



Project Summary

Soil and Fill Laboratory Support —1991, Florida Radon Research Program

C.E. Roessler, Ryan Richards, Ha Nguyen, D.L. Smith, and C. Vonada

This report presents the results of soil analysis laboratory work by the University of Florida in support of the Florida Radon Research Program (FRRP). Analyses were performed on soil and fill samples collected during 1991 by the FRRP Research House program and the New House Evaluation Program (NHEP). Work included textural classification, and particle size, moisture, radium-226, and emanation coefficient determinations.

During this period, 124 samples representing 45 sites were submitted. For North Florida sites (Gainesville vicinity), radium-226 concentrations were, in all but two sites, <1 pCi/g. At one site, moderately elevated radioactivity fill (3 pCi/g) was found over low activity (<1 pCi/g) surficial substrate. At another site, the near-surface substrate was moderately elevated in radioactivity (5 pCi/g), but the associated fill sample was of low radioactivity. Central Florida sites (Polk County) were characterized by predominantly moderately elevated (1-10 pCi/g) or elevated (>10 pCi/g) fill over either low activity or moderately elevated substrate.

This work resulted in the following conclusions:

1. The observations for North Florida support earlier conclusions (1989 and 1990 studies) that a large proportion of the fill actually used in Florida construction is of a low radium content.
2. Elevated radium concentrations do occur in some soil and fill samples in actual house construction.

3. Fill with elevated radioactivity can be an issue in selected circumstances (such as the Central Florida NHEP sites).
4. Mining-related lands (such as reclaimed overburden and/or sand tailings areas) may present a radon source.
5. Other, related studies indicate that, at some locations, the source of near-surface soil gas radon may be zones of elevated radium occurring at depths greater than being sampled for the NHEP.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

This report gives results of laboratory analyses of soils performed by the University of Florida in support of the Florida Radon Research Program (FRRP). Physical and radiological characteristics were determined on samples collected during 1991 by the Research House Program and the New House Evaluation Program (NHEP) of the FRRP.

This work is a continuation of efforts to characterize the radon* source potential and the permeability characteristics of Florida soil and fill materials. In 1989, a survey of

* In this summary, "radon" is used to designate the radon isotope, radon-222. "Radium" is used to denote the radium isotope, radium-226.

35 sites gave results of analyses of statewide fill materials at construction sites (66.7%) and native surficial soil at construction or existing house sites (33.3%). In addition, in-situ permeability and soil gas radon were measured at a sub-set of these sites. Work in 1990 emphasized in-situ permeability and soil gas radon measurement and soil sampling at 23 statewide sites as prepared for construction. (See Figures 1, 2, and 3.)

In 1991, the research contractors for the NHEP program submitted samples collected at construction sites in areas of suspected elevated radon potential in North Florida (Alachua County) and Central Florida (primarily Polk County). Samples were also received from the Alachua County and Polk County FRRP Research House sites.

Methodology

Samples were collected to represent both the sub-slab fill material and the upper layer (<1 m) of the underlying substrate. Laboratory work included textural classification, particle size measurements, moisture determination, and radium and radon emanation coefficient analyses. Samples were subjected to classification by texture and appearance, determination of size distributions by sieve analysis, and classification by sedimentation analysis (hydrometer analysis). For radiological analysis of soil samples, dried portions were sealed in a container, counted with a high resolution gamma-ray spectrometry system shortly after sealing, held for ingrowth of radon and its short-lived decay products, and counted at least one more time. Radium concentrations and radon emanation

coefficient were calculated from the activity associated with the 295.21, 351.92 and 609.31-keV peaks of the short-lived radon daughters. The radium concentration was based on the projected equilibrium radon-222 activity; radon emanation coefficient was determined from the pair of values corresponding to pre-ingrowth and equilibrium radon concentrations.

Results and Discussion

A total of 124 samples were received as summarized in Table 1.

Geological Nature of the Samples

Within Alachua County (North Florida), three major geological units prevail as surficial lithologies. In certain portions of the county, particularly in the western half,

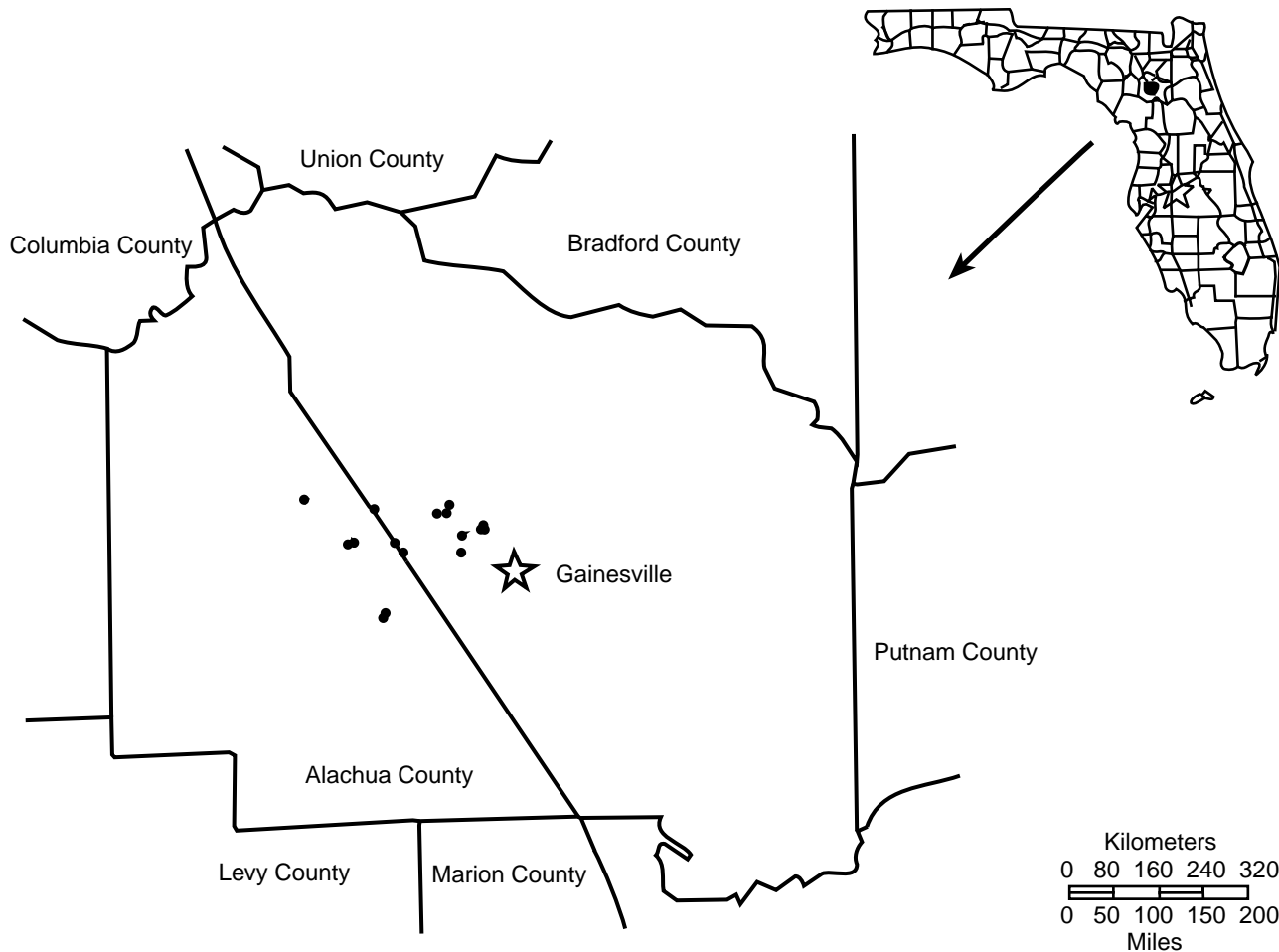


Figure 1. Sampling locations - North Florida.

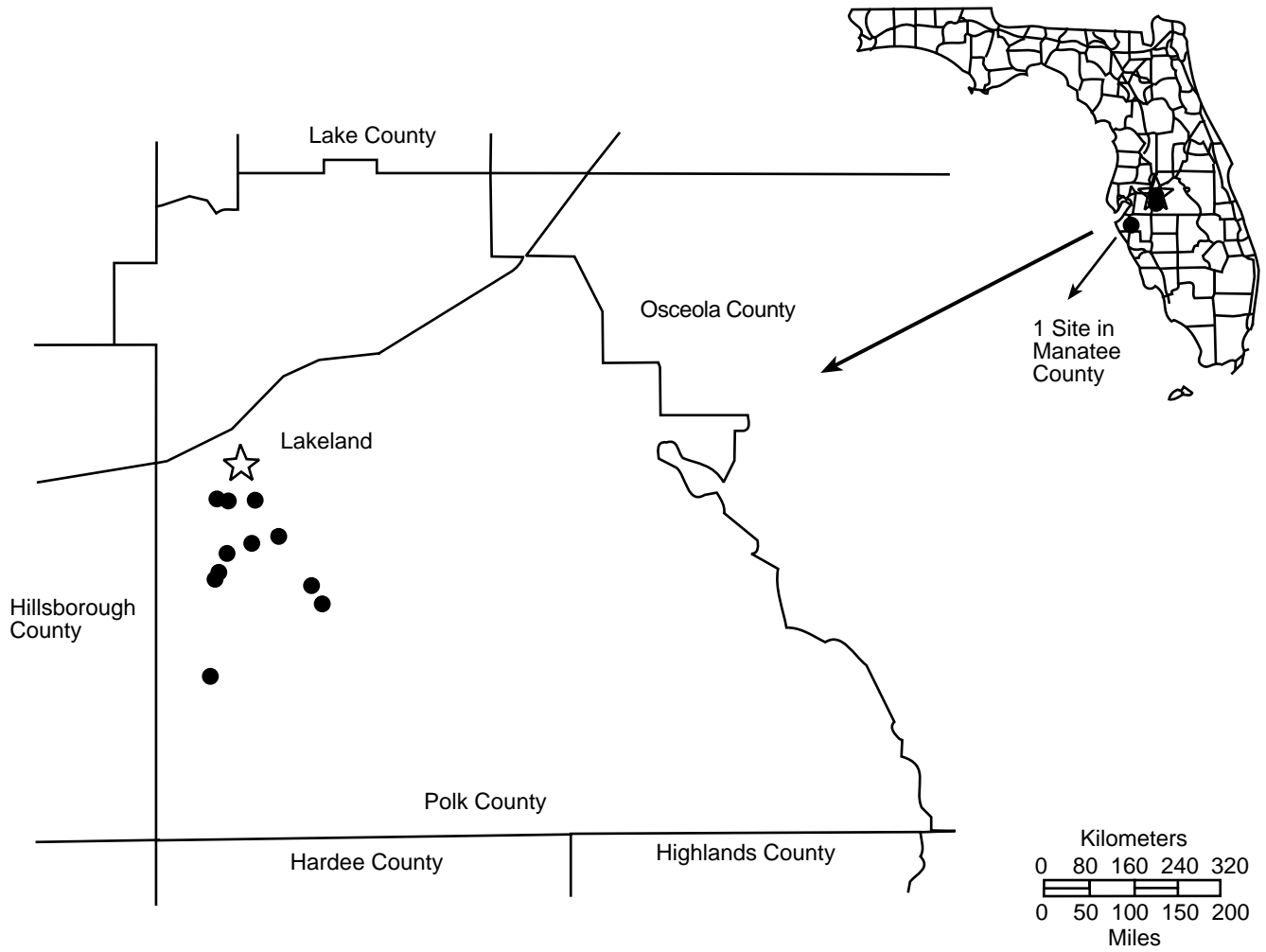


Figure 2. *Sampling locations - Central Florida.*

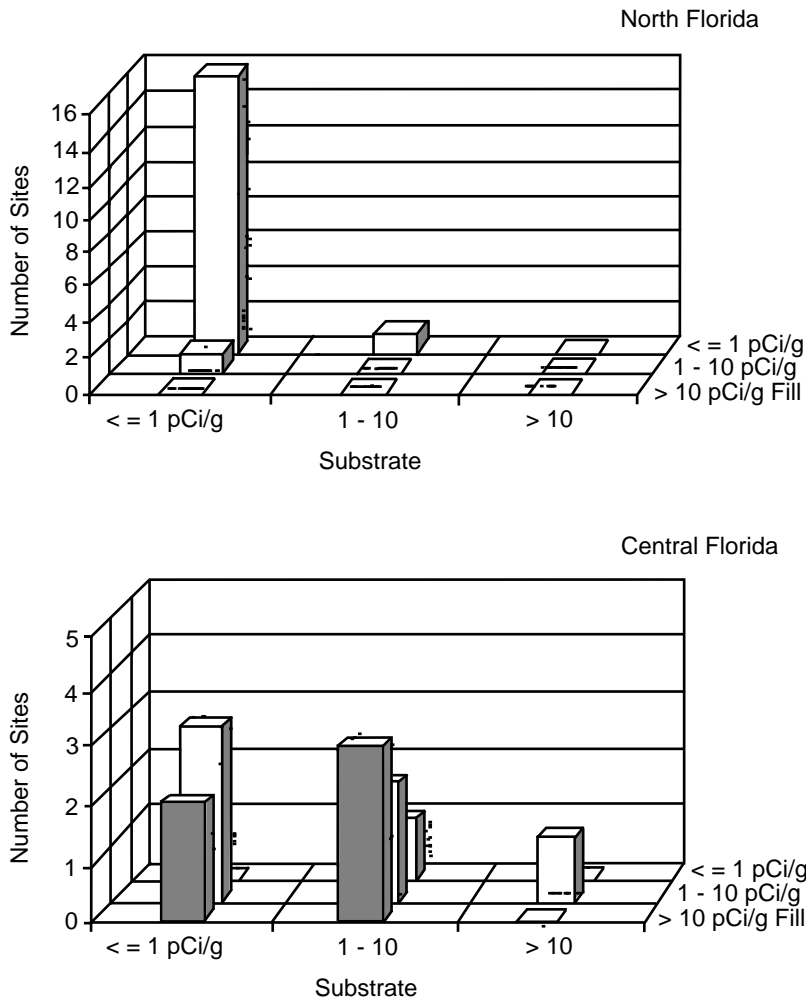


Figure 3. Distribution of soil-fill radioactivity combinations.

Table 1. Summary of Sites and Samples

Origin	Sites	Samples
N FL NHEP	26	83
C FL NHEP	16	29
Total NHEP	42	112
N FL Research House	1	5
C FL Research House	2	7
Total Research House	3	12
TOTAL	45	124

limestone of the Eocene Ocala Group is exposed. Overlying the limestone in the central and eastern portions of the county are rocks of the Miocene Hawthorn Group. These rocks consist of discontinuous lenses of unconsolidated sands, phosphatic clays, clayey sands, limestone, and dolomite. A thick sequence of relatively recent sand from beach processes exists in much of eastern Alachua County to cover the Hawthorn sediments. Thin alluvial sands cover all three major units throughout much of the county in the upper 0.3 to 1.0 m (1 to 3 ft). Throughout the exposures of Hawthorn sediments in Florida, geological evidence of reworking and mixing of surficial units exists. Accordingly, silty clayey sands and sandy clays are common and difficult to distinguish or correlate. By virtue of positive clay content, all of the North Florida NHEP

samples are considered to be from the Hawthorn group. Certain samples had higher clay compositions and could be attributed to zones or lenses of clayey or silty sands.

In Polk county (Central Florida), the geological surface of most of the area is some component of the Hawthorn group of sediments with the best known being the Bone Valley formation of phosphatic sands and clays. The surface of the easternmost portion of the county consists of marine terrace sands of recent age. Some surficial materials in Polk County are tailings from the beneficiation of minerals extracted from the Hawthorn Group. This material has undergone a sizing process that results in an inordinate sorting to yield a relatively uniform-sized sand fill. The Central Florida NHEP samples are consistent with a Hawthorn origin. Some of the samples had relatively high clay contents (>25%) and could be attributed to a zone richer in clays. The deeper Research House site samples were markedly uniform in size and low in silt and clays suggesting that they are sand tailings from mineral beneficiation.

Radiological Characteristics

The radium content of soil-fill samples is summarized in Table 2.

For the North Florida sites sampled during this reporting period, the radium concentrations of samples from the upper 0.9 m (3 ft) were less than 1 pCi/g at 25 (96%) of the 26 sites. Note that, in related studies being conducted in North-central Florida, the source of near-surface soil gas radon at some locations appears to be zones of elevated radium concentrations occurring at depths greater than 1 m. Only one fill sample had a radium concentration in excess of 1 pCi/g.

For the Central Florida sites sampled during this reporting period, 63% of the native soil and 92% of the fill samples had radium concentrations exceeding 1 pCi/g, and concentrations as high as 30 pCi/g were observed. Thus in this particular region, fill materials currently in use do contain elevated radium concentrations.

Soil-fill radioactivity combinations are summarized in Table 3. North Florida sites were characterized by the predominant occurrence of low activity (≤ 1 pCi/g) fill over low activity surficial substrate. On the other hand, the Polk County (Central Florida) sites were characterized by the predominant occurrence of moderately elevated (1-10 pCi/g) and elevated (>10 pCi/g) activity fill over either low or moderately elevated substrate. Only one Central Florida site had low activity fill; this occurred in combination with a moderately

Table 2. Summary of Radium-226 Content Soil and Fill Samples

	N FL	C FL
Native Soil		
Conc, pCi/g	0.2 - 5.5	0.7 - 10.8
Distribution of Sites		
≤1 pCi/g	25 (96.2%)	6 (37.5%)
1-10	1 (3.8%)	8 (50.0%)
>10	0 (0.0%)	2 (12.5%)
	<u>26</u>	<u>16</u>
Fill Soil		
Conc, pCi/g	0.2 - 3.2	7 - 29.5
Distribution of Sites		
≤1 pCi/g	17 (94.4%)	1* (8.3%)
1-10	1 (5.6%)	6 (50.0%)
>10	0 (0.0%)	5 (41.7%)
	<u>18</u>	<u>12</u>

* Manatee site

Table 3. Summary of Soil-Fill Radioactivity Combinations

Substrate	A	Fill		Total
		B	C	
N FL	≤1	1 - 10	>10	
A <=1 pCi/g	16	1	0	17
B 1 - 10	1	0	0	1
C >10	0	0	0	0
	<u>17</u>	<u>1</u>	<u>0</u>	<u>18</u>
C FL				
A <=1 pCi/g	0	3	2	5
B 1 - 10	1*	2	3	6
C >10	0	1	0	1
	<u>1</u>	<u>6</u>	<u>5</u>	<u>12</u>

* Manatee site

elevated substrate at a single site sampled in Manatee County.

Conclusions

This project led to the following conclusions:

1. The observations for North Florida support earlier conclusions (1989 and 1990 studies) that a large proportion of the fill actually used in Florida construction is of a low radium content.
2. Elevated radium concentrations do occur in some Florida soil and fill samples in actual house construction.
3. Fill with elevated radioactivity can be an issue in selected circumstances (this was observed at the Central Florida NHEP sites).
4. Mining-related land (such as reclaimed overburden and/or sand tailings areas) may present a radon source. These soils may have characteristics different from undisturbed soils and directly excavated fills.
5. Other studies being conducted in North-central Florida indicate that at some locations the near-surface soil gas radon may originate from depths greater than the 0.6 to 0.9 m (2 to 3 ft) being sampled for the NHEP.

C. Roessler, R. Richards, H. Nguyen, D. Smith, and C. Vonada are with the University of Florida, Gainesville, FL 32611.

David C. Sanchez is the EPA Project Officer (see below).

The complete report, entitled "Soil and Fill Laboratory Support—1991, Florida Radon Research Program," (Order No. PB94-163243; Cost: \$17.50; subject to change) will be available only from:

National Technical Information Service

5285 Port Royal Road

Springfield, VA 22161

Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

Air and Energy Engineering Research Laboratory

U.S. Environmental Protection Agency

Research Triangle Park, NC 27711

United States
Environmental Protection Agency
Center for Environmental Research Information
Cincinnati, OH 45268

Official Business
Penalty for Private Use \$300

EPA/600/SR-94/064

BULK RATE
POSTAGE & FEES PAID
EPA
PERMIT No. G-35