

DOH Pre and Post Mining Program



Program Header

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Phosphate Mining

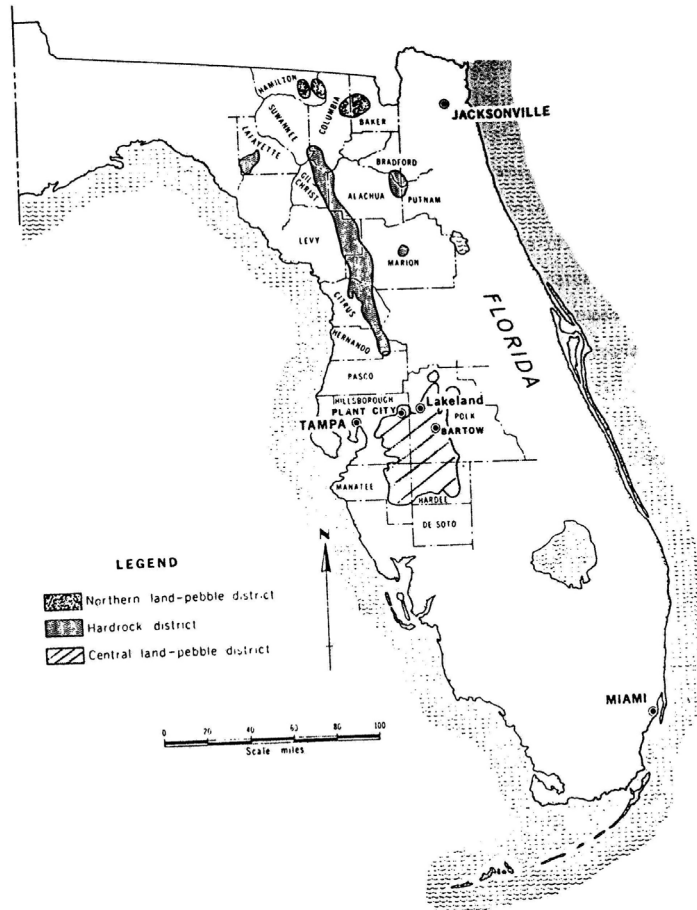


Figure 1. Phosphate deposits in Florida. (WA 74)



Figure 1.2 Phosphate Mining Activities

Reclamation



DOH Monitoring Program

1975 - United States Environmental Protection Agency (USEPA) issued a report which indicated that indoor radon decay product levels were elevated in some structures built on reclaimed phosphate land in Florida when compared with structures built on unmined land.

1978 - Department of Health and Rehabilitative Services (now Department of Health) issued the results of a study of the indoor radon gas and gamma radiation levels in houses located in phosphate mining areas (Yellow Book); this report confirmed the earlier results

1979 - USEPA released a report in 1979 which showed the potential for increased risk of lung cancer for people living in houses built on reclaimed phosphate land (Red Book)

TECHNICAL NOTE
ORP/CSD-75-4

PRELIMINARY FINDINGS
RADON DAUGHTER LEVELS IN
STRUCTURES CONSTRUCTED ON
RECLAIMED FLORIDA
PHOSPHATE LAND



THE UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RADIATION PROGRAMS

SEPTEMBER 1975

*Study of Radon Daughter
Concentrations in Structures in
Polk and Hillsborough Counties*



Department of Health and
Rehabilitative Services
Central Operations Services
Radiological Health Services
January 1978



United States
Environmental Protection
Agency

Office of
Radiation Programs
Washington, DC

February 1979
EPA 520/4-78-013

Indoor Radiation Exposure
Due To Radium-226 In
Florida Phosphate Lands



DOH Monitoring Program

Accordingly, Governor Bob Graham directed HRS to appoint a phosphate-related radiation task force.

Committee members were asked to recommend policies addressing the issue of health risks to people living on phosphate mined land.

One of the recommendations of this task force was that additional monitoring be conducted of the effect of mining and subsequent reclamation activities on the land's radiation levels.

Section 404.131, Florida Statutes, which became effective in 1984, authorized HRS to conduct surveillance of industries extracting minerals from soils in the state.

The primary objectives of this monitoring program are to determine the extent of change to the radiological characteristics of Florida lands and water caused by mining, and to identify these lands for further study or recommendations

Program Design

Collect ambient gamma, soil radium-226, soil radon before land is mined

Collect water at consistent locations each quarter, analyzed for four NORM analytes; sample for radon and ambient gamma with alpha tracks and TLDs

Collect ambient gamma, soil radium-226, soil radon after land is reclaimed.

Program is a macro sampling design, one average ambient gamma over one acre, one soil radium-226 hole per 20 acres.

Soil radium-226 at 1 foot intervals down to six feet

DOH Monitoring Program

July 1986 – Program Starts

Current – Now in 37th Year

>191,000 Ambient Gamma Measurements

>9,500 Soil Radium 226

>4,300 Water Samples Collected

DOH Monitoring Equipment

Ambient gamma surveys are conducted with Thermo Scientific RadEye PRD-handheld calibrated sodium iodide microR meter. The detector is held one meter above the ground and gives the exposure rate in microroentgens per hour. The RadEye compensates for radionuclide energy. Non-energy compensated instruments will over respond to low energy radionuclides, including many naturally occurring radioactive materials.

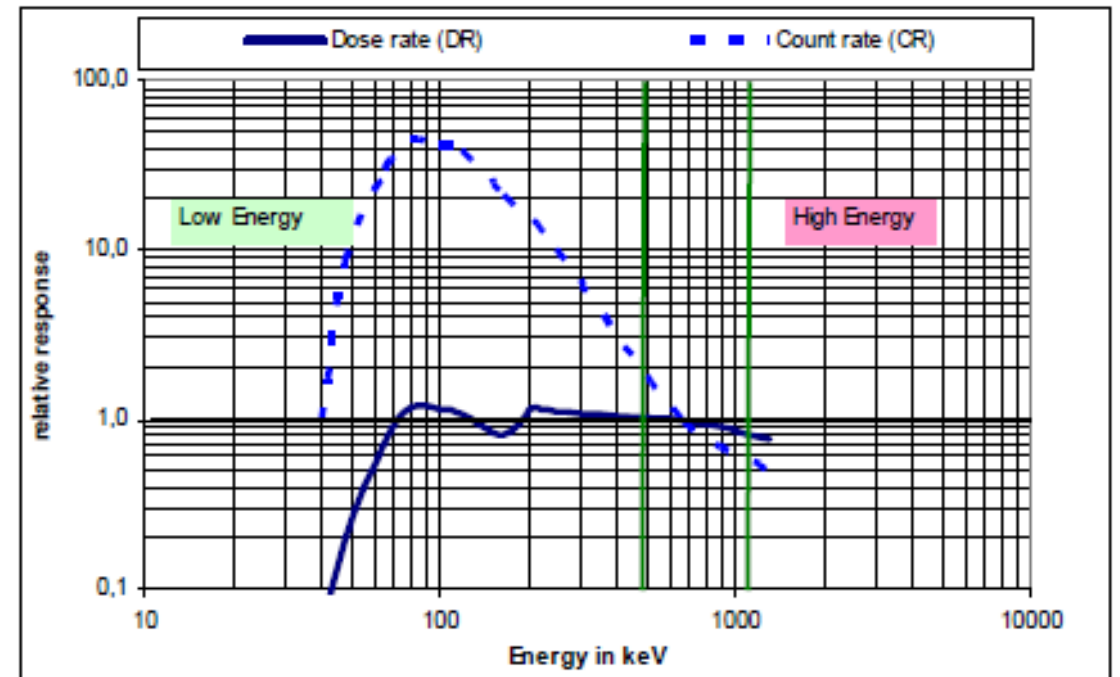
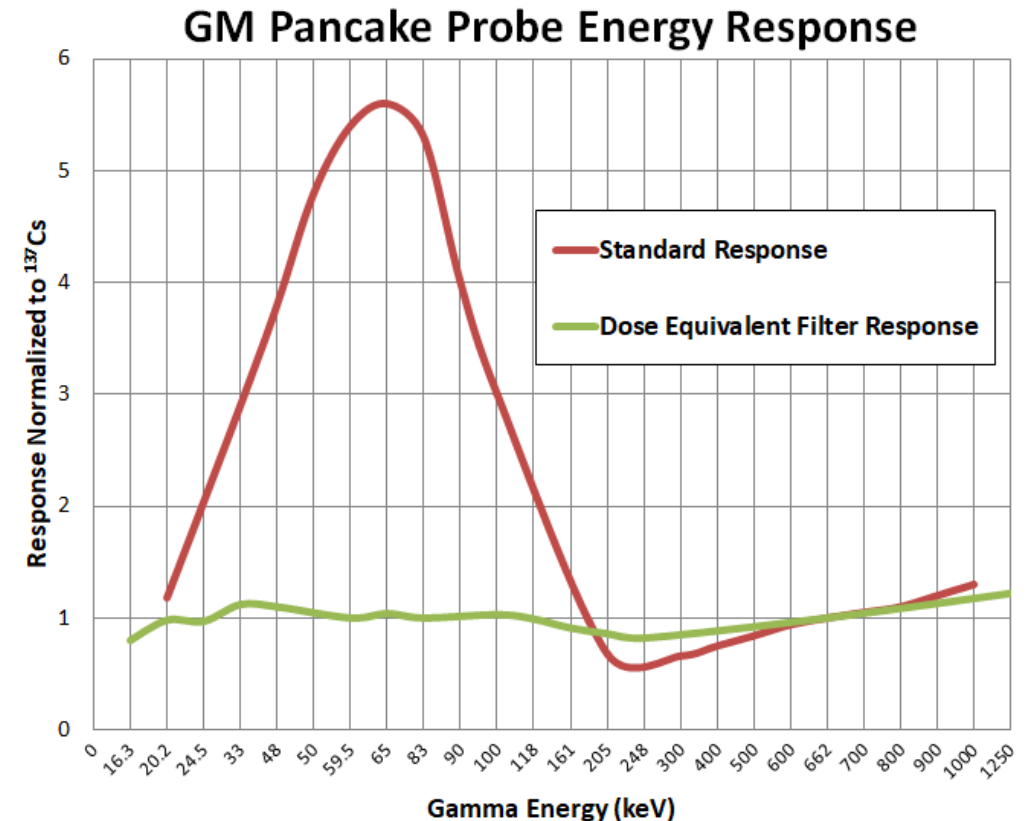


Diagram 8-3: Energy dependence in direction of max. response, perpendicular to ref. mark

DOH Monitoring Program

Radiation readings are recorded for gamma dose rate only, as this is penetrating radiation.

Open window instruments do not accurately report dose, and count rate is not directly convertible to dose.



Soil Ra-226 Lab Analysis

Soil is dried and sealed in an aluminum can for ingrowth. Soils are counted for radium-226 using NaI(Tl) detectors with Canberra Genie PC analysis software.

The NaI(Tl) detectors are energy calibrated before use by a cobalt-60 and cesium-137 mixed gamma source. The 240 milliliter cans of soil samples, which have reached equilibrium after 30 days, are counted for 30 minutes.

Efficiency calibration is completed using NIST traceable standards.

General* Results

Prior to mining, median ambient gamma measurement on land is generally similar to other lands in Florida (average of sites is 5.6 $\mu\text{R/hr}$)

Post mining (a very general observation), median ambient gamma measurement is higher on reclaimed land than on pre mined land.

The median radium-226 concentration is 3-20 times higher on reclaimed land than on pre mined land, depending on depth.

This cannot be applied to a specific area unless measurements are taken of that specific area, due to the macro scale of the PPM program.

Program also does not account for any post reclamation modification of land during construction process.

Florida has low Background radiation levels

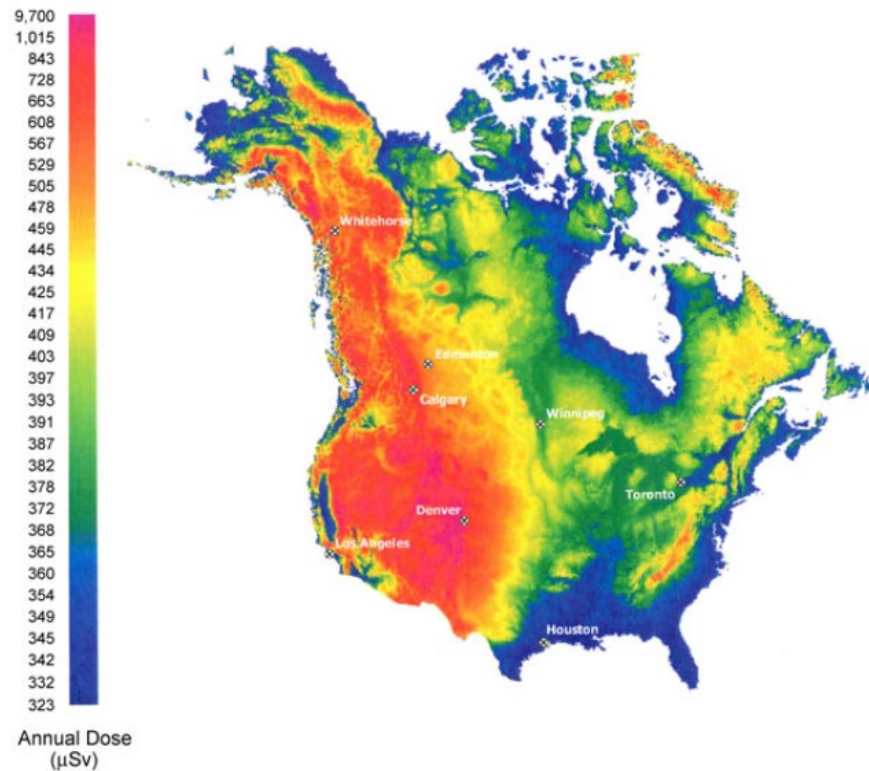


Fig. 3.4. False-color plot of CARI-6 calculations of annual cosmic radiation doses (microsievert) in North America (Grasty and LaMarre, 2004).

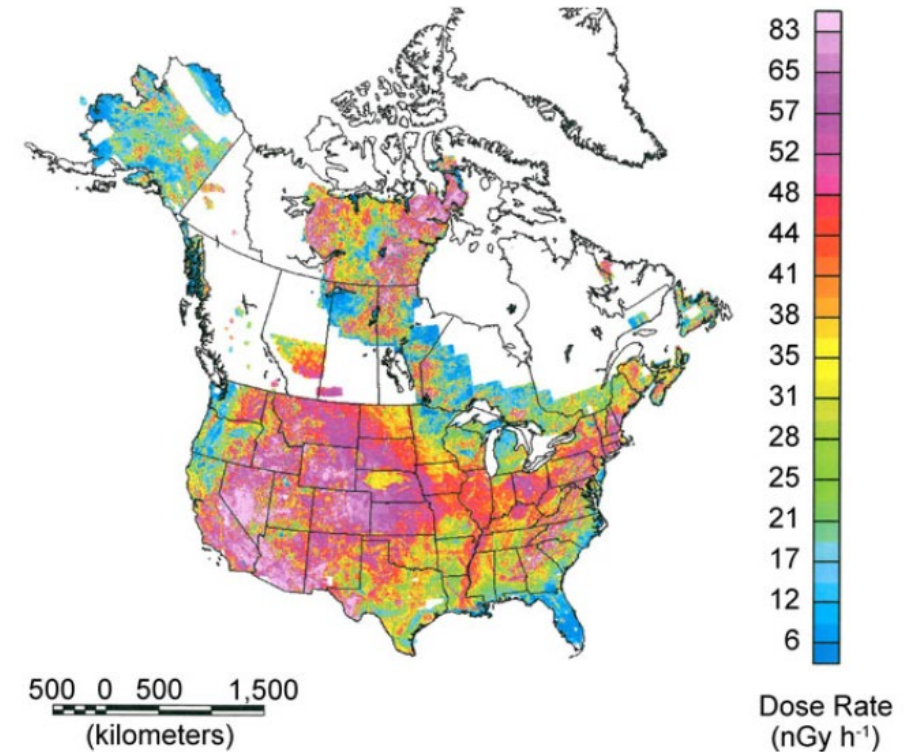
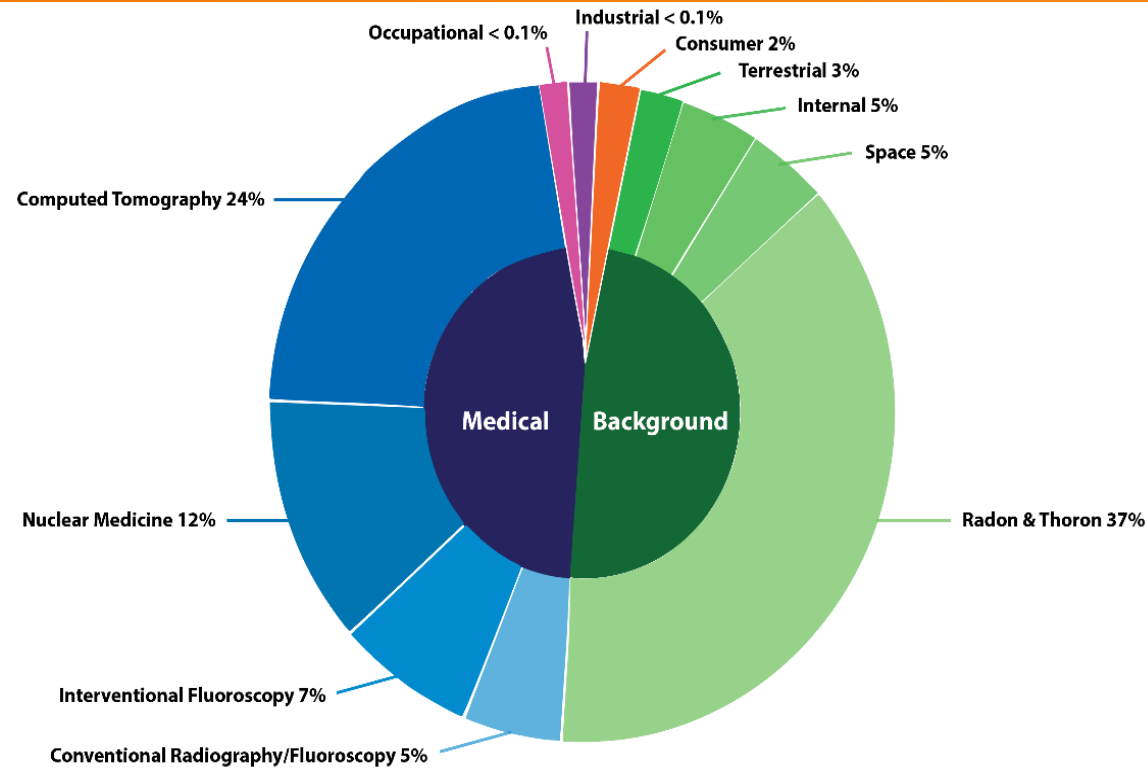


Fig. 3.9. Plot of gamma-ray absorbed-dose rate in air from USGS data, with blue being the lowest (<6 nGy h⁻¹) and lavender the highest (>83 nGy h⁻¹) (Duval *et al.*, 2005).

Sources of Radiation Dose

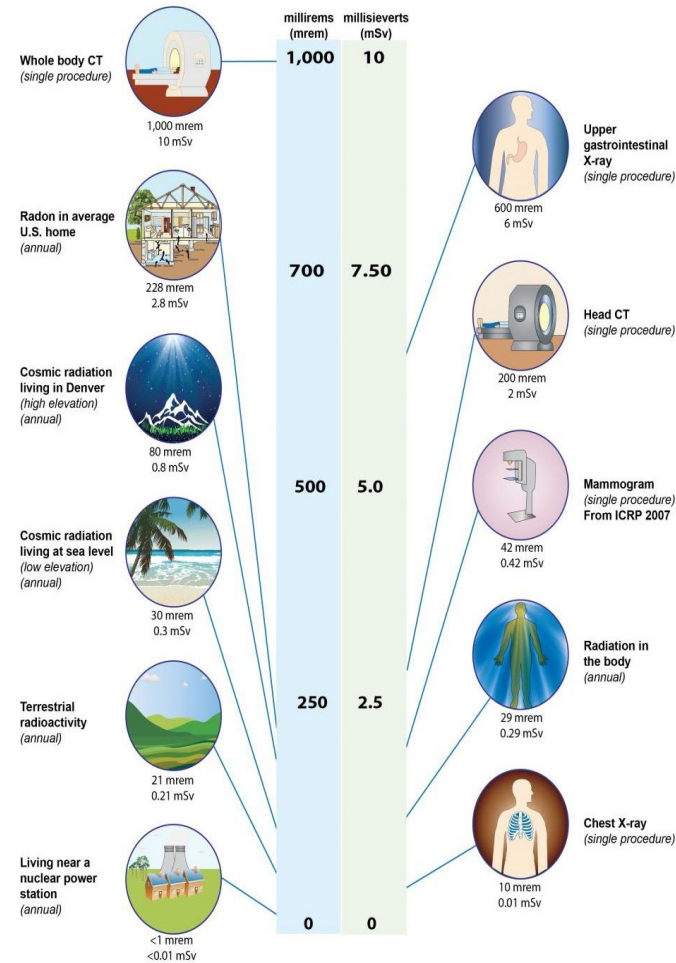


Average Annual Radiation Dose											
Sources	Radon & Thoron	Computed Tomography	Nuclear Medicine	Interventional Fluoroscopy	Space	Conventional Radiography/Fluoroscopy	Internal	Terrestrial	Consumer	Occupational	Industrial
Units											
mrem (United States)	228 mrem	147 mrem	77 mrem	43 mrem	33 mrem	33 mrem	29 mrem	21 mrem	13 mrem	0.5 mrem	0.3 mrem
mSv (International)	2.28 mSv	1.47 mSv	0.77 mSv	0.43 mSv	0.33 mSv	0.33 mSv	0.29 mSv	0.21 mSv	0.13 mSv	0.005 mSv	0.003 mSv

(Source: National Council on Radiation Protection & Measurements, Report No. 160)

Relative Radiation Doses

All doses from the National Council on Radiation Protection & Measurements, Report No. 160 (unless otherwise denoted)



Questions?

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