

HEALTH AND SAFETY RESEARCH DIVISION

Environmental Restoration and Waste Management Non-Defense Programs
(Activity No. EX 20 20 01 0; ADS3170000)

**Radiological Survey Results at 2 Porter Street,
Beverly, Massachusetts (VB005)**

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Date issued — August 1992

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for the
U. S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

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CONTENTS

LIST OF FIGURES	v
LIST OF TABLES	vii
ACKNOWLEDGMENTS	ix
ABSTRACT	xi
INTRODUCTION	1
SURVEY METHODS	2
SURFACE RADIATION MEASUREMENTS	2
SOIL SAMPLING AND ANALYSES	2
SURVEY RESULTS	3
SURFACE RADIATION MEASUREMENTS	3
SOIL SAMPLING AND ANALYSES	3
SIGNIFICANCE OF FINDINGS	3
REFERENCES	4

LIST OF FIGURES

1	Diagram showing general location of the former Ventron site.	5
2	Diagram showing location of 2 Porter Street, Beverly, Massachusetts, in relation to the former Ventron site.	6
3	View looking west at the house at 2 Porter Street, Beverly, Massachusetts.	7
4	View looking north at the house at 2 Porter Street, (near left) Beverly, Massachusetts.	7
5	Surface gamma exposure rates and soil sample locations at 2 Porter Street, Beverly, Massachusetts.	8

LIST OF TABLES

1	Applicable guidelines for protection against radiation	9
2	Background radiation levels and concentrations of selected radionuclides in soil in the Beverly, Massachusetts, area	10
3	Concentrations of radionuclides in soil samples from 2 Porter Street, Beverly, Massachusetts	11

ACKNOWLEDGMENTS

This project was sponsored by the Office of Environmental Restoration, U.S. Department of Energy, under contract DE-AC05-84OR21400 with Martin Marietta Energy Systems, Inc. The authors wish to acknowledge the contributions of W. D. Cottrell, C. A. Johnson, V. P. Patania, D. A. Roberts, and M. S. Uziel of the Measurement Applications and Development Group, Oak Ridge National Laboratory, who participated in the analyses, editing, and reporting of data for this survey. The authors also wish to thank J. F. Allred and D. A. Rose for sample preparation and D. R. McDaniel, S. C. Thompson, and T. R. Stewart for computer graphics. The graphics assistance of J. M. Lovegrove of D. R. Stone, Associates, is also appreciated.

ABSTRACT

At the request of the U.S. Department of Energy (DOE), a team from Oak Ridge National Laboratory conducted a radiological survey at 2 Porter Street, Beverly, Massachusetts. The survey was performed in May 1991. The purpose of the survey was to determine if uranium dust 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 2 Porter Street, Beverly, Massachusetts (VB005)*

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 U.S. Department of Energy (DOE) to verify that radiological conditions at such facilities comply with existing guidelines.¹ 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 surveys 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 Massachusetts Bay ~15 miles northeast of the central Boston area. The former Ventron facility, now owned by Morton International, is located at the confluence of the Bass and Danvers rivers on Congress Street near the Beverly-Salem bridge (Fig. 1, p. 5).²

From 1942 through 1948 the Metal Hydrides Corporation converted uranium oxide to uranium metal powder at the facility under contract to the MED in support of the war effort. As better methods for production of uranium metal were developed, Metal Hydrides shifted

*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.

its operations toward recovering uranium from scrap uranium and turnings from the slug fabrication plant at Hanford, Washington.¹ Contracts between Metal Hydrides and the government were completed in 1954.

Following a radiological screening survey at the site in 1977, a comprehensive survey was performed in 1982 (ref. 2). In 1987, DOE contractors removed the roof of a building when uranium residues on the roof were found to exceed natural background levels. Radioactive materials remaining on the site do not pose a health hazard under present use scenarios 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 residential property reported in this document and surveys of other surrounding properties are 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 off-site to neighboring areas including the Massachusetts Bay 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.

SURVEY METHODS

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

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 $\mu\text{R}/\text{h}$. Using a Geiger-Mueller pancake detector, beta-gamma radiation levels in cpm were measured over selected surfaces, and then converted to mrad/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}U , ^{232}Th , and ^{226}Ra concentrations.

SURVEY RESULTS

Current DOE 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 measurement results 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.

Photographs taken in May 1991 of the property at 2 Porter Street, Beverly, Massachusetts are shown in Figs. 3 and 4 (p. 7).

SURFACE RADIATION MEASUREMENTS

Results of the surface gamma scan are shown in Fig. 5 (p. 8). Surface gamma exposure rates ranged from 6 to 9 $\mu\text{R/h}$, with higher levels of 16 $\mu\text{R/h}$ on the surface of the granite rock and concrete walls. The maximum value slightly exceeds the typical range of background radiation levels in the Beverly, Massachusetts, area (6 to 9 $\mu\text{R/h}$, Table 2). Slightly higher than background values are frequently observed in association with materials such as concrete, granite or brick, which inherently contain slightly elevated concentrations of naturally occurring radionuclides.

Beta-gamma dose rates ranging from 0.04 to 0.05 mrad/h were measured over selected hard surfaces on the property. All measurements were comparable to background levels measured in the vicinity.

SOIL SAMPLING AND ANALYSES

Soil sample locations are shown in Fig. 5 (p. 8) and results of analyses are listed in Table 3 (p. 11). The maximum concentrations for ^{226}Ra and ^{232}Th in surface soil (0–15 cm) were 1.3 and 1.4 pCi/g; the maximum values in subsurface soil were 1.5 and 1.6 pCi/g for each of the radionuclides, respectively. These results are comparable to typical background levels in the Beverly area (Table 2, p. 10), and below DOE guidelines (Table 1, p. 9). Uranium-238 concentrations in surface soil ranged from 3.6 to 8.1 pCi/g, and in subsurface soil were 3.0 to 10 pCi/g. Uranium-238 concentrations in most of the samples from 2 Porter Street were above typical background soil levels in the Beverly area (Table 2, p. 10) but well below guidelines of 35 to 40 pCi/g that have been applied at other FUSRAP sites (Table 1, p. 9).

SIGNIFICANCE OF FINDINGS

The results of the radiological survey at 2 Porter Street, Beverly, Massachusetts, demonstrated no radionuclide concentrations or radiation measurements above established DOE guidelines.

REFERENCES

1. 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.

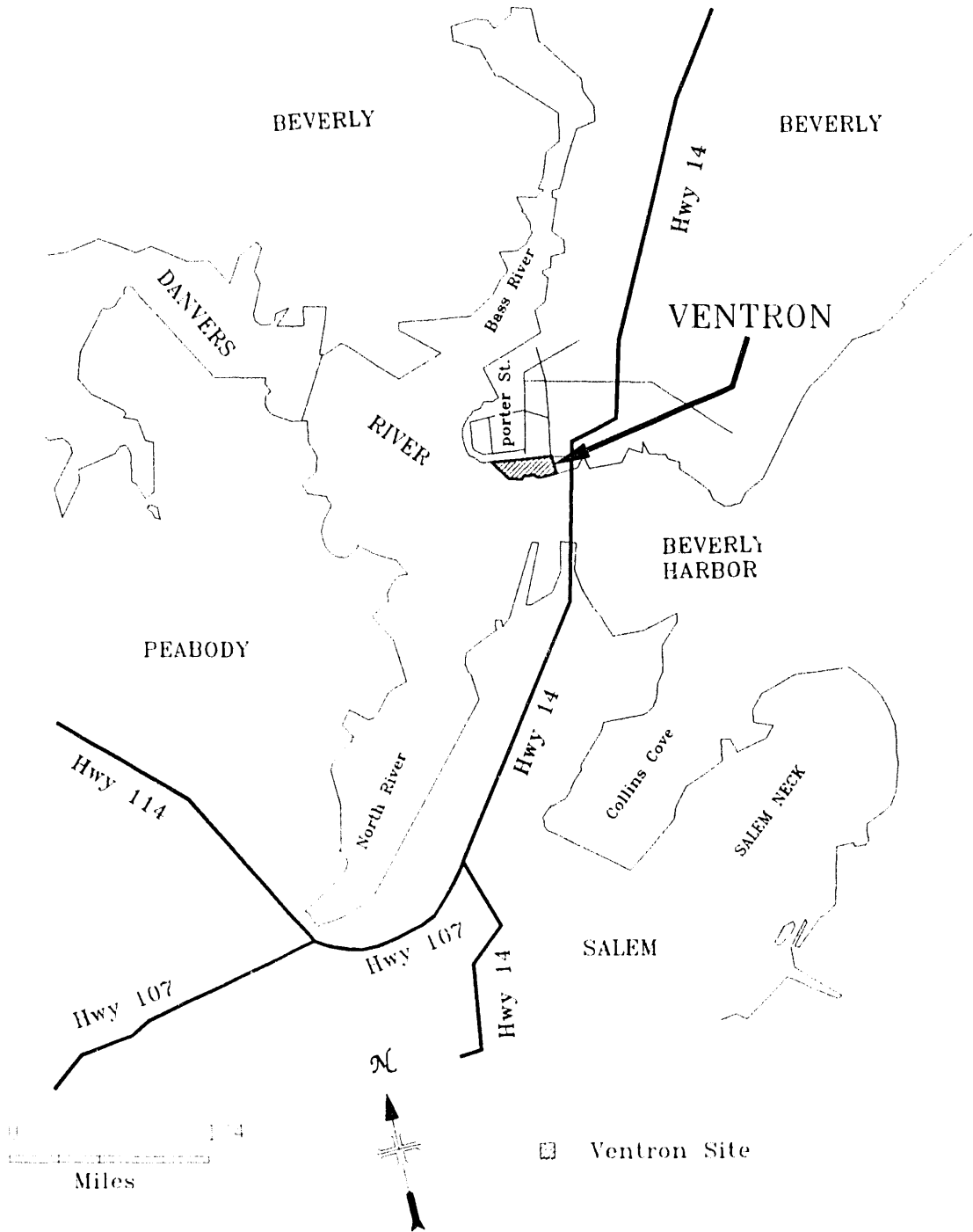


Fig. 1. Diagram showing general location of the former Ventron site.

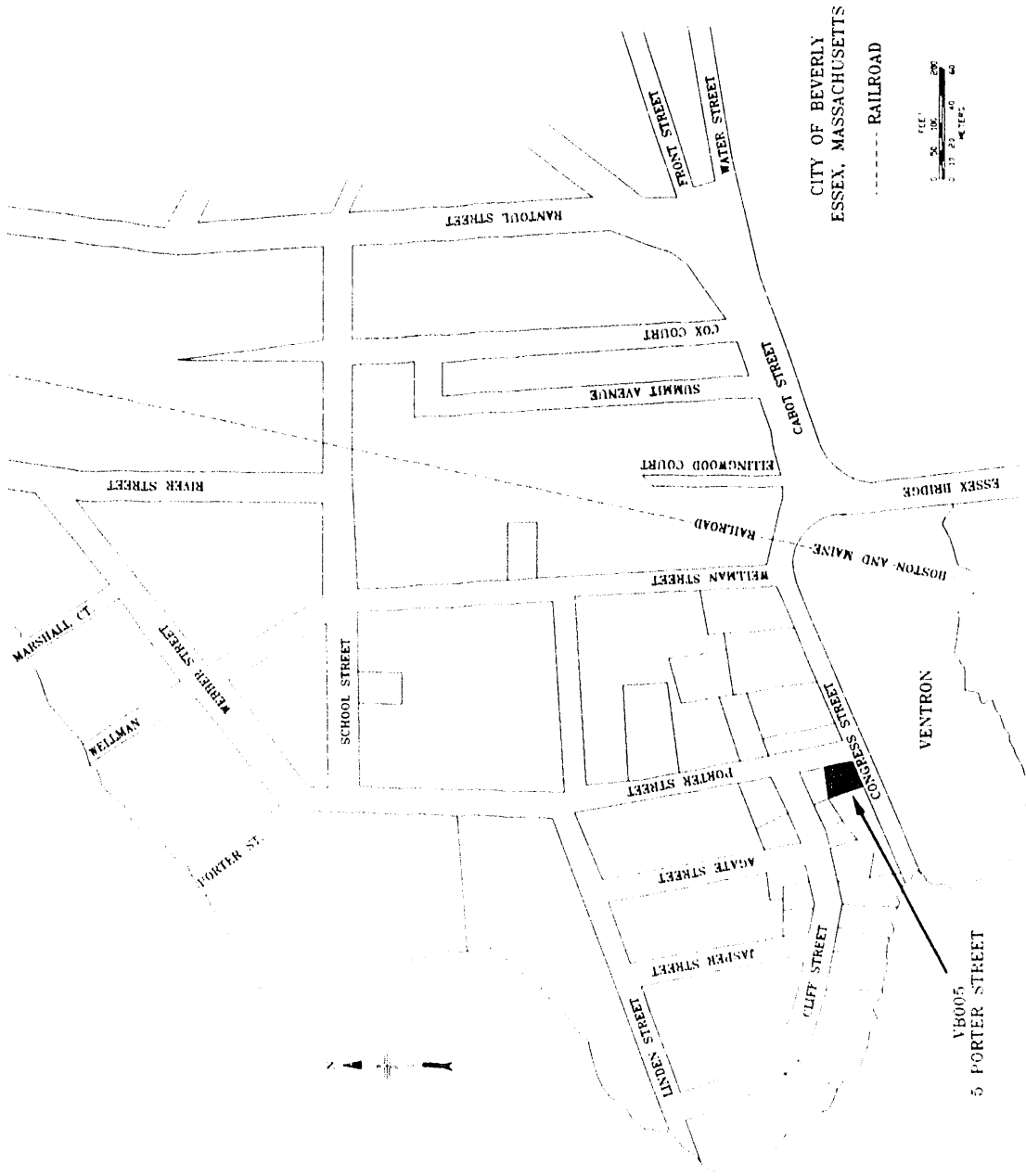


Fig. 2. Diagram showing location of 2 Porter Street, Beverly, Massachusetts, in relation to the former Ventron site.



Fig. 3. View looking west at the house at 2 Porter Street, Beverly, Massachusetts.



Fig. 4. View looking northwest at the house at 2 Porter Street (near left), Beverly, Massachusetts.

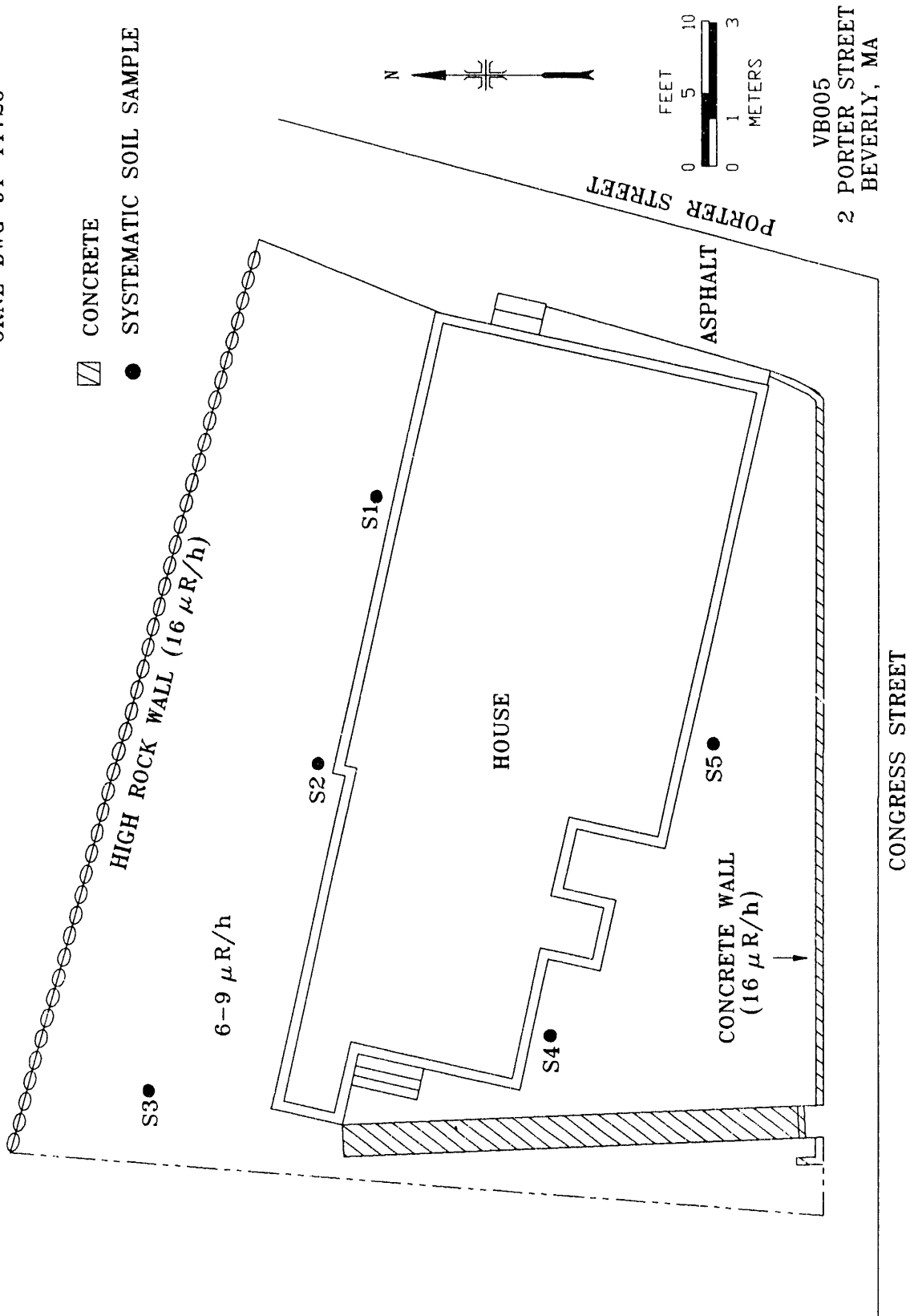


Fig. 5. Surface gamma exposure rates and soil sample locations at 2 Porter Street, Beverly, Massachusetts.

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

Modes 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 ² area ^{226}Ra ^{232}Th ^{230}Th	5 pCi/g averaged over the first 15 cm of soil below the surface; 15 pCi/g averaged over 15-cm-thick soil layers more than 15 cm below the surface
Derived concentrations	^{238}U	Site specific ^b
Guideline for non-homogeneous contamination (used in addition to the 100-m ² guideline): ^c	Applicable to locations with an area ≤ 25 m ² , 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 ² area

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

^bDOE 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 Kellogg Research Facility, Jersey City, New Jersey*, DOE/EV-0005/29, ORNL-5734, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., February 1982.

^cDOE 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, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, April 1990; U.S. Department of Energy, *Guidelines for Residual Radioactive Material at FUSRAP and Remote SFMP Sites*, Rev. 2, March 1987; and U.S. Department of Energy *Radiological Control Manual*, DOE N 5480.6 (DOE E/H-0256T) June 1992.

Table 3. Concentrations of radionuclides in soil samples from 2 Porter Street, Beverly, Massachusetts

Sample ^a	Depth (cm)	Radionuclide concentration (pCi/g) ^b		
		²²⁶ Ra	²³² Th	²³⁸ U
<i>Systematic samples^c</i>				
S1A	0–15	0.8 ± 0.02	0.81 ± 0.04	8.1 ± 1.0
S1B	15–30	0.96 ± 0.02	1.0 ± 0.04	8.6 ± 0.9
S2A	0–15	0.66 ± 0.02	0.77 ± 0.03	5.6 ± 0.5
S2B	15–30	0.77 ± 0.02	0.95 ± 0.04	3.4 ± 1.1
S3A	0–15	1.3 ± 0.03	1.4 ± 0.06	3.6 ± 0.8
S3B	15–30	1.5 ± 0.03	1.6 ± 0.05	3.0 ± 1.0
S4A	0–15	0.81 ± 0.02	0.87 ± 0.04	7.3 ± 0.9
S4B	15–30	0.89 ± 0.04	0.97 ± 0.08	10 ± 1.0
S5A	0–15	0.73 ± 0.02	0.78 ± 0.03	6.5 ± 0.9
S5B	15–30	0.80 ± 0.02	0.83 ± 0.07	3.0 ± 0.8

^aSample locations are shown on Fig. 5 (p. 8).

^bIndicated counting error is at the 95% confidence level ($\pm 2 \sigma$).

^cSystematic samples are taken at locations irrespective of gamma exposure rates

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