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**Radiological Survey Results at 15 Congress Street,
Beverly, Massachusetts (VB004)**

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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 15 Congress Street, 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, a beta-gamma scan of paved areas, 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 15 Congress Street, Beverly, Massachusetts (VB004)*

INTRODUCTION

The Metal Hydrides Corporation 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 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 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 Beverly Harbor ~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 to 1948 the Metal Hydrides Corporation (later to become the Ventron facility) converted uranium oxide to uranium metal powder at the facility under contract to MED in support of the war effort. As better methods for production of uranium metal were developed, Metal Hydrides shifted 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.

*The survey was performed by members of the Measurement Applications and Development Group of the Health and Safety Research Division at 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 1982.² 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 surveys of the property reported in this document and of other surrounding properties are part of DOE's continuing effort 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 Beverly Harbor and, if so, to what degree. The location of this vicinity property in relation to the former Ventron site is shown in Fig. 2 (p. 6). The property at 15 Congress Street contains a house; grass or asphalt cover the ground surface. Other features include a stone retaining wall along part of the eastern boundary of the property and a rock wall on the northern property boundary. The radiological survey included measurements of radiation levels over the surface of the property and analysis of soil 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 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 determined over selected paved and structural 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 concentrations of ^{238}U , ^{232}Th , and ^{226}Ra .

SURVEY RESULTS

DOE guidelines are summarized in Table 1 (p. 10). Typical background radiation levels for the Beverly, Massachusetts, area are presented in Table 2 (p. 11). These data are provided for comparison with 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 measured in soil samples.

Photographs taken in May 1991 of the property at 15 Congress Street, Beverly, Massachusetts are shown in Figs. 4 and 5 (p. 8).

SURFACE RADIATION MEASUREMENTS

Results of the surface gamma scan over the property surface are shown in Fig. 6 (p. 9). Surface gamma exposure rates averaged 8 and 9 $\mu\text{R/h}$ over the areas covered with grass and asphalt and 10 $\mu\text{R/h}$ near the stone retaining wall along the eastern boundary of the property. Blocks of granite bordering the edge of the asphalt sidewalk (see Fig. 4, p. 8) also measured 10 $\mu\text{R/h}$. These values are comparable to typical background measurements in the Beverly, Massachusetts, area (6 to 9 $\mu\text{R/h}$, Table 2, p. 11). Slightly higher exposure rates are frequently associated with structural materials such as granite or brick, which inherently contain slightly elevated concentrations of naturally occurring radionuclides.

Beta-gamma dose rates ranging from 0.04 to 0.06 mrad/h were measured over selected hard surfaces on the property. All measurements were comparable to background levels measured in the vicinity.

SOIL SAMPLES

Soil sample locations are shown in Fig. 6 (p. 9), and results of analyses are listed in Table 3 (p. 12). Concentrations of ^{226}Ra and ^{232}Th in surface soil (0-15 cm) ranged from 0.76 to 1.0 pCi/g and from 0.84 to 1.0 pCi/g, respectively. Concentrations of ^{226}Ra in subsurface soil (15-30 cm) ranged from 0.81 to 1.1; ^{232}Th ranged from 0.87 to 1.2 pCi/g in subsurface soil. These values are slightly above typical background levels in the Beverly area (Table 2, p. 11) but well below DOE guidelines (Table 1, p. 10). Uranium-238 concentrations in surface soil ranged from 3.2 to 7.9 pCi/g. Subsurface ^{238}U concentrations ranged from 1.3 to 3.8 pCi/g. Uranium-238 levels in most of the soil samples from 15 Congress Street were above typical background levels in the Beverly area (Table 2, p. 11); however, all samples were well below guidelines of 35 to 40 pCi/g that have been applied at other FUSRAP sites (Table 1, p. 10).

SIGNIFICANCE OF FINDINGS

The results of the radiological survey at 15 Congress 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.

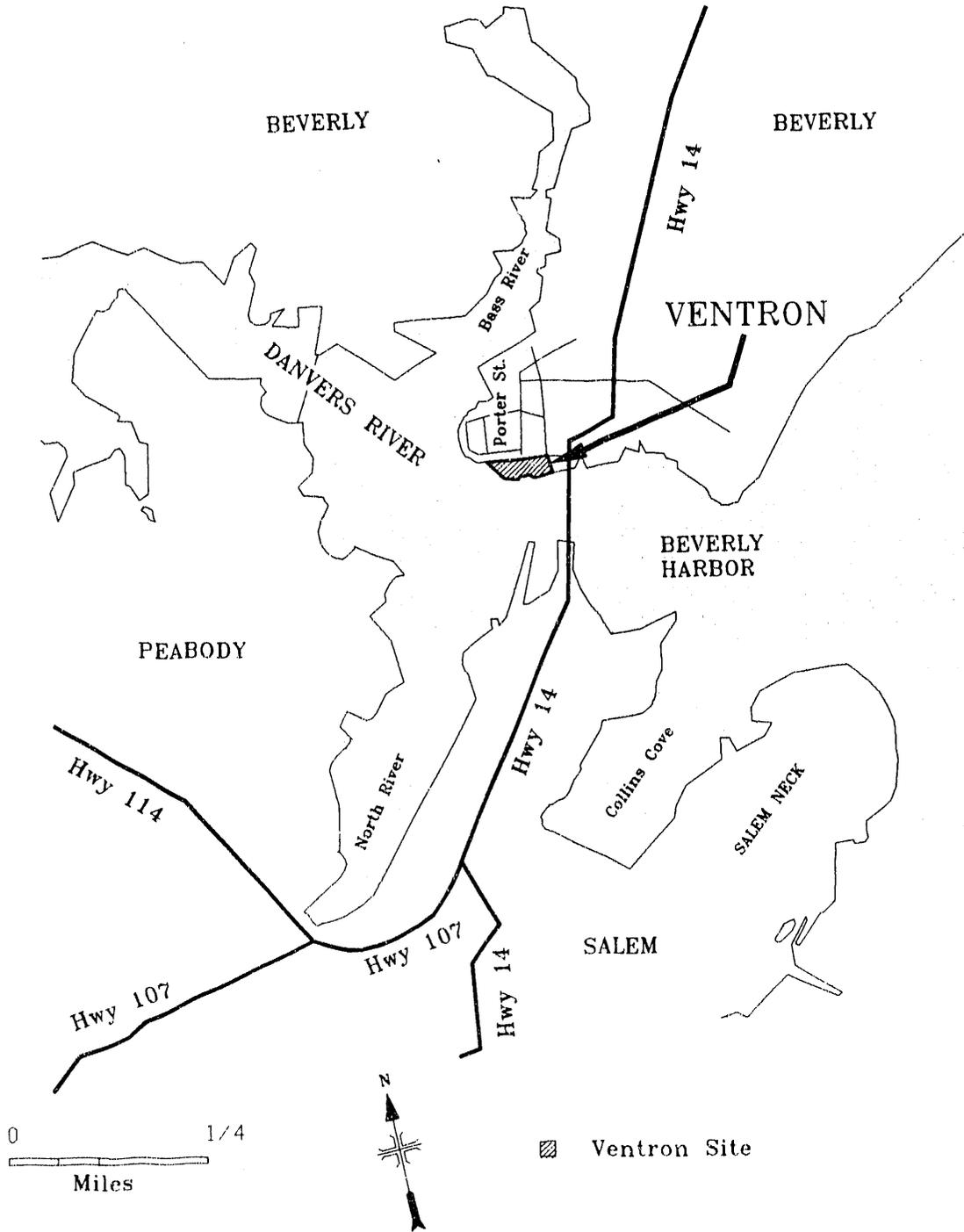


Fig. 1. Diagram showing general location of the former Ventron site.

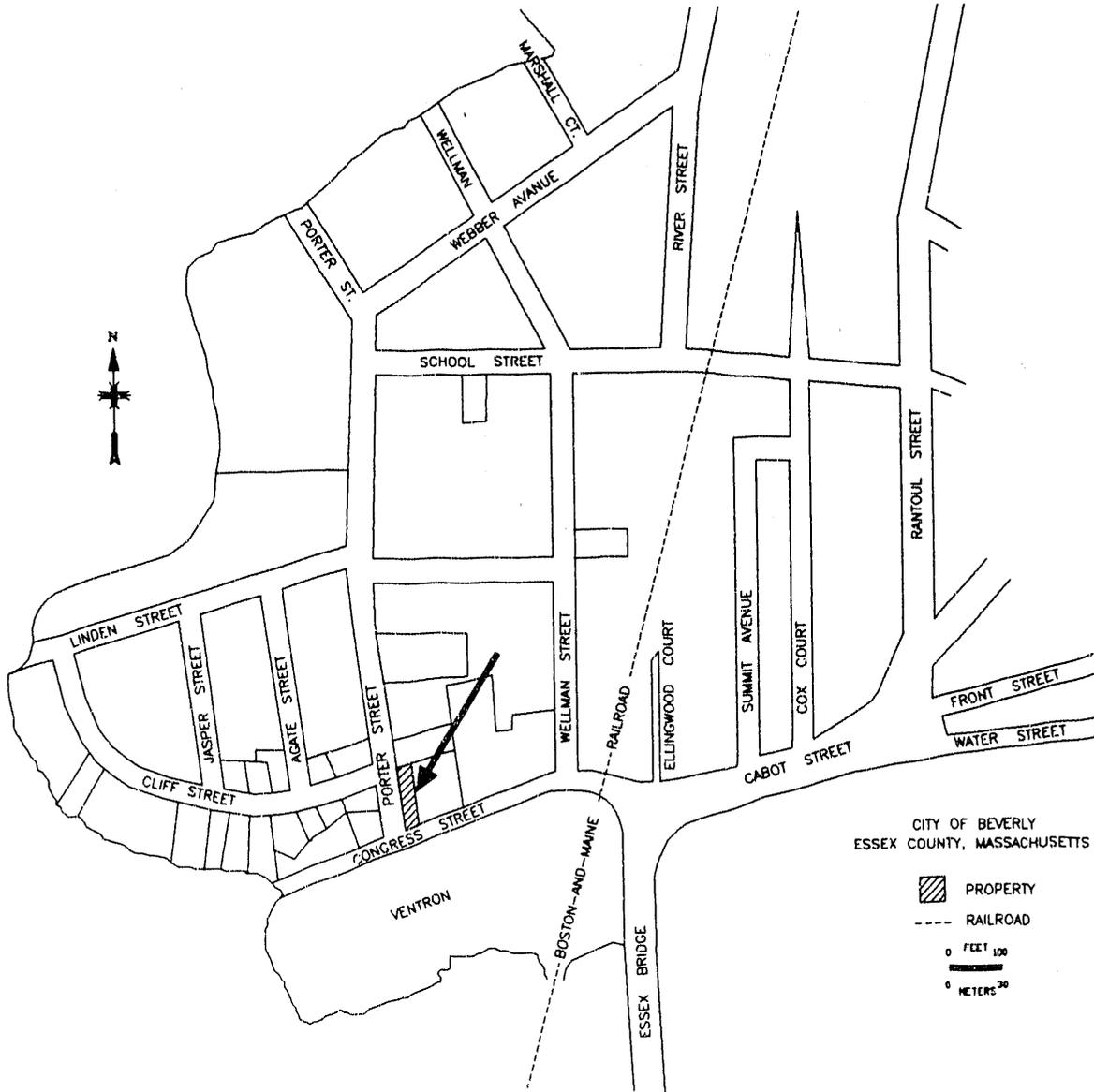


Fig. 2. Diagram showing location of 15 Congress Street, Beverly, Massachusetts, in relation to the former Ventron site.

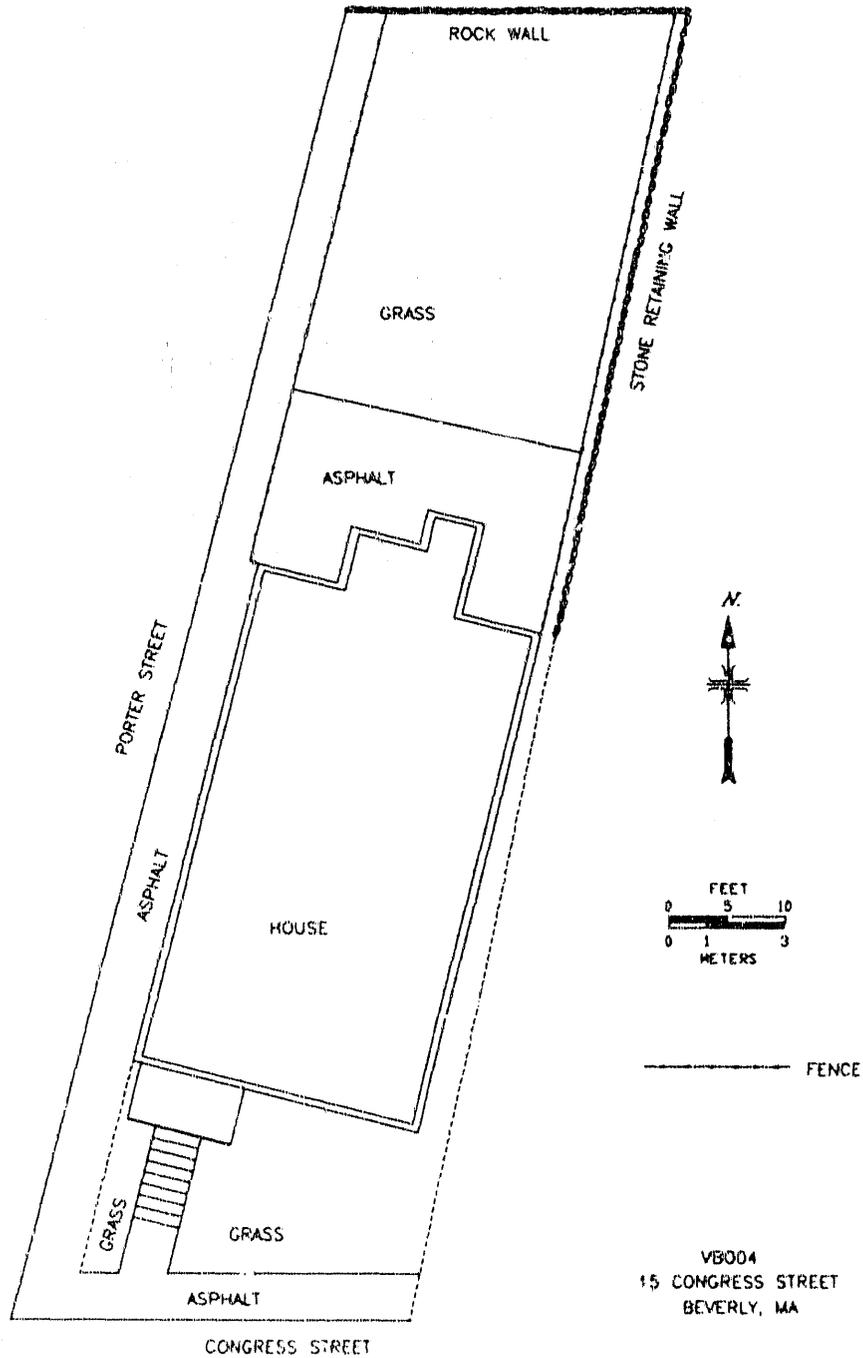


Fig. 3. Diagram of the property located at 15 Congress Street, Beverly, Massachusetts.



Fig. 4. View looking north at the house at 15 Congress Street, Beverly, Massachusetts.



Fig. 5. View looking south at the house at 15 Congress Steet, Beverly, Massachusetts.

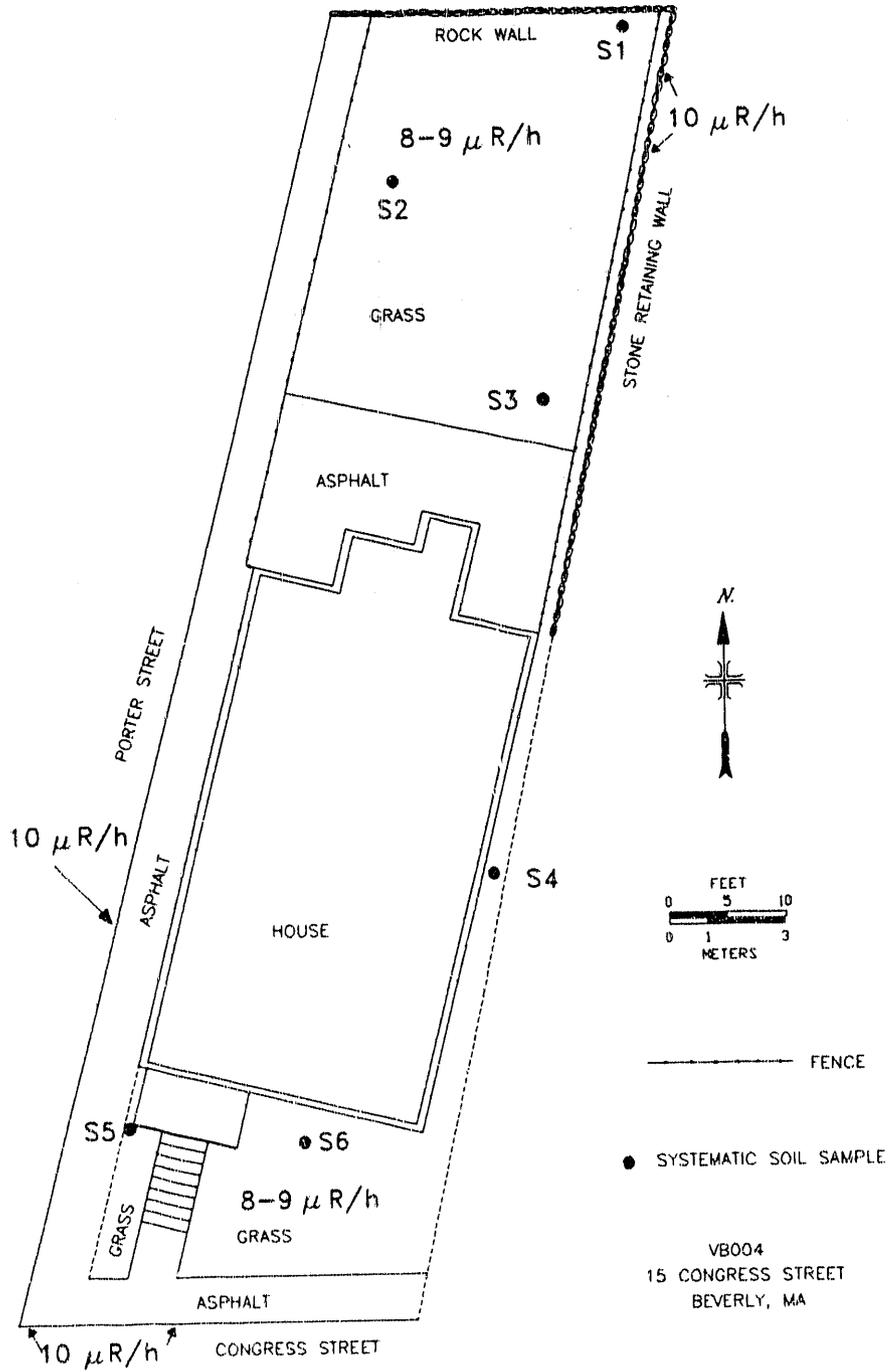


Fig. 6. Diagram showing surface gamma exposure rates and soil sampling locations at 15 Congress Street, Beverly, Massachusetts.

**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 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 when 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/year) 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. Source: 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.

^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, 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 ($\mu\text{R/h}$) ^a	6-9	7
Concentration of radionuclides in soil (pCi/g) ^a		
²³⁸ U	0.69-1.05	0.89
²²⁶ Ra	0.70-0.94	0.84
²³² Th	0.76-0.94	0.84

^aValues obtained from three locations in the Beverly area.

**Table 3. Concentrations of radionuclides in soil samples from
15 Congress Street, Beverly, Massachusetts**

Sample ^a	Depth (cm)	Radionuclide concentration (pCi/g) ^b		
		²²⁶ Ra	²³² Th	²³⁸ U
<i>Systematic samples^c</i>				
S1	0-15	0.80±0.02	0.93±0.03	3.6 ±0.6
S2A	0-15	0.76±0.04	0.84±0.07	3.2 ±0.5
S2B	15-30	0.84±0.02	0.90±0.03	1.3 ±0.7
S3A	0-15	1.0 ±0.02	1.0 ±0.03	3.9 ±1
S3B	15-30	1.1 ±0.02	1.2 ±0.03	3.6 ±0.8
S4A	0-15	1.0 ±0.04	0.85±0.06	7.9 ±0.7
S4B	15-30	0.81±0.02	0.87±0.04	3.8 ±0.6
S5A	0-15	0.81±0.02	0.89±0.03	4.8 ±0.7
S6A	0-15	0.80±0.02	0.84±0.03	6.8 ±0.8
S6B	15-30	0.82±0.02	0.94±0.04	3.5 ±1

^aSample locations are shown on Fig. 6.

^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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