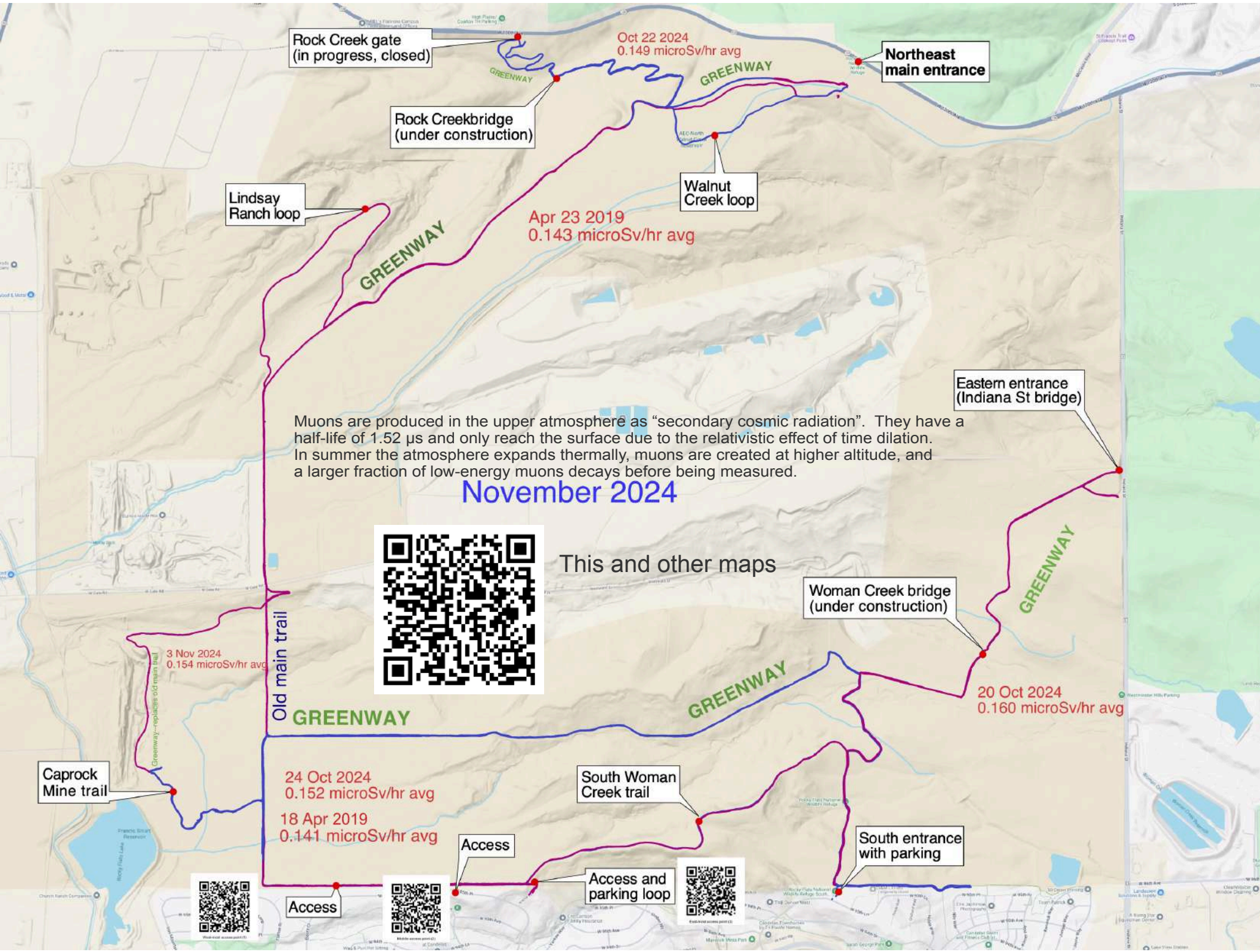

Rock Creek gate
(in progress, closed)
Oct 22 2024
0.149 microSv/hr avg
GREENWAY
GREENWAY
Northeast
main entrance
Rock Creekbridge
(under construction)
Walnut
Creek loop
Lindsay
Ranch loop
Apr 23 2019
0.143 microSv/hr avg
GREENWAY
Eastern entrance
(Indiana St bridge)
Muons are produced in the upper atmosphere as “secondary cosmic radiation”. They have a half-life of 1.52 µs and only reach the surface due to the relativistic effect of time dilation. In summer the atmosphere expands thermally, muons are created at higher altitude, and a larger fraction of low-energy muons decays before being measured.
November 2024
This and other maps
Woman Creek bridge
(under construction)
GREENWAY
3 Nov 2024
0.154 microSv/hr avg
Greenway--replaces old main trail
Old main trail
GREENWAY
GREENWAY
20 Oct 2024
0.160 microSv/hr avg
Caprock
Mine trail
24 Oct 2024
0.152 microSv/hr avg
18 Apr 2019
0.141 microSv/hr avg
South Woman
Creek trail
Access
South entrance
with parking
Access and
parking loop
Access

Distinguishing science from nonsense

No one using the Refuge or the Rocky Mountain Greenway should have any hesitation because of its history, despite what you'll see on social media or anti-nuclear websites. Three questions will help you identify conspiracy theories and misinformation. Ask Refuge opponents:

1. How much does plutonium contribute to total soil **radioactivity** as a percent? [Answer (from NIST): about 0.8%, less than the fallout isotope ^{137}Cs. In terms of alpha particle activity: about 0.6%.]
2. What is the radiation **dose** from plutonium in comparison to *background radiation*? [Answer: inhaled and swallowed dirt near the east entrance, about 1.4 μSv per year if you lived outside 24/7. Measured *background* gives about 1,230 μSv/year. (See the 'ambient dose equivalent rate' [ADER], hourly dose rates in red on the Refuge map.) Total annual dose (with unmitigated radon) living near the east entrance would be about 17,200 μSv/year.]
3. Can you cite a post-1981 scientific journal article which supports claims the Refuge poses any danger? [Answer: No. Articles in 1981 claimed elevated concer rates downwind of Rocky Flats. These claims were discredited the same year and 7 later journal articles found (i) no excess cancers and (ii) cancers found were uncorrelated with distance from Rocky Flats. Continued monitoring by the Colorado Department of Public Health and Environment confirm no excess cancers downwind.]

If they can't or don't answer these, you shouldn't believe them. Want to know more, see the details, and see what the peer-reviewed scientific literature says about Rocky Flats? Visit rockyflatsneighbors.org.

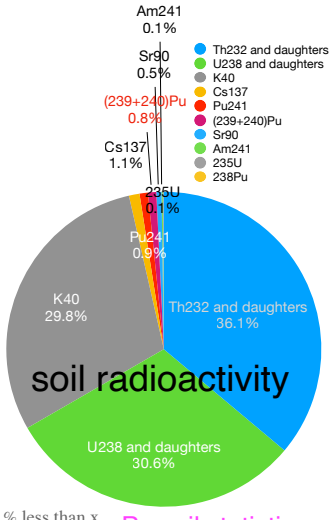
✠ D. M. Wood, B.A., physics, Princeton (1974), Ph.D, physics, Cornell (1981), wooddmarv@gmail.com
✠ Emeritus Associate Professor, Department of Physics, Colorado School of Mines, dmwood@mines.edu

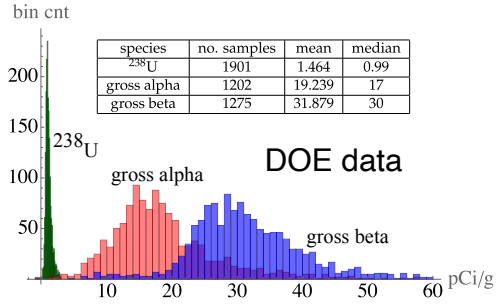
website

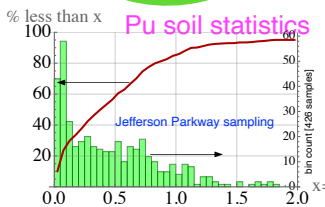
flyer/bibliography

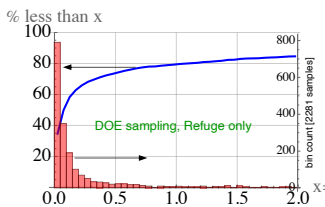
Pu radiation dose and risk

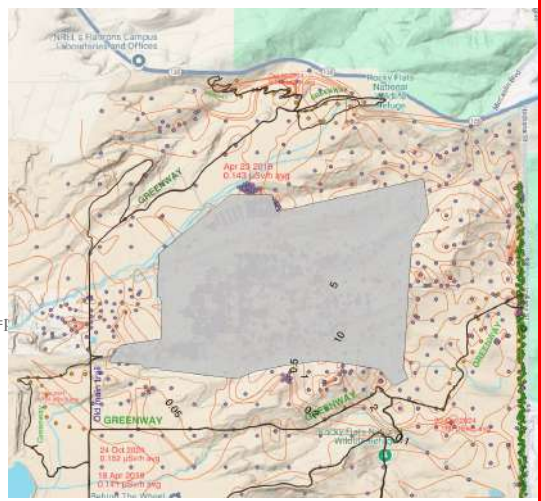
- The International Commission on Radiological Protection [ICRP, founded 1928] consists of experts from around the world. Essentially all radiation regulations in all countries stem ultimately from ICRP findings, published and updated frequently. The EPA, DOE, and other agencies all rely on carefully vetted ICRP 'dose coefficients' which relate measured radioactivity to radiation dose. These reflect the mode of exposure (inhalation, swallowing, or whole-body exposure from gamma rays), including very extensive biokinetic information. These always include a safety margin and are available for a very large number of radioactive compounds of different chemical forms. Rocky Flats worker data (graphic shown) directly impacted ICRP guidelines.
- The ICRP also maintains *risk* coefficients based on the total impact of radiation exposure, often in the form of lifetime (70-year) risk of developing cancer. These are based on often revised epidemiological studies, e.g., the INWORKS study (10.7 million person-years of followup among nuclear workers in mutliple countries).
- ICRP Publication 150 is *Cancer risk from exposure to plutonium and uranium* was published in 2021.







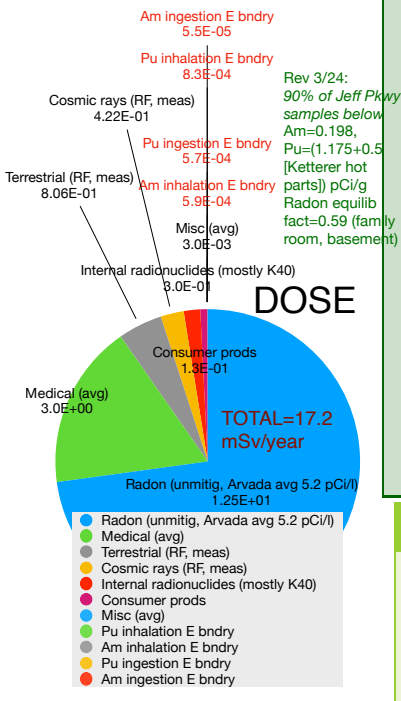




trails and very approximate contours of Pu concentration (pCi/g)

Soil plutonium and radiation

- Measured radiation levels on Rocky Flats are as expected for Front Range background. Natural radioisotopes ^{40}K (half life 1.3 billion years), ^{238}U (half life 4.5 billion years), and ^{232}Th (half life 14.2 billion years) and their 'decay daughters' account for almost all soil radiation. NIST: there is more fallout ^{137}Cs from the '60s and '70s than Pu in Rocky Flats soil.
- Pu is very similar to natural radioisotopes but emits very few gamma rays, so only exposure route is soil inhalation and ingestion.
- Over the Refuge+COU, Pu contributes less than 0.6% of soil *alpha* radioactivity. Were excess cancers due to alpha radiation found downwind (they have **not**), the 'attributable fraction' due to *natural* alpha emitters would be 99.4%
- The radiation dose from Pu (or Am) in Rocky Flats soil is **physically constrained by rarity** to be *very small*.
- More than 86% of Jefferson Parkway samples on the eastern Refuge boundary *and* 80% of DOE Refuge samples showed less than 1 pCi/g, 50 times smaller than the negotiated COU cleanup standard. Total soil radioactivity from NIST-measured standard samples and daughters is about 53.5 pCi/g [DOE: about 51.]
- Ketterer's measured hot particles (9 out of 348 samples) contribute not more than 0.5 pCi/g.



Rev 3/24:
90% of Jeff Pkwy samples below Am=0.198, Pu=(1.175+0.5 [Ketterer hot parts]) pCi/g
Radon equilib fact=0.59 (family room, basement)

spotting misinfo

Spotting pseudo-science and conspiracy theories

What are the hallmarks of misinformation and conspiracy theories? Follow the QR code at left.

- No legitimate credentials to make claims
- Claim that something's wrong with current standards
- Claim their viewpoint is being suppressed by authorities
- Reliance on long-discredited 'experts' [Carl Johnson (1981)]
- Claims of incompleteness of information about nature. (No claim can ever be supported by *lack* of information.)
- Attack the messenger, not the message.
- Cherry-pick examples out of context.
- Cite websites, social media, not peer-reviewed articles in recognized journals or using professional channels.

Takeaways

- The Refuge and Greenway are completely safe. Construction in the Refuge is safe too*
- The DOE 'Central Operable Unit' is off-limits not because of radioactivity but because monitoring stations, water control and treatment facilities should not be disturbed by the public. Remaining high levels attached to buried foundations in the COU are clearly indicated on DOE maintenance maps*

* See information, graphics, and bibliography [QR code above]

DMW, November 2024