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RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

Prepared by Post, Buckley, Schuh & Jernigan, Inc.

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Florida Institute of Phosphate Research

Bartow, Florida

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FLORIDA INSTITUTE OF PHOSPHATE RESEARCH

The Florida Institute of Phosphate Research was created in 1978 by the Florida Legislature (Chapter 378.101, Florida Statutes) and empowered to conduct research supportive to the responsible development of the state's phosphate resources. The Institute has targeted areas of research responsibility. These are: reclamation alternatives in mining and processing, including wetlands reclamation, phosphogypsum storage areas and phosphatic clay containment areas; methods for more efficient, economical and environmentally balanced phosphate recovery and processing; disposal and utilization of phosphatic clay; and environmental effects involving the health and welfare of the people, including those effects related to radiation and water consumption.

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Research Staff

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David P. Borris

Research Directors

G. Michael Lloyd, Jr.	- Chemical Processing
Gordon D. Nifong	- Environmental Services
David J. Robertson	- Reclamation
Henry L. Barwood	- Beneficiation
Robert S. Akins	- Mining

Florida Institute of Phosphate Research
1855 West Main Street
Bartow, Florida 33830
(863)534-7160

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

FINAL REPORT

Jerome J. Guidry, P.E., Principal Investigator
W.E. Bolch, Ph.D. (University of Florida)
Charles E. Roessler, Ph.D. (University of Florida)
James T. McClave, Ph.D. (Info Tech, Inc.)
James K. Moon (Zellars-Williams, Inc.)

POST, BUCKLEY, SCHUH & JERNIGAN, INC.
889 North Orange Avenue
Orlando, Florida 32801

Prepared for

FLORIDA INSTITUTE OF PHOSPHATE RESEARCH
1855 West Main Street
Bartow, Florida 33830

Contract Manager: David J. Robertson, Ph.D.

March 1986

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PERSPECTIVE

David J. Robertson, Ph.D.

Florida Institute of Phosphate Research Project Manager

Uranium is usually found associated with sedimentary phosphate ores, and the deposits of phosphate in Florida are no exception. The uranium is present as an insoluble component of the matrix that is released only upon acidulation in the manufacture of phosphoric acid. Although the uranium in the phosphate ore is relatively sequestered from the biosphere because of its low solubility, several of its radioactive decay products are more problematic. The isotope of most concern is radium-226. Radium is far more soluble than its uranium parent and biogeochemically, radium behaves like calcium, an integral component of vertebrate skeletons.

Several decay products of radium-226 itself are also of concern. Radium-226 decay progress through several short-lived isotopes to radon-222. The chemical reactivity of radon is of little inherent concern because it has a short half-life and for all practical purposes is inert. But radon is a gas that seeps from the soil and can accumulate in poorly ventilated structures. Radon decay products (particularly polonium-210 and lead-210, referred to as "progeny" or "daughters") are reactive radioisotopes that quickly adsorb onto particulates.

The radiological quality of reclaimed phosphate-mined land depends a great deal on the type of material that was used to fill the mining excavations. The average radium-226 activity in unaltered surface soil in Polk County is 0.6 pCi/g. Where the mining pits have been filled with sand tailings from the beneficiation of the phosphate matrix, the activity averages 3.2 pCi/g. Only slightly higher levels are found in areas reclaimed with overburden, where the average activity is 5.0 pCi/g.

Mining areas containing "debris" tend to have the highest radium activities. Prior to the universal adoption of flotation technology in the 1940's, much of the phosphate in the ore was discarded as waste; the pebble-sized particles were removed by washing and screening but the sand-sized phosphate could not be segregated from the quartz sand. This mixture of sand tailings and sand-sized phosphate was known as "debris" and was used to fill mining excavations. Because the debris contained significant quantities of phosphate, it was also enriched in uranium and its daughter products. The average radium-226 activity on debris lands is 9.5 pCi/g. Areas reclaimed with debris tended to be small and many have already been remined to recover the phosphate values; debris land is no longer a significant reclaimed landform.

Recognizing the concern over technologically enhanced radiation levels associated with reclaimed land, several organizations have supported or directly performed research to examine the issue. Among the most active have been the state's Department of Health and Rehabilitative Services (DHRS), the Florida Phosphate Council, the Department of Environmental Engineering Sciences at the University of Florida, and the Florida Institute of Phosphate Research. To date, the Institute has provided support for 13 projects that directly address the topic of radiation. Numerous other Institute projects have radiological components as secondary issues.

The Institute's research program approaches the radiation problem from two perspectives: public policy, and safety and health. Most research has been concentrated on health and safety issues, although the Institute has been active in providing information to support the development of reasonable public policy on radiation associated with phosphate mining. The most comprehensive treatment of policy issues was conducted by the Health and Safety Research Division of Oak Ridge National Laboratories. The goal of their project, "Radiological Studies Relating to the Florida Phosphate Industry" (Project #DFP-81-002), was to identify and quantify the risks to the public from radioactive materials associated with the phosphate industry. Following a review of available information, Oak Ridge produced four reports dealing with radon dosimetry, radium in the biosphere, and polonium-210 and lead-210 in foods. Oak Ridge also issued a final report indicating that levels of several radionuclides in the natural and human food chains have not been adequately investigated.

In an effort to set reasonable, scientifically valid regulations, the Institute has funded two separate studies with the National Council on Radiation Protection and Measurement. The first, "Population Exposure from Technologically Enhanced Radiation Sources" (Project #81-05-011) was aimed at setting permissible concentrations for specific radionuclides in indoor air and potable water in phosphate-rich areas. The results of this project served as a guide to the DHRS in its efforts to promulgate regulations. The second study, "Control and Measurement of Radon" (Project #85-05-024), will make recommendations regarding equipment and methods for standardizing the measurement of radon and its daughters.

Unlike the projects that are designed to provide information that will help regulators set policy, the Institute's health and safety research efforts involve direct assessment of the radiological quality of mined land and techniques to reduce public contact. The Institute has addressed these issues from the perspectives of indoor radon concentrations, surface and groundwater quality, radionuclide concentrations in the natural foodchain, and radioactivity in agricultural products.

Because nearly 90% of all radiation exposure to humans occurs through respiratory routes, the Institute has made a special effort to address the issue of radon in housing built on reclaimed land. American Atcon is working with the Institute on a two-phased project to "Demonstrate Construction of Radon Resistant Housing on Florida

Phosphate Lands" (Project #82-05-012). The first phase of the project has been completed. Its goal was to reach a consensus among federal, state, and local agencies on techniques that are acceptable for construction of radon-resistant foundations. The second phase is an actual demonstration of these techniques in order to train local tradesmen to reduce the methods to practice.

The Institute has supported numerous investigations of the radiological quality of groundwater. The Institute sponsored a DHRS project to measure "Natural Radiochemical Contamination of Shallow Drinking Water Wells in Florida's Phosphate Region" (Project #81-05-004) and Florida State University's investigation of the exchange of radioelements between phosphatic strata and the surficial and deep aquifers ("Radioelement Migration in Natural and Mined Phosphate Terrains," Project #80-05-002).

In addition to concern over natural sources of radiocontamination, there is a persistent uncertainty over water quality in recharge wells connecting the surficial aquifer to the artesian Floridan aquifer. Some phosphate mining companies use wells to siphon water out of the surficial aquifer as a way of dewatering their minesites. The water is discharged into the lower aquifer to replenish water removed for mining purposes. Water quality monitoring of these wells often shows an inconsistency between gross alpha radioactivity and the activity that can be attributed to radium-226. The University of South Florida the Southwest Florida Water Management District are conducting two projects to determine "The Source of Gross Alpha Anomalies in Recharge Wells" (Project #82-05-014) and the "Chemical Fate of Uranium-daughter Radionuclides in Recharge Wells" (Project #85-05-022).

Assessing the quality of surface water has been part of several projects sponsored by the Institute, but two investigations have had as their primary goal the determination of radioactivity levels in surface water associated with phosphate mining. Environmental Science and Engineering's "Ecological Considerations of Reclaimed Lakes in Central Florida's Phosphate Region" (Project #81-03-018) compared the radiological quality of reclaimed lakes with that of natural lakes in the phosphate mineralized region and correlated lake quality with physical and chemical characteristics of the lake basins. Florida State University is examining the "Mechanisms of the Release of Radium and Other Decay Series Isotopes from Florida Phosphate Rock" (Project #83-05-016). This work is being conducted on naturally weathered rock exposed in the watershed of the Suwannee River in north Florida.

Two projects that have received support from the Institute have developed information on the concentrations of radionuclides in wildlife associated with mining-altered lands. The first of these studies, "Levels of Selected Envionmental Contaminants in Birds from Phosphate Mined Wetlands" (Project #81-05-003) was conducted by the School of Forest Resources and Conservation at the University of Florida. In addition to examining levels of radionuclides in several species of game waterfowl, this project also provided information on concentrations of heavy metals and other potentially toxic trace elements in the food items of birds. The second project was performed by the Florida Audubon Society. Audubon developed data on bony vertebrates other than birds. Audubon's research ("Radionuclides and Heavy Metal Concentrations in Wildlife on Phosphate Mined and Reclaimed Lands," Project #85-05-022) involved work similar to that performed by the University of Florida but focused on terrestrial mammals and aquatic reptiles.

In order to ensure that its radiation research program is comprehensive, the Institute has devoted special attention to the human food chain. Specifically, the Institute is interested in the radiological quality of foods that are grown on reclaimed land. As phosphate mining operations continue to move southward in central Florida and mined land is increasingly available, agricultural production will become one of the principal uses for reclaimed land. The purpose of the present investigation was to characterize and quantify the levels of naturally-occurring radioactivity in foods grown on Florida phosphate lands and to project radiation doses to consumers. The foods studied were those that could be found on reclaimed land (e.g. citrus, some vegetables, and beef) and which are typically raised by farmers in central Florida.

Radiation research sponsored by the Institute has covered at least a portion of all facets of the radiation issue. Results produced by these and other investigations indicate that more research is needed in some areas such as groundwater quality and the levels of radionuclides in some foods grown on specific landforms. Other studies have indicated the relative insignificance of the technologically enhanced levels of radioactivity associated with phosphate mining. Nonetheless, all future research should be consistent with the goal of reducing exposure levels to as low as reasonable achievable.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

This study was conducted by a team of professional scientists from five organizations:

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The organization and coordination of this study involving several organizations and several participants was made that much easier because of the commitment and professionalism of these project participants. Their assistance is thoroughly appreciated.

Jerome J. Guidry, P.E.

Section 1

SUMMARY

Post, Buckley, Schuh and Jernigan, Inc. (PBS&J) was retained by the Florida Institute of Phosphate Research to study the radioactivity in foods grown on Florida phosphate lands. More than 90 land parcels in central Florida were identified and evaluated for potential food production. Over 100 food samples, replicated up to 3 times (over 300 individual replicates) were collected from 62 of these land parcels and subjected to radioassay for isotopes of radium, uranium, and thorium. Selected samples were also analyzed for lead-210 and polonium-210. Corresponding soil samples were also collected and analyzed for radium-226 and pH.

The results of the radioactivity analyses indicate that foods grown on control parcels and phosphate mineralized parcels exhibit similar concentrations of the radionuclides studied. These two land types were combined into one category (unmined lands) for subsequent evaluations. Foods grown on a single reclaimed clay settling area exhibited similar radioactivity concentrations to those foods grown on other reclaimed and mined lands. These land types were combined into one category (mined lands) for subsequent evaluations. Some of the foods collected from a unique parcel of debris land exhibited substantially higher levels of radioactivity than similar foods collected from both mined and unmined lands. Due to the uniqueness of the debris parcel, these foods were treated separately. The results of the lead-210 and polonium-210 analyses are inconclusive due to the few data values which were available.

Statistical analysis of the radium-226 data has shown that the average concentrations exhibited by foods grown on mined lands was significantly higher than the average concentrations exhibited by foods grown on unmined lands. Descriptive analyses of the other radionuclides support this conclusion. A hypothetical individual who obtains 100 percent of the foods sampled in this study from mined lands and the remainder of his diet from the general food pool is estimated to receive 4 mrem per year in committed effective dose equivalent from ingestion of the radionuclides reported in this study. This is 0.3 mrem (8 percent) per year more than a similar individual who obtains 100 percent of the foods sampled in this study from unmined lands. These dose levels are quite low and are not considered to be a health hazard.

Section 2

INTRODUCTION

The Florida Institute of Phosphate Research (FIPR) has funded this study of radioactivity in foods grown on Florida phosphate lands. The purpose of the study was to collect foods grown on phosphate-related and non-phosphate lands, to determine the radioactivity content of these foods, and to determine if differences exist between the radioactivity concentrations of foods grown on the different types of lands. Based on the concentrations measured, radiation doses and associated risks to consumers can then be estimated.

The lands targeted for study included reclaimed phosphate lands, lands potentially available for future mining (mineralized), and lands with no mining potential (control). Foods targeted for study included citrus, other fruit and vegetable crops, beef, and any other foods currently being grown on the identified lands. Collected foods were analyzed for radium-226 and isotopes of uranium and thorium in the uranium and thorium radioactivity decay series. Selected samples were also analyzed for lead-210 and polonium-210. Soil samples were also collected at each food sampling location and analyzed for radium-226 and soil pH.

A rigorous statistical analysis was conducted on the food radium-226 data to determine if differences exist between foods and between land types. Finally, estimates were made of the radiation dose to food consumers.

Section 4 of this report describes the lands which were surveyed during the study and the method used for classifying these lands, Section 5 explains the pilot study conducted on a select number of parcels to determine the replication requirements of the sampling. The field sampling and analytical methodologies are detailed in Sections 6 and 7, and the statistical analysis of the generated data is explained in Section 8. The dose evaluation is described in Section 9, and the results, conclusions and recommendations are contained in the remaining sections. Land parcel listings and data tables as well as details on the diet and dose evaluations are contained in the appendices.

Section 3

LITERATURE REVIEW

Over the past several years, a number of studies have been conducted to characterize and quantify the radioactivity associated with phosphate processing in Central Florida. Mining and milling phosphate ores redistribute large quantities of naturally-occurring radioactive materials in the environment. Most of the studies that have been conducted have concentrated on the phosphate ore, products, and wastes associated with the milling process, and radioactivity levels in the environment (7, 21, 35, 36, 39, 45, 59, 79[a]). Those studies which have addressed human exposure to phosphate-related radioactivity have focused on exposures to industry personnel and to people residing in homes built on reclaimed phosphate lands (20, 77, 88). Very little information has been developed to assess the impact of phosphate-related radioactivity on human exposures through the food chain (33, 92).

Approximately 210,000 acres of land have been mined or disturbed by phosphate mining activities in Florida. To date, approximately 55,000 acres of this land have been reclaimed. Based on the Florida Administrative Code, Chapter 16.C-16, reclamation is mandatory for all lands mined for phosphate since July 1, 1975. In addition, monetary incentives are being created to encourage the reclamation of land disturbed prior to July 1, 1975. Such regulations and incentives will likely result in the increased reclamation of disturbed land in the future.

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[a]Bibliography source numbers

Although disturbed phosphate land has been reclaimed for a variety of uses (including residential, industrial, and recreational areas), by far the predominant use of reclaimed land has been agriculture. Because of both the nature of the reclaimed soil materials and the location of most disturbed phosphate land, agriculture will probably continue to be the major use of reclaimed land.

Due to the natural occurrence of uranium and its decay products in overburden and phosphate rock, the three materials which account for the vast majority of reclaimed soils - sand tailings, overburden, and phosphatic clay - contain levels of radioactivity generally higher than natural Florida surface soils (7, 20, 59, 77). It has been suggested that foods grown on these lands may contain elevated levels of naturally-occurring radioactivity (87). The potential health hazard associated with these radioactivity levels in reclaimed land has created considerable controversy.

Section 4

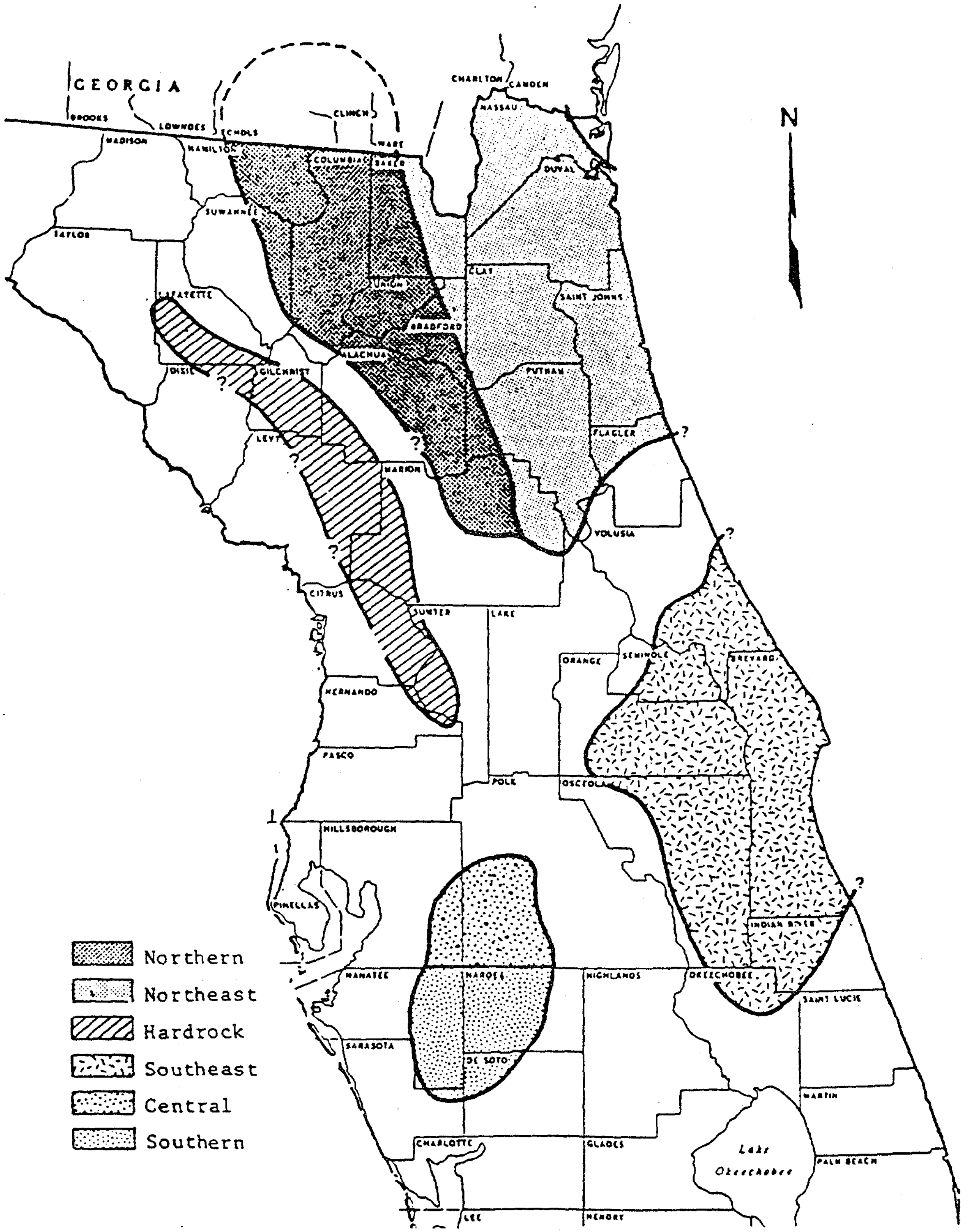
FLORIDA PHOSPHATE LANDS

Surface mining of sedimentary phosphate deposits in Florida has a history of continuous growth since the turn of the century. The mined areas remained, for the most part, in a disturbed state until 1975 when legislation was enacted requiring reclamation of all lands mined from that year forward.

Approximately 150,000 acres disturbed prior to 1975 were “orphaned” without a mechanism to effect reclamation (15). In 1978, the Florida State Legislature established a formula for setting aside (in a trust fund) a portion of the severance tax imposed on phosphate sales, for the purpose of funding the cost of reclaiming the “orphaned” lands (17).

Today, all disturbed surfaces are being reclaimed on a schedule imposed at the time mining permits are granted. “Orphaned lands” are being reclaimed with proceeds from the trust fund on an annualized schedule, to limit expenditures to the interest generated from the principal.

Since July 1975, phosphate mining activities have expanded into Manatee and Hardee Counties. Figure 4-1 (16) identifies the various Florida phosphate resource districts. Currently, all mining activity is being conducted in the central and southern districts, with the exception of one operation in Hamilton County located in the northern resource district.



IDENTIFIED FLORIDA PHOSPHATE RESOURCE DISTRICTS

FIGURE 4-1

4.1 PARCEL TYPES

The parcels targeted in this study were based on availability, accessibility and representativeness to three defined land types: (1) control, (2) mineralized, and (3) reclaimed. A fourth category, debris, was added because of available foods being grown on these unique lands. No parcels were targeted in the northern resource district.

4.1.1 Control

Control parcels are those lands which contain little or no phosphate mineral and will not be mined. Since most of the west central Florida area is considered mineralized, control parcels were located far enough outside the phosphate region to ensure that they were non-mineralized.

4.1.2 Mineralized

Mineralized parcels are those lands which contain a relatively high concentration of phosphate minerals and could be mined in the future. Lands in this category are easily identified through ownership of mining companies and confirmed prospect drilling. In Hillsborough County, some parcels have been classified as mineralized and are privately owned. These particular parcels are included in this category due to their proximity to the phosphate mining region.

4.1.3 Reclaimed

Reclaimed parcels are those lands which have been disturbed as a result of phosphate ore extraction, and reclaimed to a near natural state in accordance with requirements set forth in the Florida Statutes. Three general by-products result from current phosphate mining reclamation: overburden, phosphatic clay, and sand tailings.

Overburden consists of all the material stripped off to expose the phosphate ore. This material is usually stacked in windrows and placed on the reclaimed surface at a later date.

Phosphatic clay consists of very fine soil materials that are separated from the ore during the enrichment process. These clays are stored in impoundments and consolidated to a stable land form after approximately seven years.

Sand tailings consist of sand-sized wastes from the milling process. These sands are usually placed into the mined pits to return the disturbed land to near natural elevation. Usually one to two feet of overburden material is placed over the sand tailings to improve soil fertility for revegetation.

4.1.4 Debris

Debris parcels are those lands upon which the -14 mesh phosphate ore fraction has been disposed. In early phosphate mining operations, technology was not yet available to economically recover the sand-sized fraction (-14 mesh) of the phosphate mineral. This fraction was discarded along with the over-burden, and is termed “debris” throughout the industry. Some mining companies disposed of debris directly on unmined land.

This land type is unique and will not occur as a result of current or future mining operations, since the -14 mesh phosphate fraction is now recovered in the flotation process. Only two or three debris land forms currently exist, and at least one of them is scheduled to be re-mined in the future.

4.2 PARCEL CHARACTERIZATION

Parcel characterization consisted of compiling all available data into a common list to provide a basis for parcel selection and sampling. The parcel list includes : the county in which the parcel is located, a parcel reference number, land classification, available food type, and general remarks about the parcel. Throughout the study, this list was continually updated as new parcels were identified, achieving a final parcel count of 90. At the end of sampling, this list was modified to show all parcels sampled, and is included in Appendix A.

Research for this effort was begun by first reviewing: (1) studies conducted by various mining companies and submitted in support of permitting activities (e.g., environmental impact studies and applications for development approval); (2) past studies for the Florida Department of Natural Resources; and (3) mining and reclamation plans for various mining companies. Data such as land type and agricultural usage were extracted from these reports, along with a general location of the study parcels. The majority of this research was accomplished by reviewing the vegetation maps and aerials included in the above studies.

Land owners or lessees were then contacted to verify the land type, food type and availability, and sampling potential. A field trip to the prospective parcel was then conducted to meet the local contact person and to familiarize the sampling team with the site.

Based on the information obtained from the owner/lessee and the site inspection, the parcel was included on the characterization list and classified accordingly. Those parcels for which only visual inspection was available for characterization purposes were tentatively added to the parcel list and noted accordingly. This occurred with some of the parcels identified in Polk and Hillsborough Counties. Several parcels were unmined, not owned by mining companies, and not previously prospected. With few exceptions, these parcels were identified as being mineralized, based on close proximity to mining operations or mined-out lands, and inclusion in the area referenced in Figure 4-1. The exceptions are four parcels sampled in Hillsborough County, which were classified as control parcels due to their location near the Gulf coast west of the edge of the central Florida phosphate district.

External gamma-ray surveys were conducted on most parcels to assist in land classification. Both mineralized and control parcels exhibited similar background levels. However, the survey measurements provided additional support for classification of reclaimed lands, since these lands typically exhibited higher external gamma readings (see Appendix A). In parcels that were reclaimed under current regulations, it was sometimes difficult to visually determine the extent of reclamation with relation to surrounding lands. By using the survey meter, this could be established quite readily by comparison.

4.3 PARCEL SELECTION

The criteria used in parcel selection consisted of: (1) permission to sample; (2) food availability; (3) land type; and (4) food type. Except for sampling permission, the priority of the criteria varied throughout the study, depending on time of year, sampling episode, and the continually increasing data base. A lands/foods matrix was developed (See Table 4-1) to visually display the number of samples collected by food type and by land type. Foods were initially listed separately, and all land types were shown. As the study progressed, similar foods were grouped and land types were combined based on the statistical evaluation (See Section 9). During the later phases of the study, parcel selection was often made to better balance the matrix.

Permission to sample was usually obtained during initial contact or field reconnaissance. On the whole, permission to sample was granted willingly. Both property owners and lessees were very receptive and helpful in sampling. They also proved to be an invaluable source of information on the parcels and for locating other potential sampling sites.

Food availability was projected through the seasonal growing periods for each particular type of food. Row crops (such as lettuce, carrots, cucumbers, etc.) were available almost year-round, with the majority coming from the spring and fall harvests. Citrus was available from early December to late March, depending on location and type of citrus. Strawberries were sampled during the early spring.

TABLE 4-1
LANDS/FOODS MATRIX

	ALL LANDS	MINERALIZED	RECLAIMED	MINED NOT RECLAIMED	DEBRIS	CONTROL
BEEF	2		1			1
LEAFY VEGETABLES	18	8	4	0	1	5
Spinach	3	1			1	1
Cabbage	2	1	1			
Collard Greens	5	3	1			1
Mustard Greens	2	1				1
Turnip Greens	6	2	2			2
COLE VEGETABLES	2	1	0	0	0	1
Broccolli	1	1				
Cauliflower	1					1
LEGUMES	11	3	6	0	1	1
P. H. Crowder Peas	3	2	1			
Conch Peas	1		1			
Zipper Peas	1		1			
Blackeye Peas	2		1			1
Bush Pole/Green Beans	2	1			1	
Pole Beans	1		1			
Lima Beans	1		1			
GRAIN CROPS						
Corn	3		1			2
ROOT CROPS	19	7	7	0	1	4
Carrot	3	1	1			1
Radish	4	1	1			2
Potato	2		2			
Green Onion	4	3	1			
Turnip	6	2	2		1	1
GARDEN FRUITS	27	13	9	1	1	3
Tomato	3	1	1			1
Okra	1		1			
Y. Squash	6	3	2		1	
Citron	2	1		1		
Zucchini	4	2	2			
Green pepper	3	1	1			1
Cucumber	2		1			1
Egg Plant	1	1				
Strawberry	2	2				
Watermelon	3	2	1			
CITRUS	42	29	9	0	0	4
Orange	31	19	8			4
Satsuma Orange	1	1				
Lemon	3	3				
Grapefruit	7	6	1			
GRAND TOTAL	124	61	37	1	4	21

Using the above guidelines, contacts were made from the parcel characterization list to identify time of harvesting and duration. From the list of crop harvesting times, it was possible to develop a table of crops available during any given week or month. Where necessary, the status of any particular food was monitored closely by maintaining weekly phone contact with the appropriate property owner. This information was used in planning the monthly sampling schedule.

Emphasis on parcel type varied as the study progressed, although identification and location of any reclaimed parcel was vigorously pursued. During the pilot study (See Section 5) and first sampling episode, most available foods and parcels were sampled. However, at the start of the second sampling episode, land type (with respect to food type) played an important role in an attempt to balance the lands/foods sample matrix. Identification of mineralized lands with row crops and reclaimed lands with citrus became the priority task at the start of the second sampling episode, since few of these were located and sampled during the first episode.

4.4 MANATEE/SARASOTA COUNTY PARCEL SELECTION

Since several studies of groundwaters in west central Florida revealed elevated levels of radium-226, the study was amended to include sampling in Manatee and Sarasota Counties (10,41). Parcel selection for this addendum to the study was undertaken in a somewhat different manner than the phosphate-related lands study. The predominent criteria for parcel selection were: (1) existence of an irrigation source with elevated radium content, and (2) proximity of fruit trees or gardens to this water source. Information regarding well sites with elevated radium content was found in two earlier studies of drinking water conducted by the Environmental Health Services Section of the Manatee County Public Health Unit (41).

A report of these two studies was obtained which listed locations of sampled shallow wells in Manatee County. These wells were scattered throughout the county, so a field survey of the sites was undertaken. Coordination with personnel from the Manatee County Agricultural Extension Service revealed that no commercial groves or farms were available for sampling in the area containing the wells with elevated radium content.

A house-to-house field survey was conducted to determine the existence of any private gardens or fruit trees near the identified well sites. Upon completion of this survey, a target list of potential sampling locations was compiled. Permission to sample was then obtained by letter.

Parcel selection for Sarasota County was carried out in a similar manner. The USGS report on groundwater quality (10) served as the starting point for site location/selection. Meetings with USGS personnel provided a list of potential sites for a field survey, which was conducted immediately thereafter.

The field investigators identified 30 out of 50 possible parcels in Sarasota county where elevated radium concentrations might be found. Only 17 of these sites had wells used for drinking water supply or irrigation. Nine of these parcels were at private homes and eight were at trailer parks or multi-family complexes. A site visit to each parcel determined that none of these locations had fruit or other foods that could be sampled. In addition, the multi-family complexes all had water treatment systems associated with their water supply wells. Consequently, no parcels were sampled in Sarasota County.

4.5 SPECIAL CASES

4.5.1 IMC Garden

At the conclusion of the first sampling episode, a review of the lands/foods matrix indicated a paucity of foods grown on reclaimed lands. Since few foods were currently being grown on reclaimed lands, and the possibility of obtaining such foods during the course of the study was slight, the study team decided to locate a reclaimed land parcel and plant those foods which would better balance the data base and provide additional vegetables on reclaimed land. As part of another on-going study, International Minerals and Chemical Corporation (IMC) was growing vegetables on a reclaimed clay settling area and offered to provide samples for this study. In addition to the 15 crop varieties that were currently being grown, five additional crops were planted to complete the projected requirements of the second sampling episode.

The naturally reclaimed pond was crusted over (having no sand cap) with a moderate cover of indigenous vegetation. Preparation of the garden plot consisted of clearing the existing growth with a grader. Crops were planted directly into the moist clay, using both starter plants and seeds. A list of the 20 crop varieties planted is shown on Table 4-2. Watering the garden was accomplished via an irrigation system tied into a shallow well on site. The

Table 4-2

IMC GARDEN

	Vegetable	Nurtured from	Sampled
1.	Cabbage	Plant	X
2.	Turnips	Seed	X
3.	Celery	Seed	
4.	Onions	Plant	X
5.	Radishes	Seed	X
6.	Cantaloupes	Seed	
7.	Cucumbers	Seed	
8.	Okra	Plant	X
9.	Green peppers	Plant	X
10.	Yellow squash	Plant	X
11.	Zucchinis	Seed	
12.	Tomatoes	Plant	X
13.	Watermelons	Seed	
14.	Corn	Seed	
15.	Peas	Seed	X

Additions

16.	Beans	Seed	
17.	Spinach	Seed/Plant	
18.	Broccoli	Seed/Plant	
19.	Carrots	Seed	X
20.	Collards	Seed/Plant	X

fertilizer used was of a high nitrogen base, with no phosphate content. Spraying with insecticides was conducted at a higher than normal rate, due to the high rate of insect infestation. Several types of pesticides were tried, giving good short-term results. A mixture of several types at high strength provided the best results.

Of the 20 crop varieties planted, 11 yielded samples. In some cases several plantings were necessary to get a variety started, because certain species grew poorly in the clay.

Section 5

PILOT STUDY

5.1 METHODOLOGY

A pilot study was conducted in the fall of 1983 to determine the number of replicates necessary to obtain statistically reliable comparisons of the various foods. The pilot study consisted of statistical analysis of 39 radium-226 observations on 11 different parcels. The design is shown on Table 5-1, with the numbers in the table representing the number of replicates for each land/food combination. The table makes the design imbalance obvious; however, this affects only the ability to make statistical comparisons of the land types and foods, and not the estimation of the within-sample (replication) error. The within-sample error is the important ingredient to determine the number of replicates necessary to achieve the desired statistical reliability. Different food types were not singled out for analysis for the same reason: the goal was to obtain a reliable estimate of within-sample variability.

The lognormal distribution was assumed in the pilot study analysis, and the residual analyses indicated that the assumption was plausible. The use of logarithmic values results in an estimate of percent dispersion rather than absolute dispersion, and of geometric means rather than arithmetic means. Thus, the following discussion focuses on the percent difference between geometric means that is detectable, given a specified number of replicates. With all 11 parcels and 39 observations, the estimate of the within-sample standard deviation of the logarithmic values is 0.474. This corresponds to a geometric standard deviation of 1.61, which is used to multiply and divide the

Table 5-1

PILOT STUDY DESIGN
REPLICATES BY FOOD AND LAND TYPE

Crop	Control	Mineralized	Debris	Mined	Total
Carrots	3				3
Corn	3				3
Grapefruit		3			3
Oranges		9		3	12
Pole Beans				3	3
Potatoes				3	3
Radishes	3				3
Spinach			3		3
Squash				3	3
Tomatoes		3			3
TOTAL	9	15	3	12	39

geometric mean to describe the distribution. If the most variable parcel (the debris parcel) is removed, the estimate of standard deviation is reduced to 0.417, which is a geometric standard deviation of 1.52.

One of the primary objectives of this study is to compare the geometric means of various land/food combinations. The estimated standard error of the difference between two lognormal distribution means is:

$$\text{s.e. (diff)} = s\sqrt{\frac{2}{r}}$$

where "s" is the within-sample estimate of the standard deviation and "r" is the number of replicates. To be detectable at the 95 percent confidence level, the lognormal means must differ by 1.96 standard errors, or

$$1.96\ s\sqrt{\frac{2}{r}}$$

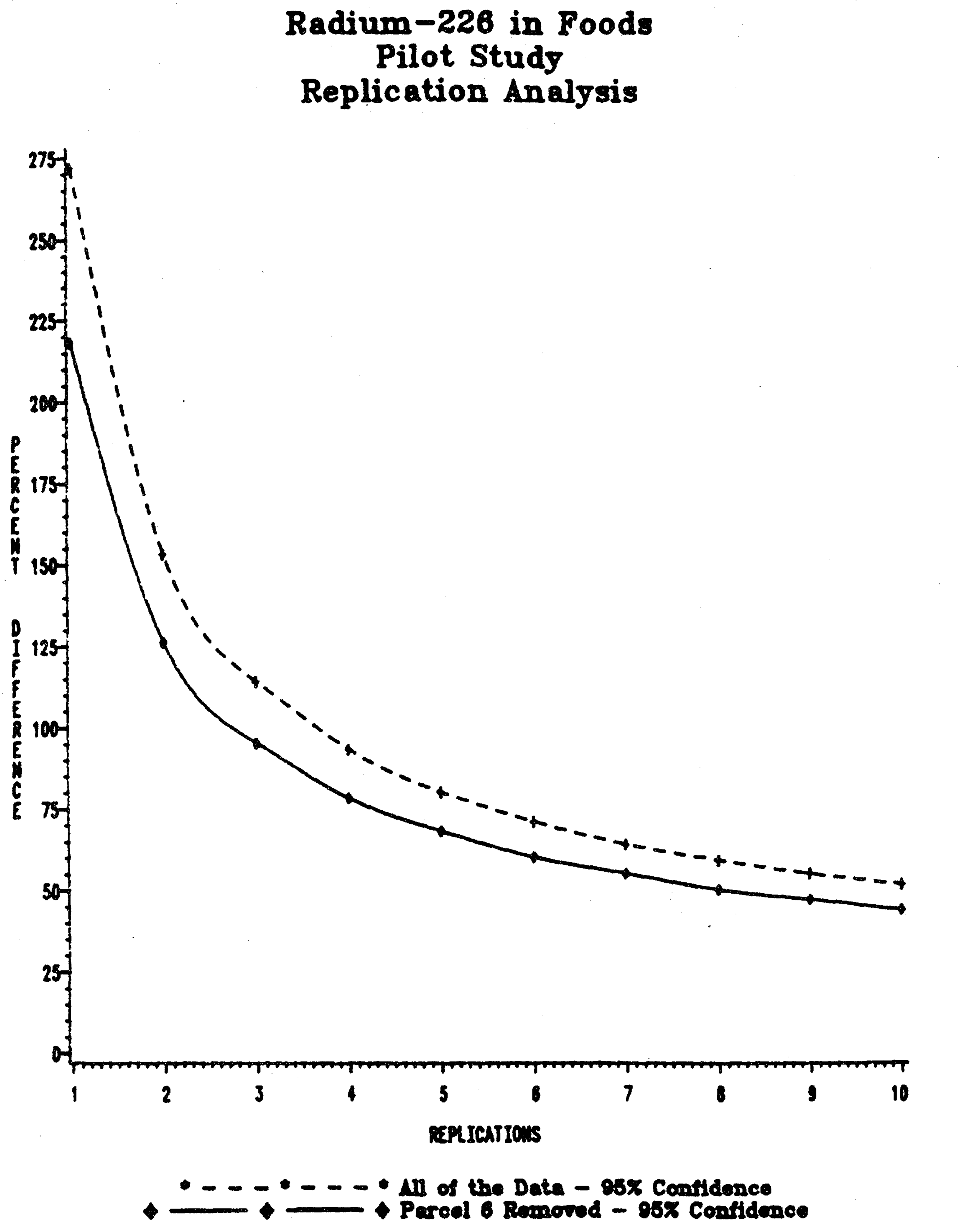
Equivalently, the ratio of geometric means must be at least

$$\exp\left\{1.96\ s\sqrt{\frac{2}{r}}\right\}$$

which can be interpreted as the smallest percent difference that will be declared significant at the 95% confidence level.

5.2 RESULTS AND RECOMMENDATIONS

Using the two estimates of "s" (with and without the debris parcel) and substituting various values for "r" (the number of replicates), a graph of percent differences detectable with 95% confidence, versus the number of replicates, was generated and is shown in Figure 5-1. Apparently, three or more replicates are necessary to detect differences of 100% or more between



RADIUM-226 IN FOODS
PILOT STUDY REPLICATION ANALYSIS

FIGURE 5-1

geometric means. Since one goal of the project was to sample as many foods on each land type as possible, the number of replicates was set at three. Contributing to this decision was the knowledge that more than one sample would be combined for many of the important comparisons (e.g., land types), in effect creating many more replicate observations for that comparison. As a result, important comparisons might detect even smaller differences than 100% as statistically significant.

The full-scale study yielded a within-sample standard deviation more than twice that estimated in the pilot study (See Section 10). However, the total number of observations used in the statistical analysis was 274, so that most comparisons were made with enough observations to permit the statistical detection of geometric means that differ by 100% or more.

Section 6

FIELD SAMPLING

6.1 GENERAL METHODOLOGY

Two separate sampling episodes were conducted in addition to the pilot study. The first episode was conducted from January to September 1984; and the second was conducted from December 1984 to May 1985, and included Manatee and Sarasota Counties. All foods sampled for radioassay were collected by hand-picking. In most cases, three replicate samples of each food were collected. Field data and observations made during the sampling events were recorded in a field notebook. When possible, the farmers or land owners were interviewed for their local knowledge of the property being sampled.

In most cases, a soil sample was collected with each food sample. Soils associated with citrus samples were separated into surface samples (top six inches of soil) and root samples (composited from the top three feet of soil). Soil samples were collected using a hand trowel (for surface samples) and a post hole digger or auger (for root samples). These sampling devices were cleaned with deionized water between replicate samples and between different parcels.

6.2 PILOT STUDY

Pilot study samples were collected primarily to determine the replication requirements for the main sampling effort, and were chosen on the basis of availability.

Citrus samples and their associated soils were collected from five mineralized parcels and one reclaimed parcel. The fruit was not completely ripe, and was approximately two months from harvest.

Row crops were collected from control parcels in the Lake Apopka area. Crops grown on reclaimed parcels were also collected. A total of 13 pilot study samples were collected.

6.3 EPISODE 1

Due to a major freeze and widespread freeze damage to central Florida crops, there was a four-month delay in starting Episode 1 sampling. Citrus was especially damaged. Row crops were also damaged, and samples were not readily available for collection. Some citrus groves, located further south in the study area, were available for sampling in late winter.

In April, the row crops planted after the freeze were available for sampling. However, these crops were limited in quantity, and samples were again collected on the basis of availability. Some row crop samples were collected in May from reclaimed parcels. Beef samples from both reclaimed and control parcels were obtained in July.

Episode 1 ended in September with the collection of some control row crops. The control parcels were located in the same general area (Lake Apopka) as in the pilot study.

6.4 EPISODE 2

Food variety and availability were much better in Episode 2. A larger number of samples were collected from each land category. Some parcels were private home gardens, but most were commercial farms. During this episode, the citrus crop had again been damaged by freeze. Also, the sampling team was denied access to many groves because of restrictions imposed by the USDA in response to the citrus canker outbreak. By December, some restrictions were ended and the team was granted access to some groves. Due to a good growing season the fruit was ripe early, and several samples were obtained. Control citrus samples were obtained from several groves in the Orlando area during December.

Episode 2 also targeted parcels in Manatee and Sarasota Counties identified as having irrigation wells with elevated concentrations of radium. Samples were collected from individual home gardens and citrus trees located on seven privately owned parcels in Manatee county. These samples included a variety of citrus, cabbage, collards and green onions. No samples were obtained from Sarasota County for the reasons described in Section 4. Episode 2 ended with spinach sampling at the end of May. These samples were collected exclusively from mineralized parcels.

6.5 CITRUS SAMPLES

Citrus samples were collected by hand-picking from individual trees. Each tree was considered to be one replicate, and three trees were chosen within the grove to represent the parcel.

Approximately five to ten pounds of fruit were obtained for each replicate. Root and soil samples were collected immediately adjacent to the trees sampled. Gamma surveys were conducted within the grove during the sampling event. All data were recorded in the field notebook. All samples were individually stored in plastic storage bags labeled with the sample time, date, parcel number, replicate number, site location and associated samples.

6.6 ROW CROPS

If the farm was large, and if the foods to be sampled were grown in large quantities, the replicates were collected (by hand-picking) from different sections of the field. Each replicate was a composite of several rows and many individual plants. The associated surface soil sample was a composite of the top six inches of soil collected adjacent to the plants sampled in that replicate.

If the farm was small, and if only one or two rows of a crop were available, the row was divided equally in three sections; and the plants in each section were sampled and composited into one replicate. The surface soil samples were similarly divided. Each replicate was stored in a plastic bag and labeled.

Occasionally, only one or two plants were available for sampling. If the plant was large enough, three replicates were collected from the same plant. This occurred only a few times, and only one soil sample was collected in that situation.

Section 7

RADIOASSAY

7.1 SAMPLE PREPARATION

All foods were prepared for normal human consumption, except that no foods were cooked. Individual food types were prepared as follows:

1. Leafy Vegetables - All leaves were washed with cold tap water to remove dirt and foreign matter, patted dry with paper towels, then freeze dried. In the case of collard and mustard greens, the excess stems were removed.
2. Root Crops - Root crops were washed of dirt and foreign matter using cold tap water and a vegetable brush. Skins were not removed before freeze drying. In the case of radish and turnips, the tops and roots were removed.
3. Garden Fruits – Garden fruits were washed of visible foreign matter using cold tap water, patted dry, then sliced and diced before freeze drying. No peeling was done.
4. Legumes - Legumes were rinsed with cold tap water, patted dry, then either shelled or diced, depending on the normal method of human consumption.
5. Citrus - Citrus commodities were washed, juiced, and frozen. Citrus peels were frozen and subsequently freeze dried.
6. Beef - Beef samples were separated from the bone, frozen, then freeze dried.

7.2 pH MEASUREMENTS

Measurements of pH in soil samples were performed by adding 50 grams (50g) of deionized water to 50g of the soil material and stirring until homogenous. Measurements of pH were then taken on the resultant slurry.

7.3 RADIUM-226 IN SOIL

Soil samples were forwarded from Post, Buckley, Schuh & Jernigan, Inc. to the University of Florida (UF) for analysis. Upon receiving the samples, log book entries were made and sample bags were labeled with the UF laboratory number.

A portion of each sample was oven dried for at least 24 hours at 100 to 110 degrees Celsius. Radium-226 was then determined in the dried sample by high resolution gamma-ray spectrometry, according to the procedure published by Bolch, et al. (7). In this method, a portion of the sample is weighed into a 0.5-liter Marinelli beaker which is then capped and sealed with a bead of cement. The sealed sample is stored at least two weeks to allow ingrowth of gaseous radon-222 (and its short-lived decay products) to radioactive equilibrium with the long-lived parent radium-226 in the sample. The sample is then counted on a high resolution gamma-ray spectrometer (shielded GeLi or high purity Ge crystal detector coupled to a multichannel analyzer). The radium-226 content of the sample is calculated from the counts associated with the 295.2, 352.0 and 609.4 keV peaks of the lead-214 and bismuth-214 radon daughters.

7.4 RADIUM-226 IN FOOD

A 50g aliquot of freeze-dried sample was digested with concentrated nitric and hydrochloric acids after addition of polonium-209, thorium-234 and uranium-232 tracers. The digestate was filtered after dissolution of the organic matter and split into two fractions. Fraction I was analyzed for radium-226 and lead-210. Fraction II was analyzed for uranium-238, uranium-234, thorium-230, polonium-210, thorium-232 and thorium-228, as described in sections 7.5 and 7.6.

Fraction I was diluted with deionized water. Barium carrier was added, and radium-226 and lead-210 were co-precipitated with barium as the sulfate. The precipitate was dissolved in ethylenediaminetetraacetic acid (EDTA) and transferred to a radon bubbler for radon-222 ingrowth. After suitable in-growth, the radon-222 was de-emanated into a radon cell and counted on a radon cell reader. After de-emanation, the EDTA solution was stored for lead-210 analysis, as described in section 7.8.

7.5 URANIUM ANALYSIS

Fraction II was evaporated and 50 ml of dilute HCl added for polonium-210 analysis, as described in section 7.7. After polonium-210 removal, the sample was partitioned with 10% Triisooctylamine (TIOA) in para-xylene. The aqueous phase was drawn off for thorium isotope analysis. The thorium isotopic analysis is described in section 7.6.

The uranium was washed from the organic phase with 0.1N nitric acid, and partitioned against para-xylene to remove residual TIOA. The lower aqueous phase was again collected and evaporated to near dryness. The sample was then ashed with nitric and hydrochloric acids to near dryness. The residue was dissolved in 50 ml of dilute HCl and heated. Ascorbic acid was added to reduce the iron, and $TiCl_3$ was added to reduce the uranium present in the sample. Lanthanum carrier and HF were added to co-precipitate the uranium isotopes with LaF. The collected precipitate was collected on a filter and mounted for counting by alpha spectroscopy. Resultant activities were corrected based on tracer recoveries.

7.6 THORIUM ANALYSIS

The collected thorium fractions from the previous step were evaporated to near dryness, and HNO_3 was added and evaporated. The residue was dissolved in 6N HNO_3 and transferred to an anion exchange column. The thorium was then eluted with 6N HCl, and the elute was collected and evaporated to near dryness. The sample was dissolved in dilute HCl, then heated. Lanthanum carrier and 3N HF were added to co-precipitate the thorium isotopes with LaF. The precipitate was collected on a filter and mounted for counting by alpha spectroscopy. The sample was also counted for beta activity on a low background gas proportional counter to determine the thorium-234 tracer recovery which was used to correct for the chemical yield.

7.7 POLONIUM-210 ANALYSIS

Polonium-210 analysis was performed on the Fraction II sample prior to uranium and thorium isotopic analysis. After filtering the digested material and working the sample into dilute HCl, the polonium-210 was removed from the solution by deposition onto a copper foil which was coated on one side to prevent deposition on both sides. The deposition was performed by stirring in a hot water bath at 80°C for two hours with the copper foil in the solution. After deposition was complete, the foil was dried and mounted on a planchet for alpha counting by alpha spectroscopy. The polonium-209 tracer was used in correcting the chemical yield of the polonium-210 activity.

7.8 LEAD-210 ANALYSIS

The EDTA solution from the radium-226 determination was evaporated, and HBr and Pb carrier were added. The HBr solution was then partitioned with 30% Aliquat-336 in toluene, and the lower aqueous layer discarded.

The organic phase was washed with 0.1N HBr, then the lead-210 was stripped from the organic phase using 12N HCl. Concentrated HNO_3 was added to the collected lead solution, and any reaction was allowed to subside. The sample was then reduced and transferred to a centrifuge tube.

Bismuth carrier was added and the sample pH adjusted to pH 8 with ammonium hydroxide. The sample was heated, cooled and centrifuged, with the supernate being discarded. The precipitate was dissolved in HCl, and 40 ml of deionized water was added. The sample was heated, cooled and centrifuged, with the supernate containing the Pb being collected in a beaker. The precipitate was redissolved in HCl; 40 ml of deionized water was added, heated, cooled and centrifuged; and the supernate containing the lead was added to the beaker.

The collected solution was analyzed for lead content by atomic absorption spectroscopy (283nm). Suitable time was allowed for bismuth ingrowth, after which the sample was transferred to a centrifuge tube. The pH was adjusted to 8, the bismuth precipitated, and the sample centrifuged. The precipitate was collected on a membrane filter and beta counted on a low background gas proportional counter. Lead-210 activity was corrected for chemical recovery using the atomic absorption data and bismuth recovery based on the gravimetric yield of the final precipitate.

Section 8

STATISTICAL ANALYSIS

8.1 EXPERIMENTAL DESIGN

The design of the experiment was a factorial, using four land types and 29 foods.[a] Replication occurred on two levels:

1. Some of the land/food combinations were sampled more than once.
2. Almost every sample was replicated three times.

The design was unbalanced due to the difficulties associated with obtaining samples of every food on each land type. The final design is shown on Table 8-1, with the numbers in the table representing the number of replicates for each land type/food combination. Note that beef and citrus are shown separately, since they were analyzed as distinct experiments. Only radium-226 concentrations were included in the analysis and results for a few of the samples collected late in the study were not available for the analysis.

8.2 ANALYSIS

The analysis of the radium-226 data for the experiment(s) summarized on Table 8-1 was accomplished using the SAS[b] software package (63).

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[a]A fifth land type, “disturbed unmined” or “debris,” was observed on a single parcel. Only four foods were sampled on this parcel and the results were analyzed separately (See Section 10.2.4). Also, some foods represent combinations of several varieties.

[b]Trademark.

Table 8-1

NUMBER OF RADIUM-226 OBSERVATIONS BY FOOD AND LAND TYPE

Crop Type	Control	Mineralized	Mined	Total
1. Beef	3	0	3	6
	3	0	3	6
2. Citrus				
Orange	11	32	19	62
Grapefruit	0	3	3	6
Satsuma Citrus	11	3	0	3
	11	38	22	71

	Unmined		Mined		Total
	Control	Mineralized	Reclaimed Clay	Other Reclaimed	
3. Non-Citrus					
Leafy/Cole Vegetables					
Broccoli	0	3	0	0	3
Cabbage	0	0	3	0	3
Cauliflower	3	0	0	0	3
Collard Greens	3	3	3	0	9
Mustard Greens	3	3	0	0	6
Spinach	3	3	0	0	6
Turnip Greens	6	6	3	3	18
Legume/Grains					
Blackeyed Peas	3	6	3	9	21
Corn	6	0	0	3	9
Green Beans	0	3	0	3	6
Lima Beans	0	0	0	3	3
Root Crops					
Carrots	3	0	0	0	3
Onions	0	3	3	0	6
Radishes	6	3	3	0	12
Potatoes	0	0	0	6	6
Turnip Roots	3	6	3	3	15
Garden Fruits					
Citrons	0	3	0	3	6
Cucumbers	3	0	0	3	6
Eggplants	0	3	0	0	3
Green Peppers	3	3	3	0	9
Okra	0	0	1	0	1
Tomatoes	3	3	3	0	9
Watermelons	0	6	0	3	9
Yellow Squash	0	9	1	3	13
Zucchinis	0	6	0	6	12
TOTAL:	48	72	29	48	197

Several tools were used in the statistical analysis:

1. The Generalized Linear Model (GLM) is an analysis of variance procedure that yields appropriate statistical analyses of unbalanced designs.

2. Least squares multiple comparison is a procedure that provides comparisons of a set of means based on an unbalanced design and unequal sample sizes. Comparisons are made only if the GLM analysis reveals a significant effect at the 0.05 level; then the multiple comparisons are made at the 0.01 level of significance. The net result is sufficient protection against concluding that differences are significant, when in fact they are not, even though many such comparisons were made.

3. Analysis of residuals is a graphical and distributional analysis of the residuals (actual values minus predicted values) to test for normality, lognormality, or the necessity of nonparametric techniques.

The analysis was structured to: (1) use GLM to identify which factors significantly affect levels of radium-226; (2) use the least squares multiple comparison procedure to identify the levels within each factor that differ significantly; and (3) use the analysis of residuals to test the assumptions that drive the analyses.

Section 9

DOSE EVALUATION

9.1 INTRODUCTION

Evaluation of potential dose to humans from radioactivity in foods requires the following: (1) scenarios describing the individuals or populations for which the dose is to be estimated, (2) a diet model describing the average intake of various food items, and (3) a dosimetry model to convert radionuclide intake to radiation dose. The dose calculation scenario describes the individual for which the dose is being calculated and specifies the source of that individual's food. For the purpose of this study, foods are separated into "study" foods and "other" foods. "Study" foods are those potentially affected by the land types under study. Thus, the simplifying assumption is made that these foods are the foods sampled in this study. The radioactivity concentrations in these foods are available from the study measurements. "Other" foods are those not sampled in this study, and are assumed to be derived from a general food pool available to the population. Radionuclide concentrations for "other" foods and drinking water must be taken from the literature (8, 11, 28, 61, 84).

The "study" foods consumed by a typical individual are likely to be a combination of those grown on mined lands and those originating elsewhere. However, an accurate assignment of acreages, production, and contributions to the food market were beyond the scope of this study. For the purpose of dose assessment, three individuals have been defined for the purpose of estimating radiation dose:

1. Control individual - an individual in the phosphate mining region who consumes "study" foods from unmined lands.
2. Local individual - an individual in the phosphate mining region whose "study" foods are a mixture of foods from both mined and unmined lands. This individual can be considered an average for the region. For the local individual's diet, 90 percent of the "study" foods were taken from unmined lands. Although the authors believe that only a few percent of the local individual's diet would come from mined lands, 10 percent was assumed to be conservative.
3. Maximum individual - obtains 100 percent of his diet of "study" foods from mined lands.

The "local" and "maximum" individuals can be compared to the "control" individual to determine incremental doses.

9.2 DIET MODEL

9.2.1 Food Items Sampled

As described in previous sections of this report, a primary factor in the selection of a diet model is the type of food items observed and sampled on the various land categories. Table 9-1 presents the finalized matrix of food items sampled by general land category and numbers of samples taken from each category. Some land types and food categories were combined as a result of the statistical analysis (see Sections 4 and 10). There are 31 food items within six general food groups.

TABLE 9-1

FINALIZED LANDS/FOODS MATRIX

	ALL LANDS	UNMINED	MINED	DEBRIS
BEEF	2	1	1	
LEAFY/COLE VEGETABLES	20	15	4	1
Spinach	3	2		1
Cabbage	2	1	1	
Collard Greens	5	4	1	
Mustard Greens	2	2		
Turnip Greens	6	4	2	
Broccolli	1	1		
Cauliflower	1	1		
LEGUMES & CORN	14	6	7	1
Blackeye Peas	7	3	4	
Green Beans	3	1	1	1
Lima Beans	1		1	
Corn	3	2	1	
ROOT CROPS	19	11	7	1
Carrot	3	2	1	
Radish	4	3	1	
Potato	2		2	
Onion	4	3	1	
Turnip	6	3	2	1
GARDEN FRUITS	27	16	10	1
Tomato	3	2	1	
Okra	1		1	
Y. Squash	6	3	2	1
Citron	2	1	1	
Zucchini	4	2	2	
Green pepper	3	2	1	
Cucumber	2	1	1	
Egg Plant	1	1		
Strawberry	2	2		
Watermelon	3	2	1	
CITRUS	42	33	9	0
Orange	31	23	8	
Satsuma Orange	1	1		
Lemon	3	3		
Grapefruit	7	6	1	
GRAND TOTAL	124	82	38	4

9.2.2 Range of Diet Models

One of the simplest diet models involves taking each sampled item and calculating the dose (millirem or microrem) per serving (100 grams) for both the mined areas and the unmined areas. Then the differential dose per serving of each item can be calculated and ranked from highest to lowest. This approach may be considered a sensitivity analysis, and can lead to identification of those lands best suited for a specific food and those lands for which some foods may be discouraged.

Another diet model considers only those items that were sampled, and groups them into some limited number of food groups, such as legumes or leafy vegetables. Concentrations of radionuclides in each of the items within the food group are then averaged, and the dose per yearly intake of each item is calculated for both the mined lands and the unmined lands. In such a model, foods having the highest and lowest concentrations are averaged out; thus the dose differences are less dependent upon a single sample. Any weighting factors that would express the fraction of the food group obtained from a given land type could also be added. A variation of this model assumes that all foods from a given land type are consumed by someone, and that the differential dose will occur in some fraction of the population. This variation on the model would require the current and/or expected yield of the food group grown on the given land type.

The most complex model considers the consumption of all food items, including such specific items as meats, milk and milk products, condiments, and beverages. Most of the items sampled in this study are vegetables, although beef and potential beverage items (such as orange juice) are also included. The benefit of this diet model is that it puts the total intake of radioactivity and the dose from both the mined lands and the unmined lands into proper perspective. The difficulty with this model is that a considerable amount of baseline data must be obtained for the non-sampled items. For example, the model would require the control concentration of thorium-230 in milk products.

Even with the aforementioned difficulty, this “total diet” model concept was used for this study. The development, justification and assumptions made with regard to selecting the diet for the individuals considered are discussed in Appendix C. Many diets have a number of selections for age and/or sex. However, for the purpose of this study, the individual considered is an adult male. Attempts to adjust the diet for southeast Florida were not successful.

9.2.3 Comparison of Diets

Six diet models from the literature were reviewed:

1) The Rupp diet (60)
2) ICRP diet for the reference man (31)
3) Nuclear Regulatory Commission Regulatory Guide 1.109 (80)
4) Nuclear Regulatory Commission Regulatory Guide 3.51 (81)
5) Food and Drug Administration (FDA) Total Diet Program (69)
6) Revised Food and Drug Administration (FDA) diet (54)

These diets are compared on Table 9-2. Consumption totals and subtotals are one method of verifying the values adopted for this study. One difficulty in cross-referencing the various diets is finding a method of combining detailed

Table 9-2

COMPARISON OF DIET MODELS
(g/day)

Diet Item	Rupp	ICRP	Reg. Guide 1.109	Reg.Guide 3.51	FDA	Revised FDA
Milk	261	457	301	355		280.99
Milk products	306	17		129		22.40
Subtotal Milk	567	474		484	756	303.30
Eggs	41	47				30.95
Meats						
Beef	86			175		129.27
Pork	76			39		39.54
Other	70					69.00
Subtotal Meats	232	227		214		237.81
Poultry	26			137		
(Meat & Poultry)	(258)	(227)	260	(351)		(238.00)
Fish	16	22	22			20.06
(Meat, Fish & Poultry)	(274)	(249)	(282)	(351)	290	(258.00)
Potatoes	69	88		180	204	85.22
Vegetables						
Leafy	50			40	59	35.67
Yellow	8					0.63
Legumes	25				74	63.58
Other veg.	99			178	122	44.08
Subtotal Vegetables	182	202		218	255	143.96

Table 9-2 (Continued)

COMPARISON OF DIET MODELS
(g/day)

	Source of Diet					
Diet Item	**Rupp**	**ICRP**	**Reg. Guide 1.109**	**Reg. Guide 3.51**	**FDA**	**Revised FDA**
Fruit						
Citrus/Tomatoes	99					
Citrus						103.75
Tomatoes						25.18
Other Fruit	87					60.36
Dried Fruit	1					
Subtotal Fruit	187	184		135	217	189.29
Grain	97	166		248	369	207.37
(Fruit, Vegetable & Grain)	(466)	(522)	520	(601)	(841)	(541.00)
Nuts, butter	5					
Fats, Oils	32	49			52	
Sugars, swt	40	66			82	78.30
SUBTOTAL	**1494**	**1525**	**1103**	**1616**	**2225**	**1296.26**
Water	[1650]	[1650]	1013	[1650]		512.00
Beverages					697	1172.44
Soup & Condiments						90.94
TOTAL	**[3144]**	**[3175]**	**2116**	**[3266]**	**2922**	**3071.64**

Brackets indicate water intake for reference man [ ]

items into a broader category; another is the placement of some fluid items into a food category.

The revised FDA diet shows 303 g/day of milk and milk products, and appears to be lower than the other diets. However, this diet has been developed more recently, and milk/milk product consumption may actually be lower than it used to be. Another explanation may be that the FDA diet also includes milk and milk products in the beverage and soup categories. Egg consumption is also lower than that shown in two other diets, perhaps for similar reasons.

Meat values are consistent among the diets when fish is also considered in the totals, The potato intake of 85 g/day in the FDA diet appears to be consistent with the Rupp and ICRP values, but much lower than the NRC diet. The FDA diet subtotal for vegetables appears to be much lower than the other diets; however, the total of all vegetables, potatoes, fruits and grains (626 g/day) is consistent with the range of all five of the other diets.

The diet subtotal for all food groups (excluding water, beverages, soups and condiments) has a narrow range. This should give credibility to all the assumptions that went into the FDA cornpositing. When the “liquid” groups are added to the FDA male intake values, the total intake is a little over three kg/day.

9.2.4 Diet Model Selected

The diet model selected for this study is shown on Table 9-3. It is patterned primarily after the recent FDA diet, and is organized around the food groupings

Table 9-3
DIET MODEL SELECTED

Diet Item	Intake (g/day)	Sampled?
DAIRY		
Milk	280.99	
Cheese	22.41	
TOTAL	303.40	
MEAT		
Beef	129.27	Sampled
Pork	39.54	
Other	69.00	
TOTAL	237.81	
FISH	20.06	
EGGS	30.95	
CEREAL FOOD		
Corn Gr	5.18	
Grains	27.49	
Cereals/Bread	174.70	
TOTAL	207.37	
LEAFY/COLE VEGETABLES		
Spinach	3.28	Sampled
Collards	0.45	Sampled
Mustard	0.45	Sampled
Turnips	0.45	Sampled
Cabbage	7.04	Sampled
Cauliflower	0.71	Sampled
Broccoli	2.80	Sampled
Other	0.76	
Lettuce	23.38	
Celery	0.62	
TOTAL	39.94	
LEGUMES/CORN		
Green Beans	8.74	Sampled
Blackeye Peas	3.36	Sampled
Lima Beans	2.25	Sampled
Corn	14.41	Sampled
Green Peas	7.29	
Other Beans	25.71	
Nuts	4.94	
Other	11.28	
TOTAL	77.99	
POTATOES	85.22	Sampled

Table 9-3 (Continued)

DIET MODEL SELECTED

Diet Item	Intake (g/day)	Sampled?
ROOT VEGETABLES		
Carrots	2.92	Sampled
Radishes	0.32	Sampled
Onions	4.20	Sampled
Turnips	0.42	Sampled
Other	1.10	
TOTAL	8.95	
GARDEN FRUITS		
Watermelons	3.44	Sampled
Citrons[a]	0.00	Sampled
Tomatoes	25.18	Sampled
Strawberries	1.23	Sampled
Cucumbers	2.62	Sampled
Yellow Squash	0.63	Sampled
Zucchini	0.63	Sampled
Okra	0.06	Sampled
Green Peppers	1.29	Sampled
Egg Plants	0.70	Sampled
Other	7.78	
TOTAL	42.27	
TREE FRUITS		
CITRUS		
Oranges	85.26	Sampled
Grapefruit	7.78	Sampled
Lemons	10.71	Sampled
OTHER	60.36	
TOTAL	164.11	
SOUPS	36.82	
CONDIMENTS	54.12	
DESSERTS	78.30	
BEVERAGES	1172.44	
WATER	512.00	
GRAND TOTAL	3071.75	

[a]Data used to generate average concentration for melons; not considered part of human diet.

sampled in this study. Subgroups have been compiled from the 201-item FDA diet. All sampled items are retained as unique items. Groupings were developed from both a general plant type basis and from a diet substitution basis. Corn is not a legume, but a likely substitution for a “bean” in a meal. Corn as a grain (meal, flakes, etc.) is treated separately and not considered a sampled item. Cole and leafy vegetables were combined.

Food intake volumes were derived from the FDA values for a young adult male. Values are available for other age groups and for females in the same group. However, the dose conversion factors chosen for the calculations were for adult males, and other sex or age group calculations would involve additional assumptions and corrections in the calculations.

9.3 DOSE COMPUTATION

9.3.1 Dose Conversion Factors

Doses from intake were calculated using dose conversion factors (DCFs), which are commonly used to transform exposure to radioactivity from ingestion, inhalation or submersion in air or water to dose. The nuclear industry uses many such conversion factors for common situations involving the fission product and activation product radionuclides. The DCFs available in the literature are discussed and compared in Appendix D.

The DCFs used for this study are those for committed effective dose equivalent (CEDE) per unit intake (mrem/pCi), as derived from the recent recommendations of the ICRP in Report No. 30 (29). This particular form was chosen because

ICRP-30 represents the most recently published compilation of dosimetry data, and because CEDE is achieving prominence as the accepted method for assessing radiation dose from radionuclide intake. The CEDE allows summing of the effects of various radionuclides that have different distributions in the body and different biological turnover rates.

9.3.2 Dose Calculation

Doses were computed with the aid of a computerized Lotus 1-2-3 spread sheet (40). A worksheet was prepared for each exposure scenario and each radionuclide. Table 9-4 shows a typical dose calculation for one radionuclide. The table includes all the essential elements necessary to make a wide variety of calculations and to draw numerous conclusions. The discussion that follows will detail the various elements of the table.

9.3.3 Heading and Note

Information contained in the heading includes: (1) date of the calculation, since any single piece of new information can be added, and the entire spreadsheet can be rapidly recalculated; (2) the diet, as described in Section 9.2.4; (3) the "DCF", as discussed above; (4) the radionuclide of interest; and (5) the case under study and the associated weighting factor; these are a general description and a mathematical function for the same concept. The "maximum individual" would take 100 percent of all sampled food items from mined lands. Mathematically, this gives the mined concentrations a weight of 1.00. If any other weighting factor is used (for example 0.10), then the individual for the calculation would take only 10% of his diet from the mined lands and 90% from unmined lands, as is the case for the local individual.

TABLE 9-4
TYPICAL DOSE CALCULATION

DATE: 7/18/85 DIET: FDA/SAMPLED DCF: 1.1E-03 (mrem/pCi)
RADIONUC: Ra-226 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED, (U)-UNMINED FILENAME: RA226MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED, (PU)-PREDICTED FROM UNMINED
(R)-RUSSELL, (L)-LITERATURE (see Footnotes)

									Sampled Items Only	
DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	DELTA INTAKE (pCi/yr)	% OF TOTAL DIFF
DAIRY										
Milk	N	280.99	2.51	(La)	2.51	(La)	2.57E+02	2.57E+02		
Cheese	N	22.41	0.22	(R)	0.22	(R)	1.80E+00	1.80E+00		
MEAT										
Beef	Y	129.27	3.98	(U)	3.41	(M)	1.88E+02	1.61E+02	-2.68E+01	-7.41%
Pork	N	39.54	0.91	(R)	0.91	(R)	1.31E+01	1.31E+01		
Other	N	69.00	0.91	(R)	0.91	(R)	2.29E+01	2.29E+01		
FISH	N	20.06	1.30	(R)	1.30	(R)	9.52E+00	9.52E+00		
EGGS	N	30.95	5.00	(R)	5.00	(R)	5.65E+01	5.65E+01		
CEREAL FD										
Corn Gr	N	5.18	2.00	(R)	2.00	(R)	3.78E+00	3.78E+00		
Grains	N	27.49	2.00	(R)	2.00	(R)	2.01E+01	2.01E+01		
Crls/Brd	N	174.70	2.00	(R)	2.00	(R)	1.28E+02	1.28E+02		
LEAFY/COLE VEG										
Spinach	Y	3.28	16.51	(U)	37.53	(PM)	1.98E+01	4.49E+01	2.52E+01	6.96%
Collards	Y	0.45	5.65	(U)	16.54	(M)	9.28E-01	2.71E+00	1.79E+00	0.49%
Mustard	Y	0.45	1.10	(U)	37.53	(PM)	1.80E-01	6.16E+00	5.98E+00	1.65%
Turnip G	Y	0.45	9.03	(U)	85.16	(M)	1.48E+00	1.40E+01	1.25E+01	3.46%
Cabbage	Y	7.04	2.10	(U)	3.68	(M)	5.39E+00	9.45E+00	4.06E+00	1.12%
Caulifwr	Y	0.71	6.03	(U)	3.68	(PM)	1.57E+00	9.56E-01	-6.10E-01	-0.17%
Brocc	Y	2.80	3.00	(U)	3.68	(PM)	3.06E+00	3.75E+00	6.91E-01	0.19%
Other	N	0.76	4.50	(R)	4.50	(R)	1.24E+00	1.24E+00		
Lettuce	N	23.38	4.50	(R)	4.50	(R)	3.84E+01	3.84E+01		
Celery	N	0.62	4.50	(R)	4.50	(R)	1.02E+00	1.02E+00		
LEGUMES/CORN										
Green Bn	Y	8.74	5.16	(U)	3.68	(M)	1.65E+01	1.17E+01	-4.71E+00	-1.30%
Blckeyes	Y	3.36	1.87	(U)	6.66	(M)	2.29E+00	8.16E+00	5.86E+00	1.62%
Lima Bn	Y	2.25	3.11	(PU)	65.71	(M)	2.56E+00	5.41E+01	5.15E+01	14.24%
Corn	Y	14.41	4.90	(U)	9.19	(M)	2.58E+01	4.84E+01	2.26E+01	6.25%
Grn Peas	N	7.29	4.50	(R)	4.50	(R)	1.20E+01	1.20E+01		
Other Bn	N	25.71	4.50	(R)	4.50	(R)	4.22E+01	4.22E+01		
Nuts	N	4.94	4.50	(R)	4.50	(R)	8.12E+00	8.12E+00		
Other	N	11.28	4.50	(R)	4.50	(R)	1.85E+01	1.85E+01		
POTATOES	Y	85.22	4.46	(PU)	3.67	(M)	1.39E+02	1.14E+02	-2.45E+01	-6.78%
ROOT VEG										
Carrot	Y	2.92	8.52	(U)	181.61	(M)	9.08E+00	1.93E+02	1.84E+02	50.97%
Radish	Y	0.32	3.82	(U)	14.90	(M)	4.41E-01	1.72E+00	1.28E+00	0.35%
Onion	Y	4.19	2.91	(U)	9.91	(M)	4.46E+00	1.52E+01	1.07E+01	2.96%
Turnip	Y	0.42	4.18	(U)	11.58	(M)	6.44E-01	1.78E+00	1.14E+00	0.32%
Other	N	1.10	2.00	(R)	2.00	(R)	8.00E-01	8.00E-01		

TABLE 9-4 (Continued)
TYPICAL DOSE CALCULATION

DATE: 7/18/85 DIET: FDA/SAMPLED DCF: 1.1E-03 (mrem/pCi)
RADIONUC: Ra-226 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME: RA226MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(R)-RUSSELL, (L)-LITERATURE (see Footnotes)

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	1.24	(U)	3.77	(M)	1.56E+00	4.74E+00	3.18E+00	0.88%
Citron	Y	.00	2.19	(U)	4.48	(M)	7.99E-04	1.64E-03	8.36E-04	.00%
Tomato	Y	25.18	2.94	(U)	1.99	(M)	2.70E+01	1.83E+01	-8.73E+00	-2.41%
Strawbry	Y	1.23	2.81	(U)	3.93	(PM)	1.26E+00	1.76E+00	5.01E-01	0.14%
Cucumbr	Y	2.62	3.22	(U)	5.60	(M)	3.08E+00	5.36E+00	2.28E+00	0.63%
Y. Sqsh	Y	0.63	4.11	(U)	3.12	(M)	9.40E-01	7.13E-01	-2.26E-01	-0.06%
Zuchin	Y	0.63	4.20	(U)	3.98	(M)	9.60E-01	9.10E-01	-5.03E-02	-0.01%
Okra	Y	0.06	2.61	(PU)	21.16	(M)	5.23E-02	4.25E-01	3.72E-01	0.10%
Gr Pppr	Y	1.29	1.87	(U)	1.14	(M)	8.77E-01	5.35E-01	-3.43E-01	-0.09%
Egg Plnt	Y	0.70	2.37	(U)	3.93	(PM)	6.06E-01	1.00E+00	3.97E-01	0.11%
Others	N	6.55	4.50	(R)	4.50	(R)	1.08E+01	1.08E+01		
TREE FTRS										
Citrus										
Orange	Y	85.26	1.65	(U)	4.24	(M)	5.14E+01	1.32E+02	8.06E+01	22.29%
Grpfrt	Y	7.78	1.63	(U)	3.14	(M)	4.63E+00	8.92E+00	4.29E+00	1.19%
Lemon	Y	10.71	1.52	(U)	3.65	(PM)	5.94E+00	1.43E+01	8.32E+00	2.30%
Other	N	60.36	4.50	(R)	4.50	(R)	9.91E+01	9.91E+01		
SOUPS	N	36.82	2.25	(Ea)	2.25	(Ea)	3.03E+01	3.03E+01		
CONDIMENT	N	54.12	0.01	(E)	0.01	(E)	1.98E-01	1.98E-01		
DESSERTS	N	78.30	0.22	(E)	0.22	(E)	6.29E+00	6.29E+00		
BEVERAGE	N	1172.44	1.00	(E)	1.00	(E)	4.28E+02	4.28E+02		
WATER	N	512.00	1.13	(Lb)	1.13	(Lb)	2.11E+02	2.11E+02		
TOTALS:		3071.80	Sampled Items Only ->				5.37E+02	8.99E+02	3.62E+02	100.00%
			Total Modeled Diet ->				1.94E+03	2.30E+03		
DOSES:	mrem/year		Sampled Items Only ->				5.91E-01	9.89E-01	3.98E-01	
			Total Modeled Diet ->				2.13E+00	2.53E+00		

FOOTNOTES: La Dairy samples from Polk Co. (Wa84, p 822)
Lb Average of 38 values for Florida (Wa84, p 818-819)
Ea Geometric Mean of Russell Vegetables and Water
E Estimated from general data trends

9.3.4 Diet Columns

The first three columns indicate the diet selected for this study as discussed in Section 9.2.4. Specific food items are listed in the first column. The second column indicates whether or not the particular item was sampled during this investigation. Some crops may not have been sampled on both the mined and unmined lands. A “Y” indicates a positive answer for either type of land; an “N” indicates that the food was not sampled in this study. The third column indicates the assigned intake values (g/day) for each of the discreet food items in the model.

9.3.5 Concentration, Unmined Column

The fourth column contains the geometric mean concentrations of the radionuclide under investigation for each specific diet item grown on unmined lands. The letter (or letters) in parentheses beside the concentration value is a code for the data source. For example, the code (U) means that all data for this item came from analysis of a food grown on one of the unmined land types. For beef, the value of 3.98 pCi/kg would indicate that this level was measured in cattle known to have grazed on at least one of the unmined land types. The concentrations for carrots (8.52 pCi/kg), radishes (3.82 pCi/kg), onions (2.91 pCi/kg), and turnips (4.18 pCi/kg) are recorded opposite the proper food item; then the geometric mean of these four values (4.46 pCi/kg) is used to predict (PU) the concentrations for potatoes on unmined lands. All other root vegetables are assigned the literature value of 2.0 pCi/kg.

Whenever the item was not sampled, but an acceptable value was located in the literature, the literature value (61) was recorded to make up the complete diet.

9.3.6 Concentration Mined Column

The fifth column follows a similar logic to the "unmined" column. The concentrations shown are the geometric means of any values obtained for the item grown on either the clay settling area or the other reclaimed lands. Statistical analysis has shown that clay areas and other mined lands can be treated similarly.

For collards and turnip greens, the values of 16.54 and 85.16 pCi/kg are numbers measured on mined lands. For the other two items not sampled on mined lands (spinach and mustard greens), an estimate of the "mined land" concentration was made using the geometric mean (37.53) of the concentrations of the two items that were sampled on mined lands.

9.3.7 Intake Columns

Columns six and seven show the predicted yearly intake (pCi/yr) for items grown on the unmined and mined lands, respectively. The equations used for calculating these values are as follows:

A. Unmined land:

$$Iu = I*365.25*0.001*CCNU$$

where Iu = yearly intake of the radionuclide, pCi/yr by the individual
I = diet item intake in grams per day
365.25 = days per year
0.001 = kg/gram
CCNU = concentration in the food grown on unmined land, pCi/kg

B. Mined land:

$$Im = I*365.25*0.001*(CCNM*WF + CCNU*(1-WF))$$

where Im = yearly intake of the radionuclide, pCi/yr by the individual
CCNM = concentration in the food grown on mined land, pCi/kg
WF = weighting factor, fraction of diet from mined lands

The columns are then summed for a total dietary intake of this particular radionuclide. The last four lines of the worksheet summarize the intake and dose from unmined and mined lands.

9.3.8 Difference Columns

The last two columns in the table highlight the differences between the unmined and mined columns for sampled foods. Column eight is the sample difference between columns six and seven for sampled items only. In column nine, the individual differences are calculated on a percent of the total difference between the unmined and mined scenario. One can then readily point to critical food items. For example, in this calculation, carrots account for about 50 percent of the total difference in the calculated radium-226 intake between the two individuals, and lima beans account for another 14 percent of the difference. As expected, there are some negative values (such as green beans), since the mined concentration is less than the unmined concentration. A check on the calculations can be made by totaling the percent differences.

9.3.9 Dose Summary

At the bottom of Table 9-4, intake is converted from picocuries to dose in millirems (mrem) on a yearly basis. In this example the “unmined lands diet” results in a yearly dose of 2.13 mrem, while the “mined lands diet” predicts a yearly dose of 2.53 mrem from the total dietary intake of radium-226. This example represents the radium-226 scenario for the maximum individual since all study foods are obtained from mined lands (weighting factor = 1.0 as described is Section 9.3.3).

For this study, one diet calculation table is generated for each of the eight radionuclides. This approach gives the investigation as much flexibility as possible, allowing data to be added or subtracted at any point.

Section 10

RESULTS

10.1 FOOD PRODUCTION ON PHOSPHATE-RELATED LANDS

To date, most reclaimed phosphate land has been used for agricultural purposes. Poor load-bearing characteristics of clay settling areas and remote distances of new mines to urban areas will likely result in these lands continuing as a mainstay for agriculture. Agricultural uses for reclaimed land include improved pasture, citrus and row crops.

Cattle production is increasing in Central Florida, and reclaimed improved pasture is in demand by the Central Florida cattle industry. Most mined lands have been reclaimed into improved pasture since July 1975 when reclamation became mandatory.

Due to Central Florida’s population growth, considerable prime citrus acreage has been lost to urban development. Mining activities have also reduced land available for citrus groves. These factors have created a strong demand in Central Florida for lands favorable to citrus production.

Citrus is not a typical use for reclaimed land. However, the potential for replacing citrus land with reclaimed land needs to be evaluated. For example, elevated clay settling areas capped with waste tailings from the phosphate beneficiation process may prove to be acceptable, since citrus requires a well-drained soil and can be produced in soils with low fertility (24). Growing citrus on reclaimed settling areas would be a desirable use, since this land is not suitable for urban development.

Row crops are produced commercially on a small scale, but these are mostly on mineralized land. The agricultural potential for row crops is dependent on the surface soils used in the reclamation process. In many instances, the surface soil of mined lands can be improved to have a higher fertility and responsiveness to management by blending soils available for reclamation (waste clays, tailings and overburden). Success of row crops will likely depend on combination ratios of these soils. The future of row crops on reclaimed land is yet to be determined, particularly in relation to the demand for pasture and citrus land.

10.2 RADIUM-226 IN SOIL

The results of radium-226 analyses of surface soil samples from row crop parcels are summarized on Table 10-l. On the basis of radium-226 content, there is no apparent difference between the near-surface soils of control lands and mineralized lands. This observation supports combining these lands into one category (unmined). With the exception of one observation at 8.9 pCi/g, individual observations fell in the range of 0.1 to 2.2 pCi/g, and the average value was less than 1.0 pCi/g. The mined lands had higher average radium-226 levels (approximately 5 pCi/g) than the unmined lands. In general, the mined categories showed considerable variation from parcel to parcel (and occasionally from sample to sample within parcels); individual observations ranged from less than 1 to 25 pCi/g. Within the mined lands, the six observations from the clay parcel were quite uniform, ranging from 22 to 24 pCi/g with an average of 23 pCi/g. The twelve observations from the debris parcel were relatively uniform, ranging from 5 to 16 pCi/g and averaging 11 pCi/g.

Table 10-1
SURFACE SOIL RADIUM-226 (pCi/g)
ROW CROP PARCELS

Land Type	Number of Observations	Number of Parcels	Geometric Mean	Range
All Unmined	100	28	0.5	(0.2-8.9)
Control	42	11	0.6	(0.2-1.5)
Mineralized	58	17	0.5	(0.2-8.9)
All Mined	51	5	4.9	(0.2-24.5)
Clays	6	1	23.4	(21.9-24.5)
Other Mined	45	4	4.0	(0.2-21.4)
Debris	12	1	10.9	(5.4-16.0)

The citrus soil data shown on Table 10-2 are summarized by depth, since soil was sampled both at the surface and through the root zone. On unmined lands, the radium-226 content of the root zone soil was generally 1 pCi/g or less and lower than in the surface soil. There were two exceptions on mineralized land. On one parcel, radium-226 concentrations in the root zone were one to two times those in the surface soil but still 0.5 pCi/g or less. On another parcel, root-zone concentrations were 1.0 to 5.0 pCi/g, surface concentrations were in the range of 0.5 to 1.3 pCi/g, and the root/surface ratios were on the order of 2 to 4. With this one possible exception, mineralized land does not appear to present the trees with a source of elevated radioactivity.

On mined lands, the radioactivity was highly variable with depth, as well as from location to location. Individual observations ranged from less than 1 to approximately 50 pCi/g.

While soil radionuclide content is one parameter expected to affect uptake by plants, radionuclide uptake may also be affected by other characteristics not summarized here. These include soil mineral type, calcium and other cation content, ion exchange capacity, and acidity, among others.

10.3 RADIOACTIVITY CONCENTRATIONS IN FOOD

Concentrations (by radionuclide) of radioactivity found in the foods sampled are presented on summary tables appearing in subsections 10.3.1 through 10.3.6 immediately following. An entry of “NS” indicates that the food was not sampled on this land type. Summary tables for lead-210 and polonium-210 are

Table 10-2

SOIL RADIUM-226 (pCi/g)

CITRUS PARCELS

Land Type	Surface Soil (Top 6 inches)				Root Zone (0.5-3 feet)			
	Number of Observations	Number of Parcels	Geometric Mean	Range	Number of Observations	Number of Parcels	Geometric Mean	Range
All Unmined	36	14	0.6	(0.2-1.7)	48	16	0.4	(0.1-4.8)
Control	12	4	0.7	(0.6-1.6)	12	4	0.3	(0.1-0.9)
Mineralized	24	10	0.6	(0.2-1.7)	36	12	0.4	(0.1-4.8)
Mined	21	5	6.4	(0.8-39.)	24	5	7.0	(0.6-49.)

not included, since so few data values were available for these radionuclides. Data values for these radioactivity concentrations in food--and all other pertinent data values--are listed in Appendix B. These summaries do not include food concentrations measured on debris lands since (1) few debris parcels exist, (2) some of the existing parcels will be re-mined, and (3) current mining techniques will not produce any more of these land types. The debris foods are treated separately in the statistical and dose analyses.

Statistical analysis of the radium-226 data has shown that the food concentrations are lognormally distributed (see Section 10.4). Thus, the data will be statistically described using geometric mean concentrations (the n^{th} root of the product of n numbers). Since zero values or values below the detection limit of the analytical procedure pose a problem when calculating geometric means, zeros were replaced by non-zero values according to the following rules:

1) If the set of observations to be averaged contained any non-zero values, the zeros in the set were replaced with ten percent of the lowest non-zero value in the set.
2) If the set of observations to be averaged contained only zero values (all below the detection limit), then the geometric mean of the set. was taken to be the lowest observed concentration for that radionuclide, regardless of food type or land type.

These rules were established to retain the input from the low values, to utilize the positive results, and to provide a usable non-zero average. In addition, this procedure provides a conservative approach to the dose calculation since it will tend to overestimate averages for low concentration foods.

10.3.1 Uranium-238

Table 10-3 summarizes the food concentrations for uranium-238. Most of the concentrations for the unmined case are a fraction of a pCi/kg. This is consistent with literature values that range from 0.2 to 0.7 pCi/kg. The value that stands out as being atypical is spinach (2.69 pCi/kg); however, no literature value for spinach as a single food was located.

For the mined concentration, a number of foods appear to be statistically higher (turnip greens, green beans, corn, and carrots). Cucumber appears to be the single food item that is lower in the mined category. The citrus concentrations are both low and appear not to be related to land type. Note that there are almost 100 analyses involved in the citrus data.

10.3.2 Uranium-234

Table 10-4 contains the summary for the uranium-234 data. Ideally, concentrations should be similar to the uranium-238 data; but given the statistical range of the two data sets, the values shown in the unmined and mined columns are reasonable. Literature values are given in micrograms of uranium per kilogram, and conversion to picocuries would yield equal activities for both uranium-238 and uranium-234, or about 0.2 to 0.7 pCi/kg.

Table 10-3

CONCENTRATIONS OF URANIUM-238 IN FOOD
(pCi/kg)*

Food	Unmined Lands			Mined Lands		
	Number of Observations	Geometric Mean	Range	Number of Observations	Geometric Mean	Range
MEAT						
Beef	3	0.08	(LLD-0.384)	3	0.41	(LLD-0.930)
LEAFY/COLE VEGETABLES						
Spinach	6	2.69	(0.286-29.7)	0	NS	NS
Collards	11	0.40	(LLD-7.88)	3	0.16	(LLD-0.163)
Mustard	6	0.90	(LLD-6.15)	0	NS	NS
Turnip Greens	12	0.32	(LLD-4.28)	6	29.73	(6.15-282.)
Cabbage	3	0.02	(LLD-LLD)	3	0.17	(LLD-0.770)
Cauliflower	3	0.02	(LLD-LLD)	0	NS	NS
Broccoli	3	0.39	(LLD-1.11)	0	NS	NS
LEGUMES/CORN						
Green Beans	3	0.17	(LLD-0.775)	3	1.95	(1.185-2.67)
Blackeyes	6	0.41	(LLD-4.29)	12	0.13	(LLD-3.65)
Lima Beans	0	NS	NS	3	0.80	(0.378-1.32)
Corn	6	0.06	(LLD-0.388)	2	2.65	(2.29-3.06)
POTATOES	0	NS	NS	6	4.87	(0.241-50.0)
ROOT VEGETABLES						
Carrots	3	1.38	(1.02-2.16)	3	12.43	(8.84-16.5)
Radish	9	0.45	(LLD-12.0)	3	0.35	(LLD-1.62)
Onions	4	0.82	(LLD-8.01)	3	0.20	(LLD-0.761)
Turnips	9	0.18	(LLD-2.08)	6	1.01	(LLD-4.30)
GARDEN FRUIT						
Watermelons	6	0.17	(LLD-0.847)	3	0.14	(LLD-0.330)
Citrons	3	0.02	(LLD-LLD)	3	0.51	(0.127-1.40)
Tomatoes	6	0.29	(LLD-5.95)	3	1.94	(LLD-0.895)
Strawberries	6	0.33	(LLD-1.95)	0	NS	NS
Cucumbers	3	2.33	(LLD-10.8)	2	0.01	(LLD-0.06)
Yellow Squash	9	0.07	(LLD-8.82)	4	0.43	(LLD-2.03)
Zucchini	6	0.16	(LLD-1.08)	6	0.80	(LLD-6.98)
Okra	0	NS	NS	1	0.02	(N/A)
Green Peppers	6	0.13	(0.113-0.850)	3	0.24	(LLD-1.13)
Egg Plant	3	1.08	(LLD-5.02)	0	NS	NS
TREE FRUITS						
Citrus						
Orange	61	0.04	(LLD-1.23)	20	0.04	(LLD-3.99)
Grapefruit	10	0.06	(LLD-0.597)	3	0.08	(LLD-0.362)
Lemon	3	0.02	(LLD-0.089)	0	NS	NS

*Citrus concentrations in pCi/liter.

Table 10-4

CONCENTRATIONS OF URANIUM-234 IN FOOD
(pCi/kg)*

Food	Unmined Lands			Mined Lands		
	No. of Observations	Geometric Mean	Range	No. of Observations	Geometric Mean	Range
MEAT						
Beef	3	0.75	(0.384-7.72)	3	0.27	(LLD-0.605)
LEAFY/COLE VEGETABLES						
Spinach	6	3.97	(0.572-21.2)	0	NS	NS
Collards	11	0.40	(LLD-3.94)	3	0.89	(LLD-4.80)
Mustard	6	1.84	(1.03-2.87)	0	NS	NS
Turnip Greens	12	0.93	(LLD-11.8)	6	30.11	(LLD-302.)
Cabbage	3	0.43	(LLD-1.1.97)	3	0.55	(LLD-1.16)
Cauliflower	3	0.62	(LLD-1.66)	0	NS	NS
Broccoli	3	1.25	(0.737-1.12)	0	NS	NS
LEGUMES/CORN						
Green Beans	3	1.67	(LLD-8.13)	3	1.57	(1.34-1.78)
Blackeyes	6	1.23	(LLD-3.34)	12	1.05	(LLD-4.17)
Lima Beans	0	NS	NS	3	1.11	(0.660-2.21)
Corn	6	0.15	(LLD-14.2)	2	2.35	(1.8-3.05)
POTATOES	0	NS	NS	6	3.81	(LLD-48.9)
ROOT VEGETABLES						
Carrots	3	1.02	(0.893-1.62)	3	11.35	(5.89-26.0)
Radish	9	0.38	(LLD-7.80)	3	1.05	(LLD-4.86)
Onions	4	0.68	(LLD-6.87)	3	1.22	(0.661-1.78)
Turnips	9	0.77	(LLD-2.08)	6	1.27	(0.382-4.14)
GARDEN FRUIT						
Watermelons	6	1.04	(0.565-1.61)	3	0.83	(0.575-1.02)
Citrons	3	1.52	(LLD-9.54)	3	0.47	(0.318-1.01)
Tomatoes	6	1.25	(0.469-4.98)	3	0.25	(LLD-1.68)
Strawberries	6	1.67	(LLD-1.76)	0	NS	NS
Cucumbers	3	3.06	(1.91-4.24)	3	0.01	(LLD-0.06)
Yellow Squash	9	0.58	(LLD-10.0)	4	0.83	(LLD-1.60)
Zucchini	6	2.18	(1.03-4.77)	6	0.77	(LLD-4.19)
Okra	0	NS	NS	1	0.05	(N/A)
Green Peppers	6	0.33	(LLD-2.15)	3	0.19	(LLD-0.566)
Egg Plant	3	1.27	(0.477-5.98)	0	NS	NS
TREE FRUITS						
Citrus						
Orange	61	0.09	(LLD-7.39)	20	0.01	(LLD-2.98)
Grapefruit	10	0.08	(LLD-0.398)	3	0.01	(LLD-0.272)
Lemon	3	0.02	(LLD-0.019)	0	NS	NS

*Citrus concentrations in pCi/liter.

The same general trends exist in the data, with spinach being high in the unmined case and turnip greens and carrots obviously higher in the mined lands data. The citrus values remain low, and although the mined data are lower than the unmined data, the difference is probably not significant.

10.3.3 Thorium-230

Table 10-5 summarizes the food concentrations for thorium-230. The literature searches have not revealed any thorium-230 data. For this radionuclide, the spinach on the unmined land and the carrots on the mined land do not stand out as in the uranium data. The highest geometric mean for unmined lands was in corn, and the highest single sample was in green peppers.

Once again, the mined lands yielded apparently higher concentrations for turnip greens, green beans, and carrots. Citrus values are low; and at this level they are not likely to be statistically different on either land type,

10.3.4 Radium-226

The concentration data for radium-226 by food type are summarized on Table 10-6. It should be stated that the detailed statistical analysis reported elsewhere in this report utilized different assumptions in the handling of “zeros;” thus, the geometric means may be somewhat different. Radium is a very sensitive analysis because of the low background alpha counting procedure; thus, few “zero” values are reported. The literature values for radium-226 are more abundant, and they range from about 2.0 to 5.0 pCi/kg for a number of food types. The data reported in this study for the unmined lands is consistent

Table 10-5

CONCENTRATIONS OF THORIUM-230 IN FOOD
(pCi/kg)*

Food	Unmined Lands			Mined Lands		
	No. of Observations	Geometric Mean	Range	No. of Observations	Geometric Mean	Range
MEAT						
Beef	3	0.97	(0.371-3.22)	3	0.05	(LLD-0.217)
LEAFY/COLE VEGETABLES						
Spinach	6	0.65	(LLD-4.41)	0	NS	NS
Collards	11	0.32	(LLD-10.3)	3	0.15	(LLD-1.71)
Mustard	6	0.35	(LLD-1.08)	0	NS	NS
Turnip Greens	12	0.21	(LLD-2.04)	6	5.64	(LLD-29.9)
Cabbage	3	0.04	(LLD-LLD)	3	0.04	(LLD-LLD)
Cauliflower	3	0.07	(LLD-0.341)	0	NS	NS
Broccoli	3	1.45	(LLD-4.40)	0	NS	NS
LEGUMES/CORN						
Green Beans	3	0.18	(LLD-0.442)	3	1.22	(0.905-1.61)
Blackeyes	6	0.14	(LLD-0.92)	12	0.50	(LLD-9.35)
Lima Beans	0	NS	NS	3	0.37	(LLD-1.51)
Corn	6	1.59	(LLD-6.44)	2	0.04	(LLD-LLD)
POTATOES	0	NS	NS	6	0.62	(LLD-17.7)
ROOT VEGETABLES						
Carrots	3	0.52	(LLD-1.83)	3	1.09	(LLD-5.04)
Radish	9	0.06	(LLD-0.910)	3	0.55	(0.392-0.738)
Onions	4	1.54	(0.788-2.99)	3	0.11	(LLD-0.508)
Turnips	9	0.31	(LLD-5.96)	6	0.66	(LLD-3.02)
GARDEN FRUIT						
Watermelons	6	0.33	(LLD-9.42)	3	0.04	(LLD-LLD)
Citrons	3	0.39	(LLD-1.16)	3	0.25	(LLD-1.16)
Tomatoes	6	1.25	(LLD-10.0)	3	0.52	(LLD-0.1.30)
Strawberries	6	0.20	(LLD-1.39)	0	NS	NS
Cucumbers	3	0.43	(0.235-0.956)	0	0.01	(LLD-0.06)
Yellow Squash	9	0.57	(LLD-3.73)	4	0.57	(0.405-1.21)
Zucchini	6	0.20	(LLD-0.534)	6	0.33	(LLD-1.28)
Okra	0	NS	NS	1	0.04	(N/A)
Green Peppers	6	1.03	(LLD-19.4)	3	0.29	(LLD-1.32)
Egg Plant	3	0.18	(LLD-0.589)	0	NS	NS
TREE FRUITS						
Citrus						
Orange	61	0.08	(LLD-15.1)	20	0.003	(LLD-1.31)
Grapefruit	10	0.06	(LLD-1.33)	3	0.04	(LLD-0.162)
Lemon	3	0.10	(LLD-0.268)	0	NS	NS

*Citrus concentrations in pCi/liter.

Table 10-6

CONCENTRATIONS OF RADIUM-226 IN FOOD (pCi/kg)*

Food	Unmined Lands			Mined Lands		
	No. of Observations	Geometric Mean	Range	No. of Observations	Geometric Mean	Range
MEAT						
Beef	3	3.98	(2.5-14.2)	3	3.41	(2.31-4.79)
LEAFY/COLE VEGETABLES						
Spinach	6	16.51	(3.46-103.4)	0	NS	NS
Collards	11	5.65	(0.140-42.3)	3	16.54	(11.3-20.1)
Mustard	6	1.10	(LLD-8.55)	0	NS	NS
Turnip Greens	12	9.03	(LLD-27.3)	6	83.16	(54.3-221)
Cabbage	3	2.10	(0.177-5.91)	3	3.68	(2.89-5.01)
Cauliflower	3	6.03	(4.77-7.85)	0	NS	NS
Broccoli	3	3.00	(2.84-3.14)	0	NS	NS
LEGUMES/CORN						
Green Beans	3	5.16	(4.80-5.64)	3	3.68	(3.39-4.00)
Blackeyes	6	1.87	(0.700-3.84)	12	6.66	(2.27-16.7)
Lima Beans	0	NS	NS	3	65.71	(54.2-72.7)
Corn	6	4.90	(2.90-12.5)	2	9.19	(7.14-11.8)
POTATOES	0	NS	NS	6	3.67	(0.733-13.7)
ROOT VEGETABLES						
Carrots	3	8.52	(7.36-10.8)	3	181.61	(74.7-391)
Radish	9	3.82	(2.22-8.75)	3	14.90	(10.7-26.0)
Onions	4	2.91	(LLD-6.25)	3	9.91	(6.04-19.6)
Turnips	9	4.18	(LLD-12.3)	6	11.58	(5.44-17.8)
GARDEN FRUIT						
Watermelons	6	1.24	(0.180-3.10)	3	3.77	(LLD-9.81)
Citrons	3	2.19	(LLD-5.28)	3	4.48	(1.48-11.8)
Tomatoes	6	2.94	(1.49-7.34)	3	1.99	(LLD-11.6)
Strawberries	6	2.81	(0.249-7.50)	0	NS	NS
Cucumbers	3	3.22	(2.82-3.68)	3	5.60	(2.68-8.74)
Yellow Squash	9	4.11	(0.995-9.97)	4	3.12	(LLD-8.62)
Zucchini	6	4.20	(LLD-7.90)	6	3.98	(1.29-10.6)
Okra	0	NS	NS	1	21.16	(N/A)
Green Peppers	6	1.87	(0.324-5.07)	3	1.14	(LLD-10.1)
Egg Plant	3	2.37	(LLD-11.0)	0	NS	NS
TREE FRUITS						
Citrus						
Orange	61	1.65	(LLD-8.90)	20	4.24	(LLD-16.0)
Grapefruit	10	1.63	(0.705-2.45)	3	3.14	(2.39-3.89)
Lemon	3	1.52	(0.419-3.05)	0	NS	NS

*Citrus concentrations in pCi/liter.

with these observations. Spinach was found to exhibit the highest radium-226 concentration for the foods grown on unmined lands; although concentrations in turnip greens and carrots were also significant.

The foods whose concentrations are substantially higher on the mined lands are collards, turnip greens, and carrots. Both the lima bean and the okra data stand out; but there are no unmined data with which to compare them. The citrus concentrations are higher on the mined lands, but all the concentrations are relatively low.

Because of the concentrations observed and the known ability of the human body to accumulate radium, it is expected that radium will be the critical radionuclide of the six for which a complete set of data was obtained.

10.3.5 Thorium-232

The other naturally occurring radioactive decay series is the radioactive chain beginning with thorium-232, and includes thorium-228. In many parts of the United States, thorium exceeds uranium as a chemical in near-surface soil strata; but because of the difference in specific activity, the equilibrium concentrations expressed in pCi/kg for each of the daughters in either series are about equal. However, in southwest Florida, thorium as a chemical is found in lower concentrations than uranium by one or two orders of magnitude. Because of this, it is expected that thorium-232 concentrations would be lower by an order of magnitude than the thorium-230 concentrations resulting from the decay of uranium-238, as shown previously in Table 10-5.

Table 10-7 summarizes the thorium-232 data for the two land types: unmined and mined. In general, the data are consistent with the discussion above, with overall concentrations lower than those of thorium-230 by about an order of magnitude. The data are also consistent with the fact that a number of food types have a literature value of less than 2.7 pCi/kg for other parts of the United States.

All of the values listed are relatively low and the differences between the concentrations observed on unmined and mined lands are not substantial. The citrus values are also comparable and uniformly low. It is unlikely that this radionuclide will contribute much to the overall radioactivity intake and radiation dose.

10.3.6 Thorium-228

From a radioactive equilibrium point of view, as well as the fact that all thorium atoms should be identical from a chemical standpoint, it is expected that thorium-228 data should be similar to thorium-232 data. Table 10-8 summarizes the concentrations for foods obtained from both unmined and mined land for thorium-228. Overall, the thorium-228 data appear to be about an order of magnitude higher than the thorium-232 data. Since thorium-228 is the decay product of radium-228, a possibility for thorium-228 occurring in excess of the predecessor thorium-232 might involve enhancement of radium-228 and subsequent ingrowth of thorium-228. Radium-228 concentrations might be enhanced relative to thorium-232 either through lower mobility of the radium as the thorium is removed by leaching and weathering or through increased mobility of the radium. Mobility of the radium might occur as (1) plant uptake of

Table 10-7

CONCENTRATIONS OF THORIUM-232 IN FOOD
(pCi/kg)*

Food	Unmined Lands			Mined Lands		
	No. of Observations	Geometric Mean	Range	No. of Observations	Geometric Mean	Range
MEAT						
Beef	3	0.28	(LLD-1.29)	3	0.09	(LLD-0.427)
LEAFY/COLE VEGETABLES						
Spinach	6	0.04	(LLD-LLD)	0	NS	NS
Collards	11	0.07	(LLD-0.571)	3	0.10	(LLD-LLD)
Mustard	6	0.08	(LLD-0.567)	0	NS	NS
Turnip Greens	12	0.19	(LLD-2.55)	6	0.18	(LLD-2.88)
Cabbage	3	0.04	(LLD-LLD)	3	0.04	(LLD-LLD)
Cauliflower	3	0.04	(LLD-LLD)	0	NS	NS
Broccoli	3	0.04	(LLD-LLD)	0	NS	NS
LEGUMES/CORN						
Green Beans	3	0.04	(LLD-LLD)	3	0.28	(0.181-0.418)
Blackeyes	6	0.04	(LLD-LLD)	12	0.08	(LLD-0.466)
Lima Beans	0	NS	NS	3	0.19	(LLD-0.904)
Corn	6	0.04	(LLD-LLD)	2	0.04	(LLD-LLD)
POTATOES	0	NS	NS	6	0.31	(LLD-2.67)
ROOT VEGETABLES						
Carrots	3	0.03	(LLD-0.122)	3	0.36	(LLD-1.68)
Radish	9	0.02	(LLD-0.224)	3	0.22	(LLD-0.738)
Onions	4	0.13	(LLD-0.733)	3	0.04	(LLD-LLD)
Turnips	9	0.20	(LLD-1.55)	6	0.08	(LLD-0.533)
GARDEN FRUIT						
Watermelons	6	0.12	(LLD-0.697)	3	0.04	(LLD-LLD)
Citrons	3	0.12	(LLD-0.558)	3	0.05	(LLD-0.232)
Tomatoes	6	0.02	(LLD-0.153)	3	0.20	(LLD-2.36)
Strawberries	6	0.04	(LLD-LLD)	0	NS	NS
Cucumbers	3	0.04	(LLD-LLD)	0	0.01	(LLD-0.06)
Yellow Squash	9	0.13	(LLD-1.027)	4	0.22	(LLD-1.22)
Zucchini	6	0.07	(LLD-0.48)	6	0.06	(LLD-0.256)
Okra	0	NS	NS	1	0.04	(N/A)
Green Peppers	6	0.05	(LLD-0.313)	3	0.04	(LLD-LLD)
Egg Plant	3	0.07	(LLD-0.321)	0	NS	NS
TREE FRUITS						
Citrus						
Orange	61	0.03	(LLD-0.352)	20	0.04	(LLD-0.669)
Grapefruit	10	0.03	(LLD-0.121)	3	0.01	(LLD-0.054)
Lemon	3	0.09	(0.089-0.089)	0	NS	NS

*Citrus concentrations in pCi/liter.

Table 10-8

CONCENTRATIONS OF THORIUM-228 IN FOOD
(pCi/kg)*

Food	Unmined Lands			Mined Lands		
	No. of Observations	Geometric Mean	Range	No. of Observations	Geometric Mean	Range
MEAT						
Beef	3	5.51	(1.55-29.0)	3	0.12	(LLD-7.16)
LEAFY/COLE VEGETABLES						
Spinach	6	0.46	(LLD-3.14)	0	NS	NS
Collards	11	0.55	(LLD-16.9)	3	0.34	(LLD-2.256)
Mustard	6	0.51	(LLD-3.86)	0	NS	NS
Turnip Greens	12	3.70	(LLD-22.5)	6	4.26	(0.963-38)
Cabbage	3	0.34	(LLD-1.95)	3	2.83	(1.79-6.52)
Cauliflower	3	0.65	(0.341-1.09)	0	NS	NS
Broccoli	3	4.30	(2.08-7.12)	0	NS	NS
LEGUMES/CORN						
Green Beans	3	0.39	(LLD-1.05)	3	7.92	(5.37-14.3)
Blackeyes	6	0.43	(LLD-10.1)	12	1.15	(LLD-32.7)
Lima Beans	0	NS	NS	3	0.63	(LLD-3.31)
Corn	6	17.19	(LLD-148.)	2	8.96	(7.93-10.1)
POTATOES	0	NS	NS	6	3.23	(LLD-33.2)
ROOT VEGETABLES						
Carrots	3	28.80	(20.0-45.4)	3	0.22	(LLD-1.01)
Radish	9	2.34	(LLD-11.6)	3	4.54	(LLD-17.7)
Onions	4	6.39	(2.20-13.4)	3	0.80	(LLD-2.24)
Turnips	9	1.58	(LLD-9.63)	6	1.69	(LLD-7.73)
GARDEN FRUIT						
Watermelons	6	6.75	(1.72-13.1)	3	1.42	(0.952-2.27)
Citrons	3	3.44	(1.68-7.03)	3	0.13	(LLD-LLD)
Tomatoes	6	2.58	(0.853-10.9)	3	1.94	(LLD-0.895)
Strawberries	6	1.01	(LLD-5.58)	0	NS	NS
Cucumbers	3	1.18	(0.705-1.67)	1	0.01	(LLD-0.06)
Yellow Squash	9	1.32	(LLD-27.9)	4	1.66	(0.529-4.84)
Zucchini	6	1.46	(0.477-1.93)	6	2.18	(LLD-9.98)
Okra	0	NS	NS	1	4.63	(N/A)
Green Peppers	6	2.72	(0.67-10.2)	3	0.10	(LLD-0.439)
Egg Plant	3	1.08	(0.643-1.47)	0	NS	NS
TREE FRUITS						
Citrus						
Orange	61	0.36	(LLD-26.3)	20	0.68	(0.068-17.6)
Grapefruit	10	1.28	(LLD-48.9)	3	1.99	(1.69-2.96)
Lemon	3	0.75	(0.626-1.073)	0	NS	NS

*Citrus concentrations in pCi/liter.

radium-228 with ingrowth of thorium-228 or (2) enhancement of radium-228 in the soil, ingrowth of thorium-228 in the soil, and plant uptake of the thorium in response to the soil concentration.

The hypothesis of plant uptake of radium-228 and subsequent ingrowth of thorium-228 has some merit because the observed concentrations of radium-226 indicate a much higher uptake for radium than for thorium. Radium-228 behavior should be similar to that of radium-226. Mean radium-226 concentrations for the various crop categories fell in the range of 1 to 100 pCi/kg with an overall average on the order of 4 to 7 pCi/kg. Radium-228 concentrations would be expected to be an order of magnitude or so lower in the range of 0.1 to 10 pCi/kg with an average around 0.5 pCi/kg. Ingrowth of thorium-228 would be governed by its 1.9 year half life. Since most of the sampled crops are annuals with a life span of a fraction of a year, thorium-228 could reach only a fraction of equilibrium with radium-228 by this mechanism and concentrations on the order of 0.1 pCi/kg would be expected. The observed thorium-228 concentrations were in the range of 0.1 to 10 pCi/kg and clustered around several pCi/kg. Thus, the hypothesis of selective radium mobility, radium-228 uptake and thorium-228 ingrowth in the plant might account for some of the observed thorium-228. However, observed levels appear to be several times to an order of magnitude higher than would be predicated.

If it is assumed that thorium-228 in the soil is in the same form and has the same biological mobility as thorium-232, it would require an enrichment in the soil of 10 to 100 times equilibrium with thorium-232 in order to explain the vegetation thorium-228 concentrations through radium-228/thorium-228 enrichment in the soil. This seems too high to be credible. This is especially so since radium-228 has a half-life of only 6.7 years and the entire enhancement would have to be a recent process rather than one occurring over geological times.

A number of quality assurance checks on the procedures and calculations were undertaken and no errors have been found. A combination of (1) selective uptake of radium-228 with subsequent ingrowth of thorium-228 and (2) radium-228 enhancement in the soil with subsequent uptake of ingrown thorium-228 may account for some of the observed thorium-228. However, these processes do not seem to provide a plausible explanation for all of the thorium-228 seen and this data set remains an enigma.

It is also interesting that the concentrations of thorium-228 on unmined lands are often higher than the concentrations on mined lands. Note, for example, the carrot values which previous data have shown to be higher on the mined lands. Here the geometric mean for the unmined land is two orders of magnitude higher than the same food grown on the mined land. Likewise, the corn data appear to be opposite than what was expected. The dose calculation would be predicted to yield a negative but small impact, since the dose conversion factor for thorium-228 is an order of magnitude lower than that for thorium-232.

10.3.7 <u>Summary</u>

The data summarized in Tables 10-3 through 10-8 are consistent with previously published data which are available for radioactivity concentrations in food. Because of its ability to concentrate in the human body, radium-226 will likely be the critical radionuclide with respect to radiation dose. The thorium data, on the other hand, are not likely to be an important dose contributor, despite the unusual thorium-228 results.

The concentration data show considerable variability from sample to sample within the same food groupings, and even between replicates of the same sample. This variation is not uncommon and underscores the need for replication of samples of this type.

10.4 STATISTICAL ANALYSIS OF RADIUM-226 IN FOOD

10.4.1 Non-Citrus Foods

The purpose of the statistical analysis was to determine significant differences between foods and land types, and to determine whether land types could be combined. Geometric means are compared throughout, since the analysis of residuals reveals that the lognormal assumption is reasonable, and since geometric means are the focus of a lognormal analysis. For the statistical analysis, zero radium-226 measurements in the data were converted to half the lowest measurements in the corresponding food, so that the logarithmic transformation could be applied.

Comparisons of the geometric means of radium-226 concentrations by land type revealed no significant differences between the control and mineralized types, and between the clay settling area and other mined types (see Table 10-9 and Figure 10-1).

Table 10-9

LAND TYPE GEOMETRIC MEANS

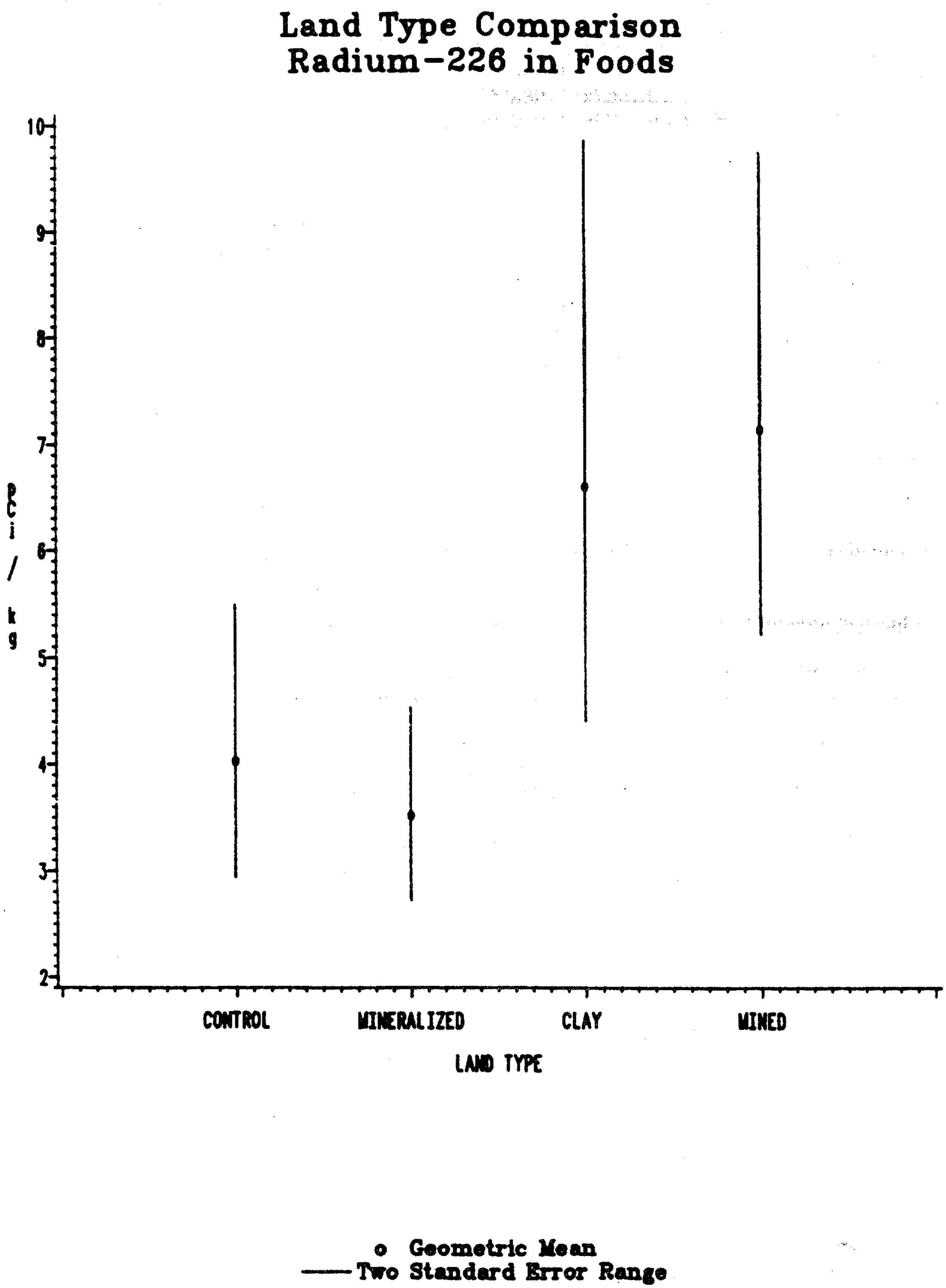
NON-CITRUS

Ra-226 (pCi/kg)

Control	4.02	No significant difference
Mineralized	3.51	
Clay Settling Area	6.59	No significant difference
Other Mined Lands	7.12	

Therefore, before proceeding to compare food types, control and mineralized samples were combined as "unmined"; and reclaimed clay and other reclaimed samples were combined as "mined". This yielded better balance in the design, and permitted more powerful comparisons of both land types and food types.

After combining these land types, the analysis of variance revealed that the land type/food type interaction was significant, and that land types differed significantly overall. The implication is that food types differ, but the nature of the difference depends on the land type. Moreover, the unmined and mined land types differ, but the extent of the difference depends on the food. Comparisons reveal that the mean level of radium-226 in foods on mined land is significantly greater than that on unmined land, with geometric means of 6.92 and 3.71, pCi/kg respectively. To determine which food types contribute most to this difference, the adjusted geometric means were compared by land type and food type to yield the significant differences shown on Table 10-10. Figure 10-2 graphically displays these differences.



LAND TYPE COMPARISON

FIGURE 10-1

Table 10-10
GEOMETRIC MEANS[a]
BY LAND TYPE AND FOOD TYPE

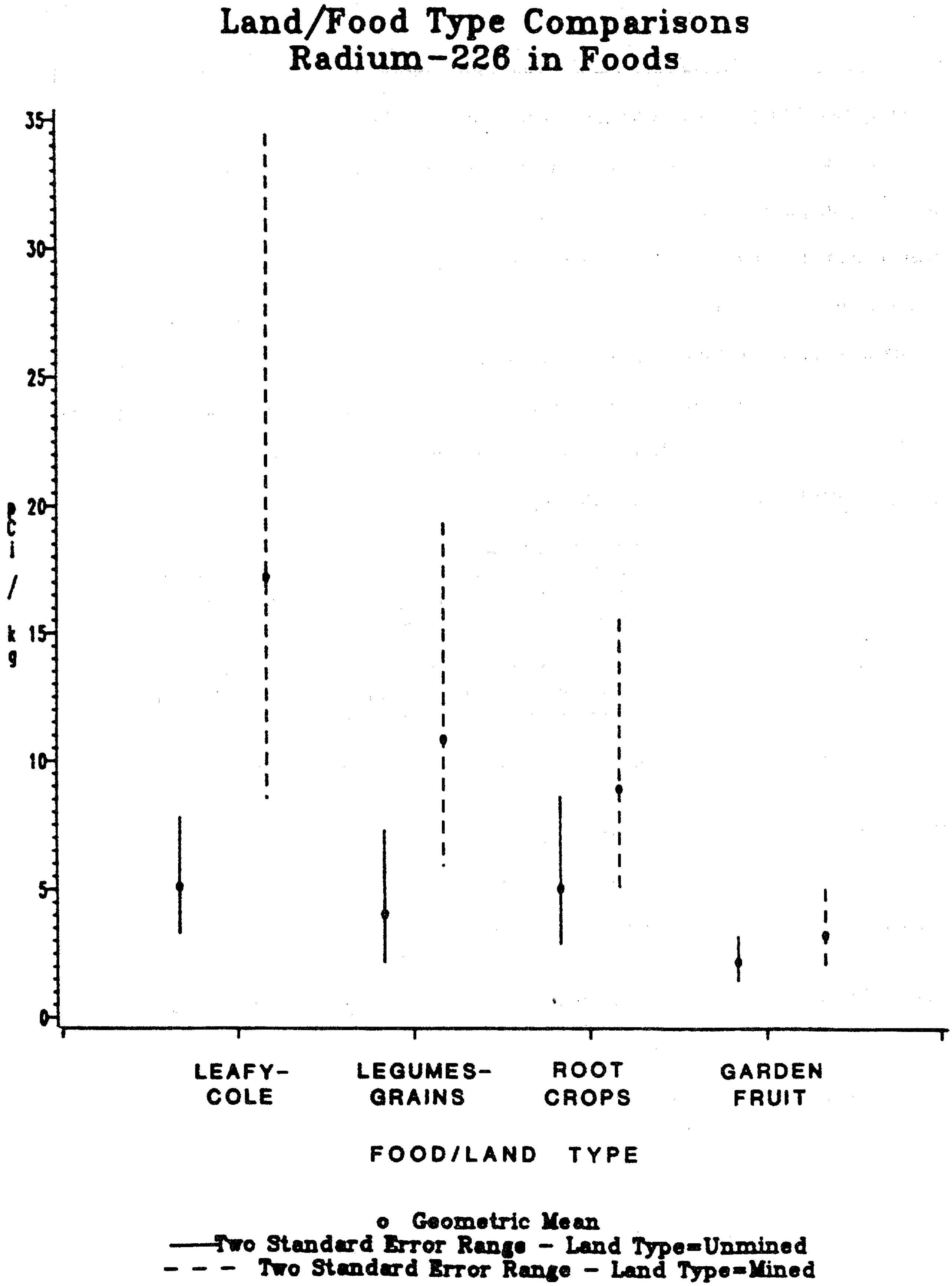
Food Type	Ra-226 (pCi/kg) Land Type Unmined	Mined
Leafy/Cole Vegetables	5.10	17.17
Legume/Grains	4.02	10.82
Root Crops	5.04	8.90
Garden Fruits	2.20	3.23

From the data above, the following land/food relationships are derived:

Ra-226 Concentration		Ra-226 Concentration
Mined Leafy/Coles	>	Unmined Leafy/Coles
Mined Legume/Grains	>	Unmined Legumes/Grains[b]
Mined Leafy/Coles	>	Mined Garden Fruit
Mined Legume/Grains	>	Mined Garden Fruit
Mined Root Crop	>	Mined Garden Fruit
Unmined Leafy/Coles	>	Unmined Garden Fruit
Unmined Root Crop	>	Unmined Garden Fruit

[a]Adjusted for design imbalance.

[b]At the 0.02 level of significance.



LAND/FOOD TYPE COMPARISONS

FIGURE 10-2

Adjusted geometric means by land type and specific food are shown on Table 10-11 and in Figures 10-3 through 10-6. Of the foods that were sampled on both mined and unmined land, only one significant difference was found:

Ra-226 concentration		Ra-226 concentration
Mined turnip greens	>	Unmined turnip greens

It should be noted, however, that in the Leafy/Cole food type, only two foods were sampled on both land types: turnip greens and collard greens. Comparing the foods sampled on mined land, the following significant differences were found (0.01 level of significance, except as noted):

Ra-226 Concentration		Ra-226 Concentration
Turnip Greens	>	Cabbage, Blackeyed Peas, Corn, Green Beans, Citrons, Cucumbers, Green Peppers, Tomatoes, Watermelon, Yellow Squash, Zucchini, Onions, Potatoes, Turnip Roots
Lima Beans	>	Cabbage, Blackeyed Peas, Green Beans, Citrons, Cucumbers, Green Peppers, Tomatoes, Watermelon, Yellow Squash, Zucchini, Potatoes
Collard Greens	>	Green Peppers, Tomatoes, Watermelon[a], Yellow Squash[a]
Blackeyed Peas	>	Green Peppers
Okra	>	Green Peppers[a]
Radishes	>	Tomatoes, Green Peppers, Watermelon[a], Yellow Squash[a]
Turnip Roots	>	Green Peppers, Tomatoes, Watermelon[a], Yellow Squash[a]

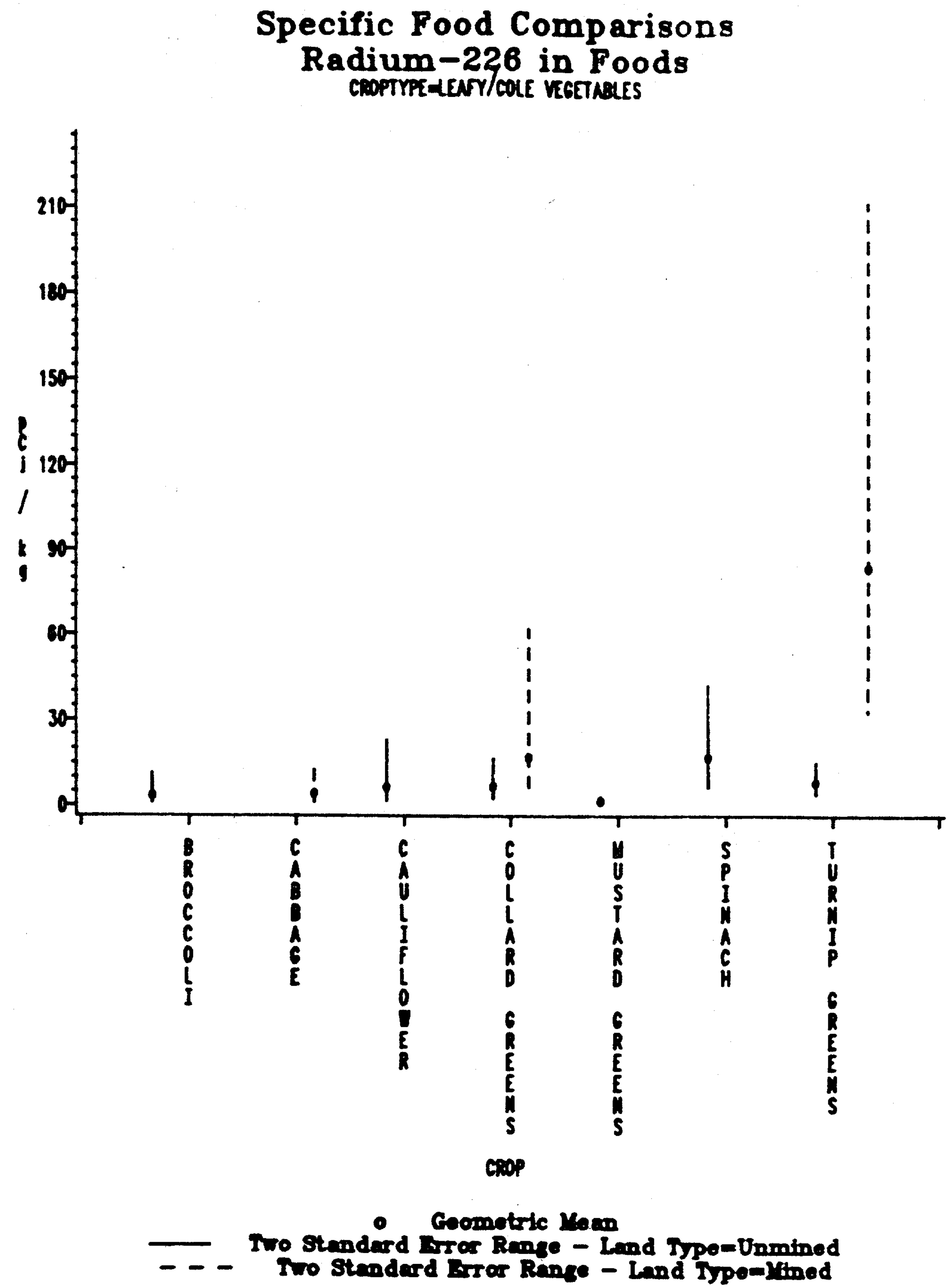
[a]At the 0.02 level of significance.

Table 10-11
GEOMETRIC MEANS[a]
BY LAND TYPE AND SPECIFIC FOOD

Crop Type	Crop	Radium-226 (pCi/kg) Land Type Unmined	Mined
Leafy/Cole Vegetables	Broccoli	3.00	--
	Cabbage	--	3.68
	Cauliflower	6.03	--
	Collard Greens	6.41	16.54
	Mustard Greens	1.18	--
	Spinach	16.51	--
	Turnip Greens	7.83	83.16[b]
Legume/Grains	Blackeyed Peas	2.57	6.66
	Corn	4.89	8.49
	Green Beans	5.16	3.68
	Lima Beans	--	65.71
Root Crops	Carrots	8.52	--
	Onions	5.40	9.91
	Radishes	3.82	14.90
	Potatoes	--	3.67
	Turnips	3.66	11.58
Garden Fruits	Citrons	1.29	4.48
	Cucumbers	3.22	5.60
	Eggplants	1.51	--
	Green Peppers	1.87	1.03
	Okra	--	21.16
	Tomatoes	2.94	1.40
	Watermelons	1.24	1.87
	Yellow Squash	4.11	2.10
	Zucchinis	3.10	3.98

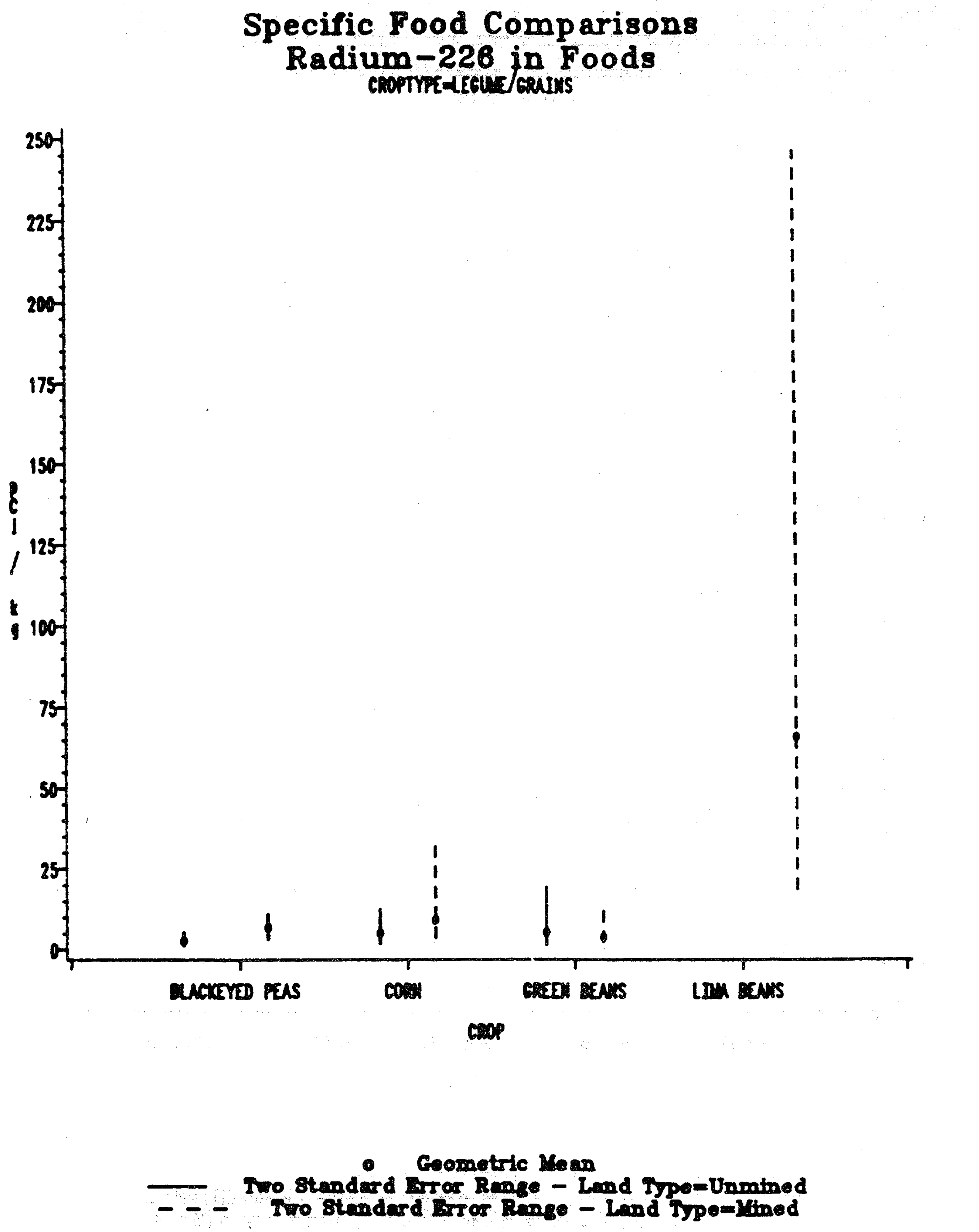
[a]Adjusted for design imbalance.

[b]Statistically different at 0.01 level



SPECIFIC FOOD COMPARISONS (LEAFY/COLE VEGETABLES)

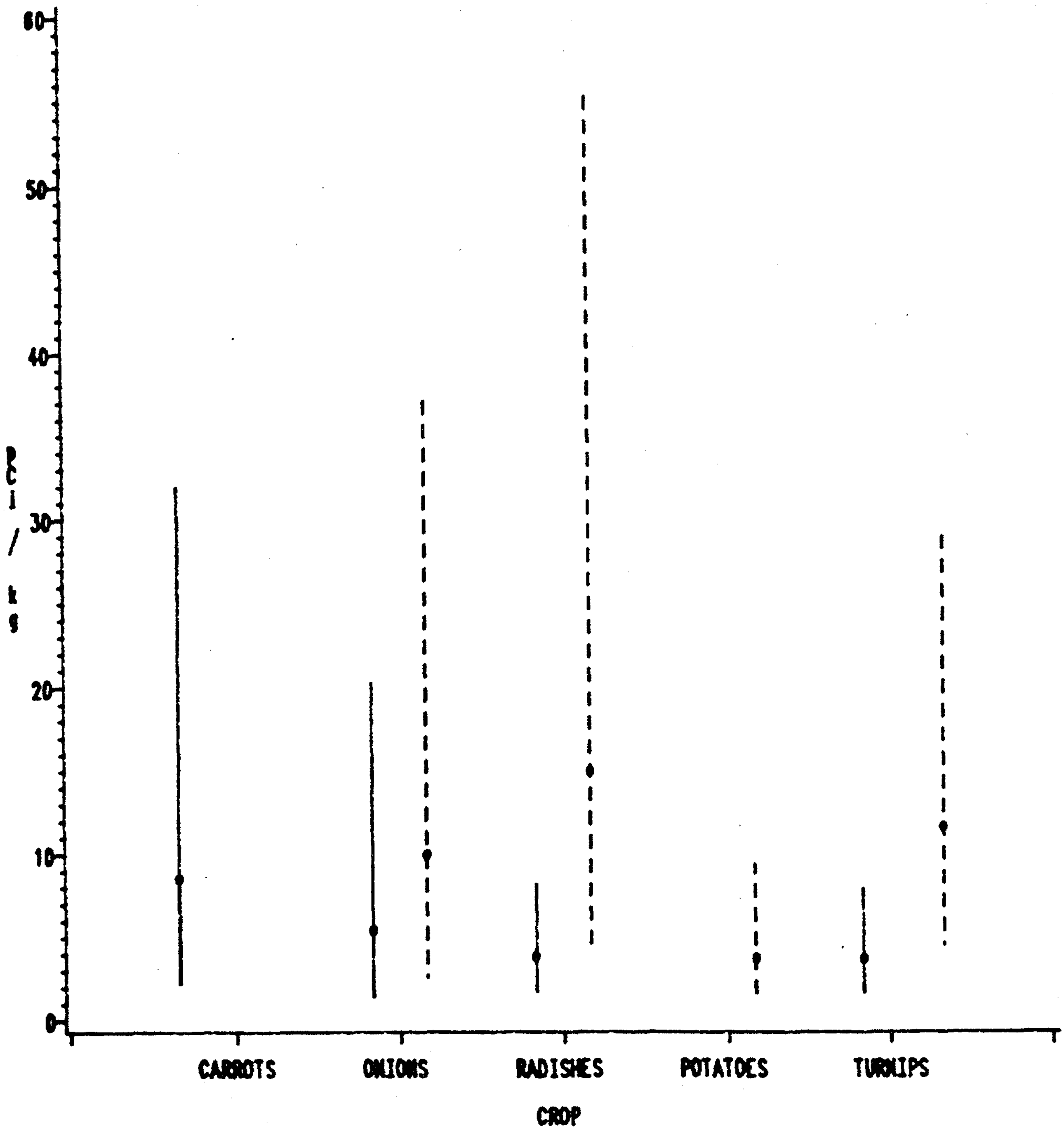
FIGURE 10-3



SPECIFIC FOOD COMPARISONS (LEGUMES/GRAINS)

FIGURE 10-4

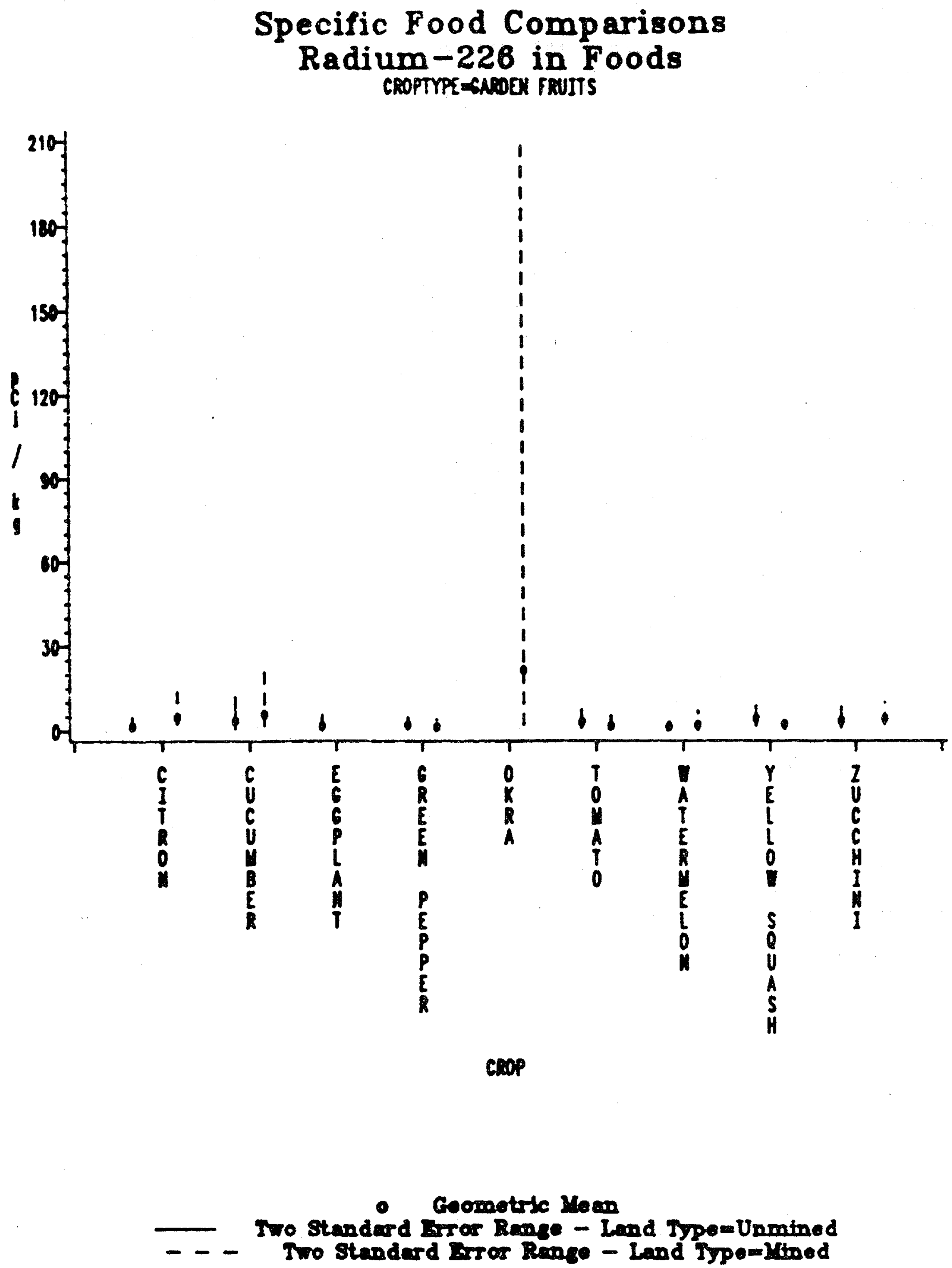
Specific Food Comparisons
Radium-226 in Foods
CROPTYPE=ROOT CROPS



o Geometric Mean
——— Two Standard Error Range - Land Type=Unmined
- - - Two Standard Error Range - Land Type=Mined

SPECIFIC FOOD COMPARISONS (ROOT CROPS)

FIGURE 10-5



SPECIFIC FOOD COMPARISONS (GARDEN FRUITS)

FIGURE 10-6

Comparing the foods sampled on unmined land, the following significant differences were found (0.01 level of significance, except as noted):

Ra-226 Concentration		Ra-226 Concentration
Spinach	>	Mustard Greens, Blackeyed Peas, Citrons, Eggplant, Green Peppers, Tomatoes, Watermelon, Turnip Roots, Zucchini, Yellow Squash[a], Radishes[a]
Turnip Greens	>	Mustard Greens, Citrons[a], Green Peppers, Watermelon
Collard Greens	>	Mustard Greens, Watermelon

In summary, the reclaimed clay land type was statistically similar to the other reclaimed parcels, and the control and mineralized land types were also similar. The combined mined type (which includes all reclaimed parcels) exhibited significantly higher overall average levels of radium-226 than the unmined type. The Leafy/Cole food type apparently is the primary cause of this difference, since it exhibited significantly higher average levels on the mined land than on the unmined land. However, the levels for the Legume/Grains food category was also significantly higher in mined samples at the 0.02 level of significance. Garden Fruits were significantly lower than all other food types on the mined land, and lower than Leafy/Coles and Root Crops on the unmined land. Of the individual foods sampled on both mined and unmined land, only turnip greens were significantly higher on mined land than they were on unmined land.

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[a]At the 0.02 level of significance.

A number of foods were found to be significantly different within the mined land type, with Leafy/Coles and Legume/Grains tending to be higher than the others. Among root foods, radishes and turnip roots had relatively high levels. The only Garden Fruit with a relatively high level was okra; however, its value was based on a single observation.

On unmined land, spinach, turnip greens, and collard greens (among the Leafy/Coles) have relatively high levels, as do carrots among the Root foods. The highest Legume/Grain on mined land (lima beans) was not available on unmined land.

10.4.2 Beef

Two beef samples were analyzed, one from mined land and one from unmined land. Each sample was replicated three times, yielding a total of six beef observations. The geometric means for radium-226 were 3.98 and 3.41 for mined and unmined land, respectively. This is considered to be a statistically insignificant difference.

10.4.3 Citrus

Results of the citrus sample analyses are reported as picocuries per liter (pCi/l). Like the non-citrus foods, no significant differences were found between control and mineralized land types, with geometric means of 1.61 and 2.24 pCi/l, respectively. (No citrus foods were sampled on reclaimed clay.) Therefore, these two land types were combined as unmined land, and the citrus analysis was conducted using the two basic land types: unmined and mined.

The adjusted geometric means of these land types are shown on Table 10-12 below and in Figure 10-7.

Table 10-12

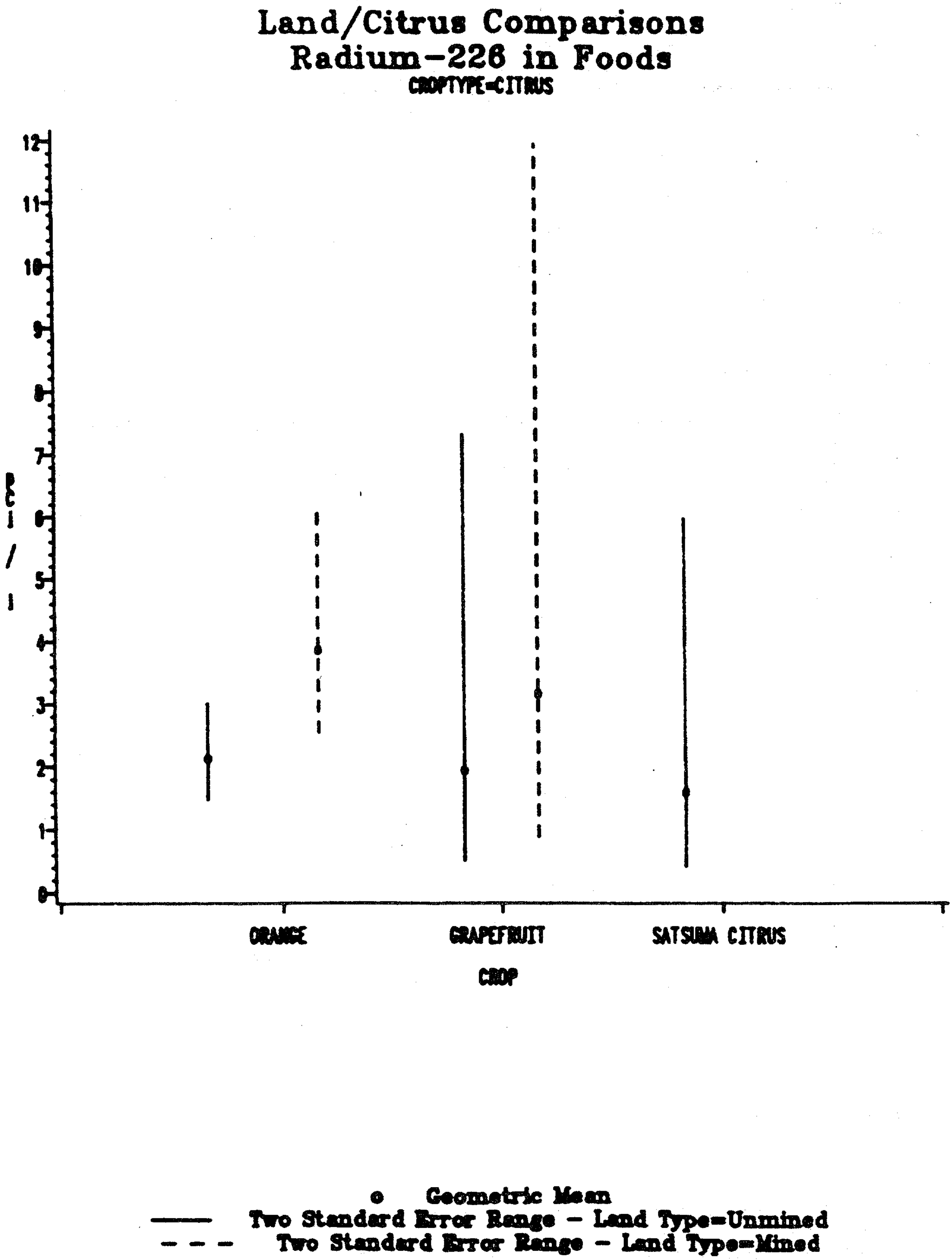
GEOMETRIC MEANS[a]
BY LAND TYPE AND CITRUS FOOD

Food Type	Radium-226 (pCi/kg) Land Type Unmined	Mined
Orange	2.11	3.84
Grapefruit	1.92	3.14
Satsuma Citrus	1.57	--

[a]Adjusted for design imbalance.

The analysis of variance on the citrus data revealed one important difference between it and the non-citrus analysis: the variation among samples of the same food was significantly greater than the variation among replicates. Note that each sample usually consists of three replicates. Best estimates are that the "between" sample (sample-to-sample) variation exceeds the "within" sample (replicate-to-replicate) variation by a factor of about 2.5. In contrast, the non-citrus analysis yielded approximately equal estimates of "between" and "within" sample variance, so that the two could be (and were) combined when conducting the various comparisons.

The replicate (within sample) error in the citrus analyses is about half that in the non-citrus analyses, implying that the replicates in the citrus sample are significantly more homogenous. The problem this poses is that only one of two sources of variation may be used to compare the crops: "between" sample or "within" sample. It is more statistically appropriate to use the "between" sample variability when making the food comparisons. This yields no signifi-



LAND/CITRUS COMPARISONS

FIGURE 10-7

cant differences among the geometric means on Table 10-3. However, if the replicate variability is used, the mined and unmined orange means will be significantly different at the 0.01 level. Although more sampling may he warranted, none of the means can be said to differ significantly on a statistical basis alone.

10.4.4 Samples From Debris Lands

Four foods were sampled on the debris land: green beans, spinach, turnip roots, and yellow squash. Each sample was replicated three times, yielding a total of 12 observations. The geometric means (pCi/kg) for radium-226 were:

Green Beans	9.79
Spinach	540.26
Turnip Roots	19.22
Yellow Squash	5.15

These means are high relative to most of the rest of the land/food combinations sampled in this study. Inclusion of these data in the statistical analyses results in the following statistically significant differences (using the same significance levels as in the main body of the analyses):

Ra-226 Concentration	Ra-226 Concentration
Debris	> Unmined
Debris	> Mined
Debris Leafy/Coles	> All Other Land/Food type combinations

The spinach sample is clearly the primary cause of the statistical significance; and while the other means are relatively high, there are insufficient sample sizes to infer statistical significance. Also, the fact that the debris samples are from a single parcel is of concern, since we have no measure of parcel-to-parcel variability on debris land.

In conclusion, the crops grown on debris land apparently have appreciably higher concentrations of radium-226. However, additional sampling would be necessary before the statistical significance of this statement can be accurately measured.

10.4.5 Nonparametric Analyses

The analyses described in the previous sections were repeated, using the ranks of the observations rather than the radium-226 values themselves; that is, all radium values were ranked from lowest to highest; then the analyses of variance and multiple comparisons were performed on the ranks. This nonparametric procedure was conducted to determine whether the results using the lognormal assumption were robust, or whether the conclusions were heavily dependent on the assumption of lognormality.

Analysis of the rank data supports every major conclusion reported above. The combinations of land types were affirmed, as were the differences between land types and food types. Only at the food level were some discrepancies found, but these would produce no major changes in the conclusions of the statistical analysis. The net result is that both the analysis of residuals and the nonparametric analysis provide strong support for the lognormal analysis and the resulting conclusions. In contrast, an analysis that is based on an assumed normal distribution of the radium measurements is not supportable.

10.5 RADIOACTIVITY INTAKE AND RADIATION DOSE

Tables 10-13 and 10-14 summarize (by radionuclide) the radioactivity intake and calculated doses to the individuals studied. Results for the lead-210 and polonium-210 analyses are not included in the intake and dose estimation since so few data values are available for these radionuclides. The available concentrations are listed in Appendix B. Intakes and doses for individuals are listed for sampled foods only and for total diet. As shown, most of the dose to the maximum individual from sampled foods (88 percent) is from the uranium series radionuclides, and the majority of that dose (89 percent) is from radium-226. The maximum individual is expected to receive 4 mrem per year from the listed radionuclides, which is only 0.3 mrem more than the control individual. This represents only an eight per cent increase in an already low radiation dose. These doses can be considered conservative estimates since (1) most foods would be cooked and peeled prior to consumption, thus reducing the radioactivity remaining in the processed food, and (2) the method used for treating concentrations which were below detection limits would tend to overestimate food concentrations and, thus, intake and dose.

Despite the paucity of data from debris lands, a similar calculation was made where the concentration of foods sampled on debris lands was substituted for all similiar foods. The total dose for this individual, who would obtain all study foods from debris and mined lands (whichever exhibited the higher concentrations), was estimated to be 6.1 mrem per year--2.5 mrem (68 percent) greater than the control individual.

Table 10-13

RADIONUCLIDE INTAKE (pCi/year)*

	Sampled Foods			Total Diet		
	Control	Local Individual	Maximum Individual	Control	Local Individual	Maximum Individual
Uranium Series						
U-238	38	56	218	786	804	966
U-234	96	105	184	844	853	932
Th-230	99	94	49	518	513	468
Ra-226	537	573	899	1940	1976	2301
Thorium Series						
Th-232	18	18	19	103	103	104
Th-228	613	576	248	1492	1456	1128

*Values only considered accurate to 2 significant figures.

Table 10-14

RADIONUCLIDE DOSE (mrem/year)*

	Sampled Foods			Total Diet		
	Control	Local Individual	Maximum Individual	Control	Local Individual	Maximum Individual
Uranium Series						
U-238	0.009	0.013	0.050	0.181	0.185	0.222
U-234	0.025	0.027	0.048	0.219	0.222	0.242
Th-230	0.053	0.051	0.026	0.280	0.277	0.253
Ra-226	0.591	0.631	0.989	2.133	2.173	2.531
SUBTOTAL	0.678	0.722	1.113	2.813	2.857	3.248
Thorium Series						
Th-232	0.048	0.048	0.052	0.277	0.277	0.281
Th-228	0.233	0.219	0.094	0.567	0.553	0.428
SUBTOTAL	0.281	0.267	0.146	0.844	0.830	0.709
Total Dose	0.959	0.989	1.259	3.657	3.687	3.957

*Values only considered accurate to 2 significant figures.

Radionuclide concentrations for lead-210 and polonium-210 are available in the literature (28) and indicate that, using the diet model for this study, the intakes for these nuclides are approximately 500 picocuries each. This intake would result in an additional CEDE of approximately 3.5 mrem per year, which is comparable to the dose from the other nuclides. The few concentrations listed in Appendix B are not conclusive in that, for some foods, the mined concentration exceeds the unmined concentration, and for other foods, the opposite is true. A statistical analysis may not be appropriate due to the small size of the data set and the few sets of paired mined/unmined concentrations. In addition, the authors feel that to estimate doses from these data would involve assumptions which would deviate substantially from the dose estimation methods used for the other data. It is important to note that (1) the dose from lead-210 and polonium-210 may be substantial, (2) the data for these nuclides generated in this study are too incomplete to allow valid comparisons of mined versus unmined concentrations in foods, and (3) subsequent studies should consider the potential dose contribution from these two radionuclides.

10.6 ESTIMATED RISK

Because the radiation doses estimated above are low, and are only a small fraction of the typical background radiation dose experienced by Central Florida residents (approximately 200 mrem per year), risk estimates were not made. It is further believed that risk estimates at these dose levels would have little value. However, the incremental risk due to radiation exposure from consumption of foods grown on Florida phosphate lands can be stated as being less than the risk due to radiation exposure from airline travel (5), and within the range of random fluctuations in natural background.

Section 11

CONCLUSIONS/RECOMMENDATIONS

11.1 CONCLUSIONS

Based on the results described in the previous sections, it can be concluded that foods grown on mined phosphate lands (including reclaimed, debris, and unreclaimed lands) exhibit higher concentrations of radium-226, uranium, and thorium than foods grown on unmined lands (including phosphate mineralized and unmineralized lands). The higher food concentrations result in higher rates of ingestion for these radionuclides and, subsequently, slightly higher radiation doses to those individuals ingesting the foods. The doses, however, are quite low, even for the hypothetical maximum individual who consumes all study foods from mined lands. All estimated radiation doses would be a small fraction of natural exposure to environmental radioactivity, and are not considered to be a health hazard.

Results of the lead and polonium analyses are inconclusive, due to the few data values which were available. The potential dose from these nuclides could be comparable to the doses shown on Table 10-14. Assuming that foods grown on mined lands exhibited similarly higher levels of these two radionuclides as the radionuclides shown, the total difference in dose between the maximum individual and the control individual should still be less than 1 mrem per year.

The data listed in Tables 10-3 through 10-8 represent an important contribution to the understanding of the uptake of naturally-occurring radionuclides, not only for Florida, but in general. In reviewing the literature it is clearly evident that this body of data is an extremely unique set. Nowhere is there a more complete set of data on these radionuclides in food crops and associated soils with the degree of replication. This data will be analyzed and re-analyized a number of times. There are a number of ways in which the data can be correlated, presented and incorporated into models and programs, The data set should provide the basis for deciding which radionuclides should be investigated in more detail and which can be "laid to rest" without further concern. The dose calculations with the single diet model that was used is one of many inputs that can utilize this very important data set.

11.2 RECOMMENDATIONS

Based on the low doses estimated from this study, a recommendation to limit food production on most reclaimed lands does not appear to be warranted. Some foods sampled on debris lands did exhibit substantially higher levels of several radionuclides than similar foods grown on other land types; however, the significance of the differences cannot be established because of the small number of samples collected from debris lands.

It is recommended that additional parcels of debris and control lands be located and their characterization confirmed. The parcels should be surveyed for external gamma radiation and soil samples should be collected and analyzed for radium-226, lead-210, polonium-210, cation exchange capacity, removable calcium, and pH. Foods currently being grown or crops planted on these parcels should be collected and analyzed for radium-226, lead-210, and polonium-210. A range of foods should be sampled; however, if this is not possible, leafy vegetables, legumes, and root crops should be given primary emphasis. Due to the few beef samples which were obtained in this study, samples of beef and forage should also be obtained.

The results of this followup study should be integrated into the existing data base so that sound statistical conclusions can be made regarding the debris land foods. In addition, the soil parameters measured should be compared to the food concentrations to provide a better understanding of the uptake mechanism for these radionuclides. It is also recommended that these evaluations be completed before restrictions on use are considered for these lands.

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APPENDIX A

APPENDIX A

PARCEL LISTING

Table A-l lists the land parcels which were investigated during the study. The land type listed is the original categorization for the parcel; as described in the body of the report, some of the parcels were grouped into the ‘mined’ and ‘unmined’ land categories. Also shown are the results of the external gamma radiation survey and any pertinent notes on the parcel. The gamma survey numbers are raw readings in microroentgens per hour, uncorrected for extended field calibration.

TABLE A-1
PARCEL LISTING

Parcel Number		Location	Land Type	Food Type	Sampling		Background Gamma Survey			Notes
ZW	PBSJ	(County)			Date	Time	High	Low	Avg.	
Pilot Study										
Z36	1	Polk	Mineralized	Tomatoes	11-1-83	10:55 a.m.				
Z33	2	Hillsborough	Mineralized	"Early" Oranges	11-1-83	11:40 a.m.				
Z33	3	Hillsborough	Mineralized	Hamlin Oranges	11-1-83	12:05 a.m.				
-	4	Polk	Mineralized	Hamlin Oranges	11-1-83	12:45 a.m.				
-	5	Polk	Mineralized	Grapefruit	11-1-83	2:30 p.m.				
Z1	6	Hillsborough	Disturbed	Spinach	11-2-83	11:50 a.m.				
-	7	Orange	Control	Corn	11-4-83	10:05 a.m.				
-	8	Orange	Control	Carrots	11-4-83	10:30 a.m.				
-	9	Orange	Control	Radishes	11-4-83	11:00 a.m.				
Z39	10	Polk	Reclaimed	Oranges	11-15-83	3:30 p.m.	120	60	80	
Z14	11	Hillsborough	Reclaimed	Pole Beans	11-22-83	1:45 p.m.	30	22	27	
Z14	11	Hillsborough	Reclaimed	Red Bliss Potatoes	11-22-83	2:10 p.m.	40	22	28	
Z14	11	Hillsborough	Reclaimed	Zucchini	11-22-83	2:30 p.m.	26	16	20	
Episode I										
Z55	12	Polk	Disturbed	Citron	4-5-84	9:45 a.m.	40	20	28	
Z86	13	Polk	Reclaimed	Oranges	4-5-84	10:55 a.m.	50	20	40	
Z46	14	Polk	Reclaimed	Oranges	4-5-84	11:50 a.m.	30	25	28	
Z35	15	Manatee	Mineralized	Oranges	4-5-84	2:00 p.m.	4	2	3	
Z17	16	Hardee	Mineralized	Oranges	4-5-84	3:10 p.m.	4	1	2.5	
Z69	17	Hardee	Mineralized	Oranges	4-5-84	4:30 p.m.	4	2	3	
Z19	18	Hardee	Mineralized	Oranges	4-5-84	5:00 p.m.	3	2	2.5	
Z66	19	Hardee	Mineralized	Oranges	4-13-84	9:43 a.m.	8	3	6	
Z67	20	Hardee	Mineralized	Oranges	4-13-84	10:30 a.m.	12	2	5	
Z68	21	Hardee	Mineralized	Oranges	4-13-84	11:20 a.m.	6	2	4	
Z14	11	Hillsborough	Reclaimed	Zucchini	4-13-84	1:30 p.m.	18	14	16	
Z1	6	Hillsborough	Disturbed	Turnip Roots	4-13-84	3:00 p.m.	60	50	55	
Z1	6	Hillsborough	Disturbed	Yellow Squash	4-13-84	3:30 p.m.	60	50	55	
Z1	6	Hillsborough	Disturbed	Fertilizer Sample	4-13-84	4:00 p.m.				
Z3	23	Hillsborough	Mineralized	Broccolli	4-13-84	4:15 p.m.	4	2	3	

TABLE A-1
PARCEL LISTING

Parcel Number ZW	PBSJ	Location (County)	Land Type	Food Type	Sampling Date	Sampling Time	Background Gamma Survey High	Low	Avg.	Notes
Episode 1 (cont)										
Z64	24	Polk	Reclaimed	Zipper Cream Peas	5-24-84	9:34 a.m.				
Z64	24	Polk	Reclaimed	Corn	5-24-84	10:30 a.m.				
Z64	24	Polk	Reclaimed	Conch Peas	5-24-84	11:30 a.m.				
Z85	44	Polk	Mineralized	Yellow Squash	5-24-84	12:45 a.m.				
Z64	24	Polk	Reclaimed	Lima Beans	5-24-84	1:00 p.m.				
Z71	25	Manatee	Mineralized	Green Pepper	5-24-84	3:00 p.m.				
Z72	26	Manatee	Mineralized	Watermelon	5-24-84	4:00 p.m.				
Z73	26	Manatee	Mineralized	Watermelon	5-24-84	4:10 p.m.				
Z14	11	Hillsborough	Reclaimed	Turnip Greens	7-5-84	9:45 a.m.				
Z14	11	Hillsborough	Reclaimed	Turnip Roots	7-5-84	9:45 a.m.				
Z73	28	Hillsborough	Reclaimed	Beef	7-5-84	1:00 p.m.				
-	99	Hillsborough	Control	Beef	7-5-84	1:00 p.m.				
-	29	Lake	Control	Turnip Greens	9-17-84	11:02 a.m.				
-	30	Lake	Control	Collard Greens	9-17-84	11:18 a.m.				
-	31	Lake	Control	Radishes	9-17-84	11:42 a.m.				
-	32	Orange	Control	Black-eyed Peas	9-18-84	10:10 a.m.				
-	33	Orange	Control	Yellow Corn	9-18-84	10:43 a.m.				
-	33	Orange	Control	Turnip Root	9-18-84	11:10 a.m.				
-	33	Orange	Control	Turnip Greens	9-18-84	11:10 a.m.				
Episode 2										
Z82	34	Polk	Mineralized	Citron	9-21-84	1:00 p.m.				
Z60	36	Hillsborough	Mineralized	Satsumo Oranges	11-8-84	1:00 p.m.				
Z79	35	Polk	Reclaimed	Radishes	11-9-84	10:20 a.m.				
Z14	11	Hillsborough	Reclaimed	Cucumbers	11-9-84	10:20 a.m.				
Z80	37	Hillsborough	Mineralized	Green Onions	11-9-84	12:15 a.m.	4	1	3	
Z80	37	Hillsborough	Mineralized	Purple Hull Crowder Peas	11-9-84	12:15 a.m.				
Z80	37	Hillsborough	Mineralized	Yellow Squash	11-9-84	12:45 a.m.				
Z80	37	Hillsborough	Mineralized	Mustard Greens	11-9-84	12:50 a.m.				
Z85	44	Polk	Mineralized	Purple Hull Crowder Peas	11-9-84	2:50 p.m.	8	4	5	

TABLE A-1
PARCEL LISTING

Parcel Number ZW	Parcel Number PBSJ	Location (County)	Land Type	Food Type	Sampling Date	Sampling Time	Background Gamma Survey High	Background Gamma Survey Low	Background Gamma Survey Avg.	Notes
Episode 2 (cont)										
Z87	38	Hillsborough	Control	Tomatoes	11-19-84	11:00 a.m.	3	1	2	
Z88	39	Hillsborough	Control	Cauliflower	11-19-84	11:30 a.m.	4	2	3	
Z89	40	Hillsborough	Control	Cucumbers	11-19-84	12:16 a.m.	2	1	0	
Z89	40	Hillsborough	Control	Green Peppers	11-19-84	12:35 a.m.	3	1	2	
Z78	41	Hillsborough	Mineralized	Zucchini	11-19-84	2:00 p.m.	4	2	3	
Z78	41	Hillsborough	Mineralized	Radishes	11-19-84	2:21 p.m.	5	2	4	
Z78	41	Hillsborough	Mineralized	Bush Pole Beans	11-19-84	2:50 p.m.	5	1	3	
Z79	42	Hillsborough	Mineralized	Yellow Squash	11-19-84	3:55 p.m.	4	1	2	
Z78	43	Hillsborough	Mineralized	Eggplant	11-19-84	4:31 p.m.	6	2	4	
Z2	45	Hillsborough	Reclaimed	Yellow Squash	11-19-84	5:20 p.m.	60	45	55	
Z79	35	Polk	Reclaimed	Yellow Squash	12-2-84	12:00 a.m.				
Z14	11	Hillsborough	Reclaimed	Potatoes	12-3-84	9:36 a.m.	29	16	22	
Z14	11	Hillsborough	Reclaimed	Purple Hull Crowder Peas	12-3-84	9:54 a.m.	30	16	24	
Z91	36	Hillsborough	Mineralized	Hamlin Oranges	12-3-84	12:24 a.m.	10	6	8	
Z60	46	Hillsborough	Reclaimed	Pink Grapefruit	12-3-84	1:25 p.m.	30	10	22,14	Average of 1st two replicates was 22, avg. of 3rd was 14
Z60	47	Hillsborough	Reclaimed	Hamlin Oranges	12-3-84	2:52 p.m.	60	20	35	
Z60	47	Hillsborough	Reclaimed	Hamlin Oranges	12-3-84	3:15 p.m.	16	6	8	
Z1	6	Hillsborough	Disturbed	Green Beans	12-3-84	4:20 p.m.	80	60	65	
Z79	35	Polk	Reclaimed	Black-eyed Peas	12-4-84	9:40 a.m.	50	50	50	
Z79	35	Polk	Reclaimed	Turnip Greens	12-4-84	9:45 a.m.				
Z79	35	Polk	Reclaimed	Turnip Roots	12-4-84	9:45 a.m.				
Z86	13	Polk	Reclaimed	Oranges	12-4-84	11:21 a.m.	40	20	30	
Z46	14	Polk	Reclaimed	Oranges	12-4-84	12:02 a.m.	40	20	30	
Z39	10	Polk	Reclaimed	Oranges	12-4-84	12:58 a.m.	130	95	110	
Z79	35	Polk	Reclaimed	Green Peppers	12-7-84	2:00 p.m.				
Z79	35	Polk	Reclaimed	Okra	12-7-84	2:00 p.m.				
Z79	35	Polk	Reclaimed	Tomatoes (Green)	12-7-84	2:00 p.m.				Still green, sampled early due to freeze warning
Z64	24	Polk	Reclaimed	Watermelon	12-7-84	4:15 p.m.				

TABLE A-1
PARCEL LISTING

Parcel Number ZW	Parcel Number PBSJ	Location (County)	Land Type	Food Type	Sampling Date	Sampling Time	Background Gamma Survey High	Background Gamma Survey Low	Background Gamma Survey Avg.	Notes
Episode 2 (cont)										
Z85	44	Polk	Mineralized	Collard Greens	12-7-84	4:20 p.m.				
Z85	44	Polk	Mineralized	Turnip Greens	12-7-84	4:45 p.m.				
Z85	44	Polk	Mineralized	Turnip Roots	12-7-84	4:45 p.m.				
Z79	35	Polk	Reclaimed	Cabbage	12-12-84	10:00 a.m.				
Z79	35	Polk	Reclaimed	Green Onions	12-12-84	10:00 a.m.				
Z92	48	Hillsborough	Mineralized	Zucchini	12-18-84	1:21 p.m.	5	1	3	
Z78	41	Hillsborough	Mineralized	Turnip Greens	12-18-84	2:35 p.m.	5	2	3	
Z78	41	Hillsborough	Mineralized	Turnip Roots	12-18-84	2:35 p.m.	5	2	3	
	49	Orange	Control	Oranges	12-21-84	9:30 a.m.	8	4	6	
	50	Orange	Control	Oranges	12-21-84	9:57 a.m.	7	4	6	
	51	Orange	Control	Oranges	12-21-84	10:25 a.m.	3	2	2.5	
	52	Orange	Control	Oranges	12-21-84	11:00 a.m.	6	3	4	
	30	Lake	Control	Spinach	3-25-85	10:16 a.m.				
	30	Lake	Control	Mustard Greens	3-25-85	10:25 a.m.				
Z90	61	Polk	Mineralized	Collard Greens	3-14-85	6:15 a.m.				
Z90	61	Polk	Mineralized	Carrots	3-14-85	4:30 p.m.				
Z79	35	Polk	Reclaimed	Carrots	3-29-85	10:45 a.m.				
Z91	48	Hillsborough	Mineralized	Strawberries	3-29-85	1:15 p.m.				
Z92	60	Hillsborough	Mineralized	Strawberries	3-29-85	1:45 p.m.	4	2	3	
Z92	60	Hillsborough	Mineralized	Onions	3-29-85	2:20 p.m.	4	2	3	
Z93	62	Polk	Mineralized	Spinach	4-24-85	3:21 p.m.				

APPENDIX B

APPENDIX B

ANALYTICAL DATA

Table B--l lists the analytical data for the radioactivity measured in the foods sampled during the study. Data are listed to three decimals for ease of evaluation in the data base; however, these data can only be considered accurate to three significant figures.

Note that surface soil pH and radium-226 data are listed only for certain citrus samples, since these were the only samples for which surface and root zone soil differed and for which both were collected. If no result is listed, then no analysis was conducted. If the result is listed as zero, then the analysis was conducted but no radioactivity was detected.

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY PARCEL	CATEGORY FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	RADIOACTIVITY CONCENTRATION (pCi/Kg or liter) U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	MIN	NTF		5.740		0.431	0.000	1.013	7.431	2.981			0.153	10.495
TOMATO	MIN	NTF		5.850		0.623	0.000	0.360	9.646	2.148			0.000	10.859
	MIN	NTF		6.440		0.470	2.123	4.984	10.023	4.581			0.000	0.853
	MIN	CIT		4.850		0.401				2.455				
ORANGE	MIN	CIT		5.160		0.456				3.073				
	MIN	CIT		5.350		0.168	0.000	0.833	2.831	1.445			0.171	15.958
	MIN	CIT		5.510		0.391				1.555				
ORANGE	MIN	CIT		5.940		0.284	0.829	1.091	0.515	2.911			0.000	12.569
	MIN	CIT		5.510		0.268	0.000	1.029	15.058	1.285			0.214	26.250
	MIN	CIT		6.060		0.102	0.000	0.000	1.630	2.463			0.043	22.780
ORANGE	MIN	CIT		5.580		0.111	0.000	1.704	0.472	1.558			0.000	13.599
	MIN	CIT		5.960		0.117	0.575	5.075	0.729	2.275			0.000	9.738
	MIN	CIT		5.410		0.390	0.000	0.000	1.329	2.342			0.000	17.117
GRAPEFRUIT	MIN	CIT		5.000		0.280	0.597	0.398	1.115	1.766			0.000	10.081
	MIN	CIT		5.190		0.382	0.000	0.000	1.158	1.716			0.085	48.900
	DEB	LEAF		5.650		13.700	257.152	284.449	180.120	753.131			6.824	103.192
SPINACH	DEB	LEAF		5.540		13.200	314.847	369.176	285.637	1091.355			9.459	134.478
	DEB	LEAF		5.100		13.800	182.578	183.857	140.158	191.854			4.903	50.075
	CTRL	LEG		5.800		0.940	0.000	14.202	4.679	3.063			0.000	139.390
CORN	CTRL	LEG		6.050		1.010	0.000	0.000	4.311	12.455			0.000	148.377
	CTRL	LEG		6.240		0.916	0.000	0.000	2.304	5.722			0.000	129.742
	CTRL	ROOT		6.300		0.586	2.157	1.618	1.830	7.821			0.122	45.389
CARROT	CTRL	ROOT		6.050		0.823	1.017	0.726	0.876	10.760			0.000	26.407
	CTRL	ROOT		5.940		0.772	1.190	0.893	0.000	7.359			0.000	19.996

TABLE B-1

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

TABLE B-1 CONTINUED

DESCRIPTION	CATEGORY PARCEL	CATEGORY FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	RADIOACTIVITY CONCENTRATION (pCi/Kg or liter) U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	CTRL	ROOT		7.290		0.800	0.860	3.057	0.000	2.729			0.000	7.950
RADISH	CTRL	ROOT		7.340		0.565	3.777	4.533	0.000	6.342			0.108	11.614
	CTRL	ROOT		7.300		0.515	1.171	0.878	0.000	4.591			0.224	6.442
	REC	CIT				13.400	0.000	0.000	0.086	3.298			0.086	17.589
ORANGE	REC	CIT				12.200	0.000	0.000	0.042	2.661			0.085	9.738
	REC	CIT				38.800	0.000	0.000	0.429	9.407			0.086	6.949
	REC	LEG				19.900	2.670	1.335	1.612	3.715			0.298	6.451
POLE BEANS	REC	LEG				21.400	1.185	1.777	0.905	3.390			0.181	5.373
	REC	LEG				4.680	2.338	1.637	1.254	3.965			0.418	14.305
	REC	ROOT				8.540	13.919	16.965	5.083	4.572			0.391	11.011
RED BLISS	REC	ROOT				7.740	14.971	20.829	17.739	4.864			1.252	33.183
POTATOES	REC	ROOT				7.170	50.041	48.888	0.000	2.976			0.431	10.135
	REC	NTF				1.730	2.149	0.477	1.279	1.289			0.256	9.979
ZUCCHINI	REC	NTF				2.370	0.000	0.000	0.248	2.941			0.248	6.439
	REC	NTF				1.620	0.514	1.286	0.456	3.243			0.000	6.387
	REC	NTF		4.550		0.217	0.726	0.327	0.000	1.476			0.000	0.000
CITRON	REC	NTF		4.500		4.930	0.127	0.318	0.000	5.156			0.000	0.000
	REC	NTF		5.050		6.070	1.398	1.009	1.159	11.836			0.232	0.000
	REC	CIT		6.300	3.390	7.060								
ORANGE	REC	CIT		5.990	4.990	8.510	0.395	0.263	0.000				0.065	0.518
	REC	CIT		6.020	11.400	1.750	0.000	0.028	1.309	1.478			0.045	0.528
	REC	CIT												
ORANGE	REC	CIT												
	REC	CIT												

TABLE B-1
CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY		SOIL pH		SOIL RA (pCi/g)		RADIOACTIVITY CONCENTRATION (pCi/Kg or liter)							
	PARCEL	FOOD	SURFACE	ROOT	SURFACE	ROOT	U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	MIN	CIT		4.500	0.799	0.365				5.382				
ORANGE	MIN	CIT		4.640	0.701	0.392	0.036	0.000	0.000	3.995			0.151	0.000
	MIN	CIT		4.240	0.761	0.371	0.057	0.115	0.000				0.186	0.000
	MIN	CIT		4.990	0.228	0.351	0.023	0.069	0.000	1.361			0.000	0.000
ORANGE	MIN	CIT		4.620	0.249	0.537	0.093	0.093	0.000	1.090			0.251	0.000
	MIN	CIT		4.800	0.250	0.254	0.032	0.097	0.000	1.209			0.000	0.282
	MIN	CIT		5.940	0.476	0.265			0.000	0.394			0.152	0.000
ORANGE	MIN	CIT		5.550	0.503	0.231	0.034	0.000	0.000	2.029			0.181	0.000
	MIN	CIT		5.090	0.275	0.367	0.023	0.046	0.000	1.234			0.000	0.000
	MIN	CIT		7.010	0.411	0.271	0.039	0.279	0.000	3.192			0.182	0.000
ORANGE	MIN	CIT		6.850	0.511	0.295	0.092	0.092	0.000	2.778			0.000	0.000
	MIN	CIT		6.100	0.236	0.376	0.000	0.028	0.000	2.572			0.000	0.647
	MIN	CIT		5.100	1.090	0.634	0.000	0.000	3.418	6.535			0.117	0.667
ORANGE	MIN	CIT		5.040	1.650	0.671	0.295	0.361	1.241	4.868			0.068	1.746
	MIN	CIT		5.710	1.410	0.782	0.053	0.080	0.000	4.610			0.000	0.000
	MIN	CIT		6.150	1.440	1.120	0.000	0.121	0.000	4.682			0.175	0.525
ORANGE	MIN	CIT		5.850	0.658	0.452	0.192	0.385	0.000	8.894			0.000	0.000
	MIN	CIT		5.700	0.767	0.405	0.236	0.177	0.000	5.300			0.129	0.000
	MIN	CIT		6.490	0.599	0.281	0.000	0.000	0.000	2.206			0.082	0.000
ORANGE	MIN	CIT		5.290	0.838	0.388	0.103	0.172	0.000	1.167			0.125	0.000
	MIN	CIT		5.820	1.020	0.427	0.000	0.000	0.000	3.720			0.000	0.000
	REC	NTF		6.450		3.710	6.976	4.185	0.000	5.289			0.000	0.000
ZUCCHINI	REC	NTF		5.720		2.540	0.829	1.804	0.357	10.645			0.000	0.000
	REC	NTF		6.400		2.290	0.806	0.921	0.661	5.708			0.000	0.000

TABLE B-1 CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY PARCEL	CATEGORY FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	DEB	ROOT		5.900		14.400	2.951	3.103	2.992	15.808			0.000	1.548
TURNIP ROOT	DEB	ROOT		5.600		11.200	5.872	6.435	8.467	13.766			0.418	5.331
	DEB	ROOT		5.750		15.300	7.289	7.289	5.344	32.650			0.000	0.000
YELLOW	DEB	NTF		5.270		15.100	1.598	1.065	0.000	5.263			0.331	8.601
SQUASH	DEB	NTF		5.390		16.000	0.933	2.780	1.432	5.660			0.000	8.592
	DEB	NTF		4.580		12.100	0.527	1.756	5.489	4.578			0.000	8.051
	MIN	LEAF		6.100		0.410	0.744	1.116	0.000	2.837			0.000	2.076
BROCCOLI	MIN	LEAF		6.100		0.378	1.105	0.737	4.402	3.039			0.000	5.380
	MIN	LEAF		6.200		0.334	0.000	2.377	2.637	3.142			0.000	7.120
ZIPPER	REC	LEG		5.610		4.610	0.700	1.575	0.000	6.777			0.457	6.392
PEAS	REC	LEG		5.920		4.040	0.882	2.117	0.000	8.041			0.318	10.181
	REC	LEG		6.050		3.240	3.651	4.172	9.346	16.679			0.501	9.180
	REC	LEG		5.000		4.430	3.063	1.801	0.000	11.841			0.000	7.930
CORN	REC	LEG		4.900		4.260	2.291	3.054	0.000	7.139			0.000	10.122
	REC	LEG		5.200		5.280	1.981	2.341	0.000	7.246			0.000	10.650
	REC	LEG		5.700		5.230	0.596	1.390	0.000	12.528			0.000	11.332
PEAS	REC	LEG		5.300		5.750	0.000	1.468	0.000	16.026			0.000	9.795
	REC	LEG		4.500		5.770	0.330	0.989	8.864	9.186			0.466	32.656
YELLOW	MIN	NTF		6.000		1.060	0.346	0.865	2.935	7.480			0.000	27.880
SQUASH	MIN	NTF		5.500		1.030	0.188	0.751	0.000	4.845			1.027	1.369
	MIN	NTF		5.050		0.816	0.000	1.137	1.500	9.970			0.000	7.000
	REC	LEG		5.100		1.460	0.378	0.946	0.000	72.655			0.000	0.000
LIMA BEANS	REC	LEG		5.400		2.460	1.019	2.209	1.506	54.219			0.904	3.314
	REC	LEG		5.200		2.390	1.319	0.660	0.582	72.024			0.000	0.873

TABLE B-1 CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY PARCEL	FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	RADIOACTIVITY CONCENTRATION (pCi/Kg or liter) U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	MIN	NTF		7.000		0.208	0.113	0.113	0.000	3.907			0.000	6.022
GREEN PEPPER	MIN	NTF		6.600		0.223	0.850	0.000	3.597	3.581			0.200	10.190
	MIN	NTF		7.100		0.170	0.000	0.598	19.384	0.324			0.313	7.191
	MIN	NTF		6.200		0.187	0.000	1.088	0.182	1.963			0.000	13.115
WATERMELON	MIN	NTF		5.700		0.297	0.000	0.894	9.420	1.730			0.000	8.858
	MIN	NTF		5.400		0.152	0.436	1.017	1.719	0.893			0.000	1.719
	MIN	NTF		6.100		0.152	0.230	1.611	0.000	2.199			0.000	7.429
WATERMELON	MIN	NTF		6.100		0.149	0.847	0.565	0.000	0.180			0.554	8.315
	MIN	NTF		6.500		0.136	0.553	1.383	1.393	3.099			0.697	7.664
	REC	ROOT		5.240		3.100	2.069	4.139	1.143	13.670			0.191	6.096
TURNIP ROOT	REC	ROOT		6.680		3.440	4.300	1.911	0.552	5.439			0.276	7.725
	REC	ROOT		5.450		4.210	1.252	0.834	0.451	6.565			0.000	6.549
	REC	LEAF		5.240		3.100	281.731	302.004	28.880	220.667			0.000	0.963
TURNIP GREENS	REC	LEAF		6.680		3.440	45.407	34.399	29.906	61.402			2.876	37.958
	REC	LEAF		5.450		4.210	115.966	115.666	28.882	55.354			0.920	15.637
	REC	BEEF					0.868	0.579	0.217	4.790			0.000	7.157
BEEF	REC	BEEF					0.930	0.000	0.000	3.562			0.427	0.000
	REC	BEEF					0.000	0.605	0.000	2.321			0.000	2.046
	CTRL	BEEF					0.000	7.724	0.371	1.762			0.000	3.714
BEEF	CTRL	BEEF					0.384	0.384	0.775	14.247			0.000	1.551
	CTRL	BEEF					0.000	0.144	3.218	2.505			1.287	28.963
	CTRL	LEAF		5.950		0.704	0.000	0.000	0.000	8.774			2.496	22.465
TURNIP GREENS	CTRL	LEAF		5.960		0.753	0.000	0.620	2.780	4.936			1.390	5.559
	CTRL	LEAF		5.953		0.872	0.000	1.375	0.535	5.500			0.535	8.559

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

TABLE B-1 CONTINUED

DESCRIPTION	CATEGORY PARCEL	CATEGORY FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
							RADIOACTIVITY CONCENTRATION (pCi/Kg or liter)							
COLLARD GREENS	CTRL	LEAF		6.569		0.836	0.896	0.000	0.000	7.008			0.000	14.016
	CTRL	LEAF		6.703		0.756	7.882	3.941	10.288	0.691			0.000	16.902
	CTRL	LEAF		6.645		0.895	0.337	2.138	0.775	5.218			0.000	0.388
RADISH	CTRL	ROOT		7.199		1.200	0.000	0.220	0.000	2.223			0.000	7.013
	CTRL	ROOT		7.182		1.020	0.000	0.000	0.207	3.058			0.000	4.757
	CTRL	ROOT		6.895		1.220	0.000	0.000	0.000	2.748			0.000	3.555
BLACKEYE PEAS	CTRL	LEG		5.338		0.970	0.000	0.000	0.000	4.288			0.000	5.670
	CTRL	LEG		5.370		0.899	1.320	0.000	0.000	4.213			0.000	0.000
	CTRL	LEG		5.250		0.839	0.000	0.000	0.000	6.324			0.000	43.135
YELLOW CORN	CTRL	LEG		6.818		1.170	0.388	0.388	6.443	5.569			0.000	4.027
	CTRL	LEG		7.197		1.040	0.000	0.000	0.000	3.896			0.000	0.000
	CTRL	LEG		6.861		1.130	0.000	0.000	0.000	2.903			0.000	5.914
TURNIP ROOT	CTRL	ROOT		5.855		1.540	0.000	0.000	0.209	5.082			0.000	9.633
	CTRL	ROOT		5.781		1.450	0.000	0.316	0.894	2.948			0.000	8.227
	CTRL	ROOT		5.853		1.460	0.000	0.725	0.000	5.055			0.000	6.679
TURNIP GREENS	CTRL	LEAF		5.855		1.540	0.295	0.590	1.002	9.387			0.000	9.617
	CTRL	LEAF		5.781		1.450	0.531	0.796	0.244	16.093			0.244	6.575
	CTRL	LEAF		5.853		1.460	0.351	1.755	0.000	7.794			0.000	1.304
CITRON	MIN	NTF		5.035		0.610	0.000	0.000	1.156	0.000			0.000	3.469
	MIN	NTF		5.481		0.346	0.000	9.540	0.000	5.285			0.558	1.675
	MIN	NTF		6.076		8.900	0.000	1.922	0.703	4.467			0.000	7.033
RADISH	REC	ROOT		8.040		22.600	0.000	0.000	0.738	25.967	18.941	0.000	0.738	17.706
	REC	ROOT		7.790		23.700	0.000	0.000	0.560	11.896	0.000	1.069	0.000	7.280
	REC	ROOT		7.790		21.900	1.621	4.863	0.392	10.704	0.000	1.424	0.392	0.000

TABLE B-1 CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY		SOIL pH		SOIL RA (pCi/g)		RADIOACTIVITY CONCENTRATION (pCi/Kg or liter)							
	PARCEL	FOOD	SURFACE	ROOT	SURFACE	ROOT	U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	MIN	CIT	6.860	5.040	1.170	4.820	0.000	0.000	0.226	1.245			0.226	3.273
SATSUMO CITRUS	MIN	CIT	5.880	4.890	0.510	1.020	0.243	0.974	0.352	1.417			0.352	0.820
	MIN	CIT	5.750	4.920	0.998	1.790	0.112	0.112	0.000	2.179			0.000	0.132
	REC	NTF		5.960		2.120	0.060	0.000	0.573	8.743			0.000	6.299
CUCUMBER	REC	NTF		5.960		1.980	0.000	0.000	3.122	7.482			0.000	17.172
	REC	NTF		6.760		2.350	0.000	0.000	3.113	2.681			0.000	8.562
	MIN	ROOT		6.490		0.449	8.011	6.867	0.788	6.247			0.000	7.885
GREEN ONIONS	MIN	ROOT		6.760		0.491	0.000	0.468	1.073	5.555			0.000	7.153
	MIN	ROOT		6.810		0.449	0.869	0.000	2.987	4.547			0.000	13.441
PURPLE HULL CROWDER	MIN	LEG					0.000	0.000	0.000	2.278			0.000	6.802
PEAS	MIN	LEG					0.000	0.000	0.000	0.700			0.000	0.000
	MIN	LEG					0.726	2.906	0.920	1.684			0.000	10.119
	MIN	NTF					0.000	0.000	0.901	4.033			0.000	0.000
YELLOW SQUASH	MIN	NTF					0.000	0.782	3.726	3.952			0.000	11.798
	MIN	NTF					0.000	0.000	0.535	1.532			0.000	0.000
	MIN	LEAF					0.000	2.145	0.884	2.976			0.000	1.767
MUSTARD GREENS	MIN	LEAF					0.000	2.868	0.567	2.033			0.567	0.000
	MIN	LEAF					0.000	2.858	1.077	0.595			0.000	1.616
PURPLE HULL CROWDER	MIN	LEG		5.170		0.690	4.051	2.621	0.000	3.845			0.000	0.244
PEAS	MIN	LEG		5.120		0.529	0.000	2.384	0.000	3.583			0.000	0.643
	MIN	LEG		5.040		0.503	4.292	3.338	0.000	1.162			0.000	0.000
	CTRL	NTF		6.890		0.206	0.469	0.469	0.000	1.489			0.000	1.067
TOMATO	CTRL	NTF		6.150		0.237	0.000	2.377	0.259	7.338			0.000	1.552
	CTRL	NTF		6.140		0.295	5.949	1.904	0.783	2.011			0.000	1.827

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

TABLE B-1 CONTINUED

DESCRIPTION	CATEGORY PARCEL	CATEGORY FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	RADIOACTIVITY CONCENTRATION (pCi/Kg or liter) U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	CTRL	LEAF		7.210		0.379	0.000	0.000	0.000	7.854			0.000	1.093
CAULIFLOWER	CTRL	LEAF		6.540		0.297	0.000	1.188	0.000	4.770			0.000	0.744
	CTRL	LEAF		6.750		0.280	0.000	1.657	0.341	5.839			0.000	0.341
	CTRL	NTF		7.660		0.185	0.000	1.911	0.956	3.684			0.000	1.673
CUCUMBER	CTRL	NTF		7.740		0.204	0.000	3.526	0.235	2.817			0.000	0.705
	CTRL	NTF		7.400		0.203	10.828	4.237	0.352	3.205			0.000	1.406
	CTRL	NTF		6.240		0.255	0.000	0.724	0.000	2.685			0.000	1.362
GREEN PEPPER	CTRL	NTF		6.420		0.315	0.000	2.145	0.000	5.066			0.000	0.679
	CTRL	NTF		6.140		0.256	0.000	1.163	0.000	0.685			0.000	0.993
	MIN	NTF		7.300		0.413	0.000	4.772	0.534	5.574			0.000	1.603
ZUCCHINI	MIN	NTF		7.380		0.350	0.000	3.102	0.000	5.671			0.000	1.192
	MIN	NTF		6.950		0.448	0.000	3.098	0.275	6.763			0.000	1.928
	MIN	ROOT		7.260		0.522	12.044	7.793	0.000	4.651			0.000	0.000
RADISH	MIN	ROOT		7.580		0.480	0.697	0.697	0.272	2.851			0.000	0.816
	MIN	ROOT		6.570		0.644	0.000	0.000	0.910	8.749			0.000	0.607
BUSH	MIN	LEG		8.030		0.462	0.775	0.000	0.000	5.638			0.000	1.049
POLE BEANS	MIN	LEG		7.970		0.444	0.000	8.133	0.372	5.065			0.000	0.744
	MIN	LEG		8.030		0.511	0.000	2.391	0.442	4.802			0.000	0.000
	MIN	NTF		5.260		0.253	0.000	2.869	0.796	0.995			0.000	1.858
YELLOW SQUASH	MIN	NTF		6.720		0.283	8.818	10.010	0.474	7.035			0.000	0.000
	MIN	NTF		6.520		0.204	0.000	0.000	0.000	5.459			0.000	1.190
	MIN	NTF		5.520		0.513	0.000	0.477	0.589	0.000			0.000	1.473
EGGPLANT	MIN	NTF		5.120		0.422	5.020	5.977	0.000	10.976			0.000	1.345
	MIN	NTF		4.810		0.821	0.000	0.719	0.321	3.483			0.321	0.643

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

TABLE B-1 CONTINUED

DESCRIPTION	CATEGORY PARCEL	CATEGORY FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	RADIOACTIVITY CONCENTRATION (pCi/Kg or liter) U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	REC	NTF		5.060		13.700	2.028	0.000	0.405	8.623			0.000	3.646
YELLOW SQUASH	REC	NTF		5.320		14.300	0.000	1.363	0.407	5.779			1.222	0.815
	REC	NTF		5.290		14.900	1.597	1.597	1.209	4.373			0.000	4.837
	REC	ROOT		6.700		3.300	0.241	0.965	0.000	0.733			0.000	0.000
POTATO	REC	ROOT		5.860		5.220	1.900	1.900	0.000	3.684			0.000	0.000
	REC	ROOT		4.930		3.030	2.801	0.000	0.891	13.730			2.674	3.120
PURPLE HULL CROWDER	REC	LEG		5.630		4.240	0.000	2.547	1.474	3.642			0.000	0.000
PEAS	REC	LEG		5.860		6.490	0.000	0.000	0.867	8.807			0.000	0.434
	REC	LEG		5.460		2.340	0.000	0.000	0.000	2.267			0.000	0.000
	MIN	CIT					0.000	0.154	0.000	1.994			0.000	1.664
ORANGE	MIN	CIT					0.000	0.000	0.622	0.986			0.078	0.778
	MIN	CIT					0.000	0.000	0.485	2.476			0.000	2.519
	REC	CIT	4.810	5.048	5.620	7.040	0.000	0.001	0.000	3.333			0.000	2.957
GRAPEFRUIT	REC	CIT	4.790	5.530	6.010	10.800	0.362	0.272	0.162	2.387			0.054	1.675
	REC	CIT	5.090	5.090	2.570	3.000	0.000	0.000	0.000	3.887			0.000	1.590
	REC	CIT	5.520	4.360	18.700	23.800	0.000	2.979	1.184	16.050	22.450	0.000	0.000	0.222
ORANGE	REC	CIT	4.600	4.270	6.490	1.530	0.000	0.000	0.000	10.662	0.000	1.489	0.188	1.126
	REC	CIT	5.960	4.630	12.800	47.400	0.000	1.727	0.000	8.341	5.215	0.000	0.000	0.578
	REC	CIT	4.570	4.460	2.010	0.591	0.000	0.298	0.000	1.848			0.082	0.494
ORANGE	REC	CIT	4.490	4.540	1.100	1.800	0.501	0.000	0.454	1.939			0.000	0.151
	REC	CIT	4.320	4.180	0.802	0.463	0.358	0.119	0.000	2.525			0.060	1.013
	DEB	LEG		5.450		22.000	0.000	0.000	0.000	14.143	125.490	0.000	0.000	0.477
GREEN BEANS	DEB	LEG		5.540		20.900	0.000	3.229	0.000	4.097	0.000	0.782	0.000	0.849
	DEB	LEG		5.370		21.800	0.000	0.582	0.896	16.188	61.427	0.000	0.448	0.448

TABLE B-1 CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY		SOIL pH		SOIL RA (pCi/g)		RADIOACTIVITY CONCENTRATION (pCi/Kg or liter)							
	PARCEL	FOOD	SURFACE	ROOT	SURFACE	ROOT	U-238	U-234	TH-230	RA-226	PB-210	PD-210	TH-232	TH-228
	REC	LEG		7.890		23.900	0.000	0.997	1.614	2.401			0.000	1.614
BLACKEYE PEAS	REC	LEG		8.000		24.500	0.000	2.070	0.000	4.199			0.000	0.000
	REC	LEG		7.660		23.900	0.000	1.192	0.000	6.181			0.000	0.000
	REC	ROOT					0.000	3.660	0.000	17.556	34.448	0.000	0.533	1.066
TURNIP ROOT	REC	ROOT					0.904	0.452	2.112	17.815	0.000	6.963	0.000	0.845
	REC	ROOT					1.146	0.382	3.015	15.819	0.000	8.301	0.000	0.000
	REC	LEAF					6.145	4.961	0.000	94.738	73.722	11.992	0.000	1.421
TURNIP GREENS	REC	LEAF					12.128	13.861	5.058	85.643	0.000	91.466	0.337	3.372
	REC	LEAF					6.248	9.025	0.000	54.341	43.079	7.259	0.000	2.167
	REC	CIT	7.680	6.930	5.820	1.590	0.091	0.091	0.619	3.824			0.310	3.097
ORANGE	REC	CIT	6.940	5.980	3.050	0.874	0.387	0.193	0.619	1.903			0.310	1.239
	REC	CIT	6.770	6.150	12.500	14.400	0.000	0.000	0.000	2.483			0.000	0.320
	REC	CIT	7.040	6.450	6.050	8.810	3.992	0.060	0.000	2.737			0.068	0.068
ORANGE	REC	CIT	7.290	7.090	6.020	11.500	0.000	0.156	0.218	4.455			0.000	0.145
	REC	CIT	7.260	7.060	6.990	9.470	0.252	0.000	0.000	2.453			0.000	0.362
	REC	CIT	6.410	6.090	35.700	42.000	0.000	0.119	0.000	7.722	8.706	0.000	0.231	0.231
ORANGE	REC	CIT	6.730	5.960	38.600	42.900	0.000	0.000	0.000	14.009	6.435	0.000	0.000	0.000
	REC	CIT	6.900	6.030	37.600	48.900	0.171	0.086	0.000	9.169	6.312	0.000	0.669	0.167
YELLOW SQUASH	REC	NTF					0.315	1.575	0.529	0.000			0.000	0.529
	REC	NTF		5.200		3.920	0.330	0.991	0.000	0.000			0.000	2.274
WATERMELON	REC	NTF		5.450		2.690	0.000	1.015	0.000	9.811			0.000	0.952
	REC	NTF		5.200		4.220	0.288	0.575	0.000	7.392			0.000	1.321

TABLE B-1 CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY		SOIL pH		SOIL RA (pCi/g)		RADIOACTIVITY CONCENTRATION (pCi/Kg or liter)							
	PARCEL	FOOD	SURFACE	ROOT	SURFACE	ROOT	U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	MIN	LEAF		5.130	0.385	0.385	5.276	0.000	1.340	13.997	35.971	0.000	0.000	0.447
COLLARD GREENS	MIN	LEAF		5.180	0.490	0.490	2.200	1.100	0.000	9.688	0.000	17.123	0.000	0.000
	MIN	LEAF		4.850	0.478	0.478	0.000	0.000	0.571	20.288	2.449	8.110	0.571	5.138
	MIN	ROOT		4.850		0.585	0.000	2.432	5.955	6.325	0.000	5.239	0.000	0.000
TURNIP ROOT	MIN	ROOT		4.750		0.592	0.000	0.922	0.000	12.256	0.000	1.822	0.000	0.000
	MIN	ROOT		4.850		0.615	2.084	2.084	0.613	5.462	5.602	0.000	0.000	2.450
	MIN	LEAF		4.850		0.585	4.281	2.446	0.619	15.027	6.552	30.495	2.549	12.745
TURNIP GREENS	MIN	LEAF		4.750		0.592	0.872	3.490	0.000	27.340	12.141	69.786	0.000	0.000
	MIN	LEAF		4.850		0.615	0.832	3.329	2.035	21.266	30.944	0.000	0.000	3.488
	MIN	NTF		6.370		1.050	1.080	1.080	0.477	7.899			0.000	0.477
ZUCCHINI	MIN	NTF		5.890		1.020	0.000	2.126	0.000	5.853			0.480	4.321
	MIN	NTF		6.850		0.990	0.000	1.028	0.427	0.000			0.000	1.281
	MIN	ROOT					0.667	1.001	1.003	0.000			0.000	1.003
TURNIP ROOT	MIN	ROOT					1.562	1.562	4.641	7.914			1.547	1.160
	MIN	ROOT					0.000	1.840	0.000	5.193			0.000	3.970
	MIN	LEAF					3.021	0.000	1.532	0.000			0.511	4.086
TURNIP GREENS	MIN	LEAF					0.000	0.569	0.000	20.725			0.404	1.212
	MIN	LEAF					2.961	11.843	0.000	11.637			0.000	2.799
	REC	NTF					1.131	0.566	1.318	1.204			0.000	0.439
GREEN PEPPER	REC	NTF					0.000	0.000	0.000	10.148			0.000	0.000
	REC	NTF					0.348	0.348	0.000	0.000			0.000	0.000
OKRA	REC	NTF					0.000	0.000	0.000	21.157			0.000	4.634

TABLE B-1 CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY		SOIL pH		SOIL RA (pCi/g)		RADIOACTIVITY CONCENTRATION (pCi/Kg or liter)							
	PARCEL	FOOD	SURFACE	ROOT	SURFACE	ROOT	U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	REC	LEAF					0.770	1.155	0.000	3.432			0.000	6.517
CABBAGE	REC	LEAF					0.000	0.000	0.000	2.893			0.000	1.944
	REC	LEAF					0.248	1.241	0.000	5.006			0.000	1.792
	REC	NTF					0.000	1.678	0.000	0.000			0.000	2.357
TOMATO	REC	NTF					0.000	0.000	1.046	2.602			0.000	0.349
	REC	NTF					0.895	0.298	1.302	11.599			0.868	0.868
	REC	ROOT					0.331	0.661	0.508	8.230			0.000	1.524
GREEN ONIONS	REC	ROOT					0.761	1.776	0.000	19.572			0.000	2.239
	REC	ROOT					0.000	1.538	0.000	6.038			0.000	0.000
	CTRL	CIT	6.600	5.450	1.630	0.920	0.539	0.449	0.335	5.402			0.000	0.437
ORANGE	CTRL	CIT	6.490	5.330	1.530	0.843	0.209	0.105	0.212	4.767			0.141	0.212
	CTRL	CIT	6.240	4.820	1.270	0.791	0.400	0.267	0.369	4.321			0.184	0.184
	CTRL	CIT	6.360	5.730	1.150	0.615	0.119	0.119	0.083	2.388			0.000	0.083
ORANGE	CTRL	CIT	6.420	5.380	1.070	0.451	0.000	0.000	0.345	0.000			0.172	0.345
	CTRL	CIT	5.970	5.550	1.010	0.394	0.721	0.240	0.000	1.288			0.316	0.790
	CTRL	CIT	7.420	5.830	0.322	0.139	0.000	0.000	0.146	0.608			0.000	0.292
ORANGE	CTRL	CIT	7.390	6.510	0.402	0.147	0.068	0.068	0.000	0.439			0.000	1.859
	CTRL	CIT	7.350	5.870	0.288	0.091	0.060	0.060	0.897	0.777			0.000	0.149
	CTRL	CIT	6.530	4.950	0.296	0.229	0.000	0.060	0.283	3.953			0.000	0.283
ORANGE	CTRL	CIT	7.170	5.160	0.337	0.185	1.231	7.386	0.132	0.997			0.000	1.188
	CTRL	CIT	7.070	6.040	0.442	0.379	0.527	0.000	0.116	2.083			0.232	0.349
ORANGE	MIN	CIT	7.450	4.720			0.000	0.894	0.000	1.374			0.151	0.151

TABLE B-1 CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY PARCEL	CATEGORY FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	RADIOACTIVITY CONCENTRATION (pCi/Kg or liter) U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
WATER	MIN	WAT					0.072	0.029	0.086	2.513			0.000	0.257
ORANGE	MIN	CIT					0.629	0.503	0.000	2.534			0.133	0.663
	MIN	LEAF		7.690			0.000	1.973	0.000	8.801			0.000	0.000
CABBAGE	MIN	LEAF		7.490			0.000	0.000	0.000	5.912			0.000	1.950
	MIN	LEAF		8.040			0.000	0.000	0.000	0.177			0.000	0.442
	MIN	LEAF					0.000	0.583	0.000	0.140			0.000	0.000
COLLARD GREENS	MIN	LEAF					0.000	3.798	1.085	9.938			0.000	3.255
	MIN	LEAF					0.698	3.488	0.916	4.112			0.000	0.916
GREEN ONIONS	MIN	ROOT					0.811	0.811	2.198	0.000			0.733	2.198
GRAPEFRUIT	MIN	CIT					0.000	0.162	0.000	1.724			0.121	0.483
ORANGE	MIN	CIT	7.060	6.230			0.119	0.000	0.000	0.000			0.000	0.483
GRAPEFRUIT	MIN	CIT					0.089	0.447	0.000	1.741			0.000	0.045

TABLE B-1 CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY PARCEL	CATEGORY FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	RADIOACTIVITY CONCENTRATION (pCi/Kg or liter) U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
WATER	MIN	WAT					0.029	0.044		4.209				
WATER	MIN	WAT					0.051	0.069	0.043	6.459			0.000	0.000
	MIN	CIT	6.350	4.710			0.089	0.089	0.000	1.445			0.089	0.715
ORANGE	MIN	CIT					0.358	0.179	0.000	2.034			0.000	0.417
	MIN	CIT					0.060	0.179	0.060	0.748			0.000	0.298
	MIN	CIT	6.340	4.920			0.182	0.000	0.179	0.000			0.000	0.447
TANGELO	MIN	CIT					0.089	0.000	0.000	2.098			0.000	1.251
	MIN	CIT					0.626	0.447	0.089	0.637			0.089	0.894
GRAPEFRUIT	MIN	CIT	5.790	6.170			0.268	0.179	0.000	1.702			0.089	0.715
	MIN	CIT	6.320	5.970			0.089	0.358	0.089	1.948			0.089	1.341
GRAPEFRUIT	MIN	CIT					0.179	0.000	0.000	1.106			0.000	1.788
	MIN	CIT					0.268	0.089	0.000	0.705			0.000	0.000
	MIN	CIT	6.440	6.080			0.000	0.280	0.000	0.812			0.000	0.000
ORANGE	MIN	CIT					0.099	0.197	0.000	3.026			0.089	0.358
	MIN	CIT					0.268	0.358	0.089	0.746			0.000	0.447
LEMON	MIN	CIT					0.000	0.089	0.268	0.419			0.089	1.073

TABLE B-1 CONTINUED

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY		SOIL pH		SOIL RA (pCi/g)		RADIOACTIVITY CONCENTRATION (pCi/Kg or liter)							
	PARCEL	FOOD	SURFACE	ROOT	SURFACE	ROOT	U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
WATER	MIN	WAT					0.179	0.105	0.163	7.851			0.000	0.204
LEMON	MIN	CIT	7.370	7.390			0.000	0.000	0.179	3.047			0.089	0.626
WATER	MIN	WAT					0.012	0.000	0.057	10.709			0.029	0.000
TANGERINE	MIN	CIT					0.089	0.089	0.000	2.290			0.114	0.572
ORANGE	MIN	CIT					0.000	0.358	0.178	1.096			0.089	0.801
GRAPEFRUIT	MIN	CIT					0.000	0.089	0.089	2.446			0.089	0.804
LEMON	MIN	CIT	8.250	8.750			0.089	0.000	0.000	2.736			0.089	0.626
SPINACH	CTRL	LEAF		5.370		0.831	0.770	1.155	0.000	3.521			0.000	3.140
	CTRL	LEAF		5.450		0.829	0.286	0.572	0.000	3.459			0.000	0.000
	CTRL	LEAF		5.390		0.653	0.379	1.136	0.000	9.223			0.000	0.000

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

TABLE B-1 CONTINUED

DESCRIPTION	CATEGORY PARCEL	FOOD	SOIL pH SURFACE	SOIL pH ROOT	SOIL RA (pCi/g) SURFACE	SOIL RA (pCi/g) ROOT	RADIOACTIVITY CONCENTRATION (pCi/Kg or liter) U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	CTRL	LEAF					0.000	1.881	0.000	0.000			0.000	3.857
MUSTARD GREENS	CTRL	LEAF					0.000	1.149	0.000	8.546			0.000	0.000
	CTRL	LEAF					6.154	1.026	0.000	0.955			0.000	0.540
	REC	ROOT					16.534	25.983	0.000	205.089	11.480	27.734	0.000	0.000
CARROTS	REC	ROOT					13.124	9.545	0.000	391.044	4.847	16.577	1.679	0.000
	REC	ROOT					8.842	5.894	5.037	74.690	0.000	9.611	0.000	1.007
	MIN	NTF					0.000	3.363	1.394	7.503			0.000	5.577
STRAWBERRIES	MIN	NTF					1.952	1.952	0.834	3.565			0.000	0.000
	MIN	NTF					0.000	5.152	0.000	0.249			0.000	4.091
	MIN	NTF		7.630		0.502	0.882	1.763	0.000	5.783			0.000	0.000
STRAWBERRIES	MIN	NTF		7.700		0.433	0.000	2.098	0.000	3.899			0.000	0.000
	MIN	NTF		7.320		0.452	1.180	0.000	0.000	3.266			0.000	1.666
	MIN	ROOT					0.000	1.098	0.000	0.000			0.000	1.394
ONIONS	MIN	ROOT					0.962	0.962	0.708	2.762			0.000	4.251
	MIN	ROOT					0.000	0.000	0.951	3.981			0.000	2.854
	MIN	LEAF		4.990		0.574	1.425	0.000	0.000	42.348			0.000	0.000
COLLARD GREENS	MIN	LEAF					0.000	0.000	0.000	11.203			0.000	0.000
CARROT	MIN	ROOT					NA	NA						
	MIN	LEAF		6.830		2.070	13.946	12.451	0.000	53.761	65.907	39.390	0.000	0.000
SPINACH	MIN	LEAF		7.450		2.130	10.906	19.631	0.000	103.434	22.227	68.171	0.000	0.000
	MIN	LEAF		7.450		2.150	29.731	21.237	4.413	32.401	27.285	53.034	0.000	0.000

RADIOACTIVITY IN FOODS GROWN ON FLORIDA PHOSPHATE LANDS

DESCRIPTION	CATEGORY		SOIL pH		SOIL RA (pCi/g)		RADIOACTIVITY CONCENTRATION (pCi/Kg or liter)							
	PARCEL	FOOD	SURFACE	ROOT	SURFACE	ROOT	U-238	U-234	TH-230	RA-226	PB-210	PO-210	TH-232	TH-228
	REC	LEAF					8.159	3.400	2.256	11.265	65.250	0.000	0.564	2.256
COLLARD GREENS	REC	LEAF					0.000	0.000	1.711	20.110	0.000	3.485	0.000	0.000
	REC	LEAF					0.000	4.796	0.000	19.985	11.827	8.997	0.000	0.000

TABLE B-1
CONTINUED

APPENDIX C

Appendix C

DIET EVALUATION

C.1 DIET MODELS IN THE LITERATURE

C.1.1 Reference Man

The ICRP document on Reference Man (31) is a recognized standard in health physics applications of dosimetry, and contains a limited table on daily dietary intake. Table C-l summarizes the data and includes a recalculation of the intakes based upon more recent diet information. The items sampled in this study would fit into about five of the 11 food groups. This diet was not given any further consideration, other than to note the general totals (grams/day) for each group and the grand total of 1,525 grams/day.

C.1.2 Rupp Diet

A diet with considerably more detail within the food groups was developed by Rupp (60). Daily intake values are given for four age groups; however, only the diet for those 18 years of age and older is shown on Table C-2. For the purpose of simplicity, the Rupp values for milk and milk products given in units of milliliters per day (ml/day) (and ml/day Ca equivalent) have been converted to grams per day (g/day) without modification of the value.

C.1.3 Regulatory Guide Diets

Two Nuclear Regulatory Commission documents contain diets which were considered for this study. Regulatory Guide 1.109 (80) is concerned with diet-related dose impacts from nuclear reactor effluents. Table C-3 is taken from this document , but does not present a total diet. Regulatory Guide 3.51, a more recent publication concerned with releases from uranium milling operations

Table C-l

PHYSIOLOGICAL DATA FOR REFERENCE MAN
UNITED STATES DIETARY INTAKE

Food Groups	Consumption (grams/day) 1955	1965
Milk (as liquid)	508	457
Cheese	19	17
Meat - products	206	227
Fish - seafood	22	22
Eggs	47	47
Fats	49	49
Sugar + preserves	69	66
Potatoes	103	88
Other vegetables	202	202
Fruit	184	184
Cereals	207	166
TOTAL	**1616**	**1525**

Table C-2

"BEST ESTIMATES" AVERAGE DAILY INTAKE OF VARIOUS FOODS BY AGE

	Age 18 and Older (grams/day)
Milk, as liquid	261
Milk and milk products (Ca equivalent)	306
Eggs	41
Meats	
Beef	85
Pork	76
Other and mixtures	70
Poultry	26
Fish	16
Potatoes	69
Vegetables	
Leafy, mixtures	50
Deep yellow, mixtures	8
Legumes, mixtures	25
Other, mixtures	99
Fruit	
Citrus, tomatoes	99
Other, mixtures	87
Dried	1
Grain (flour equivalent)	97
Nuts, nut butter	5
Fats, oils	32
Sugar, sweets	40
Total	1494

Table C-3

RECOMMENDED VALUES FOR U_{ap} TO BE USED
FOR THE AVERAGE INDIVIDUAL
IN LIEU OF SITE-SPECIFIC DATA

Pathway	Adult (g/day)
Fruits, vegetables, & grain	520
Milk	301
Meat & poultry	260
Fish	19
Seafood	3
Drinking water	1013
TOTAL	**2116**

(81), contains a more complete diet. Table C-4 is the adult column of the food consumption rate table from Regulatory Guide 3.51. Data are converted from kg/day to g/day in each case. The fresh vegetable versus processed vegetable fractionation may prove to have some value during more sophisticated diet calculations.

C.1.4 Food and Drug Administration (FDA) Diet

The FDA diet shown on Table C-5 is taken from a recent publication in Health Physics (69). The paper deals primarily with strontium-90 and cesium-137 concentrations in foods. Twelve food groups were composites of ten adult diet studies collected during the year prior to the reported data. The total consumption value indicates a rather complete diet.

C.1.5 Revised Food and Drug Administration (FDA) Diet

The diets discussed above are not sufficiently detailed to allow precise input of the individual food items sampled in the study. On the other hand, a very detailed diet has been prepared by the Food and Drug Administration (54) that has more than 200 entries for each of five age groups. Three of the groups are divided into male and female values. A very small sampling of this detailed diet is presented on Table C-6.

The detail of this diet presents the problem of combining entries into smaller groups. For example, does chili con carne go with beans or meat; or does the value divide equally into legumes and beef? This diet was used extensively in conjunction with the Rupp and FDA diets in preparing the final diet for this study. The revised FDA diet is given to three decimal place accuracy; however, for this study, additions were made to obtain group values which were then rounded.

Table C-4

FOOD CONSUMPTION RATES USED FOR CALCULATING DOSES TO POPULATIONS

Food Category		Adults (g/day)
Fresh Milk		355
Milk Products		128
	Subtotal:	483
Meat		
Beef and Lamb		175
Unprocessed Pork		39
Poultry and Processed Pork		136
	Subtotal:	350
Vegetables		
Potatoes		
Fresh		165
Processed		14
	Subtotal:	179
Leafy		
Fresh		38
Processed		2
	Subtotal:	40
Root		
Fresh		14
Processed		4
	Subtotal:	18
Other		
Fresh		71
Processed		90
	Subtotal:	161
Berries and Tree Fruit		135
Grain, Rice and Wheat		249
	TOTAL CONSUMPTION:	**1615**

Table C-5

FOOD AND DRUG ADMINISTRATION (FDA) DIET

Composite	Consumption Average (g/day)
Dairy Foods	756
Meat, Fish, Poultry	290
Cereal Foods	369
Potatoes	204
Leafy Vegetables	59
Legumes	74
Root Vegetables	34
Garden Fruits	88
Fruits	217
Oils, Fats	52
Sugar and Adjuncts	82
Beverages	697
TOTAL:	2922

Table C-6

TOTAL DIET STUDY FOOD LIST WITH GRAM QUANTITIES FOR SPECIFIED AGE-SEX GROUPS (grams per day)

Food	6-11 mo.	2 yr.	14 - 16 yr. F	14 - 16 yr. M	25 - 30 yr. F	25 - 30 yr. M	60 - 65 yr. F	60 - 65 yr. M
001 whole milk, fluid	254.846	249.285	227.379	371.862	104.484	167.877	88.013	127.02
002 low-fat milk, 2% fat, fluid	106.631	68.725	61.233	100.502	52.991	73.843	34.700	50.14
003 chocolate milk, fluid, low-fat milk	1.725	10.673	36.801	61.054	10.384	14.336	3.736	5.07
004 skim milk, fluid	33.939	19.483	17.564	19.649	15.010	13.283	20.670	19.97
005 buttermilk, fluid	0.209	0.488	0.000	0.656	1.136	1.613	5.698	8.69
006 yogurt, plain, low-fat	0.646	1.095	1.064	0.430	2.508	1.792	1.340	0.54
007 milkshake, chocolate, fast-food type	0.451	1.286	5.625	9.097	3.125	4.349	0.328	1.08
008 evaporated milk, canned	6.196	1.874	0.710	0.433	0.428	0.968	1.342	3.01
009 yogurt, sweetened, strawberry, pre-stirred	1.325	1.749	1.043	0.649	3.096	2.932	2.203	0.24
010 cheese, American, processed	1.382	5.463	4.789	7.787	6.448	8.910	3.709	5.05
011 cottage cheese, creamed, 4% milkfat	2.098	1.470	2.209	1.707	4.698	2.749	7.064	6.43
012 cheese, Cheddar, (sharp/mild)	0.194	1.815	3.326	3.185	5.482	10.746	3.930	4.83
013 beef, ground, regular hamburger, cooked in patty shape	2.282	10.973	19.693	32.515	16.609	18.098	12.211	17.48
014 beef chuck roast, oven roasted	0.613	4.754	9.226	15.290	11.004	18.845	10.835	19.97
015 beef, round steak, stewed in water	0.953	0.549	1.210	1.701	1.487	2.688	1.085	1.99
016 beef(loin/sirloin) steak, pan cooked with added fat	0.018	4.073	9.937	16.648	15.427	49.476	11.970	21.76
:								
:								
:								
201								

APPENDIX D

Appendix D

DOSE CONVERSION FACTORS

D.1 BACKGROUND

Dose conversion factors (DCFs) are used as a calculational tool to estimate radiation dose that is expected to result from radiation exposure or radionuclide intake. DCFs have been developed for various means of exposure, including ingestion, inhalation and submersion.

DCFs for radionuclide intake incorporate the following: (1) biological factors, (2) radionuclide decay characteristics, (3) absorption of the energy emitted in radioactivity decay, and (4) conversions to the appropriate units. The biological factors involved in dose following ingestion include absorption from the gastrointestinal tract, distribution in the body, relocation in the body, and excretion.

Dose from radionuclides taken into the body can be expressed a number of different ways. These include:

1. The initial annual dose rate corresponding to a single intake of a radionuclide,
2. The annual dose rate from the body burden that is eventually established after continuous prolonged intake of a radionuclide, or
3. The long-term cumulative dose that will result from a single intake of a radionuclide. This is known as the dose commitment.

It is common practice to assess intake of radionuclides, such as through consumption of food, in terms of the dose or (dose equivalent) commitment resulting from a one-year intake. The ICRP has adopted a 50-year integration time for this purpose and has defined this quantity as the committed dose equivalent.

The potentially useful DCFs for radionuclide intake fall into two general categories: (1) those based on the factors and methodologies in ICRP reports 2 and 10A (30, 32[a]); and (2) those based on ICRP report 30 (29). Two specific sets of DCFs for uranium and thorium series radionuclides were found: those in NRC Regulatory Guide 3.51 (81) and those in ICRP-30.

D.2 NRC REGULATORY GUIDE 3.51 DCFs

NRC Regulatory Guide 3.51 contains DCFs based on ICRP-B/10A methodology. DCFs based on this methodology have been widely used in various forms for a number of years. These factors calculate the dose to various individual organs (including the total body) from radionuclides deposited in those organs. Regulatory Guide 3.51, issued in 1982, contains calculational models used by the NRC staff to estimate radiation doses resulting from radioactive materials released from uranium milling operations.

D.3 DCFs BASED ON ICRP-30

The dosimetry factors and method used in preparing ICRP-30 represent an update from those of ICRP-2/10A. The ICRP-30 methodology recognizes that a given

[a]Bibliography reference number(s)

radionuclide may be distributed among a number of source organs in the body, and the dose to each important target organ is computed as the sum of contributions from all significantly contributing source organs. ICRP-30 also utilizes updated metabolic data for radionuclide behavior in the body, updated radioactive decay for the radionuclides, and an improved method for estimating the fraction of energy originating in the source organ that is deposited in the target organ.

ICRP-30 also incorporates another innovation, the "committed effective dose equivalent" ($H_{E,50}$). An individual tissue is assigned a weighting factor (WT) that represents the risk per unit dose equivalent resulting from irradiation of that tissue relative to the risk from uniformly irradiating the whole body. Weighted dose equivalents ($W_T H_T$) can then be calculated for the various tissues, and the weighted tissue doses can be summed to compute a whole-body "effective dose." When committed dose equivalents ($H_{T,50}$) are computed for the tissues, the weighting and summing yields the committed effective dose equivalent:

$$H_{E,50} = \sum W_T H_{T,50}$$

Table D-l contains DCFs based on ICRP-30 and expressed in mrem/pCi . For each radionuclide, the committed dose equivalents per unit intake are given for those tissues making a significant contribution to the committed effective dose equivalent. ICRP-30 omits the non-significant contributors. Thus, an inspection of the table provides a quick indication of the significantly irradiated tissues for each radionuclide. In addition, the table provides the factors for estimating doses to these individual tissues, if this is desired. The respective DCFs for computing committed effective dose equivalent from ingestion

TABLE D-1
INGESTION DOSE CONVERSION FACTORS (mrem/pCi)

Target Tissue (T)	Weighting Factor (W_T)	COMMITTED DOSE EQUIVALENT PER UNIT INTAKE ($H_{T,50}$) U-238	U-234	TH-230	Ra-226	Pb-210	Po-210	Th-232	Th-228
Red Marrow	0.12	2.5E-04	2.7E-04	1.1E-03	2.2E-03	5.6E-03	---	5.5E-03	7.0E-04
Bone Surfaces	0.03	3.7E-03	4.1E-03	1.3E-02	2.5E-02	8.1E-02	---	7.0E-02	8.9E-03
Kidney	0.06	1.5E-03	1.7E-03	---	---	1.0E-02	9.2E-03	---	---
Liver	0.06	---	---	---	---	2.3E-02	1.6E-03	---	---
Spleen	0.06	---	---	---	---	---	1.6E-02	---	---
Gonads	0.25	---	---	---	3.4E-04	---	---	---	---
LLI Wall	0.06	---	---	---	---	---	---	---	4.8E-04
Other*	0.36	---	---	---	---	---	---	---	---
Committed Effective Dose Equivalent	$\sum W_T H_{T,50}$	2.3E-04	2.6E-04	5.4E-04	1.1E-03	5.0E-03	1.6E-03	2.7E-03	3.8E-04

*Other includes breast (0.15), lung (0.12), thyroid (0.03), remainder not included above (0.06).

intake are presented at the bottom of each radionuclide column.

The factors in ICRP-30 are for adults only. While age-specific factors (based on the latest radionuclide and metabolic data) and the ICRP-30 methodology are being developed for at least some radionuclides, the authors of this report are not aware of any published set of age-specific factors using these data and methodology for the array of nuclides examined in this study.

D.4 DCFs USED FOR THIS STUDY

The committed effective dose equivalent DCFs based on ICRP-30 were selected for the dose assessment in this study. This decision was based on two factors:

1. ICRP-30 represents the most recently published compilation of dosimetry data for the entire set of radionuclides of interest. These dosimetry data are based on radioactive decay data, radionuclide metabolism information, and energy-absorbed fraction calculational methodologies that are updated relative to earlier works.

2. Committed effective dose equivalent is a quantity that allows direct comparison and summing of the effects of various radionuclides that (1) may have different distributions in the body; (2) follow different biological turnover rates; and (3) are characterized by different sets of significantly irradiated tissues.

APPENDIX E

APPENDIX E

DOSE CALCULATION TABLES

The following pages contain the dose calculation worksheets used for computing committed effective does equivalent as described in Section 9.3.

DATE: 7/24/85 DIET: FDA/SAMPLED DCF: 2.3E-04 (mrem/pCi)
RADIONUC: U-238 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED, (U)-UNMINED FILENAME: U238MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED, (PU)-PREDICTED FROM UNMINED
(L)-LITERATURE (see Footnotes)

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY										
Milk	N	280.99	.00	(La)	.00	(La)	3.08E-01	3.08E-01		
Cheese	N	22.41	0.67	(La)	0.67	(La)	5.48E+00	5.48E+00		
MEAT										
Beef	Y	129.27	0.08	(U)	0.41	(M)	3.87E+00	1.95E+01	1.56E+01	8.66%
Pork	N	39.54	0.13	(La)	0.13	(La)	1.88E+00	1.88E+00		
Other	N	69.00	0.13	(La)	0.13	(La)	3.27E+00	3.27E+00		
FISH	N	20.06	0.67	(La)	0.67	(La)	4.90E+00	4.90E+00		
EGGS	N	30.95	0.67	(La)	0.67	(La)	7.57E+00	7.57E+00		
CEREAL FD										
Corn Gr	N	5.18	0.17	(La)	0.17	(La)	3.21E-01	3.21E-01		
Grains	N	27.49	0.17	(La)	0.17	(La)	1.71E+00	1.71E+00		
Crls/Brd	N	174.70	0.17	(La)	0.17	(La)	1.08E+01	1.08E+01		
LEAFY/COLE VEG										
Spinach	Y	3.28	2.69	(U)	2.20	(PM)	3.22E+00	2.63E+00	-5.84E-01	-0.32%
Collards	Y	0.45	0.40	(U)	0.16	(M)	6.48E-02	2.68E-02	-3.81E-02	-0.02%
Mustard	Y	0.45	0.90	(U)	2.20	(PM)	1.48E-01	3.61E-01	2.13E-01	0.12%
Turnip G	Y	0.45	0.32	(U)	29.73	(M)	5.22E-02	4.88E+00	4.83E+00	2.68%
Cabbage	Y	7.04	0.02	(U)	0.17	(M)	5.91E-02	4.32E-01	3.73E-01	0.21%
Caulifwr	Y	0.71	0.02	(U)	0.17	(PM)	5.98E-03	4.37E-02	3.77E-02	0.02%
Brocc	Y	2.80	0.39	(U)	0.17	(PM)	4.01E-01	1.71E-01	-2.30E-01	-0.13%
Other	N	0.76	0.27	(La)	0.27	(La)	7.46E-02	7.46E-02		
Lettuce	N	23.38	0.27	(La)	0.27	(La)	2.30E+00	2.30E+00		
Celery	N	0.62	0.27	(La)	0.27	(La)	6.12E-02	6.12E-02		
LEGUMES/CORN										
Green Bn	Y	8.74	0.17	(U)	1.95	(M)	5.30E-01	6.22E+00	5.69E+00	3.15%
Blckeyes	Y	3.36	0.41	(U)	0.13	(M)	5.05E-01	1.57E-01	-3.48E-01	-0.19%
Lima Bn	Y	2.25	0.26	(PU)	0.80	(M)	2.15E-01	6.57E-01	4.41E-01	0.24%
Corn	Y	14.41	0.06	(U)	2.65	(M)	3.00E-01	1.39E+01	1.36E+01	7.56%
Grn Peas	N	7.29	0.27	(La)	0.27	(La)	7.19E-01	7.19E-01		
Other Bn	N	25.71	0.27	(La)	0.27	(La)	2.53E+00	2.53E+00		
Nuts	N	4.94	0.27	(La)	0.27	(La)	4.87E-01	4.87E-01		
Other	N	11.28	0.27	(La)	0.27	(La)	1.11E+00	1.11E+00		
POTATOES	Y	85.22	0.55	(PU)	4.87	(M)	1.71E+01	1.52E+02	1.34E+02	74.53%
ROOT VEG										
Carrot	Y	2.92	1.38	(U)	12.43	(M)	1.47E+00	1.32E+01	1.18E+01	6.52%
Radish	Y	0.32	0.45	(U)	0.35	(M)	5.21E-02	4.03E-02	-1.18E-02	-0.01%
Onion	Y	4.19	0.82	(U)	0.20	(M)	1.26E+00	3.11E-01	-9.48E-01	-0.53%
Turnip	Y	0.42	0.18	(U)	0.17	(M)	2.77E-02	2.57E-02	-2.05E-03	.00%
Other	N	1.10	0.33	(La)	0.33	(La)	1.32E-01	1.32E-01		

DATE: 7/24/85 DIET: FDA/SAMPLED DCF: 2.3E-04 (mrem/pCi)
RADIONUC: U-238 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME: U238MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED, (PU)-PREDICTED FROM UNMINED
(L)-LITERATURE (see Footnotes)

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only DELTA INTAKE (pCi/yr)	Sampled Items Only % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	0.17	(U)	0.14	(M)	2.14E-01	1.76E-01	-3.77E-02	-0.02%
Citron	Y	.00	0.02	(U)	0.51	(M)	7.30E-06	1.86E-04	1.79E-04	.00%
Tomato	Y	25.18	0.28	(U)	0.19	(M)	2.57E+00	1.75E+00	-8.27E-01	-0.46%
Strawbry	Y	1.23	0.33	(U)	0.15	(PM)	1.48E-01	6.72E-02	-8.10E-02	-0.04%
Cucumbr	Y	2.62	2.33	(U)	0.01	(M)	2.23E+00	9.57E-03	-2.22E+00	-1.23%
Y. Sqsh	Y	0.63	0.07	(U)	0.42	(M)	1.60E-02	9.60E-02	8.00E-02	0.04%
Zuchin	Y	0.63	0.16	(U)	0.80	(M)	3.66E-02	1.83E-01	1.46E-01	0.08%
Okra	Y	0.06	0.18	(PU)	0.02	(M)	4.04E-03	5.04E-04	-3.53E-03	.00%
Gr Pppr	Y	1.29	0.13	(U)	0.24	(M)	6.10E-02	1.13E-01	5.16E-02	0.03%
Egg Plnt	Y	0.70	1.08	(U)	0.15	(PM)	2.76E-01	3.83E-02	-2.38E-01	-0.13%
Others	N	6.55	0.27	(La)	0.27	(La)	6.46E-01	6.46E-01		
TREE FTRS										
Citrus										
Orange	Y	85.26	0.04	(U)	0.04	(M)	1.24E+00	1.24E+00	0.00E+00	0.00%
Grpfrt	Y	7.78	0.06	(U)	0.08	(M)	1.70E-01	2.27E-01	5.68E-02	0.03%
Lemon	Y	10.71	0.42	(U)	0.06	(PM)	1.64E+00	2.21E-01	-1.42E+00	-0.79%
Other	N	60.36	1.00	(La)	1.00	(La)	2.20E+01	2.20E+01		
SOUPS	N	36.82	0.25	(E)	0.25	(E)	3.42E+00	3.42E+00		
CONDIMENT	N	54.12	10.00	(La)	10.00	(La)	1.98E+02	1.98E+02		
DESSERTS	N	78.30	0.27	(La)	0.27	(La)	7.72E+00	7.72E+00		
BEVERAGE	N	1172.44	1.00	(La)	1.00	(La)	4.28E+02	4.28E+02		
WATER	N	512.00	0.24	(Lb)	0.24	(Lb)	4.49E+01	4.49E+01		
TOTALS:		3071.80	Sampled Items Only ->				3.79E+01	2.18E+02	1.80E+02	100.00%
			Total Modeled Diet ->				7.86E+02	9.66E+02		
DOSES:	mrem/year		Sampled Items Only ->				8.72E-03	5.02E-02	4.15E-02	
			Total Modeled Diet ->				1.81E-01	2.22E-01		

FOOTNOTES: La Diet Uranium (Ha72)
Lb Florida Aquifer Water (Co80)
E Geometric Mean of Vegetables and Water

DATE: 7/24/85 DIET: FDA/SAMPLED DCF: 2.6E-04 (mrem/pCi)
RADIONUC: U-234 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME: U234MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(L)-LITERATURE (see Footnotes)

DIET ITEM	SAMPLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY										
Milk	N	280.99	.00	(La)	.00	(La)	3.08E-01	3.08E-01		
Cheese	N	22.41	0.67	(La)	0.67	(La)	5.48E+00	5.48E+00		
MEAT										
Beef	Y	129.27	0.75	(U)	0.27	(M)	3.55E+01	1.29E+01	-2.26E+01	-25.73%
Pork	N	39.54	0.13	(La)	0.13	(La)	1.88E+00	1.88E+00		
Other	N	69.00	0.13	(La)	0.13	(La)	3.27E+00	3.27E+00		
FISH	N	20.06	0.67	(La)	0.67	(La)	4.90E+00	4.90E+00		
EGGS	N	30.95	0.67	(La)	0.67	(La)	7.57E+00	7.57E+00		
CEREAL FD										
Corn Gr	N	5.18	0.17	(La)	0.17	(La)	3.21E-01	3.21E-01		
Grains	N	27.49	0.17	(La)	0.17	(La)	1.71E+00	1.71E+00		
Crls/Brd	N	174.70	0.17	(La)	0.17	(La)	1.08E+01	1.08E+01		
LEAFY/COLE VEG										
Spinach	Y	3.28	3.97	(U)	5.17	(PM)	4.75E+00	6.19E+00	1.44E+00	1.64%
Collards	Y	0.45	0.40	(U)	0.89	(M)	6.63E-02	1.46E-01	7.94E-02	0.09%
Mustard	Y	0.45	1.84	(U)	5.17	(PM)	3.02E-01	8.49E-01	5.46E-01	0.62%
Turnip G	Y	0.45	0.93	(U)	30.11	(M)	1.53E-01	4.94E+00	4.79E+00	5.44%
Cabbage	Y	7.04	0.43	(U)	0.55	(M)	1.09E+00	1.41E+00	3.21E-01	0.37%
Caulifwr	Y	0.71	0.62	(U)	0.55	(PM)	1.60E-01	1.43E-01	-1.72E-02	-0.02%
Brocc	Y	2.80	1.25	(U)	0.55	(PM)	1.28E+00	5.61E-01	-7.14E-01	-0.81%
Other	N	0.76	0.27	(La)	0.27	(La)	7.46E-02	7.46E-02		
Lettuce	N	23.38	0.27	(La)	0.27	(La)	2.30E+00	2.30E+00		
Celery	N	0.62	0.27	(La)	0.27	(La)	6.12E-02	6.12E-02		
LEGUMES/CORN										
Green Bn	Y	8.74	1.67	(U)	1.57	(M)	5.32E+00	5.02E+00	-3.09E-01	-0.35%
Blckeyes	Y	3.36	1.23	(U)	1.05	(M)	1.50E+00	1.28E+00	-2.20E-01	-0.25%
Lima Bn	Y	2.25	1.43	(PU)	1.11	(M)	1.18E+00	9.16E-01	-2.62E-01	-0.30%
Corn	Y	14.41	0.15	(U)	2.35	(M)	7.89E-01	1.23E+01	1.15E+01	13.12%
Grn Peas	N	7.29	0.27	(La)	0.27	(La)	7.19E-01	7.19E-01		
Other Bn	N	25.71	0.27	(La)	0.27	(La)	2.53E+00	2.53E+00		
Nuts	N	4.94	0.27	(La)	0.27	(La)	4.87E-01	4.87E-01		
Other	N	11.28	0.27	(La)	0.27	(La)	1.11E+00	1.11E+00		
POTATOES	Y	85.22	0.67	(PU)	3.81	(M)	2.08E+01	1.19E+02	9.78E+01	111.10%
ROOT VEG										
Carrot	Y	2.92	1.02	(U)	11.35	(M)	1.08E+00	1.21E+01	1.10E+01	12.50%
Radish	Y	0.32	0.38	(U)	1.05	(M)	4.36E-02	1.21E-01	7.74E-02	0.09%
Onion	Y	4.19	0.68	(U)	1.22	(M)	1.04E+00	1.86E+00	8.27E-01	0.94%
Turnip	Y	0.42	0.77	(U)	1.27	(M)	1.19E-01	1.95E-01	7.64E-02	0.09%
Other	N	1.10	0.33	(La)	0.33	(La)	1.32E-01	1.32E-01		

DATE: 7/24/85 DIET: FDA/SAMPLED DCF: 2.6E-04 (mrem/pCi)
RADIONUC: U-234 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME: U234MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(L)-LITERATURE (see Footnotes)

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only DELTA INTAKE (pCi/yr)	Sampled Items Only % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	1.04	(U)	0.83	(M)	1.31E+00	1.04E+00	-2.64E-01	-0.30%
Citron	Y	.00	1.52	(U)	0.47	(M)	5.55E-04	1.72E-04	-3.83E-04	.00%
Tomato	Y	25.18	1.25	(U)	0.25	(M)	1.15E+01	2.30E+00	-9.19E+00	-10.44%
Strawbry		1.23	1.67	(U)	0.27	(PM)	7.52E-01	1.21E-01	-6.31E-01	-0.72%
Cucumbr	Y	2.62	3.06	(U)	0.05	(M)	2.93E+00	4.79E-02	-2.88E+00	-3.27%
Y. Sqsh	Y	0.63	0.58	(U)	0.83	(M)	1.33E-01	1.90E-01	5.72E-02	0.06%
Zuchin	Y	0.63	2.18	(U)	0.77	(M)	4.99E-01	1.76E-01	-3.22E-01	-0.37%
Okra		0.06	1.21	(PU)	0.05	(M)	2.64E-02	1.01E-03	-2.54E-02	-0.03%
Gr Pppr	Y	1.29	0.33	(U)	0.19	(M)	1.55E-01	8.91E-02	-6.57E-02	-0.07%
Egg Plnt	Y	0.70	1.27	(U)	0.27	(PM)	3.24E-01	6.90E-02	-2.55E-01	-0.29%
Others	N	6.55	0.27	(La)	0.27	(La)	6.46E-01	6.46E-01		
TREE FTRS										
Citrus										
Orange	Y	85.26	0.09	(U)	0.01	(M)	2.80E+00	3.11E-01	-2.49E+00	-2.83%
Grpfrt	Y	7.78	0.08	(U)	0.01	(M)	2.27E-01	2.84E-02	-1.99E-01	-0.23%
Lemon	Y	10.71	0.02	(U)	0.01	(PM)	7.82E-02	3.91E-02	-3.91E-02	-0.04%
Other	N	60.36	1.00	(La)	1.00	(La)	2.20E+01	2.20E+01		
SOUPS	N	36.82	0.25	(E)	0.25	(E)	3.36E+00	3.36E+00		
CONDIMENT	N	54.12	10.00	(La)	10.00	(La)	1.98E+02	1.98E+02		
DESSERTS	N	78.30	0.27	(La)	0.27	(La)	7.72E+00	7.72E+00		
BEVERAGE	N	1172.44	1.00	(La)	1.00	(La)	4.28E+02	4.28E+02		
WATER	N	512.00	0.24	(Lb)	0.24	(Lb)	4.49E+01	4.49E+01		
TOTALS:		3071.80	Sampled Items Only ->				9.59E+01	1.84E+02	8.80E+01	100.00%
			Total Modeled Diet ->				8.44E+02	9.32E+02		
DOSES:	mrem/year		Sampled Items Only ->				2.49E-02	4.78E-02	2.29E-02	
			Total Modeled Diet ->				2.19E-01	2.42E-01		

FOOTNOTES: La Diet Uranium (Ha72)
Lb Florida Aquifer Water (Co80)
E Geometric Mean of Vegetables and Water

DATE: 7/21/85 DIET: FDA/SAMPLED DCF: 5.4E-04 (mrem/pCi)
RADIONUC: TH-230 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME:TH230MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(E)-ESTIMATED, (L)-LITERATURE

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY										
Milk	N	280.99	0.10	(E)	0.10	(E)	1.03E+01	1.03E+01		
Cheese	N	22.41	0.10	(E)	0.10	(E)	8.18E-01	8.18E-01		
MEAT										
Beef	Y	129.27	0.97	(U)	0.05	(M)	4.60E+01	2.22E+00	-4.37E+01	87.80%
Pork	N	39.54	0.50	(E)	0.50	(E)	7.22E+00	7.22E+00		
Other	N	69.00	0.50	(E)	0.50	(E)	1.26E+01	1.26E+01		
FISH	N	20.06	0.50	(E)	0.50	(E)	3.66E+00	3.66E+00		
EGGS	N	30.95	0.50	(E)	0.50	(E)	5.65E+00	5.65E+00		
CEREAL FD										
Corn Gr	N	5.18	0.50	(E)	0.50	(E)	9.45E-01	9.45E-01		
Grains	N	27.49	0.50	(E)	0.50	(E)	5.02E+00	5.02E+00		
Crls/Brd	N	174.70	0.50	(E)	0.50	(E)	3.19E+01	3.19E+01		
LEAFY/COLE VEG										
Spinach	Y	3.28	0.65	(U)	0.91	(PM)	7.75E-01	1.09E+00	3.11E-01	-0.62%
Collards	Y	0.45	0.32	(U)	0.15	(M)	5.25E-02	2.40E-02	-2.86E-02	0.06%
Mustard	Y	0.45	0.35	(U)	0.91	(PM)	5.70E-02	1.49E-01	9.19E-02	-0.18%
Turnip G	Y	0.45	0.21	(U)	5.64	(M)	3.36E-02	9.26E-01	8.93E-01	-1.79%
Cabbage	Y	7.04	0.04	(U)	0.04	(M)	1.08E-01	1.08E-01	0.00E+00	0.00%
Caulifwr	Y	0.71	0.07	(U)	0.04	(PM)	1.90E-02	1.09E-02	-8.06E-03	0.02%
Brocc	Y	2.80	1.45	(U)	0.04	(PM)	1.48E+00	4.28E-02	-1.44E+00	2.89%
Other	N	0.76	0.50	(E)	0.50	(E)	1.38E-01	1.38E-01		
Lettuce	N	23.38	0.50	(E)	0.50	(E)	4.27E+00	4.27E+00		
Celery	N	0.62	0.50	(E)	0.50	(E)	1.13E-01	1.13E-01		
LEGUMES/CORN										
Green Bn	Y	8.74	0.18	(U)	1.22	(M)	5.84E-01	3.90E+00	3.32E+00	-6.66%
Blckeyes	Y	3.36	0.14	(U)	0.50	(M)	1.65E-01	6.15E-01	4.50E-01	-0.90%
Lima Bn	Y	2.25	0.16	(PU)	0.37	(M)	1.29E-01	3.04E-01	1.75E-01	-0.35%
Corn	Y	14.41	1.59	(U)	0.04	(M)	8.34E+00	2.21E-01	-8.12E+00	16.29%
Grn Peas	N	7.29	0.50	(E)	0.50	(E)	1.33E+00	1.33E+00		
Other Bn	N	25.71	0.50	(E)	0.50	(E)	4.69E+00	4.69E+00		
Nuts	N	4.94	0.50	(E)	0.50	(E)	9.02E-01	9.02E-01		
Other	N	11.28	0.50	(E)	0.50	(E)	2.06E+00	2.06E+00		
POTATOES	Y	85.22	0.34	(PU)	0.62	(M)	1.07E+01	1.93E+01	8.62E+00	-17.31%
ROOT VEG										
Carrot	Y	2.92	0.52	(U)	1.09	(M)	5.55E-01	1.16E+00	6.02E-01	-1.21%
Radish	Y	0.32	0.06	(U)	0.55	(M)	6.35E-03	6.30E-02	5.66E-02	-0.11%
Onion	Y	4.19	1.54	(U)	0.11	(M)	2.35E+00	1.68E-01	-2.18E+00	4.38%
Turnip	Y	0.42	0.31	(U)	0.66	(M)	4.84E-02	1.02E-01	5.31E-02	-0.11%
Other	N	1.10	0.50	(E)	0.50	(E)	2.00E-01	2.00E-01		

DATE: 7/21/85 DIET: FDA/SAMPLED DCF: 5.4E-04 (mrem/pCi)
RADIONUC: TH-230 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME:TH230MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(E)-ESTIMATED, (L)-LITERATURE

DIET ITEM	SAMPLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	0.33	(U)	0.04	(M)	4.15E-01	5.03E-02	-3.64E-01	0.73%
Citron	Y	.00	0.38	(U)	0.25	(M)	1.39E-04	9.13E-05	-4.75E-05	.00%
Tomato	Y	25.18	1.25	(U)	0.52	(M)	1.15E+01	4.78E+00	-6.71E+00	13.47%
Strawbry	Y	1.23	0.20	(U)	0.26	(PM)	8.99E-02	1.16E-01	2.59E-02	-0.05%
Cucumbr	Y	2.62	0.43	(U)	1.77	(M)	4.12E-01	1.69E+00	1.28E+00	-2.57%
Y. Sqsh	Y	0.63	0.57	(U)	0.57	(M)	1.30E-01	1.30E-01	0.00E+00	0.00%
Zuchin	Y	0.63	0.20	(U)	0.33	(M)	4.57E-02	7.55E-02	2.97E-02	-0.06%
Okra	Y	0.06	0.40	(PU)	0.04	(M)	8.10E-03	8.03E-04	-7.30E-03	0.01%
Gr Pppr	Y	1.29	1.03	(U)	0.28	(M)	4.83E-01	1.31E-01	-3.52E-01	0.71%
Egg Plnt	Y	0.70	0.18	(U)	0.26	(PM)	4.60E-02	6.64E-02	2.04E-02	-0.04%
Others	N	6.55	0.50	(E)	0.50	(E)	1.20E+00	1.20E+00		
TREE FTRS										
Citrus										
Orange	Y	85.26	0.08	(U)	.00	(M)	2.49E+00	9.34E-02	-2.40E+00	4.81%
Grpfrt	Y	7.78	0.06	(U)	0.04	(M)	1.70E-01	1.14E-01	-5.68E-02	0.11%
Lemon	Y	10.71	0.10	(U)	0.01	(PM)	3.91E-01	4.28E-02	-3.48E-01	0.70%
Other	N	60.36	0.50	(E)	0.50	(E)	1.10E+01	1.10E+01		
SOUPS	N	36.82	0.50	(E)	0.50	(E)	6.72E+00	6.72E+00		
CONDIMENT	N	54.12	0.50	(E)	0.50	(E)	9.88E+00	9.88E+00		
DESSERTS	N	78.30	0.10	(E)	0.10	(E)	2.86E+00	2.86E+00		
BEVERAGE	N	1172.44	0.50	(E)	0.50	(E)	2.14E+02	2.14E+02		
WATER	N	512.00	0.50	(E)	0.50	(E)	9.34E+01	9.34E+01		
TOTALS:		3071.80	Sampled Items Only ->				9.85E+01	4.87E+01	-4.98E+01	100.00%
			Total Modeled Diet ->				5.18E+02	4.68E+02		
DOSES:	mrem/year		Sampled Items Only ->				5.32E-02	2.63E-02	-2.69E-02	
			Total Modeled Diet ->				2.80E-01	2.53E-01		

NOTE: Since the delta intake for sampled items is negative, the percent difference is "negative" if the mined concentration exceeds the unmined concentration.

DATE: 7/18/85 DIET: FDA/SAMPLED DCF: 1.1E-03 (mrem/pCi)
RADIONUC: Ra-226 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME: RA226MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(R)-RUSSELL, (L)-LITERATURE (see Footnotes)

									Sampled Items Only	
DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	DELTA INTAKE (pCi/yr)	% OF TOTAL DIFF
DAIRY										
Milk	N	280.99	2.51	(La)	2.51	(La)	2.57E+02	2.57E+02		
Cheese	N	22.41	0.22	(R)	0.22	(R)	1.80E+00	1.80E+00		
MEAT										
Beef	Y	129.27	3.98	(U)	3.41	(M)	1.88E+02	1.61E+02	-2.68E+01	-7.41%
Pork	N	39.54	0.91	(R)	0.91	(R)	1.31E+01	1.31E+01		
Other	N	69.00	0.91	(R)	0.91	(R)	2.29E+01	2.29E+01		
FISH	N	20.06	1.30	(R)	1.30	(R)	9.52E+00	9.52E+00		
EGGS	N	30.95	5.00	(R)	5.00	(R)	5.65E+01	5.65E+01		
CEREAL FD										
Corn Gr	N	5.18	2.00	(R)	2.00	(R)	3.78E+00	3.78E+00		
Grains	N	27.49	2.00	(R)	2.00	(R)	2.01E+01	2.01E+01		
Crls/Brd	N	174.70	2.00	(R)	2.00	(R)	1.28E+02	1.28E+02		
LEAFY/COLE VEG										
Spinach	Y	3.28	16.51	(U)	37.53	(PM)	1.98E+01	4.49E+01	2.52E+01	6.96%
Collards	Y	0.45	5.65	(U)	16.54	(M)	9.28E-01	2.71E+00	1.79E+00	0.49%
Mustard	Y	0.45	1.10	(U)	37.53	(PM)	1.80E-01	6.16E+00	5.98E+00	1.65%
Turnip G	Y	0.45	9.03	(U)	85.16	(M)	1.48E+00	1.40E+01	1.25E+01	3.46%
Cabbage	Y	7.04	2.10	(U)	3.68	(M)	5.39E+00	9.45E+00	4.06E+00	1.12%
Caulifwr	Y	0.71	6.03	(U)	3.68	(PM)	1.57E+00	9.56E-01	-6.10E-01	-0.17%
Brocc	Y	2.80	3.00	(U)	3.68	(PM)	3.06E+00	3.75E+00	6.91E-01	0.19%
Other	N	0.76	4.50	(R)	4.50	(R)	1.24E+00	1.24E+00		
Lettuce	N	23.38	4.50	(R)	4.50	(R)	3.84E+01	3.84E+01		
Celery	N	0.62	4.50	(R)	4.50	(R)	1.02E+00	1.02E+00		
LEGUMES/CORN										
Green Bn	Y	8.74	5.16	(U)	3.68	(M)	1.65E+01	1.17E+01	-4.71E+00	-1.30%
Blckeyes	Y	3.36	1.87	(U)	6.66	(M)	2.29E+00	8.16E+00	5.86E+00	1.62%
Lima Bn	Y	2.25	3.11	(PU)	65.71	(M)	2.56E+00	5.41E+01	5.15E+01	14.24%
Corn	Y	14.41	4.90	(U)	9.19	(M)	2.58E+01	4.84E+01	2.26E+01	6.25%
Grn Peas	N	7.29	4.50	(R)	4.50	(R)	1.20E+01	1.20E+01		
Other Bn	N	25.71	4.50	(R)	4.50	(R)	4.22E+01	4.22E+01		
Nuts	N	4.94	4.50	(R)	4.50	(R)	8.12E+00	8.12E+00		
Other	N	11.28	4.50	(R)	4.50	(R)	1.85E+01	1.85E+01		
POTATOES	Y	85.22	4.46	(PU)	3.67	(M)	1.39E+02	1.14E+02	-2.45E+01	-6.78%
ROOT VEG										
Carrot	Y	2.92	8.52	(U)	181.61	(M)	9.08E+00	1.93E+02	1.84E+02	50.97%
Radish	Y	0.32	3.82	(U)	14.90	(M)	4.41E-01	1.72E+00	1.28E+00	0.35%
Onion	Y	4.19	2.91	(U)	9.91	(M)	4.46E+00	1.52E+01	1.07E+01	2.96%
Turnip	Y	0.42	4.18	(U)	11.58	(M)	6.44E-01	1.78E+00	1.14E+00	0.32%
Other	N	1.10	2.00	(R)	2.00	(R)	8.00E-01	8.00E-01		

DATE: 7/18/85 DIET: FDA/SAMPLED DCF: 1.1E-03 (mrem/pCi)
RADIONUC: Ra-226 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME: RA226MAX

"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(R)-RUSSELL, (L)-LITERATURE (see Footnotes)

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only DELTA INTAKE (pCi/yr)	Sampled Items Only % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	1.24	(U)	3.77	(M)	1.56E+00	4.74E+00	3.18E+00	0.88%
Citron	Y	.00	2.19	(U)	4.48	(M)	7.99E-04	1.64E-03	8.36E-04	.00%
Tomato	Y	25.18	2.94	(U)	1.99	(M)	2.70E+01	1.83E+01	-8.73E+00	-2.41%
Strawbry	Y	1.23	2.81	(U)	3.93	(PM)	1.26E+00	1.76E+00	5.01E-01	0.14%
Cucumbr	Y	2.62	3.22	(U)	5.60	(M)	3.08E+00	5.36E+00	2.28E+00	0.63%
Y. Sqsh	Y	0.63	4.11	(U)	3.12	(M)	9.40E-01	7.13E-01	-2.26E-01	-0.06%
Zuchin	Y	0.63	4.20	(U)	3.98	(M)	9.60E-01	9.10E-01	-5.03E-02	-0.01%
Okra	Y	0.06	2.61	(PU)	21.16	(M)	5.23E-02	4.25E-01	3.72E-01	0.10%
Gr Pppr	Y	1.29	1.87	(U)	1.14	(M)	8.77E-01	5.35E-01	-3.43E-01	-0.09%
Egg Plnt	Y	0.70	2.37	(U)	3.93	(PM)	6.06E-01	1.00E+00	3.97E-01	0.11%
Others	N	6.55	4.50	(R)	4.50	(R)	1.08E+01	1.08E+01		
TREE FTRS										
Citrus										
Orange	Y	85.26	1.65	(U)	4.24	(M)	5.14E+01	1.32E+02	8.06E+01	22.29%
Grpfrt	Y	7.78	1.63	(U)	3.14	(M)	4.63E+00	8.92E+00	4.29E+00	1.19%
Lemon	Y	10.71	1.52	(U)	3.65	(PM)	5.94E+00	1.43E+01	8.32E+00	2.30%
Other	N	60.36	4.50	(R)	4.50	(R)	9.91E+01	9.91E+01		
SOUPS	N	36.82	2.25	(Ea)	2.25	(Ea)	3.03E+01	3.03E+01		
CONDIMENT	N	54.12	0.01	(E)	0.01	(E)	1.98E-01	1.98E-01		
DESSERTS	N	78.30	0.22	(E)	0.22	(E)	6.29E+00	6.29E+00		
BEVERAGE	N	1172.44	1.00	(E)	1.00	(E)	4.28E+02	4.28E+02		
WATER	N	512.00	1.13	(Lb)	1.13	(Lb)	2.11E+02	2.11E+02		
TOTALS:		3071.80	Sampled Items Only ->				5.37E+02	8.99E+02	3.62E+02	100.00%
			Total Modeled Diet ->				1.94E+03	2.30E+03		
DOSES:	mrem/year		Sampled Items Only ->				5.91E-01	9.89E-01	3.98E-01	
			Total Modeled Diet ->				2.13E+00	2.53E+00		

FOOTNOTES: La Dairy samples from Polk Co. (Wa84, p 822)
Lb Average of 38 values for Florida (Wa84, p 818-819)
Ea Geometric Mean of Russell Vegetables and Water
E Estimated from general data trends

DATE: 7/24/85 DIET: FDA/SAMPLED DCF: 5.0E-03 (mrem/pCi)
RADIONUC: PB-210 CASE: Max Indiv WT FCTR: 1.00
NOTE: (M)-MINED,(U)-UNMINED FILENAME:PB210MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	CCN MINED (pCi/Kg)	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only DELTA INTAKE (pCi/yr)	% OF TOTAL DIFF
DAIRY								
Milk	N	280.99	0.34 (E)	0.34 (E)	3.49E+01	3.49E+01	0.00E+00	ERR
Cheese	N	22.41	0.34 (E)	0.34 (E)	2.78E+00	2.78E+00	0.00E+00	ERR
MEAT								
Beef	Y	129.27	0.34 (E)	0.34 (E)	1.60E+01	1.60E+01	0.00E+00	ERR
Pork	N	39.54	0.27 (La)	0.27 (La)	3.90E+00	3.90E+00	0.00E+00	ERR
Other	N	69.00	0.27 (La)	0.27 (La)	6.80E+00	6.80E+00	0.00E+00	ERR
FISH	N	20.06	0.27 (La)	0.27 (La)	1.98E+00	1.98E+00	0.00E+00	ERR
EGGS	N	30.95	0.27 (La)	0.27 (La)	3.05E+00	3.05E+00	0.00E+00	ERR
CEREAL FD								
Corn Gr	N	5.18	1.98 (La)	1.98 (La)	3.74E+00	3.74E+00	0.00E+00	ERR
Grains	N	27.49	1.98 (La)	1.98 (La)	1.99E+01	1.99E+01	0.00E+00	ERR
Crls/Brd	N	174.70	1.98 (La)	1.98 (La)	1.26E+02	1.26E+02	0.00E+00	ERR
LEAFY/COLE VEG								
Spinach	Y	3.28	0.43 (E)	0.43 (E)	5.15E-01	5.15E-01	0.00E+00	ERR
Collards	Y	0.45	0.43 (E)	0.43 (E)	7.06E-02	7.06E-02	0.00E+00	ERR
Mustard	Y	0.45	0.43 (E)	0.43 (E)	7.06E-02	7.06E-02	0.00E+00	ERR
Turnip G	Y	0.45	0.43 (E)	0.43 (E)	7.06E-02	7.06E-02	0.00E+00	ERR
Cabbage	Y	7.04	0.43 (E)	0.43 (E)	1.11E+00	1.11E+00	0.00E+00	ERR
Caulifwr	Y	0.71	0.43 (E)	0.43 (E)	1.12E-01	1.12E-01	0.00E+00	ERR
Brocc	Y	2.80	0.43 (E)	0.43 (E)	4.39E-01	4.39E-01	0.00E+00	ERR
Other	N	0.76	0.33 (La)	0.33 (La)	9.12E-02	9.12E-02	0.00E+00	ERR
Lettuce	N	23.38	0.33 (La)	0.33 (La)	2.82E+00	2.82E+00	0.00E+00	ERR
Celery	N	0.62	0.33 (La)	0.33 (La)	7.48E-02	7.48E-02	0.00E+00	ERR
LEGUMES/CORN								
Green Bn	Y	8.74	0.43 (E)	0.43 (E)	1.37E+00	1.37E+00	0.00E+00	ERR
Blckeyes	Y	3.36	0.43 (E)	0.43 (E)	5.27E-01	5.27E-01	0.00E+00	ERR
Lima Bn	Y	2.25	0.43 (E)	0.43 (E)	3.54E-01	3.54E-01	0.00E+00	ERR
Corn	Y	14.41	0.43 (E)	0.43 (E)	2.26E+00	2.26E+00	0.00E+00	ERR
Grn Peas	N	7.29	0.33 (La)	0.33 (La)	8.78E-01	8.78E-01	0.00E+00	ERR
Other Bn	N	25.71	0.33 (La)	0.33 (La)	3.10E+00	3.10E+00	0.00E+00	ERR
Nuts	N	4.94	0.33 (La)	0.33 (La)	5.95E-01	5.95E-01	0.00E+00	ERR
Other	N	11.28	0.33 (La)	0.33 (La)	1.36E+00	1.36E+00	0.00E+00	ERR
POTATOES	Y	85.22	4.26 (E)	4.26 (E)	1.33E+02	1.33E+02	0.00E+00	ERR
ROOT VEG								
Carrot	Y	2.92	4.26 (E)	4.26 (E)	4.54E+00	4.54E+00	0.00E+00	ERR
Radish	Y	0.32	4.26 (E)	4.26 (E)	4.92E-01	4.92E-01	0.00E+00	ERR
Onion	Y	4.19	4.26 (E)	4.26 (E)	6.52E+00	6.52E+00	0.00E+00	ERR
Turnip	Y	0.42	4.26 (E)	4.26 (E)	6.56E-01	6.56E-01	0.00E+00	ERR
Other	N	1.10	3.40 (La)	3.40 (La)	1.36E+00	1.36E+00	0.00E+00	ERR

DATE: 7/24/85 DIET: FDA/SAMPLED DCF: 5.0E-03 (mrem/pCi)
RADIONUC: PB-210 CASE: Max Indiv WT FCTR: 1.00
NOTE: (M)-MINED,(U)-UNMINED FILENAME:PB210MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	CCN MINED (pCi/Kg)	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only DELTA INTAKE (pCi/yr)	% OF TOTAL DIFF
GRDN FRT								
Watermln	Y	3.44	0.43 (E)	0.43 (E)	5.40E-01	5.40E-01	0.00E+00	ERR
Citron	Y	.00	0.43 (E)	0.43 (E)	1.57E-04	1.57E-04	0.00E+00	ERR
Tomato	Y	25.18	0.43 (E)	0.43 (E)	3.95E+00	3.95E+00	0.00E+00	ERR
Strawbry	Y	1.23	0.43 (E)	0.43 (E)	1.93E-01	1.93E-01	0.00E+00	ERR
Cucumbr	Y	2.62	0.43 (E)	0.43 (E)	4.12E-01	4.12E-01	0.00E+00	ERR
Y. Sqsh	Y	0.63	0.43 (E)	0.43 (E)	9.83E-02	9.83E-02	0.00E+00	ERR
Zuchin	Y	0.63	0.43 (E)	0.43 (E)	9.83E-02	9.83E-02	0.00E+00	ERR
Okra	Y	0.06	0.43 (E)	0.43 (E)	9.42E-03	9.42E-03	0.00E+00	ERR
Gr Pppr	Y	1.29	0.43 (E)	0.43 (E)	2.02E-01	2.02E-01	0.00E+00	ERR
Egg Plnt	Y	0.70	0.43 (E)	0.43 (E)	1.10E-01	1.10E-01	0.00E+00	ERR
Others	N	6.55	0.33 (La)	0.33 (La)	7.89E-01	7.89E-01	0.00E+00	ERR
TREE FTRS								
Citrus								
Orange	Y	85.26	0.43 (E)	0.43 (E)	1.34E+01	1.34E+01	0.00E+00	ERR
Grpfrt	Y	7.78	0.43 (E)	0.43 (E)	1.22E+00	1.22E+00	0.00E+00	ERR
Lemon	Y	10.71	0.43 (E)	0.43 (E)	1.68E+00	1.68E+00	0.00E+00	ERR
Other	N	60.36	0.33 (La)	0.33 (La)	7.27E+00	7.27E+00	0.00E+00	ERR
SOUPS	N	36.82	0.16 (Ea)	0.16 (Ea)	2.15E+00	2.15E+00	0.00E+00	ERR
CONDIMENT	N	54.12	0.43 (E)	0.43 (E)	8.49E+00	8.49E+00	0.00E+00	ERR
DESSERTS	N	78.30	0.43 (E)	0.43 (E)	1.23E+01	1.23E+01	0.00E+00	ERR
BEVERAGE	N	1172.44	0.16 (Ea)	0.16 (Ea)	6.85E+01	6.85E+01	0.00E+00	ERR
WATER	N	512.00	0.05 (La)	0.05 (La)	9.34E+00	9.34E+00	0.00E+00	ERR
TOTALS:		3071.80	Total Modeled Diet -->		5.12E+02	5.12E+02	0.00E+00	ERR
DOSES:	(mrem/yr)		Total Modeled Diet -->		2.56E+00	2.56E+00	0.00E+00	

FOOTNOTES: La Listed intake (pCi/day) by food group divided by rate of food intake (Kg/day) in this model to yield "literature" concentrations (Holtzman, NRE III, p 755)

E Total intake rate for US citizen well documented at about 1.4 pCi/day. Estimated values adjusted from similar food groups (La) upward until total intake (512 pCi/y / 365.25 d/y) equaled the 1.4 pCi/day quoted by Holtzman.

Ea Geometric mean of water and vegetables

DATE: 7/25/85 DIET: FDA/SAMPLED DCF: 1.6E-03 (mrem/pCi)
RADIONUC: Po-210 CASE: Max Indiv WT FCTR: 1.00
NOTE: (M)-MINED,(U)-UNMINED FILENAME:PO210MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(L)-LITERATURE, (E)-ESTIMATED

							Sampled Items Only	
DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	CCN MINED (pCi/Kg)	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	DELTA INTAKE (pCi/yr)	% OF TOTAL DIFF
---------		---------	---------	---------	---------	---------	---------	---------
DAIRY								
Milk	N	280.99	0.39 (E)	0.39 (E)	4.00E+01	4.00E+01	0.00E+00	ERR
Cheese	N	22.41	0.39 (E)	0.39 (E)	3.19E+00	3.19E+00	0.00E+00	ERR
MEAT								
Beef	Y	129.27	0.39 (E)	0.39 (E)	1.84E+01	1.84E+01	0.00E+00	ERR
Pork	N	39.54	0.31 (La)	0.31 (La)	4.47E+00	4.47E+00	0.00E+00	ERR
Other	N	69.00	0.31 (La)	0.31 (La)	7.81E+00	7.81E+00	0.00E+00	ERR
FISH	N	20.06	0.31 (La)	0.31 (La)	2.27E+00	2.27E+00	0.00E+00	ERR
EGGS	N	30.95	0.31 (La)	0.31 (La)	3.50E+00	3.50E+00	0.00E+00	ERR
CEREAL FD								
Corn Gr	N	5.18	2.26 (La)	2.26 (La)	4.27E+00	4.27E+00	0.00E+00	ERR
Grains	N	27.49	2.26 (La)	2.26 (La)	2.27E+01	2.27E+01	0.00E+00	ERR
Crls/Brd	N	174.70	2.26 (La)	2.26 (La)	1.44E+02	1.44E+02	0.00E+00	ERR
LEAFY/COLE VEG								
Spinach	Y	3.28	0.49 (E)	0.49 (E)	5.87E-01	5.87E-01	0.00E+00	ERR
Collards	Y	0.45	0.49 (E)	0.49 (E)	8.04E-02	8.04E-02	0.00E+00	ERR
Mustard	Y	0.45	0.49 (E)	0.49 (E)	8.04E-02	8.04E-02	0.00E+00	ERR
Turnip G	Y	0.45	0.49 (E)	0.49 (E)	8.04E-02	8.04E-02	0.00E+00	ERR
Cabbage	Y	7.04	0.49 (E)	0.49 (E)	1.26E+00	1.26E+00	0.00E+00	ERR
Caulifwr	Y	0.71	0.49 (E)	0.49 (E)	1.27E-01	1.27E-01	0.00E+00	ERR
Brocc	Y	2.80	0.49 (E)	0.49 (E)	5.00E-01	5.00E-01	0.00E+00	ERR
Other	N	0.76	0.38 (La)	0.38 (La)	1.05E-01	1.05E-01	0.00E+00	ERR
Lettuce	N	23.38	0.38 (La)	0.38 (La)	3.24E+00	3.24E+00	0.00E+00	ERR
Celery	N	0.62	0.38 (La)	0.38 (La)	8.61E-02	8.61E-02	0.00E+00	ERR
LEGUMES/CORN								
Green Bn	Y	8.74	0.49 (E)	0.49 (E)	1.56E+00	1.56E+00	0.00E+00	ERR
Blckeyes	Y	3.36	0.49 (E)	0.49 (E)	6.00E-01	6.00E-01	0.00E+00	ERR
Lima Bn	Y	2.25	0.49 (E)	0.49 (E)	4.03E-01	4.03E-01	0.00E+00	ERR
Corn	Y	14.41	0.49 (E)	0.49 (E)	2.58E+00	2.58E+00	0.00E+00	ERR
Grn Peas	N	7.29	0.38 (La)	0.38 (La)	1.01E+00	1.01E+00	0.00E+00	ERR
Other Bn	N	25.71	0.38 (La)	0.38 (La)	3.57E+00	3.57E+00	0.00E+00	ERR
Nuts	N	4.94	0.38 (La)	0.38 (La)	6.86E-01	6.86E-01	0.00E+00	ERR
Other	N	11.28	0.38 (La)	0.38 (La)	1.56E+00	1.56E+00	0.00E+00	ERR
POTATOES	Y	85.22	4.87 (E)	4.87 (E)	1.51E+02	1.51E+02	0.00E+00	ERR
ROOT VEG								
Carrot	Y	2.92	4.87 (E)	4.87 (E)	5.19E+00	5.19E+00	0.00E+00	ERR
Radish	Y	0.32	4.87 (E)	4.87 (E)	5.63E-01	5.63E-01	0.00E+00	ERR
Onion	Y	4.19	4.87 (E)	4.87 (E)	7.46E+00	7.46E+00	0.00E+00	ERR
Turnip	Y	0.42	4.87 (E)	4.87 (E)	7.50E-01	7.50E-01	0.00E+00	ERR

DATE: 7/25/85 DIET: FDA/SAMPLED DCF: 1.6E-03 (mrem/pCi)
RADIONUC: Po-210 CASE: Max Indiv WT FCTR: 1.00
NOTE: (M)-MINED, (U)-UNMINED FILENAME: PO210MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED, (PU)-PREDICTED FROM UNMINED
(L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)		CCN MINED (pCi/Kg)		INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only DELTA INTAKE (pCi/yr)	% OF TOTAL DIFF
Other	N	1.10	3.89	(La)	3.89	(La)	1.56E+00	1.56E+00	0.00E+00	ERR
GRDN FRT										
Watermln	Y	3.44	0.49	(E)	0.49	(E)	6.16E-01	6.16E-01	0.00E+00	ERR
Citron	Y	.00	0.49	(E)	0.49	(E)	1.79E-04	1.79E-04	0.00E+00	ERR
Tomato	Y	25.18	0.49	(E)	0.49	(E)	4.50E+00	4.50E+00	0.00E+00	ERR
Strawbry	Y	1.23	0.49	(E)	0.49	(E)	2.20E-01	2.20E-01	0.00E+00	ERR
Cucumbr	Y	2.62	0.49	(E)	0.49	(E)	4.69E-01	4.69E-01	0.00E+00	ERR
Y. Sqsh	Y	0.63	0.49	(E)	0.49	(E)	1.12E-01	1.12E-01	0.00E+00	ERR
Zuchin	Y	0.63	0.49	(E)	0.49	(E)	1.12E-01	1.12E-01	0.00E+00	ERR
Okra	Y	0.06	0.49	(E)	0.49	(E)	1.07E-02	1.07E-02	0.00E+00	ERR
Gr Pppr	Y	1.29	0.49	(E)	0.49	(E)	2.30E-01	2.30E-01	0.00E+00	ERR
Egg Plnt	Y	0.70	0.49	(E)	0.49	(E)	1.25E-01	1.25E-01	0.00E+00	ERR
Others	N	6.55	0.38	(La)	0.38	(La)	9.08E-01	9.08E-01	0.00E+00	ERR
TREE FTRS										
Citrus										
Orange	Y	85.26	0.49	(E)	0.49	(E)	1.52E+01	1.52E+01	0.00E+00	ERR
Grpfrt	Y	7.78	0.49	(E)	0.49	(E)	1.39E+00	1.39E+00	0.00E+00	ERR
Lemon	Y	10.71	0.49	(E)	0.49	(E)	1.91E+00	1.91E+00	0.00E+00	ERR
Other	N	60.36	0.38	(La)	0.38	(La)	8.37E+00	8.37E+00	0.00E+00	ERR
SOUPS	N	36.82	0.18	(Ea)	0.18	(Ea)	2.42E+00	2.42E+00	0.00E+00	ERR
CONDIMENT	N	54.12	0.49	(E)	0.49	(E)	9.68E+00	9.68E+00	0.00E+00	ERR
DESSERTS	N	78.30	0.49	(E)	0.49	(E)	1.40E+01	1.40E+01	0.00E+00	ERR
BEVERAGE	N	1172.44	0.18	(Ea)	0.18	(Ea)	7.70E+01	7.70E+01	0.00E+00	ERR
WATER	N	512.00	0.06	(La)	0.06	(La)	1.12E+01	1.12E+01	0.00E+00	ERR
TOTALS:		3071.80	Total Modeled Diet -->				5.84E+02	5.84E+02	0.00E+00	ERR
DOSES:	(mrem/yr)		Total Modeled Diet -->				9.35E-01	9.35E-01	0.00E+00	

FOOTNOTES: Total intake rate for US citizen well documented at about 1.6 pCi/day. Estimated values adjusted from similar food groups for Pb-210 upward until total intake (584 pCi/y / 365.25 d/y) equaled the 1.6 pCi/day Po-210 quoted by Holtzman, NRE III, p 755

DATE: 7/24/85 DIET: FDA/SAMPLED DCF: 2.7E-03 (mrem/pCi)
RADIONUC: TH-232 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED, (U)-UNMINED FILENAME: TH232MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED, (PU)-PREDICTED FROM UNMINED
(L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY										
Milk	N	280.99	0.01	(E)	0.01	(E)	1.03E+00	1.03E+00		
Cheese	N	22.41	0.01	(E)	0.01	(E)	8.18E-02	8.18E-02		
MEAT										
Beef	Y	129.27	0.28	(U)	0.09	(M)	1.31E+01	4.34E+00	-8.78E+00	-539.57%
Pork	N	39.54	0.10	(E)	0.10	(E)	1.44E+00	1.44E+00		
Other	N	69.00	0.10	(E)	0.10	(E)	2.52E+00	2.52E+00		
FISH	N	20.06	0.10	(E)	0.10	(E)	7.32E-01	7.32E-01		
EGGS	N	30.95	0.10	(E)	0.10	(E)	1.13E+00	1.13E+00		
CEREAL FD										
Corn Gr	N	5.18	0.10	(E)	0.10	(E)	1.89E-01	1.89E-01		
Grains	N	27.49	0.10	(E)	0.10	(E)	1.00E+00	1.00E+00		
Crls/Brd	N	174.70	0.10	(E)	0.10	(E)	6.38E+00	6.38E+00		
LEAFY/COLE VEG										
Spinach	Y	3.28	0.04	(U)	0.14	(PM)	5.15E-02	1.62E-01	1.10E-01	6.77%
Collards	Y	0.45	0.07	(U)	0.10	(M)	1.15E-02	1.66E-02	5.09E-03	0.31%
Mustard	Y	0.45	0.08	(U)	0.14	(PM)	1.38E-02	2.22E-02	8.37E-03	0.51%
Turnip G	Y	0.45	0.19	(U)	0.18	(M)	3.09E-02	2.97E-02	-1.15E-03	-0.07%
Cabbage	Y	7.04	0.04	(U)	0.04	(M)	1.11E-01	1.11E-01	0.00E+00	0.00%
Caulifwr	Y	0.71	0.04	(U)	0.04	(PM)	1.12E-02	1.09E-02	-2.60E-04	-0.02%
Brocc	Y	2.80	0.04	(U)	0.04	(PM)	4.39E-02	4.28E-02	-1.02E-03	-0.06%
Other	N	0.76	0.10	(E)	0.10	(E)	2.76E-02	2.76E-02		
Lettuce	N	23.38	0.10	(E)	0.10	(E)	8.53E-01	8.53E-01		
Celery	N	0.62	0.10	(E)	0.10	(E)	2.27E-02	2.27E-02		
LEGUMES/CORN										
Green Bn	Y	8.74	0.04	(U)	0.28	(M)	1.37E-01	9.03E-01	7.66E-01	47.08%
Blckeyes	Y	3.36	0.04	(U)	0.08	(M)	5.27E-02	9.31E-02	4.04E-02	2.49%
Lima Bn	Y	2.25	0.04	(PU)	0.19	(M)	3.54E-02	1.60E-01	1.24E-01	7.64%
Corn	Y	14.41	0.04	(U)	0.04	(M)	2.26E-01	2.26E-01	0.00E+00	0.00%
Grn Peas	N	7.29	0.10	(E)	0.10	(E)	2.66E-01	2.66E-01		
Other Bn	N	25.71	0.10	(E)	0.10	(E)	9.38E-01	9.38E-01		
Nuts	N	4.94	0.10	(E)	0.10	(E)	1.80E-01	1.80E-01		
Other	N	11.28	0.10	(E)	0.10	(E)	4.12E-01	4.12E-01		
POTATOES	Y	85.22	0.06	(PU)	0.31	(M)	1.89E+00	9.58E+00	7.69E+00	473.05%
ROOT VEG										
Carrot	Y	2.92	0.03	(U)	0.36	(M)	2.77E-02	3.85E-01	3.58E-01	22.00%
Radish	Y	0.32	0.02	(U)	0.22	(M)	2.31E-03	2.59E-02	2.36E-02	1.45%
Onion	Y	4.19	0.13	(U)	0.04	(M)	1.99E-01	6.58E-02	-1.33E-01	-8.19%
Turnip	Y	0.42	0.20	(U)	0.08	(M)	3.08E-02	1.17E-02	-1.91E-02	-1.17%
Other	N	1.10	0.10	(E)	0.10	(E)	4.00E-02	4.00E-02		

DATE: 7/24/85 DIET: FDA/SAMPLED DCF: 2.7E-03 (mrem/pCi)
RADIONUC: TH-232 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME:TH232MAX

"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN MINED (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	0.12	(U)	0.04	(M)	1.55E-01	5.03E-02	-1.04E-01	-6.41%
Citron	Y	.00	0.12	(U)	0.05	(M)	4.42E-05	1.83E-05	-2.59E-05	.00%
Tomato	Y	25.18	0.02	(U)	0.19	(M)	2.02E-01	1.72E+00	1.52E+00	93.24%
Strawbry	Y	1.23	0.04	(U)	0.07	(PM)	1.93E-02	2.96E-02	1.03E-02	0.63%
Cucumbr	Y	2.62	0.04	(U)	0.04	(M)	4.12E-02	4.12E-02	0.00E+00	0.00%
Y. Sqsh	Y	0.63	0.13	(U)	0.22	(M)	3.04E-02	4.96E-02	1.92E-02	1.18%
Zuchin	Y	0.63	0.07	(U)	0.06	(M)	1.60E-02	1.26E-02	-3.43E-03	-0.21%
Okra	Y	0.06	0.06	(PU)	0.04	(M)	1.40E-03	9.42E-04	-4.59E-04	-0.03%
Gr Pppr	Y	1.29	0.05	(U)	0.04	(M)	2.16E-02	2.02E-02	-1.41E-03	-0.09%
Egg Plnt	Y	0.70	0.07	(U)	0.07	(PM)	1.76E-02	1.79E-02	2.56E-04	0.02%
Others	N	6.55	0.10	(E)	0.10	(E)	2.39E-01	2.39E-01		
TREE FTRS										
Citrus										
Orange	Y	85.26	0.03	(U)	0.04	(M)	8.40E-01	1.15E+00	3.11E-01	19.13%
Grpfrt	Y	7.78	0.03	(U)	0.01	(M)	8.24E-02	3.12E-02	-5.11E-02	-3.14%
Lemon	Y	10.71	0.09	(U)	0.02	(PM)	3.48E-01	7.88E-02	-2.69E-01	-16.54%
Other	N	60.36	0.10	(E)	0.10	(E)	2.20E+00	2.20E+00		
SOUPS	N	36.82	0.10	(E)	0.10	(E)	1.34E+00	1.34E+00		
CONDIMENT	N	54.12	0.10	(E)	0.10	(E)	1.98E+00	1.98E+00		
DESSERTS	N	78.30	0.01	(E)	0.01	(E)	2.86E-01	2.86E-01		
BEVERAGE	N	1172.44	0.10	(E)	0.10	(E)	4.28E+01	4.28E+01		
WATER	N	512.00	0.10	(E)	0.10	(E)	1.87E+01	1.87E+01		
TOTALS:		3071.80	Sampled Items Only ->				1.78E+01	1.94E+01	1.63E+00	100.00%
			Total Modeled Diet ->				1.03E+02	1.04E+02		

DOSES:	mrem/year				
		Sampled Items Only ->	4.80E-02	5.23E-02	4.39E-03
		Total Modeled Diet ->	2.77E-01	2.81E-01	

NOTE: A number of literature analyses were located in Drury, et. al. 1983
However, all were "less than" values. Some typical results were:
<2.7 pCi/Kg --> broccoli, cabbage, corn, cucumber, eggplant, lettace, melon, yellow squash, tangelo, and tangerine
<5.4 pCi/Kg --> dry beans, carrots, orange, and bell pepper
<8.1 pCi/Kg --> celery, pear and sweet potato
<10.8 pCi/Kg --> grapes, grapefruit and tomato
It appears that the estimated value of 0.10 pCi/Kg Th-232 is not an overestimation of the concentration in a normal diet.

DATE: 7/21/85 DIET: FDA/SAMPLED DCF: 3.8E-04 (mrem/pCi)
RADIONUC: TH-228 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME:TH228MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	CCN MINED (pCi/Kg)	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY								
Milk	N	280.99	0.31 (E)	0.31 (E)	3.16E+01	3.16E+01		
Cheese	N	22.41	0.31 (E)	0.31 (E)	2.52E+00	2.52E+00		
MEAT								
Beef	Y	129.27	5.51 (U)	0.12 (M)	2.60E+02	5.57E+00	-2.54E+02	69.70%
Pork	N	39.54	3.08 (E)	3.08 (E)	4.45E+01	4.45E+01		
Other	N	69.00	3.08 (E)	3.08 (E)	7.76E+01	7.76E+01		
FISH	N	20.06	3.08 (E)	3.08 (E)	2.25E+01	2.25E+01		
EGGS	N	30.95	3.08 (E)	3.08 (E)	3.48E+01	3.48E+01		
CEREAL FD								
Corn Gr	N	5.18	3.08 (E)	3.08 (E)	5.82E+00	5.82E+00		
Grains	N	27.49	3.08 (E)	3.08 (E)	3.09E+01	3.09E+01		
Crls/Brd	N	174.70	3.08 (E)	3.08 (E)	1.96E+02	1.96E+02		
LEAFY/COLE VEG								
Spinach	Y	3.28	0.46 (U)	1.20 (PM)	5.52E-01	1.44E+00	8.85E-01	-0.24%
Collards	Y	0.45	0.55 (U)	0.34 (M)	9.06E-02	5.58E-02	-3.48E-02	0.01%
Mustard	Y	0.45	0.51 (U)	1.20 (PM)	8.35E-02	1.97E-01	1.13E-01	-0.03%
Turnip G	Y	0.45	3.67 (U)	4.26 (M)	6.02E-01	6.98E-01	9.62E-02	-0.03%
Cabbage	Y	7.04	0.34 (U)	2.83 (M)	8.64E-01	7.28E+00	6.42E+00	-1.76%
Caulifwr	Y	0.71	0.65 (U)	2.83 (PM)	1.69E-01	7.36E-01	5.67E-01	-0.16%
Brocc	Y	2.80	4.30 (U)	2.83 (PM)	4.39E+00	2.89E+00	-1.50E+00	0.41%
Other	N	0.76	3.08 (E)	3.08 (E)	8.51E-01	8.51E-01		
Lettuce	N	23.38	3.08 (E)	3.08 (E)	2.63E+01	2.63E+01		
Celery	N	0.62	3.08 (E)	3.08 (E)	6.98E-01	6.98E-01		
LEGUMES/CORN								
Green Bn	Y	8.74	0.39 (U)	7.92 (M)	1.23E+00	2.53E+01	2.40E+01	-6.59%
Blckeyes	Y	3.36	0.43 (U)	1.15 (M)	5.25E-01	1.41E+00	8.80E-01	-0.24%
Lima Bn	Y	2.25	0.41 (PU)	0.63 (M)	3.35E-01	5.19E-01	1.84E-01	-0.05%
Corn	Y	14.41	17.19 (U)	8.96 (M)	9.04E+01	4.71E+01	-4.33E+01	11.87%
Grn Peas	N	7.29	3.08 (E)	3.08 (E)	8.20E+00	8.20E+00		
Other Bn	N	25.71	3.08 (E)	3.08 (E)	2.89E+01	2.89E+01		
Nuts	N	4.94	3.08 (E)	3.08 (E)	5.56E+00	5.56E+00		
Other	N	11.28	3.08 (E)	3.08 (E)	1.27E+01	1.27E+01		
POTATOES	Y	85.22	5.11 (PU)	3.23 (M)	1.59E+02	1.00E+02	-5.85E+01	16.05%
ROOT VEG								
Carrot	Y	2.92	28.83 (U)	0.22 (M)	3.07E+01	2.31E-01	-3.05E+01	8.36%
Radish	Y	0.32	2.34 (U)	4.54 (M)	2.71E-01	5.25E-01	2.54E-01	-0.07%
Onion	Y	4.19	6.39 (U)	0.80 (M)	9.78E+00	1.23E+00	-8.55E+00	2.35%
Turnip	Y	0.42	1.58 (U)	1.69 (M)	2.43E-01	2.60E-01	1.76E-02	.00%
Other	N	1.10	3.08 (E)	3.08 (E)	1.23E+00	1.23E+00		

DATE: 7/21/85 DIET: FDA/SAMPLED DCF: 3.8E-04 (mrem/pCi)
RADIONUC: TH-228 CASE: Max Indiv WT FCTR: 1.00
KEYS: (M)-MINED,(U)-UNMINED FILENAME:TH228MAX
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	CCN MINED (pCi/Kg)	INTAKE UNMINED (pCi/yr)	INTAKE MINED (pCi/yr)	Sampled Items Only DELTA INTAKE (pCi/yr)	Sampled Items Only % OF TOTAL DIFF
GRDN FRT								
Watermln	Y	3.44	6.75 (U)	1.42 (M)	8.48E+00	1.78E+00	-6.70E+00	1.84%
Citron	Y	.00	3.44 (U)	0.13 (M)	1.26E-03	4.82E-05	-1.21E-03	.00%
Tomato	Y	25.18	2.58 (U)	0.89 (M)	2.37E+01	8.22E+00	-1.55E+01	4.25%
Strawbry	Y	1.23	1.01 (U)	1.12 (PM)	4.53E-01	5.04E-01	5.06E-02	-0.01%
Cucumbr	Y	2.62	1.18 (U)	9.47 (M)	1.13E+00	9.07E+00	7.94E+00	-2.18%
Y. Sqsh	Y	0.63	1.32 (U)	1.66 (M)	3.01E-01	3.80E-01	7.91E-02	-0.02%
Zuchin	Y	0.63	1.46 (U)	2.18 (M)	3.34E-01	4.98E-01	1.64E-01	-0.04%
Okra	Y	0.06	0.96 (PU)	4.63 (M)	2.10E-02	1.01E-01	8.05E-02	-0.02%
Gr Pppr	Y	1.29	2.72 (U)	0.10 (M)	1.28E+00	4.46E-02	-1.23E+00	0.34%
Egg Plnt	Y	0.70	1.08 (U)	1.12 (PM)	2.77E-01	2.86E-01	9.20E-03	.00%
Others	N	6.55	3.08 (E)	3.08 (E)	7.36E+00	7.36E+00		
TREE FTRS								
Citrus								
Orange	Y	85.26	0.36 (U)	0.68 (M)	1.11E+01	2.11E+01	9.93E+00	-2.72%
Grpfrt	Y	7.78	1.28 (U)	1.99 (M)	3.65E+00	5.65E+00	2.01E+00	-0.55%
Lemon	Y	10.71	0.75 (U)	1.16 (PM)	2.93E+00	4.54E+00	1.61E+00	-0.44%
Other	N	60.36	3.08 (E)	3.08 (E)	6.79E+01	6.79E+01		
SOUPS	N	36.82	0.98 (E)	0.98 (E)	1.31E+01	1.31E+01		
CONDIMENT	N	54.12	3.08 (E)	3.08 (E)	6.08E+01	6.08E+01		
DESSERTS	N	78.30	0.31 (E)	0.31 (E)	8.86E+00	8.86E+00		
BEVERAGE	N	1172.44	0.31 (E)	0.31 (E)	1.33E+02	1.33E+02		
WATER	N	512.00	0.31 (E)	0.31 (E)	5.79E+01	5.79E+01		
TOTALS:		3071.80	Sampled Items Only ->		6.13E+02	2.48E+02	-3.65E+02	100.00%
			Total Modeled Diet ->		1.49E+03	1.13E+03		
DOSES:		mrem/year	Sampled Items Only ->		2.33E-01	9.42E-02	-1.39E-01	
			Total Modeled Diet ->		5.67E-01	4.28E-01		

NOTE: Since the delta intake for sampled items is negative, the percent difference is "negative" if the mined concentration exceeds the unmined concentration.
Literature values are very sparse. Drury et. al 1983 contains some "less than" values:
<2.7 pCi/Kg --> corn, melon, squash, and tomato (two entries)
Thus the estimated value in the table (3.08 pCi/Kg) from the grand average of all sampled foods may be conservative (overestimation).

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 2.3E-04 (mrem/pCi)
RADIONUC: U-238 CASE: Debris Indiv. WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS, (M)-MINED, (U)-UNMINED FILENAME: U238DEB
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED, (PU)-PREDICTED FROM UNMINED
(PD)-PREDICTED FROM DEBRIS, (L)-LITERATURE

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY										
Milk	N	280.99	.00	(La)	.00	(La)	3.08E-01	3.08E-01		
Cheese	N	22.41	0.67	(La)	0.67	(La)	5.48E+00	5.48E+00		
MEAT										
Beef	Y	129.27	0.08	(U)	0.41	(M)	3.87E+00	1.95E+01	1.56E+01	2.54%
Pork	N	39.54	0.13	(La)	0.13	(La)	1.88E+00	1.88E+00		
Other	N	69.00	0.13	(La)	0.13	(La)	3.27E+00	3.27E+00		
FISH	N	20.06	0.67	(La)	0.67	(La)	4.90E+00	4.90E+00		
EGGS	N	30.95	0.67	(La)	0.67	(La)	7.57E+00	7.57E+00		
CEREAL FD										
Corn Gr	N	5.18	0.17	(La)	0.17	(La)	3.21E-01	3.21E-01		
Grains	N	27.49	0.17	(La)	0.17	(La)	1.71E+00	1.71E+00		
Crls/Brd	N	174.70	0.17	(La)	0.17	(La)	1.08E+01	1.08E+01		
LEAFY/COLE VEG										
Spinach	Y	3.28	2.69	(U)	245.42	(D)	3.22E+00	2.94E+02	2.91E+02	47.31%
Collards	Y	0.45	0.40	(U)	245.42	(PD)	6.48E-02	4.03E+01	4.02E+01	6.55%
Mustard	Y	0.45	0.90	(U)	245.42	(PD)	1.48E-01	4.03E+01	4.01E+01	6.53%
Turnip G	Y	0.45	0.32	(U)	245.42	(PD)	5.22E-02	4.03E+01	4.02E+01	6.55%
Cabbage	Y	7.04	0.02	(U)	0.17	(M)	5.91E-02	4.32E-01	3.73E-01	0.06%
Caulifwr	Y	0.71	0.02	(U)	0.17	(PM)	5.98E-03	4.37E-02	3.77E-02	0.01%
Brocc	Y	2.80	0.39	(U)	0.17	(PM)	4.01E-01	1.71E-01	-2.30E-01	-0.04%
Other	N	0.76	0.27	(La)	0.27	(La)	7.46E-02	7.46E-02		
Lettuce	N	23.38	0.27	(La)	0.27	(La)	2.30E+00	2.30E+00		
Celery	N	0.62	0.27	(La)	0.27	(La)	6.12E-02	6.12E-02		
LEGUMES/CORN										
Green Bn	Y	8.74	0.17	(U)	2.15	(Da)	5.30E-01	6.86E+00	6.33E+00	1.03%
Blckeyes	Y	3.36	0.41	(U)	2.15	(PD)	5.05E-01	2.63E+00	2.13E+00	0.35%
Lima Bn	Y	2.25	0.26	(PU)	2.15	(PD)	2.15E-01	1.77E+00	1.55E+00	0.25%
Corn	Y	14.41	0.06	(U)	2.65	(M)	3.00E-01	1.39E+01	1.36E+01	2.22%
Grn Peas	N	7.29	0.27	(La)	0.27	(La)	7.19E-01	7.19E-01		
Other Bn	N	25.71	0.27	(La)	0.27	(La)	2.53E+00	2.53E+00		
Nuts	N	4.94	0.27	(La)	0.27	(La)	4.87E-01	4.87E-01		
Other	N	11.28	0.27	(La)	0.27	(La)	1.11E+00	1.11E+00		
POTATOES	Y	85.22	0.55	(PU)	5.02	(PD)	1.71E+01	1.56E+02	1.39E+02	22.63%
ROOT VEG										
Carrot	Y	2.92	1.38	(U)	12.43	(M)	1.47E+00	1.32E+01	1.18E+01	1.92%
Radish	Y	0.32	0.45	(U)	5.02	(PD)	5.21E-02	5.80E-01	5.28E-01	0.09%
Onion	Y	4.19	0.82	(U)	5.02	(PD)	1.26E+00	7.69E+00	6.43E+00	1.05%
Turnip	Y	0.42	0.18	(U)	5.02	(D)	2.77E-02	7.73E-01	7.46E-01	0.12%
Other	N	1.10	0.33	(La)	0.33	(La)	1.32E-01	1.32E-01		

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 2.3E-04 (mrem/pCi)
RADIONUC: U-238 CASE: Debris Indiv.WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS,(M)-MINED,(U)-UNMINED FILENAME: U238DEB
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED, (PU)-PREDICTED FROM UNMINED
(PD)-PREDICTED FROM DEBRIS,(L)-LITERATURE

DIET ITEM	SAMPLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	0.17	(U)	0.92	(PD)	2.14E-01	1.16E+00	9.42E-01	0.15%
Citron	Y	.00	0.02	(U)	0.92	(PD)	7.30E-06	3.36E-04	3.29E-04	.00%
Tomato	Y	25.18	0.28	(U)	0.92	(PD)	2.57E+00	8.46E+00	5.88E+00	0.96%
Strawbry	Y	1.23	0.33	(U)	0.92	(PD)	1.48E-01	4.13E-01	2.65E-01	0.04%
Cucumbr	Y	2.62	2.33	(U)	0.92	(PD)	2.23E+00	8.81E-01	-1.35E+00	-0.22%
Y. Sqsh	Y	0.63	0.07	(U)	0.92	(D)	1.60E-02	2.10E-01	1.94E-01	0.03%
Zuchin	Y	0.63	0.16	(U)	0.92	(PD)	3.66E-02	2.10E-01	1.74E-01	0.03%
Okra	Y	0.06	0.92	(PU)	0.92	(PD)	2.01E-02	2.01E-02	0.00E+00	0.00%
Gr Pppr	Y	1.29	0.13	(U)	0.92	(PD)	6.10E-02	4.32E-01	3.71E-01	0.06%
Egg Plnt	Y	0.70	1.08	(U)	0.92	(PD)	2.76E-01	2.35E-01	-4.09E-02	-0.01%
Others	N	6.55	0.27	(La)	0.27	(La)	6.46E-01	6.46E-01		
TREE FTRS										
Citrus										
Orange	Y	85.26	0.04	(U)	0.04	(M)	1.24E+00	1.24E+00	0.00E+00	0.00%
Grpfrt	Y	7.78	0.06	(U)	0.08	(M)	1.70E-01	2.27E-01	5.68E-02	0.01%
Lemon	Y	10.71	0.42	(U)	0.06	(PM)	1.64E+00	2.21E-01	-1.42E+00	-0.23%
Other	N	60.36	1.00	(La)	1.00	(La)	2.20E+01	2.20E+01		
SOUPS	N	36.82	0.25	(E)	0.25	(E)	3.42E+00	3.42E+00		
CONDIMENT	N	54.12	10.00	(La)	10.00	(La)	1.98E+02	1.98E+02		
DESSERTS	N	78.30	0.27	(La)	0.27	(La)	7.72E+00	7.72E+00		
BEVERAGE	N	1172.44	1.00	(La)	1.00	(La)	4.28E+02	4.28E+02		
WATER	N	512.00	0.24	(Lb)	0.24	(Lb)	4.49E+01	4.49E+01		
TOTALS:		3071.80	Sampled Items Only ->				3.79E+01	6.52E+02	6.14E+02	100.00%
			Total Modeled Diet ->				7.86E+02	1.40E+03		
DOSES:	mrem/year		Sampled Items Only ->				8.72E-03	1.50E-01	1.41E-01	
			Total Modeled Diet ->				1.81E-01	3.22E-01		

FOOTNOTES: La Diet Uranium (Ha72)
Lb Florida Aquifer Water (Co80)
E Geometric Mean of Vegetables and Water
Da Reported as <LLD, Geom. Mean of Turnip and Y. Squash Utilized

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 2.6E-04 (mrem/pCi)
RADIONUC: U-234 CASE: Debris Indiv WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS,(M)-MINED,(U)-UNMINED FILENAME: U234DEB
"MINED" - CROPS ON CLAYS, MINIED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(PD)-PRECICTED FROM DEBRIS,(L)-LITERATURE

DIET ITEM	SAMPLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY										
Milk	N	280.99	.00	(La)	.00	(La)	3.08E-01	3.08E-01		
Cheese	N	22.41	0.67	(La)	0.67	(La)	5.48E+00	5.48E+00		
MEAT										
Beef	Y	129.27	0.75	(U)	0.27	(M)	3.55E+01	1.29E+01	-2.26E+01	-3.77%
Pork	N	39.54	0.13	(La)	0.13	(La)	1.88E+00	1.88E+00		
Other	N	69.00	0.13	(La)	0.13	(La)	3.27E+00	3.27E+00		
FISH	N	20.06	0.67	(La)	0.67	(La)	4.90E+00	4.90E+00		
EGGS	N	30.95	0.67	(La)	0.67	(La)	7.57E+00	7.57E+00		
CEREAL FD										
Corn Gr	N	5.18	0.17	(La)	0.17	(La)	3.21E-01	3.21E-01		
Grains	N	27.49	0.17	(La)	0.17	(La)	1.71E+00	1.71E+00		
Crls/Brd	N	174.70	0.17	(La)	0.17	(La)	1.08E+01	1.08E+01		
LEAFY/COLE VEG										
Spinach	Y	3.28	3.97	(U)	268.27	(D)	4.75E+00	3.21E+02	3.16E+02	52.74%
Collards	Y	0.45	0.40	(U)	268.27	(PD)	6.63E-02	4.40E+01	4.40E+01	7.33%
Mustard	Y	0.45	1.84	(U)	268.27	(PD)	3.02E-01	4.40E+01	4.37E+01	7.29%
Turnip G	Y	0.45	0.93	(U)	268.27	(PD)	1.53E-01	4.40E+01	4.39E+01	7.31%
Cabbage	Y	7.04	0.43	(U)	0.55	(M)	1.09E+00	1.41E+00	3.21E-01	0.05%
Caulifwr	Y	0.71	0.62	(U)	0.55	(PM)	1.60E-01	1.43E-01	-1.72E-02	.00%
Brocc	Y	2.80	1.25	(U)	0.55	(PM)	1.28E+00	5.61E-01	-7.14E-01	-0.12%
Other	N	0.76	0.27	(La)	0.27	(La)	7.46E-02	7.46E-02		
Lettuce	N	23.38	0.27	(La)	0.27	(La)	2.30E+00	2.30E+00		
Celery	N	0.62	0.27	(La)	0.27	(La)	6.12E-02	6.12E-02		
LEGUMES/CORN										
Green Bn	Y	8.74	1.67	(U)	1.57	(Ma)	5.32E+00	5.02E+00	-3.09E-01	-0.05%
Blckeyes	Y	3.36	1.23	(U)	1.05	(M)	1.50E+00	1.28E+00	-2.20E-01	-0.04%
Lima Bn	Y	2.25	1.43	(PU)	1.11	(M)	1.18E+00	9.16E-01	-2.62E-01	-0.04%
Corn	Y	14.41	0.15	(U)	2.35	(M)	7.89E-01	1.23E+01	1.15E+01	1.92%
Grn Peas	N	7.29	0.27	(La)	0.27	(La)	7.19E-01	7.19E-01		
Other Bn	N	25.71	0.27	(La)	0.27	(La)	2.53E+00	2.53E+00		
Nuts	N	4.94	0.27	(La)	0.27	(La)	4.87E-01	4.87E-01		
Other	N	11.28	0.27	(La)	0.27	(La)	1.11E+00	1.11E+00		
POTATOES	Y	85.22	0.67	(PU)	5.26	(PD)	2.08E+01	1.64E+02	1.43E+02	23.80%
ROOT VEG										
Carrot	Y	2.92	1.02	(U)	11.35	(M)	1.08E+00	1.21E+01	1.10E+01	1.83%
Radish	Y	0.32	0.38	(U)	5.26	(PD)	4.36E-02	6.08E-01	5.64E-01	0.09%
Onion	Y	4.19	0.68	(U)	5.26	(PD)	1.04E+00	8.05E+00	7.02E+00	1.17%
Turnip	Y	0.42	0.77	(U)	5.26	(D)	1.19E-01	8.10E-01	6.91E-01	0.12%
Other	N	1.10	0.33	(La)	0.33	(La)	1.32E-01	1.32E-01		

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 2.6E-04 (mrem/pCi)
RADIONUC: U-234 CASE: Debris Indiv WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS,(M)-MINED,(U)-UNMINED FILENAME: U234DEB
"MINED" - CROPS ON CLAYS, MINIED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(PD)-PRECICTED FROM DEBRIS,(L)-LITERATURE

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	1.04	(U)	1.73	(PD)	1.31E+00	2.17E+00	8.67E-01	0.14%
Citron	Y	.00	1.52	(U)	1.73	(PD)	5.55E-04	6.31E-04	7.66E-05	.00%
Tomato	Y	25.18	1.25	(U)	1.73	(PD)	1.15E+01	1.59E+01	4.41E+00	0.74%
Strawbry		1.23	1.67	(U)	1.73	(PD)	7.52E-01	7.77E-01	2.51E-02	.00%
Cucumbr	Y	2.62	3.06	(U)	1.73	(PD)	2.93E+00	1.66E+00	-1.27E+00	-0.21%
Y. Sqsh	Y	0.63	0.58	(U)	1.73	(D)	1.33E-01	3.96E-01	2.63E-01	0.04%
Zuchin	Y	0.63	2.18	(U)	1.73	(PD)	4.99E-01	3.96E-01	-1.03E-01	-0.02%
Okra		0.06	1.21	(PU)	1.73	(PD)	2.64E-02	3.79E-02	1.15E-02	.00%
Gr Pppr	Y	1.29	0.33	(U)	1.73	(PD)	1.55E-01	8.12E-01	6.57E-01	0.11%
Egg Plnt	Y	0.70	1.27	(U)	1.73	(PD)	3.24E-01	4.42E-01	1.18E-01	0.02%
Others	N	6.55	0.27	(La)	0.27	(La)	6.46E-01	6.46E-01		
TREE FTRS										
Citrus										
Orange	Y	85.26	0.09	(U)	0.01	(M)	2.80E+00	3.11E-01	-2.49E+00	-0.41%
Grpfrt	Y	7.78	0.08	(U)	0.01	(M)	2.27E-01	2.84E-02	-1.99E-01	-0.03%
Lemon	Y	10.71	0.02	(U)	0.01	(PM)	7.82E-02	3.91E-02	-3.91E-02	-0.01%
Other	N	60.36	1.00	(La)	1.00	(La)	2.20E+01	2.20E+01		
SOUPS	N	36.82	0.25	(E)	0.25	(E)	3.36E+00	3.36E+00		
CONDIMENT	N	54.12	10.00	(La)	10.00	(La)	1.98E+02	1.98E+02		
DESSERTS	N	78.30	0.27	(La)	0.27	(La)	7.72E+00	7.72E+00		
BEVERAGE	N	1172.44	1.00	(La)	1.00	(La)	4.28E+02	4.28E+02		
WATER	N	512.00	0.24	(Lb)	0.24	(Lb)	4.49E+01	4.49E+01		
TOTALS:		3071.80	Sampled Items Only ->				9.59E+01	6.96E+02	6.00E+02	100.00%
			Total Modeled Diet ->				8.44E+02	1.44E+03		
DOSES:	mrem/year		Sampled Items Only ->				2.49E-02	1.81E-01	1.56E-01	
			Total Modeled Diet ->				2.19E-01	3.75E-01		

FOOTNOTES: La Diet Uranium (Ha72)
Lb Florida Aquifer Water (Co80)
E Geometric Mean of Vegetables and Water
Ma Mined value higher than debris, mined value retained

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 5.4E-04 (mrem/pCi)
RADIONUC: TH-230 CASE: Debris Indiv WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS,(M)-MINED,(U)-UNMINED FILENAME:TH230DEB
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(PD)-PREDICTED DEBRIS,(E)-ESTIMATED, (L)-LITERATURE

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY										
Milk	N	280.99	0.10	(E)	0.10	(E)	1.03E+01	1.03E+01		
Cheese	N	22.41	0.10	(E)	0.10	(E)	8.18E-01	8.18E-01		
MEAT										
Beef	Y	129.27	0.97	(U)	0.05	(M)	4.60E+01	2.22E+00	-4.37E+01	-9.71%
Pork	N	39.54	0.50	(E)	0.50	(E)	7.22E+00	7.22E+00		
Other	N	69.00	0.50	(E)	0.50	(E)	1.26E+01	1.26E+01		
FISH	N	20.06	0.50	(E)	0.50	(E)	3.66E+00	3.66E+00		
EGGS	N	30.95	0.50	(E)	0.50	(E)	5.65E+00	5.65E+00		
CEREAL FD										
Corn Gr	N	5.18	0.50	(E)	0.50	(E)	9.45E-01	9.45E-01		
Grains	N	27.49	0.50	(E)	0.50	(E)	5.02E+00	5.02E+00		
Crls/Brd	N	174.70	0.50	(E)	0.50	(E)	3.19E+01	3.19E+01		
LEAFY/COLE VEG										
Spinach	Y	3.28	0.65	(U)	193.20	(D)	7.75E-01	2.31E+02	2.31E+02	51.18%
Collards	Y	0.45	0.32	(U)	193.20	(PD)	5.25E-02	3.17E+01	3.17E+01	7.03%
Mustard	Y	0.45	0.35	(U)	193.20	(PD)	5.70E-02	3.17E+01	3.17E+01	7.03%
Turnip G	Y	0.45	0.21	(U)	193.20	(PD)	3.36E-02	3.17E+01	3.17E+01	7.03%
Cabbage	Y	7.04	0.04	(U)	0.04	(M)	1.08E-01	1.08E-01	0.00E+00	0.00%
Caulifwr	Y	0.71	0.07	(U)	0.04	(PM)	1.90E-02	1.09E-02	-8.06E-03	.00%
Brocc	Y	2.80	1.45	(U)	0.04	(PM)	1.48E+00	4.28E-02	-1.44E+00	-0.32%
Other	N	0.76	0.50	(E)	0.50	(E)	1.38E-01	1.38E-01		
Lettuce	N	23.38	0.50	(E)	0.50	(E)	4.27E+00	4.27E+00		
Celery	N	0.62	0.50	(E)	0.50	(E)	1.13E-01	1.13E-01		
LEGUMES/CORN										
Green Bn	Y	8.74	0.18	(U)	1.22	(Ma)	5.84E-01	3.90E+00	3.32E+00	0.74%
Blckeyes	Y	3.36	0.14	(U)	0.50	(M)	1.65E-01	6.15E-01	4.50E-01	0.10%
Lima Bn	Y	2.25	0.16	(PU)	0.37	(M)	1.29E-01	3.04E-01	1.75E-01	0.04%
Corn	Y	14.41	1.59	(U)	0.04	(M)	8.34E+00	2.21E-01	-8.12E+00	-1.80%
Grn Peas	N	7.29	0.50	(E)	0.50	(E)	1.33E+00	1.33E+00		
Other Bn	N	25.71	0.50	(E)	0.50	(E)	4.69E+00	4.69E+00		
Nuts	N	4.94	0.50	(E)	0.50	(E)	9.02E-01	9.02E-01		
Other	N	11.28	0.50	(E)	0.50	(E)	2.06E+00	2.06E+00		
POTATOES	Y	85.22	0.34	(PU)	5.14	(PD)	1.07E+01	1.60E+02	1.49E+02	33.12%
ROOT VEG										
Carrot	Y	2.92	0.52	(U)	5.14	(PD)	5.55E-01	5.47E+00	4.92E+00	1.09%
Radish	Y	0.32	0.06	(U)	5.14	(PD)	6.35E-03	5.94E-01	5.87E-01	0.13%
Onion	Y	4.19	1.54	(U)	5.14	(PD)	2.35E+00	7.87E+00	5.52E+00	1.23%
Turnip	Y	0.42	0.31	(U)	5.14	(D)	4.84E-02	7.92E-01	7.43E-01	0.17%
Other	N	1.10	0.50	(E)	0.50	(E)	2.00E-01	2.00E-01		

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 5.4E-04 (mrem/pCi)
RADIONUC: TH-230 CASE: Debris Indiv WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS,(M)-MINED,(U)-UNMINED FILENAME:TH230DEB
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(PD)-PREDICTED DEBRIS,(E)-ESTIMATED, (L)-LITERATURE

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only DELTA INTAKE (pCi/yr)	Sampled Items Only % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	0.33	(U)	2.24	(PD)	4.15E-01	2.81E+00	2.40E+00	0.53%
Citron	Y	.00	0.38	(U)	2.24	(PD)	1.39E-04	8.18E-04	6.79E-04	.00%
Tomato	Y	25.18	1.25	(U)	2.24	(PD)	1.15E+01	2.06E+01	9.10E+00	2.02%
Strawbry	Y	1.23	0.20	(U)	2.24	(PD)	8.99E-02	1.01E+00	9.17E-01	0.20%
Cucumbr	Y	2.62	0.43	(U)	2.24	(PD)	4.12E-01	2.14E+00	1.73E+00	0.38%
Y. Sqsh	Y	0.63	0.57	(U)	2.24	(D)	1.30E-01	5.12E-01	3.82E-01	0.08%
Zuchin	Y	0.63	0.20	(U)	2.24	(PD)	4.57E-02	5.12E-01	4.66E-01	0.10%
Okra	Y	0.06	0.40	(PU)	2.24	(PD)	8.10E-03	4.50E-02	3.69E-02	0.01%
Gr Pppr	Y	1.29	1.03	(U)	2.24	(PD)	4.83E-01	1.05E+00	5.68E-01	0.13%
Egg Plnt	Y	0.70	0.18	(U)	2.24	(PD)	4.60E-02	5.72E-01	5.26E-01	0.12%
Others	N	6.55	0.50	(E)	0.50	(E)	1.20E+00	1.20E+00		
TREE FTRS										
Citrus										
Orange	Y	85.26	0.08	(U)	.00	(M)	2.49E+00	9.34E-02	-2.40E+00	-0.53%
Grpfrt	Y	7.78	0.06	(U)	0.04	(M)	1.70E-01	1.14E-01	-5.68E-02	-0.01%
Lemon	Y	10.71	0.10	(U)	0.01	(PM)	3.91E-01	4.28E-02	-3.48E-01	-0.08%
Other	N	60.36	0.50	(E)	0.50	(E)	1.10E+01	1.10E+01		
SOUPS	N	36.82	0.50	(E)	0.50	(E)	6.72E+00	6.72E+00		
CONDIMENT	N	54.12	0.50	(E)	0.50	(E)	9.88E+00	9.88E+00		
DESSERTS	N	78.30	0.10	(E)	0.10	(E)	2.86E+00	2.86E+00		
BEVERAGE	N	1172.44	0.50	(E)	0.50	(E)	2.14E+02	2.14E+02		
WATER	N	512.00	0.50	(E)	0.50	(E)	9.34E+01	9.34E+01		
TOTALS:		3071.80	Sampled Items Only ->				9.85E+01	5.49E+02	4.50E+02	100.00%
			Total Modeled Diet ->				5.18E+02	9.69E+02		
DOSES:	mrem/year		Sampled Items Only ->				5.32E-02	2.96E-01	2.43E-01	
			Total Modeled Diet ->				2.80E-01	5.23E-01		

NOTE: Since the delta intake for sampled items is negative, the percent difference is "negative" if the mined concentration exceeds the unmined concentration.
Wrenn gives body burden of Th-230 in avg individual (NRE III)
Can this be used with Ra-226 body burden to estimate Th-230 intake?
Ma - Mined value larger than debris value, mined value retained

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 1.1E-03 (mrem/pCi)
RADIONUC: Ra-226 CASE: Debris Indiv WT FCTR: 1.00
KEYS: (U)-UNMINED, (D)-DEBRIS LANDS, (M)-MINED FILENAME: RA226DEB
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
"MINED" -CROPS ON CLAYS, MINED AND RECLAIMED LANDS
(PD)-PREDICTED FROM DEBRIS LANDS,(PU)-PREDICTED FROM UNMINED
(PM)-PREDICTED FROM MINED,(R)-RUSSELL, (L)-LITERATURE

DIET ITEM	SAMPLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY										
Milk	N	280.99	2.51	(La)	2.51	(La)	2.57E+02	2.57E+02		
Cheese	N	22.41	0.22	(R)	0.22	(R)	1.80E+00	1.80E+00		
MEAT										
Beef	Y	129.27	3.98	(U)	3.41	(M)	1.88E+02	1.61E+02	-2.68E+01	-1.55%
Pork	N	39.54	0.91	(R)	0.91	(R)	1.31E+01	1.31E+01		
Other	N	69.00	0.91	(R)	0.91	(R)	2.29E+01	2.29E+01		
FISH	N	20.06	1.30	(R)	1.30	(R)	9.52E+00	9.52E+00		
EGGS	N	30.95	5.00	(R)	5.00	(R)	5.65E+01	5.65E+01		
CEREAL FD										
Corn Gr	N	5.18	2.00	(R)	2.00	(R)	3.78E+00	3.78E+00		
Grains	N	27.49	2.00	(R)	2.00	(R)	2.01E+01	2.01E+01		
Crls/Brd	N	174.70	2.00	(R)	2.00	(R)	1.28E+02	1.28E+02		
LEAFY/COLE VEG										
Spinach	Y	3.28	16.51	(U)	520.26	(D)	1.98E+01	6.23E+02	6.03E+02	34.86%
Collards	Y	0.45	5.65	(U)	520.26	(PD)	9.28E-01	8.54E+01	8.45E+01	4.88%
Mustard	Y	0.45	1.10	(U)	520.26	(PD)	1.80E-01	8.54E+01	8.52E+01	4.93%
Turnip G	Y	0.45	9.03	(U)	520.26	(PD)	1.48E+00	8.54E+01	8.39E+01	4.85%
Cabbage	Y	7.04	2.10	(U)	3.68	(M)	5.39E+00	9.45E+00	4.06E+00	0.23%
Caulifwr	Y	0.71	6.03	(U)	3.68	(PM)	1.57E+00	9.56E-01	-6.10E-01	-0.04%
Brocc	Y	2.80	3.00	(U)	3.68	(PM)	3.06E+00	3.75E+00	6.91E-01	0.04%
Other	N	0.76	4.50	(R)	4.50	(R)	1.24E+00	1.24E+00		
Lettuce	N	23.38	4.50	(R)	4.50	(R)	3.84E+01	3.84E+01		
Celery	N	0.62	4.50	(R)	4.50	(R)	1.02E+00	1.02E+00		
LEGUMES/CORN										
Green Bn	Y	8.74	5.16	(U)	9.79	(D)	1.65E+01	3.12E+01	1.48E+01	0.85%
Blckeyes	Y	3.36	1.87	(U)	9.79	(PD)	2.29E+00	1.20E+01	9.70E+00	0.56%
Lima Bn	Y	2.25	3.11	(PU)	65.71	(M)	2.56E+00	5.41E+01	5.15E+01	2.98%
Corn	Y	14.41	4.90	(U)	9.19	(M)	2.58E+01	4.84E+01	2.26E+01	1.31%
Grn Peas	N	7.29	4.50	(R)	4.50	(R)	1.20E+01	1.20E+01		
Other Bn	N	25.71	4.50	(R)	4.50	(R)	4.22E+01	4.22E+01		
Nuts	N	4.94	4.50	(R)	4.50	(R)	8.12E+00	8.12E+00		
Other	N	11.28	4.50	(R)	4.50	(R)	1.85E+01	1.85E+01		
POTATOES	Y	85.22	4.46	(PU)	19.22	(PD)	1.39E+02	5.98E+02	4.59E+02	26.54%
ROOT VEG										
Carrot	Y	2.92	8.52	(U)	181.61	(M)	9.08E+00	1.93E+02	1.84E+02	10.65%
Radish	Y	0.32	3.82	(U)	19.22	(PD)	4.41E-01	2.22E+00	1.78E+00	0.10%
Onion	Y	4.19	2.91	(U)	19.22	(PD)	4.46E+00	2.94E+01	2.50E+01	1.44%
Turnip	Y	0.42	4.18	(U)	19.22	(D)	6.44E-01	2.96E+00	2.32E+00	0.13%
Other	N	1.10	2.00	(R)	2.00	(R)	8.00E-01	8.00E-01		

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 1.1E-03 (mrem/pCi)

RADIONUC: Ra-226 CASE: Debris Indiv WT FCTR: 1.00

KEYS: (U)-UNMINED, (D)-DEBRIS LANDS, (M)-MINED FILENAME: RA226DEB

"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS

"MINED" -CROPS ON CLAYS, MINED AND RECLAIMED LANDS

(PD)-PREDICTED FROM DEBRIS LANDS,(PU)-PREDICTED FROM UNMINED

(PM)-PREDICTED FROM MINED,(R)-RUSSELL, (L)-LITERATURE

DIET ITEM	SAMPLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	1.24	(U)	5.15	(PD)	1.56E+00	6.47E+00	4.91E+00	0.28%
Citron	Y	.00	2.19	(U)	5.15	(PD)	7.99E-04	1.88E-03	1.08E-03	.00%
Tomato	Y	25.18	2.94	(U)	5.15	(PD)	2.70E+01	4.73E+01	2.03E+01	1.17%
Strawbry	Y	1.23	2.81	(U)	5.15	(PD)	1.26E+00	2.31E+00	1.05E+00	0.06%
Cucumbr	Y	2.62	3.22	(U)	5.60	(M)	3.08E+00	5.36E+00	2.28E+00	0.13%
Y. Sqsh	Y	0.63	4.11	(U)	5.15	(D)	9.40E-01	1.18E+00	2.38E-01	0.01%
Zuchin	Y	0.63	4.20	(U)	5.15	(PD)	9.60E-01	1.18E+00	2.17E-01	0.01%
Okra	Y	0.06	2.61	(PU)	21.16	(M)	5.23E-02	4.25E-01	3.72E-01	0.02%
Gr Pppr	Y	1.29	1.87	(U)	5.15	(PD)	8.77E-01	2.42E+00	1.54E+00	0.09%
Egg Plnt	Y	0.70	2.37	(U)	5.15	(PD)	6.06E-01	1.32E+00	7.10E-01	0.04%
Others	N	6.55	4.50	(R)	4.50	(R)	1.08E+01	1.08E+01		
TREE FTRS										
Citrus										
Orange	Y	85.26	1.65	(U)	4.24	(M)	5.14E+01	1.32E+02	8.06E+01	4.66%
Grpfrt	Y	7.78	1.63	(U)	3.14	(M)	4.63E+00	8.92E+00	4.29E+00	0.25%
Lemon	Y	10.71	1.52	(U)	3.65	(PM)	5.94E+00	1.43E+01	8.32E+00	0.48%
Other	N	60.36	4.50	(R)	4.50	(R)	9.91E+01	9.91E+01		
SOUPS	N	36.82	2.25	(Ea)	2.25	(Ea)	3.03E+01	3.03E+01		
CONDIMENT	N	54.12	0.01	(E)	0.01	(E)	1.98E-01	1.98E-01		
DESSERTS	N	78.30	0.22	(E)	0.22	(E)	6.29E+00	6.29E+00		
BEVERAGE	N	1172.44	1.00	(E)	1.00	(E)	4.28E+02	4.28E+02		
WATER	N	512.00	1.13	(Lb)	1.13	(Lb)	2.11E+02	2.11E+02		
TOTALS:		3071.80	Sampled Items Only ->				5.37E+02	2.27E+03	1.73E+03	100.00%
			Total Modeled Diet ->				1.94E+03	3.67E+03		
DOSES:	mrem/year		Sampled Items Only ->				5.91E-01	2.49E+00	1.90E+00	
			Total Modeled Diet ->				2.13E+00	4.04E+00		

FOOTNOTES:
La Dairy samples from Polk Co. (Wa84, p 822)
Lb Average of 38 values for Florida (Wa84, p 818-819)
Ea Geometric Mean of Russell Vegetables and Water
E Estimated from general data trends

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 2.7E-03 (mrem/pCi)
RADIONUC: TH-232 CASE: Debris Indiv WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS,(M)-MINED,(U)-UNMINED FILENAME:TH232DEB
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(PD)-PREDICTED DEBRIS, (L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
DAIRY										
Milk	N	280.99	0.01	(E)	0.01	(E)	1.03E+00	1.03E+00		
Cheese	N	22.41	0.01	(E)	0.01	(E)	8.18E-02	8.18E-02		
MEAT										
Beef	Y	129.27	0.28	(U)	0.09	(M)	1.31E+01	4.34E+00	-8.78E+00	-42.44%
Pork	N	39.54	0.10	(E)	0.10	(E)	1.44E+00	1.44E+00		
Other	N	69.00	0.10	(E)	0.10	(E)	2.52E+00	2.52E+00		
FISH	N	20.06	0.10	(E)	0.10	(E)	7.32E-01	7.32E-01		
EGGS	N	30.95	0.10	(E)	0.10	(E)	1.13E+00	1.13E+00		
CEREAL FD										
Corn Gr	N	5.18	0.10	(E)	0.10	(E)	1.89E-01	1.89E-01		
Grains	N	27.49	0.10	(E)	0.10	(E)	1.00E+00	1.00E+00		
Crls/Brd	N	174.70	0.10	(E)	0.10	(E)	6.38E+00	6.38E+00		
LEAFY/COLE VEG										
Spinach	Y	3.28	0.04	(U)	6.82	(D)	5.15E-02	8.16E+00	8.11E+00	39.24%
Collards	Y	0.45	0.07	(U)	6.82	(PD)	1.15E-02	1.12E+00	1.11E+00	5.36%
Mustard	Y	0.45	0.08	(U)	6.82	(PD)	1.38E-02	1.12E+00	1.11E+00	5.35%
Turnip G	Y	0.45	0.19	(U)	6.82	(PD)	3.09E-02	1.12E+00	1.09E+00	5.26%
Cabbage	Y	7.04	0.04	(U)	0.04	(M)	1.11E-01	1.11E-01	0.00E+00	0.00%
Caulifwr	Y	0.71	0.04	(U)	0.04	(PM)	1.12E-02	1.09E-02	-2.60E-04	.00%
Brocc	Y	2.80	0.04	(U)	0.04	(PM)	4.39E-02	4.28E-02	-1.02E-03	.00%
Other	N	0.76	0.10	(E)	0.10	(E)	2.76E-02	2.76E-02		
Lettuce	N	23.38	0.10	(E)	0.10	(E)	8.53E-01	8.53E-01		
Celery	N	0.62	0.10	(E)	0.10	(E)	2.27E-02	2.27E-02		
LEGUMES/CORN										
Green Bn	Y	8.74	0.04	(U)	0.45	(D)	1.37E-01	1.43E+00	1.29E+00	6.25%
Blckeyes	Y	3.36	0.04	(U)	0.45	(PD)	5.27E-02	5.49E-01	4.96E-01	2.40%
Lima Bn	Y	2.25	0.04	(PU)	0.45	(PD)	3.54E-02	3.69E-01	3.33E-01	1.61%
Corn	Y	14.41	0.04	(U)	0.04	(M)	2.26E-01	2.26E-01	0.00E+00	0.00%
Grn Peas	N	7.29	0.10	(E)	0.10	(E)	2.66E-01	2.66E-01		
Other Bn	N	25.71	0.10	(E)	0.10	(E)	9.38E-01	9.38E-01		
Nuts	N	4.94	0.10	(E)	0.10	(E)	1.80E-01	1.80E-01		
Other	N	11.28	0.10	(E)	0.10	(E)	4.12E-01	4.12E-01		
POTATOES	Y	85.22	0.06	(PU)	0.42	(PD)	1.89E+00	1.31E+01	1.12E+01	54.06%
ROOT VEG										
Carrot	Y	2.92	0.03	(U)	0.42	(PD)	2.77E-02	4.47E-01	4.20E-01	2.03%
Radish	Y	0.32	0.02	(U)	0.42	(PD)	2.31E-03	4.85E-02	4.62E-02	0.22%
Onion	Y	4.19	0.13	(U)	0.42	(PD)	1.99E-01	6.43E-01	4.44E-01	2.15%
Turnip	Y	0.42	0.20	(U)	0.42	(D)	3.08E-02	6.47E-02	3.39E-02	0.16%
Other	N	1.10	0.10	(E)	0.10	(E)	4.00E-02	4.00E-02		

DATE: 7/23/85 DIET: FDA/SAMPLED DCF: 2.7E-03 (mrem/pCi)
RADIONUC: TH-232 CASE: Debris Indiv WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS,(M)-MINED,(U)-UNMINED FILENAME:TH232DEB
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(PD)-PREDICTED DEBRIS, (L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM-PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	KEY	CCN DEBRIS (pCi/Kg)	KEY	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only: DELTA INTAKE (pCi/yr)	Sampled Items Only: % OF TOTAL DIFF
GRDN FRT										
Watermln	Y	3.44	0.12	(U)	0.33	(PD)	1.55E-01	4.15E-01	2.60E-01	1.26%
Citron	Y	.00	0.12	(U)	0.33	(PD)	4.42E-05	1.20E-04	7.63E-05	.00%
Tomato	Y	25.18	0.02	(U)	0.33	(PD)	2.02E-01	3.03E+00	2.83E+00	13.69%
Strawbry	Y	1.23	0.04	(U)	0.33	(PD)	1.93E-02	1.48E-01	1.29E-01	0.62%
Cucumbr	Y	2.62	0.04	(U)	0.33	(PD)	4.12E-02	3.16E-01	2.75E-01	1.33%
Y. Sqsh	Y	0.63	0.13	(U)	0.33	(D)	3.04E-02	7.55E-02	4.50E-02	0.22%
Zuchin	Y	0.63	0.07	(U)	0.33	(PD)	1.60E-02	7.55E-02	5.95E-02	0.29%
Okra	Y	0.06	0.06	(PU)	0.33	(PD)	1.40E-03	7.23E-03	5.83E-03	0.03%
Gr Pppr	Y	1.29	0.05	(U)	0.33	(PD)	2.16E-02	1.55E-01	1.33E-01	0.64%
Egg Plnt	Y	0.70	0.07	(U)	0.33	(PD)	1.76E-02	8.43E-02	6.67E-02	0.32%
Others	N	6.55	0.10	(E)	0.10	(E)	2.39E-01	2.39E-01		
TREE FTRS										
Citrus										
Orange	Y	85.26	0.03	(U)	0.04	(M)	8.40E-01	1.15E+00	3.11E-01	1.51%
Grpfrt	Y	7.78	0.03	(U)	0.01	(M)	8.24E-02	3.12E-02	-5.11E-02	-0.25%
Lemon	Y	10.71	0.09	(U)	0.02	(PM)	3.48E-01	7.88E-02	-2.69E-01	-1.30%
Other	N	60.36	0.10	(E)	0.10	(E)	2.20E+00	2.20E+00		
SOUPS	N	36.82	0.10	(E)	0.10	(E)	1.34E+00	1.34E+00		
CONDIMENT	N	54.12	0.10	(E)	0.10	(E)	1.98E+00	1.98E+00		
DESSERTS	N	78.30	0.01	(E)	0.01	(E)	2.86E-01	2.86E-01		
BEVERAGE	N	1172.44	0.10	(E)	0.10	(E)	4.28E+01	4.28E+01		
WATER	N	512.00	0.10	(E)	0.10	(E)	1.87E+01	1.87E+01		
TOTALS:		3071.80	Sampled Items Only ->				1.78E+01	3.84E+01	2.07E+01	100.00%
			Total Modeled Diet ->				1.03E+02	1.23E+02		
DOSES:	mrem/year		Sampled Items Only ->				4.80E-02	1.04E-01	5.58E-02	
			Total Modeled Diet ->				2.77E-01	3.33E-01		

NOTE: A number of literature analyses were located in Drury, et. al. 1983
However, all were "less than" values. Some typical results were:
<2.7 pCi/Kg --> broccoli, cabbage, corn, cucumber, eggplant, lettace, melon, yellow squash, tangelo, and tangerine
<5.4 pCi/Kg --> dry beans, carrots, orange, and bell pepper
<8.1 pCi/Kg --> celery, pear and sweet potato
<10.8 pCi/Kg --> grapes, grapefruit and tomato
It appears that the estimated value of 0.10 pCi/Kg Th-232 is not an overestimation of the concentration in a normal diet.

DATE: 7/25/85 DIET: FDA/SAMPLED DCF: 3.8E-04 (mrem/pCi)
RADIONUC: TH-228 CASE: Debris Indiv WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS,(M)-MINED,(U)-UNMINED FILENAME:TH228DEB
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(PD)-PREDICTED FORM DEBRIS,(L)-LITERATURE, (E)-ESTIMATED

							Sampled Items Only	
DIET ITEM	SAM- PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)	CCN DEBRIS (pCi/Kg)	INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	DELTA INTAKE (pCi/yr)	% OF TOTAL DIFF
DAIRY								
Milk	N	280.99	0.31 (E)	0.31 (E)	3.16E+01	3.16E+01		
Cheese	N	22.41	0.31 (E)	0.31 (E)	2.52E+00	2.52E+00		
MEAT								
Beef	Y	129.27	5.51 (U)	0.12 (M)	2.60E+02	5.57E+00	-2.54E+02	206.79%
Pork	N	39.54	3.08 (E)	3.08 (E)	4.45E+01	4.45E+01		
Other	N	69.00	3.08 (E)	3.08 (E)	7.76E+01	7.76E+01		
FISH	N	20.06	3.08 (E)	3.08 (E)	2.25E+01	2.25E+01		
EGGS	N	30.95	3.08 (E)	3.08 (E)	3.48E+01	3.48E+01		
CEREAL FD								
Corn Gr	N	5.18	3.08 (E)	3.08 (E)	5.82E+00	5.82E+00		
Grains	N	27.49	3.08 (E)	3.08 (E)	3.09E+01	3.09E+01		
Crls/Brd	N	174.70	3.08 (E)	3.08 (E)	1.96E+02	1.96E+02		
LEAFY/COLE VEG								
Spinach	Y	3.28	0.46 (U)	88.57 (D)	5.52E-01	1.06E+02	1.05E+02	-85.82%
Collards	Y	0.45	0.55 (U)	88.57 (PD)	9.06E-02	1.45E+01	1.44E+01	-11.75%
Mustard	Y	0.45	0.51 (U)	88.57 (PD)	8.35E-02	1.45E+01	1.45E+01	-11.76%
Turnip G	Y	0.45	3.67 (U)	88.57 (PD)	6.02E-01	1.45E+01	1.39E+01	-11.34%
Cabbage	Y	7.04	0.34 (U)	2.83 (M)	8.64E-01	7.28E+00	6.42E+00	-5.22%
Caulifwr	Y	0.71	0.65 (U)	2.83 (PM)	1.69E-01	7.36E-01	5.67E-01	-0.46%
Brocc	Y	2.80	4.30 (U)	2.83 (PM)	4.39E+00	2.89E+00	-1.50E+00	1.22%
Other	N	0.76	3.08 (E)	3.08 (E)	8.51E-01	8.51E-01		
Lettuce	N	23.38	3.08 (E)	3.08 (E)	2.63E+01	2.63E+01		
Celery	N	0.62	3.08 (E)	3.08 (E)	6.98E-01	6.98E-01		
LEGUMES/CORN								
Green Bn	Y	8.74	0.39 (U)	7.92 (Ma)	1.23E+00	2.53E+01	2.40E+01	-19.54%
Blckeyes	Y	3.36	0.43 (U)	1.15 (M)	5.25E-01	1.41E+00	8.80E-01	-0.72%
Lima Bn	Y	2.25	0.41 (PU)	0.63 (M)	3.35E-01	5.19E-01	1.84E-01	-0.15%
Corn	Y	14.41	17.19 (U)	8.96 (M)	9.04E+01	4.71E+01	-4.33E+01	35.21%
Grn Peas	N	7.29	3.08 (E)	3.08 (E)	8.20E+00	8.20E+00		
Other Bn	N	25.71	3.08 (E)	3.08 (E)	2.89E+01	2.89E+01		
Nuts	N	4.94	3.08 (E)	3.08 (E)	5.56E+00	5.56E+00		
Other	N	11.28	3.08 (E)	3.08 (E)	1.27E+01	1.27E+01		
POTATOES	Y	85.22	5.11 (PU)	3.23 (M)	1.59E+02	1.00E+02	-5.85E+01	47.62%
ROOT VEG								
Carrot	Y	2.92	28.83 (U)	2.33 (PD)	3.07E+01	2.48E+00	-2.82E+01	22.96%
Radish	Y	0.32	2.34 (M)	4.54 (M)	2.71E-01	5.25E-01	2.54E-01	-0.21%
Onion	Y	4.19	6.39 (U)	2.33 (PD)	9.78E+00	3.57E+00	-6.21E+00	5.06%
Turnip	Y	0.42	1.58 (U)	2.33 (D)	2.43E-01	3.59E-01	1.16E-01	-0.09%

DATE: 7/25/85 DIET: FDA/SAMPLED OCF: 3.8E-04 (mrem/pCi)
RADIONUC: TH-228 CASE: Debris Indiv WT FCTR: 1.00
KEYS: (D)-DEBRIS LANDS,(M)-MINED,(U)-UNMINED FILENAME:TH228DEB
"MINED" - CROPS ON CLAYS, MINED AND RECLAIMED LANDS
"UNMINED" - CROPS ON EITHER MINERALIZED OR CONTROL LANDS
(PM)-PREDICTED FROM MINED,(PU)-PREDICTED FROM UNMINED
(PD)-PREDICTED FORM DEBRIS,(L)-LITERATURE, (E)-ESTIMATED

DIET ITEM	SAM- PLED? Y/N	INTAKE OF ITEM (g/day)	CCN UNMINED (pCi/Kg)		CCN DEBRIS (pCi/Kg)		INTAKE UNMINED (pCi/yr)	INTAKE DEBRIS (pCi/yr)	Sampled Items Only DELTA INTAKE (pCi/yr)	% OF TOTAL DIFF
Other	N	1.10	3.08	(E)	3.08	(E)	1.23E+00	1.23E+00		
GRDN FRT										
Watermln	Y	3.44	6.75	(U)	8.41	(PD)	8.48E+00	1.06E+01	2.09E+00	-1.70%
Citron	Y	.00	3.44	(U)	8.41	(PD)	1.26E-03	3.07E-03	1.81E-03	.00%
Tomato	Y	25.18	2.58	(U)	8.41	(PD)	2.37E+01	7.73E+01	5.36E+01	-43.61%
Strawbry	Y	1.23	1.01	(U)	8.41	(PD)	4.53E-01	3.78E+00	3.32E+00	-2.70%
Cucumbr	Y	2.62	1.18	(U)	9.47	(M)	1.13E+00	9.07E+00	7.94E+00	-6.46%
Y. Sqsh	Y	0.63	1.32	(U)	8.41	(D)	3.01E-01	1.92E+00	1.62E+00	-1.32%
Zuchin	Y	0.63	1.46	(U)	8.41	(PD)	3.34E-01	1.92E+00	1.59E+00	-1.29%
Okra	Y	0.06	8.52	(PU)	8.41	(PD)	1.87E-01	1.84E-01	-2.45E-03	.00%
Gr Pppr	Y	1.29	2.72	(U)	8.41	(PD)	1.28E+00	3.95E+00	2.67E+00	-2.17%
Egg Plnt	Y	0.70	1.08	(U)	8.41	(PD)	2.77E-01	2.15E+00	1.87E+00	-1.52%
Others	N	6.55	3.08	(E)	3.08	(E)	7.36E+00	7.36E+00		
TREE FTRS										
Citrus										
Orange	Y	85.26	0.36	(U)	0.68	(M)	1.11E+01	2.11E+01	9.93E+00	-8.08%
Grpfrt	Y	7.78	1.28	(U)	1.99	(M)	3.65E+00	5.65E+00	2.01E+00	-1.63%
Lemon	Y	10.71	0.75	(U)	1.16	(PM)	2.93E+00	4.54E+00	1.61E+00	-1.31%
Other	N	60.36	3.08	(E)	3.08	(E)	6.79E+01	6.79E+01		
SOUPS	N	36.82	0.98	(E)	0.98	(E)	1.31E+01	1.31E+01		
CONDIMENT	N	54.12	3.08	(E)	3.08	(E)	6.08E+01	6.08E+01		
DESSERTS	N	78.30	0.31	(E)	0.31	(E)	8.86E+00	8.86E+00		
BEVERAGE	N	1172.44	0.31	(E)	0.31	(E)	1.33E+02	1.33E+02		
WATER	N	512.00	0.31	(E)	0.31	(E)	5.79E+01	5.79E+01		
TOTALS:		3071.80	Sampled Items Only ->				6.13E+02	4.90E+02	-1.23E+02	100.00%
			Total Modeled Diet ->				1.49E+03	1.37E+03		
DOSES:	mrem/year		Sampled Items Only ->				2.33E-01	1.86E-01	-4.67E-02	
			Total Modeled Diet ->				5.67E-01	5.20E-01		

FOOTNOTES: Ma Mined value higer than debris, mined value retained