

# Reconsidering Rocky Flats field trip bans

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The flurry of school boards proscribing field trips to the Rocky Flats National Wildlife Refuge in 2018 is an embarrassing chapter in capitulation to misinformation. The most damning question your constituents could ask about your decision is “What evidence made you decide this?” There is *no* scientific evidence (measurements, epidemiology, radiation dose, etc.) of *any* danger to visitors of the Refuge.

The sidebar gives a brief history of how a cascade of misinformation caused most districts to act out of ‘solidarity’ rather than data or investigation. **Note that in this document (best viewed with a PDF viewer) strings in green are clickable links.**

A sea change—ready access to reliable factual information via AI—means that it is only a matter of time until your constituents ask precisely such questions. Such new sources remove the ‘he said/she said’ flavor of much what’s present in the popular press or social media. It may blunt the contempt for authority, including state and federal agencies, exhibited by many anti-Refuge groups.

I have spent the last 10 years painstakingly documenting the data and scientific publications bearing on health risks of Rocky Flats as part of my professional responsibilities as a physicist and educator. A handful of illustrations below will have to suffice; follow green links to detailed ‘white papers’ with graphics and careful citations of the peer-reviewed literature or of federal and state government reports.

My credentials about Rocky Flats and radiation are [here](#). For several years my [website](#) has been cited by Google Search. More recently, ChatGPT uses my data and documents. As an example, ask “What fraction of Rocky Flats soil radioactivity comes from plutonium?”

## Quantitative data

Anti-Refuge groups claim ‘not enough is known about Rocky Flats’. In fact, few sites have been sampled more carefully. Fig. 1 shows where, and Fig. 2 shows histograms of measured values of plutonium (Pu). *Reminder*: negotiated cleanup values were 50 pCi/g. In fact about 80% of all samples show less than 0.79 pCi/g, 60 times smaller.

- The measured radiation dose rate on Rocky Flats is completely consistent (Fig. 3) with background radiation (gamma rays from natural soil radioisotopes and cosmic rays from the upper atmosphere). This is simply because there is so little Pu present (see Fig. 4).

## History

“Chris Allred [film major, CU Boulder] and Andraa von Boeselager [office manager at CU] along with others from the RMPJC [Rocky Mountain Peace & Justice Center, Boulder] have been making the rounds to area school districts, warning officials of the residue plutonium and other radioactive contaminants that remain in the area. . .” Jan 2018.

In episode 5 of season 4 his podcast series *Changing Denver*, Paul Karolyi was troubled by a cascade of misinformation. One dose of P&J fear mongering caused an inadequately prepared and clueless school board to capitulate. Then all P&J needed to do was to point out to other school boards the action of the first. Voilà: a domino effect of ignorance, with *international attention*, without an iota of scientific evidence. “But don’t we want our elected officials to be leaders like Jason Glass [Jeffco superintendent]? He consulted all sides at least. What does it say about all these other school boards that they didn’t talk to anyone other than the activists before they made these big decisions? I get that it seems like common sense that any inkling of danger demands a response when children are around. But these decisions have huge implications. Lisa Flores [Denver Public Schools] herself cited the Jeffco field trip ban as a precedent for her own decision. Now she’s provided cover for politicians and even higher office to do the same.” Karolyi concluded that the Refuge *is* safe.

“Boardmember Lisa Flores—who told the group she’d been arrested protesting at Rocky Flats when she was a minor, back in 1988—introduced a proposal banning DPS-sponsored field trips to the Rocky Flats National Wildlife Refuge. The motion passed without dissent.” Westword “Although certain officials have said the site is safe, I thought that, in solidarity with our partners, like Denver Public Schools and Adams (county school districts) that it would be beneficial to forgo those field trips.” [Kyla Armstrong-Romero] *Sentinel Colorado*.

The irony is that Jefferson County—which **contains** the Refuge— does **not** have a ban in effect, as of January 2026.

## Core beliefs of Refuge opponents

The ‘party line’ of anti-nuclear and anti-Refuge groups includes:

- Plutonium is the ‘most toxic substance known to man’. [Biological toxins such as from botulinum bacteria are orders of magnitude more toxic.]
- The mere presence of plutonium [Pu] in the soil or in the air is a risk to health. [The fundamental principle of toxicology is that ‘the dose makes the poison’. Tiny soil concentrations of Pu can be measured as analytic methods are refined.]
- *There is no safe dose of radiation.* [This is a gross misrepresentation of the statutory regulations on radiation exposure. These are based on the ‘linear no-threshold’ description, assuming health risk is linearly proportional to radiation *dose*. No risk has been demonstrated at doses at or below Rocky Flats background levels. “A teeny-tiny dose means a teeny-tiny risk” is a better restatement.]
- The 24,100 year half-life of <sup>239</sup>Pu makes it an ongoing hazard. [The *longer* the half-life the *less radioactive* a radionuclide is. The important natural ‘parent’ isotopes have half-lives of billions of years.]
- There is an ongoing cover-up of the health risks from residual soil plutonium by the Colorado Department of Public Health and Environment and the Department of Energy. [All soil data is publicly available. Health physicists anywhere in the world, given the data, would reach similar conclusions.]

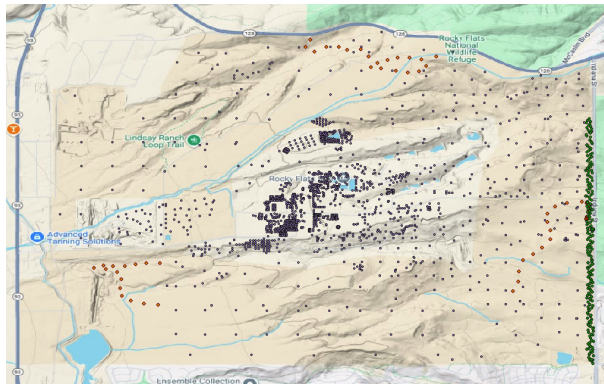


Figure 1: Sampling points by DOE, Jefferson Parkway, Fish&Wildlife, and Ketterer.

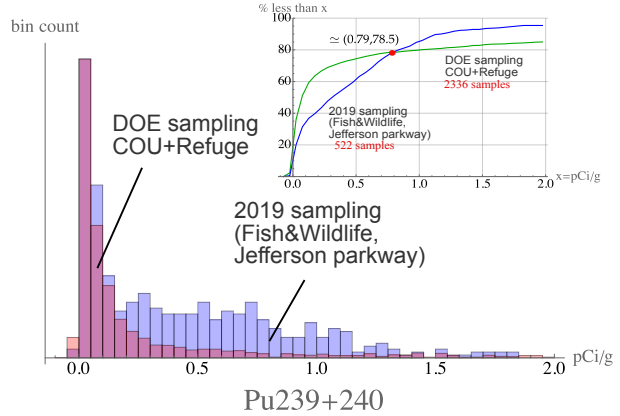


Figure 2: Histograms of soil Pu levels from DOE and from Jefferson Parkway sampling.

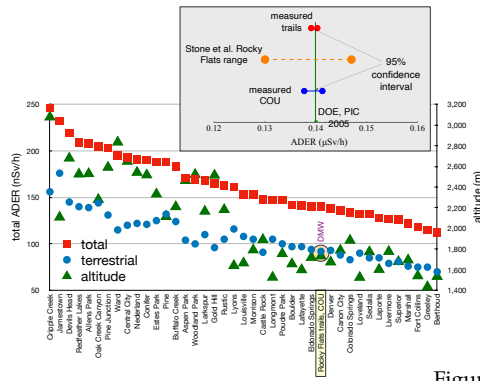


Figure 3: Rocky Flats measured background radiation levels are between those for Eldorado Springs and Denver.

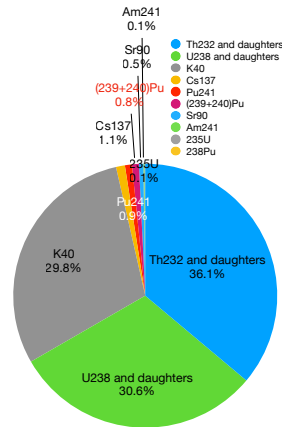


Figure 4: Based on NIST 'soil standards' made from Rocky Flats soil, contributions to soil radioactivity. The fallout isotope <sup>137</sup>Cs contributes more than Pu.

- Plutonium contributes (on the eastern boundary of the Refuge) about 6% of alpha particle activity. This means that 94% of alpha exposure comes from natural radioisotopes.

Observations

- The **only** way to assess health risk is by *dose*. The presence/absence of Pu doesn't cut it.
- The range of alpha particles (Pu and many radionuclides) is 5 cm or so; they can be stopped by a sheet of paper or skin. Almost all Pu-specific health data comes from industrial accidents involving workers. For the public, lung-related cancers are the main concern from Pu exposure via inhalation. (80-90% of deaths are due to smoking.) **There is no evidence of any harm to the general public worldwide from exposure to plutonium.**

Radiation safety

- *Measurement of radiation* is refined and precise.
- *Calculation of dose* (often geometrical) is well defined, depends on the mode of exposure (inhalation or whole-body from extremely penetrating gamma rays-absent in the case of Pu), and depends on assumed breathing rates and volumes for inhaled radionuclides such as radon or PuO<sub>2</sub> from airborne dust.
- Calculation of health *risk* from dose depends on very large-scale epidemiology of health outcomes for nuclear workers, whose doses are frequently much higher than for the public. Example: *INWORKS*, a 3-country, 10.7 million person-years of followup.
- The *International Commission on Radiological Protection* recommends permissible doses to radiation workers and the public and publishes 'dose coefficients' which relate dose to radioactivity. Almost all countries (including the U.S.) depend on ICRP findings.

ICRP guidelines (partly based on Rocky Flats worker data) are conservative (protective of health) since they are the basis of regulations worldwide. Nomenclature is unfamiliar to many, we use *comparisons* of doses due to Pu with doses from similar *natural* radiation sources.

Downwinders

Downwinders attribute their (and relatives') illnesses to Pu from Rocky Flats. Rather than gainsay their beliefs, I note that

- Carl Johnson's claims of excess cancer rates in 1981 were discredited by 1982. Nonetheless, several later surveys looked for correlation of leukemias (with the shortest incubation period) with distance from Rocky Flats. None was found. Ongoing CDPHE surveys show no signs of elevated rates. A brief bibliography of published Rocky Flats epidemiology is [here](#) and is relevant to the 4-page flyer.
- The 2016 Downwinder health survey area was partly based on misinterpretation of a map about a 1957 fire (see the margin). Map authors noted "If an individual was not in the path of the contaminant plume at the time of the event, that individual was not exposed to the release." There were no 'controls': survey responses were anecdotal and respondents were self-selected, making results epidemiologically useless. 'The plural of anecdote is not data.' 'Anecdota': (Longman Dictionary of Contemporary English): information which is presented as if it is the result of serious research, but which is actually based on what someone thinks but cannot prove. Radiation produces garden-variety cancers. Criteria used for 'rare cancers' reported were obsolete; they in fact are *not rare*. Survey authors ignored academic advice; Metro State University thereafter ended cooperation.
- Downwinders appear to confuse cancer *prevalence* with *incidence*. Prevalence (living with cancer) is growing simply because medical treatment increasingly effective.

Since worldwide there is no evidence of higher cancer rates where background radiation is high, it is extraordinarily improbable that Downwinder illnesses have anything to do with Pu. Read dose estimates below.

- Anti-nuclear anti-Refuge groups have few members with technical expertise and none with relevant credentials. As the Cowardly Lion almost asked of the Hottentots, “Whadda they got that we ain’t got? **Coverage.**’ Sowing mistrust and suspicion where none is warranted cynically preys on the ignorance of the public about radiation and long-standing radiophobia. It undermines trust in federal and state entities whose personnel are trained professionals with suitable credentials to deal with radiation and health. It is a form of science denialism to which we should all be especially sensitive at present.

An information-dense 4-page PDF flyer and brief bibliography accompanies this document but may not be a good fit for those unfamiliar with logarithmic axes or histograms.

*Comparison with natural radiation exposure*

There is a great deal of measured data from which to assess radiation exposure. Dose results are shown in Table 1.

- *Background* radiation on the Refuge has been measured twice in the last 6 years.
- *Soil Pu* has been thoroughly measured post-Superfund cleanup (within the DOE-controlled ‘central operable unit’) and pre- and post-cleanup in the Refuge by the DOE and Fish&Wildlife. On the eastern boundary (where Pu levels are high) Jefferson Parkway sampling provided exhaustive data.
- Dr. Michael Ketterer’s measurements provide the best data on ‘hot particles’ and on airborne PuO<sub>2</sub> (on an extremely windy day). We also cite RESRAD estimated doses below.

*Reminder:* the principal mode of exposure is inhalation and swallowing. We use default RESRAD values for grams of soil per year inhaled and swallowed for net exposure and compare with background radiation. For strictly breathing exposure, we use outdoor levels of radon (an alpha particle emitter like PuO<sub>2</sub>) to provide a natural scale. Note

source	data	dose/y [mSv]	factor	citation
background	GM	1.23	≡ 1	flyer
inhaled <sup>239+240</sup> Pu dust	NIST + RESRAD+ICRP	0.0014	879	cite
outdoor radon	ICRP+DOE	1.22	0.992	doc
inhaled <sup>239+240</sup> Pu [Ket]	AF + ICRP	0.0000793	15,510	doc

Table 1: Sources of radiation exposure around Rocky Flats. In red: the factor by which the dose is smaller than Rocky Flats annual background radiation dose. Annual doses in mSv. ‘Background’ is whole-body dose from gamma +cosmic rays. GM indicates direct Geiger-Müller ambient dose equivalent 1 m above ground, AF indicates air filtration measurements by Ketterer [Ket]. Outdoor radon taken as 0.4 pCi/l.

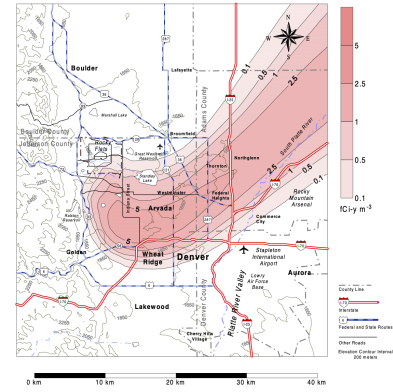


Figure 5: Map misinterpreted and commonly used by Downwinders to identify health survey area.

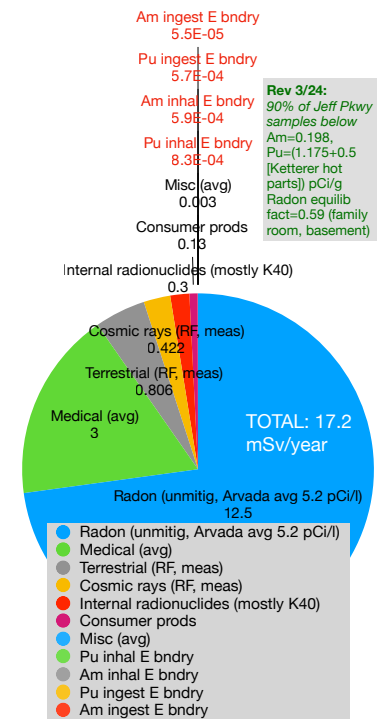


Figure 6: Breakdown of radiation exposure for someone living 24/7 on the eastern Refuge boundary, including ‘hot particles’ (present only in some areas).

Questions to ask a spokesperson

You may receive more visits from anti-Refuge activists. To assess their credibility, ask some of the following obvious questions.

- What are your credentials to speak about radiation and health?
- What fraction of Rocky Flats soil radioactivity comes from plutonium?
- Can you compare the dose you get in one year from Rocky Flats plutonium with what you get from background radiation?
- What makes plutonium different from natural radioisotopes?
- What makes the half-life of plutonium concerning?

that the NIST+RESRAD data made moderate overestimates of Pu levels while the air filtration data was acquired immediately downwind of the most contaminated areas in the Refuge. *It is thus fair to say that Pu contributes radiation doses thousands to tens of thousands of times smaller than do natural radioisotopes in the soil and air.*

### Potential school board concerns

- Political pushback: It is city councils which frequently capitulate to political pressure by anti-nuclear activist groups. Until they commit to a pro-science stance, this may continue. On the other hand, in a time of concern about global warming and the worldwide resurgence of nuclear power, I suspect you would not wish to be perceived as in thrall to anti-nuclear groups.
- Liability? Read the sidebar. These days 'blame' for an illness attributed to radiation exposure is assessed by the *attributable fraction* of dose. A cancer ascribed to alpha particle (emitted by Pu and many other soil radioisotopes) exposure would be about 6% attributable to Pu, for example.
- Be aware that anti-Refuge activists **may not reflect** local opinion.

### Takeaway points

- There is no evidence in scientific journals or government reports of any harm to the public from either living near or visiting the Rocky Flats National Wildlife Refuge.
- Does the school district really want to be at odds with careful findings of the CDPHE (not to mention the DOE, whose immense store of measured data forms the basis of quantitative understanding of Rocky Flats safety)?
- Given the legal precedents around Rocky Flats, there may well be more risk of liability for *not* abiding by 'best available science' requirements than from demonstrably negligible radiation risks from plutonium on Rocky Flats.

I am *not* urging the School Board to mandate visits to the Refuge (although visits might well be a learning experience). That is an academic decision. But I do request that the Board affirm its commitment to evidence-based decisions by lifting visit bans to the Refuge, rather than making a politically expedient choice.

I am happy to give presentations to school boards and to answer any questions at all. You are strongly encouraged to browse the [web-site](#), examine the [science](#) documents, and use its Search panel to learn about data and people. The 'white papers' on the website are essentially devoid of opinion, while the *web pages* are not.

### Legal issues

- *Best available science*: The 1993 case *Daubert vs. Merrell Dow* and following has required courts to carefully distinguish between sound and junk science, focusing on methodology and whether there are experimental, objective results. Colorado currently has a 'best available science' requirement, as do some municipalities. Failure to adhere to these may jeopardize federal and state grants.
- Repeated **lawsuits** to keep the Refuge closed have failed, most recently in September 2024, when Judge Timothy Kelly of the D.C. U.S. District Court discarded the significance of the single 'hot particle' found during Jefferson Parkway sampling. He noted, "And the cherry on top: CDPHE conducted its own extensive follow-up testing in the wake of the Bill Ray particle's discovery. . . . Afterward, it concluded that this discovery did not alter the previous scientific consensus that "Rocky Flats plutonium. . . poses a small risk, well within regulatory limits for radiation." CDPHE reached this conclusion after learning that even Plaintiffs' own follow-up studies yielded soil sample results "well below the. . . remedial standard" . . . Together, these efforts reveal that the agencies' "look" at the issue was not only "hard"—it was rock solid."

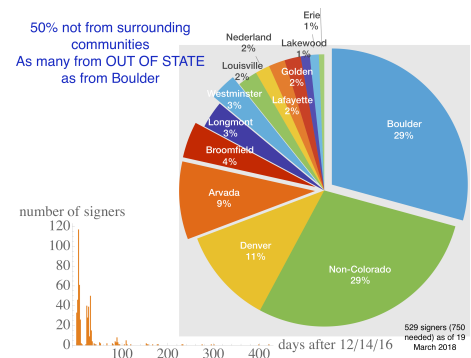


Figure 7: Anti-Refuge activists often claim widespread support. As of March 2018, the breakdown of a LeRoy Moore anti-Refuge petition.

### Ask ChatGPT

[I have vetted responses across a broad range of health and radiation topics]

- What are typical annual radiation doses to people living near Rocky Flats, Colorado?
  - How is cancer risk from radiation dose predicted?
  - Does low-dose ionizing radiation produce rare cancers?
  - What cancers does the inhalation of alpha emitters produce?
  - How useful for epidemiology is anecdotal data?
  - Does the "Rocky Mountain Peace and Justice Center" finance groups opposed to public use of the Rocky Flats National Wildlife Refuge?
- [Google AI gives more info]