

ROCKY FLATS PLUTONIUM: ENVIRONMENTAL EVIDENCE

Measurements and research documenting plutonium in soil, dust, sediment, water, vegetation and air around Rocky Flats.

Government records, peer-reviewed studies, independent technical sampling and documented monitoring findings.

HOW TO READ THIS

Presence of plutonium does not by itself establish a health dose or regulatory exceedance. Isotope-ratio studies are especially important because they can distinguish Rocky Flats weapons-grade plutonium from global fallout.

1969

Aug 1969 / reported Jan-Feb 1970

HIGH

Off-site environs east/downwind of Rocky Flats; water and soils | Soil / water / sediment | Colorado Committee for Environmental Information (CCEI)

Committee sampling found substantially elevated off-site plutonium; EPA's later report says the committee concluded that 'curies to tens of curies' of plutonium from Rocky Flats had been deposited off-site. A contemporaneous report entered in the Congressional Record said soil near the plant contained far more plutonium than expected.

Early independent evidence of off-site deposition and the public controversy that prompted federal follow-up.

<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=91015F6X.TXT>

1970

Feb 1970

HIGH

Up to ~3 miles from Rocky Flats boundary; strongest sectors adjacent/east of plant | Surface soil | Colorado Department of Health

EPA summarized Colorado results as plutonium above global-fallout levels at radial distances up to 3 miles; maximum topsoil concentrations in two sectors adjacent to the plant were 2.5 and 11 pCi/g.

Direct state evidence that off-site/topsoil contamination exceeded fallout background and extended miles from the plant.

<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=91015F6X.TXT>

1970

Feb 25-26, 1970

HIGH

Walnut Creek, Woman Creek/Indiana Street, Great Western Reservoir, nearby lakes | Soil / water / sediment | U.S. EPA predecessor Water Quality Office / Public Health Service laboratory

Federal sampling documented plutonium in stream/reservoir sediments and soil. The EPA report states contamination in Walnut Creek sediments and Woman Creek at Indiana Street was probably caused by wind transport and/or surface runoff of plutonium-contaminated soil.

Direct federal documentation of transport from contaminated soil into off-site drainage pathways, including Indiana Street.

<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=91015F6X.TXT>

1970

Sep 21-25, 1970

HIGH

Walnut Creek at Indiana Street; Great Western Reservoir; Standley Lake | Water / bottom sediment / soil / biota | U.S. EPA

Walnut Creek sediment measured 0.60 pCi/g at Indiana Street; nearly the entire bed of Great Western Reservoir contained plutonium above the estimated sediment baseline of <0.10 pCi/g, with ~1.0 pCi/g near the inlet. Limited deep-water Standley Lake sampling indicated possible sectors attributable to plant emissions.

Shows off-site contamination in a public water-supply reservoir and transport down Walnut Creek.

<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=94002SQF.TXT>

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1971

Study begun late 1971; later published

MEDIUM-HIGH

Rocky Flats soils, especially east of 903 Pad | Soil | C.A. Little and collaborators / Rocky Flats ecological research
Study examined concentrations, location, depth and particle association after off-site contamination had been detected. Later summaries identify soil as the dominant ecosystem compartment for retained plutonium and potential transport.

Documents persistence and spatial structure of plutonium contamination in soil after the major releases.

<https://lmpublicsearch.lm.doe.gov/SiteDocs/SW-A-004619.PDF>

1973

Oct 1973 sampling; baseline reservoirs Apr 1974; report Feb 1975

HIGH

Great Western Reservoir, Standley Lake, Cherry Creek, Marston, Ralston | Bottom sediment | U.S. EPA Region VIII
EPA found baseline Pu-239 in comparison-reservoir sediments ≤ 0.10 pCi/g. Great Western Reservoir sediment was contaminated throughout, with surface-layer maxima ~ 4.0 pCi/g ($\sim 40\times$ baseline), and contaminated sediment thickness ≥ 5 cm at most stations.

Strong federal measurement of persistent plutonium accumulation in the principal downstream reservoir.

<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=94009X2A.txt>

1976

Feb 1976

HIGH

Denver-area soils surrounding Rocky Flats | Soil | Philip W. Krey, Health Physics

Rocky Flats-derived plutonium could be identified at deposition levels as low as 0.2 mCi/km² (about 10% of global fallout). Integrated estimates indicated 3.4 ± 0.9 Ci of Pu-239+240 from Rocky Flats deposited on public and private land.

Quantified the regional inventory of Rocky Flats plutonium beyond the plant and used isotopes to distinguish it from fallout.

<https://pubmed.ncbi.nlm.nih.gov/1245421/>

1976

Aug 6, 1976

HIGH

Off-site soils downwind from Rocky Flats | Respirable surface dust / fine soil fraction ≤ 5 micrometers | C.J. Johnson, R.R. Tidball, R.C. Severson; Science

Pu-239 concentration in the respirable fraction of off-site surface soils downwind of Rocky Flats was as much as 380 times background.

Especially relevant to inhalation: demonstrated enrichment of plutonium in particles small enough to become airborne and be respirable.

<https://pubmed.ncbi.nlm.nih.gov/941018/>

1980

1980 publication

HIGH

Lake downwind of Rocky Flats | Lake sediment core | E.P. Hardy, H.L. Volchok, H.D. Livingston, J.C. Burke

A downwind lake core showed a peak in transuranic concentrations in late 1969 attributable to the plant; mass isotopic analysis differentiated plant plutonium from global fallout. Estimated plant-derived accumulation was 18 nCi Pu-239+240/m² in sediment.

Independent time-stratigraphic confirmation of an off-site Rocky Flats deposition pulse around the 1969 period.

<https://www.sciencedirect.com/science/article/abs/pii/0160412080900902>

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1982

Feb 1982 publication

HIGH

Rocky Flats grassland | Vegetation / attached soil | W.J. Arthur III, A.W. Alldredge

Mean Pu in washed grass, forb and shrub samples was 1.12, 0.61 and 0.03 pCi/g; an earlier unwashed-vegetation study in the same area averaged 28.6 pCi/g. Authors concluded plutonium on vegetation was primarily due to attached contaminated soil.

Shows a mechanism by which contaminated surface soil adheres to vegetation and can move through the ecosystem.

<https://www.sciencedirect.com/science/article/abs/pii/0098847282900065>

1982

1982 report

MEDIUM

Six locations west of Indiana Street along eastern Rocky Flats boundary | Soil | C.T. Illsley / Rocky Flats monitoring program

Soils were collected over three years at six locations to monitor plutonium migration and compare with proposed EPA transuranic guidance.

Documents continued formal monitoring of the eastern boundary where historical plutonium concentrations were greatest.

<https://digital.library.unt.edu/ark:/67531/metadc1114362/>

1991

Nov 1991 sampling; 1994 publication

HIGH

Well 1587 at Rocky Flats | Groundwater / particulates / colloids | U.S. Geological Survey

In a 60-L well-water sample, 65% of Pu-239+240 activity was associated with particulate and largest colloidal fractions (22% particulate, 43% colloidal).

Demonstrated that plutonium was present in groundwater-associated material and that particles/colloids can be important transport phases.

<https://www.usgs.gov/publications/particulate-colloidal-and-dissolved-phase-associations-plutonium-and-americiu-a-water>

1992

1992-1994 sampling; Jan 1997 publication

HIGH

Transects east/northeast/southeast of Rocky Flats, reaching ~19 km | Soil | S.A. Ibrahim, S.B. Webb, F.W. Whicker, Colorado State University

Pu-239+240 ranged from 1.1 Bq/kg off-site to 57 Bq/kg on-site. Isotope ratios indicated a measurable Rocky Flats contribution may extend >=19 km east; at off-site locations, estimated Rocky Flats contribution to total plutonium ranged from 24% to 90%.

One of the strongest isotope-fingerprint studies showing Rocky Flats-derived plutonium well into surrounding communities/open lands.

<https://pubmed.ncbi.nlm.nih.gov/8972825/>

1992

1992 RFI/RI data summarized in 1997 EPA ROD

HIGH

Great Western Reservoir, Standley Lake, Mower Reservoir | Subsurface sediment | EPA / DOE remedial investigation

EPA's OU3 Record of Decision reports subsurface Pu maxima of 4.3 pCi/g in Great Western Reservoir (~18 in depth), 0.38 pCi/g in Standley Lake (~18 in), and 1.11 pCi/g in Mower Reservoir (~6 in). It identifies waterborne transport to Great Western and aeolian transport as significant for Mower and Standley.

Federal remedial record explicitly links measured reservoir contamination to Rocky Flats transport pathways.

<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=9100MW8M.TXT>

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1993

1993-1995 monitoring; 1998 publication

HIGH

Contaminated Rocky Flats soil toposequence | Soil interstitial water / suspended particles | M.I. Litaor and collaborators
Pu-239+240 and Am-241 were largely retained in semi-arid soils under normal conditions, but extreme simulated rainfall occasionally remobilized fluxes equal to 1-3.3% of stored Pu/Am. About 83-97% of radionuclides in soil water were associated with suspended particles.

Shows that stored soil plutonium is not perfectly immobile and can be particle-mobilized during extreme hydrologic events.

<https://www.sciencedirect.com/science/article/pii/S0265931X97000192>

1994

1994 citizen field sampling; 2004 publication

HIGH

28 minimally disturbed locations around Rocky Flats | Soil | Citizens Environmental Sampling Committee; later peer-reviewed

More than 60 surface/core samples were collected. Elevated Pu-239+240 was found immediately east of the plant, falling with distance toward fallout background; south, west and north samples were generally background. Results were consistent with DOE/CDPHE historical sampling.

Independent community-designed study reproduced the eastward contamination pattern seen in government data.

<https://pubmed.ncbi.nlm.nih.gov/15172724/>

1994

Summer 1994; May 1996 publication

HIGH

Denver-area background-soil sites | Soil | Rocky Flats Background Soils Characterization Program / peer-reviewed analysis

Background soils showed a predictable Cs-137/Pu relationship consistent with worldwide fallout. Authors noted deviations from this relationship can indicate plutonium from a non-fallout source.

Provides the scientific baseline used by later Rocky Flats studies to distinguish weapons-plant plutonium from global fallout.

<https://www.sciencedirect.com/science/article/pii/S0045653596001087>

1995

Dec 1995 publication; incorporates 1969-1994 datasets

HIGH

Rocky Flats and surrounding soils | Surface soil | M.I. Litaor, D. Ellerbroek, L. Allen, E. Dovala

An exhaustive compiled dataset reported Pu-239+240 activities from 0.03 to 407,000 Bq/kg (mean 1,443; median 6.6 Bq/kg), with historical and contemporary sampling used to model spatial contamination around Rocky Flats.

Major synthesis documenting extreme spatial variability and the broad historical footprint of contaminated soil.

<https://pubmed.ncbi.nlm.nih.gov/7493808/>

1996

Oct 1996 publication

HIGH

Off-site areas beyond plant property, east/downwind | Airborne release/deposition reconstruction | Colorado Department of Public Health-sponsored study; T.R. Mongan et al.

Best estimate of Pu release from the 903 Pad to areas beyond plant-owned property was ~0.26 TBq (7 Ci), with off-site airborne concentrations and deposition modeled from 1960s-1970s environmental data.

State-sponsored reconstruction quantified a substantial historical off-site plutonium release from contaminated soil/oil at the 903 Pad.

<https://pubmed.ncbi.nlm.nih.gov/8830753/>

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1997

Aug 1997 publication; sampling 1992-1994

HIGH

Four transects from 903 Pad out to ~19 km | Soil profiles (0-21 cm) | S.B. Webb, S.A. Ibrahim, F.W. Whicker
Pu concentration decreased with depth, distance and angle away from due east. The model used ~1,400 independent measurements; soil profiles confirmed the strongest plume geometry east of the 903 Pad.

Large dataset that quantifies the directional plume and vertical concentration of plutonium in surface soil.

<https://pubmed.ncbi.nlm.nih.gov/9228169/>

1998

Feb 1998 publication

HIGH

Rocky Flats macroporous soils | Soil water / particles | M.I. Litaor et al.; Environmental Science & Technology
Researchers monitored plutonium activities in water moving through soil during rainfall simulations and found rapid macropore flow and particle-associated mobilization.

Mechanistic evidence that particle movement can carry plutonium through the vadose zone during flow events.

<https://pubs.acs.org/doi/10.1021/es970339u>

1999

Feb 1999

HIGH

~120 km² east of Rocky Flats including open space/residential areas | Soil | M.I. Litaor, Health Physics
The ~120 km² study area east of the plant showed Pu isotope ratios identified as a definitive indicator of Rocky Flats-derived plutonium. Estimated plutonium loading on open-space and residential areas was 111.2 GBq (SE 50.8 GBq).

Direct peer-reviewed conclusion that Rocky Flats-derived plutonium was present across open space and residential soils east of the plant.

<https://pubmed.ncbi.nlm.nih.gov/9929128/>

2015

Reported in 2016 feature; sampling conducted prior

MEDIUM-HIGH

Indiana Street corridor east of Rocky Flats | Soil | Michael E. Ketterer
Ketterer reported plutonium levels near Rocky Flats, including Indiana Street, elevated compared with other continental U.S. locations he sampled, with isotope evidence tying it to Rocky Flats rather than global fallout.

Modern independent confirmation of elevated Rocky Flats-source plutonium along the eastern corridor.

<https://5280.com/rogue-agent/>

2019

Aug 2019 preliminary result; final program Dec 2019

HIGH

Jefferson Parkway right-of-way / Indiana Street east of Refuge | Soil | Jefferson Parkway Public Highway Authority sampling; analyzed by contracted labs; reviewed by CDPHE
One sample measured 264 pCi/g Pu, later attributed to an approximately 8.8-micrometer PuO₂ 'hot particle.' Most of the roughly 450+ samples were far lower; the single result nevertheless directly demonstrated a discrete high-activity plutonium particle in the corridor.

Important modern proof that discrete plutonium dioxide particles persist in soil east of Rocky Flats and can evade interpretation based only on average concentrations.

<https://rockyflatsneighbors.org/wp-content/uploads/SummEnd2019.pdf>

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2019

Summer 2019

HIGH

Jefferson County right-of-way immediately west of Indiana Street near former east gate | Surface soil composites | Michael E. Ketterer & collaborators / Hansen-Roddenberry project

All Rocky Flats composite samples had readily detectable Pu-239+240. Surface composites were considerably above Colorado fallout background, and Pu-240/Pu-239 ratios showed a weapons-grade signature; report concluded essentially all measured plutonium activity in those soils originated from Rocky Flats.

Direct isotope fingerprint linking present-day Indiana Street corridor soils to Rocky Flats weapons-grade plutonium.

<https://rockyflatsdownwinders.com/rocky-flats-hemp-phytoremediation-project/activities-of-239240pu-and-pu-atom-ratios-in-hemp-study-soils/>

2020

Apr 1, 2020 report

HIGH

Indiana Street west-side right-of-way and Westminster open space east of Indiana Street | Fine surface soil fractions / micro-portions | Michael E. Ketterer & Scott C. Szechenyi, Northern Arizona University

Across nine composite soils, researchers found a consistent baseline plus specific ~200 mg portions with elevated Pu-239, interpreted as individual plutonium-dioxide hot particles. The work expanded on 2019 findings and older Westminster soils (2000-2002).

Evidence that hot particles were not limited to the single 264 pCi/g 2019 sample but could be detected repeatedly in multiple composite soils.

<https://www.psrcolorado.org/news/apr-1-2020-soil-contamination-plutonium-update>

2020

Jul-Aug 2020 review

HIGH

Jefferson Parkway corridor, Refuge and east of Refuge | Soil | CDPHE review / Colorado State University summary / DOE Legacy Management communication

State review acknowledged measurable remaining Rocky Flats plutonium, including the anomalous hot-particle sample, but concluded remaining plutonium in the transportation corridor/off-site posed a small risk within regulatory limits.

Useful because it confirms the measurements while providing the official risk interpretation—important context for credible advocacy.

<https://www.energy.gov/lm/articles/soil-sample-plutonium-results-near-rocky-flats-site-summarized-state-regulators>

2024

Apr 6, 2024 sampling; results public May-Jul 2024

HIGH

Former East Gate and Southeast Gate along Indiana Street; CO-128/Rock Creek underpass | Airborne dust on high-volume air filters | Michael E. Ketterer & Jon S. Lipsky; analysis at Northern Arizona University

During extreme west winds and visible dust movement, plutonium was unequivocally detected in both Indiana Street air filters and in all six individual ash preparations from those two filters. Media reporting gave soil-equivalent Pu values of ~0.15 to 1.19 pCi/g for the collected dust/ash preparations.

Direct modern evidence that Rocky Flats-signature contaminated dust can become airborne and cross toward Indiana Street during a high-wind event.

<https://www.rockyflatsnuclearguardianship.org/single-post/detection-of-airborne-plutonium-from-rocky-flats-in-air-filters-collected-along-indiana-street-under>