toward UNC?

Bailey: It was an overreaction. You know, we had the Three Mile Island incident, then this thing happened, people were worrying about old buildings made out of uranium mill tailings, and so everybody overreacted, including us probably. We sure as hell didn't want to hurt anybody and wanted to be responsible and do the best job we knew how to do.

I can remember when I first came here we had heavy equipment operating in that arroyo to the tune of 100,000 bucks a month scraping [two inches of dirt] off the bottom of that damn thing trying to decide if we had it clean or didn't have it clean, and there was no way of measuring whether we did. Nobody knew what it was before, what background is, so nobody can tell us what clean is. So we wasted some money, and I don't think we accomplished anything for anybody.

It's common for people to say that United Nuclear damaged the local people and didn't make any effort to help them. But we have been hauling water and are continuing to haul water to anybody that asks us and anybody who said they were from the local chapters. We went to them and said, "Hey, who needs water and who was affected by this thing?" We were hauling clear to the Arizona border, and we know for a fact from the native people themselves that there were only two families that ever used water out of the wash, and we're hauling to 15 or so families over there.

I'm not going to make a big issue out of it. I think that those people were damaged, but they were damaged by the regulatory people and the press. No doubt they have genuine concerns, but nobody's got to them and said, "Hey, it's all right" or "It's not all right."

Well, it seems that they've gotten a lot of both.

Bailey: Well, who they supposed to believe? Anyway, we have resolutions from the local chapter house that say we've been good neighbors. The local people, the people closest to us here, they've said, "You're good neighbors, you tried to help us. United Nuclear's been good neighbors and they've tried to help when we needed it."

So you still don't want to talk about the causes or consequences of the accident?

Bailey: I just think it's improper for us to discuss those things. If you want to get into what we're doing now and what we're trying to accomplish here, that's fine.

Okay, then how about the seepage problem? The original seepage control discharge plan advocated a method of controlling the seepage basically by drilling capture wells in an arc around the central tailings area. EID was not very enthused about that plan, and in fact, several memos had some very strong language that the plan was not adequate from an engineering standpoint.

Bailey: At the time we put those wells around the central cell we really thought that was what they [EID] wanted us to do, and we mentioned before we started it that it wasn't the best plan or the ultimate plan to control the seepage and to remove whatever contamination there was that may have occurred. The attitude [in late 1980] was that you will do this and you will do it in a hurry and you will prove that it works, even though our own engineers did not feel it was the best plan. Everything was done in such a time crunch, and it was the best we could do in the time that was allowed.

There's one fault which follows the road bounding the west side of the site and then another, the Fort Wingate Lineament, that intersects the [Pipeline Canyon Arroyo] in the central cell area. Given that system — and I note that there is some disagreement between the hydrologists and geologists on the nature of the fracturing under the site — do you think that what you're doing now [April 1981] is going to be able to collect the seepage and return it to the site?

Hill: The history of the place suggests that the fault [lies] along the arroyo.

Bailey: There's a lineament, but you can't find displacement along it. You drill on either side of the road and try to pick the tops of the formations and

you can't see displacement. The Kerr-McGee mines are connected underground in the Westwater formation, and you can't find that fault. You can walk through those drifts, as our geologists have, and you can't find it. It's a crack, but you can't find any displacement.

Hill: It's characterized as a fracture now.

Are you confident that the seepage control plan that's underway is going to work?

Hill: It's working now.

Bailey: And we can demonstrate that. We can pump one hole and see a draw down in the monitoring wells near it. And we can pump them. Since they're affecting each other, you must have it under control. Where the hell is it going to go?

Before the mill was cranked up, we drilled these holes [north of the tailings impoundment]. We have never found contamination in these monitoring holes to date. When we [later] found some contamination, they [EID] told us to submit a discharge plan. That was in November [1979]. Winter conditions did not allow us to get those holes dug, to get the drillers in, in the places where [EID] had determined they should be placed. We later drilled holes all over the tailings area and we did find some contamination, but we still didn't see anything in the monitoring holes to the north. We drilled all over the tailings area and found contamination, but we sure as hell didn't find it in the monitoring holes out north. That's a coincidence. Somewhere or another the monitoring holes missed the flow.

There was no preparation or compaction in the bottom of this thing [the north pond, which originally was thought to be the cause of seepage], nobody thought it was necessary. We'd have these monitoring holes, and as soon as they showed any contamination we'd start doing something to control it. Never did show up so we never did anything about it.

The Upper Gallup outcrops in about the middle of the tailings area. This is where we first started putting water and solid tailings, and I would suspect that whatever contamination occurred did so rapidly, maybe in the first year or 18 months that the mill was operating, until such time as the slimes from the tailings formed a layer that pretty well sealed it off. Now, that stuff is just damn near impervious.

So when that slimed over, the bulk

of the seepage stopped. Then we went to the borrow pits, the ones we're using now. Originally, the No. 1 borrow pit didn't have any shale lining in it and no one was very concerned about it, and we were allowed to start operating, after the breach. It probably leaked in its early days, again, until it pretty well slimed over. Now it's completely full of slimes so in all probability there's very little seepage coming out of that thing now.

You're basically saying that the slimes that have built up in there are going to prevent the pits from leaking again?

Bailey: No. 2 borrow pit has a compacted lining of shale in it. As much as we'd like it to keep from happening, the slimes of No. 1 are encroaching on No. 2, so that is adding further to the shale cover in making it basically impervious. Now what will happen is we'll pump that stuff back to the No. 1 borrow pit and whatever leaks will leak and the rest will evaporate.

And the wells will be maintained so whatever leaks out again will be captured and returned?

Bailey: Yes. The proof in the pudding is that if we have proven connection and we're pumping and it shows contamination to begin with, after a certain period of time it won't show contamination. Preliminarily, that water we're pumping back doesn't look all that bad.

What are some of the figures on the chemical and radiological constituents of that water?

Hill: Well, radiologically it hasn't migrated too far. It's not going very far, even to the fence line. As Tom was saying, we're not even sure we've got contamination.

Bailey: We're finding different kinds of concentrations of heavy metals than you'd ordinarily see in the tailings themselves. I tend to think a lot of it's probably coming from these coal seams here in this upper formation.

The radiological stuff would tend to attach to clay particles and doesn't move as fast. Do you think there is a potential over the years for the radiological materials to begin moving off site?

Bailey: Of all the samples we've taken north of the property, there was only one hole that we have ever found where the radiological standards were exceeded. So when people say there are

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Is United Nuclear Getting Out of the Uranium Business?

Is UNC Resources Inc. of Falls Church, Va. — the parent company of United Nuclear Mining and Milling of Church Rock, N.M. — getting out of the uranium business?

If UNC's recent corporate behavior is any indication, the answer is yes. And if the pullout occurs, it will mark the further decline of what once was one of the top U.S. uranium producers. It might also spell trouble for state agencies concerned that the company may abandon its Church Rock mill and tailings site, leaving New Mexicans an environmental headache to cure with tax dollars.

In recent years and months, UNC Resources has diversified its activities to include the manufacture of defense products and machine tools and the operation of businesses in support of the oil and gas industry in an effort to maintain high revenues even with the currently weak uranium market.

During 1982, UNC acquired several diverse companies, including Swiftships, Inc., a builder of aluminum and steel marine vessels, National Automatic Tool Co. (NATCO), a machine tool manufacturer, and Falcon Pump and Supply Co., a distributor of industrial pumps principally to the oil and gas industry. These businesses added to UNC's already strong position as a manufacturer of fuel rods and reactor cores for the U.S. Navy's nuclear submarine program.

Keith Cunningham, president and chief executive officer of UNC Resources, said earlier this year that the company's diversification program is being accelerated because of the continuing weakness of the uranium market. Former Chairman of the Board, James Bancroft, said the market problems have put the firm's uranium operations "in a painful transition."

At the end of the second quarter of this year UNC reported a net loss of \$6.4 million; that compares with a net loss of \$734,000 in the same quarter of 1981. Commenting on the figures, Cunningham said, "Most of the quarter's loss is attributable to approximately \$7.5 million of expenses incurred in placing our uranium mining and milling facilities in a standby condition." According to the Aug. 30 edition of *NuclearFuel*, UNC

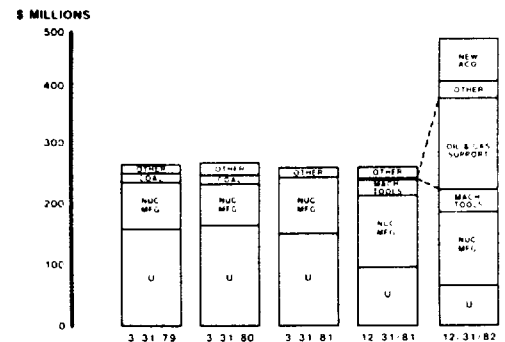
lost \$6 million from the Church Rock tailings spill alone.

Because the uranium market continues to weaken, UNC discontinued uranium production at the beginning of May and began to place its remaining uranium operations on standby. UNC's exploration and development program is being directed increasingly toward precious metals and oil and gas, the company says.

These moves should further reduce uranium's share of the company's operating revenues, which have been declining since March 1980. According to UNC's first quarter 1982 financial report, the company's nuclear manufacturing division outgained its uranium operations for the first time in four years in 1981. And projections for 1982 show that uranium production will bring in less cash than either the nuclear manufacturing or oil and gas support sectors. (See accompanying graphic.)

But even though uranium may provide only about 15 to 20 percent of revenues for 1982 (all through spot market purchases, according to Cunningham and the firm's financial report), the company officially is not giving up on uranium. UNC officials say that uranium prices eventually will recover and return to at least their

OPERATING REVENUES BY SOURCE



UNC 1st Quarter 1982 Financial Report

previous high, about \$60 per pound in current dollars (about \$45 in 1979 dollars). Any substantial recovery is expected to take three to five years, they say.

In the meantime, UNC is conducting mineral exploration and development of low-cost, high-grade ores in Australia in a joint venture with North Kalguri Mines Ltd. of Australia. UNC's subsidiary, Teton Australia, has a 25.5-percent interest in a uranium prospect in South Australia, as well as other joint venture interests in uranium prospects on the continent. The company also is active in uranium exploration in Paraguay.

But despite the company's optimistic view of the market, indications are that uranium will hold but a small position in the company's overall corporate picture until well into the future. UNC's aggressive diversification program and de-emphasis on domestic uranium production — including the 1981 sale of its 70-percent share in the Homestake Mining Co. mill and four associated uranium mines near Milan, N.M. — indicate that the decision to temporarily halt production at its Church Rock facilities in May was part of a calculated and planned phase-out of uranium operations, at least those in the U.S.

Lynda Taylor

Radiation Doses from Tailings Spill May Have Been Underestimated

Radiation doses to residents of Church Rock, N.M., resulting from exposure to radioactivity released in the United Nuclear Corp. (UNC) uranium tailings spill may have been underestimated due to major shortcomings in the only assessment of potential health risks conducted since the accident three years ago.

The federal Centers for Disease Control's (CDC) health assessment study* failed to calculate doses to Church Rock residents from all possible sources of exposure and used radiation risk models which did not take into account the type of radiation released during the spill or differences in sensitivity to radiation among various members of the local population.

*Ruttenber, A. James; Kathleen Kreiss, et al. "Radiological Assessment After Uranium Mill Tailings Spill, Church Rock, New Mexico." Centers for Disease Control, U.S. Public Health Service (EPI-79-84-2); Dec. 24, 1980.



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Despite finding that predicted radiation doses to Church Rock residents who ate contaminated meat were "higher than normal," the CDC concluded that no significant health threat was posed by exposure to spill-related radioactivity or radiation from continuous dewatering of underground uranium mines in the Church Rock district. And even though it recognized the limitations inherent in current radiation risk models and that key environmental monitoring data were incomplete and lacking, CDC insisted that the establishment of health registries to monitor the Church Rock community would not produce reliable indications of adverse impacts to the health of area residents.

This article will discuss the shortcomings in the agency's health assessment in more detail and point out why there is a need for an expanded survey of area livestock to determine average radionuclide concentrations in edible tissues and to evaluate the possible causes of animal birth defects observed in the Church Rock area since the spill. This report also will explain how conducting epidemiological studies in small populations is possible and why such studies of the Church Rock population are necessary, and discuss the need for a 30-year, independent follow-up health study of six Navajos believed to have been directly exposed to radioactive spill materials.

Using the Church Rock situation as an example, a companion article describes how various "loopholes" in current radiation regulations and regulatory frameworks allow populations in or near uranium producing areas greater exposure to routine releases of radiation than populations living near other nuclear facilities such as nuclear power plants.

Shortcomings in the CDC Health Assessment

Two pathways of potential radiation exposure to the Church Rock population were analyzed by the CDC: inhalation of thorium-230 (the isotope of the highest concentration found in the Rio Puerco wash) and ingestion of animal meat containing elevated concentrations of various uranium decay chain radionuclides. In both cases, the CDC noted that although calculations of inhalation and ingestion rates resulted in "higher than normal" radiation doses to maximally exposed members of the local population, these doses did not individually exceed state or federal regulatory standards or guidelines. However, had the CDC calculated the *combined* effects of many different radioactive elements from several pathways and derived assessments geared to the more sensitive members of the population, the health risks may have been much greater than acknowledged.

Inhalation Pathway. Calculations of doses from exposure to contaminated dust particles were based on air monitoring samples taken downstream in Gallup, about 10 miles from the affected Church Rock community, according to the CDC report. Since thorium was the major element identified as a respirable health hazard, dose calculations were made for thorium only. The CDC said the doses represented a small health hazard and were within regulatory limits. However, no dose assessment was conducted for the *collective* hazard of exposure to other respirable radioactive elements such as radon gas and its daughter products.

That the CDC may have underestimated the risk from exposure to thorium-230 only was underscored by a 1981

Opposite: Sheep tracks in the Rio Puerco one day after the United Nuclear uranium mill tailings spill.

Lynda Taylor is coordinator of the Radiation and Health Project at Southwest Research and Information Center.

Nuclear Regulatory Commission (NRC) study* which reported radionuclide concentrations in about 1,200 stream bed sediment samples. Many of these samples exceeded New Mexico state river cleanup standards, indicating the continued presence of "hot spots" of thorium in the Rio Puerco. Should mine dewatering, which constitutes all non-runoff flows in the stream, cease in the near future, the flow of the Rio Puerco during the summer months will stop, allowing the hot spots to dry up, thereby presenting a concentrated inhalation pathway for thorium and any other lingering radionuclides. The CDC recommended that Church Rock residents stay away from the banks of the Rio Puerco during "dry dusty days" (which constitute a very large percentage of the days in arid New Mexico), but did not address the need for UNC to continue and complete its state-ordered cleanup of radioactive materials left in the Puerco by the spill.

Ingestion Pathway. The ingestion of meat from livestock that water in the Rio Puerco was identified by the CDC as the major route of radiation exposure to Church Rock residents. Tissue samples from eight local livestock were analyzed for radionuclide concentrations, and the resulting doses to local residents were calculated based on an individual consumption rate of 78 kg/yr (kilograms per year) of meat from maximally exposed animals. The CDC concluded that although radionuclide concentrations were higher in Church Rock animals than in a control group of livestock, the levels were within current state and federal standards. The CDC also noted that the elevated radionuclide concentrations in local livestock tissue could have resulted from chronic exposure to uranium mine dewatering activities as well as the spill.

The CDC recommended that Church Rock residents not allow their livestock to drink water from the Rio Puerco, a suggestion designed to reduce the radiation dose to those eventually consuming the meat or milk of an area animal. However, the Puerco has been an important, long-standing source of water for local Navajo livestock. Since few alternative livestock watering sources have been made available to Church Rock residents or other downstream Navajos, the likelihood that the recommendation will be carried out is remote.

General Shortcomings. The CDC said that any health assessment should be made for credible "worst-case conditions" to provide the most conservative approach to determining potential health hazards. However, the lack of an assessment of cumulative radiation risk from *all* sources which also compensates for exposures to different age groups and persons of varying physical health indicated that the agency did not follow its own recommended approach.

This lack of a cumulative assessment of risk was one of several other weaknesses in the CDC study that may have contributed to an underestimation of radiation dose to the Church Rock population.

Doses were calculated only for adult members of the population and not for children or unborn children who are the most sensitive to the effects of radiation. The assessment was based on models which determine adverse effects only to healthy, white, adult males. Since federal health statistics show Indian populations generally to be less healthy than white populations, the possible extra sensitivity of the Church Rock population to the effects of radiation should have been taken into account.

*Weimer, W.C., et al. *Survey of Radionuclide Distributions Resulting from the Church Rock, New Mexico, Uranium Mill Tailings Pond Dam Failure.* Pacific Northwest Laboratory (PNL-4122), prepared for USNRC (NUREG/CR-2449); Dec. 1981.

Neither did the CDC assess the possible genetic risks incurred by Church Rock residents as a result of exposure to the spill or previous mining activities. External gamma radiation exposure, for example to those herding livestock near the river, also was ignored.

On top of these shortcomings, the CDC made the falsely reassuring statement that the levels were "within current standards," indicating that those standards connote a degree of safety. Regulatory limits for radioactivity are set at "acceptable" levels with government and industry encouraged to keep exposures considerably below them. Health hazards do not disappear simply because the legal limits have not been exceeded.

Radiation Risk Models. The CDC's dose assessment for the Church Rock population was based on mathematical models which assume that radiation causes certain effects in the human body. These models, however, have serious limitations for accurately predicting health effects, limitations recognized not only by scientists in the field, but also by at least two of the authors of the CDC/Church Rock study.

The dose-response model used by the CDC and virtually all other radiation standards-setting agencies nationally and internationally is called the "linear model." It assumes that exposure to *any* amount of radiation carries with it some risk, that health effects would rise in proportion to dose with effects down to zero dose (Figure 1). Although the linear model has been deemed the most conservative in assessing the risks from exposures to varying levels of radiation, it is based on extrapolations from studies of large populations exposed to high doses of radiation (for example, the Hiroshima and Nagasaki survivors), rather than on studies of the biological effects on groups exposed to low levels of radiation, such as nuclear workers. The exposure levels at Church Rock were in the low-dose range.

Many radiation experts now believe, however, that it is extremely difficult – if not impossible – to predict health effects of low doses of radiation by extrapolating from high-dose data. This view is shared by Karl Z. Morgan, considered the "father of health physics," and Alice B. Stewart, a statistician internationally recognized for her epidemiological studies linking increased incidences of childhood leukemia to fetal X-ray exposure. Both scientists believe that the linear model is *not* conservative because of the problems associated with ex-

trapolating from the high-dose data. (See: K.Z. Morgan, "Cancer and low level ionizing radiation," *Bulletin of the Atomic Scientists*, September 1978.)

Morgan and Stewart say lower doses of radiation actually can be more harmful than slightly higher doses. They note that low level radiation can damage a cell without directly killing it, thereby leaving it intact in its defective form to reproduce and possibly lead to the induction of cancer or some other effect. This phenomenon contrasts with the effects of high doses of radiation. A cell killed outright by a large amount of radiation cannot produce a cancer or a genetic effect – it is removed from the body by natural processes.

Even more of a concern in the case of the Church Rock exposures is the knowledge that alpha radiation, considered 10 to 20 times more biologically damaging than either beta or gamma radiation, was the predominant radiation released in the spill and is the predominant radiation of the uranium decay chain. Morgan and Stewart, as well as Edward Radford, former chairman of the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation (the so-called "BEIR Committee"), have stated that there is a much greater potential for damage in the low-dose range (approximately 1 to 5 rads) than in the high-dose range from exposure to alpha radiation. This relationship is illustrated by the "superlinear curve" in Figure 1.

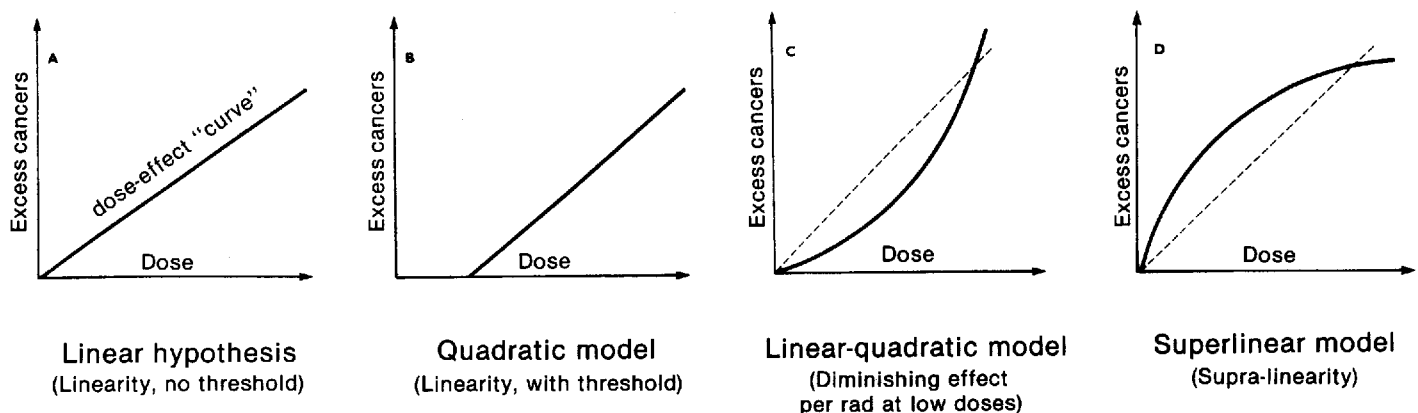
Alpha's greater potential for biological damage results from its relatively large size (a helium nucleus) which inflicts serious localized cell damage by delivering high amounts of energy to a few cells for extended periods of time. Because of this damaging potential, alpha radiation is considered a high-LET (linear energy transfer) radiation as opposed to beta and gamma radiation, which are considered low-LET radiations. Most radiation risk models are based on the linear model using low-LET radiation. Consequently, the use of the linear model without consideration of alpha's greater biological "effectiveness" also may tend to greatly underestimate the potential health risks incurred by Church Rock residents.

Need for an Expanded Livestock Tissue Survey

A Surveillance program to monitor Church Rock livestock for radioactive and heavy metal contamination has not been implemented despite a recommendation by CDC that such a

Figure 1

DOSE-EFFECT RELATIONSHIP AND "THRESHOLD" DOSE¹



¹Adapted from: Gofman, John. *Radiation and Human Health*. Sierra Club Books (San Francisco), 1981.

program be conducted and at least one major proposal for funding and laboratory facilities to accomplish it.

As discussed above, the CDC's dose assessment determined that ingestion of meat from local animals which historically used the Rio Puerco for watering was a primary source of potential radiation exposure to humans. Doses to people were determined by measured concentrations of radionuclides and heavy metals in edible animal tissues, such as muscle, liver, kidney and bone. Autopsies were performed on eight livestock (two cows, four sheep and two goats) from the Church Rock area and three control animals (one cow and two sheep) from outside the area.

The CDC analysis found that most radionuclide concentrations for most of the exposed animal organ samples were "consistently higher than control concentrations" and that the kidneys of exposed animals were the organs with the highest concentrations and muscle the lowest. The health agency said human exposure could be reduced by minimizing consumption of kidney and liver from Puerco-area animals.

The CDC warned, however, that the small sample of potentially exposed animals would not give an accurate picture of "representative concentrations for the animal herds in the Church Rock area." It said doses to local residents would depend on a "clarification of average animal radionuclide concentrations and . . . exposure routes" and recommended that "a surveillance program be established for radionuclide concentrations in Church Rock animals."

The Navajo Area Indian Health Service (IHS, a division of the U.S. Public Health Service) submitted a proposal for an expanded animal monitoring program to the U.S. Environmental Protection Agency (EPA) in mid-1981. The proposed program, estimated to cost roughly \$94,000, would have surveyed about 45 animals (sheep, goats and cattle) with about half coming from the Church Rock area and the remainder from an area not presently experiencing uranium mining and milling activities.

IHS officials in Window Rock, Ariz., said recently that a Lutheran Church agency had agreed to donate funds to purchase some of the animals, but that EPA had not made a decision to commit to conducting the required radionuclide analyses through its Office of Radiation Programs (ORP) laboratory facilities in Las Vegas, Nev.

EPA/ORP chief Glen L. Sjobolm said the estimated time needed for laboratory analysis of the projected number of animal tissue samples "represents a significant portion" of EPA's staff time at its Las Vegas facility, according to a June 24 letter to IHS official Wayne Mohler in Window Rock. Sjobolm also expressed concern for the financial requirements of the program given EPA's budget and personnel cuts under the Reagan administration. When contacted in July, Sjobolm said ORP had not reviewed the CDC final report nor made a decision on the amount of staffing and laboratory time to devote to the project, if any.

In addition to the need for additional tissue sampling of local Church Rock livestock to determine possible radiation doses to residents consuming the meat, an evaluation of the health impacts to local livestock themselves also should be carried out. The need for such a livestock health survey is underscored by reports of birth defects in some Church Rock-Rio Puerco livestock.

According to the draft report of a church-sponsored group of scientists studying the long-term effects of the spill, a Gallup veterinarian who inspected some Church Rock livestock after the accident reported this spring that observed

birth defects in the area "included large-headed lambs, cleft palate and hydrocephalus." The study group said the veterinarian, Dr. Clinton Balok, also reported that "there was one three-legged lamb" and that "none of these animals were examined or autopsied." He reported having seen "some birth defects in the 1981 lambing season" and heard of others in the 1980 season, but no information was available on reports of animal birth defects this year, the group said.

Despite these reports, no attempt has been made by qualified medical personnel to comprehensively examine Church Rock-area livestock. Balok, in offering an explanation of possible causes, referred only to a number of "natural occurrences" such as viruses, bacteria and diseases which produce similar birth defects. No mention was made of the possibility of these ailments being associated with radiation exposure although radiation exposure could have similar effects and no suggestions were made to investigate the problems further.

Feasibility of Conducting Epidemiological Studies of the Church Rock Population

The final CDC report concluded that epidemiological studies of mortality and morbidity rates in Church Rock should not be undertaken due to the difficulty in detecting risks associated with radiation exposure in a small population. This conclusion effectively blocked discussion of a clinical study of health effects in the local community despite the agency's finding that predicted radiation doses to individuals consuming the meat of exposed animals were "higher than normal" and that local animals exhibited higher concentrations of critical radionuclides in edible tissues than control animals.

The implication was that small populations which confront potential environmental health threats should be ignored because of their size alone. This view allowed CDC to use mathematical models only in assessing radiation risk to Church Rock residents and to conclude that no significant threat to health exists.

However, according to several experts in the field of radiation epidemiology, clinical studies of small populations to detect the possible effects of radiation are feasible and can produce statistically credible results. They say that until such time as a study is implemented in the Church Rock community, conclusions that no significant health threat exists are premature and possibly inaccurate.

One of these experts, Dr. Carl Johnson, former director of the Jefferson County (Colo.) Health Department and lead investigator for a National Cancer Institute study of cancer rates among nuclear workers at the Rocky Flats Nuclear Weapons Facility near Denver, suggested in June 1980 that cancer and birth registries be established for the Church Rock population and that they be coupled with an ongoing program of "surveillance of chromosome changes, cancer incidence and rates of congenital malformation in persons and animals living in the area or in the vicinity of the contaminated stream."

Johnson, who has published results of several epidemiological studies of cancer incidence around the Rocky Flats plant, said more recently that a population of 500 or less, such as that affected by Church Rock, is sufficiently large to establish both a birth and cancer registry which over the years would show any unusual increase in adverse health effects.

"The field of radiation epidemiology is too young to be burdened with doctrines which use only mathematical calculations to determine radiation risks in small populations," he said. "Empirical studies on the effects of low level radiation,

combined with mathematical models, would provide a better understanding of potential and actual risks."

Dr. Joseph Wagoner, former senior epidemiologist for the National Institute of Occupational Safety and Health (NIOSH) and a specialist in radiation epidemiology, acknowledged that as a general rule, the smaller the population, the larger the increase in risk must be before a statistically significant excess in adverse health effects can be shown. "However," he said, "this difficulty should not be used to bar an epidemiological survey of adverse effects or reproductive consequences in small populations such as Church Rock's. This would have the unfortunate result of drawing conclusions of health risks based only on currently disputed radiation models."

Wagoner, who has documented excessive lung cancers among underground uranium miners and currently is a consultant to a March of Dimes study of birth anomalies in the Shiprock, N.M., area, noted that epidemiologic guidelines have been published for determining risks in small populations for a number of birth categories. Table 1, which was adapted from those guidelines, shows several common adverse birth events and the level of increased risk needed to detect a statistically significant excess above the national incidence rate.

Using such health anomalies as spontaneous abortions, reduced birth weight, birth defects and stillbirths, Table 1 demonstrates that a sample population size of only 50 births is adequate to detect a statistically significant excess anywhere from threefold (in the case of spontaneous abortions) to 7.7-fold (for birth defects and stillbirths) at the 95-percent confidence limit (the probability of detecting a risk if it exists). Ironically, the guidelines upon which these minimum detectable risks were based were published by the March of Dimes based on epidemiologic research reported at a conference held in January 1981 and sponsored by several federal agencies, including the Center for Disease Control.

Births in Church Rock might average 15 per year, based on a population of 500 and a reservation-wide average birth rate of 3 births per 100 persons per year. Since the guidelines call for at least 50 births for the purpose of conducting of a study, the Church Rock population would need to be followed for three to four years or longer to attain a sufficiently large birth population to detect any significant adverse birth trends. More

than three years have already passed since the spill, making this method of study practical now.

Wagoner warned against arriving at hasty predictions that potential health effects in the Church Rock area will be minimal or nonexistent. "Until one actually goes into a population and takes a look at medical or birth records that monitor and follow health or birth changes, any conclusions that the health effects will be insignificant or nonexistent are premature and possibly inaccurate," he said. "Public health responsibility would dictate that such a birth and/or health registry be established."

A birth registry could track and analyze birth trends before and after the spill. The current state of the health of Church Rock newborns could be compared to the health of infants born in other Navajo communities unassociated with uranium activities. Past and present birth trends in the same population also could be compared and the results analyzed to detect any changes in the local pattern of normalcy. Since the unborn child is known to be the most sensitive of the human population to the effects of radiation and toxic chemicals, anomalous birth patterns, if they are present, would provide clues to the potential harmful effects of various environmental pollutants in a much shorter period than the 30 to 40 years that cancers take to show up.

A cancer registry established for the adult population of the area should extend throughout the known latency periods (approximately 40 years) for cancers of the solid tumor type. Special attention should be given those health effects and/or cancers involving organs known to concentrate radioactive elements of the uranium decay chain. Radium, thorium and lead, for example, are bone seekers; thorium also concentrates in immune system organs such as the liver and spleen. Similarly, the target organ for radon and its progeny is the lung.

The Health of Six Navajos Exposed to Spill Materials Should Be Studied for 40 Years

The health of five Navajo children and one adult believed to have been on the banks of the Rio Puerco during the spill and thereby exposed to radiation should be followed for at least the next 30 years to detect any adverse effects. The need for a follow-up study of the health of these individuals arises

Table 1

MINIMUM DETECTABLE RISKS¹

Event	Expected Frequency ²	Sample size	Required period of time to observe Church Rock population ³	Relative risk detectable ⁴
Reduced birth weight (LT 2,500 g)	7 in 100 live births	50	3.5 years	4.6-fold
Spontaneous abortions	ave. 15 per 100 pregnancies	50	2.5 years	3.0-fold
Still births	3 per 100 pregnancies	50	3.5 years	7.7-fold
Still births	3 per 100 pregnancies	100	7.0 years	5.3-fold
Birth defects	2 to 3 per 100 births	50	3.5 years	7.7-fold
Birth defects	2 to 3 per 100 births	100	7.0 years	5.3-fold

¹Adapted from Tables 1 and 2, pp. 37-100: March of Dimes Birth Defects Foundation. "Guidelines for Studies of Human Populations Exposed to Mutagenic and Reproductive Hazards." (Bloom and Arthur, eds.) Proceedings of a conference sponsored by the Centers for Disease Control, U.S. Environmental Protection Agency, March of Dimes, et al.; Jan. 26-29, 1981.

²Based on natural incidence nationwide.

³Based on a Church Rock population of 500 with an average of 15 births per year.

⁴95-percent confidence level.

LT — less than

from concerns raised about the appropriateness of certain tests performed on the six Navajos to determine if they had been contaminated by exposure to radioactivity in the spill.

The tests were conducted at Los Alamos National Laboratory (LANL) on Aug. 23, 1979. Soon thereafter, LANL scientists concluded that the six individuals "exhibited radiation levels that are normal in every respect compared to the general population," according to a letter from George Voelz of LANL to Kathleen Kreiss, one of the principal investigators for the CDC in its Church Rock dose assessment.

Two months later, however, a Gallup physician charged that LANL's testing procedures and analysis were conducted too soon after the reported exposures and that the detection limits of lung scans performed on each of the six Navajos were high enough to have allowed doses approaching the limits for nuclear workers to go undetected.

In an analysis of the potential health impacts from the UNC spill, Dr. Joerg Winterer, formerly with the Indian Health Service in Gallup, said that to accurately measure radiation doses, particularly from thorium-230, whole body counting "must be accomplished years after the introduction of thorium in the body, or else the gamma radiation emitting daughters will not be there in sufficient quantity to make the test reliable." The Los Alamos testing of the six Navajos came less than 40 days after their suspected exposure.

Winterer also noted that the detection limits of the LANL lung scans performed on each of the individuals to determine thorium uptake (lung dose rate of 4.0 rem/yr and lung dose of 7.9 rem) were near the federal limit of 5 rem/yr for radiation exposure to nuclear workers. (A rem is a measure of the biological effectiveness of a given amount of radiation.) Allowable doses to radiation workers usually are 10 to 20 times greater than those permitted members of the public.

"Until one actually goes into a population and takes a look at medical or birth records that monitor and follow health or birth changes, any conclusions that the health effects will be insignificant or nonexistent are premature and possibly inaccurate. Public health responsibility would dictate that a birth and/or health registry be established" in Church Rock.

— Dr. Joseph Wagoner

Winterer also said that the literature on medical experience with thorium-232 used as an in-body radioactive tracer in diagnostic examinations (so-called "Thorotrast" treatments) shows that thorium isotopes are excreted predominantly through the human stool. LANL, on the other hand, analyzed urine samples taken from the six Navajos and concluded that for uranium, thorium, radium, cadmium and lead, "no values suggestive of uptakes of these materials . . . were obtained" in any of the exposed individuals, according to the Voelz letter to Kreiss. The finding prompted Winterer to suggest that LANL's urinalysis might seriously have underestimated the Th-230 exposures to the six people tested.

Winterer recommended, on the basis of his finding that at least five years must elapse before accurate measurements of thorium-230 uptake can be made, that total body counting for thorium contamination be conducted every five years for each of the six Navajos and that they be followed for a minimum of 30 years. To date, however, no health follow-up of the children and the adult has been implemented or even proposed.

Loopholes in Uranium Regulatory Frameworks Must Be Closed to Protect Public Health and Safety

Formulation and implementation of regulations designed to protect the public health and environment from the hazards of radiation-emitting industries generally have not kept pace with the rapid growth in the nuclear industry over the past 20 years. Many phases of the nuclear fuel cycle either have gone unregulated or have been governed by weak requirements for health and environmental protection. Uranium mining and milling, which never has come under a comprehensive environmental code that was formally implemented or enforced, is a prime example of this gap in local, state and federal regulatory frameworks.

A. James Ruttenger and Kathleen Kreiss, the principal authors of the federal Centers for Disease Control's study of the Church Rock population following the United Nuclear Corp. tailings spill, pointed out in a paper presented at the Colorado School of Mines International Conference on Radiation Hazards in Mining in October 1981 that a number of radioactive elements and sources of radiation exposure from uranium mining and milling are not regulated.

This lack of regulation permits higher radiation doses to persons who live near uranium facilities than those living near nuclear facilities, such as nuclear power plants. These regulatory

"loopholes" (which the uranium industry has fought hard to maintain) must be corrected to bring more uniformity to population radiation exposure control and better protection to those communities where uranium activities are conducted.

Using the Church Rock situation as an example, these loopholes can be grouped into the following three categories: exposure to radon gas and its daughter products, exposure to mine dewatering pollutants, and a lack of monitoring requirements and radiation exposure reduction programs necessary to comply with the ALARA principle of keeping exposures "as low as reasonably achievable."

Exposure to radon gas and its daughter products. The U.S. Environmental Protection Agency (EPA) in late 1980 promulgated final regulations limiting radiation doses to members of the public to 25 mrem/yr (millirems per year) from exposure to routine releases from all phases of the nuclear fuel cycle including, for the first time, uranium mill operations and tailings piles (see 40 Code of Federal Regulations, Part 190). Although this standard remains the strongest yet in protecting the public from radiation exposure (earlier U.S. Nuclear Regulatory Commission regulations allowed doses up to 170 mrem/yr from all sources), it specifically *excludes* radon

gas and its daughter products.

Radon-222 and its progeny have been identified as the major contributors to increased lung cancer among underground uranium miners and by the NRC collectively as one of the largest sources of radiation exposure to nearby communities. Radon gas, the primary emission from uranium mill tailings and underground mine exhaust vents, is easily dispersed by local winds and carried for many miles, thereby increasing radiation exposure to persons far from the actual uranium mill site or mine vent. As radon decays, its particulate daughters settle onto nearby vegetation, and through the vegetation-livestock-people pathway these decay products become an internal radiation hazard for humans through ingestion.

Due to the EPA's specific exclusion of radon and radon progeny, persons in uranium processing areas are permitted doses greater than the 25 mrem/yr allowed for exposures from other aspects of the nuclear fuel cycle. The EPA, through its rule-making process, could revise the regulations to include radon and daughters if enough concerns were raised by citizens.

Mine Venting of Radon. Radioactive emissions from uranium mine vents, particularly radon gas and its daughters, *are not regulated* by any federal or state agency in the U.S., despite studies that show venting from underground mines contributes the majority of atmospheric radon in uranium mining and milling districts.

The EPA was mandated by the Clean Air Act to regulate radioactive emissions from sources such as uranium mines. However, the agency is two years late in setting emission standards for radon and other atmospheric radioactive releases. A Sierra Club lawsuit filed in 1981 seeks a court order to force EPA to comply with the Clean Air Act's requirements, but due to the continued slump in the uranium market and the current leadership of the agency, it is doubtful these standards will be set soon.

The states could assume the authority to regulate mine emissions, but industry resistance is strong. The staff of the New Mexico Environmental Improvement Division recommended in a January draft report on a two-year study of radon concentrations in the Grants Mineral Belt that consideration be given to amending the state's radiation protection regulations to include licensing of mine vent emissions. The study showed that mine emissions in the area are the major source of atmospheric radon, surpassing radon emissions from active tailings piles.

Mine dewatering. For many years, the Rio Puerco wash in the Church Rock community was an intermittent stream which lost flow during some of the dry summer months. However, in 1968 United Nuclear Corp. began discharging waste water from its new underground mines northeast of Church Rock directly to an arroyo which empties into the Puerco about one mile south of the company's mill and tailings pile. Kerr-McGee Nuclear Corp. began "dewatering" its subsurface Church Rock mines in 1972. The resulting flows — up to 5,000 gallons per minute continuous discharge by 1979 — transformed the normally dry channel into a perennial stream with elevated levels of radioactivity and heavy metals.

At the time dewatering of the uranium-laden sandstone aquifers began, no regulations existed to treat mine effluent for removal of certain radioactive elements, particularly radium-226, an extremely carcinogenic bone-seeker. Throughout this time, Church Rock residents continued to use the Puerco as a source of water for their livestock.

After this practice of untreated discharge was identified as a public health hazard by federal agencies, EPA in 1976,

under its National Pollutant Discharge Elimination System (NPDES) permitting process, began regulating Ra-226 concentrations in mine effluent. Later, a Kerr-McGee challenge to the EPA's regulatory authority to set limits on the concentrations of radiological and nonradiological pollutants in mine discharge was rejected by the courts, which upheld EPA's NPDES regulations under the Clean Water Act.

UNC voluntarily began treating its mine effluent before release to the Rio Puerco soon after it started mining in the Church Rock area. However, Kerr-McGee only sporadically treated its discharges between 1972 and 1977, claiming that until the court rejected its legal challenge the company was under no obligation to comply with the restrictions of its NPDES permit. During this period, maximum radium concentrations reached eight times today's 30 pCi/l (picoCuries per liter) limitation and 50 times the federal drinking water standard of 5 pCi/l, according to state and federal data.

Under the NPDES process, concentrations of other radionuclides and toxic heavy metals in mine effluent can be limited, but untreated discharges to surface streams are allowed if the discharge is within the permit limits. In setting discharge limitations, the EPA is permitted to impose the more stringent of applicable state or federal water quality standards.

NPDES permits usually limit the flow of the discharge and the concentrations of various contaminants, including chemical oxygen demand, fecal coliform, lead, uranium (if the regulated discharge is from a uranium mine), sulfate, chloride, radium-226 and radium-228, gross alpha radiation, and others (such as arsenic, zinc, molybdenum and selenium) depending on the mineralization of the orebody.

When EPA proposes to issue an NPDES permit, it must hold a public hearing and seek written comments if enough public interest has been shown in the proposal. (What constitutes "enough public interest" varies from one EPA region to another.) Citizens can use the hearing process and comment period to demand more stringent limits on pollutants in mine discharges. Additionally, the requirements for "best available technology," "best practicable technology" and "best management plan" may enable communities to demand that all mine discharges be contained on-site in evaporation ponds with no release to surface systems.

ALARA. The principle of ALARA ("as low as reasonably achievable") was incorporated into federal regulations governing public and worker radiation exposure to provide an extra layer of protection above the numerical requirements of the regulations themselves. This effort at keeping radiation doses below regulatory limits and as low as possible is consistent with the medical knowledge that no "safe" level of radiation exists.

However, compliance with ALARA is seriously hindered because of a lack of federal guidelines or requirements for on-site and off-site radiological monitoring programs and exposure reduction programs at nuclear facilities. There is no system for examining the records of employee and public exposures from nuclear facilities over a period of several years to determine if exposures are in fact being kept below regulatory standards.

Even though the NRC is conducting a "comprehensive" revision of its radiation exposure limits (10 CFR Part 20) and considering several specific proposals for exposure reduction (such as better monitoring for pregnant women who work at nuclear installations), the commission, as well as the EPA, must implement procedures to verify compliance with ALARA and regulations to enforce its goal of minimizing radiation exposure to workers and members of the public alike.

Janet Siskind

The noise of rushing water woke Tom Charley and his family in their home near Lupton, Ariz. It was the early morning hours of July 16, 1979, and the sun had barely cleared the sandstone mesas of the Defiance and Zuni uplifts to the east.

Charley walked over the hard, dry ground of his homestead and toward the banks of an intermittent stream his people once called *Toinjoni* — “The Beautiful River That Flows.” Looking down, he saw pale, muddy water running about three feet deep and filling the broad, winding stream bed from one side to the other. It had a strange smell. Something was not right.

Farther downstream, Aurelia Curley also noticed that the flow in the Rio Puerco wash was uncommonly heavy — and a rather putrid shade of yellow. It reminded her of battery acid or water from a rusty pipe. Even Nasbah Russell, still alert at 95, described it as “muddy and yellowish.” Their friends up and down the river also sensed something was awry. The Beautiful River That Flows was no longer beautiful, and its flow now “strange.”

By 11 that morning, word started getting around, and the mood turned anxious. Gallup radio was saying the “Perky” was dangerous. It warned the people not to let their livestock drink the water or allow their children to play in it. The Puerco residents, in turn, warned relatives and neighbors. A few days later, signs began appearing along the river banks. The words were written in three languages, none of which the rural Navajos, or their animals, could read. But the message soon became quite clear: don’t use the water, it’s no good.

The people along the Rio Puerco, from Church Rock, N.M., to Chambers, Ariz., didn’t have to know *why* they shouldn’t use the river. The mysterious, open sores that began to develop on the legs of their sheep and horses shortly after the animals had been in the river told them the water was not clean. The ewes that would inexplicably abandon their newborn or the healthy rams that would simply up and die were indications that the river wasn’t the way it once was. And since it was the white officials from Santa Fe who had put up the signs and told them the river was not fit for either animals or people, they avoided it. That was reason enough.

The river had set the pattern of settlement. For the Navajos, it had been the source of water for their sheep, goats and cattle, the irrigation for their corn and peach trees, and a playground for their children in the hot summer. But that was past now; they were told not to eat their animals and the butchers in Gallup wouldn’t buy them; their friends and relatives away from the river began to shun them or refuse to visit them at home for fear of being harmed; and they had to make more frequent trips to the chapter houses where the well water was said to be safe. It was as if the residents themselves were being avoided.

So they renamed *Toinjoni*, and called it “The River That Is Harmful.”

Some folks would just as soon forget that the Church Rock uranium tailings spill ever occurred. After all, the mill across the road from the dam that broke is closed, one of the mines that produced for it is shut down and another recently cut back its work force. People are out of work throughout

Janet Siskind, a professor of anthropology at Rutgers University, spent part of last summer interviewing residents along the Rio Puerco to compile this article.

“Toinjoni” — A Beautiful River That Turned Sour



Tom Charley and his grandchildren at their home along the banks of the Rio Puerco wash near Lupton, Ariz.

the region, so it’s not too wise to speak unkindly of the uranium companies. The New Mexico Environmental Improvement Division says the Rio Puerco is returning to normal, and the federal Center for Disease Control says people again can eat their animals — as long as they avoid the liver, kidney, spleen and, perhaps, the bone.

For its own part, United Nuclear Corp., the company responsible for the accident, is quick to remind inquirers that it dutifully supplied replacement water “to whomever asked” — even if they were 40 miles downstream. The spill injured no one, said a company official, unless “they were in the bottom of the wash when the damn thing broke — and then they’d probably have drowned.”

But for Tom Charley, Aurelia Curley and Nasbah Russell — just three of the hundreds of Navajo people who live along the Rio Puerco — the spill has been a recurring nightmare for the last three years. “I worry about the sheep, and I worry about my children and their future, and their health,” says Kieyone Begay, a 57-year-old sheepherder and lifelong resident of Manuelito, N.M., near the banks of the Puerco. “I worry about myself, my health and my future. That’s what I mean by mental anguish.”

“Locally, the people along the Rio Puerco are really



Josephine Benally and one of her grandchildren (right) know that their sheep could be affected “even 20 years from now.”

suffering.” said Peterson Zah, former executive director of DNA-People’s Legal Service, the legal-aid agency on the Navajo Reservation which sued United Nuclear on behalf of 243 individuals living along the stream. The spill, he said, has had “a devastating effect on their lives and the lives of their children.” The lawsuit, say many of the plaintiffs, is simply an effort to get back a small part of what they have lost.

About 94 million gallons of radioactive and chemically toxic waste water and 1,100 tons of contaminated solids were lost in what became known as the largest release of radioactive wastes ever in the U.S. The liquids emptied into the Rio Puerco about 20 miles northeast of Gallup and were last seen east of Holbrook, Ariz., more than 80 miles downstream. Somewhere in that remote stretch of the Colorado Plateau, they disappeared into the stream bed. For some people, the smelly, yellowish water has simply vanished; for the Navajos along the stream, it is there every day.

The Rio Puerco is dry during much of the summer. Its banks cut into a flat plain which connects the mesas a half-mile to a mile on either side. Their layers are visibly laid bare, as in a geologic illustration; the landscape of eroded rocks is typical of the Southwest. Sections of the river were bypassed as it changed its course over the millennia; lush grasses now grow in these spots.

All along the Puerco from Gallup to Holbrook and south there is an old and continuing pattern of Navajo households: clusters of several families, many of them related or members of the same “clan.” Each family has a separate house or trailer, but they all share a common hogan — the traditional, single-room Navajo abode that is separately, but concurrently, living space, meeting place and ceremonial site.

In Tom Charley’s hogan, for instance, the old grandmother watches the babies of the clan, and two enterprising youngsters (Tom’s grandchildren) plan how to train a growing colt. The adults are busy working, herding sheep, cooking, building a new room, or hauling water for the corn. Nearby are corrals, one for the sheep and goats, another for a few horses. A pair of cars, old and rusting, and a truck are parked near one of the houses. The Santa Fe railroad tracks follow the Puerco

west from Gallup, paralleling old Route 66 and the new Interstate 40. Throughout the area, the scene is nearly the same — the river defines it all.

And so in this quiet, rural setting, an incident such as the tailings spill is bound to draw attention. Not long after the accident, officers of the local chapters (the smallest units of the Navajo political structure) began holding educational meetings to inform the Puerco residents about *why* the river was “dangerous.” A new word cropped up: “radiation.” The river folks could understand hardly a word of English, let alone a term which symbolized a concept more than an “object” they couldn’t see, feel, smell, taste or hear.

The Church Rock Chapter at first was vehement in demanding assistance from the tribal government, the state and United Nuclear. The company agreed to supply the clean water it so readily boasted about — never mind that the state license which governed its operation *required* that replacement water be made available in the event of an accident that made existing water supplies unusable. Soon, the other affected chapters, Manuelito, and Lupton and Houck, Ariz., followed with similar demands for assistance, particularly with fencing to keep the sheep out of the Perky.

In the days, weeks, months and even years subsequent to the spill, the Manuelito chapter house, a large assembly hall off Rte. 66, was the scene of meeting after meeting. Many were held with medical scientists and officials from the tribal government and the state agencies appearing. These men and women were asked by the Navajos about the dangers created by the spill, about its causes, and about solutions to the problems it had left to them. The answers were equivocal or evasive, often protective of the industry or simply designed to allay fears without explanation. Contradiction was quite apparent, especially when the federal health folks told the residents about a year after the spill that they could eat their animals again without much worry, but only if they didn’t eat specific parts.

The officials from Santa Fe and other faraway places, who were responsible for regulating the companies and protecting the public, did not point out to the local people what they knew and suspected of the company’s negligence in the

operation of its dam. And they admitted freely, and without shame, that they did not know how to deal with the emergency. Actually, no one seemed to know. To the Navajos, perhaps no one cared.

Harold Tso, the longtime director of the Navajo Environmental Protection Commission, was a bit disillusioned by the whole process. A veteran of the nuclear industry before returning to Navajoland to head up his people's environmental program, Tso is not known as the tribe's antagonist of local uranium companies. But on the subject of the Church Rock spill, his criticism is sharp-edged:

"There was some failure somewhere on the part of the officials administering their responsibility," he said. "They all just pointed fingers at each other . . . and the image came out of it in the same sense as at Three Mile Island — who knows what about anything." Tso said the state and federal environmental monitoring programs set up to respond to the immediate impacts from the spill and to provide reliable information to deal with their effects was at best sketchy, with no active sampling of vegetation or river sediments and an inadequate program for monitoring surface and ground water. Monitoring systems were simply not in place to the extent that the officials said they would be.

When the spill occurred, he added, state-run testing laboratories were not fully prepared to deal with the volume of environmental samples needing analytic attention. The U.S. Environmental Protection Agency's laboratories were busy with post-TMI work, often delaying the receipt of results of sample analyses for several months. For a while, the only immediate laboratory facility was one provided by UNC; a mobile sediment testing lab provided by the U.S. Nuclear Regulatory Commission did not arrive on-site until late in September, more than two months after the accident. A lack of coordination between the Navajo Nation and the various state and federal agencies, and jurisdictional haggling over responsibility for Indian lands in two states, complicated matters.

Consequently, Tso said, emergency planning was virtually nonexistent. There was nothing more comprehensive than UNC's broad statement to "do everything from A to Z as soon as possible and in as short a time as possible. Well, it didn't make any sense . . . [and] everybody lost brownie points and credibility. Now, nobody knows what's safe in the nuclear industry."

Kieyone Begay's house is about a half-mile south of the Manuelito chapter house, across the railroad tracks, Rte. 66 and the Rio Puerco. His wife and her parents and relatives own the flat land that runs back into the canyon between the low mesas that rise up south of the plain. The animals there belong to various family members, old and young, but they have always been herded together, grazing on both sides of the river.

Two weeks after the spill, Begay heard for the first time that the river was contaminated, but during those two weeks the horses and sheep grazed by the river, drinking the water and eating the grasses that grew alongside. Begay first noticed flaking and sores on the horses' feet and mouths. Later, he saw them lose weight and eventually die. About 20 of the sheep and goats died in the same way, some three years ago and some more recently, since despite the family's efforts some of the animals get through the fence at night and head for the familiar water. "Even to this day," says Begay, "the calves don't grow like they normally would. There is no fatness or meat to them." In the years since he learned to herd as a young boy, Begay says, he has never seen illnesses like these.

Downriver in Nasbah Russell's sheep herd, "some died, and they were coughing, and they were skinny-like." The sheep became weak and the ewes "don't have a normal birth." She remembers each sheep individually and when asked by a lawyer about the value of the animals, she answered, "They were very valuable to me. Especially the ram that had a lot of wool and was very muscular, and I always think about that lamb."

Other residents also experienced similar problems with their animals. Sheep and horses, or even dogs, became weak and thin and eventually died. The few veterinarians called to tend to the sick livestock could not say what the illnesses were or how they were caused. But the people along the Rio Puerco said they could guess, because the sickness and death always came after their animals had ventured into the stream.

Tending the herds that remain has become an arduous job. Keeping them out of the Puerco and finding alternative sources of water have been the predominant tasks. Some families around Lupton, just inside the Arizona border, herd their sheep a considerable distance to tanks which for a while were kept full by UNC and later by the tribal government. When the tanks run dry, it means driving three times a day to a spring 15 to 20 miles distant, in an old pickup truck which gets 10 miles a gallon if it doesn't break down. Near Manuelito, people drive pickups to the chapter house to fill water barrels at the well there. As an added burden, the advisory against butchering animals from the Rio Puerco meant that the people were forced to buy meat to feed their families, something they had rarely done in the past.

Peterson Zah, now a candidate for tribal chairman, compared the importance of livestock to the Navajos with the importance of jobs to other Americans. "I think in your society, jobs are very important because from jobs you pay for your food and you pay for the rent on your house and car. Now in the Navajo way, what takes the place of a job is livestock, sheep, because it means your job, it's daily work, it's bread, it means food. It means rug weaving like that thing there." He pointed to his handwoven briefcase. "So the way the Navajos are feeling is like the American people wiping out all [their] jobs."

Speaking through a translator, Begay elaborated: "Before the spill, as far as I know, my goats and sheep were healthy, and they grazed up the river with no problem, and it was a blessing to my family. We also lived off the sheep. We used it for food, and also shared it with my community when they had a squaw dance or a sing. We would donate the meat. But all that has been pretty much discouraged now. Our people, my relatives, are afraid of me because of the spill."

Donna Deyhle, an anthropologist writing in the May 19, 1982, edition of *Century* magazine, cites the same cultural dislocation: "Navajos from the communities [affected by the Rio Puerco spill] are reluctant to donate sheep that might not be healthy to relatives for ceremonies. Ceremonies are less frequently held in these communities. 'They do not carry the prayer stick over here because they probably are afraid of our mutton.'"

Kieyone Begay is one of the litigants in the Navajo case now pending in federal district court in Albuquerque against United Nuclear. An honest, patient man, he has developed a strong sense of outrage since the accident. "I feel like I invested my life, energy and talent and tears in building what I have," he said. "And to have that lost, I think it's — that's why I don't sleep at night."

None of the Navajos have given up their sheep despite the difficulty of watering them and despite the advice of the

authorities not to butcher them. Some, however, sold their cattle since they could not be sure the animals had not drunk from the contaminated river. Some people with no other means of feeding their families were forced to butcher their sheep. One woman, herself sick since the spill, recalled, "After the spill, five days later, my father slaughtered sheep for us, and after that, the children became ill. They had sores, and we took them to the Indian hospital. To date, the kids are still coughing, with running noses." But, she added, the doctors told her and others along the Puerco that it could not be said for certain that the ailments were attributable to exposure to pollutants in the river. No one knows for sure, "so we speculated," she said.

Deyhle observed that the Navajos' suspected health problems, whether they were caused by the spill or not, represent adverse psychological impacts which can be equally, if not more, detrimental to physical health. She wrote, "They say that physically they are not well. 'Now we always go to the hospital; there the doctors tell us there is nothing wrong with us.' 'We are sick; the doctors can't diagnose our illness.' 'We are not well because our livestock are sick. . . .'"

"Opposed to the difficulty of documenting the physical effects on these Navajo people are the visible and verbally expressed psychological stresses they are currently experiencing. Such stresses stem from what these traditional Navajos perceive as the devastation of their land, land which is at the core of their religious and ceremonial beliefs. This has created a disruption in their way of life. 'We are to blame for not protecting our environment.'"

"Instead of externalizing their problems and blaming their mental and physical troubles on the existence of the local mining industry, many of the older Navajos seem to have internalized the situation and placed the blame on themselves for having allowed the destruction of their traditional land. This is perhaps the greatest tragedy of the Church Rock spill, that elderly Navajos feel guilty and assume the blame for a situation totally beyond their control. 'Even though we have faith and try to keep our hopes up, we keep falling, sometimes on our knees.'"

Herman Charley is about 35 years old. He and his wife and children live with his father, Tom Charley, and his sister and her husband and children. Herman translated for Tom Charley who speaks some English, but with difficulty.

When he first moved to this section of land near Lupton, Tom recalled, the Puerco ran pure and sweet, and the family used it for themselves as well as their livestock. In more recent years, before the spill, they used it only for livestock. Now, Tom said, there were white crystals left on the dry riverbed after the water went away. "I don't know what they are or if they can hurt you. They blow around; it may be bad for us, may be bad for those kids," and he pointed to the two three-year-olds who were playing nearby. "After a rain the water smells funny. We don't let the children go down to the wash. We'll never have cattle again; it's forever."

Josephine Benally lives across the wash from Tom and Herman Charley. A strong, friendly woman, she finished high school in Oklahoma and moved back to her land. "I've lived here all my life. Dad was born here. Sheep used to just go down to the wash to drink; now we have to bring water in. Never used to be all that white stuff like salt." She was hoeing weeds between rows of corn. "I'm afraid that's what's making the weeds dry out, and the trees too — it never used to be like this."

Rural life since the spill has changed substantially for Josephine Benally. She once put in a much larger garden than now. Water from the river was plentiful for the garden and her trees. She also once raised turtles, chickens, horses and cattle — now, only sheep. And like the other Navajos along the Rio Puerco, she must continually try to keep the sheep out of the wash, despite the Centers for Disease Control's lifting of the advisory against using Puerco water.

Lynda Taylor, coordinator of the Health and Radiation Project at Southwest Research and Information Center in Albuquerque, believes it was unfair for the CDC to ask the local people to change their lifestyles "to accommodate the misuse of the tailings operation by United Nuclear."

The CDC, she said, "recommended that the people reduce the consumption of certain organs like liver and kidney and spleen which had the highest concentrations [of radioactivity] and they recommended that the livestock not be watered out of the river and that the people generally should stay away from the banks of the river on dry, dusty days. But there is not any day in New Mexico that is not dry and dusty, and it is very hard to keep children away from the water, especially during the hot summer months, and it is quite difficult to remember to remove the kidney, liver, and spleen every time you have slaughtered a sheep or goat or cow."

The most recent update of the agency's report which lifted the year-long advisory did not take into account new information to support its position that there no longer is the potential for long-term health effects among people living along the Rio Puerco, Taylor said. She concludes that the claim of CDC and others that the population is not at risk is a way to sweep the Church Rock issue under the rug forever.

Her words were echoed independently by Kee Joe Benally, a Gallup silversmith and one of the first litigants against United Nuclear. "They don't really care," Benally said. "They're making a lot of money. Just because they're making money from that, they don't care about life and the future and the livestock, they only care about money."

Like the other Navajos of the Rio Puerco, Benally still is asking, "Is it dangerous or not? Is it all right for our future or for our animals?" Three years after the spill, a Navajo teacher also inquired: "Does the water affect the people? Is it contaminated?" For these people, as for anyone confronted by radioactive contamination of one magnitude or another, the long-lasting nature of the danger is what raises it to a level of threat unlike any other. The CDC's answer apparently is not reliable. The spill, then, is not yet over. As Herman Charley said, "Radiation could show up and hurt us 30 to 40 years from now. They say it lasts 4,000 years."

Josephine Benally is worried that her two daughters may want to move back to their land from Oklahoma, and she is very much worried about what will happen to her two grandchildren as they grow older. She knows that "even 20 years from now, people and sheep and land will be affected." Kieyone Begay also expressed the same concern when he said, "I feel my future is pretty much at stake."

It is because of their bond to the land, their need to live in harmony with the environment, their Mother, and their concern for the future that the Navajos living along the Rio Puerco are concerned. They have sued UNC for disrupting that bond, that harmony, and that future. As Begay said, "The way we felt is that somebody took our heart while we were still alive."

(continued to page 59)

UPDATES

EPA, DOE Push for In-Situ Disposal, Higher Radon Limits for Tailings Piles

If the U.S. Environmental Protection Agency (EPA) and Department of Energy (DOE) have their way, abandoned uranium mill tailings piles along watercourses and in population centers will be left exactly where they are today.

EPA's final general environmental standards for cleanup and disposal of inactive tailings at 23 sites in the West and one in Pennsylvania would make stabilization-in-place of the nine most hazardous sites a priority over moving the piles to remote locations. If the proposal survives, it also would likely foreclose any option of relocating more isolated "medium" and "low" priority inactive tailings piles.

DOE seems to have embraced stabilization-in-place for all inactive sites as its "preferred option" for remedial action, a move which has at least two western states where 12 of the 24 abandoned piles are located concerned that the ultimate cleanup and disposal of the piles will not be done properly. Said an aide to Colorado Gov. Dick Lamm, "DOE's plans for remedial action at this point are just unacceptable to us."

EPA's final inactive-site standards remain in draft form, but indications are the agency will publish them in the *Federal Register* before Oct. 1, if amendments to the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 being considered by a House-Senate conference committee are approved by Congress in September. Otherwise, the environmental agency will miss another deadline for standards which under the original language of UMTRCA had to be adopted by November 1979.

The final standards also would allow 10 times more radon emissions from reclaimed piles than was proposed by EPA in January 1981, give DOE discretionary authority in cleaning up off-site contamination "only where a hazard is identified," and eliminate specific requirements for protection of ground water around tailings piles. The standards would reduce the effective life of design and stabilization to "at least 200 years" and permit larger amounts of residual radioactivity at decontaminated sites.

A copy of the draft final standards, which were being circulated within EPA, DOE and the Office of Management and Budget this summer, was obtained by *Mine Talk* from individuals close to the DOE's remedial action program.

Environmental groups and citizens living in the vicinity of abandoned tailings expressed concern that the draft final standards would not insure that the abandoned mill wastes would be properly cleaned up to minimize or eliminate future maintenance or surveillance and protect the public health and environment.

"When Congress passed UMTRCA, it intended that the job of cleaning up these tailings would be done right the first time," said Dave Berick of the Environmental Policy Center in Washington, D.C. "EPA's final rules now cast considerable doubt on whether that mandate will be met."

Louise Yellowman, a Coconino County (Ariz.) supervisor and member of the Tuba City Citizens Committee for Uranium Radiation Control, said she feared the effect EPA's



The Grand Junction, Colo., mill tailings pile (in brackets) lies along the northern bank of the Colorado River.

Chris Shuey

final standards would have on the performance of the entire remedial action program.

"This apparently places not only the Tuba City Rare Metals pile in jeopardy, but also the high priority sites, such as Shiprock," she said. "We don't want the [Navajo] tribe to have to spend its limited resources to clean these things up again in 20 years after it was done wrong because of weak standards."

When contacted in July by the *Arizona Republic* which also had obtained a copy of the draft final standards, Dr. Stanley Lichtman, project leader for the EPA inactive-site effort, would not comment on the proposed revisions, saying, "You aren't supposed to have that document." Lichtman said the standards were being circulated to other agencies and therefore could be changed prior to final promulgation.

The EPA official may have been referring to DOE, which this summer was working quietly behind the scenes to convince EPA and the U.S. Nuclear Regulatory Commission (NRC) that the standards should be relaxed still further. One department official said DOE now believes that a 100-year longevity requirement coupled with "a small amount of active maintenance" would be sufficient to reclaim both abandoned and active tailings. Asked where he thought DOE would get the money for "active maintenance," the official said, "We'll have to deal with that later."

But some states participating in the remedial action program don't buy DOE's view. A Colorado radiation licensing official told the department at a June 10 remedial action program participants meeting in Denver, "Changing (weakening) [sic] the standards would invalidate a good effort and miss the goal of UMTRAP [Uranium Mill Tailings Remedial Action Program]. The money spent should not be wasted by doing a job that will have to be redone later."

Rahe Junge of the Colorado Geological Survey, which has recommended rail transportation to move two inactive piles at Rifle and one at Grand Junction (all three lie adjacent to or near the Colorado River), reminded DOE that the "overall goal for tailings disposal is safe, long-term containment for thou-

sands of years. Short-term convenience or benefits should not outweigh the primary emphasis of a permanent solution to the tailings problem."

Utah uranium tailings officials accused DOE of a "change in position" on the question of relocation and charged that the DOE branch responsible for designating "vicinity sites" had precluded Oak Ridge National Laboratory officials from releasing key information on off-site contamination surveys.

Harold Tso, director of the Navajo Environmental Protection Commission, said in-place disposal "is not acceptable" for the four inactive piles on the Navajo Reservation and suggested that if the government would give the tribe a sixth of the program funds it would "implement the program in a timely and efficient manner."

DOE's response was predictable. "The basic program need is to do the work at a minimum cost and meet the minimum standards," a department official said, referring to EPA's "minimum national standards." "Cost is not stated in the Act but the program and the efforts must be cost effective," he said.

A Colorado assistant attorney general, however, said in a memo to Al Hazle, director of the state's Radiation Control Division, that "the state arguably has a broader, implicit authority to apply more stringent general standards than DOE's and to refuse to concur in remedial action if it believes that the EPA standards are inadequate."

When this position was enunciated at the participants' meeting, DOE waffled a bit. According to minutes of the meeting, the department at one juncture said, "The program can go beyond the EPA standards if we mutually agree but there must be a good and valid reason for doing so. We're not going to move them unless we have to." Later, agency officials were more succinct: "The State would pay 100 percent of the cost of remedial action above and beyond that mutually agreed to."

Under the requirements of UMTRCA, the federal government will pay 90 percent of the cost of stabilizing inactive tail-

Table 1
SUMMARY OF TAILINGS QUANTITIES AT COMMINGLED SITES¹

Mill	Total through 1981	AEC-related (base case)	Commercial (base case)	Commingled piles	AEC-only piles	Commercial only piles
Cotter, Colo.	1.9	0.3	1.6	1.5	0	0.4
Union Carbide, Colo.	9.9	5.7	4.2	9.4	0.5	0
Anaconda, N.M.	23.6	8.8	14.8	22.8	0.8	0
Homestake, N.M.	21.2	11.4	9.8	19.9	1.3	0
Kerr-McGee, N.M.	30.4	10.0	20.4	30.4	0	0
TVA, S. Dakota	2.0	1.6	0.4	1.5	0.5	0
Atlas, Utah	10.2	6.0	4.2	10.2	0	0
Dawn, Wash.	3.0	1.2	1.8	0	1.2	1.8
FAP, Wyo.	5.9	2.1	3.8	5.4	0.5	0
Pathfinder, Wyo.	9.5	2.7	6.8	8.2	0	1.3
Petrotomics, Wyo.	5.5	0.7	4.8	5.5	0	0
Union Carbide, Wyo.	7.3	2.1	5.2	6.5	0	0.8
WNI, Wyo.	7.7	3.4	4.3	7.7	0	0
Totals	138.1	56.0	82.1	129.0	4.8	4.3

¹Adapted from: U.S. Department of Energy. "Plan for Stabilization and Management of Commingled Uranium Mill Tailings." DOE/DP-0011, June 30, 1982.

TVA — Tennessee Valley Authority; FAP — Federal-American Partners; WNI — Western Nuclear, Inc.

Union Carbide Seeks Changes in NRC Mill Licensing Rules

Union Carbide Corp. (UCC), a uranium processing company with facilities in Wyoming and Colorado, has petitioned the U.S. Nuclear Regulatory Commission (NRC) to amend NRC's Oct. 3, 1980 uranium mill licensing regulations.

In a Nov. 30 *Federal Register* notice, NRC said, "The petitioner believes that the suggested amendments will continue to protect adequately the public health, safety and the environment..." while "significantly" reducing the costs to uranium operators of complying with the regulations. The agency said the company was basing its suggested amendments on "information its says was not available to the NRC at the time the regulations were issued."

UCC wants to change NRC's long-term stabilization criteria for disposal of active uranium mill tailings from "thousands of years" to 100 to 200 years. The company said the 1,000-year requirement "is unreasonable" and that the "technology does not exist to assure the isolation of tailings for thousands of years."

Union Carbide cited testimony before the NRC, New Mexico, Colorado and congressional committees to support its contention, even though Colorado has adopted revised uranium licensing regulations that incorporate the 1,000-year longevity requirement. New Mexico's revised radiation protection regulations, adopted in 1981, call for protection against wind and water erosion for 200 years.

The company suggests deleting NRC's 2-pCi/m²-sec. radon emanation rate limit for reclaimed tailings piles to a requirement that tailings covers "shall be designed to result in a calculated reduction in radon emanation...to assure that concentrations of radon and other radioactive material concentrations beyond a small buffer zone of approximately 500 feet established around covered areas do not exceed limits..." of NRC's 10 CFR Part 20 radiation standards.

These limits are for radioactive materials in air and water and their substitution for the NRC radon limit would result in a less stringent standard for the amount of cover needed to reclaim tailings piles.

UCC also wants to change NRC's regulations for groundwater protection to give "guidance" to operators of existing tailings impoundments where seepage is a problem. This guidance includes taking into account current uses of affected groundwater, the potential for use of that groundwater, the size of the aquifer affected, and the availability of alternative water supplies.

Union Carbide operates a uranium and vanadium mill at Uravan, Colo., and mills at Maybell, Colo., and Gas Hills, Wyo. The company also remains in control of a former uranium mill (which now processes vanadium ore) and tailings pile near Rifle, Colo., and was active in uranium exploration in the Black Hills of South Dakota through 1981.

UCC's petition is more than 400 pages long and can be obtained free from John Philips, Chief, Rules and Procedures Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, D.C., 20555, (301) 492-7086. *NRC is accepting written comments until Jan. 31. All comments should include the petition docket number, PRM-40-24.*

ings generated for use in defense programs, with the states picking up the remaining 10 percent and enjoying a statutory right of consultation and concurrence. The federal government will foot the entire bill for cleanup of the five abandoned tailings sites on Indian lands.

Some individuals who attended the meeting told *Mine Talk* they doubt that the states' views of what constitutes adequate remedial action would be "mutually agreeable" to DOE. This, they said, makes the prospects of proper reclamation less likely in that state legislatures may not look favorably upon a request for funds for a job that was supposed to have been handled by the federal government.

But all indications are that EPA and DOE are firm about relaxing requirements for inactive site cleanup and the ultimate reclamation of "commingled" tailings at active sites. In fact, proposals by DOE's remedial action program office in Albuquerque to scrap all radon emission rate standards have been adopted by the agency's Office of Defense Wastes and By-products Management (DOE/ODWBM) which is studying the question of what to do with commingled tails.

Commingled tailings piles contain both tailings generated solely for sale to the U.S. Atomic Energy Commission prior to Jan. 1, 1971 and those produced for commercial sale since then. According to DOE's plan for stabilization and management of commingled tailings, some 56 million tons of AEC- or defense-related tailings are located at 13 active uranium pro-

cessing sites in the West. These sites contain a total of 138.1 million tons of tailings, of which 134 million tons are commingled or "AEC-only" piles. (See Table 1 for details.)

DOE makes the legal claim that the government is not under a statutory requirement to pay for stabilizing and maintaining defense-related tailings at these sites, nor is it liable under prior contracts between the AEC and mill owners for cleanup costs because the yellowcake purchase contracts did not provide for decontamination or decommissioning provisions. But it adds that "establishment of a program of financial assistance to the mill owners could prevent or defer time consuming, costly, politically embarrassing, and precedent setting litigation."

In a June report that was produced under a congressional mandate to study the problem of commingled tailings, DOE said it was recommending relaxation of proposed EPA standards for inactive sites and final mill licensing regulations adopted in October 1980 by the NRC because "the cost to implement [them] does not appear to be commensurate with the health benefits achievable." DOE said it preferred implementation of a set of requirements similar to New Mexico's revised radiation protection regulations, which the NRC and some other states view as inadequate for long-term stabilization and which environmentalists regard as adequate only to meet the needs of industry.

The agency is proposing elimination of the radon emission

Table 2¹

PROPOSED URANIUM MILL TAILINGS STABILIZATION STANDARDS AND REGULATIONS

Standard/Regulation	USNRC ²	USEPA ³	USEPA ⁴	New Mexico ⁵	USDOE ⁶
Longevity (years)	1,000 plus	1,000	200-1,000	200	100
Radon Emanation Rate (pCi/m ² -sec)	2	2	20	Not Specified	Site Boundary Level Only
Ground Water Requirements	No Degradation	EPA Drinking Water Standards	None	N.M. Water Quality Rules	None
Radon Concentration (pCi/l)					
On Tailings Area	30 ⁷	Not Specified	Not Specified	30	Not Specified
At Site Boundary	3	Not Specified	Not Specified	3	3
Cover Thickness (m)	3	Not Specified	Not Specified	No Requirement	No Requirement

¹Adapted from: U.S. Department of Energy. "Plan for Stabilization and Management of Commingled Uranium Mill Tailings." DOE/DP-0011, June 30, 1982; Table 2, p. 13

²U.S. Nuclear Regulatory Commission, 45 FR 65525, Oct. 3, 1980 (for active tailings piles).

³U.S. Environmental Protection Agency, 46 FR 2556, Jan. 9, 1981 (proposed standards for inactive tailings piles).

⁴U.S. Environmental Protection Agency, draft *Federal Register*

notice, June 2, 1982 (for inactive tailings piles).

⁵State of New Mexico Environmental Improvement Board. "Amended Radiation Protection Regulations and Statement of Reasons for Their Adoption." Oct. 9, 1981.

⁶U.S. Department of Energy, from DOE/DP-0011, Vol. 1, p. 6.

⁷Same as 10 CFR Part 20, Appendix B-II.

pCi/m²-sec — picoCuries per square meter per second; pCi/l — picoCuries per liter; m — meters.

rate standard, raising the radium limit for decontaminated surface soil to at least 15 pCi/g (picoCuries per gram), shortening the longevity requirement to 100 years and eliminating a tailings cover thickness requirement. A comparison of some of these recommendations with NRC's regulations, EPA's proposed and draft final standards, and New Mexico's requirements is shown in Table 2.

DOE said its recommended standards would be more cost effective, estimating that the commingled program would cost \$260 million, of which about \$110 million would be the government's share for defense-related tailings. As Table 3 shows, these figures are identical to the costs associated with applying New Mexico's regulations.

It was unclear, however, if the \$260-million estimate also included industry's cost of the ultimate cleanup of

"commercial-only" tailings at active sites. DOE's latest estimates for the entire remedial action program for 24 sites totaling only 26 million tons ranged from about \$500 million to about \$725 million in 1981 dollars. At the end of this year, various estimates place the total number of tons at active tailings in the U.S. close to 200 million. The figures have gotten jumbled somewhere along the line, but nobody can say how or why.

The suggested scrapping of radon flux measurements originated in DOE's remedial program office. Richard Campbell, program manager, said in August the agency was having "difficulty in getting agreement" on a flux standard for inactive piles because of wide variation in physical conditions from site to site, so it suggested a standard limiting airborne radon concentrations to 3 pCi/l at the site boundary.

Campbell said a site boundary standard would be "easier to measure" and could be used to predict radon emission rates from reclaimed piles. "You could apply an accepted transport model which then yields an estimate of what the flux rate will be. You can tell the designers to design a cover not to exceed the boundary measurement." He added that a 3 pCi/l radon concentration in air equates to a flux rate anywhere from 50 pCi/m²-sec to 100 pCi/m²-sec (picoCuries per square meter per second).

Tony Kluk, a DOE/ODWBM official in Washington, D.C., said a 3 pCi/l air concentration equates to "roughly" 100 pCi/m²-sec. Meeting a site boundary concentration standard, he said, could be accomplished by varying the composition of cover materials on the pile or "extending the site boundary." He noted that this had been done in New Mexico where Homestake Mining Co. had spent \$2 million to buy a half-mile buffer zone around its active tailings pile near Milan as a method of tailings dust control.

But Paul Robinson, environmental analyst at Southwest Research and Information Center in Albuquerque, said he thought DOE's scheme was "a little shortsighted, given that the department is recommending relaxation of standards to make both the remedial and commingled programs more cost

Table 3

**COST SUMMARY FOR RECLAIMING
COMMINGLED TAILINGS PILES
U.S. DEPARTMENT OF ENERGY
JANUARY 1982 (millions of dollars)¹**

Assumptions	All Tailings ²	Commingled Tailings
NRC Regulations	590	260
N.M. Regulations	260	110
N.M. Regulations (stabilization only)	130	50
Flat Free (\$4.80/ton)	640	270
GAO Estimate ('79 \$)	315	129

¹Adapted from: U.S. Department of Energy. "Plan for Stabilization and Management of Commingled Uranium Mill Tailings." DOE/DP-0011, June 30, 1982; p. 18.

²Tailings quantities as of January 1982, excluding "commercial-only" impoundments.

effective." Purchasing land to comply with standards not only is outside of the scope of UMTRCA, he said, but also does not comply with the act's requirements of effective, long-lasting control of active and inactive uranium tailings and could set a precedent for other federal programs dealing with radioactive and hazardous wastes.

Robinson also said that a "quick review" of earlier

engineering assessments performed for DOE by the Salt Lake City firm of Ford, Bacon and Davis Utah, Inc., for each of the 24 inactive sites "shows that a 3 pCi/l radon boundary concentration already exists at some sites. Is this the standard DOE has been looking for to get around completing the remedial program at many isolated piles?"

— Chris Shuey

Canonsburg EIS Out; DOE Favors Stabilization-In-Place for First of 24 Inactive Sites

About 212,000 tons of uranium mill tailings and related contaminated material from vicinity sites would be stabilized in place at two locations in and near Canonsburg, Pa., under a proposal by the U.S. Department of Energy (DOE).

Stabilization in place is the preferred of five alternatives for remedial action at the 19-acre Vitro Rare Metals tailings site in Canonsburg, according to a recently released draft environmental impact statement.

The EIS on Canonsburg — the first of 24 sites in the U.S. to be cleaned up under provisions of the federal Uranium Mill Tailings Radiation Control Act of 1978 — also proposes stabilization in place for 12,000 tons of tailings on a 9-acre site in nearby Burrell Township, a mile east of Blairsville, Pa. Material from more than 100 vicinity properties (buildings and houses where tailings were used for construction) would be disposed at the Canonsburg site, DOE said.

Radium ores processed between 1911 and 1922 at the Canonsburg property were remilled for their uranium content for the federal government between 1942 and 1957 by Vitro Corporation of America. The site now is in private hands and known locally as the Canonsburg Industrial Park. Vitro was a contractor to the U.S. Atomic Energy Commission during the 1940s and 1950s.

The EIS on the proposed remedial action assessed five alternatives, including "no action." Costs of each of the stabilization modes ranged from \$13.7 million for the preferred alternative to \$44.5 million for remote disposal. DOE said in a December press release that remote stabilization at "an unpopulated, hydrogeologically acceptable repository" in nearby Hanover Township would "require moving contaminated materials out of the county in which they currently reside, against the guidelines of the Commonwealth of Pennsylvania."

DOE's Uranium Mill Tailings Remedial Action Project (UMTRAP) Office in Albuquerque said formal public hearings on the draft environmental statement will be held Jan. 11 and 12 in the Canonsburg area. (See schedule below.) *Written comments will be accepted until Jan. 24* and should be addressed to Project Manager, UMTRAP Office, Albuquerque Operations Office, U.S. Department of Energy, P.O. Box 5400, Albuquerque, N.M., 87115, (505) 844-3941.

DOE said persons interested in making oral

statements at the hearings should notify the UMTRAP office in advance. Persons who do not make advance arrangements to speak may register at the hearings, the agency said. Statements may be limited to a certain amount of time depending on the number of persons who have asked to speak.

Copies of the EIS are available at the Washington County Commission Office and city offices in Canonsburg, North Strabane, Burrell and Hanover, and at public libraries in the area. Copies also may be obtained by writing Dick McKee, Public Information Officer, Jacobs Engineering Group Inc., 5301 Central Ave., NE, Suite 1700, Albuquerque, N.M., 87108, or by calling (505) 846-4030.

CANONSBURG REMEDIAL ACTION PUBLIC HEARING SCHEDULE

January 11 — 10 a.m. to noon
Burrell Township Supervisors Office
Black Lick, Pa.

January 11 — 7 p.m. to 10 p.m.
Hanover Township Fire Hall
Old U.S. Route 22
between Florence and Paris, Pa.

**January 12 — 3 p.m. to 5:30 p.m.
and 7:30 p.m. to 10 p.m.**
North Strabane Township Hall, Rte. 519
North Strabane, Pa.

In other inactive-site news, the draft EIS for cleanup of the Vitro tailings pile at Salt Lake City, Utah, was expected to be published and available by Dec. 23, according to a Jacobs Engineering press release. Jacobs is the lead contractor to DOE on the remedial action program.

Public hearings on the document have been scheduled for Feb. 1 and 2 in South Salt Lake City and Tooele County, Jacobs said. *Written comments will be accepted until Feb. 11.*

Jacobs said meeting times and places, location of documents available for review, and addresses for submission of written comments "will be published as soon as they are available."

Earth-moving Starts at Bisti Despite Sierra Club Challenges

Sunbelt Mining Co., a wholly owned subsidiary of Public Service Co. of New Mexico (PNM), has started moving earth preparatory to building roads at its proposed Gateway coal mine 30 miles south of Farmington. The activity follows decisions by a state mining commission and two state courts not to prevent Sunbelt from conducting site preparations until a Sierra Club challenge to mining in the area has been settled.

The mine is on a section of state land surrounded on three sides by the Bisti Wilderness Study Area (WSA) on U.S. Bureau of Land Management (BLM) land. Both the WSA and Gateway mine site contain colorful badlands, scenic pinnacles of rock, and important fossil deposits.

The Bisti region, which also is the home of several thousand Navajos, has been the subject of an intense battle between environmentalists and the federal government over the need for coal leasing and a new coal-fired power plant. The Gateway site itself contains only one-tenth of one percent of the estimated 6 billion to 10 billion tons of strippable coal believed to underlie the San Juan Basin of northwest New Mexico (*Mine Talk*, Vol. 1, No. 4, "Slicing Up the Baby").

The Sierra Club asked the state Coal Surface Mining Commission in late August to prevent Sunbelt from engaging in site preparations until the environmental group had exhausted all appeals avenues for its Gateway unsuitability petition that had been dismissed earlier in the month by the state Mining and Minerals Division.

The commission rejected the Club's request for a stay, finding that Sunbelt's claim that money and jobs would be lost if it could not begin mining activities immediately outweighed Sierra Club's claim that irreparable damage to the wilderness qualities of the area would result from site preparations.

Sierra Club had filed the unsuitability petition on the Gateway site in March, asking the state to prohibit strip mining there. The Club said that the recreational qualities of the adjoining WSA would be greatly harmed by the noise, blasting, traffic and landscape alterations associated with the mine; that the Gateway site itself was primarily used for recreation and could not be restored to that use after strip mining; and that the badland topography of Gateway could not be reclaimed and would be replaced by a mass of gullies within a few decades.

At a June hearing on the petition, Sunbelt Mining and Americans for Rational Energy Alternatives (AREA), intervenors in the case, argued that the site was presently used for grazing and could be reclaimed to that use after mining; that the badlands of the Bisti area were not unique; and that the mine should be approved because it would provide 200 jobs.

Ed Kelley, director of the Mining and Minerals Division, announced in August that the area was in fact suitable for mining. Soon thereafter, Sierra Club asked a state court for a temporary restraining order to prevent mine site activities pending an appeal of Kelley's decision. The court ruled it had no jurisdiction because the group had not exhausted all of its administrative appeals options.

Sierra Club then went back to the commission which

rejected its request for a stay in site preparations until after a scheduled Sept. 21 appeals hearing on the state's dismissal of the Sierra unsuitability petition. Following the commission's action, Kelley accepted a bond from Sunbelt allowing surface-disturbance activities to begin.

A different state district court judge subsequently rejected another request by the environmental group for a stay in mining activities at Gateway, finding that Sunbelt would suffer "irreparable harm" if the Club's request was granted and that the group was not likely to prevail on the merits of its unsuitability appeal. The court said its finding that Sierra Club was unlikely to succeed on appeal was based solely on an identical finding of the Surface Mining Commission.

The court acknowledged that the organization also would be irreparably harmed if site preparations proceeded, but found that the harm to Sunbelt was greater because the company would not be able to recover damages in a legal action against the environmental group. Sierra Club, the court said, is a non-profit organization and therefore would not have the financial resources to pay damages to Sunbelt.

Sunbelt's claims of revenue loss and job layoffs stood well with the commission and courts, but contradicted other statements that indicated mining activities at Gateway would not be needed to maintain the company's coal operations in the region.

Sunbelt said at the June unsuitability hearings that its nearby De-Na-Zin mine, also on state land, had only five months of coal reserves left and was in danger of imminent closure. Sunbelt said Gateway would have to be opened as soon as possible to prevent the layoff of the 200 workers.

However, the company told the industry journal *Coal Age* in August that eight months of reserves remained at De-Na-Zin and boasted about controlling another 200 million tons of surface mineable coal in New Mexico. Additionally, a company proposal to extend the mine onto adjacent federal coal tracts currently is under review by the federal Office of Surface Mining, which has requested more data. All this came on top of a 1981 mine plan in which Sunbelt had projected that De-Na-Zin reserves would last through 1984.

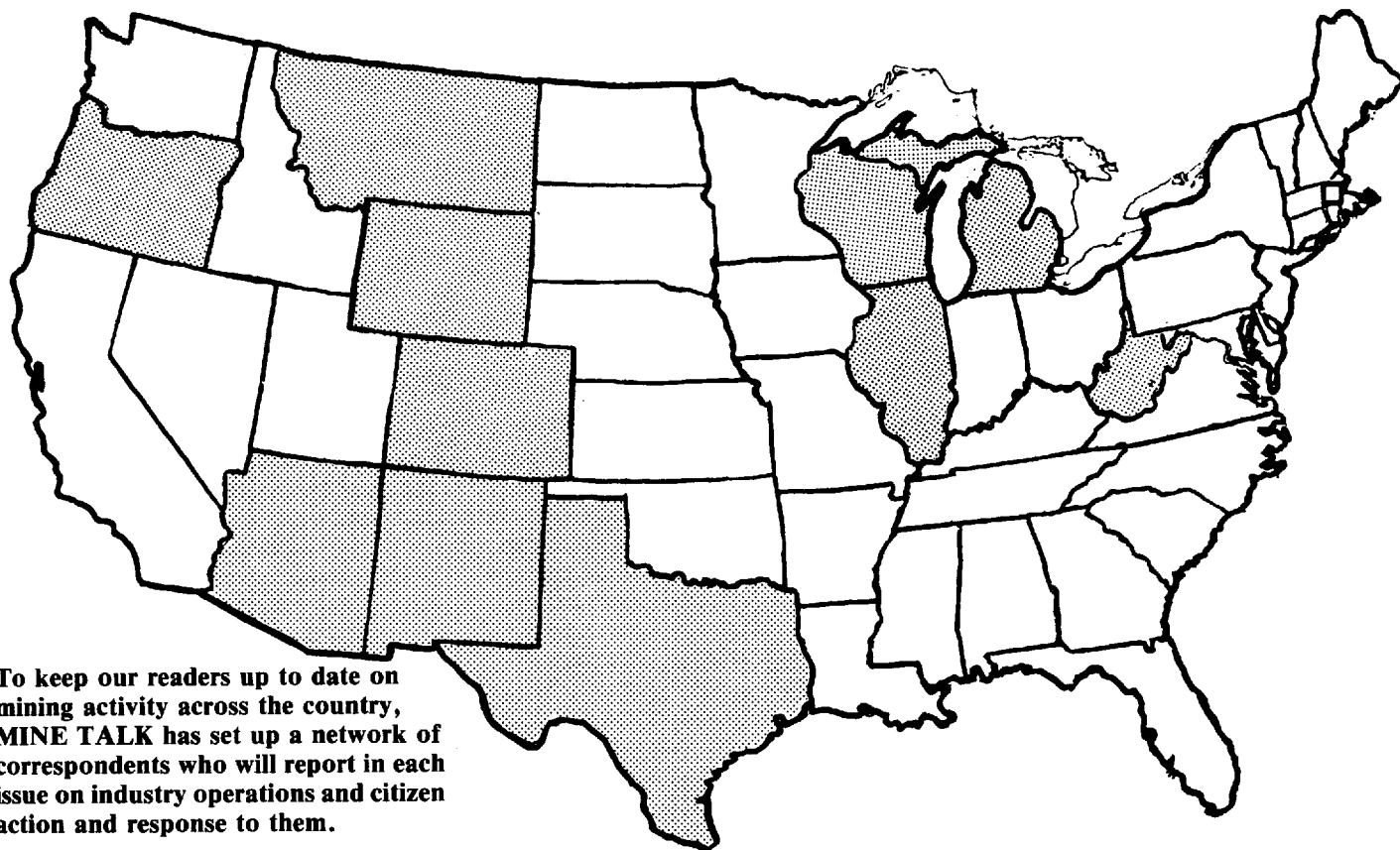
The Gateway site should have been acquired long ago by BLM in an exchange for federal coal tracts elsewhere in the region, thus preserving the badlands of the Bisti area. Acquisition of the site was an objective in BLM's fall 1981 management plan and the federal agency had informally encouraged the New Mexico Land Office and Sunbelt to work out the proposed exchange of Gateway coal for other federal coal. However, neither Sunbelt nor the land office showed any enthusiasm, saying the exchange would be too time consuming.

A later action by a BLM official also threw a monkey wrench into the efforts to preserve the Gateway section. Larry Woodward, then-associate state director for the BLM, said in response to an inquiry by Sunbelt that the Bisti WSA was not a "public park" under the state surface mining regulations. The opinion led the Mining and Minerals Division also to conclude that the Bisti was not a public park. The state agency said it was "compelled to give credence" to Woodward's letter which contained the opinion, despite the fact that the federal official is not an attorney.

— Alison Monroe, SRIC

Alison Monroe keeps track of coal development in northwest New Mexico for Southwest Research and Information Center and the Committee on Coal in Albuquerque, New Mexico. Her last article for Mine Talk, titled "Slicing Up the Baby," appeared in the Spring 1982 edition.

STATE REPORTS



To keep our readers up to date on mining activity across the country, MINE TALK has set up a network of correspondents who will report in each issue on industry operations and citizen action and response to them.

ARIZONA

Loring Wirbel
Nuclear Free State

COPPER INDUSTRY SAGS DESPITE GOVERNMENT PLAN FOR PURCHASES

A plan to increase U.S. government purchases of copper from domestic corporations, announced by Secretary of the Interior James Watt June 29, was not enough of an emergency infusion to re-suscitate the Southwest's ailing copper industry, which continued its headlong plunge into economic despair this summer.

Phelps Dodge Corp. workers received the bad news early this summer that, as expected, company operations in Arizona and New Mexico would not resume June 1 as promised, but would remain shut down indefinitely. The company furloughed 3,300 Arizona miners and 600 New Mexico workers on April 17.

Union leaders originally responded harshly to Phelps Dodge President George Munroe's call in early May for wage concessions and other givebacks in exchange

for reopening the mining facilities. On May 11, local union spokesman Cass Alvin announced that the National Nonferrous Coordinated Bargaining Committee, a coalition of 20 unions meeting in Los Angeles, had rejected all industry appeals for wage concessions.

Within two months, union resolve had weakened somewhat. United Steelworkers locals in Arizona asked Phelps Dodge for an emergency extension of medical-insurance benefits, which were scheduled to end July 17 for out-of-work miners. Company officials appeared to have the unemployed workers over a barrel.

A corporate move by Phelps Dodge administrative employees also meant financial trouble for the city of Douglas, in the southeast corner of Arizona near the Mexican border. Citing a need to be near a center of business activity, company officials moved international headquarters and more than 100 white collar employees to new facilities in the recently constructed Phelps Dodge Towers in downtown Phoenix. Douglas officials said the move hit the town at a particularly bad time, when the effect of the layoffs and the headquarters change was exacerbated by the devaluation of the peso in Mexico,

an important element in the town's tourist trade.

James Watt's announcement in June to a Senate Energy and Natural Resources subcommittee that the U.S. intended to increase its purchases of copper had an effect on the industry the Reagan administration may not have bargained for.

Although Associated Press reports said Watt had told the subcommittee the new purchases would be for the nation's strategic minerals stockpile, government sources said June 30 that the purchasers were the Defense and Treasury Departments, which had immediate needs for copper in wiring and minting uses.

Instead of spurring production, the announcement of purchases sparked a new round of layoff announcements.

Kennecott Corp. announced June 30 that about 400 of the bare-bones maintenance staff left at Ray Mines in Hayden following its May 2 closing would be laid off in July. Kennecott also announced the layoff of 813 Utah employees and salary cuts of 10 percent for all salaried employees.

On July 7, Inspiration Consolidated Copper Co. dismissed 91 hourly workers and 45 salaried workers, and announced it was considering shutting down its

operations in the Arizona mining towns of Globe and Miami.

Although it avoided any layoffs, the Cyprus Bagdad Copper Co. announced July 13 its 924 employees in Bagdad would be taking a 10 percent reduction in work hours, as the company was cutting production levels by a similar amount.

NEW URANIUM MINE SEEKS NPDES PERMIT

Uranium development in the Arizona Strip area north of the Grand Canyon continued this summer with the opening of a new mine and an application for an Environmental Protection Agency permit to discharge mine water.

Bureau of Land Management officials said the district office at St. George, Utah, had approved a plan of operations for Energy Fuels Nuclear Inc.'s (EFNI) third uranium mine in the area. EFNI opened the Hack Canyon mines in mid-1981 and is proposing to operate the Pigeon Mine about 10 miles north of the Hack site.

Discharge of mine water from Pigeon Mine would be to Snake Gulch, which is a tributary to Kanab Creek and later the Colorado River in the Grand Canyon. Discharge from the Hack mines also was allowed to Kanab Creek, but no study was conducted by BLM of the cumulative impacts to Kanab Creek.

EFNI currently is pumping all mine water from its Hack mines into settling ponds where it is evaporated, according to BLM officials. In a draft of the National Pollutant Discharge Elimination System (NPDES) permit for the Pigeon Mine, EPA would require Energy Fuels to develop within one year of the approval of the permit a plan to contain all mine wastes in settling ponds to eliminate discharge to Snake Gulch.

In comments on the proposed permit, Southwest Research and Information Center in Albuquerque, N.M., said EPA should require containment of all mine water immediately in light of the EFNI practice at its Hack Canyon operations.

No information was included in either the draft permit or an accompanying fact sheet supplied by EPA's San Francisco office as to the amount of water projected to be released. The Pigeon ore zone is in a breccia pipe similar to that in Hack Canyon. BLM officials said very little water is encountered in these collapsed sandstone and conglomerate vertical formations.

Billy Templeton, district manager for the BLM in St. George, said his office has required Energy Fuels to sink its

Pigeon shaft from the top of a mesa overlying the ore body. Templeton said this would create fewer environmental impacts to the Snake Gulch canyon floor where the adits originally had been proposed. Entrances to the Hack mines are from the bottom of Hack Canyon and much concern was expressed during the permitting of these mines about the potential for flood impacts to ore pads and ore waste piles.

COLORADO

EXXON RECEIVES PERMIT TO PUT COLONY ON HOLD WITH NO RECLAMATION

With Exxon's rapid pullout in May from the Colony oil shale project, there is concern among local residents and environmental groups about reclamation of the site north of Parachute, Colo.

Exxon's possible intent to return to the project at a future date could short-circuit reclamation requirements of the firm's state-approved reclamation permit.

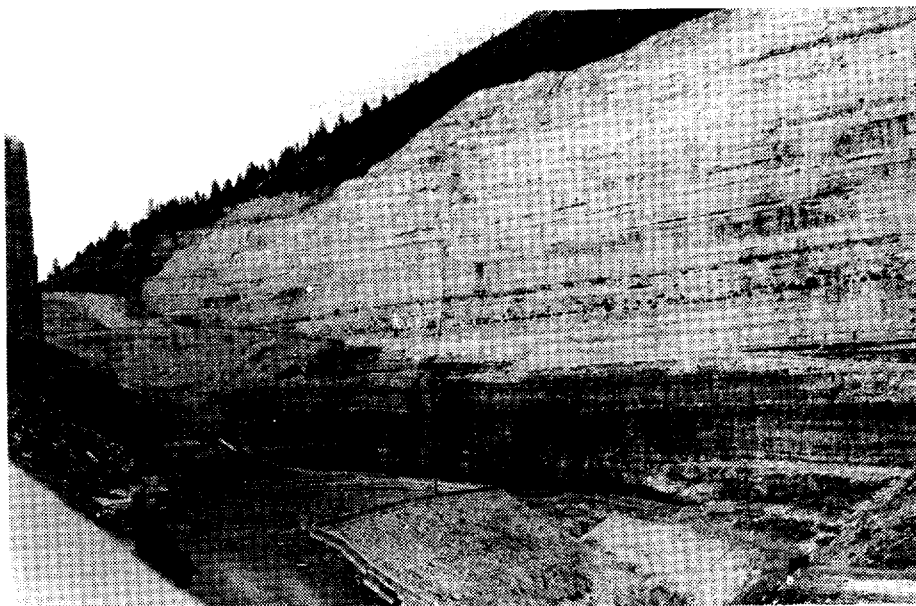
The state Mined Land Reclamation Board (MLRB) in December approved an amendment to the permit which places a three-year hold on the project, allowing Exxon to restart Colony after 1984 if its economic feasibility improves. Under the amendment, Exxon can suspend operations at the site with no reclamation requirements for the three-year period.

Gerald Ortloff of Exxon said that cost estimates for the holding pattern would be in the millions of dollars, according to an Aug. 27 article in the *Glenwood Post*. Ortloff said that the project was being put on hold so that the company "wouldn't have difficulty coming back on short notice" if economic conditions improved. Ortloff did not specify the conditions necessary to restart the project.

In the meantime, the company will stabilize disturbed areas and revegetate areas that won't be disturbed again if the company resumes operations at the site, Ortloff said. More than 100 acres will be revegetated now, and the remainder will be "stabilized" to prevent erosion and dust pollution. The stabilization techniques that will be used were not specified in the newspaper account.

While the issue was being settled, Exxon was engaged in transitional activities, including some reclamation efforts. These were outlined in a list distributed by the company at an MLRB meeting in June. The document lists several reseeding and product-testing projects that serve the immediate needs for site maintenance, reclamation and stabilization of the area. However, no data on the success of these efforts were provided in Exxon's mining and reclamation plans.

Reclamation of the Colony project has been the source of local concern and criticism because most of the 1,130-acre site will remain unreclaimed for the holding period while Exxon



This exclusive photograph inside the Exxon Colony oil shale project demonstrates why local citizens are concerned about reclamation of the site. The cuts in the canyon walls are some 300 to 400 feet deep.

decides whether to resume operations. Until the December MLRB meeting, Exxon was not obligated to provide a post-1984 plan for the site.

However, a proposal submitted by the Colorado West office of Friends of the Earth (FOE), which was accepted by the Board in December, will require Exxon to provide a plan for the site after expiration of the new three-year permit. Connie Albrecht of FOE said acceptance of the proposal marks progress in the organization's struggle to hold the company responsible for restoration of the site.

FOE and the Garfield County Citizens Association (GCCA) have been watching events at the project and are intent on assuring that Exxon does not abandon the site without adequate reclamation. Judy Moffatt of GCCA asked the MLRB this summer to create a citizens advisory committee to monitor reclamation activity at the site. The Board turned down the request at its meeting in June, but encouraged GCCA to establish its own committee to participate in public board meetings and to communicate with state technical staff.

—Cindy Bogner

ILLINOIS

Illinois South Project

WATT SUED OVER STATE MINE PROGRAM

Illinois South Project and nine other Illinois citizen organizations filed suit in U.S. District Court for central Illinois July 16 challenging Interior Secretary James Watt's conditional approval of Illinois' regulatory program for implementing the federal Surface Mining Control and Reclamation Act of 1977 (SMCRA).

The complaint listed more than 60 deficiencies in the state program and seeks to have the court direct Watt to require Illinois to make changes in the program to bring it into compliance with the national minimum standards set forth in the Surface Mining Act and concomitant regulations.

SMCRA encourages states to take the lead authority for administering and enforcing the environmental protection and reclamation standards of the Act. Illinois applied for this lead authority, or "primacy," in March 1980, but was turned down by former Interior Secretary

Cecil Andrus in October 1980. Illinois re-submitted its program on Dec. 22, 1981, and Watt granted final approval in mid-May.

In January, Illinois South, a Herrin-based coal industry watchdog group, and 15 other organizations submitted several hundred pages of detailed legal and technical comments regarding the revised Illinois program submitted to Watt by the Illinois Department of Mines and Minerals (IDMM). The groups requested that the many problems and deficiencies cited in the comments be corrected, and urged Watt not to approve the Illinois program as submitted. (For details, see *Mine Talk*, Spring 1982, pp. 33-34.)

"Without question," said Mark Squillace, an attorney for the Washington, D.C.-based Environmental Policy Institute (EPI), "this program is the worst one we've seen submitted to the Office of Surface Mining [OSM], and Watt's decision approved a state program with more uncorrected deficiencies and thus fewer conditions than any other program approved to date."

Among the 60 major issues addressed in the lawsuit are:

- * inadequate criteria for post-mining alternative land uses that would allow major variances for coal companies to avoid returning mined lands to their pre-mining condition or to permit lesser standards for reclamation;

- * weaker provisions for the protection and reclamation of prime farmlands than existing federal regulations;

- * deficient design and performance standards for creating water impoundments and covering exposed coal seams with water (prohibited by the Act);

- * deficiencies in provisions for citizen participation in the review of mining permit applications;

- * deficiencies in provisions for protecting people and property from blasting damages;

- * deficiencies in the state process for designating lands unsuitable for mining; and

- * deficiencies in the permit application requirements that address prevention and/or control of subsidence from underground mines.

Not only does the Illinois program contain numerous provisions that are less effective than the federal standards, but Illinois' program also will not assure citizens the quality of reclamation, the protection of property and the citizen rights that are essential for controlling mining's negative impacts. Illinois South and other groups have attempted to correct prob-

lems in the Illinois program through testimony at public hearings, state rule-making proceedings, meetings with IDMM, and comments to OSM. Unfortunately, IDMM and OSM have become increasingly unresponsive to citizen input, and the courts provide the only remaining avenue for correcting many of the deficiencies.

Another key reason for taking Interior to court is that IDMM already has sued Watt over the approval. The Interior Secretary bent over backward in approving the state program; however, he conditioned the approval contingent upon IDMM's correcting five specific deficiencies. Apparently, this wasn't sufficient for the litigation-prone IDMM because the day after Watt signed the approval, Illinois filed suit. The citizens' lawsuit not only addresses the 60 major issue areas, but also is aimed at preventing IDMM from weakening the three conditions it challenged.

Among the organizations joining Illinois South were: Citizens for the Preservation of Knox County (CPKC), the Illinois Division of the Izaak Walton League of America, the Audubon Council of Illinois, the Illinois Farmers Union (IFU) and the League of Women Voters of Illinois. As one CPKC board member said, "We shouldn't be allowed to keep our name if we don't join this litigation."

Harold Dodd, IFU president, said of the action: "Our suit doesn't ask the Court to overturn [Watt's] decision and impose a federal program in Illinois. This would lead to further delays in implementing the full protections of the Act and would slow the flow of Abandoned Mine Land Reclamation monies to the state to clean up the past abuses of the coal industry. By asking the Court to require changes in the program, while keeping Illinois as the primary regulator, our suit will lead to better reclamation of the state's most important and irreplaceable resource, prime farmland."

League of Women Voters spokesperson Judy Beck said the 7,000-member organization is a party to the litigation because of inadequate public participation in the approval of the program and limits to citizen participation in its eventual enforcement. Beck, vice president for natural resources for the Illinois chapter of the League, said she was disappointed by the Watt decision. "The program denies citizen rights that are essential for controlling mining's negative impacts. For instance, the program will allow permit applications to begin the public review process before they are complete, and the state may only give

citizens 10 days to comment on a complete application."

Vernon Caupert, chairperson of the Reclamation Coalition, an association of 13 county boards, municipalities, soil and water conservation district boards and planning commissions in the coal producing counties of southern Illinois and a plaintiff in the lawsuit, said the state program does not protect prime farmland from the surface impacts of underground mining.

"In fact," Caupert said, "the way the state has defined the area over underground mine works raises serious doubt about the program's ability to address the problem of coal mine subsidence. Furthermore, the program totally exempts underground operations from having to meet the prime farmland standards in instances where surface facilities are located on prime farmland." Caupert also criticized the state's blasting regulations, citing "weak standards for blasting flyrock prevention" and "allowances for unjustified nighttime blasting."

Jim Tyas of the 3,200-member Illinois Division of the Izaak Walton League said the program does not meet the Act's requirement that land be returned to a condition capable of supporting pre-mining uses or higher or better uses through its allowance for coal operators to leave "improperly planned and designed water impoundments" after mining ends.

Tyas said lakes left by operators "may not be suitable for outdoor recreational activities important to Izaak Walton League members because the program allows operators to cover the toxic coal seam directly with water rather than four feet of overburden . . ." The program also "fails to require detailed plans for water impoundments and allows operators to leave angle of repose slopes and highwalls on the perimeters of water impoundments," he said.

Rudy Rice, chairperson of the Perry County Board-appointed Land Reclamation Plan Review Committee, said, "We are hoping for a quick resolution of the problems in the state program so that Perry County, Illinois' leading coal producing county, can obtain the full protections and rights in the permit review process provided by the Surface Mining Act."

Audubon Council spokesperson Margaret Hollowell said her organization "is fully committed to reasonable development of Illinois' vast coal resources. However, we have joined this litigation because of our concern that coal development

under the Watt-approved program will be at the expense of our state's prime agricultural soils."

Illinois South staff member Charles Sheketoff said, "Illinois' vigorous opposition to requiring coal operators to meet the national minimum standards set forth in the Surface Mining Act led to [its] submission of a totally inadequate surface mining program." He said the citizen action puts Watt "on notice that political expedience has no place in such far-reaching decisions for protecting people's rights and the environment."

Sheketoff added that in this case Watt cannot simply dismiss the challenge as an action by a few "environmental extremists." "The 10 plaintiff groups comprise a broad cross section of Illinoisans representing local government, environmental, farming and civic organizations that are deeply committed to the principle that the Illinois program should meet the national minimum standards mandated by Congress."

Other plaintiffs in the lawsuit are the Illinois West Central Conservation Coalition and the Great Lakes Chapter of the Sierra Club.

MICHIGAN

Jeff Bell

CLEVELAND CLIFFS SUED FOR Hg CONTAMINATION

The Michigan attorney general has sued Cleveland Cliffs Iron Co. (CCI) over alleged mercury contamination of fish in Deer Lake near Ishpeming in the Upper Peninsula.

The action against CCI, a major mining company operating in the UP, came in early July after prompting by environmentalists and recreationists who cited a September 1981 discovery that mercury levels in fish in Deer Lake exceeded federal and state standards.

CCI officials expressed surprise at the filing of the lawsuit, saying they had been cooperating with the Michigan Department of Natural Resources (DNR) to remedy the problem.

However, Attorney General Frank Kelly, in an interview on radio station WMPL in Houghton July 3, said that negotiations between the state and CCI had broken down in March over the issue of the state's paying the cost of cleaning up Deer Lake.

CCI's troubles began in summer 1981 when an independent research firm doing an ecological inventory for another company contemplating a gold mining

operation in the area discovered high levels of mercury in fish and sediment samples taken from Deer Lake, a popular local fishing spot and part of the Carp River system. The research firm reported its findings to the DNR, which then took its own samples confirming the results of the independent study.

A DNR interoffice memo dated Oct. 27 reported preliminary results showing an average concentration of mercury in 44 fish samples at 1.38 mg/kg (parts per million by weight). The U.S. Food and Drug Administration standard for mercury in fish is 1 ppm. The Michigan standard is 0.5 ppm. Of the fish sampled, 77.3 percent exceeded the Michigan standard, and 59 percent exceeded the federal standard. The next day the Department of Public Health (DPH) issued a health advisory warning that fish from the lake should not be eaten, and the lake was posted with warnings to fishermen.

In September, shortly before being alerted to the mercury contamination of Deer Lake, the DNR had received a study showing a possible mercury problem at the Ishpeming municipal waste water treatment plant. Samples taken at the plant enabled the DNR to trace the mercury to CCI, then (prior to recent operational cutbacks) the Upper Peninsula's major corporate employer. CCI, with headquarters in Ishpeming, has for years operated extensively in Marquette County, employing several thousand workers at open pit iron mines and iron pellet plants.

Investigation at the waste water treatment plant established that the discharge point for the mercury in city sewers was two CCI laboratories in Ishpeming, where mercuric chloride was routinely used to analyze ore samples and then disposed of in the city sewer system. The labs date to 1929 and 1974 and may have been discharging the chemical for as many as 30 years. According to the DNR, the labs had used and discharged into the Ishpeming sewer system approximately 930 lbs. of mercuric chloride from 1967 to September 1981. Prior to 1964, Ishpeming's sewage went untreated into the Carp River and thus into Deer Lake. Following investigation, Elwin Evans of the biology section of DNR's Water Quality Division said that CCI was considered "the primary source of contaminants of Deer Lake."

In November, CCI stopped dumping mercuric chloride into the city sewer system, and both CCI and the city of Ishpeming announced they were cooperating with the DNR. The DNR informed the attorney general's office of its findings, but calls

for legal action issued by the Michigan United Conservation Clubs and the Upper Peninsula Environmental Coalition went unanswered during the spring and early summer. The DNR refused to comment on questions about its awareness of CCI's use and discharge of mercuric chloride, and CCI remained silent about its lack of care in disposing of a substance as hazardous as mercuric chloride.

The city of Ishpeming will clean its sludge digester in 1982 to remove any mercury residue, but the ban on fishing in Deer Lake will continue, said the DNR's Jack Rydquist, until "natural cleansing processes" dissipate the mercury now in the lake, a process expected to take three to five years. Upper Peninsula residents as yet have no answers to their questions about how CCI is presently disposing of its mercuric chloride or about what the health and environmental effects of CCI's contamination have been. Attorney General Kelly gave some indication of the latter when he stated in his interview with WMPL that mercury contamination has affected mammals and birds as well as fish in the Upper Peninsula.

CCI's sagging business, with poor demand for pellets by the dormant mid-western steel industry, now has more than 3,000 workers on layoff and operations at Tilden and Empire have been suspended indefinitely.

The White Pine Copper Co. began layoffs and cutbacks at its mine and smelter in White Pine in April but will continue work on the \$80 million electrolytic smelter being built at the site. Copper Range Co., a division of Louisiana Land and Exploration Co., appeared to be heading back into copper exploration and mining with announcement of the sale of its UP timber properties, 120,000 acres of forest land and a sawmill, to the Mead Corp.

Uranium mining in the state, under executive ban since August 1980, was recently touted for reinstatement in a report by the DNR and the DPH. The Center for Alternative Mining Development Policy (CAMDP) of Madison, Wis., promptly blasted the report as "a cover-up of the health and environmental hazards of uranium mining."

The report recommends lifting the ban on mineral leasing of state land for uranium mining imposed by Gov. William Milliken in response to public pressure. It concludes that the adverse environmental effects of uranium mining can be minimized or eliminated through regulation and self-monitoring by the uranium industry.

CAMDP said in a statement that Michigan has neither a program for collecting baseline environmental data in uranium exploration areas nor a program for monitoring drill holes for radiation releases. The statement cited the poor regulatory histories of the DNR and the DPH. The DNR, it said, responsible for assuring the proper plugging of drill holes, has a track record of observing only 15 percent to 20 percent of plugging operations, and the DPH has no program for testing individual wells possibly contaminated by radiation stemming from exploratory drilling.

CAMDP said that while the report claims that uranium mining can be safe, it names no locations where uranium has been mined without contaminating area water and air. "Until there is scientific evidence for the claims of the report," said CAMDP, "the uranium mining ban on state-owned lands should remain in effect."

MONTANA

COAL LEASE SALE FUELS 'FAIR VALUE' FEUD

A scandal is brewing over the Powder River Basin coal lease sale of April 28, the biggest federal coal lease sale since the 1971-80 moratorium. Interior Secretary James Watt apparently wants to go back to the old days that preceded and led to the moratorium, in which federal coal was leased to whomever asked for it for a tiny fraction of its value.

The sale of coal leases in northeastern Wyoming and southeastern Montana garnered \$55 million in bids, half of which is to go to the federal government and half to the states of Wyoming and Montana. Watt and Bureau of Land Management (BLM) Director Robert Burford declared the sale a success and pointed out that it was the largest coal sale in history. However, few others are impressed with this amount as a fair price for the public's resources. Some 23,000 acres and 1.486 billion tons of coal were leased, averaging out to less than four cents per ton. Prices for market-ready coal currently range from \$7 to \$40 per ton. The deal looks even less sweet considering that some coal in the ground has changed hands in non-federal transactions for 20 cents to \$1 per ton.

A lawsuit filed by the Northern Plains Resource Council, the Montana Wildlife Federation, the National Wildlife Federation, and the Powder River Basin Resource Council charges that the Secretary of Interior failed to secure the "fair mar-

ket value" for the coal required by the Federal Coal Leasing Amendments Act (FCLAA). It also alleges that the land use plan required by FCLAA and other legislation as a prerequisite of coal leasing failed to discuss such important considerations as agricultural use of the land, land use on non-federal lands in the plan area, and whether the land leased was reclaimable.

The environmentalists' lawsuit was consolidated by a Montana judge with one filed by the Northern Cheyenne Indian Tribe which charges that coal development impacts on the Montana reservation were not considered in the environmental impact statement governing leasing of adjacent tracts. The tribe is requesting financial aid to mitigate the socioeconomic impacts, provisions for training and hiring of Indians, and compliance by mining companies with tribal laws.

To understand the significance of the "fair market value" argument raised by the NPRC/NWF/PRBRC suit, it is necessary to go back more than 10 years to the days before 1971, when the federal government leased coal basically on request to the first company that could prove "commercial quantities" of coal existed on a tract. Over the decades this practice led to leasing of massive quantities of coal at a tiny fraction of their actual value; the companies involved often resold the tracts to other firms at prices much higher than those they paid the federal government. Many tracts remained undeveloped. In 1971, the Bureau of Land Management quietly suspended leasing while it tried to work out a more rational system for deciding when and where coal ought to be leased. The resulting proposed leasing program, called EMARS, was hit with a lawsuit by the Natural Resources Defense Council in 1975. The court's decision in the case (*NRDC v. Hughes*) required the Department of Interior (DOI) to discuss the need for new federal coal leasing in an impact statement, finding it still uncertain whether there was need for any new federal leasing at all. In 1976, after considering the excess of federal coal that had been leased for less than its true value, Congress passed FCLAA over President Ford's veto, requiring Interior to secure "fair market value" when leasing federal coal.

Finally, in the late '70s Interior devised a coal regulatory program to comply with FCLAA, other important legislation such as the Federal Land Policy and Management Act (FLPMA) and the Surface Mining Control and Reclamation Act, (SMCRA) and the decision in *NRDC v.*

Hughes. BLM was to calculate a "leasing target" for each federal coal region based on forecasted supply and demand for coal, and the Geologic Survey, the branch now called Minerals Management Service (MMS), was to calculate fair market value for each tract to be leased based on predicted costs of production and local markets for coal.

Companies interested in acquiring coal in the Powder River Basin and other coal regions have expressed considerable impatience with this ten-year moratorium, asking Interior and Congress when, if ever, they could add to their coal holdings in these areas. Yet the moratorium has not yet led to constraints on the supply of coal, owing to the massive amounts of federal, state, and private coal already held by industry. A report done by the Office of Technology Assessment on federal coal leasing in the Powder River Basin found that the projected capacity of existing and proposed mines would exceed demand in 1990 by 122 million tons per year — without any new federal leasing. This year the market for existing coal holdings seems to be particularly soft, with companies already holding leases finding it difficult to unload them (see *Wall Street Journal*, Feb. 22, 1982; *Washington Post*, May 5, 1982; *New York Times*, May 16, 1982).

However, true to his apparent practice of doing whatever environmentalists don't like whether it benefits the economy or

not, the present Secretary of the Interior has taken steps to lease especially huge quantities of coal over the next year-and-a-half. Leasing targets have been set at high levels in the San Juan Basin (1.2 to 1.5 billion tons; see *Mine Talk*, Vol. 1, No. 4), the Uinta-Southwest Utah Region (1.6 to 2.1 billion tons), the Fort Union Region (0.8 to 1.2) and in the Powder River Basin (2.5 billion tons). These levels disregard the Carter administration target formulas, which although disliked by the present DOI have never been officially and finally changed in the regulations. The Powder River target exceeded levels thought manageable by state government officials and Montana Senator John Melcher.

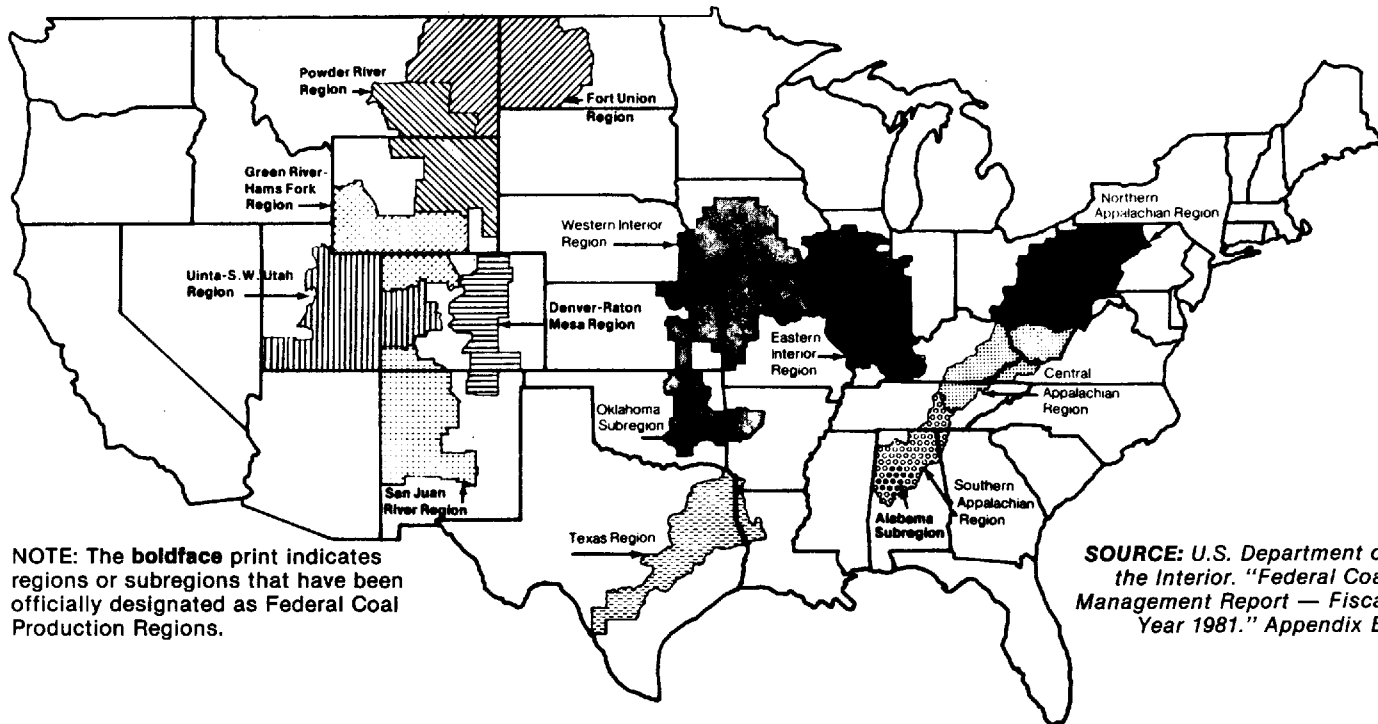
As the NPRC complaint lays out, preparations for the sale proceeded in a way that further circumvented the regulations in order to lease plenty of coal at a price that ensured it would be taken off government hands. The Minerals Management Service calculated "fair market values" for the tracts which were to be used as minimum bids for the sale. Interior admits that somehow these values were leaked to industry well before the sale. NPRC alleges that industry personnel then complained that they would boycott the sale if these minimum bids stood. On April 1, the notice of the sale in the *Federal Register* contained new and lower bids for three of the largest and choicest tracts — a markdown of \$5 million, \$26 million,

and \$15 million respectively. The notice explained that these bids might be lower than actual fair market value, but that the actual fair market value would be calculated after the results of the sale. No previous notice had been given or public comments solicited on this unusual procedure.

When the actual sale of thirteen tracts was held April 28, eight tracts received one bid which was at or slightly above the minimum price set in the Federal Register notice — including the three sale-priced tracts mentioned above. Two tracts received no bids. Three tracts were bid on by two companies each, the bidding driving up the price to twelve to sixteen times the minimum bid. Due to a mistake in the *Federal Register*, one of the tracts was listed at 2.5 cents per ton, 80 times higher than its previously calculated market value, which duly attracted one bid at the mistaken price.

Clearly, what determined the price the government got for the coal in the eight tracts which got only one bid was not a reasoned determination of how much coal the market would absorb and what its value would be, but rather the minimum figure published in the *Federal Register*, including errors and industry-sponsored discounts. If targets had been correctly calculated in the first place, the sale would never have been held. If in this situation the fair market value had then been correctly set by MMS, few or none of the

U.S. COAL PRODUCTION REGIONS AS OF NOV. 9, 1979



NOTE: The boldface print indicates regions or subregions that have been officially designated as Federal Coal Production Regions.

SOURCE: U.S. Department of the Interior. "Federal Coal Management Report — Fiscal Year 1981." Appendix B.

tracts would have received bids. This would have been simply a result of the invisible hand of the marketplace — when supply exceeds demand, you can't sell your goods except by bringing down the price.

Watt should not be so proud of himself for having obtained \$55 million in this sale, when he considers what he is giving away for it. Can the country get something for nothing? First of all, residents of the Powder River Basin are now in a struggle against potential coal development and its effects on the landscape, the water supply, and the economy, which a rational coal leasing system would have averted. Some of the tracts are in areas previously spared coal development, areas which NRC and others have been trying to protect, and which now have been opened up in effect by industry request. Second, if Interior had delayed the sale several years until the market firmed up (as some of the surface owners in the sale areas desired), the federal and state treasuries could have reaped a bonanza approaching the true value of this coal. The present administration's drive to help balance the budget by selling off coal, oil, and federal lands to whom-ever will take them is shortsighted; it will contribute a pittance toward balancing the federal budget in this administration, while denying the option to future administrations who might be able to get a bigger mess of pottage for our national heritage.

— Alison Monroe, SRIC

NEW MEXICO

Southwest Research and Information Center

RADON RELEASE LICENSES RECOMMENDED BY STATE

The Radiation Protection Bureau of the New Mexico Environmental Improvement Division is recommending the licensing of uranium mines in the state in a draft report on radon concentrations in the state's uranium belt.

The report, titled "Radon and Radon Progeny Concentrations in New Mexico's Uranium Mining and Milling District," concludes that uranium mines are the primary causes of elevated levels of radon gas near Grants, N.M.

The 60-page report discusses the results of two years of continuous

monitoring of radon and radon progeny levels around the Anaconda, Homestake Mining and Kerr-McGee uranium mills and mines in the Ambrosia Lake/Grants mining area.

The findings contradict a long-held industry view that elevated concentrations of radon in the area were primarily caused by surficial outcrops of uranium ore.

Thirty-three sites were monitored to determine background and facility-associated radiation levels for the area and to identify the source of high airborne concentrations of radioactivity. Eighteen indoor locations were sampled for radon decay products. The monitoring program was designed to determine if the state's regulations are being met and to provide recommendations for any necessary changes in the New Mexico Radiation Protection Regulations (NMRPR).

The regulations govern the release of radon by holders of radioactive material licenses to people and communities outside lands controlled by operators of uranium processing facilities (which include uranium mills, ion-exchange plants and in situ leach operations). Currently, uranium mining is not regulated by NMRPR and is specifically exempted from the licensing requirements of NMRPR Part 3-110.B. The state standards limiting radon releases are designed to protect the public health and apply in a legal regulatory sense only to radon emanations from uranium mills.

The NMRPR limit the maximum amounts of radon from licensed facilities (uranium mills) to which individuals and populations (defined as 25 or more people) may be legally exposed. The results of NMEID's radon monitoring program showed that several monitoring stations in the Ambrosia Lake area exceeded the individual exposure limit of 3 picoCuries of radon per liter of air (pCi/l) and the population exposure limit of 1 pCi/l. Some stations exceeded both the individual and population exposure limits both years of the study (1978 and 1979).

In the first year the individual average concentration limit of 3 pCi/l was exceeded at five stations by as much as 50 percent. These five stations, and two others, exceeded the individual limit again in the second year by as much as two times. The highest average concentration at one sampling location was 6.4 pCi/l.

The 1-pCi/l population limit was applied to some of these locations because more than 25 people live in the area of six stations. In the first year the standard was exceeded at five of the six locations and in the second year at four of the six.

The study determined that the average background radon concentration was .57 pCi/l in the first year and .51 in the second year, with background levels ranging from .10 to 1.12 pCi/l. Most of the lowest background concentrations were upwind from the mining and milling areas, suggesting that elevated background levels downwind from mining and milling facilities were influenced by facility-associated releases of radon.

The study found that environmental factors, such as temperature inversions and wind patterns, caused large seasonal fluctuations in radon concentrations at individual sampling locations. For instance, radon levels were higher in winter months due to the trapping of gases and dust at the earth's surface under layers of warm air. The highest one-site winter concentration exceeded 20 pCi/l in an area influenced by radon releases from several mine vents, according to Jere Millard, one of the authors of the study.

Radon progeny levels were monitored at 18 indoor stations (predominantly houses) with average levels ranging from .0029 to as high as .0393 WL. Interim federal standards for cleanup of homes built with uranium mill tailings limit radon progeny concentrations to .015 WL. (WL means Working Level where .005 WL equals 1 pCi/l and .015 WL equals 3 pCi/l.) The highest radon progeny concentrations were located near the Kerr-McGee mill in the Ambrosia Lake area; the highest single value was in a building surrounded by mine vents.

Southwest Research and Information Center (SRIC) in March 1981 filed an amended petition with the New Mexico Environmental Improvement Board (NMEIB) requesting a hearing on five proposed amendments to the NMRPR, including the licensing of uranium mines in the state.

An original version of the mine licensing regulation, proposed by SRIC in November 1978, was challenged by the mining industry, which claimed that the New Mexico Radiation Protection Act precluded NMEIB's adopting regulations which infringed on the authority of other state and federal

agencies. The industry cited a provision of the Act which exempts from the Board's jurisdiction "the mining, extraction, processing, storage or transportation of radioactive ores or uranium concentrates that are regulated by the U.S. Bureau of Mines or any other federal or state agency having authority, unless the authority is ceded by such agency to the board."

The Board failed to adopt SRIC's petition after hearings in May 1979. The group's March 1981 revised proposed regulation included a provision that licensing of radon releases from uranium mines is not regulated by any existing state or federal agencies. A rehearing before NMEIB on the licensing proposal and other amendments to NMRPR is scheduled for April 1983.

A copy of the study may be obtained from Jere Millard, Surveillance and Field Operations Section, Radiation Protection Bureau, NMEID, P.O. Box 968, Santa Fe, N.M., 87504-0968, (505) 984-0030, or from Southwest Research and Information Center, P.O. Box 4524, Albuquerque, N.M., 87106, (505) 262-1862.

EISs RELEASED ON BISTI, NORTHWEST NM COAL

Three draft Environmental Impact Statements (EISs), each dealing with the future status of the Bisti Badlands area of northwest New Mexico, were released by the U.S. Bureau of Land Management (BLM) in late November.

One document examines three proposed wilderness designations for the Bisti area, another considers potential future leasing for coal strip mining, and the third discusses the construction of a proposed 2,000-megawatt power plant in the area. A Cumulative Overview released with the environmental statements analyzes the significant cumulative impacts of all three proposals. Copies of the documents are available through the BLM, and public comment and participation in hearings is encouraged. (See schedule below.)

In the EIS titled "Proposed Wilderness Areas," the BLM considers three separate units totaling about 28,000 acres in the Bisti Badlands area. Two of the three Wilderness Study Areas (WSAs), the Bisti and De-na-zin, are recommended for wilderness designation, and the Ah-shi-sle-pah WSA is recommended for non-wilderness designation. Wilderness designation of the Bisti and De-na-zin WSAs would allow

increased backcountry visitor use and protect archaeological resources in the areas. Energy resource development would be allowed in the Ah-shi-sle-pah WSA, since a non-wilderness designation would open its estimated 270 million tons of coal to surface mining.

The BLM rejected several alternative proposals, including non-wilderness designations for all three WSAs. However, an alternative designation for the Bisti WSA could result if Interior Secretary James Watt drops the site from further consideration as wilderness because it contains less than 5,000 acres.

About 3.5 billion tons of coal in the San Juan Basin are proposed to be leased in various leasing schemes, according to the draft EIS on coal leasing in the region. The EIS discusses the impacts of leasing 2.2 billion tons of coal leased prior to 1971 in so-called preference right lease applications (PRLAs) and 1.3 billion tons in new competitive leases in 1983. BLM said meeting these targets could triple the region's present coal production, from 20 million tons per year to about 61 million tons per year in 1990.

The proposed leasing would disturb 110 square miles (about 70,000 acres) of soil and vegetation, the environmental statement said. It would force the relocation of some 125 Navajo families and the removal of at least seven Indian sacred sites, 40 known grave sites, about 1,800 archaeological sites and 2,500 paleontological sites. The EIS said 16,500 acre-feet of water per year would be required for mining operations and that the mine facilities would

PUBLIC HEARINGS SCHEDULE NEW MEXICO WILDERNESS AND COAL EISs

Specific times may be reserved by individuals to testify at each of the following hearings by contacting the BLM Public Affairs Office, P.O. Box 1449, Santa Fe, N.M., 87501, (505) 988-6316.

Crownpoint: January 10, 1 p.m., Crownpoint Navajo Chapter House.

Farmington: January 12, two sessions, 9 a.m. and 7 p.m., Farmington Civic Center

Albuquerque: January 14, two sessions, 9 a.m. and 7 p.m., Albuquerque Four Seasons Hotel.

bring several thousand new jobs to the towns of Farmington, Bloomfield, Aztec, Cuba and Grants.

The third draft EIS concerns the New Mexico Generating Station (NMGS), a \$6-billion, 2,000-megawatt coal-fired power plant proposed by Public Service Co. of New Mexico (PNM). Criticisms of the need for construction of the plant and its proposed site lead a long list of environmentalist and Indian objections to NMGS.

The proposed site is close to the Bisti and De-na-zin WSAs and the Chaco National Monument and Historical Park. The coal region is within a large area of northwest New Mexico that the Navajo Tribe is seeking to regain from the federal government through litigation. The tribe also is considering lands in the Bisti area as potential homes for Navajos affected by the Navajo-Hopi Relocation Act. The Act sets aside 35,000 acres of undesignated federal land to be given to the tribe as part of the relocation settlement.

The most controversial aspect of the proposed NMGS, however, is the need for a power plant — especially a 2,000-megawatt facility. Though PNM claims that the generating units at the Bisti site are necessary to meeting increasing electricity demands, opponents contend that PNM overstates future demands so the plant can be built to operate on San Juan Basin coal and the electricity can be sold out of state.

Construction of NMGS at the proposed site could have substantial adverse environmental and social impacts on the area, according to the EIS. Sulfur dioxide, nitrogen oxide and particulate emissions from the plant will add to the hundreds of tons of pollutants already emitted by other plants in the area. The EIS said operation of the plant will require about 35,000 acre-feet of water from the San Juan River per year. The possible development of a boomtown could have adverse social impacts by displacing Navajo Indians already residing in the area.

The cumulative impacts of water use by projected coal leasing and the proposed power plant are large. The 51,500 acre-feet of water demanded by both is about 20 percent greater than the amount of water the city of Albuquerque uses yearly. Current mining and power generation use close to 50,000 acre-feet annually, meaning that the proposed BLM actions will

double the amount of water used for energy production in the San Juan Basin.

Copies of the EISs are available from and written comments should be directed to the State Director, Bureau of Land Management, P.O. Box 1449, Santa Fe, N.M., 87501. Formal hearings will be held to take testimony on the documents. Written comments will be accepted by BLM until April 8.

— *Cindy Bogner*

OREGON

Sally Bourgeois

HIGH GAMMA RATES VERIFIED AT ABANDONED LAKEVIEW URANIUM MINE

The Oregon State Health Department has verified high gamma radiation levels coming from slag piles and overburden at an abandoned uranium mine 13 miles north of Lakeview in south-central Oregon.

Measurements by department personnel in late July verified those taken in 1978 by a high school class and others taken recently by the Radiation Education Council (REC). The White King mine at which the readings were taken provided ore-feed for the now-abandoned Lakeview uranium mill. Average grade of the ore was 0.3 percent, or about six pounds of yellowcake per ton of ore.

The state measurements were made by George Poombs who said peak gamma values at the overburden and along a road near the mine site would give an equivalent dose of 2.17 rem per year (rem/yr) from continuous exposure.

Earlier measurements by Parkrose High School (Portland) students and teachers, using Health Department equipment, found gamma levels ranging from 100 to 250 microroentgens per hour (uR/hr) along the face of one slag pile. The levels are equivalent to a continuous dose of 0.876 to 2.19 rem/yr. Recent measurements by REC personnel picked up numerous areas around the mine with gamma readings three to four times the upper values reported in the student survey.

Poombs said his measurements verified the earlier findings, noting that the equipment he used was more sensitive than either the students' or REC's. However, he

said state regulations do not require remedial action, or even posting or fencing, of mine waste piles registering less than 2 milliroentgens per hour. A milliroentgen is 1,000 times greater than a micro-roentgen.

The mine and overburden are located partly on U.S. Forest Service land and partly on private land. The site is not fenced or posted. REC requested both at a June 30 meeting with state and federal officials who said they would consider posting warning signs saying that uranium activities had taken place at the site.

EXCESS BREAST CANCERS CITED IN LAKE COUNTY

A study titled "Investigation of Cancer Risks in Lake County, Oregon," was presented to Lake County commissioners last October. The study was undertaken in response to questions raised about high breast cancer rates observed in the county and was the combined effort of researchers at the Oregon Health Sciences University and the Lake County Health Department.

The most recent figures in the study showed the county leading the state in the highest rate of breast cancer. The Lake County rate was 44.7 per 100,000 population compared to the state average of 25.8 per 100,000 population.

Because breast cancer occurs relatively early in life, it is one of the first cancers to be manifest as a result of childhood and early life irradiation, according to Dr. John Gofman in his book, *Radiation and Human Health*, p. 234.

A surprise finding of the study was the increase in Lake County of oat cell lung cancer, the variety of excessive lung cancer found in early underground uranium miners and usually an indicator of exposure to high levels of radon-222. Oat cell cancers increased from 1.5 per 100,000 population between 1961 and 1969 to 4.8 per 100,000 population between 1966 and 1974 to 12.2 per 100,000 population between 1971 and 1979.

All cases of oat cell lung cancer were located either to the north or south of the abandoned Lakeview uranium mill tailings pile, with the largest percentage in the north end of town, which is nearest the pile. Prevailing winds in the area are from the north and south.

The study, however, did not lead to any substantive conclusions since no figures were included on the length of residence, ages of the deceased, or specific housing during residence in the county.

TEXAS

Central Texas Lignite Watch

LIGNITE STRIPMINING UNSUITABILITY DECISION EXPECTED SOON

Both the federal Office of Surface Mining (OSM) and the Texas Railroad Commission (TRC) are expected to reach decisions sometime in August on whether to designate certain lands in Bastrop County, Texas, as unsuitable for lignite stripmining.

OSM hearings were held June 7 in Bastrop on a petition filed by John Prager of Elgin concerning federal military lands — Camp Swift — in Bastrop County. The petition alleged that reclamation would be technically and economically unfeasible on these lands owing to highly erodible soils in the area, irregular rainfall patterns, often highly acidic overburden, and the likelihood that formation of a "clay pan" layer will prevent the reestablishment of a groundwater table.

Testimony at the hearings included presentations that indicated that stripmining on Camp Swift lands would threaten the long-range productivity of the Bastrop city water supply. Since it is anticipated that mining will require dewatering of the county's two aquifers, many persons are concerned that lowering of the water table level and seepage of acid mine water into the aquifer will disrupt the city water wells.

A federal endangered species, the Houston toad (*Bufo houstonensis*), makes its home in the Camp Swift area, according to at least one naturalist who lived nearby at Camp Swift itself. After 40 years as a military reservation, Camp Swift has taken on many characteristics of a wildlife refuge, according to OSM's own publications. The Houston toad once lived in Houston and was widespread in other parts of Texas. With its range limited to only two noncontiguous counties in Texas (Bastrop and Burleson), its existence is further endangered by proposed lignite development.

Surface water quality is also threatened by the proposed mining plans, according to public testimony by concerned area residents. Increased erosion from dewatering and depressurization operations and acid water leached from highly erodible spoil piles can increase total dissolved solids and trace elements in the Colorado River and its tributaries in the area.

Sally Bourgeois is with the Radiation Education Council in Lakeview.

Texas Railroad Commission hearings were held June 3 on a similar petition filed by Prager and joined by the City of Bastrop. This petition concerns non-federal lands along the Powell Bend of the Colorado River. In addition to reiterating most of the concerns expressed in the Camp Swift (OSM) petition, the Powell Bend petition makes additional claims. First, it alleges that stripmining so close to the Colorado River alluvium will lead to additional water quality problems — and, second, that extensive abandoned underground mines in the area, used in deep-mining activities in the first few decades of this century, will exacerbate environmental problems. Mining through old mine pits containing acid waters may pose a threat for as yet uncontaminated ground water in the area. Sinkholes and unexpected voids make stripmining with heavy equipment a very risky undertaking.

Several city utilities in the Central Texas area are involved in plans to stripmine up to 40,000 acres of land in Bastrop County alone. In most cases, the Lower Colorado River Authority (LCRA), an electric utility, is also involved. LCRA's presentations at the OSM and TRC hearings were choreographed by the head of one of Austin's more conservative law firms and included the performances of four high-powered consulting firms.

Using a wide range of geological reports, studies done on other stripmined lands, hydrological information, soil data, and economic analytical techniques, members of the public criticized the consultants' work as inconsistent and self-contradictory and based on data that by the consultants' own admission was inadequate.

WEST VIRGINIA

West Virginia Rivers Coalition

UNSUITABILITY PETITION FOR COAL MINING IN WV DENIED BY STATE BOARD

A West Virginia environmental group's attempt to declare two central-state watersheds off limits to coal mining due to the threat of acid mine drainage was turned back by the state Reclamation Commission in early 1982. However, the commission, acting on an unsuitability petition brought by the West Virginia Rivers Coalition (WVRC) in late 1981,

discouraged development of the vast coal reserves of the area until a solution to the acid drainage problem is found.

The petition sought to close 461 square miles of the watersheds of two rivers, the Buckhannon and Middle Fork, in Upshur County. It contended that available technology does not control acid drainage from surface coal mines and that until non-polluting mining techniques are developed the area should be designated as unsuitable for surface mining.

The petition was accompanied by a lengthy set of excerpts from state Department of Natural Resources (DNR) documents which chronicled

Geological Survey estimates some 4 billion tons of high quality coal reserves underlie the region.

The Island Creek Coal Co., owned by Occidental Petroleum, operates a 600-acre tract which it plans to expand to 38,000 acres to make it the largest strip mine in the East. The DLM Coal Co. is another large operator in the area, which abounds in acid-producing coal seams.

Rick Webb, coordinator of the Mountain Streams Monitor Project and petition committee chairman for WVRC, said of the unsuitability petition, "We are calling for a higher level of responsibility in resource management than is now prevailing." He told



Deanna Smith, Rock Cave, WV.

DLM Coal Co. workers install plastic cover over mined area to combat acid mine drainage in West Virginia.

the adverse effects of acid mine drainage from operating strip mines on West Virginia rivers.

Numerous fish kills and extensive aquatic habitat degradation during the last decade were due to discharges of mine wastes containing high acidity and alkalinity, according to memos from various DNR offices. WVRC charged that in the last 10 years of strip mining, one high-quality trout stream after another has been destroyed.

WVRC's petition did not include some 1,000 acres in which mining permits are already in force. Central West Virginia is a burgeoning coal mining area which companies operating there expect to become the strip mining capital of the eastern U.S. The U.S.

the *Charleston Gazette*, "It is our contention that while mine reclamation in West Virginia has advanced in recent years, and coal can be mined in many areas without serious problems, there are places and conditions where coal cannot at this time, given the currently available technology, be mined without serious and irreversible environmental damage."

The petition said mining in the area cannot meet certain requirements of the West Virginia code, which among other provisions mandates that mining operations avoid discharges of acid or toxic wastes and show that the cumulative impacts of anticipated mining will not cause material damage to the hydrologic balance.

In offering supporting evidence that these requirements could not be met, WVRC cited a long list of DNR water quality information which showed that numerous streams contained water below a pH of 5 or above a pH of 8.5, which the state defines as "critical pH levels."

The petition cited data showing high acid or alkaline levels in raw mine discharges from mining operations in the area. It noted that DLM's neutralization program possibly was the cause of high alkaline concentrations in some downstream rivers.

DNR internal documents quoted in the petition said the agency had discovered streams receiving mine discharges with pH levels above 9, indicating high alkalinity, a result of over-neutralization of wastewaters. The petition also said that both DLM and Island Creek were discharging water of a pH of 9. A West Virginia University agriculture professor told the company's president in a spring 1978 memo that alkaline conditions above 8.5 will "destroy desirable aquatic life."

DNR had suspended DLM Coal's mining permit in 1978 and according to an Aug. 30, 1978, memo from the agency's reclamation division, the company had been "prosecuted for failing to properly treat [its] runoff water." The same memo said DLM had installed settling ponds to treat its mine effluent before discharge and was making other improvements in waste-storage facilities to prevent accidental discharges of both solids and liquids.

But acid and alkaline discharges from the mining operations apparently continued well into 1981. In a May 7, 1981, memo, DNR Director David C. Callaghan told Island Creek President Talmadge M. Mosley that his firm's Ten Mile operation had "failed to demonstrate that mining can be accomplished without long-term water quality degradation."

Nevertheless, the Reclamation Commission found that due to the "substantial financial and legal commitment" the companies made prior to the 1977 federal Surface Mining Control and Reclamation Act, they should be exempted from unsuitability findings in the area. In denying WVRC's petition, the panel acknowledged, however, that the evidence could support a decision upholding the petition in certain parts of the two watersheds.

WISCONSIN

Al Gedicks

Center for
Alternative Mining
Development Policy

LOCAL TOWNSHIPS ENACT FURTHER MORATORIA ON MINING

Citizens of the town of Grant in Rusk County (site of Kennecott Corp.'s proposed open pit copper mine) joined more than 50 other Wisconsin townships in April in passing a moratorium on all mining.

The grassroots movement to enact local mining moratoria came after the Wisconsin Natural Resources Board on March 24 adopted rules proposed by the Wisconsin Department of Natural Resources (DNR) for prospecting, mining and disposing of mine wastes. These rules were developed by a so-called "consensus group" composed of lawyers for Exxon and Kennecott; Peter Peshek, the Wisconsin Public Intervenor; representatives of the DNR and Wisconsin Environmental Decade; and lawyers representing some of the affected townships.

The rules were opposed by 17 environmental groups in the state which objected to provisions which allow contamination of groundwater by mining wastes; place the burden of proof of water contamination on the individual citizen; disregard radiation hazards from copper or uranium mining; allow companies to withhold information about the content of drill core samples; place responsibility for groundwater monitoring on the industry; and provide insufficient funds for communities to deal with the economic impact of mining.

A majority of the citizens (33 out of 35) who testified about the mining rules at a Feb. 24 Natural Resources Board hearing spoke in opposition to the rules and to the "closed door" methods of the consensus group. At the center of the controversy is a provision that would establish the "maximum contaminant levels" for various substances — levels which are specified in state and national drinking water standards — as the normally permissible levels of groundwater pollution 1,200 feet from a mine waste site.

Terry Kakida, research director for Citizens for a Better Environment in Milwaukee, said petitions signed by 15,000 people expressed displeasure with the

result of what he called "closed door negotiations." Kakida said the rules penalize Wisconsin for having high quality groundwater and are illegal because they violate the DNR's mandate to protect the waters of the state.

Thomas Calabressa, former head of the DNR's water supply section, called the maximum contaminant levels "a license to pollute. By what stretch of the imagination is allowable degradation improvement of the waters of the state?"

Strong criticism of the rules also came from Walter Maas, president of the Wisconsin Water Well Association. Maas told board members that nothing in the state statutes permits the DNR to allow pollution: "I beg of you gentlemen, do not allow this to happen, for once our underground water aquifers are polluted . . . it could take centuries to recover, and there is the possibility they will never be recovered."

Despite overwhelming public opposition to the DNR's proposed mining rules, the media reported that the rules were the "toughest" in the nation and were supported by a wide variety of groups represented in the consensus process. One of the first steps taken by the town of Grant at its annual meeting in April was to fire the town's lawyer, Kevin Lyons, who had participated in the consensus groups' rule-making process. The town also voted to adopt the Rusk County mining ordinance, which is now being developed to provide better protection than that afforded by state rules.

On June 15, the leaders of northern environmental groups and three mining impact committees charged that Public Intervenor Peter Peshek is no longer representing the environmental concerns of northern Wisconsin citizens. Dianne Bady, president of the Rusk County Citizens Action Group, charged that "Peter Peshek has become our own James Watt." Roscoe Churchill, chairman of the impact committee in Rusk County, where Kennecott controls three mineral deposits, said of Peshek, "For the past three years, it seems to me that he's been more interested in helping the mining industry get started than in protecting the ground water here in the north." Al Reinemann, chairman of the Round Lake Impact Committee, said dozens of firms interested in mining uranium were either holding leases or exploring in northern Wisconsin, yet Peshek never acknowledged the possibility of a major uranium complex.

Other groups supporting the criticism of Peshek included the Town of Doyle

Mining Committee, Chippewa Valley Friends of the Earth, Northwoods Alliance, Northern Thunder, League Against Nuclear Dangers, and Citizens for Tomorrow. The groups called for a meeting with Attorney General Bronson La Follette to discuss Peshek's role in drafting mining rules. The attorney general refused to meet with the groups, calling them "environmental extremists."

The Rusk County Citizens Action Group hosted a statewide strategy conference on mining at Mount Scenario College in Ladysmith on July 31. Environmentalists, Indian tribes and potentially affected mining communities from northern Wisconsin discussed how to expand the mining moratorium movement and how to establish health and environmental codes to protect communities from unregulated mining pollution.

WYOMING

Powder River Basin Resource Council

CITIES SERVICE CONSENT AMENDMENT CRITICIZED

The Powder River Basin Resource Council (PRBRC), in a letter sharply criticizing changes in Wyoming mining regulations proposed by Cities Service Co., told the state Environmental Quality Council (EQC) in late June that the changes are "an attempt to plow under the surface owner consent provisions of Wyoming law."

While both state and federal law assert that the property rights of surface owners who make their living on the land have priority over companies desiring the parcels for mining, Cities Service proposes to reverse that standard, the PRBRC charged in a statement.

"Through subtle wording, Cities Service's proposed regulations would plow under the surface owner consent provisions protecting the lands and livelihoods of hardworking farmers and ranchers," said Bob Myszewski, chairman of PRBRC.

In objecting to the proposed changes, PRBRC told the EQC in its letter that the "Cities Service proposal clearly contravenes the surface owner consent provisions of the [state] Environmental Quality Act . . . and strays from the principles of surface owner protection set forth in the [federal] Surface Mining Control and Reclamation Act (SMCRA) of 1977.

"SMCRA specifically protects landowners who live or run agricultural operations on lands proposed for federal coal leasing, and recognizes as inviolate their right to farm over the right of a company to mine . . . This precept is carried through in Wyoming's Environmental Quality Act . . . which places the rights of 'resident or agricultural landowners,' farmers or ranchers who live or make their living on the land, above those of commercial interests desiring the same parcel for mining purposes."

PRBRC's letter went on to say that the Cities Service proposals "would make a mockery of the very meaning of surface owner consent." If adopted, the proposed regulations would require that mining companies "merely submit their mining and reclamation plans for surface owner approval, not actually obtain consent as a part of 'complete application' requirements . . . Thus a mining and reclamation plan could be deemed 'complete' (which is one of the criteria for issuance of a mining permit) in terms of surface owner consent if the mining and reclamation plan is just dropped in the mail to affected surface owners."

If owner consent provisions are weakened, PRBRC warned, and those who live or work on land under consideration for mining are stripped of their present absolute veto over coal mining in the interests of protecting their land, principles fundamental to SMCRA and the Environmental Quality Act would be overturned, and the EQC "would find itself saddled with a regulation which, if enforced, would violate its controlling statute."

The Cities Service proposals would allow the EQC to permit mining to take place on lands where the resident or agricultural landowner has withheld his consent, the PRBRC said. According to Myszewski, "These proposed regulations could set an appalling precedent that would send public involvement in energy development decisions back to square one, while dismissing agriculture as of minimal value."

William Henry, chairman of the Converse County Landowners Conservation Association headquartered in Douglas, also objected to the proposals in a letter to the EQC, saying he was "unalterably opposed to these changes on the grounds that they provide mining companies an unfair advantage in negotiations with surface landowners." Henry described the changes as "obviously a ploy to enable mining companies to avoid their legal and ethical responsibilities to surface landowners."

UNC Officials Speak Out

(continued from page 28)

gallons and gallons of radioactivity going out of here, we sure as hell couldn't find it. We've looked everywhere out there and we're not lucky enough to miss every place. I mean, if you drill in a pattern and cut across the fracture, you can't miss them all.

Some monitoring wells have been dug along the east side of the property. Does your data indicate there has been seepage offsite east of the property?

Hill: There's one well that the state interprets that yes, there has been. The interpretation by our consultants sees a potential for an increase in contamination in that area. I don't know that we would say it's offsite yet. But there's the potential for it. I guess the state is not saying it's offsite, they're saying they've seen some elevations increasing and that the process of migrating in that direction can be established.

There's the possibility EID will not be satisfied with the seepage control discharge plan you've filed and will order the place shut down. Will you stop operations, or continue to mine and ship the ore elsewhere to be processed? And what kind of impact will that have on the company?

Bailey: If the mill is not operating, we will not operate the mine. There's no economics in that, it's too long a truck haul.

It's not economical for the company to mine alone?

Bailey: No way. We're in a [market] situation where there's all kinds of pounds out there to buy. At today's [April 1981] price of \$25 a pound, it's pretty tough for anybody operating underground mines and mills to say they can produce cost effectively at \$25 a pound.

Does UNC have a large stockpile of yellowcake right now? An article in the Wall Street Journal said you had a contract with somebody in the Far East to supply yellowcake.

Bailey: We are not deliberately inventorying yellowcake. We have some, maybe a couple of hundred thousand pounds in barrels right now, but that's just the matter of the timing of the sales. It's all sold, it just hasn't been delivered.

Seepage Plagues UNC Ponds

(continued from page 26)

Raymondi said that the aquifer's natural cleansing process could be aided by continuing certain stopgap measures, such as the current pump-back program (which as shown above has met with limited success) and the tailings neutralization program UNC began in January but discontinued when it closed the mill in May.

Either way, he said, restoration will take many years. "Short of getting the tailings out of there, which will save some of the water, there's really not much more you can do," he said.

SRIC's Paul Robinson agrees that a cleanup program at Church Rock is not a short-term proposition. But he insists that there are ways to restore polluted water.

"You first have to define the extent of the contaminant plume and then try a range of clean water injection systems and contaminated water collection systems," he said. The theory would be to inject alkaline waters into the contaminated aquifers at the periphery of the plume in an attempt to raise the pH of the acidic seepage liquids. He said the idea is similar to UNC's neutralization plan, but differs significantly in the manner in which the tailings fluids are neutralized. "Surface neutralization affects only the tailings and very little of the water in the layers beneath and around the pile, or at the edge of the seepage where fresh waters are being degraded," he said.

Moving the tailings, which UNC committed to in several letters to NMEID in the past two years, would be the only ultimate solution, Robinson said. This would allow for installation of a drainage system in the contaminated aquifers and a series of pumping wells to siphon off the contaminated water, perhaps to be disposed of in a series of deep injection wells. He added that Canadian operators in the Elliot Lake uranium district of Canada have, with some success, used cement grout curtains to halt the outward movement of contaminants from leaking tailings ponds there.

Whatever the scheme, he said, United Nuclear should pay the entire cost of groundwater restoration and site cleanup. "The state's surety requirements were put into place for this very purpose. Any deviation from that intent would make the regulations worthless."

'Toinjoni' No More

(continued from page 40)

The suit, which asks for both compensatory and punitive damages, first was taken to tribal court, but UNC successfully moved to have the case heard in federal district court where it is not expected to go to trial much before mid-1983.

The lawsuit is referred to as the case of 243 Navajos versus UNC and Kaiser Engineering, the firm that designed and built the faulty dam. But it could be countless thousands of Navajos bringing suit, since any genetic damage done three years ago, last month or yesterday can be carried to generations to come, and the radioactive isotopes that lie in the sediment of the river may continue to affect the people, the land, the livestock and the future for thousands of years and beyond.

It seems, then, that the Navajos were correct. Today's Rio Puerco, "The River That Is Harmful," is not the old river. *Toinjoni* — "The Beautiful River That Flows" — is forever gone.

RESOURCES

The following organizations are the beginning of a resource list for information and communication about mining development in the U.S., Canada, Australia and Europe, and its impacts on local communities, their environment and their health. We urge our readers to send us additional contacts we inadvertently missed, including libraries and dates and places of upcoming conferences, workshops or public meetings. Send all materials to: **Mine Talk**, P.O. Box 4524, Albuquerque, N.M., 87106, or call (505) 262-1862.

ARIZONA

Arizona Sierra Club
4202 E. North
Tucson, AZ 85712

DNA-People's Legal Services
P.O. Box 306
Window Rock, AZ 86515
(602) 871-4151

Friends of the River
Colorado Plateau Chapter
Box 1115, 20½ E. Cherry Ave.
Flagstaff, AZ 86002
(602) 774-0130

Maricopa Audubon Society
4619 E. Arcadia Lane
Phoenix, AZ 85018
(602) 959-0052

National Parks and Conservation
Association — Western Office
Box 67
Cottonwood, AZ 86326
(602) 634-5758

Nuclear Free State
1114 N. Rincon
Tucson, AZ 85719
(602) 622-8785

Palo Verde Truth Force
1322 W. Roosevelt St., No. 6
Phoenix, AZ 85007
(602) 258-0089

Sacred Mountain Alliance
Rt. 3, P.O. Box 125
Flagstaff, AZ 86001
(602) 526-6170

Thunder River League
c/o Vivienne Jake
P.O. Box 68
Fredonia, AZ 86022

Tuba City Citizens Committee for
Uranium Radiation Control
P.O. Box 532
Tuba City, AZ 86045
(602) 283-5403

CALIFORNIA

Alliance for Survival
1473 Echo Park Ave.
Los Angeles, CA 90026

Burnham/Big Mountain Support
Group
1412 Cypress
Berkeley, CA 94703
(415) 824-8190

Natural Resources Defense
Council
25 Kearny St.
San Francisco, CA 94108
(415) 421-6561

Oaktree Alliance
6604 Portola Road
Atascadero, CA 93422
(805) 466-0352

Stop Uranium Now (SUN)
P.O. Box 772
Ojai, CA 93023
(805) 646-3832

COLORADO

Citizens for Safe Energy
309 Colorado
Pueblo, CO 81004
(303) 543-5340

Citizens for Safe Tailings
Management
P.O. Box 2331
Durango, CO 81301
(303) 247-3471

Colorado Open Space Council
Mining Committee
2239 E. Colfax
Denver, CO 80206
(303) 321-6588

Denver Research Group
1808 Gaylord
Denver, CO 80206
(303) 333-5474

Environmental Defense Fund
1405 Arapahoe
Boulder, CO 80302
(303) 440-4901

High Country Citizens Alliance
Box 1066
Crested Butte, CO 81224
(303) 349-5640

Huerfano Valley Citizens Alliance
P.O. Box 696
Redwing, CO 81066
(303) 746-2286

National Wildlife Federation
Natural Resource Clinic
Univ. of Colorado School of Law
Boulder, CO 80309
(303) 492-6552

Pikes Peak Justice and Peace
Committee
235 Fountain Blvd.
Colorado Springs, CO 80903
(303) 632-6189

Public Lands Institute
1657 Pennsylvania
Denver, CO 80203
(303) 831-7101

Two Rivers Citizens Association
Colorado West Friends of the
Earth
P.O. Box 2932
530 Main St.
Grand Junction, CO 81502
(303) 245-7047

Western Colorado Congress
P.O. Box 472
Montrose, CO 81402
(303) 249-1978

DISTRICT OF COLUMBIA

Environmental Policy Center
317 Pennsylvania SE
Washington, DC 20003
(202) 547-5330

Rural America/National Office
1346 Connecticut Ave. NW
Washington, DC 20036
(202) 659-2800

Sierra Club
330 Pennsylvania SE
Washington, DC 20003
(202) 547-1141

World Information Service on
Energy (WISE)
1536 16th St. NW
Washington, DC 20036

IDAHO

Idaho Conservation League
Box 844
Boise, ID 83701
(208) 345-6933

ILLINOIS

Illinois South Project
701 N. Park
Herrin, IL 62948
(618) 942-6613

IOWA

Rural America/Midwest Office
550 11th St., Suite 200
Des Moines, IO 50309
(515) 244-5671

MINNESOTA

Ad Hoc Coalition on Uranium
Mining
Box 322
Barnum, MN 55707
or
618 E. 22nd St.
Minneapolis, MN 55404
(612) 870-4700

The Minnesota Project
c/o Loni Kemp
Box 4
Preston, MN 55965

National Audubon Society
Regional Office
Suite 920
Lumber Exchange Building
10 S. 54th St.
Minneapolis, MN 55401
(612) 375-9140

Northern Sun Alliance
1519 E. Franklin
Minneapolis, MN 55404

MISSISSIPPI

Rural America/Southeast Office
4795 McWillie Drive
Jackson, MS 39206
(601) 362-2260

MONTANA

Headwater Alliance
Box 494
Bonner, MT 59823

Montana Environmental
Information Center
Box 1184
Helena, MT 59624
(406) 443-2520

Northern Plains Resource
Council
419 Stapleton Building
Billings, MT 59101
(406) 248-1154

Northern Rockies Action Group
9 Placer St.
Helena, MT 59601
(406) 442-6615

NEVADA

Nevada Indian Environmental
Research Project
P.O. Box 7440
Reno, NV 89510
(702) 786-3128

NEW JERSEY

Morris County Safe Energy
Alternatives Alliance
Box 271
New Vernon, NJ 07976
(201) 538-6676

Prevent Uranium Mining Alliance
c/o Mary and Gary Gitelson
Rural Rt. 3, Box 494
Hewitt, NJ 07421

Stop Uranium Now
Box 34
Oak Ridge, NJ 07438

NEW MEXICO

American Citizens Together
P.O. Box 3046
Taos, NM 87571
(505) 758-1818

American Indian Environmental
Council
P.O. Box 7082
Albuquerque, NM 87194
(505) 265-1509

Citizens for Alternatives to
Radioactive Dumping (CARD)
Box 555
Albuquerque, NM 87103
(505) 842-1194

DNA-People's Legal Services
P.O. Box 116
Crownpoint, NM 87317
(505) 786-5277

La Colectiva
Box 1287
Española, NM 87532

La Raza Unida
General Delivery
La Madera, NM 87539

New Mexico Peace Conversion
Project
2504 Meadow Rd., SW
Albuquerque, NM 87105
(505) 256-9473

New Mexico Physicians for
Social Responsibility
P.O. Box 4096
Albuquerque, NM 87106
(505) 266-5646

New Mexicans for Clean Air
and Water
113 Monte Rey Drive North
Los Alamos, NM 87544

Resource Center
P.O. Box 4726
Albuquerque, NM 87106
(505) 266-5009

Sandoval Environmental Action
Community
P.O. Box 1220
Bernalillo, NM 87004
(505) 867-2046

Save The Jemez
P.O. Box 4067
Albuquerque, NM 87106
(505) 884-2106

Sierra Club
1709 Paseo de Peralta
Santa Fe, NM 87501
(505) 983-2703

Southwest Research and
Information Center
P.O. Box 4524
Albuquerque, NM 87106
(505) 262-1862

Taos Environmental Association
P.O. Box 231
Arroyo Seco, NM 87514
(505) 776-8218

NEW YORK

Environment Information Center
48 W. 38th St., 7th Floor
New York, NY 10018

Friends of the Earth
208 W. 13th St.
New York, NY 10011
(212) 675-5911

People for Safe Energy
c/o John Franceschi
Box 578
Carmel, NY 10512
(914) 279-4887

RISE
c/o Dolores Carpentier
Rt. 3, Box 490
Warwick, NY 10990
(914) 986-2462

Sullivan Nuclear Opponents
c/o Rose Spada
Star Rt. Box 15
South Fallsburg, NY 12779
(914) 434-3088

NORTH CAROLINA

Institute for Southern Studies
P.O. Box 531
Durham, NC 27702
(919) 688-8167

NORTH DAKOTA

Dakota Resource Council
P.O. Box 254
Dickinson, ND 58601
(701) 227-1851

OREGON

Oregon Environmental Council
2637 SW Water Ave.
Portland, OR 97201
(503) 222-1963

Oregon Wilderness Coalition
271 W. 12th Ave.
Eugene, OR 97401

Pacific Northwest Research
Center
University Station Box 3708
Eugene, OR 97403
(503) 686-5125

Radiation Education Council
P.O. Box 705
Lakeview, OR 97630
(503) 947-4630

SOUTH DAKOTA

Black Hills Alliance
P.O. Box 2508
Rapid City, SD 57709
(605) 342-5127

Black Hills Energy Coalition
Box 8092
Rapid City, SD 57709
(605) 343-8006

Families Against Radioactive
Mining
c/o Jim Kellar
1503 Cedar
Yankton, SD 57078
(605) 665-3726

South Dakota Resources
Coalition
609 Broadway
Watertown, SD 57201
(605) 886-3532

TENNESSEE

Highlander Research and
Education Center
Rt. 3, Box 370
New Market, TN 37820
(615) 933-3443

Save Our Cumberland Mountains
Box 457
Jacksboro, TN 37757

TEXAS

Central Texas Lignite Watch
P.O. Box 8328
Austin, TX 78712
(512) 479-0678

or
P.O. Box 728
Bastrop, TX 78602
(512) 221-5250

Lone Star Alliance
1022 W. 6th
Austin, TX 78703

Rural America/Southwest Office
223 W. Anderson Lane
Austin, TX 78752
(512) 459-3320

Texas Mining Research
Committee
P.O. Box 3472
Austin, TX 78764
(512) 258-6435

UTAH

Citizen's Call
1321 E. 400 S
Salt Lake City, UT 84102
(801) 583-2683

Southern Utah Residents
Concerned About Their
Environment (SOURCE)
P.O. Box 1453
Cedar City, UT 84720

Southern Utah Resource Center
126 S. 1400 W
Cedar City, UT 84720

Southern Resource Council
P.O. Box 1182
Hurricane, UT 84737

VERMONT

Vermont PIRG
43 State St.
Montpelier, VT 05602
(802) 223-5221

VIRGINIA

Appalachian Coalition Against
Strip Mining
c/o Rev. R.B. Lloyd
P.O. Box 1007
Blacksburg, VA 24060
(703) 522-3795

Council of Southern Mountains
Drawer N
Clintwood, VA 24228
(703) 926-4495

Piedmont Environmental Council
28-C Main St.
Warrenton, VA 22186
(703) 347-2334

WASHINGTON

Preservation of Mt. Tolman
Alliance
P.O. Box 99
Inchelium, WA 99138

Washington PIRG
FK-10 University of Washington
Seattle, WA 98195

WEST VIRGINIA

Cheat Lake Environmental
Conservancy
c/o Donald Strimbeck
Rockley Road
Morgantown, WV 26505

Coal River Improvement
Association
107 River Bend Blvd.
St. Albans, WV 25177

Concerned Land and Natural
Resources Owners
Rt. 2, Box 112
Bristol, WV 26332

Mountain Streams Monitor
Project
P.O. Box 1853
Elkins, WV 26241
(304) 636-7218

Save Our Mingo Mountains
Homes and Streams
Marrowbone Creek Area
c/o John and Michael Fanning
Box 611
Kermit, WV 25674

West Virginia Rivers Coalition
P.O. Box 490
New Martinsville, WV 26155
(304) 455-5455

WISCONSIN

Center for Alternative Mining
Development Policy
1121 University Ave.
Madison, WI 57315
(608) 251-7246

Land Educational Associates
Foundation (LEAF)
3368 Oak Ave.
Stevens Point, WI 54481
(715) 344-6158

WYOMING

Powder River Basin Resource
Council
624 N. 6th St.
Douglas, WY 82633
(307) 358-5211
or
48 N. Main St.
Sheridan, WY 82801
(307) 635-3416

Wyoming Outdoor Council
Box 1365
Lander, WY 82520

AUSTRALIA

Campaign Against Nuclear
Power
P.O. Box 238
North Quay, Brisbane
Queensland 4000

International Nuclear News
Service
Canberra & South-East Region
Environment Centre
P.O. Box 1875
Canberra City, ACT 2601

CANADA

Group for Survival
524 5th Ave., North
Saskatoon, Sask. S7K 2R2
(306) 244-7911

Ontario PIRG-Peterborough
c/o Trent University
Peterborough, Ontario K9J 7B8

Saskatoon Environmental Society
P.O. Box 1372
Saskatoon, Sask. S7K 3N9

Scientific Pollution and
Environmental Control Society
405-207 W. Hastings
Vancouver, BC V6B 1H7
(604) 669-4554

South Okanagan Environmental
Coalition
Box 188
Penticton, BC V2A 6K3

EUROPE

World Information Service on
Energy (WISE-Amsterdam)
Blasiusstraat 90
1091 CW Amsterdam,
The Netherlands
Tel: 020-924264

FINLAND

Energypolitical Association
Alternative to Nuclear Power
Jaakarinkatu 6 b D 31
00150 Helsinki 15, Finland
Tel: 358-0-631 047

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Vol. VI, No. 2

Greenway Research and Information Center

March/April, 1981

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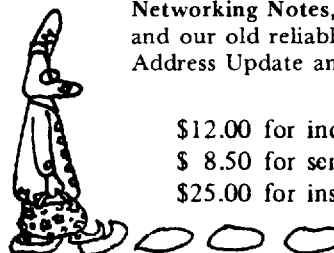
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Vol. I, No. 2 July-August 1981
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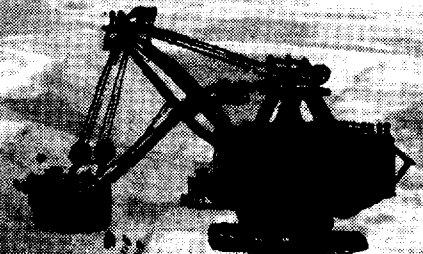
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