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RADIOLOGICAL SURVEY  
RESULTS  
AT PORTER STREET CITY PARK,  
BEVERLY, MASSACHUSETTS  
(VB026)

R. D. Foley  
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HEALTH AND SAFETY RESEARCH DIVISION

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(Activity No. EX 20 20 01 0; ADS3170000)

**Radiological Survey Results at Porter Street City Park,  
Beverly, Massachusetts (VB026)**

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## ABSTRACT

At the request of the U.S. Department of Energy (DOE), a team from Oak Ridge National Laboratory conducted a radiological survey at the Porter Street City Park, Beverly, Massachusetts. The survey was performed in May 1991. The purpose of the survey was to determine if uranium from work performed under government contract at the former Ventron facility had migrated off-site to neighboring areas. The survey included a surface gamma scan and the collection of soil samples for radionuclide analyses.

Results of the survey demonstrated no radionuclide concentrations or radiation measurements in excess of the DOE Formerly Utilized Sites Remedial Action Program guidelines



# RADIOLOGICAL SURVEY RESULTS AT PORTER STREET CITY PARK, BEVERLY, MASSACHUSETTS (VB026)\*

## INTRODUCTION

The Metal Hydrides Corporation facility in Beverly, Massachusetts (which became the Ventron Corporation in 1965), was one of many companies performing work during the 1940s associated with the development of nuclear energy for defense-related projects under contract to the Manhattan Engineer District (MED) and the Atomic Energy Commission (AEC). Operations conducted under government contract at such sites included the procurement, storage, and processing of uranium oxides, salts, and metals, and the subsequent machining of these products. As a result of activities involving these materials, equipment, buildings, and land at some of the sites became radiologically contaminated with small amounts of the material resulting in low levels of contamination on the properties. At contract termination, release limits and decontamination operations were typically applied in conformance with standards currently deemed adequate for purposes of health and environmental protection. Subsequent to original assessments and the release of these facilities, new research and information have resulted in the development of more stringent guidelines for release of such facilities for unrestricted use. Furthermore, in some instances, documentation is limited or nonexistent, and conditions at a specific site may be unknown. It is the policy of the Department of Energy (DOE) to verify that radiological conditions at such facilities comply with existing guidelines.<sup>1</sup> The Formerly Utilized Sites Remedial Action Program (FUSRAP) was established by DOE in 1974 to assist in assessment and cleanup activities at these sites.

The radiological survey detailed in this report was performed under the FUSRAP program and is one of several conducted in May, 1991, on properties in the vicinity of the former Ventron facility by members of the Oak Ridge National Laboratory (ORNL) at the request of DOE. The city of Beverly lies on Beverly Harbor approximately 15 miles northeast of the central Boston area. The former Ventron facility, now owned by Morton International, Inc., is located at the confluence of the Bass and Danvers rivers on Congress Street near the Beverly-Salem bridge (Fig. 1, p. 5).

From 1942 through 1948, the Metal Hydrides Corporation (later to become the Ventron facility), converted uranium oxide to uranium metal powder at the facility under contract to the MED in support of the war effort. Other operations conducted at the facility included the recovery of uranium from scrap uranium and turnings from the slug fabrication plant at Hanford, Washington. Contracts between Metal Hydrides and the government were completed in 1954.

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\*The survey was performed by members of the Measurement Applications and Development Group of the Health and Safety Research Division of Oak Ridge National Laboratory under DOE contract DE-AC05-84OR21400.

Following a radiological screening survey at the site in 1977, a comprehensive survey was performed in 1982.<sup>2</sup> In 1987, DOE contractors removed the uranium-contaminated roof from a Ventron building, which had begun to leak. Radioactive materials remaining on the site do not pose a health hazard under present use conditions, but could cause radiation exposure to workers if excavation or major renovation took place on the property. DOE plans a complete characterization study of the site in 1992 and the initiation of remedial action soon thereafter.

The survey of the property reported in this document and of other surrounding properties is part of DOE's continuing program to assess the former Ventron site and plan for remedial action. The objective of the surveys was to determine if uranium from plant operations had migrated offsite to neighboring areas including Beverly Harbor, and if so, to what degree. The relative location of this vicinity property to the former Ventron site is shown in Fig. 2 (p. 6). The radiological surveys consisted of measurements of radiation levels over the ground surface of the properties and analysis of soil, sediment, and other material samples for the presence of radionuclides in concentrations exceeding guidelines.

A view of the Beverly City Park beach area is shown in Fig. 3 (p. 7).

## SURVEY METHODS

A comprehensive description of the survey methods and instrumentation used in this survey is presented in *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, ORNL/TM-8600 (April 1987).<sup>3</sup>

### SURFACE RADIATION MEASUREMENTS

Gamma radiation levels were determined using a portable NaI gamma scintillation meter. Because NaI gamma scintillators are energy dependent, measurements of gamma radiation levels in counts per minute (cpm) are normalized to pressurized ionization chamber (PIC) measurements to estimate gamma exposure rates in  $\mu\text{R/h}$ .

### SOIL SAMPLING AND ANALYSES

Surface and subsurface soil samples were systematically collected over the property in a pattern sufficient to obtain a characterization of the radionuclide content of the soil. All soil samples were analyzed to determine  $^{238}\text{U}$ ,  $^{232}\text{Th}$ , and  $^{226}\text{Ra}$  concentrations.

## SURVEY RESULTS

Current guidelines for sites included within the FUSRAP are summarized in Table 1 (p. 9). Typical background radiation levels for the Beverly, Massachusetts area are presented in Table 2 (p. 10). These data are provided for comparison with the survey results presented in this section. All direct measurements presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations in soil, debris, and other samples.

### SURFACE RADIATION MEASUREMENTS

Gamma measurements at the park were taken at the ground surface in the playground area, on the beach outside the retaining wall, and on the sand between the water and the beach during low tide. Results are shown on Fig. 4 (p. 8). Exposure rates at the ground surface of the property ranged from 6 to 8  $\mu\text{R/h}$ . These values are comparable to the typical background measurements in the Beverly area (6 to 9  $\mu\text{R/h}$ , Table 2).

### SOIL SAMPLES

Locations of systematic soil samples are diagrammed in Fig. 4 and results of analyses are listed in Table 3 (p. 11). Maximum concentrations of  $^{232}\text{Th}$ , and  $^{226}\text{Ra}$  in surface soil (0-15 cm) were 0.93, and 0.81 pCi/g, respectively. In subsurface soil, maximum values were 0.97 pCi/g for  $^{232}\text{Th}$ , and 0.93 pCi/g for  $^{226}\text{Ra}$ . These values are comparable to the typical Beverly area background levels (Table 2) and well below DOE guidelines (Table 1). Maximum  $^{238}\text{U}$  concentrations in surface and subsurface soil of 5.0 and 3.0 pCi/g, respectively, were measured in samples from the beach area southwest of the park. The samples (S12) were collected near the water's edge during low tide (see Fig. 4). These values are above typical background soil concentrations for  $^{238}\text{U}$  in the Beverly area, but well below guidelines of 35 to 40 pCi/g that have been applied at other FUSRAP sites (Table 1).

## SIGNIFICANCE OF FINDINGS

The results of the radiological survey at the Porter Street City Park, Beverly, Massachusetts, demonstrated no radionuclide concentrations or radiation measurements above established DOE guidelines.

## REFERENCES

1. U.S. Department of Energy, *Radiological Control Manual*, DOE/EH-0256T (DOE N 5480.6), June 1992; U.S. Department of Energy, *A Background Report for the Formerly Utilized Manhattan Engineer District/Atomic Energy Commission Sites Program*, DOE/EV-0097, September 1980.
2. W. D. Cottrell and R. F. Carrier, *Results of the Radiological Survey at the Ventron Site, Beverly, Massachusetts*, ORNL/TM-10053, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., May 1988.
3. T. E. Myrick, B. A. Berven, W. D. Cottrell, W. A. Goldsmith, and F. F. Haywood, *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, ORNL/TM-8600, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., April 1987.

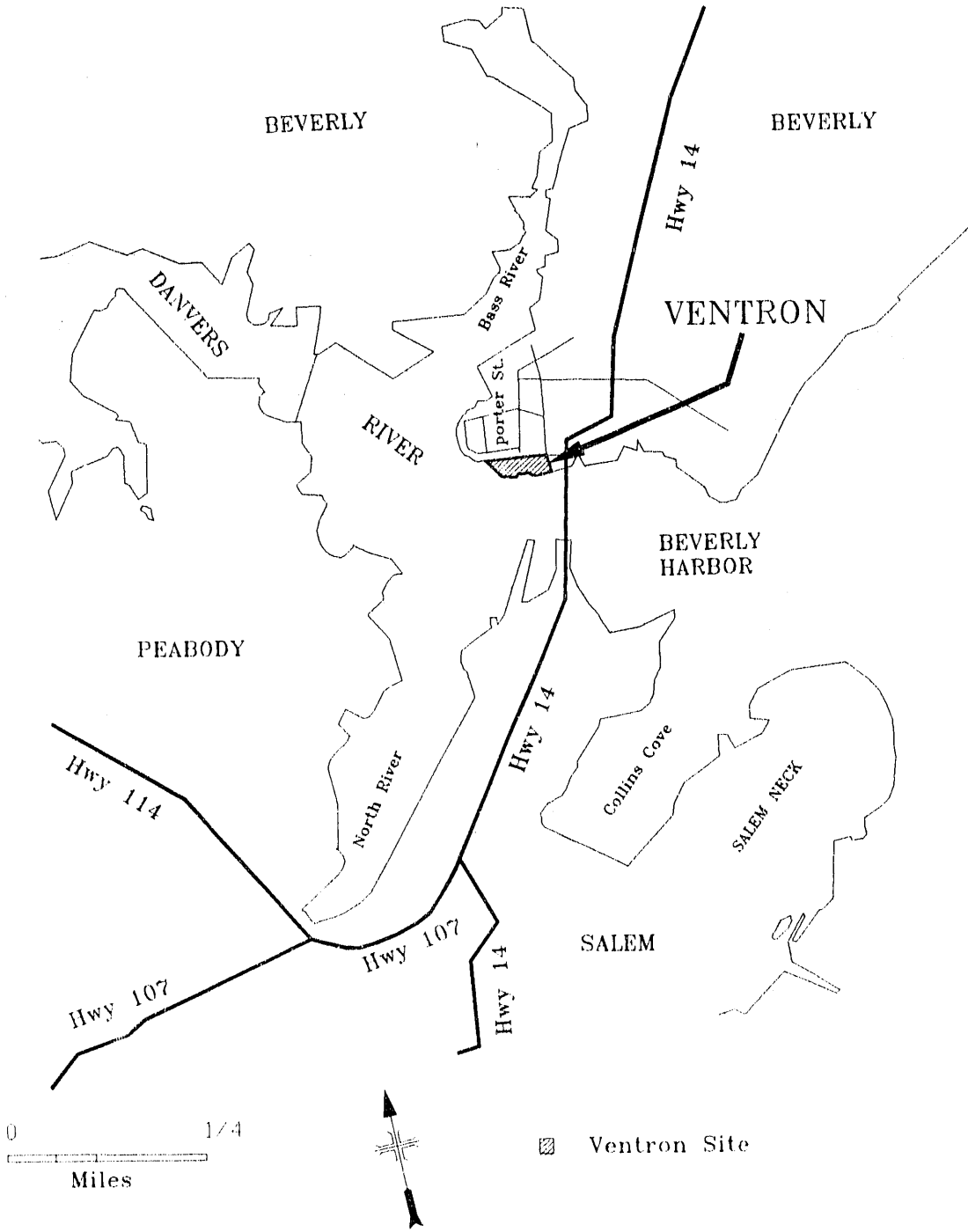


Fig. 1. Diagram showing general location of the former Ventron site.

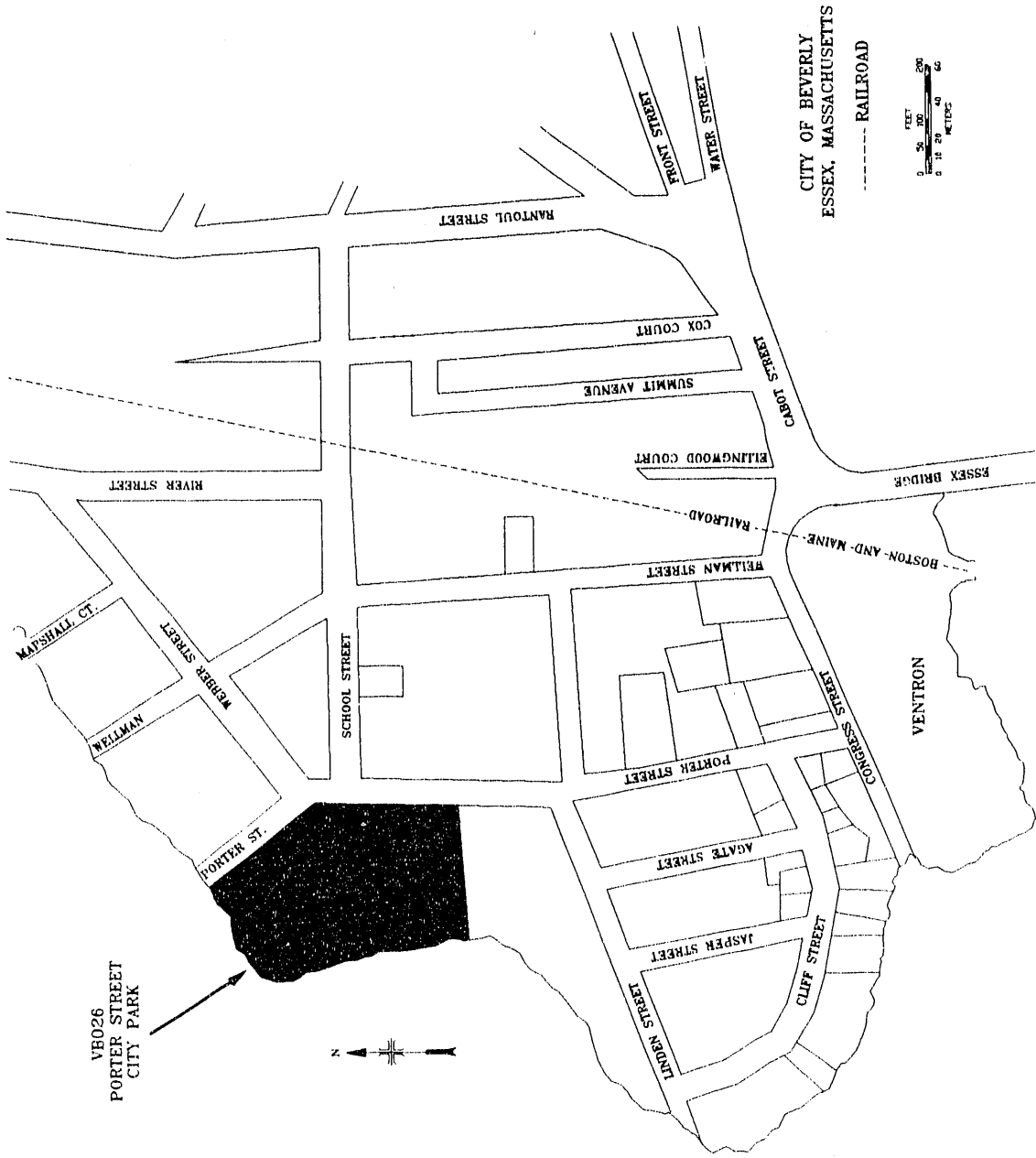


Fig. 2. Diagram showing relative location of the Porter Street City Park, Beverly, Massachusetts, to the former Ventron site.

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**Fig. 3.** View looking southwest from the beach area of the Porter Street City Park, Beverly, Massachusetts, at low tide.

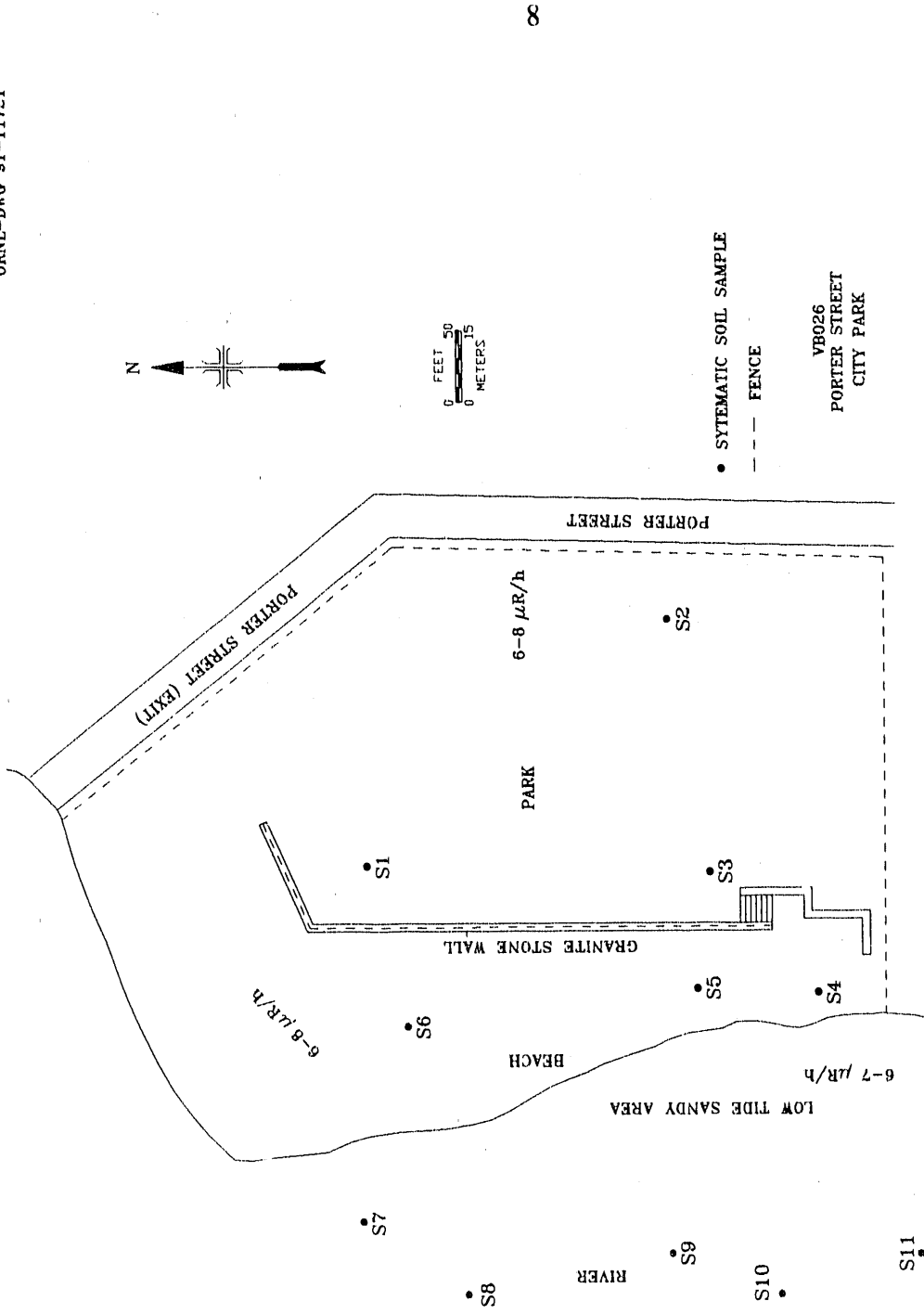


Fig. 4. Surface gamma exposure rates and soil sampling locations at the Porter Street City Park, Beverly, Massachusetts.



**Table 1. Applicable guidelines for protection against radiation**  
(Limits for uncontrolled areas)

Mode of exposure	Exposure conditions	Guideline value
Gamma radiation	Indoor gamma radiation level (above background)	20 $\mu\text{R}/\text{h}^a$
Radionuclide concentrations in soil (generic)	Maximum permissible concentration of the following radionuclides in soil above background levels, averaged over a 100-m <sup>2</sup> area  $^{226}\text{Ra}$ $^{232}\text{Th}$ $^{230}\text{Th}$	5 pCi/g averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over 15 cm-thick soil layers > 15 cm below the surface
Derived concentrations	$^{238}\text{U}$	Site specific <sup>b</sup>
Guideline for non-homogeneous contamination (used in addition to the 100-m <sup>2</sup> guideline) <sup>c</sup>	Applicable to locations with an area $\leq 25$ m <sup>2</sup> , with significantly elevated concentrations of radionuclides ("hot spots")	$G_A = G_i (100/A)^{1/2}$ , where $G_A$ = guideline for "hot spot" of area (A) $G_i$ = guideline averaged over a 100-m <sup>2</sup> area

<sup>a</sup>The 20  $\mu\text{R}/\text{h}$  shall comply with the basic dose limit (100 mrem/yr) when an appropriate-use scenario is considered.

<sup>b</sup>DOE guidelines for uranium are derived on a site-specific basis. Guidelines of 35-40 pCi/g have been applied at other FUSRAP sites. Sources: J. L. Marley and R. F. Carrier, *Results of the Radiological Survey at 4 Elmhurst Avenue, Colonie, New York (AL219)*, ORNL/RASA-87/117, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., February 1988; B. A. Berven et. al., *Radiological Survey of the Former Kellex Research Facility, Jersey City, New Jersey*, DOE/EV-0005/29, ORNL-5734, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., February 1982.

<sup>c</sup>DOE guidelines specify that every reasonable effort shall be made to identify and to remove any source that has a concentration exceeding 30 times the guideline value, irrespective of area (adapted from *Revised Guidelines for Residual Radioactive Material at FUSRAP and Remote SFMP Sites*, April 1987).

Sources: Adapted from U.S. Department of Energy, DOE Order 5400.5, April 1990, and U.S. Department of Energy, *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites*, Rev. 2, March 1987.

**Table 2. Background radiation levels and concentrations of selected radionuclides in soil in the Beverly, Massachusetts, area**

Type of radiation measurement or sample	Radiation level or radionuclide concentration	
	Range	Average
Gamma exposure rate at ground surface ( $\mu\text{R/h}$ ) <sup>a</sup>	6-9	7
Concentration of radionuclides in soil (pCi/g) <sup>a</sup>		
<sup>226</sup> Ra	0.70-0.94	0.84
<sup>232</sup> Th	0.76-0.94	0.84
<sup>238</sup> U	0.69-1.05	0.89

<sup>a</sup>Values obtained from three locations in the Beverly area.

**Table 3. Concentrations of radionuclides in soil samples from Porter Street City Park, Beverly, Massachusetts**

Sample number <sup>a</sup>	Depth (cm)	Radionuclide concentration (pCi/g) <sup>b</sup>		
		<sup>226</sup> Ra	<sup>232</sup> Th	<sup>238</sup> U
<i>Systematic samples<sup>c</sup></i>				
S1A	0-15	0.75 ± 0.02	0.85 ± 0.03	1.30 ± 0.40
S1B	15-18	0.70 ± 0.02	0.80 ± 0.03	0.96 ± 0.7
S2A	0-15	0.79 ± 0.02	0.87 ± 0.03	1.5 ± 0.7
S2B	15-30	0.67 ± 0.02	0.75 ± 0.03	1.1 ± 0.7
S3A	0-15	0.68 ± 0.02	0.81 ± 0.03	1.8 ± 0.9
S3B	15-30	0.93 ± 0.02	0.97 ± 0.03	1.0 ± 0.7
S4A	0-15	0.43 ± 0.01	0.45 ± 0.03	1.6 ± 0.5
S4B	15-30	0.37 ± 0.01	0.39 ± 0.02	0.56 ± 0.3
S5A	0-15	0.57 ± 0.02	0.67 ± 0.04	1.1 ± 0.8
S5B	15-30	0.60 ± 0.02	0.68 ± 0.02	1.3 ± 0.6
S6A	0-15	0.47 ± 0.01	0.53 ± 0.03	1.2 ± 0.4
S6B	15-30	0.51 ± 0.01	0.57 ± 0.02	1.1 ± 0.6
S7	0-15	0.42 ± 0.01	0.49 ± 0.02	0.78 ± 0.4
S8A	0-15	0.59 ± 0.01	0.67 ± 0.02	1.3 ± 0.8
S8B	15-30	0.50 ± 0.02	0.55 ± 0.03	1.1 ± 0.4
S9	0-15	0.50 ± 0.01	0.61 ± 0.03	0.89 ± 0.4
S10A	0-15	0.51 ± 0.01	0.57 ± 0.02	<1.1
S10B	15-30	0.59 ± 0.02	0.70 ± 0.02	1.6 ± 0.8
S11	0-15	0.42 ± 0.02	0.51 ± 0.03	2.0 ± 0.7
S12A	0-15	0.81 ± 0.02	0.93 ± 0.03	5.0 ± 1.0
S12B	15-30	0.66 ± 0.04	0.8 ± 0.07	3.0 ± 1.0

<sup>a</sup>Locations of soil samples are shown on Fig. 4.

<sup>b</sup>Indicated counting error is at the 95% confidence level ( $\pm 2\sigma$ ).

<sup>c</sup>Systematic samples are taken at locations irrespective of gamma exposure rates.

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