WATER AND ENERGY

A lot of people can't understand the effects that mining for energy resources would have on water in western South Dakota -- the reason is that they don't know much about underground water. As a matter of fact, scientists don't know that much about underground water in South Dakota either, but they use terms that make what they do know hard for the rest of us to understand. This paper is an attempt to make a simple explanation of how water collects and flows in the Black Hills area -- and then describe how coal and uranium activities could affect water in a much larger area.

WATER IN THE BLACK HILLS RECION

Surface water -- streams, ponds, and reservoirs -- show how water runs on top of the earth. The movement of surface water is related to the movement of underground water, which is called by the shorter name, "groundwater." Groundwater runs through many different layers of rock, moving through cracks in the earth and through the layers of rock themselves. Certain layers of rock are called "aquifers," because they contain large amounts of water. When someone drills a well, they drill into an aquifer to get water that is stored underground.

Figure 1 shows some of the layers of underground rock and major aquifers in western South Dakota. In reality, the thickness of the layers varies from place to place. And some layers are under huge areas, while others are fairly small.

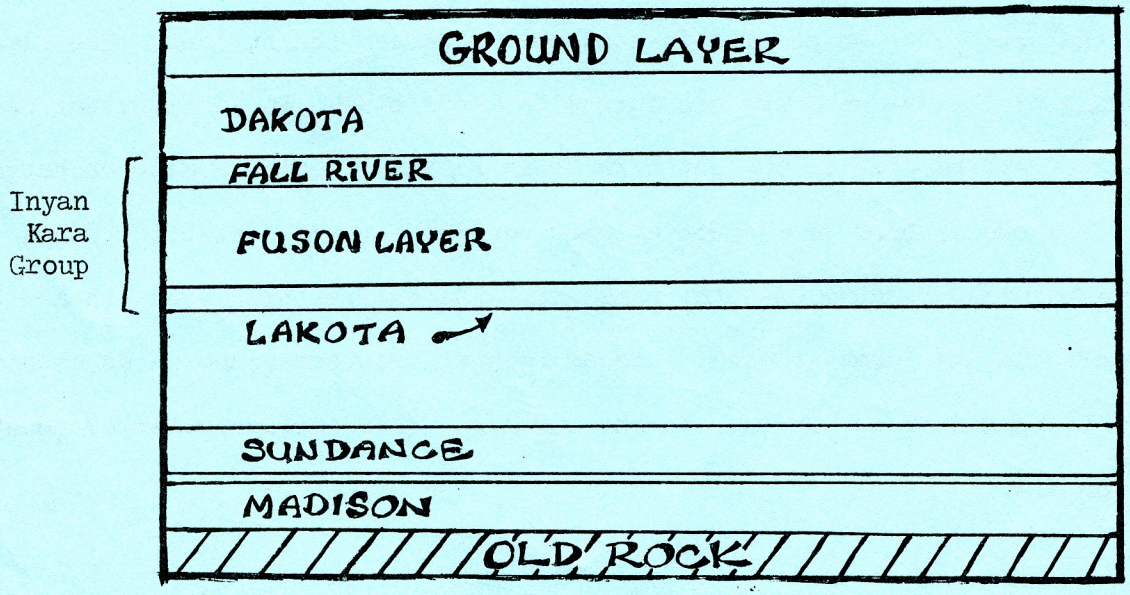


Figure 1 -- Not to Scale

WATER AND ENERGY (CON'T)

When the Black Hills were formed, pressure from under the earth forced very old rocks (at the bottom of Figure 1) to the surface -- this made a kind of "bubble" of old rocks at the middle of the Black Hills. Around the "bubble," other layers of rock were pushed on their sides, so what we ended up with is a number of exposed edges of rock formations (Figure 2). Because of the edges of aquifer layers are exposed, water from rain and streams runs into the exposed areas and under the earth for storage -- and eventual pumping back to the surface.

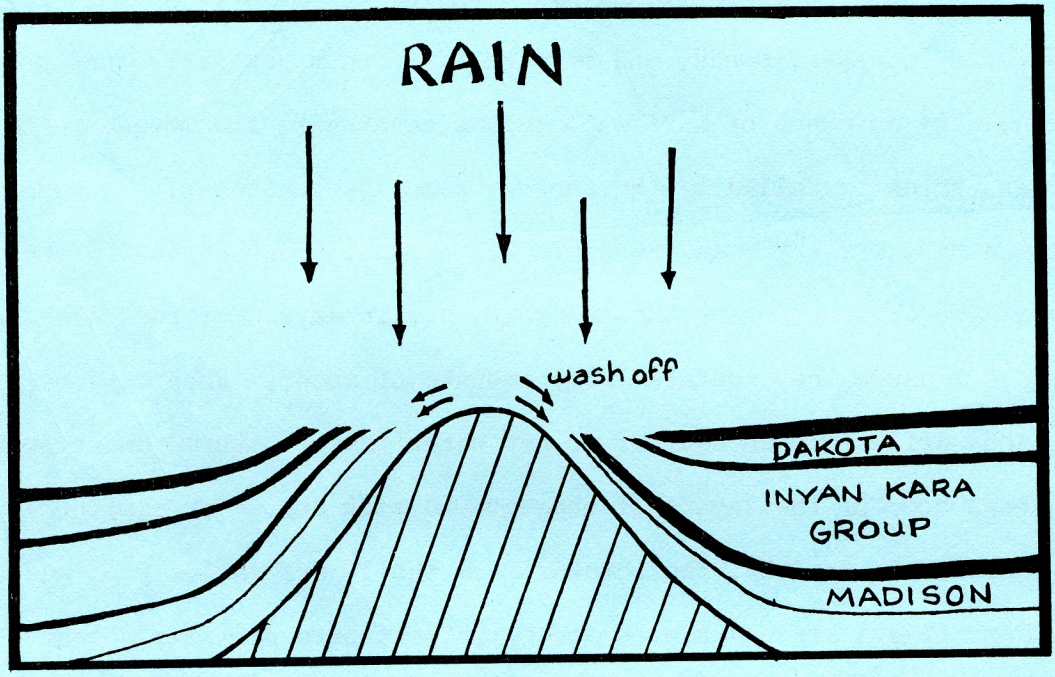


Figure 2

Water that runs into an aquifer is said to "recharge" the aquifer. The Black Hills, because of the way aquifers are turned on their sides, is an important recharge area for groundwater in the northern Great Plains. Aquifers also recharge when water from one aquifer leaks into a lower aquifer, or when water is pushed into a higher aquifer because of water pressure. The entire thing works in a cycle: rain falls and forms streams, streams recharge aquifers, and water stored in aquifers is pushed or pumped back to the surface. Then surface water evaporates back into the air.

WATER AND ENERGY (CON'T)

The activity of people can disrupt this cycle by taking more water out of the ground than the rain puts in. In the northern Great Plains, the cycle is easy to disrupt because of the relatively low amount of rain.

The Dakota aquifer and the Madison aquifer are the 2 most important groundwater sources in western South Dakota. The Dakota aquifer supplies 25% of the water used in South Dakota, while the Madison aquifer is used by many people in the southern Black Hills. Both aquifers are under high pressure and flow to the surface of the earth without being pumped -- their water is called "artesian" because it doesn't have to be pumped. Cascade Springs and Evans Plunge are 2 of the artesian springs that come from the Madison aquifer.

The Madison aquifer is under parts of Alberta, Saskatchewan, Montana, Wyoming, North Dakota, Nebraska, and Colorado -- as well as under most of South Dakota west of the Missouri and north of a line from near Oelrichs to near White River. In the Black Hills area, the Madison is called the Paha Sapa Formation, and the underground water flows generally east. Because there are many holes and caverns in the Paha Sapa Formation, like Wind Cave and Jewel Cave, the water moves fairly fast.

WATER FOR INDUSTRY

The use of groundwater in the northern Great Plains has increased rapidly in the last 15 years, and the need for water is projected to become greater. The reasons for increased use are the larger population and the growing number of industries. Much of the population growth was caused by the availability of skilled jobs in the industries, which usually mine or turn resources into electricity. For example, industrial use of groundwater in the Missouri Basin increased 153% from 1965 to 1970, while use of groundwater for irrigation increased by about 65%. This trend continued from 1970 to 1980.

WATER AND ENERGY (CON'T)

The trend to more industrial use of water could cause problems for farmers and ranchers as water becomes harder to get. As one federal publication explains:

> "Normally, users of water for irrigation or rural purposes require low-cost supplies; users of water for industrial or public-supply purposes can afford to pay higher prices for supplies. Competition for water supplies may cause a shift in water demand and use toward those users that are willing to pay higher prices...."

Financially-pressed agricultural producers could be in big trouble, if that happens.

WATER FOR COAL DEVELOPMENT

The 3 biggest planned uses of water for industry in the Black Hills area are coal gasification plants, coal-carrying slurry pipelines, and uranium mills. The coal slurry pipeline proposed by Energy Transportation Systems, Inc. (ETSI) has gotten widespread attention in the southern Black Hills. The pipeline would mix coal and water and pump them from Gillette, Wyoming, to Arkansas. The ETSI line would use 15,000 acre-feet of water a year (an acre-foot is the amount of water that covers one acre of land a foot deep), and the water would not be returned.

The ETSI proposal calls for pumping water from the Madison aquifer near the Wyoming-South Dakota boarder. The pumping is to be done at a key place in the aquifer -- where the water is "turning a corner" from the southern Hills to the east. According to Dr. Perry Rahn, a South Dakota water specialist, pumping for ETSI would cause artesian wells at Edgemont to stop flowing. People would have to pump water from 1,000 feet below the surface. The decline in water would be "almost instantaneous" and would affect a large area.

ETSI officials promise that there will be no such lowering of the water table, but they have made promises before. In 1974, they lobbied the Wyoming legislature for an amendment to its Water Moratorium Act that would allow for the slurry pipeline.

WATER AND ENERGY (CON'T)

The amendment was passed after ETSI convinced the legislature that the pipeline would use poor-quality water, but it was later shown that the company planned to take drinking water.

In addition, the connections between the Madison aquifer and the Lakota and Dakota aquifers could mean that all 3 aquifers would lose water.

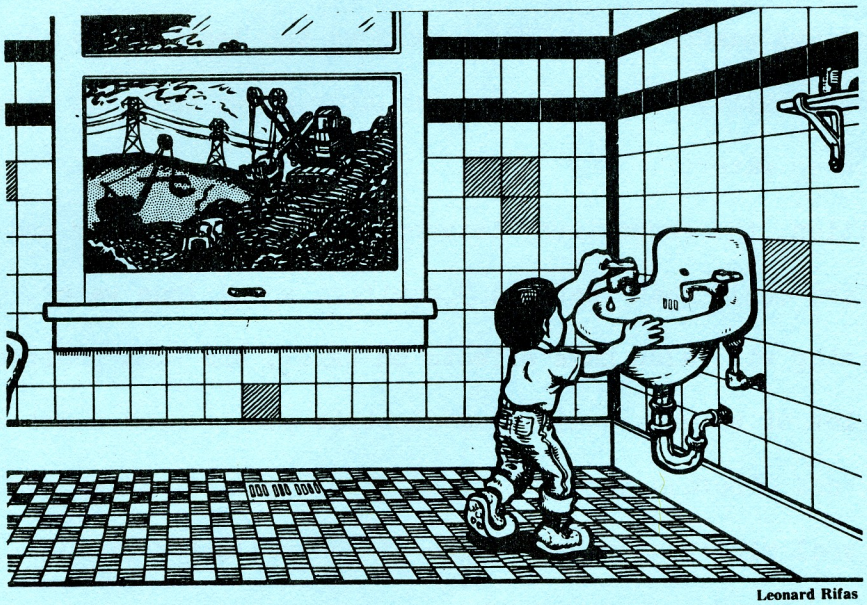
Coal mining will also have effects on water, and coal gasification plants would use a lot of water. Coal-fired electric plants need a lot of water to operate too, and minerals that are found with coal hurt water quality. Heavy metals from coal mine wastes cause much of the pollution problem, and the metals concentrate in plants and animals that use the water.

In March, 1979, 9 coal mines were working or being built in north-eastern Wyoming, with at least 6 more planned before 1990. South Dakota will be affected by heavy metals, and by loss of water from the aquifers and from the Belle Fourche, Missouri, and Cheyenne Rivers.

URANIUM DEVELOPMENT AND WATER

Uranium exploration, mining, and milling all cause water problems -- both from contamination and from the use of large quantities of water. Uranium milling was called "the dominant contribution" to radiation exposure from the nuclear cycle by the Department of HEW's study on health effects of ionizing radiation. But radiation problems begin with uranium exploration, which pierces thousands of holes through underground rock layers. The holes let water flow between aquifers much faster, as people discover when their wells start draining. Wells have been lost from uranium exploration in Wyoming and the Black Hills by Exxon, Kerr-McGee, and other companies. Also, cattle in South Dakota and the Southwest have died from contact with uranium exploration holes.

WATER AND ENERGY (CON'T)



Leonard Rifas

Underground water contamination is hard to stop once it starts, partly because it spreads slowly and can go for years without being discovered. In the case of radiation from uranium activities, the problem is even harder to detect. Radon, a major uranium by-product, dissolves easily in water, but is tasteless, odorless, and invisible. And the federal government doesn't test wells that serve less than 25 people, so rural people can go for quite awhile without knowing that their water is radioactive.

Examples of mines causing pollution are found in the Southwest and in Canada. When Church Rock, N.M., mines were dug, the amount of radioactive radium in water rose to 75 times the natural, background rate. And in Canada, people can't eat fish taken downstream from a mining area, because 10 lakes and 55 miles of river are too radioactive to drink. These problems face our area for several reasons.

Most important, uranium mines planned for the Black Hills will take ore from the Inyan Kara group, which includes the Lakota and Fall River aquifers. So companies will be mining right in aquifers -- and directly below the important Dakota aquifer.

WATER AND ENERGY (CON'T)

For one of the mines planned by Tennessee Valley Authority, water will be pumped out of the Lakota aquifer at the rate of 675 gallons a minute for 10 years. And that is only 1 mine -- 7 others have received federal permission to go ahead, and at least another 10 are planned.

Taken together, these mines will mean that those who lose their wells are probably lucky -- they won't be drinking from the most contaminated areas. But the flow of water from one area to another and from one aquifer to another will still cause problems for people who live a long way from the mines.

Although there are dangers of water loss and contamination from coal projects and from uranium exploration and mining, uranium milling is the biggest problem. Many people already know about some of these problems because of milling wastes (called "tailings") that exist in Western states -- 140 million tons of them as of early 1979.

Tailings move easily in wind or water because they are fine particles like sand. But they are very different from most sand, because they retain 85% of the radioactivity of the original uranium ore. The Department of the Interior summed up the problems from uranium milling. It said that contamination in tailings-holding ponds:

> "Is well beyond the safe limit for animals. Escape by infiltration to the water table or by breakout to stream drainages could cause contamination by dangerous levels of radioactivity. Stock or humans using water from wells down gradient from tailings ponds would be exposed. Plants and animals encountering contaminated flows or contaminated sediments deposited in drainage channels would be exposed. Increasing the danger is the nondegradable and accumulative character of this type of contamination."

The report goes on to say how plants, edible crops, and river life hold and concentrate radioactive radium.

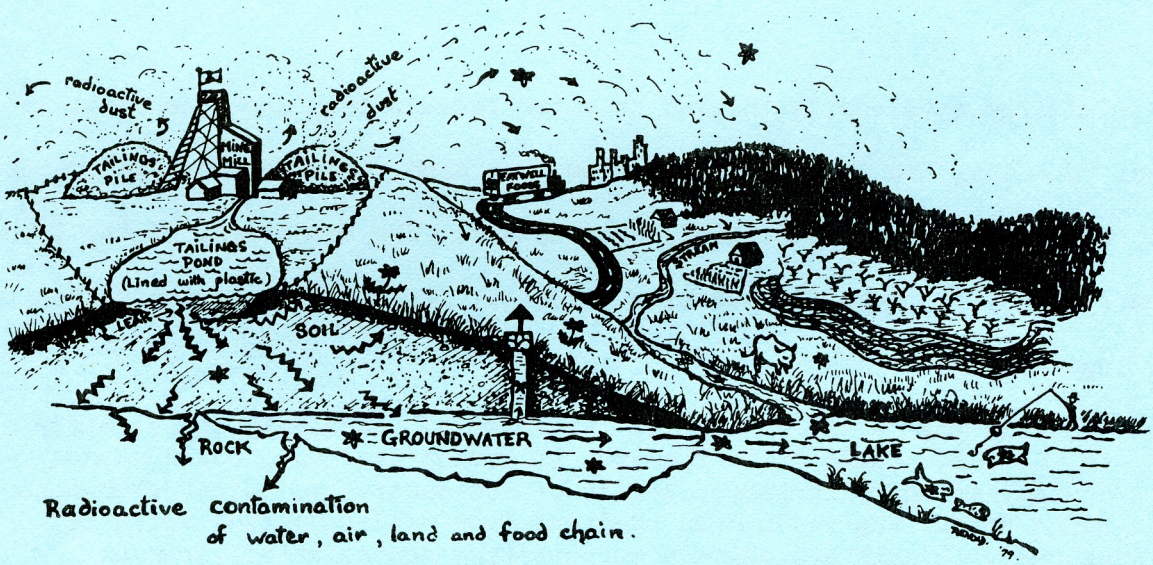
There are many places that have been poisoned by radiation from mills. The widespread nuclear activities in the Southwest provide quite a few examples.

WATER AND ENERGY (CON'T)

The radiation is measured in "picocuries" per liter of water; a "picocurie" isn't much, but the U.S. Public Health Service limit for safe water is only 3 picocuries per liter of water.

About 60 water samples taken in the Southwest had from 0.5 to 65 picocuries of radium per liter. Several streams have been declared unfit for irrigation and for drinking by stock and humans. Unfortunately, animals can't read, and they continue to drink from dangerous streams.

Another pollutant, selenium, was present in wells near the United Nuclear/ Homestake mill at levels 340 times the recommended maximum for drinking water. Studies show that water from mill activities moves from streams to aquifers, and that effects on groundwater are "marked."



To make things worse, tailings are often stored mixed with water, so they move unexpectedly in a flood or if the dam used to hold them breaks. There have been over a dozen tailings-dam breaks in the U.S., none of which has been cleaned up. The biggest was a spill at the United Nuclear mill in Church Rock, N.M., in July of 1979.

WATER AND ENERGY (CON'T)

The dam break spread 100 million gallons of tailings and water for 50 miles down a river, despite the fact that the dam was "of the newest and safest type approved by federal and state agencies." Radioactivity readings were more than 6,000 times the drinking water standard.

There have also been radiation problems in the Gas Hills area of Wyoming and in Colorado. Drinking water has to be trucked in to well-users near a Chaffee County, Colorado, mill run by Homestake/United Nuclear. A mill near Canon City, Colorado, caused pollution in stock producers' wells. The cattle "got sores, lost hair, and had diarrhea so often they didn't put on weight." Some people's herds became too sickly to keep.

And in South Dakota, people in the Cheyenne River valley have had tailings problems from the old mill at Edgemont, which sits on the banks of the River. Not only have the tailings eroded badly, but the Cheyenne River is the main source of recharge for wells along the River. In 1962, the problem was aggravated by the spilling of 200 tons of tailings, much of which washed 25 miles, then sank into the Angostura Reservoir. Current plans for moving the tailings will reduce the release of radiation into the air and the Cheyenne, but will not stop seepage through the ground -- only slow it down. And the tailings will be moved at taxpayer's expense.

Of all the metals mining industries, a 1975 report decided that "wastes produced and land-disposal by the uranium mining industry...have the highest toxic hazardous rating." The radiation left by uranium exploration, mining, and milling are the greatest of several threats to the Black Hills water.

It is important to realize, though, that health is not the only thing threatened by energy resource activities. The economy of the area would be badly hurt if the water became unuseable -- from farming to ranching to tourism.

WATER AND ENERGY (CON'T)

A recent study found that the number 1 "recreational" use of the James River was sitting and looking at the water! If there's less water or if it's stripped of fish and plants, the pleasure will decrease. Besides pleasure, revenues from fishing licenses, boat dealership, bait shops, motels, restaurants, gas stations, and many related businesses would decline.

In the words of the Secretary of Game, Fish and Parks:

> "It would be a mistake to regard the water related recreational benefits as just a lot of people having a lot of idle fun. It is that, of course--idle fun--but we tend to regard it as idle only when someone else is enjoying the fun...."

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