

7, Part 1. "CLEANUP" AND CLOSURE (1992-2005): FAILURE CLAIMED AS SUCCESS

Preparation for the "cleanup": EG&G had come to Rocky Flats in 1990 to produce bombs, not to clean up a contaminated site. When in 1992 the mission changed from production to cleanup it was assumed that soon EG&G would be replaced by another contractor. On July 1, 1995, EG&G was replaced by Kaiser-Hill, a company specially formed for this task, as a joint venture between two environmental engineering firms, CH2M Hill and ICF Kaiser. The name of the site was changed from Rocky Flats Plant to Rocky Flats Environmental Technology Site. It's not a bad name if it could be true, that is, if technology to remove contamination from the environment could be developed at Rocky Flats, an idea later proposed but regrettably rejected by the DOE.

With the end of production at Rocky Flats some hoped the old culture of secrecy was ended so that citizens now could work directly with their government to deal forthrightly with the contamination left from the production years. Unfortunately, as the following shows, we learned that the old way still prevailed. Also DOE did not act alone. In making the cleanup a new version of an old story, the DOE was joined by EPA and CDPHE, the organizations that regulated the "cleanup." "Cleanup" in fact is not really an appropriate word for what happened at Rocky Flats. For this word implies removal of contaminants, at least to the maximum extent possible, with a parallel effort to eliminate any danger they pose. This did not happen at Rocky Flats. Some prefer the word "remediation," which according to the dictionary means reversing or stopping contamination. This certainly didn't happen at Rocky Flats. So I will use "cleanup" when referring specifically to what happened at Rocky Flats. Enclosing the word in quotation marks signifies that what happened was only a partial "cleanup" and thus hardly deserves this word.

RFLII: Help for displaced workers: One of the concerns arising from the change of mission was taking care of Rocky Flats workers who would lose their jobs. DOE funded the Rocky Flats Local Impacts Initiative (RFLII) to deal with this problem. RFLII provided training and start-up assistance for new businesses, but it was short-lived because the plight of workers proved less severe than expected, thanks to the relatively robust economy of the 1990s in the Denver area.

The Citizens Advisory Board: In 1993, as part of a national trend at DOE sites facing cleanup, the Rocky Flats Citizens Advisory Board (CAB) came into existence. Funded by the DOE and established as a broadly representative body under the Federal Advisory Committee Act (FACA), the group's task was to advise DOE on matters related to the cleanup of Rocky Flats. The group decided that all its recommendations to the DOE would be reached by the process of consensus, meaning each decision would have the support of the whole group rather than a voting majority. This was intended to prevent DOE from using a divide-and-conquer approach with the group. The CAB's work was also member-driven, not staff-driven. Its recommendations thus were stronger and tended to unify the public. RFLII and the CAB were quite influential going into the "cleanup."¹ But RFLII was soon dissolved, and DOE undermined the CAB, a point to be discussed below. I myself was one of the original members of the CAB.

What the public wanted: Cleanup to background: One step that at the time seemed very hopeful was the creation in 1994 of the DOE-funded broadly representative Rocky Flats Future Site Use Working Group. This ad hoc group was given one year to tell the DOE what the public wanted at Rocky Flats. The group consisted of 12 delegates and 12 alternates, each pair representing a particular part of the community – economic, local government, environmental, Rocky Flats workers, residents and land-owners, etc. I and my alternate, a physician, represented peace and health interests. After working together for a year, in June 1995, the group recommended by consensus that Rocky Flats be cleaned "*to average background level for Colorado*" when it is

¹ The CAB replaced the Rocky Flats Environmental Monitoring Council, which had been renamed the Colorado Council on Rocky Flats. Ackland, *Making a Real Killing*, p. 236. Another oversight body, the Rocky Flats Cleanup Commission, funded by an EPA Technical Assistance Grant, was created in 1989 and dissolved in 1994 when funding ended. For a very interesting article on the relation of the CAB to the Cleanup Commission, see <http://www.westword.com/1994-10-05/news/melting-down/>

technologically and fiscally possible to achieve this in an environmentally sensitive manner. The average background from fallout for plutonium, the contaminant of principal concern, is 0.04 picocuries per gram of soil (0.04 pCi/g). The group recognized that “current laws do not require this level of cleanup,” but it expected that “technology will continue to improve,” so that “at some time in the future” cleanup to background will become possible. To ensure improvement of technology, the group called for “an earmarked, secure trust fund,” and for turning the site into a laboratory for development of technology that did not yet exist. Technology developed locally could be used at plutonium-contaminated sites elsewhere. “We are willing,” the report said, “to wait as long as is necessary, but no longer than necessary, to see the site cleaned up, even if that takes many generations to accomplish” (see Figure 7.1).²

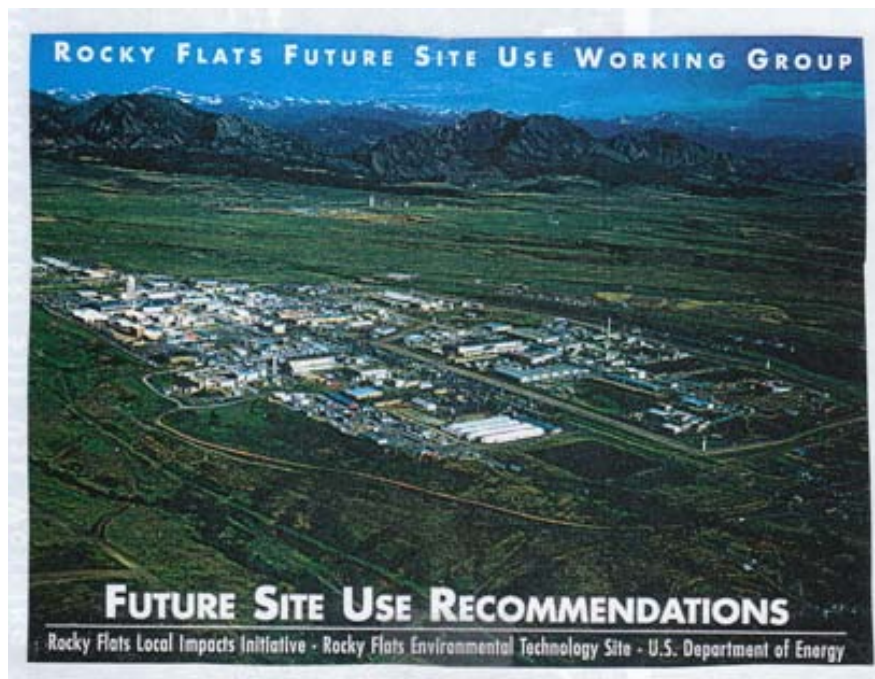


Figure 7.1: In its report published in June 1995 the Rocky Flats Future Site Use Working Group recommended that the ultimate cleanup at Rocky Flats be to average background radiation level.

Proposed cleanup to average background, its difference from natural background, the strong support it had and DOE’s rejection: Edward Martell of NCAR often emphasized that all humans on the planet are exposed to natural background radiation – from radioactive materials in soil and air as well as trace amounts in our own bodies. Natural background radiation is higher at higher elevations; in Denver it is about double what it is at sea level. For most people, exposure to natural background will do no harm; for a few it will prove harmful, perhaps even fatal. Fallout from atmospheric nuclear bomb tests, has added additional radioactivity to natural background globally, increasing illness and death. We no longer live in an environment of only natural background radiation. The recommendation of the Future Site Use Working Group that Rocky Flats be cleaned to average background level meant acceptance of naturally occurring background plus the radiation from plutonium that resulted from global fallout – 0.04 picocuries per gram of soil. The group sought eventual removal from the soil of all plutonium deposits above this 0.04 pCi/g level.

The CAB and RFLII, the only Rocky Flats oversight bodies then existing, as well as many individuals and public interest groups endorsed this recommendation, making it without question the single most widely supported cleanup recommendation ever made for Rocky Flats. Despite this overwhelming support, DOE and the agencies regulating the cleanup, EPA and CDPHE, responded to this recommendation with silence, total silence. After waiting more than six months, in January 1996, I published an op-ed saying that the DOE wasn’t

² *Rocky Flats Future Site Use Working Group Recommendations for Rocky Flats Environmental Technology Site* (July 1995), pp. 17, 18-19.

interested in what the public wanted at Rocky Flats, since it had totally ignored the recommendation it received from the Future Site Use Working Group that it had funded. Only then did the DOE site manager acknowledge receipt of the recommendation, but he dismissed it because the group asked for more than the law required and the site would be cleaned only “to levels prescribed by law.”

Confusion regarding what “cleanup” is, what it would cost, and how long it would take: In March 1995 DOE’s Office of Environmental Management estimated that all the activities that would have to be dealt with in shutting down the Rocky Flats plant would stretch out to 2060 and cost as much as \$36.6 billion. In addition to actual cleanup of soil and water at the site were four non-cleanup activities: 1) relocation of weapons-grade material, 2) removal of bomb-production waste, 3) demolition of buildings, and 4) end site security. While it’s a clear misuse of language, the word “cleanup” came to be almost universally used to encompass all the above-mentioned activities. Actual cleanup in fact cost less than each of the other four activities. This was the context for what followed.

On July 1, 1995, EG&G was gone and DOE welcomed Kaiser-Hill as the “cleanup” contractor. In a big public meeting later that month DOE and Kaiser-Hill revealed their “cleanup” plan – to leave most of the contamination in place on the site beneath a cover of rock and soil. They were surprised that the public treated their proposal like a joke.

DOE and Kaiser-Hill held secret meetings with key members of Congress out of which emerged an agreement to do the “cleanup” and closure in less time and for a lower cost. They referred to their new plan as the “accelerated risk-based cleanup.”

Secrecy: Cost of the “cleanup” capped and a deadline set for its completion: Out of the secret meetings with Congress came the decision that all work necessary for site closure would be done in ten years for a total cost of \$7 billion. Most of this \$7 billion paid for the four non-cleanup items mentioned above: 1) relocation of weapons-grade material, 2) removal of bomb-production waste, 3) demolition of buildings, and 4) ending site security. Actual “cleanup” of soil and water was done with what was left -- \$473 million, or about 7% of the total. Kaiser-Hill allocated a specific maximum for each of these five areas and specified that any funds saved in one area by doing the job early or below budget could not be used to get a better “cleanup” or to improve work in another area. The \$473 million budgeted for actual environmental “cleanup” is the maximum that could be spent for this task. Kaiser-Hill received \$560 million for its work, more than was spent on actual “cleanup.” It became common by the first years of the 21st century to lump all the above activities together under the term “cleanup” and to say that the “cleanup” cost about \$7 billion. Below I will provide detail about the actual “cleanup” but not about the four non-cleanup activities. .

The U.S. government is miserly when it comes to cleaning up its nuclear weapons facilities, by comparison to the \$5.5 trillion (in constant 1996 dollars) that it spent between 1940 and 1996 on nuclear weapons and related programs.³ People subjected to essentially unknown health risks from contaminants released into the environment through the years of production at Rocky Flats now have to deal with the effects of such stinginess. This is a poor precedent, though government officials laud Rocky Flats as setting a precedent for a cheaper “cleanup.”

Kaiser-Hill’s role: Kaiser-Hill was very good at developing long-range plans that closely linked available funds to actual work. They created a step-by-step sequence for doing the job and finishing it ahead of schedule. Then they bragged that they reduced the cost of “cleanup” from \$36 billion to \$7 billion and the time for the job from 70 years to 10.⁴ In fact, as noted above, only 7% of the \$7 billion allocated to close Rocky Flats went to actual environmental “cleanup.”

³ Stephen I. Schwartz, ed., *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940* (Washington, D.C.: Brookings Institution Press, 1998), p. 4.

⁴ See Kim Cameron and Marc Lavine, *Making the Impossible Possible: Leading Extraordinary Performance: The Rocky Flats Story* (San Francisco: Berret-Koehler, 2006), p. 3.

How clean is clean? What about the official level established in 1996: The Future Site Use Working Group said Rocky Flats should be cleaned to average background, which is 0.04 pCi/g. In the July 1996 *Rocky Flats Cleanup Agreement*, DOE, EPA and CDPHE gave a very different answer. They set the official standard for cleaning plutonium in soil at 651 pCi/g, which is 16,275 times the 0.04 pCi/g Future Site Use Group's recommendation. The agencies adopted the 651 standard with only scant public participation. By coincidence, Assistant Secretary of Energy Al Alm was scheduled to hold a public meeting in Colorado on Environmental Management for DOE, which he managed. Having seen a brief notice in the morning paper that the standard had been set, I arrived early at the place for the Alm meeting and told the person presiding that those present must know the new standard before Mr. Alm spoke. He agreed. The announcement was made. The room exploded with outrage. Mr. Alm saw this.

Having seen public anger very directly, Mr. Alm told Rocky Flats officials to commission and fund an independent group of local people to hire specialists to study the Rocky Flats cleanup issue and recommend an appropriate cleanup level for the site. The only limit he placed on the group is that the cleanup level they proposed must allow an annual radiation exposure to any individual of up to 15 millirem (a measure of radiation) for the next 1,000 years. In 1998 the Rocky Flats Radionuclide Soil Action Level Oversight Panel (RSALOP) was formed for this work. Its name indicates its task, a soil action level being the maximum amount of a radioactive material allowed to remain in soil; if the radiation in soil exceeds this specified limit, an "action" is triggered to deal with the contamination, usually by removing it. The new group would challenge the official 651 pCi/g action level. So, what did the group propose?

The action level proposed by the RSALOP: The RSALOP, of which I was a member, hired the Risk Assessment Corp. (RAC) to do the technical research and for about 18 months worked closely with them. In February 2000 RAC issued its *Final Report* on the basis of which the RSALOP recommended that the action level for radionuclides in soil at Rocky Flats be reduced from 651 pCi/g to 35 pCi/g. This was a 99.5% reduction below the level set by DOE and the regulators in 1996, yet still 875 times the 0.04 pCi/g average background level recommended by the Future Site Use Working Group. The 35 pCi/g would allow a maximum annual radiation exposure of 15 millirem, as required by Mr. Alm.⁵

RMPJC proposes a 5 to 10 pCi/g plutonium soil action level to protect future generations: The Rocky Mountain Peace and Justice Center, with which I am affiliated, contracted with Arjun Makhijani and his colleagues at the Institute for Energy and Environmental Research (IEER) to recommend a radionuclide soil action level not constrained by Mr. Alm's specification about allowable exposure. We wanted an action level that provided maximum safety under any conceivable condition. We recognized that due to plutonium's long half-life, plans for the future of the Rocky Flats site must assume that state and federal government agencies on which we now depend will vanish long before plutonium in the environment ceases to be harmful. We asked: What specific humans in the unknown future will be most vulnerable to the plutonium in their environment, about which they are most likely ignorant? Protecting them will protect everyone else. Considering all this, the IEER scientists calculated a radionuclide soil action level for Rocky Flats that would protect a farming family that live all their lives on what is now the Rocky Flats site and eat food produced there and drink local water. Accordingly IEER and RMPJC recommended a cleanup level of 5 to 10 pCi/g (see Figure 7.2). This very conservative recommendation alone was realistic about the future.⁶

⁵ Risk Assessment Corporation, *Final Report, Technical Project Summary: Radionuclide Soil Action Level Oversight Panel* (February 2000).

⁶ Makhijani and Sriram Gopal, *Setting Cleanup Levels to Protect Future Generations: The Scientific Basis of the Subsistence Farmer Scenario and Its Application to the Estimation of Radionuclide Soil Action Levels (RSALs) for Rocky Flats* (IEER, December 2001). Summary version on line at <http://ieer.org/article/science-for-democratic-action/volume-10-number-3/> For full details of the IEER and RMPJC recommendation, see http://www.clarku.edu/mtafund/prodlib/rmpjc/rmpjc_01-015.pdf

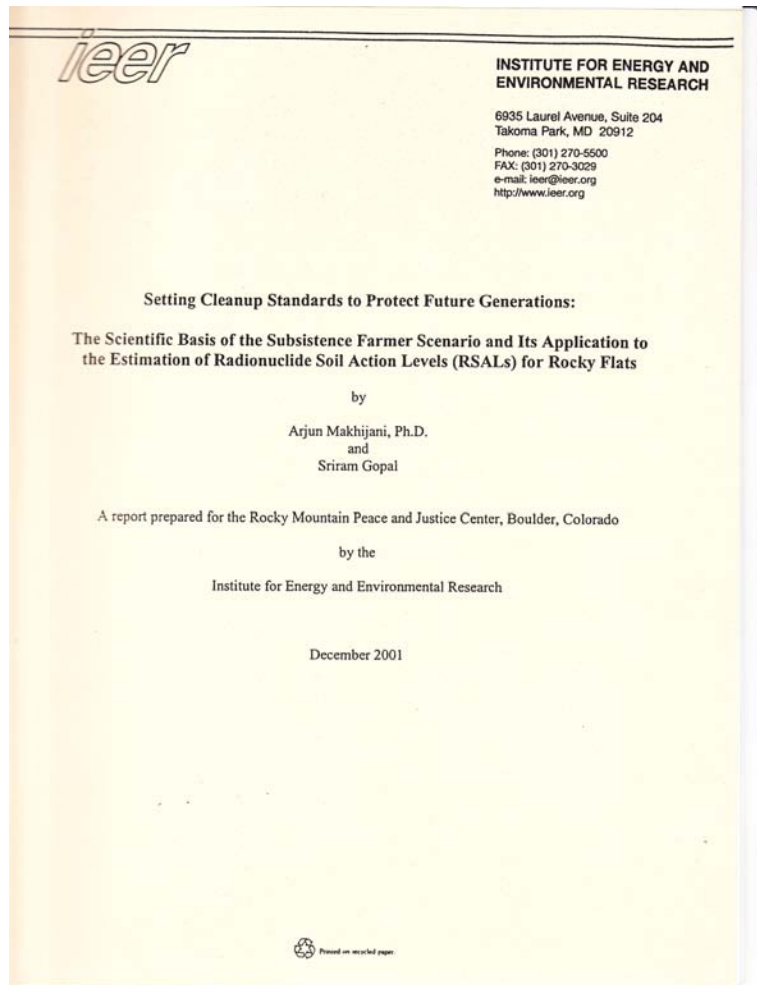


Figure 7.2: Booklet recommending plutonium cleanup standard of 5 to 10 picocuries/gram of soil.

What scenario for the future? Superfund law (CERCLA⁷) requires that the cleanup standard for a Superfund site be based, first, on a scenario of the site's future use, and, second, on protecting that scenario's most endangered future user. Those setting the standard thus must identify the future user to be protected. The scenario for the immediately preceding IEER proposal is a family of subsistence farmers who live on the site and eat food grown by themselves. They will be the most vulnerable, long after DOE, EPA and CDPHE disappear. But the agencies responsible for the "cleanup" made a short-term decision that most of the Rocky Flats site would become a wildlife refuge and that the person to be protected would be a wildlife refuge worker. Had the site's future use been designated as housing, farmland or a park, the cleanup would be more thorough and safer – and more expensive. The wildlife refuge designation meant a cheaper "cleanup." Superfund law does not require a cheaper cleanup, but lowering the cost became a fundamental principle – an addition – in determining the level of "cleanup" to be done at Rocky Flats. A chief driver of the "cleanup" was cost. Not cost to human and animal health and well-being, not cost to the environment, but cost in dollars. It was an economic, not a public health or ecological, decision.

Deciding on the scenario: A fateful decision: In 2003, well before the "cleanup" was completed, U.S. Fish & Wildlife Service (FWS), the agency that would receive much of the Rocky Flats land to operate as a wildlife refuge, decided to allow public recreation at the site, even though 81% of the parties commenting on the FWS plan opposed public access and only 11% explicitly favored it.⁸ Many thought allowing site-access to infants

⁷ Comprehensive Environmental Response, Compensation, and Liability Act

⁸ http://docs.wixstatic.com/ugd/cff93e_a9cff9a4c30b4ac5bbfa27e93b91a9bf.pdf

and children, who of all creatures are the most vulnerable, would be unwise. But the government agencies insisted that, because a wildlife refuge worker would spend more time on the site than anyone else, protecting this person would protect the others. They did not mention that all official exposure standards are calculated to protect “reference man,” not women or children or the elderly or infirm. And they had no plan to protect wildlife that live on or visit the site. Nor did they say how they would protect a wildlife refuge worker who just happened to be genetically susceptible to radiation exposure. Undoubtedly there are others who would be far more vulnerable than the typical wildlife refuge worker. Congress passed a bill to make Rocky Flats a wildlife refuge after the “cleanup.” In accord with the official orthodoxy, the most vulnerable person would be the wildlife refuge worker. Everything was falling into place.

Proposals that were more protective were rejected as the government agencies coalesced around a proposal of their own: Both the 35 pCi/g recommended in February 2000 by the RSALOP and the 5 to 10 pCi/g proposed in December 2001 by IEER and the Rocky Mountain Peace and Justice Center, like the Future Site Use Group’s cleanup-to-background recommendation, were rejected by the government agencies responsible for the “cleanup.” At a public meeting about the “cleanup” on November 9, 2001, Steve Gunderson, the Rocky Flats point person for CDPHE, said that the agencies designing the “cleanup” were “only looking ahead for the next 100 to 150 years, nothing beyond that.”⁹ By the time he admitted their very short-term view, the agencies had rejected all the genuinely long-term proposals mentioned above, though formal rejection was not made until November 2002, when DOE, EPA and CDPHE issued for public comment a revised *Rocky Flats Cleanup Agreement* (see Figure 7.3). This document (RFCA) proposed to revise the 651 pCi/g RSAL that had been officially adopted in 1996. The proposed revision will be discussed below. Let it suffice to repeat here that all the above-mentioned rejected recommendations were far more protective than what the agencies were proposed and finally adopted as the official soil action levels. As will be shown, the story was not simply one of making a different calculation. Behind the facade of time-consuming public participation, the government agencies were engaged in secrecy and exclusion of the public. I will discuss this before turning to the details of their new proposal.

Public participation: The hope and the reality: In an attempt to gain the trust of a public alienated by a history of accidents and contamination topped off by the FBI raid, DOE went out of its way to provide opportunity for public participation in the “cleanup.” At first, the CAB was quite active. But after getting more from the public than it wanted with the Future Site Use Working Group report in 1995, DOE undermined the very public participation it had sought and marginalized the Citizens Advisory Board. The CAB’s sole task was to advise DOE on cleanup; its membership included personnel from local governments, as part of its broadly representative membership. In 1999 DOE created a new group to help oversee the “cleanup,” the Rocky Flats Coalition of Local Governments (CLG), a move that undermined the CAB by depriving it of members from local governments. Having two organizations commenting on the “cleanup” allowed DOE to play the game of divide and conquer and more easily ignore the CAB. Also, the CLG was the kind of body from which DOE was more likely to get what it wanted, because representatives of suburban towns near Rocky Flats often favored urban growth and avoided the negativity of attention-getting issues like contamination and protecting public health. At the same time DOE planted some of its own people within the CAB, notably a former employee of DOE’s Los Alamos Lab who dismissed conflict-of-interest charges, got himself elected as chair and tried to get the CAB to end its practice of making all recommendations to DOE by consensus.

Public participation became far more difficult as well as frustrating in the summer of 2000 when DOE created the Rocky Flats Cleanup Agreement Focus Group. This group met for 3 to 4 hours twice monthly for two-and-a-half years, focused only on the “cleanup.” Unlike the CAB, the agenda for Focus Group meetings was planned not by the participants but by DOE and the regulators. Moreover, while individual participants could express themselves on any issue before the group, unlike the CAB they could make no formal recommendations to the DOE to which the DOE was obliged to respond. But most crucially, the Focus Group was the only place to get details on the “cleanup,” participate in discussions and possibly have some influence. If you wanted to be involved with the “cleanup,” this was where you had to be. Meetings occurred on Thursday afternoons at a time convenient for government employees paid to attend. People with a daytime job could not participate. Of course the Focus Group, with its long very detailed meetings, increased public participation, but

⁹ The meeting was at the Rocky Mountain Peace and Justice Center and included personnel from DOE and EPA.

participation was also diminished, because the public didn't set the agenda and make formal recommendations. The CAB and the CLG continued to meet, but they were now more like sideshows.

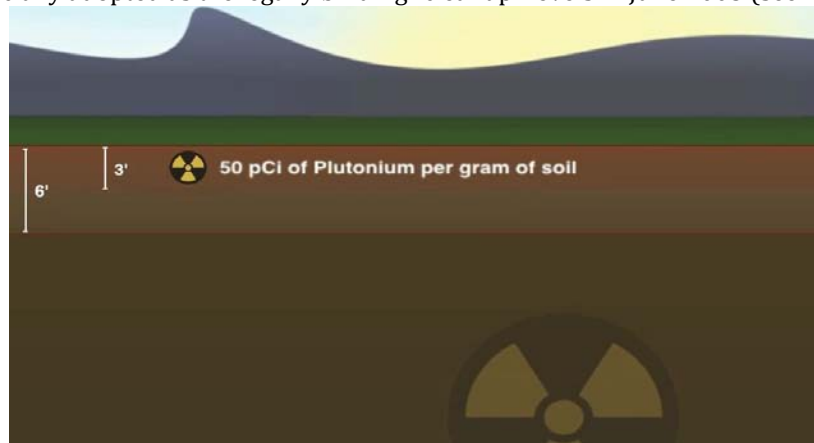
Money, the real driver of the “cleanup”: At almost every Focus Group meeting someone would urge DOE to adopt the Future Site Use Working Group's recommendation of cleanup to background. “Tell us the cost for doing this,” we said, “and we'll lobby Congress for the funds.” It was clear from the looks on the faces of personnel from DOE, EPA and CDPHE that they weren't happy. We had been meeting for well over a year when at a session in June 2001 an irritated DOE official finally made it clear that the better cleanup we sought was not in the cards, because years earlier DOE had made a deal with Congress that put a ceiling on what could be spent on the cleanup and set a deadline for its completion. From what he said, it was obvious, first, that the real driver of the “cleanup” was money, not public health or environmental integrity, and, second, that the public participation to which we were devoting so much time was largely a sham. The official – Joe Legare – who revealed the deal with Congress later said that the effect of his words on those present was “like throwing a dead rat on the table.”¹⁰

Many of us who initially went into the Focus Group with the hope that we'd get to help design the house of “cleanup” found instead that we only got to rearrange the furniture a bit. We had pushed for the best cleanup possible with current technology, plus staying with the job until the site was cleaned to background. But behind closed doors a deal was made from which we were excluded. Whatever DOE did, EPA and CDPHE tagged along. At a large weekend meeting in 2001, an EPA specialist from their lab in Las Vegas said he'd like a word with me. “I've been to many DOE sites around the country,” he told me. “Usually on an issue like this, the EPA and state officials meet with local people so they can address DOE with a common voice. But here in Colorado, EPA and state personnel meet with the DOE so they can address the public with a common voice.”

New “cleanup” standards: Without any warning Focus Group meetings suddenly came to a dead halt in the summer of 2002 by the simple expedient of not announcing the next session. I awaited such an announcement as weeks passed. DOE, EPA and CDPHE had evidently decided on a new “cleanup” standard and had no more need of us. Several months later, in November 2002, the agencies released for public comment revisions to the *Rocky Flats Cleanup Agreement*, where the agencies proposed to replace the 651 pCi/g standard for plutonium in soil with not one but three standards, as follows:

- Top 3 feet of soil: up to 50 pCi/g of plutonium allowed to remain in soil
- Soil 3 to 6 feet below the surface: 1,000 to 7,000 pCi/g allowed, the amount depending on the size of the contaminated area; a small area may be allowed contamination up to 7,000 pCi/g.
- Soil 6 or more feet below the surface: no limit on the amount of plutonium that may remain

The public comment period straddled the busiest holiday period of the year, embracing Thanksgiving, Christmas and New Years. Under public pressure the comment period was extended two weeks. The above numbers were officially adopted as the legally binding “cleanup” levels in June 2003 (see Figure 7.3 and 7.4).



¹⁰ Theresa Satterfield and Joshua Levin, “Risk Communication, Fugitive Values, and the Problem of Tradeoffs: Diagnosing the Breakdown of Deliberative Processes,” *Decision Research* (2002), p. 15.

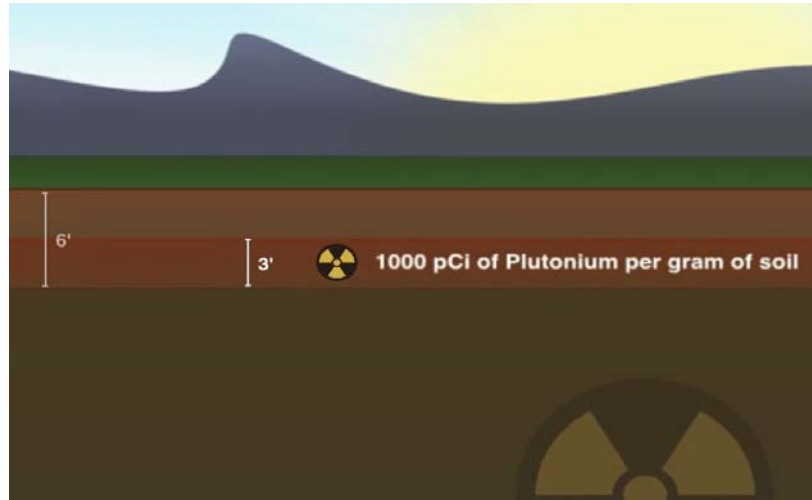


Figure 7.3: These two images, produced by the DOE, show, first, the plutonium “cleanup” standard for the top 3 feet of soil and, second, for soil at a depth of 3 to 6 feet. The latter does not show that in some cases at the 3 to 6 foot depth the standard allowed plutonium contamination up to as much as 7,000 pCi/g of soil. Not mentioned is that soil below 6 feet may contain any quantity of plutonium.

Two crucial facts about the final “cleanup” standards: Cost and lack of public support:

First, “cleaning” the site to the three-level graduated standards adopted for Rocky Flats in 2003 (see p. 80), could be done for the same sum as the rejected 651 pCi/g approach (see p. 76). Thus, the agencies made this change without violating the deal made with Congress. Second, when the proposal for the three-level revised “cleanup” standards was put out for comment, 86% of the parties commenting rejected the proposal and urged the agencies to begin anew.¹¹ Clearly, informed people wanted a better cleanup, but their concerns were ignored.

¹¹ http://docs.wixstatic.com/ugd/cff93e_c74ed342de524330a178e1d6fb74f0f5.pdf

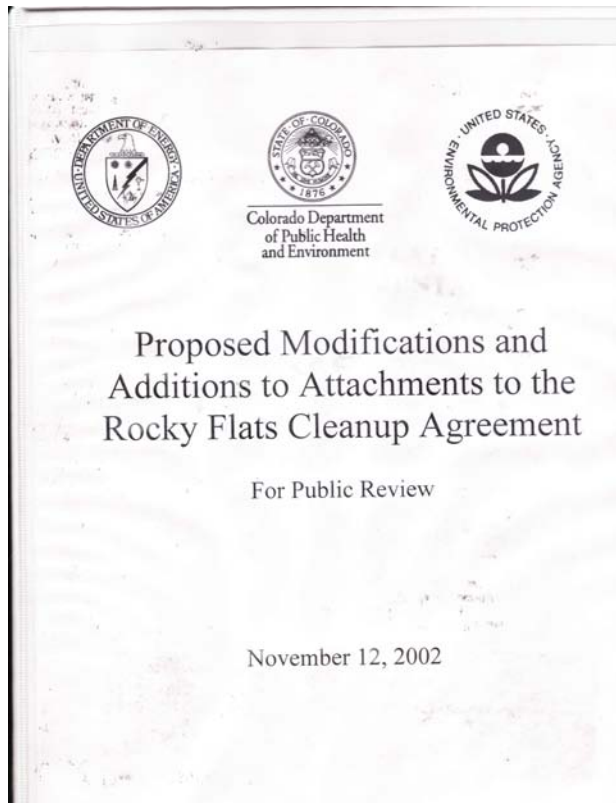


Figure 7.4: In November 2002 DOE, EPA and CDPHE released for comment *Proposed Modifications and Additions to Attachments to the Rocky Flats Cleanup Agreement*. This proposed revision included the three-level plutonium “cleanup” standards that were adopted and made official in June 2003.

Comparison to cleanup standards at other sites: How do the standards adopted for Rocky Flats compare to standards set for cleanup of plutonium-contaminated sites elsewhere? At the following sites, with one exception, standards are lower than the 50 pCi/g for the top 3 feet of soil at Rocky Flats. Also, by contrast to the graduated standards for varying depths adopted for Rocky Flats, the following apply to soil in the environment without respect to depth below the surface.

- 40 pCi/g at the Enewetak Atoll bomb test site (see Figure 7.5)
- 14 pCi/g at the Johnston Atoll bomb test site
- 34 pCi/g for a portion of the DOE’s Hanford, WA, site
- 8 pCi/g at Fort Dix, NJ
- 10 pCi/g for a portion of the Livermore National Lab, CA
- 200 pCi/g for a portion of the Nevada Test Site

Comparison to background radiation: For a second perspective, how do the standards cited above compare to background plutonium radiation at Rocky Flats?

- The prevailing view of government agencies is that the average background level for plutonium from global fallout in soil along the Front Range of the Rockies in Colorado is 0.04 pCi/g. The Future Site Use Working Group sought eventual Rocky Flats cleanup to this level.
- The 50 pCi/g allowed to remain in the top 3 feet of soil at the site is 1,250 times the 0.04 pCi/g average background level.
- The 1,000 to 7,000 pCi/g of plutonium allowed at a depth of 3 to 6 feet at the site is 25,000 to 175,000 times the 0.04 pCi/g average background level.
- Below 6 feet at Rocky Flats, there is no limit.

- Plutonium is not a part of natural background radiation. Natural background has been altered globally by the addition of fallout of plutonium and other radionuclides from the human activity of detonating nuclear devices in the atmosphere.



Figure 7.5: Ivy King nuclear test, November 15, 1952, one of 43 nuclear bombs fired at the Enewetak Atoll by the U.S. from 1941 to 1958. Far more contaminated than Rocky Flats, the atoll was cleaned to 40 pCi/g. Enewetak is part of the Republic of the Marshall Islands.

Assessment of public response to the final official “cleanup” standards: By the time the final legally binding “cleanup” standards were adopted by DOE, EPA and CDPHE in June 2003, some of the affected population had more or less willingly gone along with these agencies. The final three-layered standard is better than the old 651 level, because much less plutonium remains in the top 3 feet of soil. But it leaves a dangerous situation, as will be shown below. To call the end result “safe,” as many government spokespersons do, is a misuse of language.

7, Part 2. “CLEANUP” AND CLOSURE (1992-2005): FAILURE CLAIMED AS SUCCESS

After the “cleanup,” what remains in the depths below 6 feet where no “cleanup” standard applies? At the highly contaminated 903 Pad area, where drums stored outdoors corroded and leaked plutonium into the soil for a decade, those doing the “cleanup” found that plutonium had percolated down to levels considerably below 6 feet. This had not been anticipated. Also, at least 14,700 feet of process waste lines containing plutonium, many below 6 feet, were grouted and left in place. In addition, three large Solar Evaporation Ponds were not dug up and removed but were backfilled with material originally taken from them; their liners, each containing an unknown quantity of plutonium, were left intact. Jack Weaver, who had managed two of the large plutonium processing buildings, thought the whole structure of each building and radioactive material that had leaked into the soil under them should be totally removed, but, he pointed out, the “cleanup” plan only “calls for taking the roof and the walls down to the slab and then pouring a cap over the slab.” He said, “There’s too much stuff under 771 and even 776 Building that has the potential some day to leach out into the rest of the world. I don’t believe that’s acceptable.”¹⁴ Another former Rocky Flats worker recently told me that the 20 or so “infinity rooms” in these buildings were not cleaned up but were imploded into the basement of the buildings and covered over with soil, so that their highly radioactive remains were left at least 6 feet below the surface. “Infinity rooms” at Rocky Flats were so contaminated with plutonium that the levels of alpha radiation in them were too high for standard monitoring equipment to measure. These rooms were off-limits to workers (see Figure 7.6).



Figure 7.6. Sealed door at one of the “infinity rooms” at Rocky Flats. There were more than 20 of these rooms, the largest 100 yards X 50 yards. Photo by Robert Del Tredici.

Map showing where waste had been deeply buried was ignored in the “cleanup”: Former Rocky Flats worker Jerry San Pietro says that he and a fellow-worker were allowed once to see a map that showed where plutonium waste had been buried 20 to 30 feet below the surface at various locations on the site. San Pietro tried to bring attention to what he had seen on this map, because the “cleanup” focused only on what was in the top 6 feet of soil and didn’t deal with what the map showed. He was ignored by those doing the “cleanup,” including the regulators (EPA and CDPHE), as well as by members of Congress and state officials. Convinced that a great deal of waste remains deeply buried at the site, he calls Rocky Flats “the largest unlicensed nuclear

¹⁴ Ackland, *Making a Real Killing*, p. 242.

burial site in the United States.”¹⁵ When he contacted me about this, I made a Freedom of Information Act (FOIA) request for the map he had seen. In response DOE sent not the map he described but one with which I was familiar showing well-known disposal sites. San Pietro thinks the map showing the deep burials by now may have been destroyed.

Concerns about the environmental condition: The previous two sections provided a few examples about plutonium in the Rocky Flats environment at depths below where the “cleanup” standards apply. In what follows I will introduce a range of concerns about plutonium in the soil on and off the site. Already it has been emphasized that plutonium has a half-life of 24,110-years and that it is present in soil as minute particles that can be picked up by wind and made available to be inhaled, the worst way to be exposed to plutonium.

How much plutonium was released to the environment? Varied answers: No one knows how much was released or where it went. Scientists P. W. Krey and E. P. Hardy of the Atomic Energy Commission (AEC), predecessor to DOE, sampled soil throughout the metro area in an effort to find out. In 1976 Krey published a map based on their sampling. The map shows that an estimated 2.6 curies (36 grams or 0.079 pounds) of plutonium released from Rocky Flats was deposited in off-site areas southeast from the plant across most of the City of Denver and east as far as Thornton, with heavier concentrations nearer the plant¹⁶ (see Figure 5.2, p. 37). Martell and Poet, who in 1970 had revealed to the public that plutonium had been released from Rocky Flats, estimated the quantity to be 6.6 Curies (92 grams or 0.203 pounds).¹⁷

A more comprehensive effort, the Rocky Flats Dose Reconstruction Study, estimated that the total off-site of plutonium releases for 1953-1989 ranged from 0.086 to 0.24 curies (1.2 to 3.4 grams, or (0.0022 to 0.0075 lbs.)).¹⁸ Those who did this study did as comprehensive a search for evidence as possible, but in the end they had to rely on data provided by the DOE and this may have been incomplete. Quantities of radioactive materials are indicated in curies or a sub-portion thereof. One curie is the quantity of any radioactive material that undergoes 37 billion disintegrations or releases of radiation per second. Thus, according to the dose reconstruction estimate, the 0.0022 to 0.0075 pounds of plutonium released off site and distributed widely emits between 3.18 billion and 8.88 billion bursts of alpha radiation each second. After 24,110 years, the half-life of plutonium-239, the number of alpha bursts per second will be reduced by half. The particles are too small to see but not too small to be inhaled and to do harm.

Small amount of plutonium, big health problem for a very long time: The foregoing estimates of the quantity of plutonium released from Rocky Flats into the environment are small, ranging from 0.0022 pound to 0.0075 pounds. Why worry about so small a quantity? Because a small amount can be very harmful. According to physicist Fritjof Capra of the University of California at Berkeley, “Plutonium . . . is by far the most dangerous of all nuclear waste products. Less than one-millionth of a gram – an invisible dose – is carcinogenic. One pound, if uniformly distributed, could potentially induce cancer in every person on earth.”¹⁹ This toxicity plus plutonium’s 24,110-year half-life, make Rocky Flats a local hazard forever.

Energy Secretary Hazel O’Leary reveals that more than a ton of Rocky Flats plutonium is missing: Those who did the dose reconstruction study were not aware of what Energy Secretary Hazel O’Leary would reveal on June 27, 1994. Referring to inventories at Rocky Flats, she revealed that a total of 1.2 metric tons (2,640 pounds) of plutonium had arrived at the plant but could no longer be accounted for. This was enough

¹⁵ For San Pietro’s story, see Transcript OH1384v in the Rocky Flats Oral History Collection, Maria Rogers Oral History Program at the Carnegie Branch of the Boulder Public Library.

¹⁶ Krey, “Remote Plutonium Contamination and Total Inventories from Rocky Flats,” *Health Physics*, vol. 30 (Feb. 1976).

¹⁷ S. E. Poet and Martell, “Plutonium-239 and Americium-241 Contamination in the Denver Area,” *Health Physics*, vol. 23 (Oct. 1972).

¹⁸ Summary of Findings, Historical Public Exposures Studies on Rocky Flats, August 1999, Colorado Department of Public Health and Environment (CDPHE).

¹⁹ Capra, *The Turning Point* (1982), pp. 246-47.

plutonium for more than 400 bombs. The official term for this missing plutonium is “MUF,” or “material unaccounted for.”

Thomas B. Cochran says some of the MUF is in the off-site environment: A nuclear physicist with the Natural Resources Defense Council, Cochran insists that some of this huge quantity of MUF was released to the external environment. In testimony given in the class action lawsuit (*Cook v. Dow and Rockwell*) brought on behalf of property-holders in areas shown to be contaminated with plutonium released from Rocky Flats (see Figure 7.8), Cochran explained his unsuccessful effort to get the DOE to declassify some of its vast store of documents on the plutonium unaccounted for at Rocky Flats.²⁰ He said that the plutonium release estimates made by Krey and Hardy and the dose reconstruction study “could be increased by orders of magnitude [ten or more times] and still be consistent with the MUF,”²¹ because the quantity is so large.

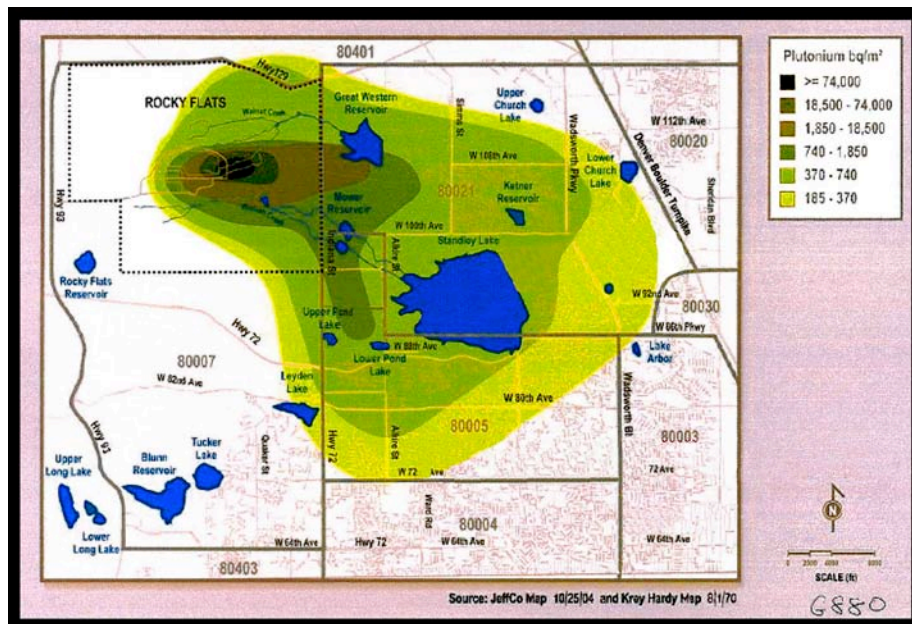


Figure 7.8. Distribution of plutonium contamination from Rocky Flats in becquerels per square meter (one becquerel equals one disintegration or burst of radiation per second). The original version of this map was prepared by P. W. Krey and E. P. Hardy of the AEC’s Health and Safety Laboratory, New York City, and published in their 1970 report, “Plutonium in Soil Around the Rocky Flats Plant,” HASL 235. The above adaptation of their map was used to delineate the area of the class of affected property owners seeking compensation for damage to their property in the *Cook v. Dow & Rockwell* lawsuit heard in federal court in Denver and finally settled in 2016.

DOE claims the MUF is in Idaho: In 2012 I received as email a link to *The United States Plutonium Balance, 1944-2009*, June 2012. The text purported to clear up the mystery about the Rocky Flats MUF. It asserts that most of the missing Rocky Flats plutonium went to the Idaho National Lab and was buried there prior to 1970.²² Up to the time of O’Leary’s 1994 announcement about the MUF, DOE’s position was that the MUF couldn’t be explained because records of early shipments of plutonium-bearing waste from Rocky Flats to Idaho were woefully incomplete. But in 2012 DOE suddenly claimed it knows how much Rocky Flats plutonium

²⁰ See his extensive testimony in *Cook v. Rockwell International*, United States District Court, District of Colorado, No. 90-CV-00181, pp. 5230-5655.

²¹ Cochran, “Plutonium Inventory Differences at the Rocky Flats Plant and Their Relationship to Environmental Releases,” Nov. 22, 1996 <http://www.nrdc.org/nuclear/cochran/cochranpubs.asp#pubs>

²² <http://nnsa.energy.gov/ourmission/managingthestockpile/plutoniumpits/puinventory> Though I received this link out of the blue, and read the claim mentioned above, now the link is invalid. My current copy of *The Plutonium Balance, 1944-2009*, downloaded from the web, says nothing about MUF at Rocky Flats.

was buried in Idaho. This is not credible and will remain not credible until an independent party with unfettered access to all the evidence does an assessment. Can they overcome the following denials?.

Denial 1) Some MUF was dumped at Lowry Landfill: A very well documented story by Pulitzer Prize winning journalist Eileen Welsome counters DOE's claim to have found in Idaho the plutonium O'Leary said was lost. In three articles published in *Westword* in April 2001 (see Figure 7.9), Welsome, in tandem with environmentalist Adrienne Anderson, showed that a large quantity of plutonium waste from Rocky Flats was illegally dumped at the Lowry Landfill southeast of Denver.²³ Welsome is quite familiar with plutonium. She received the Pulitzer Prize in 1994 for her *Albuquerque Tribune* articles on an AEC program to determine the health effects of plutonium by injecting it into the bodies of unwilling and unknowing people, most of them "poor, powerless and sick," and several of them black. Her later *The Plutonium Files: America's Secret Medical Experiments in the Cold War* (1999) provides more information on this secret program.



Figure 7.9: On April 12, 16, and 19 of 2001 Eileen Welsome published a series of three carefully documented articles in the Denver weekly *Westword* providing details about the illegal dumping of a large quantity of plutonium from Rocky Flats at the Lowry Landfill southeast of Denver, about 30 miles from Rocky Flats.

The local story she tells is that Rocky Flats plutonium was dumped at the Lowry Landfill from the early 1950s until about 1980 (see Figure 7.10), that is, for all the years of production except for the last decade (1980-89). At the same time, according to Welsome, most of the large corporations in the Denver area and many smaller ones, disposed of many kinds of waste there. After Lowry Landfill was named a Superfund site in 1994, the polluters scrambled to escape high costs for what they had done, while also working behind the scenes and off the record to avoid publicity. A coalition of the larger corporations wanted to make Rocky Flats operators pay a high fee to clean up the radioactive materials. But, with the complicity of the EPA and the City of Denver (which for years owned the site), they reversed themselves, paid fees to get immunity from future charges related to the radionuclides, and worked out a "cleanup" scheme to reduce the quantity of plutonium and other toxins buried at Lowry. Their solution for the plutonium was to move it in liquid form more than 15 miles (as the crow flies) through city sewer lines to the Metro Wastewater Reclamation District plant just south of where the South Platte River flows under Interstate 270 in north Denver. Sewer lines are not authorized to transport radioactive material, so this was – and continues to be – clandestine.

In the summer of 2000 the plutonium-contaminated waste began flowing from the Lowry Superfund site at a rate of 20 to 25 gallons a minute, or about 30,000 gallons per day. This flow of radioactive liquid will continue for 50 years or longer, until the plutonium is no longer at Lowry. Once the plutonium-bearing liquid waste reaches the Wastewater plant it is treated. The cleaner water is released into the South Platte, the

²³ Welsome, "The Lowdown on Lowry," "A Matter of Trust," and "Board Games," *Westword*, April 12, 19 and 26, 2001. On line at <http://www.westword.com/authors/eileen-welsome/>

heavier plutonium-bearing sludge (“biosolids”) is trucked 50 miles east and spread as fertilizer on farmland, and the remaining mildly contaminated water is used to irrigate parks, school yards and parkways in Denver. The large polluters included the two major newspapers, the *Denver Post* and the former *Rocky Mountain News*, neither of which ever carried a story critical of the contamination at Lowry Landfill.



Figure 7.10: Map showing the Lowry Landfill in relation to Rocky Flats.

Not surprisingly, Rocky Flats authorities denied that radionuclides from the plant were ever dumped at Lowry. But according to Welsome, several drivers of tank trucks admitted that they delivered liquid waste from Rocky Flats to Lowry Landfill. Also, police officers said they saw some of the deliveries, and trucking company records confirm that the transport happened. A letter addressed by a coalition of the polluters to EPA shows alarmingly high levels of plutonium and americium at numerous wells drilled at the site. EPA now denies that such a letter exists, but both Welsome and Anderson had copies. The level of denial about what’s present at Lowry Landfill is well nigh universal among the polluters. But when denial meets documentation, documentation prevails. Welsome and Anderson provided the documentation. The extent of the denial makes this perhaps the greatest single environmental scandal in Colorado history. Hazel O’Leary’s term as Secretary of Energy ended in 1997, well before publication of Welsome’s articles.²⁴

Denial 2) Deep burial of plutonium on the Rocky Flats site: During the Superfund cleanup at Rocky Flats former worker Jerry San Pietro reported that plutonium had been buried on the Rocky Flats site at levels 20 to 30 feet below the surface. What he found should have been reviewed for the cleanup, but it was not. For details, see above, pp. 83-84.

Denial 3: Evidence collected by the FBI never reviewed: In the 1989 raid the FBI collected 65 cartons of evidence of environmental crime at the site. This evidence was never reviewed by the agencies that regulated the cleanup – the EPA and CDPHE. For details, see pp. 68 and 90.

Lawsuit brought on behalf of people who live in areas known to be contaminated with plutonium:

Shortly after the June 1989 FBI raid of Rocky Flats, a class action lawsuit was filed in Denver federal court against Dow Chemical and Rockwell International, operators of the plant during production years. The suit was brought on behalf of residents of a sector of about 30 square miles shown by AEC scientists P. W. Krey and E. P. Hardy to be contaminated with plutonium released from Rocky Flats (see Figure 7.8, p. 80). As originally filed,

²⁴ In June 2001, CDPHE and EPA provided an alternate view, on line at https://www.colorado.gov/pacific/sites/default/files/HM_LowryLandfill-Lowry-radionuclides.pdf

the case claimed harm to both the health of residents of the “class area” and their property values. The judge set aside the health aspect and restricted the case to property values. By the time the case was finally tried in the fall of 2005 the “cleanup” was finished. Thus, despite the fact testimony in this case provided much detail regarding how Dow and Rockwell had contaminated the environment, what was revealed in court would have no effect on the “cleanup.”

On February 14, 2006, the jury found the corporations guilty²⁵ and assessed penalties of \$554 million (a figure subsequently raised by the judge to just short of \$1 billion). This suggests that when uninformed people are presented evidence of the contamination around Rocky Flats and hear as well countervailing arguments, they are likely to conclude, as the jurors in this case did, that the companies that operated Rocky Flats contaminated property and endangered people. The large sum of money, a record-breaking amount, awarded as compensation by the jury to property holders in the class area, has not reached them, because on appeal the verdict was overturned in March 2010, not on grounds of evidence but on procedural issues. In June 2012 the Supreme Court decided not to hear the case and remanded it back to the original court. On June 23, 2015 the Appeals Court for the District of Colorado vacated the March 2010 decision and reestablished the original verdict.²⁶ As of September 19, 2015, defendants (the corporations) are seeking a Supreme Court review, and attorneys for the plaintiffs are briefing the district court.²⁷ In May 2016 the case was finally settled. The plaintiffs were awarded compensation of \$375 million; payments began in 2017, though many plaintiffs have died.

Failure to create a reliable record of contamination: In addition to the history of contamination at Rocky Flats is the history of failure of DOE, its predecessors and its contractors as well as the EPA and the CDPHE carefully and accurately to document this contamination. A reliable record of contamination at Rocky Flats thus does not exist.²⁸

Questions about sampling dust for plutonium at Rocky Flats: The previously reported research of Harvey Nichols and Gale Biggs (see pp. 42-44) showed that most plutonium particles released from Rocky Flats were of such a small size that they could attach to dust motes tiny enough to be carried great distances by wind and be readily inhaled by some unsuspecting person anywhere along the way. Given this reality, Carl Johnson proposed that to protect the health of people in off-site areas the state adopt the method he had pioneered of testing only respirable dust samples for plutonium content (see pp. 45-46). The state rejected his proposal and continued its method of collecting the top quarter-inch of soil, which includes dust but dilutes it by mixing it with other matter that cannot be inhaled. There has never been a program at Rocky Flats either on the site or off for routine collecting of discrete samples of respirable dust and analyzing them for plutonium content. Such sampling would demonstrate the extent to which plutonium is present at the time of the sampling in breathable particles, the most dangerous way for humans to be exposed.

In an effort to refute my remarks about sampling breathable dust, David Abelson and Rik Getty, staff of the Rocky Flats Stewardship Council, searched for examples of dust sampling done at Rocky Flats. In a March 22, 2011, memo to Council members they reported that they had found one example. After a July 2000 lightning-caused fire denuded the soil in an area on the site near the very contaminated 903 Pad, dust was collected with a whiskbroom and a portable wind tunnel. This dust contained very little plutonium. But this was not confirmation that I was wrong to emphasize dust sampling, because this project was a faulty example for two reasons. First, samples weren’t taken until six weeks after the fire, by which time any dust in the denuded area would have blown away. Second, the wind tunnel filters captured for analysis only particles that ranged from 10 to 45 microns in size, while, as shown by Gale Biggs (see pp. 44-45), most of the airborne

²⁵ Civil Action No. 90-cv-00181 (JLK), *Cook vs. Dow Chemical & Rockwell International*, U.S. District Court, District of Colorado, 14 February 2006.

²⁶ Allison Frankel, “10th Circuit in Rocky Flats case: After 25 years, give plaintiffs justice,” Reuters, June 24, 2015. <http://blogs.reuters.com/alison-frankel/2015/06/24/10th-circuit-in-rocky-flats-case-after-25-years-give-plaintiffs-justice/>

²⁷ Email message from Merrill Davidoff, lead attorney for plaintiffs, September 19, 2015.

²⁸ Professor Michael Ketterer of the Chemistry Dept., Metro State University in Denver, made the case for this on August 4, 2015. See at <https://www.youtube.com/watch?v=keZZ1A7-xys>

plutonium particles at Rocky Flats would be so small they would pass undetected through these monitoring filters. Besides, this was a one-time event, not an ongoing program where dust sampling is routine. The moral of this story is that you can't find what you don't look for. Or maybe the moral is that you'd best not look for what you don't want to find.

Questionable characterization, using the kriging method: While the failure to determine what's actually present in dust is the bigger problem from a public health standpoint, some of the sampling that was done to characterize the site – that is, locate, measure and map contamination there – was questionable. This is true especially of the “kriging” approach which estimates plutonium concentration in a given area by commingling a few surface soil samples collected from within a large plot to come up with an average concentration for that plot. This method was used to characterize most of the Rocky Flats buffer zone, the part of the site outside the industrial area that today is the Wildlife Refuge. Kriging can miss hot spots or average them away.²⁹ In addition, for the reasons pointed out earlier, it doesn't take account of the higher toxicity of plutonium present in respirable dust since at Rocky Flats only whole soil samples were used. Also because the measurements are surface ones, kriging misses plutonium deposited on the surface years and decades earlier that has percolated down below the level at which surface samples are taken.

Plutonium that has percolated down can be brought back to the surface by the action of animals, plants, humans, weather or geologic disturbance. It can then be redistributed by wind, perchance to be inhaled by a wholly unsuspecting person. This is a permanent reality at Rocky Flats not detected at all by kriging. The agencies responsible for the Rocky Flats “cleanup,” on the basis of results of characterization by kriging, decided that the area that is now the wildlife refuge met their exposure standards and thus required no “cleanup.” In 2006 the roughly seven square miles of land transferred by the DOE to FWS to operate as the Rocky Flats National Wildlife Refuge was certified as suitable for any use and was removed from the Superfund list. Inadequate characterization means those responsible for the “cleanup” missed material they supposedly were cleaning up. The following shows other ways their “cleanup” was questionable or faulty.

Evidence from the FBI raid not examined: To summarize a point made previously (see p. 68), the FBI raided Rocky Flats in 1989 to collect evidence of alleged environmental law-breaking by plant operators Dow Chemical and Rockwell International. Federal Judge Sherman Finesilver reached an out-of-court settlement in which he dropped major charges against Rockwell and sealed 65 cartons of documents from the case, documents that should have been reviewed as part of the Rocky Flats “cleanup.” Though the documents were made available to the “cleanup” regulators, the EPA and CDPHE, they made no effort to examine them.³⁰ Above it was noted that *The Ambushed Grand Jury* by Wes McKinley and Caron Balkany argues that the real purpose of the FBI raid was not to reveal environmental law-breaking but to cover it up by collecting and sealing the evidence. The Department of Justice should make the sealed documents available not to the regulators, who have shown themselves to be irresponsible, but to the public.

False data used: In a paper released at a news conference on August 18, 2004, former Rocky Flats worker Jacque Brever, whistleblower to the FBI regarding illegal operation of the incinerator, said that much of the badly contaminated “East Spray Fields” area at Rocky Flats was excluded from the “cleanup” then nearing completion, because the DOE had knowingly given false information about this area to the regulators (see Figure 7.11).³¹ According to Brever, the data DOE should have provided was later revealed in publicly available reports from the out-of-court settlement reached with former contractor Rockwell International in the trial triggered by the 1989 FBI raid. Joseph A. Legare of DOE, in a September 1, 2004, letter and paper addressed to Steve Gunderson of CDPHE and Mark Aguilar of EPA, avoided direct response to Brever's

²⁹ See “Rocky Flats Environmental Technology Site: Independent Review and Technical Evaluation of the Soil Sampling Protocols for Site Characterization and Cleanup Confirmation,” a report prepared for the Rocky Mountain Peace and Justice Center by Camp Dresser & McKee, Inc. (August 2005). Available on line at <http://www.clarku.edu/research/kaspersonlibrary/mtafund/> and scroll down to Rocky Mountain Peace.

³⁰ Anne Imse, “Rocky Flats Brouhaha,” *Rocky Mountain News*, August 20, 2004.

³¹ Brever, “An Analysis of the Department of Energy's Cleanup Plans for Four Areas at Rocky Flats: The Coverup Continues.” http://www.utwatch.org/war/jacquebrever_rockyflatscleanup.html

allegation that DOE provided false information about the East Spray Fields to the regulators. Neither correcting nor refuting what she had said, he simply piled the new lie of his denial on top of an old lie.

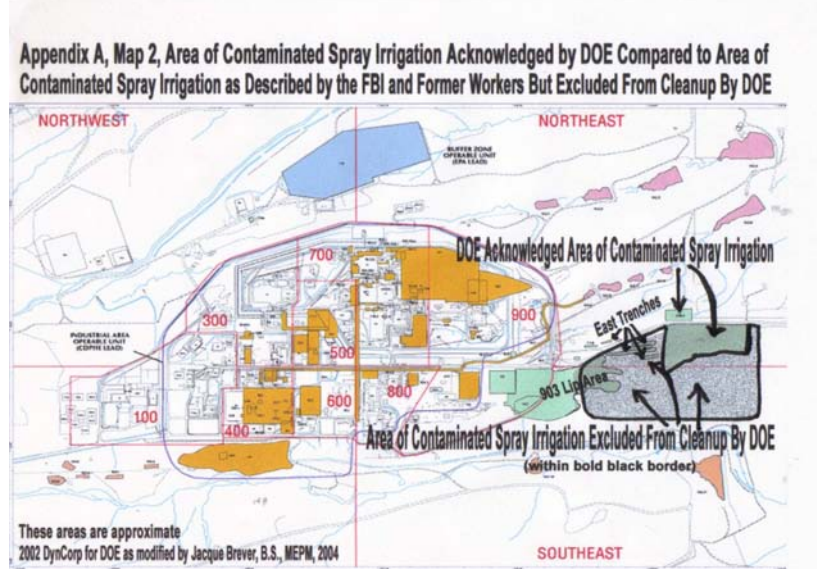


Figure 7.11: Jacques Brever's report shows that for purposes of the site "cleanup," the DOE falsely stated to the EPA and CDPHE that the badly contaminated East Spray Field Area (shown in gray on this map) was not contaminated. This area thus was excluded from the "cleanup."

The "cleanup is based on the false assumption that plutonium in soil at Rocky Flats will not migrate:

Those who designed the "cleanup" for Rocky Flats relied on the team of scientists who did a multi-year Actinide Migration Evaluation (AME) at the site and concluded that plutonium in the soil at Rocky Flats remains "relatively immobile."³² But their results were based primarily on computer modeling rather than on empirical observation. By contrast, environmental engineer M. Iggy Litaor, with instruments he had set up in the field in the unusually wet spring of 1995 detected significant horizontal migration of plutonium in shallow subsurface soil at Rocky Flats. Soon after his stunning real-time discovery, which attracted a great deal of attention because it countered the prevailing Rocky Flats orthodoxy, he was involuntarily terminated by Kaiser-Hill and replaced by the AME team. Back in his native Israel, he tried for about two years with my assistance to get DOE-Rocky Flats to provide him with computerized data he needed to complete a report of his findings. They ignored his request. He thus never published a report documenting what he had found. Absent such documentation in a technical journal, it's as if the movement of plutonium Litaor directly observed in the saturated conditions at Rocky Flats in the spring of 1995 never happened.³³ The Rocky Flats orthodoxy triumphed truth. But studies showing migration of plutonium are abundant.³⁴

The AME claim that plutonium will not migrate was refuted by one of its own reports: The AME team's conclusion of inconsequential plutonium migration at Rocky Flats flies in the face of one of their own reports. This report maintains that cleanup of plutonium in the soil at Rocky Flats even to as low as the 10 pCi/g

³² Kaiser-Hill Co., Actinide Migration Evaluation Pathway Analysis Summary Report, ER-108 (April 2004), p. 28.

³³ The author possesses a copy of a preliminary report Litaor prepared about his discovery.

³⁴ For references on recent findings of plutonium migration in soil at various sites, see Alexander P. Novikov et al., "Colloid Transport of Plutonium in the Far-Field of the Mayak Production Association, Russia," *SCIENCE*, vol. 314 (27 October 2006), notes 6 and 8. Research done by Annie Kersting of DOE's Lawrence Livermore National Laboratory confirms colloidal transport of plutonium. See "Plutonium Hitches a Ride on Subsurface Particles," *Science & Technology Review*, LLNL, Oct./Nov. 2001, pp. 16-18. Also see my "Science compromised in the Cleanup of Rocky Flats," on line at http://media.wix.com/ugd/cff93e_1ae76276c5814bf8aa21dc530da95857.pdf

recommended by the Rocky Mountain Peace and Justice Center (see pp. 76-77), rather than the 50+ actually adopted, would result under conditions of either a 10-year or a 100-year storm in failure at certain downstream areas to meet the Colorado State standard for plutonium in surface water of 0.15 pCi/liter.³⁵ This contradictory report, though it was part of the AME work, is not cited in the final summary report of the AME project.³⁶ Twice in 1997, before the wayward AME report was written, the quantity of plutonium in Walnut Creek at the downstream boundary of the Rocky Flats site exceeded the state standard.³⁷ This occurred on several subsequent occasions not at the site boundary “points of compliance” where the state plutonium-in-water standard must be met. Failures to meet the state standard have happened at upstream “points of evaluation,” which have triggered efforts to find the source of the fugitive plutonium. The exact source has never been identified. And the violations have occurred not at the times of severe storms, as predicted in the paper. Recent “exceedances” of the state standard have happened at monitoring location GS10 on South Walnut Creek, a “point of evaluation,” not of “compliance.” In its January 2014 report, DOE stated: “12 month rolling average for Am-241 and Pu-239 exceeded state standard of 0.15 pCi/L for year ending July 24, 2012.”³⁸ This means that all samples of americium and plutonium collected at GS10 over a period of 12 months were added together and averaged to arrive at the average quantity of plutonium and americium for the year ending on the date given; this average exceeded the state standard. As noted earlier, efforts to find the source have so far not been successful. DOE deals with the problem with engineered controls that divert and dilute the water. Can maintenance of such controls be expected to outlast the plutonium? Can DOE Legacy Management outlast the plutonium?

³⁵ Kaiser-Hill Co., Report on Soil Erosion and Surface Water Sediment Transport Modeling for the Actinide Migration Evaluation at the Rocky Flats Environmental Technology Site, 00-RF-01823/DOE-00-93258 (August 2000), p. 51.

³⁶ Kaiser-Hill, *AME Pathway Analysis Summary Report*, ER-108 (April 2004).

³⁷ J. E. Law, Rocky Mountain Remediation Services, L.L.C., Memo to D. C. Shelton, K-H. Environmental Compliance, dated August 18, 1997, Re: Recent elevated plutonium and americium in water at RFCA point of compliance, Walnut Creek at Indiana Street.

³⁸ Rocky Flats Site Quarterly Report of Site Surveillance and Maintenance Activities—3rd Quarter, Calendar Year 2013, U.S. Department of Energy, Doc. No. S11334, January 2014.

7, Part 3. "CLEANUP" AND CLOSURE (1992-2005): FAILURE CLAIMED AS SUCCESS

Burrowing animals move plutonium: In an unprecedented 1996 study, ecologist Shawn Smallwood identified 18 species of burrowing animals at Rocky Flats that constantly move soil and any adhering contaminants. They take surface material down and bring buried material up. Major diggers, like pocket gophers, prairie dogs and harvester ants (see Figure 7.12), burrow to depths of 10 to 20 feet and disturb very large areas on the surface, while coyotes, badgers, rabbits, and other animals move additional soil. Plants loosen soil and create passages animals can use. Smallwood estimates that burrowing animals disturb 11 to 12% of surface soil at Rocky Flats in any given year. Undisturbed soils do not exist at the site. Plutonium and americium at Rocky Flats were only partially removed down to a depth of 6 feet and are not removed at all below that level. They are being constantly re-circulated in the environment. What's now buried is likely some day to be brought to the surface for wider dispersal by wind, water, fires or other means. Material brought to the surface in the more contaminated DOE-retained land at the center of the Wildlife Refuge can be redistributed widely within the Refuge and beyond, posing a danger now and in perpetuity. Human and non-human beings will unwittingly take particles into their body



Figure 7.12: Deep diggers among the burrowing animals at Rocky Flats include pocket gophers and harvester ants. According to ecologist Shawn Smallwood they go down 16 to 20 feet and constantly redistribute soil and its contents. In any given year burrowing animals disturb on average 11 to 12% of surface soil at Rocky Flats.

In his research Smallwood of the University of California Davis, went onto the Rocky Flats site on three separate occasions in the summer and fall of 1996, each time accompanied by Rocky Flats personnel. He finished his report before the end of that year and two years later published results in a technical journal.³⁹ But his findings were totally ignored by officials from DOE, EPA and CDPHE who established the soil remediation standards in the Rocky Flats Cleanup Agreement of June 2003. Regarding burrowing animals, the analysis by these agencies was limited to prairie dog activity in the top 6 feet of soil. But they relied primarily on the conclusion of the Actinide Migration Evaluation scientists that plutonium and americium left in the Rocky Flats soil would remain "relatively immobile." The AME scientists, in their 2004 final report, stated that data on highly mobile species that might transport actinides "are not available and would be difficult and in some cases logistically nearly impossible to obtain."⁴⁰ Smallwood's study had been completed eight years earlier.

Earthworms as movers of plutonium: Smallwood did not include earthworms in his study, but they need to be reckoned among the plutonium movers at Rocky Flats (see Figure 7.13). Prof. Tim Seastedt of the Department of Ecology and Evolutionary Biology at the University of Colorado stated what I also heard from

³⁹ Smallwood et al., "Animal Burrowing Attributes Affecting Hazardous Waste Management," *Environmental Management*, vol. 22, no. 6, 1998, pp. 831-847.

⁴⁰ Kaiser-Hill Co., Actinide Migration Evaluation Pathway Analysis Summary Report, ER-108 (April 2004), p.

others: “To my knowledge, there are no density or biomass estimates for earthworms on the Front Range.”⁴¹ According to my own estimates, the soil of the full ten square-mile Rocky Flats site likely contains at any given time as many as half-a-billion earthworms.⁴² One million earthworms weigh a ton, and in a span of 24 hours “each worm will pass through its body its own weight of soil” and its contents,⁴³ which at Rocky Flats would sometimes include plutonium. Environmental engineer Iggy Litaor, who paid considerable attention to earthworms during his years at Rocky Flats, says that at the site, though they can burrow much deeper, most of them work the soil to a depth of about 50 centimeters (19.5 inches).⁴⁴ Each year they may bring to the surface as much as an inch-thick layer of subsoil.⁴⁵ Litaor reported that in the saturated conditions of the spring of 1995, when he detected rapid plutonium migration at the site, earthworms surfaced in huge numbers. Various predators devoured many of them, so that whatever contaminants the worms bore within entered their predators’ bodies either to lodge there or to be defecated elsewhere. Untold numbers of the worms dried on the surface and disintegrated into dust that perhaps contained plutonium and americium particles that could be dispersed by wind or other forces. Whenever comparably wet



Figure 7.13: The earthworm population at Rocky Flats, according to my estimate, is about half-a-billion (see footnote 47). They are major movers of soil and its contents. At Rocky Flats this includes plutonium and other contaminants.

conditions recur at Rocky Flats, such as the flood of September 2013, similar activity will recur. But, as noted, earthworms otherwise will be constantly bringing plutonium particles to the surface. Those responsible for the “cleanup” at Rocky Flats paid scant attention to this significant reality.

Uptake of plutonium in grass: An eleven-year study done at DOE’s Savannah River Site in South Carolina demonstrates that plutonium in subsurface sediments at that site moved upward from the buried source material. The authors of this study conclude “that the upward movement was largely the result of invading grasses taking up the plutonium and translocating it upward,” producing a “measurable accumulation of

⁴¹ Email communication from Tim Seastedt, June 2, 2011.

⁴² While earthworm populations per acre “of between one and two million are quite common” (http://journeytoforever.org/farm_library/oliver/balfour_intro.html), poor soil may contain only 250,000 per acre (<http://www.experiencefestival>). Applying this number to the 6,219 acres of land held by DOE and FWS at Rocky Flats in 2012 suggests a total earthworm population at the site in excess of 1.5 billion. Dropping this number by two-thirds in order to be exceedingly conservative about the high plains environment at the base of the Rockies puts the number of earthworms at the Rocky Flats site at any given time at upwards of half-a-billion.

⁴³ http://journeytoforever.org/farm_library/oliver/balfour_intro.html

⁴⁴ Email communication from M. Iggy Litaor, May 17, 2011.

⁴⁵ <http://www.ext.colostate.edu/mg/gardennotes/218.html>

plutonium on the ground surface.”⁴⁶ By contrast, the Actinide Migration Evaluation done at Rocky Flats concluded that “uptake into plant . . . tissues is minor.”⁴⁷ The Rocky Flats site consists for the most part of prairie grassland (see Figure 7.14). If grass at the Savannah River Site brings plutonium up to the surface, should we not expect something similar at Rocky Flats? Very likely the grasses at Rocky Flats have roots that run deeper into the soil than those at Savannah River, due to the drier climate at Rocky Flats. The question whether the grass at Rocky Flats brings plutonium to the surface presents an uncertainty worth detailed exploration. It is prudent to assume that the grass abundant on the Rocky Flats site is constantly bringing to the surface some of the plutonium that is in the environment.



Figure 7.14: Xeric tall-grass prairie at the Rocky Flats National Wildlife Refuge.

Monitoring of windblown particles: If, as indicated above, plutonium particles are likely at any time to be blowing in the wind at Rocky Flats, won't air monitors detect them? The answer is no, because air monitoring no longer occurs at Rocky Flats. But even if it did, the answer would still be no, because the monitors previously used were inadequate and the government reports of airborne monitoring were inaccurate (see pp. 44-45, on the inadequacy of air monitoring).

Aquifers never examined: Beneath much of northern Colorado is the 7,000 square-mile Denver Basin system of four aquifers (see Figure 7.15). Each of these four aquifers lies at a different level within the Denver Basin. They provide water for agricultural and residential use. Rocky Flats is located in northeastern Jefferson County directly over the western edge of the Denver Basin. The official view at Rocky Flats is that the terrain beneath the site is impermeable and thus that the contamination released from the plant into the environment never reached the underlying aquifers. In the September 2007 issue of *Physics Today* chemist Anne Fenerty said that “no independent evaluation has been conducted of the bedrock under the 10-square-mile [Rocky Flats] site, which is in an earthquake zone. It is questionable that an area of this size will have no fractures in the event of an earthquake.” Fenerty is not convinced that the aquifers are free of plutonium and other contaminants released from Rocky Flats. But, as she points out, there have been no independent studies of possible Rocky Flats contamination of aquifer water.

⁴⁶ D. I. Kaplan et al., “Upward Movement of Plutonium to Surface Sediments During an 11-Year Field Study,” SRNL-STI-2010-00029, January 25, 2010. <http://sti.srs.gov/fulltext/SRNL-STI-2010-00029.pdf>

⁴⁷ Kaiser-Hill Co., Actinide Migration Evaluation Pathway Analysis Summary Report, ER-108 (April 2004), p. 28; see p. 24.

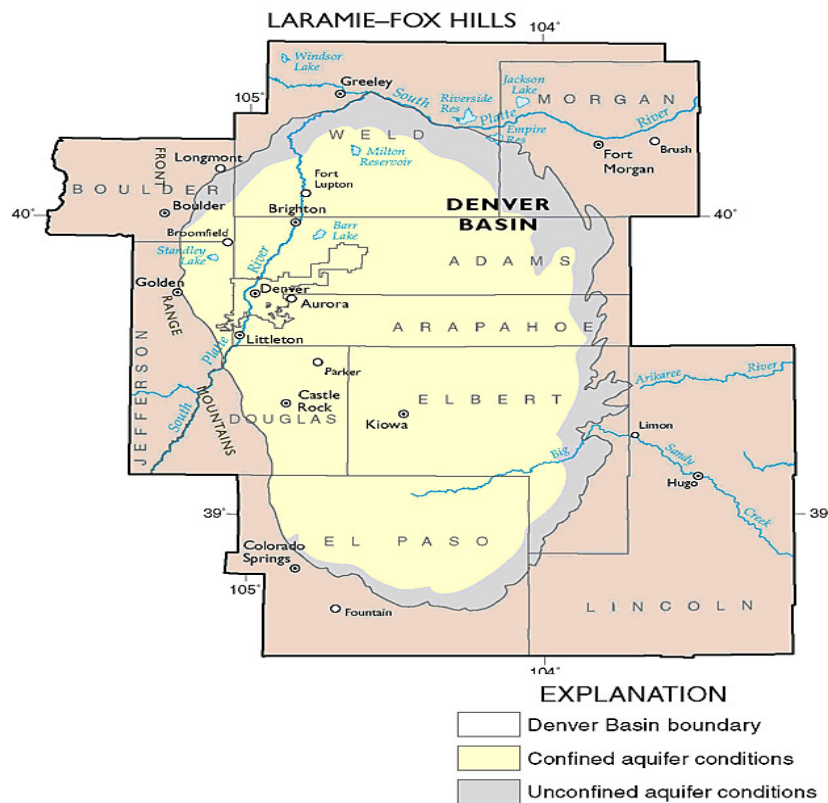


Figure 7.15: Map of the Denver Basin system of aquifers. Rocky Flats is located northwest of Standley Lake between Boulder and Golden, directly above the western edge of the Denver Basin.

The flood of September 2013: What happened in the September 2013 flood, often referred to as a 1,000-year flood? Was plutonium washed off the site? Whether the state's strict standard for plutonium and americium in surface water (0.15 pCi/L) is ever violated is determined by sampling at two specific on-site "points of compliance," one on Walnut Creek, the other on Woman Creek (see Figure 7.16). Was this standard violated during the September 2013 flood? No one knows. Why? Two explanations have been given. DOE site manager Scott Surovchak stated at a public meeting in June 2014 that in the midst of the flood it was too dangerous to sample water. He said he went to check the samplers at the height of the flood and was forced to flee to save his life (a worker at the Rocky Flats site later reported that Surovchak was in Florida at the time of the flood, not even present at Rocky Flats). A second explanation, provided in an official DOE report, is that the automatic sampling equipment "was full and did not collect any water for the period 9/11/13 21:49 to 9/13/13 15:30. Therefore, no analytical results are available for this period."⁴⁸ September 12 and 13 were the days of peak flooding. A Rocky Flats official said that the more water that was flowing would be beneficial because there would be less plutonium per volume of water.

⁴⁸ Rocky Flats Site Quarterly Report of Site Surveillance and Maintenance Activities—3rd Quarter Calendar Year 2013, U.S. Department of Energy, Doc. No. S11334, January 2014, p. 26.



Figure 7.16. The author observes debris from the September 2013 flood in the Walnut Creek channel just east of the Rocky Flats boundary at Indiana St. This photo by Robert Del Tredici was taken in June 2014, nine months after the flood.

Another aspect of sampling during this flood is making measurements of what is called “sheet flooding” – vast sheets of water flowing at a depth of two or three inches or more over broad stretches of land rather than in the stream channels that ordinarily drain the area. The highly specialized equipment designed to measure the flow in sheet flooding was not present at Rocky Flats. Thus, whether plutonium flowed freely in the sheet flooding is not known. Of course such flow affected large areas on site as well as off. If plutonium was released, we do not know where it went, only that its effect will be long-term.

If what happened in September 2013 was not really a catastrophic flood, might we have one?

Meteorologist Gale Biggs wonders if at some unforeseen time there might be a flood like the one that long ago deposited the alluvium that became the area known as Rocky Flats. He imagines a torrent rushing down Coal Creek Canyon and washing before it the whole of the gravelly Rocky Flats formation, carrying the contaminants left there to unknown destinations with unimaginable health and environmental effects. His observation is not far-fetched. Climate warming increases the likelihood that mountain pine forests killed by pine beetles will be ignited by lightning into catastrophic fires that denude mountainsides and prepare the way for massive flash floods in the wake of extreme weather. Those who designed the Rocky Flats “cleanup” made no effort to protect against this sort of environmental devastation.

Risk-based cleanup and the myth that a little exposure is “safe”: Rocky Flats is an example of what the DOE calls “risk-based cleanup.” The language itself is a tip-off that the “cleanup” is not risk-free. The cleanup standards adopted for Rocky Flats were accompanied by assertions of government officials that the site “cleaned” to these standards is “safe.” His or her use of the term “safe” implies that a little radiation can’t hurt anyone. The late Edward Martell, the NCAR radiochemist who opened up the public health question for Rocky Flats when he found plutonium in the off-site environment after the 1969 fire, observed that some people get cancer from naturally occurring radiation and some of them die prematurely. He said further that the small exposures resulting from global fallout from nuclear weapons tests have increased disease and death worldwide. The same was said by Andrei Sakharov, the dissident Soviet nuclear scientist, who won the Nobel Prize in 1975 for championing human rights in the Soviet Union. We thus should do our best to eliminate risk or to reduce it to the lowest possible level. The Rocky Flats risk-based cleanup did neither.

The Precautionary Principle: Over the past three decades people worldwide have formulated the precautionary principle. The best-known U.S. statement was drawn up in the Wingspread Conference on the Precautionary Principle in Racine, WI, in January 1998. The following words from the statement aptly describe the situation at Rocky Flats:

"We believe existing environmental regulations and other decisions, particularly those based on risk assessment, have failed to protect adequately human health and the environment – the larger system of which humans are but a part.

"We believe there is compelling evidence that damage to humans and the worldwide environment is of such magnitude and seriousness that new principles for conducting human activities are necessary.

"While we realize that human activities may involve hazards, people must proceed more carefully than has been the case in recent history. Corporations, government entities, organizations, communities, scientists and other individuals must adopt a precautionary approach to all human endeavors.

"Therefore, it is necessary to implement the Precautionary Principle: When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof.

"The process of applying the Precautionary Principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action."⁴⁹

The precautionary principle was not followed at Rocky Flats. Though there are very few places in the U.S. where the principle has the force of law as it does in some other countries, the existence of the concept is a reminder that we fall short of the most humane practice regarding public health and environmental integrity. The necessity of applying the Precautionary Principle will be discussed more fully under Nuclear Guardianship.

⁴⁹ <http://www.p!Unexpected End of Formulasrast.org/precaut.htm>

7, Part 4: “CLEANUP” AND CLOSURE (1992-2005): FAILURE CLAIMED AS SUCCESS

Conclusion: The “cleanup” done at Rocky Flats endangers people of present and future generations. As the foregoing shows, the site was “cleaned” using questionable ways of calculating risk and inadequate or erroneous data about contamination. Though most of the site has legally become a wildlife refuge, it will cease being a wildlife refuge long before plutonium left in the environment ceases to be dangerous. What happens after fences fall and memory fades? From a public health and environmental perspective, the “cleanup” at Rocky Flats was a failure, though DOE touts it as a model to be followed elsewhere and Kaiser-Hill calls it a success.⁵⁰ The “cleanup” removed all buildings and structures, but it left a site contaminated essentially forever (see Figures 7.17 and 7.18).



Figures 7.17. The Rocky Flats site at the height of production. What appears to be a road surrounding a portion of the industrial area is actually a high security barrier, to protect the “hot” side of the plant, where plutonium pits were produced. The other “cold” side is where non-nuclear parts made with beryllium and stainless steel were produced. Photo courtesy DOE.

⁵⁰ See Kim Cameron and Marc Lavine, *Making the Impossible Possible: Leading Extraordinary Performance, The Rocky Flats Story* (San Francisco: Berrett-Koehler Publishers, Inc., 2006).



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Figure 7. 18. The Rocky Flats site in 2005, after all structures have been removed. Contamination remains, but it is not visible. Photo courtesy DOE.