

From: David Wood, Candelas
 To: Broomfield City Council
 Date: August 10, 2019
 Regarding: Rebuttal to [REDACTED] letter of 21 July 2019

Dear Council members,

Below are remarks about points raised by [REDACTED] in his letter to the Council dated July 21st, in order to assist the Council to distinguish what is known *factually* about radiation around the Rocky Flats National Wildlife Refuge from what is believed by 'activist' groups opposed to any use of the Refuge. Much briefer summary documents are forthcoming.

Despite [REDACTED]'s claim, I am personally ambivalent about the Parkway (it will certainly affect my view), but I am *not* ambivalent about misinformation and pseudo science. I am acting from what I perceive to be a professional obligation. Below are direct (clickable) links in green. Citations (such as [1]) are also in green and will take you to a short bibliography at the end with links to the relevant document. If you're in a rush, please at least read the contents (not the sidebars) as far as the Appendix.

In the portions of his letter concerning me, [REDACTED]

1. Argues that the beliefs of experts from the early 1970s are more credible than data from the late 1970s through the present.
2. Reviews and adds to anecdotes of cancer cases downwind of Rocky Flats, and conjectures that these are due to proximity to Rocky Flats.
3. Objects that our measurements of ambient radiation on trails in the Refuge and on roads and paths in the DOE-controlled "central operable unit" are meaningless since they don't include alpha radiation.
4. Takes me to task over the 'scientific method', then proceeds to make a number of serious methodological blunders in proposed testing of his hypotheses about cancer and Rocky Flats.

[REDACTED] gives me too much credit. The statements I made to the Broomfield City Council represent *mainstream* views of epidemiologists, health physicists, etc, not simply my own. This is why they agree in every respect with what you heard from Chris Urbina, M.D. on June 18th.

Before responding, I urge the Council to compare the *nature* of evidence cited by [REDACTED]'s side of the Rocky Flats issue with those cited by 'my side' (and Dr. Urbino's, and the 'establishment' 's): (i) A rehash of the positions held by workers in the mid 1970s with strong ideological biases vs. reports in current peer-reviewed journals in scientific disciplines such as health physics, environmental contamination, and epidemiology; (ii) Anecdotal 'evidence' vs firmly-established measurements and epidemiological data.

I thank [REDACTED] for making widely available a number of early or hard-to-find documents he has duplicated as a result of a great deal of work in his study of the history of Rocky Flats.

You may wish to read this PDF on a computer to use these links.

Among these, Dr. John Gofman: "Three months after the Chernobyl disaster, Gofman predicted that Chernobyl would cause "475,000 fatal cancers plus about an equal number of additional non-fatal cases, occurring over time both inside and outside the ex-Soviet Union". In contrast, even some 19 years later in September 2005, an official UN/IAEA report claimed 4,000 deaths as the final estimated toll from Chernobyl." [Wikipedia]

As noted in 2003 by a well-known radiation epidemiologist in the United Kingdom [1], "The argument has become very familiar—that radionuclides introduced into the environment from nuclear installations, fall-out from weapons testing, or whatever source, are responsible for substantial increases in cancer rates, and, because current risk estimates do not support this conclusion, they must be very wrong. It is argued that there must be some way in which low levels of artificial radionuclides, levels that result in tissue doses lower than from naturally-occurring radionuclides, pose a risk that is yet to be appreciated."

Quick observations on the points above:

1. (That beliefs of experts from the early 1970s are preferable to data from the 1970s through the present.) Would you buy this argument if you were confronting radiation therapy next week? The field has changed immensely in the last 45 years.
2. Anecdotal data and the fallacy that ‘correlation implies causation’ appear to afflict many of ██████’s followers. I illustrate below how extremely unlikely there is to be a connection between Rocky Flats and (for example) breast cancer. A clear conclusion about whether there *are* excess cancers downwind of Rocky Flats lies probably decades in the future, for reasons discussed below and in the Appendix.
3. The NIST [soil standards](#) comprehensively address the issue of common alpha emitters in Rocky Flats soil. They show unequivocally that plutonium isotopes contribute less than 5% of total alpha radiation. See the Figure. The issue of ‘hot particles’—inhaled alpha emitters—is addressed [here](#).
4. ██████’s proposed tests as they stand, although plausible, would permit no conclusions. Suggestions to make them better (though based on an extremely unlikely premise) are deferred to the Appendix.

Perhaps the most insidious effect of the activist groups is that some members of local municipalities may believe that cancers can be somehow *averted* if only Rocky Flats were placed off limits to the public and to public use (for example, by the Jefferson Parkway).

Each cancer case is a wrenching ordeal for victim and family. However, in the context of public policy and the use of public funds, it is necessary to treat all of this aggregate pain statistically. ██████ accuses me of *ignoring* the statistics about cancers around Rocky Flats. In fact I believe there is *no* Rocky Flats connection and I regarded it as none of my business, since I felt I was representing (albeit informally) those living in new developments around the Refuge. ██████ has *made* it my business by his accusation.

Radiation is a *weak* carcinogen, which is why cancer radiation therapy does not (often) cause additional cancers. The author of the most recent general review [2] I could find about risk factors for breast cancer notes:

In a 1991 update, breast cancer incidence was tabulated for 2,573 women who were examined by x-ray fluoroscopy an average of 88 times during therapy for tuberculosis and who were followed for an average of 30 years. Extrapolating from the data collected in this population, the relative risk for 1 Gy of radiation exposure at a latency period of 10 years was estimated to be 1.61. They found that younger women were at higher risk than older women ...

This makes a couple of points: (i) breast cancers (like all cancers) have a ‘latency’ (incubation) period that must elapse before tracing

As noted [here](#), “Whereas anecdotal evidence is sometimes the starting point of a proper scientific investigation, it is all too often the ending point and *every* point of a pseudo-scientific investigation. In the world of pseudoscience, an anecdote is the equivalent of a peer-reviewed, double-blind, repeatable scientific experiment with consistent results.

Anecdotal evidence is often used in politics, journalism, blogs and many other contexts to make or imply generalizations based on very limited and cherry-picked examples, rather than reliable statistical studies.

Anecdotes ... do not constitute evidence. This is because anecdotes only ever apply to individuals or individual experiences and are subject to the biases that this brings with it. It is impossible to say that an individual anecdote is representative and it is also impossible to actually detect the real cause of the [outcome].”

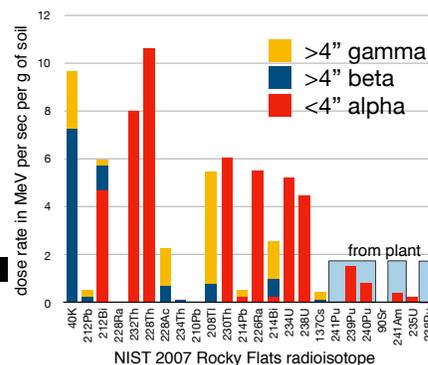


Figure 1: Radiation from radioisotopes in [Refuge soil](#) decomposed into alpha radiation (range less than 4 inches), beta, and gamma. Isotopes in order of measured contribution due to total soil radioactivity. Takeaway: plutonium isotopes emit almost no beta or gamma radiation and less than 5% of alpha radiation. Measured soil radioactivity of the *fallout* isotope ^{137}Cs (from atmospheric tests by France in French Polynesia and by China in extreme western China) are higher than from plutonium measured in Rocky Flats soil.

cause, and (ii) it quantifies the relationship between radiation exposure and risk. The more commonly used *excess relative risk* (ERR = relative risk - 1) is thus 0.61 per gray (the international unit of absorbed radiation dose). A 2015 report from the INWORKS consortium of nuclear worker epidemiology (8.2 million person-years of data) [3] finds the ERR per Gy for all solid cancers to be 0.47 (90% confidence interval 0.18 to 0.79).

What approximate radiation dose is needed to raise the risk of breast cancer by, say, 10%? This is 0.16 Gy (for an ERR/Gy = 0.61) or 0.21 Gy (ERR/Gy = 0.47). An average American has an annual dose due to *all* radiation of about 620 rem (=6.2 mSv). This means that for an average woman 26 to 34 to years of ordinary radiation exposure would be needed for the 10% higher risk.

What is the excess radiation dose per year due to the Pu and Am in Rocky Flats soil? It is conservatively (over-) estimated as 0.2 mrem (0.002 mSv = 2 μ Sv (for the 'Refuge worker' scenario for someone working full time within the Refuge) [4] (see also for example). This means that a female worker would need to spend 82,000 to 106,000 years in the Refuge to increase her risk of breast cancer by 10% because of Rocky Flats-specific radioisotopes.

An influential recent examination[5] concludes, in effect, that based on 40 years of experience it is so difficult and expensive to identify cancer clusters that money is better spent elsewhere. Each case (see the figure) was brought by concerned citizens and investigated by state or federal health authorities. 87.3% were not clusters; 0.5% could be traced to environmental exposure, and for 0.12% was the cause established. Given these statistics it is quite unlikely that clarity will emerge anytime soon. More precise specification of cancers based on testable hypotheses is needed. Dr. Sasha Stiles, who claimed expertise in epidemiology in her joint presentation 'Let the Doctors Speak' with Dr. Mark Johnson on November 28, 2018, must surely already know the facts in the previous three paragraphs.

In summary, we saw a (i) 2% effect from soil plutonium (on top of background soil radiation which varies by 1000 times more within Colorado) and (ii) a dose rate from Rocky Flats soil immensely smaller than background radiation. How then does the malignant influence of Rocky Flats propagate? Soil dust in air? No, 97% of soil radioactivity comes from *natural* soil radioisotopes. 'Hot particles'? No, they are few and far between and you'd need to inhale thousands anyway to raise your cancer risk by 1% (see this [document](#)). Plutonium's alpha particles have a range in air of less than two inches and cannot even penetrate skin. Beta particles or gamma rays? No, plutonium and americium emit almost none (and they are absorbed eventually in air).

Quite apart from the absence of *evidence*, there is no plausible *mechanism* for Rocky Flats in its current state to induce significant excess cancers. There are also very large odds against identifying the source of cancers. Health studies of plutonium began in earnest in 1942. Of the 1200 documents currently in my collection, none found

$$\text{ERR} = \frac{\text{excess breast cancer rate due to radiation}}{\text{breast cancer rate in unexposed population}}$$

= 0.10/0.61 or 0.10/0.47. We can flip between Gy and Sv (a unit of tissue-effective radiation dose) since for X rays and gamma rays these units coincide.

Note: Most international regulatory agencies since 2005 agree that no convincing evidence exists for health effects due to doses below about 0.1 Gy; some claim low doses are *protective* against cancers. The slow dose *rate* probably means this is a substantial overestimate for breast cancer.

The process of going from known concentrations of soil radioisotopes in a known geometry to external radiation doses is quite effectively carried out by RESRAD, the software tool used by the DOE to verify radiation compliance.

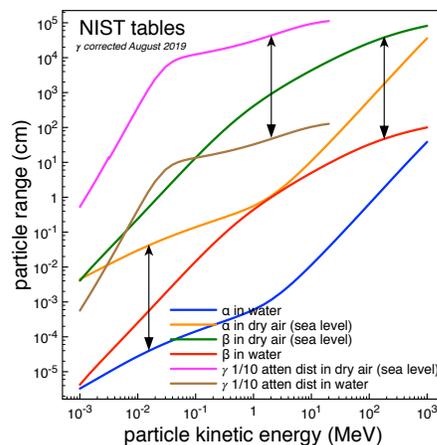
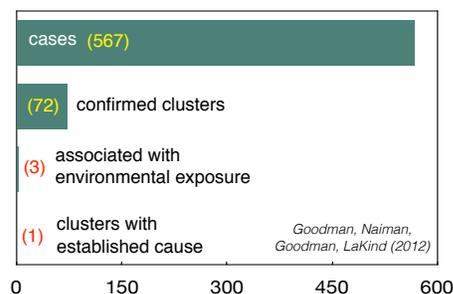


Figure 2: Range of radiation in air and water.

that plutonium (or other alpha emitters) preferentially produce rare cancers. It's worth noting that the National Institute of Health provides rare cancer information through its Genetic and Rare Diseases Information Center.

In acknowledgment of how busy the Council is, I have deferred a few more detailed or technical responses to the Appendix. I urge each Council member to scan these for specific topics of interest to them. I would be happy to meet informally to clarify questions you might have about the data shown above (and on our [web site](#)), or answer questions by email (wooddmarv@gmail.com).

Unlike public servants, I can call things as I see them without fear of political repercussions. So, finally, some personal opinions. Council members must decide whether to acquiesce to pressure from highly vocal and well-organized activist groups (with more than 40 years of practice using the media effectively) or to believe data from a (much quieter) science and medical community lacking much formal organization but with a good paper trail.

Despite absolutely sincere intentions and 30 years in which to educate themselves, the activist groups have repeatedly demonstrated an almost complete ignorance of 45 years of published literature on radiation epidemiology and radiation physics, an inability to make any quantitative estimates of outcomes, and a penchant for spreading fear about plutonium and radiation. Their spokesmen are on public record that they believe a large conspiracy to suppress information is afoot. Conspiracy theory groups are impervious to facts and will simply shift their focus to another remotely plausible Rocky Flats health risk (for burrowing critters, see our web site!) or delay-causing regulatory procedural minutiae, and enlarge the scope of those conspiring to suppress information to include (in addition to the DOE and the CDPHE) U.S. and international regulatory agencies and labs, and health physicists and epidemiologists.

There have been 40 years of protests, lawsuits about procedural (non-substantive) issues, and dire warnings of cancers never confirmed by legitimate epidemiology. The misinformation and obvious disregard for and ignorance of the scientific and medical literature continue. Once-plausible dangers ('hot particles') were carefully examined and rejected more than 40 years ago.

Maybe it's time for a different paradigm for Rocky Flats. Why not put the burden of proof on the anti-Refuge activists, where it has belonged since at least 2005?

Sincerely yours,



David M. Wood
Candelas

It should be clear from my estimates above that I regard any epidemiology on cancers around Rocky Flats as potentially useful but probably doomed to failure. A longer discussion is [here](#). (I did not want to say this on our web site for fear of discouraging efforts toward a citizen survey, but am saying it here for the sake of the City Council.)

Appendix

Here I revisit points made by ██████████ in slightly more detail.

He remarks,

- "... Why would you choose to believe Dr. Wood's opinions over the authoritative testimony of these historically giant experts in their fields? "

A reasonable question, except that I have I worked quite hard, both on our web site and in person, to *not* express opinions. My 'opinions' are in fact a representation of the general consensus of the *science* community about Rocky Flats. I urge the City Council to consult with professional health physicists, nuclear physicists or engineers, the Department of Energy, and the Colorado Department of Health and Environment if they suspect otherwise.

As those who have actually read the documents on our [web site](#) know already, I tried hard to examine only *recent* documents concerning Rocky Flats matters; the history to me was pointless because it cannot be changed and is irrelevant to those who moved into the area post-1989.

The authorities cited above did work long ago in a field that has changed hugely since the 1970s. For example: the 'hot particle' theory (related to Martell's work) has not been taken seriously since the mid-1970s. The linear no-threshold (LNT) description of radiation dose/response, while in use for statutory purposes (compliance with cleanup regulations, for example) no longer (post 2000 or so) is regarded as meaningful below doses of about 0.1 gray. In this region the LNT is happy to predict cancers where none have been observed. A longer [document](#) has links directly to journal articles.

A glimpse at Wikipedia is very useful for all three. From a current perspective, all three of these people were authoritative (in their time) and turned out to be *wrong*. One of the takeaways from these three is that the mixing of science with ideological positions (for example, a rigid anti-nuclear stance) leads to pseudo-science and fear mongering.

- If Dr. Wood were adhering to the principles of the scientific method, he would formulate and test a hypothesis to explain why this phenomenon is occurring. But he simply ignores data conflicting with his contentions. I *do* have a hypothesis, supported by evidence so far: that 'excess cancers' around Rocky Flats do not actually exist. Look at the figure on cancer clusters in the main text. Occam's Razor would suggest that *this* is the simplest explanation. I will of course concede being wrong if I see data I regard as convincing.
- Dr. Wood goes on to allege: "the fear that there are buried barrels of plutonium waste in the Refuge ... is by its very nature untestable speculation." Here again he is ignoring available data.

Dr. Edward Martell put forward in 1974 the theory that radioactive particles in cigarette smoke were responsible for lung cancer, at the same time that Tamplin and Cochran put forward the theory that radiation from 'hot particles' of plutonium were 150,000 times more carcinogenic than an equivalent uniform dose of radiation. (Disproven by 1976.)

Dr. John Gofman: "Three months after the Chernobyl disaster, Gofman predicted that Chernobyl would cause "475,000 fatal cancers plus about an equal number of additional non-fatal cases, occurring over time both inside and outside the ex-Soviet Union". In contrast, even some 19 years later in September 2005, an official UNIAEA report claimed 4,000 deaths as the final estimated toll from Chernobyl." [Wikipedia]

Karl Z. Morgan: As a [reviewer](#) (himself a radiation physicist) of his 'autobiography' (ghost written with a noted trial lawyer, "At some point in his career, however, Morgan turned to radiation phobia." "There is a good reason why Morgan could give no evidence to support the LNT model of risk; it is theoretically impossible to do so! Even the Japanese atomic bomb survivors had a threshold for the induction of leukemia of about 0.25 Gy, a dose roughly equal to 100 years' accumulation of background radiation."

There is no data; there are recorded memories of workers at Rocky Flats. **Oxford: speculation: the forming of a theory or conjecture without firm evidence.**

- Next Dr. Wood asserts that “direct calculation of predicted cancer rates given measured plutonium levels” is one of the “several ways to conclude that neither excess radiation nor inhaled hot particles are significant risks.” The fallacy in this assertion is its reliance on predicted cancer rates using the Department of Energy’s RESRAD software. The data on cancer incidence, in new downwind neighborhoods alone, clearly belies DOE’s predictions.

I placed my RESRAD remarks as the *least* convincing of the arguments that Refuge radiation levels are safe. Why did [REDACTED] not address the NIST soil standards which show that plutonium contributes less than 2% of background soil radioactivity [less than 5% of alpha activity] at Rocky Flats and my remarks that background radiation levels are invariably ignored in radiation-related cancer epidemiology? I have in several instances done calculations (for example, of cancer rates due to inhaled ‘hot particles’) which are completely independent of DOE data *or* results, only to find that my estimates agree to within reasonable margins of error with those from the DOE. I have personally checked RESRAD results for test cases (for example, the Pu levels around where I live) and found results quite consistent with what is quoted in DOE reports.

- ‘Measurement outweighs modeling’. I must have missed the *measurements* [REDACTED] presents. There *is* no data on downwind cancer rates apart from what has been published in peer reviewed journals or in CDPHE updates. There are *anecdotal* results (the words of Carol Jensen, the nurse at Metro State who ran the 2016 health survey) suggesting excess rare cancers.
- Finally Dr. Wood describes how “Kim Griffiths and I measured ambient radiation levels in the Refuge and even inside the DOE-controlled donut hole—the COU. We found the same values in both places.” Yet he admits in his own writings that he did not measure alpha radiation.

This is, as clearly stated in the documents in the section INSIDE THE REFUGE [here](#) because the SAFecast radiation monitoring network uses the usual protocol for measuring the ‘ambient dose equivalent [radiation] rate’ dictates measurement from a height of 1 meter. (The Geiger-Müller detector used most certainly *can* detect α radiation. I used a Geiger-Müller detector with an identical tube to compare background *surface* radioactivity in 2013.) The figure in the margin on p. 2 shows graphically that radioisotopes from the Rocky Flats plant contribute less than 5% of alpha radiation and almost negligibly to gamma radiation.

Methodological problems

The following maps compiled by Brittany Kelly of 70 cases of young breast cancer in the Denver metro area show significant clustering downwind of Rocky Flats.

These maps exhibit a bias (known as 'selection bias') by failing to show any data from regions *far* from RF. If you solicit survey responses downwind of RF, this is all you will get. Where is equivalent data for areas far from RF, to act as 'control' to test whether breast cancers (for example) are due to RF? ██████████ should know better than to present such 'data'.

I on the other hand have a hypothesis: that the excess cancer and rare cancer downwind of Rocky Flats is caused by contamination of the environment with plutonium or other contaminants. And that hypothesis is testable. Excised primary tumor tissue can be analyzed for Rocky Flats plutonium content. If excised primary tumors are found to contain Rocky Flats –specific plutonium by isotope ratio, those findings would constitute smoking-gun evidence of causality.

No, it does not. This procedure reflects selection bias yet again. Also, ██████████'s hypothesis already assumes that tissue RF plutonium caused the tumors, by no means a foregone conclusion.

Every Earthling has plutonium in his or her body (fallout). It would be *astounding* if the alleged victims' bodies did **not** contain RF plutonium, and at levels somewhat higher than what background would produce, if they lived around or downwind of the plant. *The fix*: If 100 tissue samples are taken of alleged Rocky Flats victims, 100 more would need to be taken of people with similar tumors who did *not* live anywhere near RF, again to serve as controls.

Also, it is in general hard to prove a connection between a tumor and a particular radiation exposure unless the tumors are *known* to be associated with plutonium exposure. Many workers at Los Alamos and Rocky Flats died of old age with sizable internal doses of plutonium.[6]

For only one or two percent of what Broomfield is spending on the Jefferson Parkway, it could fund the science necessary to test this hypothesis, for the benefit of its citizens' public health.

Why should it fall to *Broomfield* to fund this expensive project? If you firmly believe in this, you should find a way to fund it yourself.

References

- [1] John Harrison. "Carcinogenic risk from hot particle exposures -has ICRP got it right?" In: *Journal of radiological protection* 23

- (2003), p. 1. URL: <https://pdfs.semanticscholar.org/cf0f/d006ccfd4fb5f9af6bb04cbcee797aa85a05.pdf>.
- [2] S.E. Singletary. "Rating the risk factors for breast cancer." In: *Annals of Surgery* 237.4 (2003), pp. 474–482. ISSN: 0003-4932. DOI: 10.1097/01.SLA.0000059969.64262.87. URL: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1514477/pdf/20030400s00007p474.pdf>.
- [3] David B Richardson et al. "Risk of cancer from occupational exposure to ionising radiation: retrospective cohort study of workers in France, the United Kingdom, and the United States (INWORKS)". In: *Bmj* (2015), h5359. ISSN: 1756-1833. DOI: 10.1136/bmj.h5359. URL: <http://www.bmj.com/lookup/doi/10.1136/bmj.h5359>.
- [4] US Department of Energy. *Rocky Flats Environmental Technology Site Proposed Plan*. Tech. rep. 2006. URL: https://www.lm.doe.gov/land/sites/co/rocky_flats/closure/references/209-Proposed_Plan_FINAL_DOCUMENT.pdf.
- [5] Michael Goodman et al. "Cancer clusters in the USA: What do the last twenty years of state and federal investigations tell us?" In: *Critical Reviews in Toxicology* 42.6 (2012), pp. 474–490. ISSN: 1040-8444. DOI: 10.3109/10408444.2012.675315. URL: <http://www.tandfonline.com/doi/full/10.3109/10408444.2012.675315>.
- [6] George L Voelz and Ileana G Buican. *Plutonium and Health*. Tech. rep. 26. Department of Energy, Los Alamos National Laboratory, 2000. URL: <http://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-00-1613>.