

Uranium Activities' Impacts On Lakota Territory.

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Uranium exploration, mining, and milling are the “front end” of the nuclear chain – the often-forgotten activities without which neither nuclear power nor nuclear weapons could exist. The history of these activities is virtually unknown to the general public outside mining areas, but most uranium mining in the United States has occurred on or near reservations. Both mining and milling were common on the northern Great Plains from the 1940s until the early 1980s.

This paper focuses on the history and impacts of those activities on Lakota Territory – the area now known as western South Dakota and North Dakota, eastern Montana and Wyoming, the panhandle of Nebraska, and northeastern Colorado. The general problems with past uranium activities, and current projects are covered.

In the last several years, a boom in uranium exploration and proposed new mining projects has brought new attention to the ongoing impacts of old mining and milling sites. This new uranium boom is a result of the belief that nuclear power will have a “renaissance” as a “clean” alternative to fossil fuels in an era of climate change -- and to a resulting spike in uranium prices. However, nuclear power is not clean, as this paper illustrates and as the crisis at the Fukushima nuclear plants makes clear.

Before going into the specific impacts on Lakota Territory, an overview is provided of the uranium mining and milling processes. This will be followed by a summary of the known impacts on each past mining area and by brief information on current uranium activities.

Uranium Mining Overview

Uranium is unique because it emits radiation. When uranium is underground, it is not generally dangerous. But when it is brought to the surface and concentrated by mining activities, it emits dangerous levels of radiation.

Uranium breaks down into a series of other substances in a decay process, and each step of that process emits radiation. Each substance has a “half-life,” the amount of time it takes for its radiation emissions to decrease by half. The half-life of uranium-238 – a major waste product of uranium milling – is 4.5

billion years. Some uranium byproducts, such as radon and radium, are more dangerous than the uranium itself. Eventually, uranium decays into a stable form of lead.¹

There are three major types of uranium mining, all of which have been used in Lakota Territory. The first is open pit mining. The second is underground shaft mining. The third is a newer process, *in situ* (“in place”) leach mining. In situ leach mining involves pumping a chemical/water solution into the ground, where it leaches uranium out of a water-bearing rock layer. The uranium solution is then pumped to the surface for further refining.

The ore recovered during open pit and underground mining must be milled to remove uranium-235, which is concentrated and used for nuclear power or weapons. Uranium can be milled by a grinding-and-chemical process, by heap leaching – putting the ore in a pile and leaching the uranium out with acids²-- or by burning the ore, which is done when uranium is naturally mixed with lignite coal.³

The remaining ore is left in tailings piles, which are 85% as radioactive as the uranium that is taken for further processing. Tailings piles are large – covering hundreds of acres and involving millions of tons. Tailings also contain substances commonly found with uranium, such as molybdenum, arsenic, lead, and selenium.⁴They are the consistency of sand and move easily in the wind or water. In some locations, before their danger was understood, people used them for construction materials. Tailings may also be disposed of by mixing them with water in large ponds. Tailings pond dams have occasionally broken. A 1979 dam break at Churchrock, NM, was the largest expulsion of radioactive materials in U.S. history. In Lakota Territory, there have been three tailings releases in Wyoming and one in South Dakota.⁵

All types of mining and milling, like all nuclear activities, emit radiation into the environment. Uranium exploration, mining, and milling contaminate surface and groundwater, soil, and air with radioactive materials and heavy metals. Plants and the animals that eat them, in turn, take up these

¹ Environmental Science Division, Argonne National Laboratory.2002.Natural Decay Series: Uranium, Radium, and Thorium.www.ead.anl.gov/pub/doc/NaturalDecaySeries.pdf. Accessed December 23, 2009.

² R.G. Woolery, S. Ramachandran, and M.R. Woolery, Union Carbide Corporation.1983.Heap Leach in the Edgemont Area.In Maurice C. Fuerstenau and Bruce R. Palmer, eds.*Gold, Silver Uranium, and Coal: Geology, Mining, Extraction and the Environment*.New York: The American Institute of Mining.

³ U.S. Energy Information Administration.Belfield Ashing Facility Site.www.eia.doe.gov/cneaf/nuclear/page/umtra/belfield_title1.html. Accessed December 29, 2009.

⁴ US Energy Information Administration.Uranium Mill Sites under the UMTRA Project.www.eia.doe.gov/cneaf/nuclear/page/umtra/background.html. Accessed December 23, 2009; WISE Uranium Project.Uranium Radiation Properties.www.wise-uranium.org/rup.html. Accessed December 23, 2009; WISE Uranium Project.Uranium Maps.www.wise-uranium.org/umaps.htm?set=tail. Accessed November 3, 2009; Eric Mogen.2002.*Warm Sands: Uranium Mill Tailings Policy in the Atomic West*.Albuquerque: University of New Mexico Press.

⁵ *Ibid.*; WISE Uranium Project.Chronology of Uranium Tailings Dam Failures.www.wise-uranium.org/mdafu.html. Accessed December 23, 2009; US Nuclear Regulatory Commission.1980.Regulatory Guide 3.11.1: Operational Inspection and Surveillance of Embankment Retention Systems for Uranium Mill Tailings; Marley Shebala.July 23, 2009.Poison in the Earth: 1979 Church Rock spill a symbol for uranium dangers.*Navajo Times* Online.<http://navajotimes.com/news/2009/0709/072309uranium.php>. Accessed December 28, 2009.; Bruce E. Johansen.1997.The High Cost of Uranium in Navajoland.www.ratical.org/radiation/UraniumInNavLand.html. Accessed October 4, 2007.

contaminants. The animals that eat animals, including humans, can then ingest these contaminants at the top of the food chain.⁶

These are some of the reasons why there are concerns about both current and old uranium operations in Lakota Territory. In addition to health and environmental concerns, there are negative impacts on cultural and historical resources, community and cultural cohesion, local economies, and the long-term survival of indigenous communities. Keeping these impacts in mind, the specifics of past operations will be considered.

Overview of Past Operations

As mentioned above, there are old uranium operations across Lakota Territory. The US Environmental Protection Agency combined over a dozen lists of old and current mine and prospect sites to create the *Uranium Location Database Compilation: Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM)*⁷ in 2006. As part of this research, the TENORM database was consulted, and the different lists were checked to prevent double counting. The results are shown in Table One.

Table One: Old and Operating Uranium Mines and Prospects: Lakota Territory: Northern Missouri River Basin

STATE	WATERSHED	NUMBER
COLORADO		
	SOUTH PLATTE	351
	NORTH PLATTE	<u>36</u>
STATE TOTAL		<u>387</u>
MONTANA		
	YELLOWSTONE	102
	MISSOURI	<u>295</u>
STATE TOTAL		<u>397</u>
NORTH DAKOTA		
	SOURIS	13
	MISSOURI	<u>100</u>
STATE TOTAL		<u>113</u>

⁶ Portage Environmental. 2004. *Human Health and Ecological Risk Assessment for the Riley Pass Uranium Mines in Harding County, South Dakota*. Butte, MT.; for US Forest Service, Department of Agriculture, Missoula, MT.

⁷ It is unclear how radioactive materials can be both “technologically enhanced” and “naturally occurring.”

SOUTH DAKOTA		
	CHEYENNE	169
	MOREAU/GRAND	<u>103</u>
STATE TOTAL		<u>272</u>
WYOMING		
	YELLOWSTONE	1039
	NORTH PLATTE	397
	CHEYENNE/BELLE FOURCHE	<u>667</u>
STATE TOTAL		<u>2103</u>
OVERALL TOTAL		3272

The database lists approximately 3,272 sites in Lakota Territory, all of them in the northern Missouri River basin, which flows into the Mississippi River. Nearly two-thirds of these sites are in Wyoming. These old mines and prospects are generally located on private, tribal, Bureau of Land Management, or National Forest Service land.

This overview of uranium activities' impacts on Lakota Territory is organized according to current state boundaries, beginning with southwestern North Dakota.

Impacts in Southwestern North Dakota

In southwestern North Dakota, there were several uranium mines and two uranium-removal facilities in the 1960s. Both of these facilities burned uranium-bearing lignite coal, which concentrated the uranium. Kerr-McGee Oil Industries ran the first facility, which was near Bowman, from 1964 to 1967. The second facility, which was one mile south of Belfield, was operated by Union Carbide Corporation from 1965 to 1967.⁸

At the Bowman site, wastes eventually covered 12 acres. There were an estimated 28,000 cubic yards of contaminated materials on the site and 100,000 more outside the site boundary. Pollution leached into the ground, and water under the site was contaminated with sulfate, chromium, selenium, and uranium. Because of the contamination, one local rancher lost 2500 sheep. Before they died, the sheep

⁸ Energy Information Administration, US Department of Energy. Bowman Ashing Facility Site. www.eia.doe.gov/cneaf/nuclear/page/umtra/bowman_title1.html. Accessed April 27, 2008; Energy Information Administration, US Department of Energy. Belfield Ashing Facility Site. www.eia.doe.gov/cneaf/nuclear/page/umtra/belfield_title1.html. Accessed April 27, 2008.

glowed and lost their hair. The State of North Dakota has been responsible for remediation of the site, and it has not been cleaned up.⁹

Forty years after the Bowman site closed, its impacts on stream sediments were studied. Researchers from the South Dakota School of Mines and Technology looked at sediments in the Bowman-Haley Reservoir on the South Dakota-North Dakota border. They found the highest levels of uranium where Spring Creek entered the reservoir, a site about 15 miles downstream from the Bowman site. And they concluded that the Bowman facility was the source of these elevated readings.¹⁰

The second site, at Belfield, left 58,000 square yards of contaminated material along the Heart River. Contamination, including airborne materials, covered 32 acres. Residents reported that a red dust blew over town when materials were loaded onto rail cars, and mine wastes were used to backfill buildings' foundations. In addition, an estimated 4.7 million gallons of groundwater were contaminated because pollution leaked into the ground. The contaminants included selenium, radium²²⁶ and ²²⁸, molybdenum, and uranium. The State did clean up this site in 2004.¹¹

There are also an estimated 113 old uranium mines and prospects in North Dakota. One of the larger mines was the Fritz Mine. There, uranium was removed by burning the actual coal seam. Observers reported that there was no vegetation around the mine, and that the water that filled it was a dead green color.¹²

Seven of the abandoned mines -- a total of 440 acres -- were reclaimed, and a water monitoring program was put in place. The water monitoring process was suspended in the mid-1990s.¹³

Impacts in Montana

There are old exploration sites and two abandoned uranium mines in Custer National Forest in the Pryor Mountains in south-central Montana. In this area, a state study found that waste piles at one mine had uranium readings that were up to 369 times the background level – the level of radiation that is present naturally. At the second mine, readings were as high as 145 times background. In this former mining area, as elsewhere, members of the public have explored the old mine sites. A study noted that radioactivity may be a hazard at both mines.¹⁴

⁹ Energy Information Administration, Bowman, *ibid.*; US Department of Energy. Section 3.2.14: Bowman, North Dakota. *Technical Approach to Groundwater Restoration*. www.lm.doe.gov/documents/3_pro_doc/guidance/gw/peis/umtra_3.htm. Accessed April 27, 2008; Lauren Donovan. November 15, 2003. Belfield family looks for connection between uranium mine and illness. *Bismarck, ND, Tribune*.

¹⁰ Lance Larson, James Stone, and Larry Stetler. 2010. Arsenic and Uranium Impacted Sediment Behavior Within the Bowman-Haley Reservoir, Bowman County, North Dakota. Paper Abstract: Western South Dakota Hydrology Conference.

¹¹ Energy Information Administration, Belfield, *op cit.*; US Department of Energy. Section 3.2.13: Belfield, North Dakota. *Technical Approach to Groundwater Restoration*; Donovan, *ibid.* www.lm.doe.gov/documents/3_pro_doc/guidance/gw/peis/umtra_3.htm. Accessed April 27, 2008; State to reclaim abandoned Belfield uranium mine. December 16, 2003. *Bismarck, ND, Tribune*; Donovan, *ibid.*

¹² Donovan, *ibid.*

¹³ Donovan, *ibid.*

¹⁴ *Op. cit.*, Kerschen, et al.

Impacts in Northwestern South Dakota

Of all the areas covered in this report, the best records on the environmental impacts of uranium activity in Lakota Territory were created in what is now northwestern South Dakota. Due to a series of studies, most of them done by Oglala Lakota College and the South Dakota School of Mines and Technology, reports have been created on contamination of water, soil, stream sediment, and air around a number of old open pit mines. These studies show widespread contamination of the Grand River and Moreau River watersheds, which then flow east through the Standing Rock and Cheyenne River Reservations.

Uranium mining took place in northwestern South Dakota from 1954 until 1964. Most mining was on US Forest Service land in four areas: the North Cave Hills, South Cave Hills, Slim Buttes, and Flint Buttes. There are 103 identified former mining sites, and exploration sites, mines, and spoils covered almost 1,000 acres. No restoration was required when the mining was done, and Stone and Stetler described spoils piles as “mostly devoid of vegetation” with high erosion rates. Because mining was done on the tops of buttes, wastes often slid or were pushed downhill.¹⁵

In this area, as in some other locations, uranium is found in deposits that also include arsenic. So both were often measured to determine risks to human health.¹⁶

An initial study of contamination in areas that might need clean-up was done in 1990 and 1991 – nearly 30 years after mining had ceased. This study looked at 12 bluffs at the Riley Pass uranium mines in the North Cave Hills. It found gamma radiation readings as much as 100 times the background level. The report found that radioactive materials in the soil were three times higher than the background level at nine sites. Arsenic, molybdenum, and thorium were more than three times background.¹⁷

Surface water samples at and downstream from the mining area showed widespread contamination by arsenic, lead, molybdenum, selenium, thorium, vanadium, and radium²²⁶. Stream sediment samples were at least three times background for at least some of the contaminants at seven of the bluffs. Sediment ponds constructed in 1989 along the waterway were trapping some contaminated particles as the water moved downstream.¹⁸

¹⁵ James Stone and Larry D. Statler. Study of Abandoned Uranium Mine Impacts On Private Land Surrounding US Forest Service Land In Western South Dakota. <http://uranium.sdsmt.edu/default.htm>. Accessed September 29, 2009; Michael D. Kerschen, Phyllis A. Hargrave, John J. Metesh, Catherine McDonald, and Robert Wintergerst. 2003. Abandoned-Inactive Mines on Custer National Forest-Administered Land. Montana Bureau of Mines and Geology, for US Forest Service.

¹⁶ John Kenneth Dane. 1978. Alteration of Sedimentary Rocks Related to Uranium Mineralization in the North Cave Hills of Harding County, South Dakota. Master's Thesis: Geology: South Dakota School of Mines and Technology; James Stone and Larry Stetler. 2008. Environmental Impacts from the North Cave Hills Abandoned Uranium Mines, South Dakota. In *Uranium, Mining and Hydrogeology*. Berlin: Springer.

¹⁷ Denver, Knight, Piesold Investigation Results. 1991. In US Forest Service. *Riley Pass Uranium Mines, Harding County, South Dakota: Draft Final Engineering Evaluation/Cost Analysis (EE/CA)*. Missoula, MT: US Forest Service.

¹⁸ *Ibid.*; Portage Environmental, Inc. 2004. *Human Health and Ecological Risk Assessment for the Riley Pass Uranium Mines in Harding County, South Dakota*. Butte, MT. Prepared for US Forest Service, Missoula, MT.

A second study was done in 2004 by Portage Environmental and again focused on the North Cave Hills. Soil and surface water samples were collected. The results for soil samples are shown in Table Two. The results for surface water samples are shown in Table Three.¹⁹

Clearly, uranium activities had major negative impacts on the environment in the North Cave Hills. The report then went on to calculate the risks to humans from the old mine sites. The conclusions were that, in this area:

- Construction workers would be considered “radiation workers” under federal Nuclear Regulatory Commission (NRC) guidelines; and
- Recreational visitors and ranchers who held grazing permits faced unacceptable risks for cancer as a result of exposure to arsenic and radiation.²⁰

Table Two: Soil Sample Results for 2004 North Cave Hills Study

	MAXIMUM READING	NUMBER OF TIMES HIGHER THAN AVERAGE BACKGROUND
Arsenic	3390 mg/kg	121
Molybdenum	6550 mg/kg	1638
Selenium	98 mg/kg	20
Radium ²²⁶	116 pCi/g	64
Uranium ²³⁸	151 pCi/g	151
Uranium ²³⁴	156 pCi/g	156
Thorium ²³⁰	161 pCi/g	107
Uranium ²³⁵	7.1 pCi/g	71

Table Three: Surface Water Sample Results for 2004 North Cave Hills Study

	MAXIMUM READING	NUMBER OF TIMES HIGHER THAN MAXIMUM BACKGROUND
Arsenic	1420 µg/L	53
Copper	442 µg/L	50
Lead	442 µg/L	69
Molybdenum	335 µg/L	38
Selenium	34 µg/L	10
Vanadium	944 µg/L	41
Radium ²²⁶	16 pCi/L	13

¹⁹ *Ibid.*, Portage.

²⁰ *Ibid.*

A third study was done in 2000 – 2001. This study found that soil at Slim Buttes was as much as 1,704 times more radioactive than background levels. Fifteen other samples exceeded the background level for uranium by more than 20 times.²¹

A mix of South Dakota School of Mines (SDSMT) students and faculty and Oglala Lakota College faculty then completed follow-up studies. They looked at groundwater, airborne contaminants, stream sediments, and surface water. A groundwater study looked at the potential for contamination in a well located 1.9 miles from the abandoned Riley Pass mines. The authors concluded that groundwater in that area was moving only .047 feet per day. At this rate, it would take contamination about 370 years to reach the well. It wasn't clear why this well was selected, and the overall effect of abandoned uranium mines on groundwater in that area has yet to be determined.²²

Wind erosion of surface dust was studied at 30 locations in the North Cave Hills. The authors noted that soils could be moved beginning at a wind speed of 10 – 11 mph. They then say that the conservative threshold wind speed for the study area is 13 mph, and that winds blow harder than that about 23% of the time. Not surprisingly, the tests found high readings for uranium, arsenic, selenium, molybdenum, and vanadium in the air – although not all of these were present at all sites. The authors concluded that “Uranium concentration distribution show the highest correlation to the abandoned mine sites and the prevailing wind direction,” although other factors were likely to be at work.²³

Stream sediment and surface water testing, the third and fourth areas of study, were done at all four mining areas. In the Slim Buttes region, nearly half of the stream sediment samples exceeded background levels for uranium and for arsenic. Just over a third of the surface water samples exceeded background for uranium, and a quarter exceeded it for arsenic. The author concluded that old uranium mines posed “a great concern and potential for contamination of offsite drainages.” However, this study actually minimized the potential risks, because of the way the researcher calculated background levels - - she used samples that were collected only 5 km downstream from abandoned mine sites. Since other studies showed that there was contamination at least eight times further downstream, her methodology inflated the background numbers and minimized the amount of contamination that was identified.²⁴

A study by Albertus-Benham measured stream sediments at the North Cave Hills, South Cave Hills, and Flint Hills sites in order to determine if arsenic and uranium had migrated onto private lands. The results indicated that they had at all three locations. Arsenic levels were as much as 33 times background, and were elevated as much as 42 km (26 miles) downstream from mining areas. Uranium was as much as 23 times background and was elevated as far as 37 km (23 miles) downstream.²⁵ An additional finding for the North Cave Hills was that the sedimentation ponds built in 1989 and noted

²¹ *Op. cit.*, Kerschen, et al.

²² *Ibid.*

²³ *Ibid.*

²⁴ Hannah Albertus-Benham. 2009. *Surface water and sediment investigation concerning abandoned uranium mines within the Slim Buttes region, Harding County, South Dakota*. Master's Thesis: Civil and Environmental Engineering: South Dakota School of Mines and Technology.

²⁵ *Op. cit.*, Albertus-Benham.

above, which were designed to stop contamination from moving downstream, were no longer working.²⁶

While all these studies were being done, ranchers in the area asked for better clean up of the old mining areas. Tronox, Inc. – a spin-off of Kerr-McGee Corporation, the company that had mined in Harding County -- was initially going to do some clean up. Unfortunately for local ranchers, when Tronox was made a separate company in 2006, Kerr-McGee made the new company responsible for environmental remediation and litigation costs. Not surprisingly, Tronox declared bankruptcy in 2009.²⁷ This corporate maneuver let Kerr-McGee off the hook for cleaning up after its mining operations.

Today, local residents report that the trail to a local cave cannot be reached without going through radioactive spoils piles. Past mining destroyed archeological sites, and some that remain are too dangerous to visit. Mine dust still blows in the wind.²⁸ And contamination flows toward both the Cheyenne River and Standing Rock Reservations.

Impacts in Southwestern South Dakota

Uranium deposits are located in an oval around the outside rim of the Black Hills in the Inyan Kara geological formation. There are at least 169 abandoned uranium mines and prospects in southwestern South Dakota in the Black Hills. The Hills are the sacred center of Lakota Territory, and digging up the ground is considered sacrilege. There are thousands of specific cultural and historical sites, including petroglyphs, camp sites, and burials, as well as locations of particular importance, such as Wind Cave and Mato Paha (Bear Butte).

The majority of Black Hills uranium mines are in Fall River County in the far southwestern corner of what is now known as South Dakota. These include both open pit and underground mines. There are also thousands of old exploration holes and a former mill site at Edgemont.

Starting at the front end of the nuclear chain, exploration holes were drilled in the 1960s and 1970s along the rim of the Hills. Exploration holes create pathways between groundwater aquifers, making it possible for contaminated water to pollute clean water. In the southern Black Hills, a 1980 study showed that these types of connections between aquifers exist near the town of Burdock. Other problems related to exploration have also been reported, including “uranium test holes that were uncased, unplugged, and flowing at the surface.” This wasted huge amounts of water.²⁹

Turning to mine sites, two studies of the southern Black Hills paint a dismal picture. Hall, a graduate student at the South Dakota School of Mines and Technology, prepared the first study in 1982. He identified 38 of the old mines, 491 acres of disturbed areas, and 390,620 square yards of spoils piles.

²⁶ Emmanuel Tuombe. 2009. *Surface water and sediment investigation concerning abandoned uranium mines in the South Cave Hills, North Cave Hills, and Flint Buttes region, Harding County, South Dakota*. Master's Thesis: Civil and Environmental Engineering: South Dakota School of Mines and Technology.

²⁷ Brandon Bennett. January 13, 2009. Tronox Bankruptcy raises questions about uranium cleanup. *Black Hills Spearfish, SD Pioneer*.

²⁸ Jerry Wilson. July/August 2009. Radioactive Hills: Can uranium be safely mined the second time around? *South Dakota Magazine*: 53-58.

²⁹ *Op. cit.*, Boggs and Jenkins; Jack R. Keene. 1970. *Ground Water Resources of the Western Half of Fall River County, South Dakota*. Master's Thesis: Geological Engineering: South Dakota School of Mines and Technology.

He observed that, “Essentially no reclamation was done in the old mined areas,” and that spoils piles were exposed and potentially dangerous.³⁰

He also measured above-ground gamma rays, the most dangerous type of radiation associated with uranium mining. All the readings were at least four times higher than background levels, and one was 60 times higher than the background level. Measurements in small mine shafts were as much as 27 times higher than what the author set as a “safe” level for members of the public who visited the area.³¹ Besides looking at radiological hazards, the author looked at impacts on the land, noting, “Uranium mining usually involves considerable disturbances of surface lands and associated biota.” Among the hazards identified were:

- Unplugged and hidden drill holes up to 8” in diameter and 200 feet deep at 30 out of 32 sites;
- Eroded roads and spoils piles;
- Mining trash at all the mines and open pit mines being used as garbage dumps;
- 31 out of 32 mines were unfenced;
- Cave-ins at underground mines;
- Two mines that “could easily be driven into at night as a result of their obscure nature;”
- Underground mines that were used as recreational sites and cattle shelters;
- Two unmarked and obscured mine ventilation shafts that were two feet wide and 60 feet deep. Hall provided a photo of his legs dangling into one of these holes, which was plenty large enough for a person to fall into.³²

Having said all this, the author was pro-mining. He feared that the impacts of unreclaimed sites hurt uranium mining’s image. The negative impacts, he said, gave “radical groups” such as the Black Hills Alliance – an area organization -- fuel in their opposition to future uranium mining.³³

The second study, done by Webb, Davis, and Hodge in 1995, looked water samples from two old open pit mines, a downstream stock dam, a nearby well, and the site of the former uranium mill in Edgemont. The mill and its associated tailings had, by this time, been buried at a cost of \$33 million. One of the open pit mines was described as “a large, open pond of highly acidic and radioactive seepage water.”³⁴

The study, done 13 years after the first research, recorded similar conditions. At the Diane-A mine, the levels of uranium in water were up to 500 times higher than background. Contamination had reached the stock dam and ranch well below the mine, and it had reached Cottonwood Creek by the old uranium mill. The authors noted that the latter was a threat to groundwater, because the water in the creek’s sediments and riverside wells could be linked to underground aquifers.³⁵ To date, according to

³⁰ Rowland L. Hall. 1982. *Radiological and Environmental Assessment of Abandoned Uranium Mines in the Edgemont Mining District, South Dakota*. Master’s Thesis: Geology: South Dakota School of Mines and Technology.

³¹ *Ibid.*

³² *Ibid.*

³³ *Ibid.*

³⁴ C.J. Webb, A.D. Davis, and V.F. Hodge. March 1995. Rare Earth Elements at Abandoned Uranium Mines in the Southern Black Hills of South Dakota. Presented at the Annual Meeting of the Society for Mining, Metallurgy, and Exploration.

³⁵ *Ibid.*

the State of South Dakota, four mines on US Forest Service land have been reclaimed, and a fifth has been partially reclaimed.³⁶

These problems are not unusual. As should be clear by now, mining poses a variety of risks. There are also major risks from uranium mills, and the former mill at the town of Edgemont has had dramatic impacts on the area. As noted by the 1995 study, there were clear impacts on water even after the mill and its associated wastes had been removed and buried.

Uranium ore was milled at Edgemont from 1956 to 1972. The mill site covered 213 acres and included 2.5 million tons of tailings. The tailings blew across the area and were used in construction of houses and commercial buildings -- a basement room in one house had radiation levels 39 times the background level, and the family abandoned its home. A cluster of dwellings known as the Cottonwood Community was surrounded on three sides by mill operations, and windblown tailings "significantly contaminated" the area.³⁷

The tailings also contaminated soil and plants. Soil at the tailings site had high concentrations of uranium, radium²²⁶, lead²¹⁰, polonium²¹⁰, and gross alpha radiation. The highest uranium reading was 38 times higher than the highest offsite reading, and the highest rate for radium²²⁶ was 121 times higher. Uranium concentrations were significantly higher in plants, as well.³⁸

But the greatest damage was to surface water. In addition to the usual erosion, 200 tons of tailings washed into Cottonwood Creek in 1962 and were carried down the Cheyenne River. The river flows from the southern end of the Black Hills and across the corner of the Pine Ridge Reservation, and is the southern boundary of the Cheyenne River Reservation. Several studies of water quality have been done since the tailings spill. This research will be discussed in some detail, because of its implications for modern Lakota and their land base.

The first study was done by the Tennessee Valley Authority, the mill's owner, as part of its plan for decommissioning the site. The highest uranium readings taken downstream of the mill were nearly 3 times higher than the highest readings taken upstream of the site. Bottom sediments were also contaminated. More alarming, the highest uranium readings for groundwater at the mill were 71 times higher than the highest readings for wells that were away from the area.³⁹

A second study compared 1988 data with 1994 data. Concentrations of uranium, selenium, and molybdenum were high in both datasets.⁴⁰ In another study in 1997, the Bureau of Reclamation looked at sediment contamination in the Cheyenne River between Edgemont and Red Shirt, at the corner of the Pine Ridge Reservation. At the site nearest the reservoir's dam and at a downstream pond, the levels

³⁶ Mike Cepak, Department of Environment and Natural Resources. October 30, 2009. E-mail correspondence.

³⁷ Harvey Wasserman and Norman Solomon. 1982. *Killing Our Own: The Disaster of America's Experience with Atomic Radiation*. New York: Dell Publishing Co., Inc.; US Energy Information Administration, Department of Energy. Edgemont Mill Site. www.eia.doe.gov/cneaf/nuclear/page/umtra/edgemont_title1.html. Accessed January 20, 2010; Tennessee Valley Authority. 1980. *Edgemont Uranium Mill Decommissioning Plan: Environmental Report*.

³⁸ *Ibid.*, Tennessee Valley Authority; Mark A. Rumble and Ardell J. Bjugstad. 1986. Uranium and Radium Concentrations in Plants Growing on Uranium Mill Tailings in South Dakota. *Reclamation and Revegetation Research*: 4:271-277.

³⁹ *Ibid.*, Tennessee Valley Authority.

⁴⁰ Steven K. Sando and Joyce E. Williamson. 2001. *Irrigation Drainage Studies of the Angostura Reclamation Unit and the Belle Fourche Reclamation Project, Western South Dakota: Results of 1994 Sampling and Comparisons with 1988 Data*. Water Resources Investigations Report 01-4103. US Geological Survey, Department of the Interior.

of uranium were elevated. There were also higher levels of uranium contamination at Red Shirt. The authors noted that the levels were higher than in the 1988 or 1994 data.⁴¹ This indicated that the contamination was not getting better with time.

A fourth study is cited in the US Geological Survey's *Atlas of Water Resources in the Black Hills Area*. This 2001 study showed that the highest levels of uranium along the Cheyenne River were located in Edgemont and near the Pine Ridge Reservation. Elevated levels were present all along the Cheyenne River.⁴²

Taken together, the studies track uranium contamination from the Edgemont mill site to the Reservation – a total of about 60 miles as the crow flies. On the Reservation, there have been chronic problems with radioactive contamination of water supplies. A 1980 community survey done by Women of All Red Nations showed higher levels of miscarriages and cancer than in a control population. In the same year, samples of groundwater showed high gross alpha levels at Red Shirt and ten other locations. Samples taken at Red Shirt in 1999-2002 also showed that gross alpha radiation was as much as four times the federal Maximum Contaminant Level (MCL), and a 2007 water sample taken just upstream of Red Shirt also found gross alpha radiation above the MCL. Signs were posted warning people not to use the water.⁴³

In addition to the environmental impacts of uranium activities in southwestern South Dakota, Edgemont suffered the typical economic impacts as a result of the mining “boom and bust” cycle. The “boom” brought new people and employment. But the town’s population dropped substantially, as workers sought employment elsewhere during the “bust” part of the mining cycle. Today, most buildings on the main street are empty. A few bars, a municipal building, and the offices of a new uranium company are among the only operating buildings.

Rivers across western South Dakota have been impacted by past uranium mining and milling. The air, soil, groundwater, and economy have also suffered. But South Dakota has not experienced nearly as much uranium activity as Wyoming, to which we now turn.

Impacts in Eastern Wyoming

The state of Wyoming has more old uranium operations than any other state in Lakota Territory – over 2100 in the northeastern two-thirds of the state. There have been two boom-and-bust cycles for Wyoming’s uranium industry. When the price of uranium dropped the last time, in the 1980’s, all of the

⁴¹ *Op. cit.*, US Bureau of Reclamation. Sediment at Angostura Reservoir.

⁴² J.M. Carter, D.G. Driscoll, and J.E. Williamson. *Atlas of Water Resources in the Black Hills Area, South Dakota*. US Geological Survey, Hydrologic Investigations Atlas HA-747.

⁴³ Owe Aku/Bring Back the Way. A Summary of the OST Rural Water Reports and Indian Health Service. www.bringbacktheway.com/50.html. Accessed September 25, 2009; Bob Yellowbird. July 30, 1980. Memo to the the Oglala Sioux Tribe Health Board; Women of All Red Nations. 1980. *Report to Mr. Stanley Looking Elk, Tribal President, the Oglala Sioux Tribal Council, the Tribal Health Board, and the People of the Pine Ridge Reservation*. Pine Ridge Health Investigation; Defenders of the Black Hills. July 16, 2007. Radiation Warning Signs Placed on Cheyenne River; http://www.defendblackhills.org/index.php?option=com_content&task=view&id=104&Itemid=3. Accessed August 2, 2007; Charmaine White Face. June 18, 2007. Memo to Everit Poor Thunder, Red Shirt Village.

state's mills and nearly all of its mines shut down. Mining towns, like Jeffrey City in the central part of the state, quickly went bust; the town lost 95% of its population in just three years.⁴⁴

For the purposes of this paper, the mining areas within Wyoming that are in Lakota Territory will be broken down into the Powder River Basin, the Northern Black Hills, and the Gas Hills in the center of the state. Pumpkin Buttes in the Powder River Basin became the first uranium district in the state in 1951 and extended from Campbell County west into Johnson County. Ore was taken to the mill at Edgemont, SD.⁴⁵

To the south, the Monument Hill area produced 90% of the uranium mined in the Powder River Basin between 1953 and 1965. Most of this ore was shipped to Edgemont, but there was also a uranium heap leaching facility -- aptly named the Spook Site -- in Converse County, which operated between 1962 and 1965. Heap leaching involves making a heap of ore, then leaching the uranium out using acid. At the Spook Site, this left 55 acres of tailings, which were buried in an old open pit mine. Groundwater was contaminated both under the site and up to half a mile away with uranium, selenium, chromium, molybdenum, radium, and other contaminants. The site is currently considered "stabilized," but there is still groundwater contamination.⁴⁶

In Johnson County, Cogema Mining (more recently Uranium One) has operated two in situ leach mines, the Irigary site and the Christensen Ranch site. From 1980 to 2000, 4.7 million pounds of uranium were recovered. In 2001, Cogema put its licensure on "possession-only" status, but it is now working to restart mining at these sites.⁴⁷

The Christensen Ranch site and the nearby Irigary site have been plagued with operational difficulties. According to the company's records, there have been over 1 million gallons of production and injection fluid spills at the two sites, both during past operations and after mining ended. These include above-ground and below-ground spills. At Christensen Ranch, there were 34 underground "excursions" of mining fluids between 1992 and 2009, meaning that underground mining fluids left the mine area. As of the end of 2009, seven of those excursions were still not controlled.⁴⁸

Given these sloppy operations, it is not surprising that Cogema's own study indicated that post-restoration water quality at a Christensen Ranch mine field exceeded both "target restoration values" and federal or state groundwater standards. Groundwater standards were exceeded for uranium and for radium²²⁶, which was at 47 times the standard.⁴⁹

⁴⁴ *Op. cit.*, Amundson.

⁴⁵ MINOBRAS. 1976. *Uranium Guidebook for Wyoming*. Dana Point, CA.: MINOBRAS.

⁴⁶ US Energy Information Administration, Department of Energy. Spook Leaching Facility Site. www.eia.doe.gov/cneaf/nuclear/page/umtra/spook_title1.html. Accessed February 18, 2010; US Department of Energy. Environmental Management: Spook, Wyoming (UMTRA Site). www.em.doe.gov/bemr/BEMRSites/spok.aspx. Accessed February 18, 2010; Legacy Management, US Department of Energy. Undated. Spook, Wyoming, Disposal Site: Fact Sheet.

⁴⁷ US Nuclear Regulatory Commission. Cogema Mining, Inc. www.nrc.gov/info-finder/decommissioning/uranium/cogema-mining-inc.html. Accessed February 18, 2010; Cogema Mining, Inc./Petrotek, Engineering Corporation. 2008. Restoration Data Package: Mine Unit 5: Christensen Ranch Project. Mills, WY.

⁴⁸ Tom Hardgrove, Areva Resources. December 17, 2009. E-mail to Ron Linton, Nuclear Regulatory Commission.

⁴⁹ WISE Uranium. Christensen Ranch/Irigary (Wyoming). www.wise-uranium.org/umopwy.html. Accessed February 18, 2010; *Ibid.*, Cogema Mining.

Further south in the Powder River Basin is the Highland area, which is still an active mining district. Historically, the area included a number of open pit mines, underground mines, and the Highland Mill, now owned by ExxonMobil, which operated from 1972 to 1984. At the Highland mill, the old tailings were buried, but a pit lake was left behind. It contained elevated levels of radon, gross alpha radiation, uranium, and selenium. In addition, a plume of contamination reached the water under the tailings site. The company has denied that this pollution has migrated offsite. However, the Nuclear Regulatory Commission stated that there is offsite pollution, which includes contamination of a local well.⁵⁰

The second area under consideration is the northwestern part of the Black Hills, which stretches from South Dakota into Wyoming. This area, like the rest of the Black Hills, contains numerous cultural and historical sites, including Mato Tipila (Devil's Tower). In this area, uranium production began in 1953 and continued until 1968, and the ore was milled at Edgemont. In the early 1970s, there was renewed exploration just west of Oshoto. Over 5500 exploration holes were drilled, and a small in situ leach test was done. In 1979, restoration at this project, known as the Nubeth site, was described as "imminent." Uranium, molybdenum, and vanadium were still above "upper restoration limits" (URL) approved by the NRC and the State of Wyoming. Uranium was 4.5 times higher than the URL, and vanadium was 88 times higher. The URLs, in turn, allowed contamination that was several times higher than pre-mining standards for radium, gross alpha radiation, and gross beta radiation. By 1982, restoration was being described as "nearing completion."⁵¹

The third uranium mining district within Lakota Territory and Wyoming is the Gas Hills district. It is in the central part of the state and – while spread out – focuses on the towns of Jeffrey City and Riverton. The Gas Hills district produced large amounts of uranium beginning in 1953.

Early in the nuclear era, there was a mill at Riverton, operated by Susquehanna Western. The Riverton mill contaminated 115 acres and left 900,000 tons of tailings. These materials were buried between 1988 and 1990, but polluted the Little Wind River. Over time, three more major mills were built along the Natrona County–Fremont County line. These were operated by Federal-American Partners, Utah International (later Pathfinder and then Cogema), and Union Carbide Corporation (now UMETCO). The Union Carbide operation included both a conventional mill and a heap leaching operation. Two additional heap leaching mills were located at Western Nuclear's Split Rock and Day Loma sites.⁵²

⁵⁰ Keith I. McConnell, Nuclear Regulatory Commission. August 12, 2008. Letter to Maheshi Vidyasagar, ExxonMobil; U.S. Nuclear Regulatory Commission. Exxonmobil Highlands. www.nrc.gov/info-finder/decommissioning/uranium/exxonmobil-highlands.html. Accessed on February 18, 2010.

⁵¹ *Op. cit.*, MINOBRAS; Michael Douglas Buswell. 1982. *Subsurface Geology of the Oshoto Uranium Deposit, Crook County, Wyoming*. M.S. Thesis, Geology, South Dakota School of Mines and Technology; Francis X. Canaday. 1979. Restoration Summary Report On In Situ Solution Mining Test Site, Sundance Project, Crook County, Wyoming: Source Material License No. SUA-1331: Docket No. 40-8663.

⁵² *Op. cit.*, MINOBRAS; US Energy Information Administration, Department of Energy. Riverton Mill Site. www.eia.doe.gov/cneaf/nuclear/page/umtra/riverton_mill_title1.html. Accessed February 18, 2010; WISE Uranium. Day Loma heap leach site, Wyoming. www.wise-uranium.org/udusawy.html. Accessed February 18, 2010; WISE Uranium. Western Nuclear Split Rock uranium mill site, Wyoming. www.wise-uranium.org/udusawy.html. Accessed February 18, 2010; Legacy Management, US Department of Energy. Undated. Riverton, Wyoming, Processing Site: Fact Sheet.

Information is available on the three major mills, all of which left serious contamination. The Utah International mill, also known as the Lucky McMill, operated from 1958 to 1988. The milling left behind 241 acres of tailings that contaminated both ground and surface water. After reclamation attempts didn't clean up the site, the company gave up.⁵³ Instead of forcing the company to reclaim the site, the Nuclear Regulatory Commission (NRC) changed the reclamation standards to make them fit the situation. This is a common move in uranium reclamation that is known as “relaxing” water quality standards. In this situation, a company asks a government body to declare its current water reclamation efforts – however poor – to be “within the law.” The current water quality standard is “relaxed” (raised), and more contamination is allowed. Then the company only has to meet the higher standard for its reclamation to be considered “successful.”

This may leave water many times more contaminated than current regulations allow. Table Four shows what happened at the Pathfinder mill. As a result of these relaxed standards, reclamation at the Pathfinder mill was declared “complete” in 2004.⁵⁴

Table Four: Relaxed Groundwater Standards at Pathfinder Mill

CONTAMINANT	CURRENT STANDARD	RELAXED NRC STANDARD AT PATHFINDER MILL	NRC STANDARD = x TIMES CURRENT STANDARD
Uranium (milligrams/liter)	.11	1.70	15.5
Selenium (mg/l)	.01	1.10	110
Nickel (mg/l)	.09	.85	9.4
Radium226 + 228 (picoCuries/l)	5.0	7.50	1.5

The NRC also relaxed federal water quality standards at Western Nuclear's Split Rock mill, which operated from 1958 until 1984. The federal Department of Energy knew that it would eventually become the custodian of the mill wastes and objected to the idea. But the NRC made the changes anyway. There was also groundwater contamination, but the NRC let the company stop reclamation that was designed to contain the pollution – allowing clean groundwater to become contaminated.⁵⁵

At the Union Carbide/UMETCO site, the story was similar. The mill, which operated from 1960 to 1979, was dismantled, and tailings were moved to an old mine. Some of the topsoil used to cover the tailings was dangerously radioactive, so the NRC relaxed the air quality standard for radium²²⁶ and allowed levels that were three times higher than the standard. Groundwater was also contaminated, and

⁵³ US Nuclear Regulatory Commission. Pathfinder – Lucky Mc. <http://www.nrc.gov/info-finder/decommissioning/uranium/pathfinder-lucky-mc.html>. Accessed February 18, 2010; WISE Uranium. Gas Hills North disposal site (ex Pathfinder Mines Lucky Mc uranium mill site), Fremont County, Wyoming. www.wise-uranium.org/udusawy.html. Accessed February 18, 2010.

⁵⁴ *Ibid.*

⁵⁵ WISE Uranium. Western Nuclear Split Rock uranium mill site, Wyoming. www.wise-uranium.org/udusawy.html. Accessed February 18, 2010; US Nuclear Regulatory Commission. Western Nuclear, Inc. – Split Rock. www.nrc.gov/info-finder/decommissioning/uranium/western-nuclear-inc-split-rock.html. Accessed February 18, 2010.

the company asked the NRC to relax water quality standards. The NRC obliged, as shown in Table Five.

Table Five: Relaxed Groundwater Standards AT UMETCO Mill

CONTAMINANT	CURRENT STANDARD	RELAXED NRC STANDARD AT UMETCO MILL	NRC STANDARD = x TIMES CURRENT STANDARD
Uranium (milligrams/liter)	.29	34.1	117.6
Selenium (mg/l)	.01	.53	53
Nickel (mg/l)	.04	9.34	233.5
Radium226 + 228 (picoCuries/l)	24.9	353	14.2
Arsenic (mg/l)	.05	1.8	36
Gross alpha radiation (pCi/l)	17.8	6223	349.6
Lead210 (pCi/l)	4.6	46.7	10.2
Thorium230	6.6	57.4	8.7

These were the impacts of conventional mining and milling operations. In addition to the Nubeth site, mentioned above, information was collected on three additional in situ leach mines. Company employees wrote a 1984 article about these three pilot projects – the Bison Basin, Leuenberger, and Reno Creek projects. These projects were very small and short-term, as each operated for only a few months.⁵⁶ These small, brief projects might be expected to have little environmental impact.

Nonetheless, where post-restoration numbers were provided, they were stunning. At the Leuenberger project, radium remained nearly twice pre-mining levels at the end of the project. At the Reno Creek project, post-mining uranium was as much as 122 times higher than the baseline. At the Bison Basin project, the average concentration of uranium was 85 times higher than baseline.⁵⁷ What was perhaps most interesting about this article was that the authors bragged about the “success” of their efforts.

In the portion of Wyoming that is within Lakota Territory, the environmental impacts of past uranium activities continue. Mill sites continue to pollute water because of the NRC’s willingness to relax water quality standards to whatever level a company thinks is financially beneficial. According to the State’s Abandoned Mine Land Project Manager, there have been only 49 reclamation projects for old uranium mines, mostly large open pit mines.⁵⁸

While the impacts of uranium activities have not been thoroughly measured in Wyoming, the information that is available is not encouraging. There is clearly a lot of contamination that is not being cleaned up, and monitoring of old sites appears superficial.

⁵⁶ Glenn Catchpole, Roger Garling, and Mike Neumann. June 1984. Groundwater Restoration at Wyoming Uranium Solution Mining Sites. *The Mining Claim*: 6-9; Glenn Catchpole, Roger Garling, and Mike Neumann. Date unknown (after June 1984). Groundwater Restoration at Wyoming Uranium Solution Mining Sites (Part II). *The Mining Claim*: 14-19.

⁵⁷ *Ibid.*

⁵⁸ Marcia Murdock, Abandoned Mine Land Project Director, State of Wyoming. December 21, 2009. E-mail to Liliars Jarding.

Impacts in Northeastern Colorado

The Great Plains of Colorado formed the southwestern portion of Lakota Territory. In the 1950s through the 1970s, there were about 387 uranium mines and prospects in northeastern Colorado, as well as a test facility for in situ leach uranium mining. Most of these sites were small and were located in the South Platte River watershed. The larger uranium mines and the mills in Colorado have been located on the western slope of the Rocky Mountains along the Utah border.

In the Platte River watershed, exploration and mining took place in South Park, North Park, and along the Front Range of the Rocky Mountains. The Front Range is by far the most populous area within Lakota Territory.

There is no available research specific to contamination from past exploration, open pit mines, or underground mines. However, there are at least 2,600 abandoned exploration holes in the Wyoming/Nebraska/Colorado border region.⁵⁹ These holes pose a threat to groundwater, especially if in situ leach (ISL) mining is started in the area, as proposed.

There was experimental ISL mining in the late 1970s near the town of Grover. The experiment, which was done by Wyoming Mineral Corporation, left elevated levels of gross alpha radiation, gross beta radiation, molybdenum, and selenium in the water. More troubling in the long run was the fact that, after the State signed off and said that the mine had been restored, the amount of contaminants in the water actually rose.⁶⁰

This indicated that the contaminated water that was sucked out of the mining area during the restoration process was only part of the problem. After the company and the State considered restoration complete, contaminated water was still moving around underground. This was significant, because closed ISL mines only have to be monitored for a short period of time. Radioactive contamination, however, lasts for thousands of years. Contaminated groundwater may not reach people's wells for decades – or longer -- by which time mining companies are usually long gone.

Clearly, past uranium operations have had significant impacts in Lakota Territory. Air, soil, stream sediment, and both surface and groundwater have been polluted. The end of the last uranium rush in the 1980s did little to correct this situation, as few mines were cleaned up and plumes of contamination reached out from old mining and milling sites.

But, across Lakota Territory, the uranium was still in the ground, and mining companies still knew where it was located. All it took was talk of an expansion of nuclear power -- a “nuclear renaissance” -- for companies to return to former mining areas. So beginning in the mid-2000s, new exploration activities were undertaken. Companies staked claims, leased private land, and began to publicize their proposals for new uranium projects. Most of these proposals were for in situ leach mines. This history

⁵⁹ Jeffrey C. Parsons. September 29, 2009. Letter to Colorado Division of Reclamation, Mining and Safety RE: Powertech (USA) Inc. Request for Modification to Notice of Intent (NOI) File No. P-2008-043. Western Mining Action Project.

⁶⁰ Susan Hall. 2009. *Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain*. Reston, VA: US Geological Survey; Kenneth S. Wade. 1981. *Uranium In Situ Solution Mining and Groundwater Quality at the Grover Test Site, Weld County, Colorado*. Master's Thesis: Earth Resources: Colorado State University.

of uranium activities concludes with a summary of the current proposed and operating projects in Lakota Territory.

Current and Proposed Operations

Western Nebraska

The Crow Butte in situ mine near Crawford, in the far northwestern part of Nebraska, is the only uranium mine that has been opened since the 1980s uranium “bust.” It began operating in 1991 and is owned by Cameco. The mine is about 60 miles and upstream from the Pine Ridge Reservation – both in terms of surface and groundwater. A proposal to enlarge the mine is currently under consideration by the Nuclear Regulatory Commission. Citizens in the area, including an organization on the Reservation, are formally opposing this proposal.⁶¹

The Crow Butte mine, like other ISL mines, has had its share of problems. Those related to water quality have included:

- Failing to report the release of well development water onto the ground for nearly three years;
- Failure to restore water to baseline conditions after mining was completed, including contamination from alkalinity, arsenic, radium²²⁶, and vanadium;
- During the restoration process, levels of contaminants actually increased, leading the NRC to deny approval of the mine’s clean-up process; and
- At least 35 violations of the mine’s license to operate, including leaks in evaporation ponds, excursions of mining fluids out of the mining area, and a 10,260-gallon spill of mining fluid.⁶²

In 2006, there were wildfires east of the Crow Butte central processing plant, and evacuation was discussed. This threat to in situ plants is commonly overlooked.⁶³

Western North Dakota

At least two companies are exploring for uranium in Billings and Slope Counties in southwestern North Dakota. Prospect Uranium, Inc., has leased more than 1,000 acres for its Connors Project, which might include in situ leach mining and/or open pit mining. Formation Resources, Inc., a subsidiary of Australian company PacMag Metals, has received exploration permits from the state. The permits cover exploration at the company’s Sentinel Project, which would extract uranium, germanium, and molybdenum. The company has said it wants to use an acid heap leaching process.⁶⁴

⁶¹ Stephen F. Collings and Ralph H. Knode.1983?.Geology and Discovery of the Crow Butte Uranium Deposit, Dawes County, Nebraska.www.wma-minelife.com/uranium/papers/crwbt01.htm. Accessed January 20, 2010; Cameco.Crow Butte: History/Innovations.www.cameco.com/mining/crow_butte/history/.Accessed January 20, 2010.

⁶² Hannan LaGarry. January 14, 2008.E-mail Correspondence; WISE-Uranium.Crow Butte in-situ leach uranium mine, Dawes County, Nebraska.www.wise-uranium.org/umopusa.html.Accessed January 20, 2010.

⁶³ *Ibid.*, WISE-Uranium; J.A. Davis and G.P. Curtis.2007.*Consideration of Geochemical Issues in Groundwater Restoration at Uranium In-Situ Leach Mining Facilities*.Menlo Park, CA: US Geological Survey.

⁶⁴ Associated Press.September 22, 2009.Company considers chemical ND uranium extraction.www.kxnet.com/getArticle.asp?setCity=min&ArticleId=441159.Accessed January 20, 2010; PacMag Metals Limited.Sentinel Project (North Dakota, USA) – PagMag 100%.

Eastern Wyoming

Wyoming is the most active uranium mining area within Lakota Territory. There are both exploration and, as noted above, operating in situ leach mines.

Together, the Smith Ranch and Highlands mines constitute the nation's largest ISL uranium mine. Problems in past years were talked about earlier, and they continue. The company has been cited for failing to report uranium solution excursions into the surrounding aquifer and for a 198,500-gallon spill of injection fluid.⁶⁵ The Smith Ranch portion of the operation has been cited for violations that include failure to cap drill holes and monitoring wells, radiation levels that exceed the public dose limit, and hiring an unqualified radiation safety officer.⁶⁶

The mines' most severe public relations setback came in 2008, when the State's Department of Environmental Quality apparently lost patience. The State issued a Notice of Violation citing, among other things, an "inordinate number of spills, leaks and other releases," inadequate reclamation, and surface and groundwater contamination. The State also said that bonds designed to cover reclamation, in case the company left or went bankrupt, were woefully inadequate.⁶⁷ The company and the state reached a settlement in which the company paid a fine of \$900,000, with \$400,000 suspended for good behavior. Bonding was increased to about half of what the state said could be necessary.⁶⁸

In addition to the Smith Ranch-Highlands project, a Russian/Canadian company, Uranium One, is in the process of restarting the Irigary and Christensen Ranch projects, as noted above. The company has all the permits needed to resume mining. Uranium One completed its purchase of the mines in 2010 and announced that it planned to incorporate three other facilities – Moore Range, Ludeman, and Allemand-Ross – under the same license.⁶⁹

As of the end of 2009, fifteen facilities are expected to apply for Nuclear Regulatory Commission permits, seven of them in the Powder River Basin.⁷⁰ At least three uranium companies are exploring along the northwestern Black Hills: Peninsula Energy (Australian), Bayswater Uranium (Canadian), and Powertech Uranium (Canadian). Bayswater is the closest to beginning a mining operation at its 17,500 acre Reno Creek property. Strathmore Minerals is exploring in the Gas Hills district. Rare

www.pacmag.com.au/sentinel_project.36.html. Accessed January 20, 2010; Prospect Uranium, Inc. Connors Uranium Project. www.prospecturanium.com/s/Midwest.asp. Accessed January 20, 2010; James MacPherson. March 31, 2008. North Dakota has first uranium land lease in three decades. *Grand Forks, ND, Herald*; Ed Murphy. Uranium Exploration Permits Issued. www.dmr.nd.gov/ndgs/newsletter/n/0908/pdfs/uranium.pdf. Accessed January 20, 2010.

⁶⁵ WISE Uranium. Cameco Resources Highland Uranium Project (Wyoming). www.wise-uranium.org/umopwy.html. Accessed February 18, 2010.

⁶⁶ Jeff E. Whitten, Nuclear Regulatory Commission. November 16, 2009. Letter and Attachments to John McCarthy; State of Wyoming, Department of Environmental Quality. August 28, 2008. Notice of Violation, Docket No. 4314-08. WISE Uranium. Smith Ranch, Converse County (Wyoming). www.wise-uranium.org/umopwy.html. Accessed February 18, 2010.

⁶⁷ John V. Corra, Wyoming Department of Environmental Quality. March 10, 2008. Letter, Notice of Violation, and Attachments to John McCarthy.

⁶⁸ WISE Uranium. Wyoming DEQ denounces poor environmental compliance at Smith Ranch/Highland in situ leach mine, issues Notice of Violation to PRI for failure to conduct concurrent reclamation. www.wise-uranium.org/umopwy.html. Accessed February 18, 2010.

⁶⁹ WISE Uranium. Christensen Ranch/Irigary (Wyoming). www.wise-uranium.org/umopwy.html. Accessed February 18, 2010.

⁷⁰ Steve McManamen. November 14, 2009. Uranium Renaissance. *Gillette News Record*. www.gillette news record.com/articles/2009/11/15/news/today/news01.txt. Accessed November 16, 2009.

Element Resources, a Canadian company, is also exploring for “rare earths.” Rare earths mining leaves radioactive thorium and uranium as waste products.⁷¹

Because these operations are often “below the radar” until claims or leases are made public, and because companies change their names and buy each other out at a rapid pace, it is difficult to tell exactly what is going on. The existing in situ leach operations, the permitting of the Christensen Ranch-Irigary project, and the many exploration activities insure that eastern Wyoming will remain the most active uranium mining area within Lakota Territory.

Western South Dakota

Four companies are known to be exploring in western South Dakota. The most active project is a proposed in situ leach mine along the Wyoming border, at the southwest corner of the Black Hills in the heart of Lakota Territory. This is known as the Dewey-Burdock project. Powertech Uranium, the company that proposes the mine, has been doing exploration drilling. The company is working on getting the necessary permits from the US Nuclear Regulatory Commission, US Environmental Protection Agency, and US Bureau of Land Management. It also applied to the state Department of Environment and Natural Resources.⁷²

The company’s original permit applications to the NRC and the State were deemed inadequate, and the company had to rewrite and resubmit them. After the State turned down the company’s application twice, the company went to the legislature, which passed a law suspending most state regulation of ISL uranium mining. The NRC recently stopped consideration of the safety portion of the company’s application, because the company has repeatedly failed to provide adequate information. Local citizens are also formally opposing the NRC application.

Uranium mining has been successfully opposed in the past in the Black Hills, partly because of staunch Lakota protection of their sacred area. There will undoubtedly continue to be resistance to uranium mining proposals in this area.

Northeastern Colorado

Six uranium companies – including companies from Canada and Australia – are exploring for uranium in northeastern Colorado. Powertech Uranium is also doing exploration work in Weld County along the Wyoming border at its Centennial project. The company’s plan is to do ISL mining on part of its deposit and open pit mining on the other part. The proposed open pit mine is only seven miles from Fort Collins, a college town of 100,000 people. The proposal has been effectively opposed by local organizations, and the state legislature passed three pieces of legislation in 2008 that will make in situ uranium mining very difficult.⁷³ The company sued the state over the resulting regulations. It has

⁷¹ Powertech Uranium Corp. Dewey Terrace. www.powertechuranium.com/s/DeweyTerrace.asp. Accessed January 20, 2010; Bayswater Issues NI 43-101 Technical Report on Elkhorn Project. January 11, 2010. *Earth Times*. www.earthtimes.org. Accessed January 11, 2010; Strathmore Minerals Corp. Gas Hills, Wyoming. www.strathmoreminerals.com/s/GasHills.asp. Accessed September 28, 2009; *Op. cit.*, McManamen.

⁷² Powertech Uranium Corp. Dewey Burdock. www.powertechuranium.com/s/DeweyBurdock.asp. Accessed January 20, 2010.

⁷³ Coloradoans Against Resource Destruction. FAQ 5: What companies are looking for uranium in Weld County? www.nunnglow.com/faqs/faq-6-what-companies-are-looking-for-uranium-in-weld-county.html. Accessed

recently put this project on hold, so that it can focus its resources on the proposed South Dakota mining.

South Park in Park County has been the other active area in the South Platte River watershed. There, citizen opposition convinced New Horizon Uranium Corporation to abandon any immediate plans after it had made numerous uranium claims.

There are several reasons that opposition to uranium mining has been relatively successful in northeastern Colorado. First, it is more difficult to “sell” uranium mining when 275,000 people live within twenty miles of a proposed mine. Second, the northern Front Range is one of the most highly educated areas in the nation. This means that experts are available who can rebut uranium company claims. Third, Colorado healthcare professionals have taken the lead in opposing mining based on its negative health impacts. This is a powerful and respected segment of the population. As a result, uranium activity has been successfully opposed in northeastern Colorado.

Summary

Lakota Territory has been the site of extensive uranium activities since the dawn of the nuclear age. From exploration to mining to milling, these activities have left a mark. Past and ongoing contamination has impacted water, soil, plants, livestock, wildlife, air, and people. Cultural and historical resources have been destroyed and continue to be threatened. The boom and bust cycle has created instability for local economies and communities.

Plans to begin, resume, or expand open pit and in situ leach mining could increase these impacts. But Lakota people and their allies are opposing many mining proposals and are meeting with some success. Unlike in the early years of the nuclear age, people who live in uranium mining areas now know the impacts of the front end of the nuclear chain, and there is strong opposition to the idea of a “nuclear renaissance.” Whether public opposition, market forces, or other factors will prevent future uranium activities remains to be seen. But the issue is sure to remain contentious in much of Lakota Territory.

January 20, 2010 ;Powertech Uranium Corp.Centennial.www.powertechuranium.com/s/Centennial.asp. Accessed January 20, 2010.