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**RESULTS OF THE
RADIOLOGICAL SURVEY
AT
113 AVENUE E, LODI,
NEW JERSEY (LJ081)**

**R. D. Foley
L. M. Floyd**

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HEALTH AND SAFETY RESEARCH DIVISION

**Nuclear and Chemical Waste Programs
(Activity No. AH 10 05 00 0; ONLWCO1)**

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SURVEY AT 113 AVENUE E, LODI,
NEW JERSEY (LJ081)**

R. D. Foley and L. M. Floyd

Date Published - June 1989

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for the
U. S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-84OR21400**

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ACKNOWLEDGMENTS

Research for this project was sponsored by the Division of Facility and Site Decommissioning Projects, U.S. Department of Energy, under Contract No. DE-AC05-84OR21400 with Martin Marietta Energy Systems, Inc. The authors wish to acknowledge the support of J. E. Baublitz, Acting Director, Office of Remedial Action and Waste Technology; J. J. Fiore, Director, Division of Facility and Site Decommissioning Projects; and members of their staffs. The authors also appreciate the contributions of J. L. Rich, S. W. Hawthorne, B. C. Littleton, and L. J. Jeffers of the Publications Division; M. S. Uziel of the Environmental Information Systems Group; B. S. Ellis, D. A. Roberts, and T. R. Stewart of the Measurement Applications and Development Group; and W. H. Shipaugh of Don Stone Associates for participation in the collection, analyses, editing, and reporting of data for this survey.

ABSTRACT

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the U.S. Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th , derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 113 Avenue E, Lodi, New Jersey (LJ081), was conducted during 1988.

Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site.

**RESULTS OF THE RADIOLOGICAL
SURVEY AT 113 AVENUE E, LODI,
NEW JERSEY (LJ081)***

INTRODUCTION

From 1916 to 1956, process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores were generated by the Maywood Chemical Works (MCW), Maywood, New Jersey. During the latter part of this period, MCW supplied rare earth metals and thorium compounds to various government agencies. In the 1940s and 1950s, MCW produced thorium and lithium, under contract, for the Atomic Energy Commission (AEC). These activities ceased in 1956, and, approximately three years later, the 30-acre real estate was purchased by the Stepan Company. The property is located at 100 Hunter Avenue in a highly developed area in Maywood and Rochelle Park, Bergen County, New Jersey.

During the early years of operation, MCW stored wastes and residues in low-lying areas west of the processing facilities. In the early 1930s, these areas were separated from the rest of the property by the construction of New Jersey State Highway 17. The Stepan property, the interim storage facility, and several vicinity properties have been designated for remedial action by the U.S. Department of Energy (DOE).

The waste produced by the thorium extraction process was a sandlike material containing residual amounts of thorium and its decay products, with smaller quantities of uranium and its decay products. During the years 1928 and 1944 to 1946, area residents used these process wastes mixed with tea and cocoa leaves as mulch in their lawns and gardens. In addition, some of the contaminated wastes were apparently eroded from the site into Lodi Brook and carried downstream.

Lodi Brook is a small stream flowing south from Maywood with its headwaters near the Stepan waste storage site. Approximately 150 ft after passing under State Route 17, the stream has been diverted underground through concrete or steel culverts until it merges with the Saddle River in Lodi, New Jersey. Only a small section near Interstate 80 remains uncovered. From the 1940s to the 1970s when the stream was being diverted underground, its course was altered several times. Some of these changes resulted in the movement of contaminated soil to the surface of a few properties, where it is still in evidence. In other instances, the contaminated soil was covered over or mixed with clean fill, leaving no immediate evidence on the surface. Therefore, properties in question may be drilled in search of former stream bed material, even in the absence of surface contamination.

As a result of the Energy and Water Appropriations Act of Fiscal Year 1984, the property discussed in this report and properties in its vicinity contaminated with residues from the former MCW were included as a decontamination research

*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.

and development project under the DOE Formerly Utilized Sites Remedial Action Program. As part of this project, DOE is conducting radiological surveys in the vicinity of the site to identify properties contaminated with residues derived from the MCW. The principal radionuclide of concern is thorium-232. The radiological surveys discussed in this report are part of that effort and were conducted, at the request of DOE, by members of the Measurement Applications and Development Group of the Oak Ridge National Laboratory.

A radiological survey of the private, residential property at 113 Avenue E, Lodi, New Jersey, was conducted during 1988. The survey and sampling of the ground surface were carried out on May 7, 1988.

SURVEY METHODS

The radiological survey of the property included: (1) a gamma scan of the entire property outdoors, both at the surface and one meter above the surface and (2) collection of soil samples. No indoor survey measurements were performed.

Using a portable gamma scintillation meter, ranges of measurements were recorded for areas of the property surface and one meter above the surface. If the gamma readings were elevated, a biased soil sample was taken at the point showing the highest gamma radiation level. Systematic soil samples were taken at various locations on the property, irrespective of gamma radiation levels. These survey methods followed the plan outlined in Reference 1. A comprehensive description of the survey methods and instrumentation has been presented in another report.²

SURVEY RESULTS

Applicable federal guidelines are summarized in Table 1.³ The normal background radiation levels for the northern New Jersey area are presented in Table 2. 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 environmental samples.

Gamma Radiation Levels

Gamma radiation levels measured during a gamma scan of the surface of the property are given in Fig. 1, with corresponding measurements one meter above the surface where indicated. Gamma exposure rates over the major portion of the property ranged from 5 to 11 $\mu\text{R}/\text{h}$. One-meter readings were between 6 and 13 $\mu\text{R}/\text{h}$; the normal background level at one meter is 8 $\mu\text{R}/\text{h}$ for the northern New Jersey area (Table 2). Elevated readings were in scattered areas of both the front and back yards, with the highest levels ranging from 13 to 26 $\mu\text{R}/\text{h}$ in the southern corner of the front yard and the northern section of the back yard; corresponding one-meter readings for these two areas were 10 and 11 $\mu\text{R}/\text{h}$, respectively (Fig. 1).

Three other isolated spots in the front yard were 17, 21, and 21 $\mu\text{R}/\text{h}$. Flower beds in the front and side yards were 13 to 21 $\mu\text{R}/\text{h}$. Elevated areas lay on either side of the house, ranging from 13 to 17 $\mu\text{R}/\text{h}$ on the west and from 13 to 21 $\mu\text{R}/\text{h}$ on the east.

Systematic and Biased Soil Samples

Systematic and biased soil samples were taken from various locations on the property for radionuclide analyses. Locations of the systematic (S) and biased (B) samples are shown in Fig. 2, with results of laboratory analyses provided in Table 3. Concentrations of radium, thorium, and uranium in these samples ranged from 0.65 to 2.2 pCi/g, 0.79 to 15 pCi/g, and 1.0 to 10 pCi/g, respectively. Biased samples B1A&B, B3A, B4A, and B5A were above DOE guidelines for ^{232}Th (Table 1). All biased samples were above normal background levels for the northern New Jersey area (Table 2).

SIGNIFICANCE OF FINDINGS

Measurements taken at 113 Avenue E indicate that the property contained residual radioactive material primarily from the ^{232}Th and ^{238}U decay chains. These radionuclide distributions are typical of the type of material originating from the MCW site. The concentration and extent of ^{232}Th on this property were in excess of the applicable DOE criteria (Table 1). As shown in Fig. 2, this material was found at sampling locations B1, B3, B4, and B5, consistent with the elevated gamma radiation measurements in those areas. Results of this radiological assessment indicate that the property contains residual radioactivity derived from MCW in concentrations that exceed remedial action guidelines.

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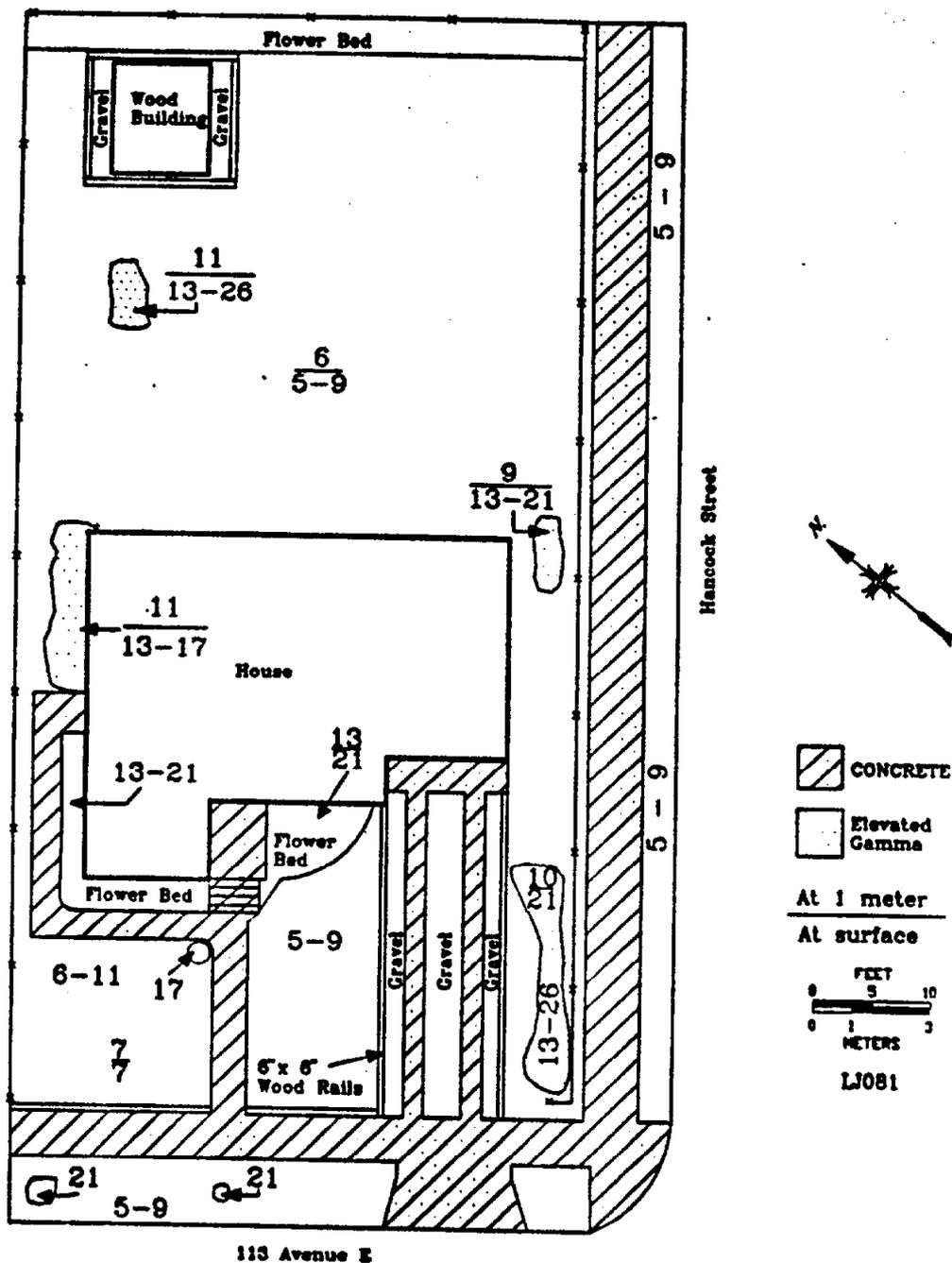


Fig. 1. Gamma radiation levels ($\mu\text{R/h}$) measured on the surface at 113 Avenue E, Lodi, New Jersey (LJ081), with corresponding measurements one meter above the surface where indicated.

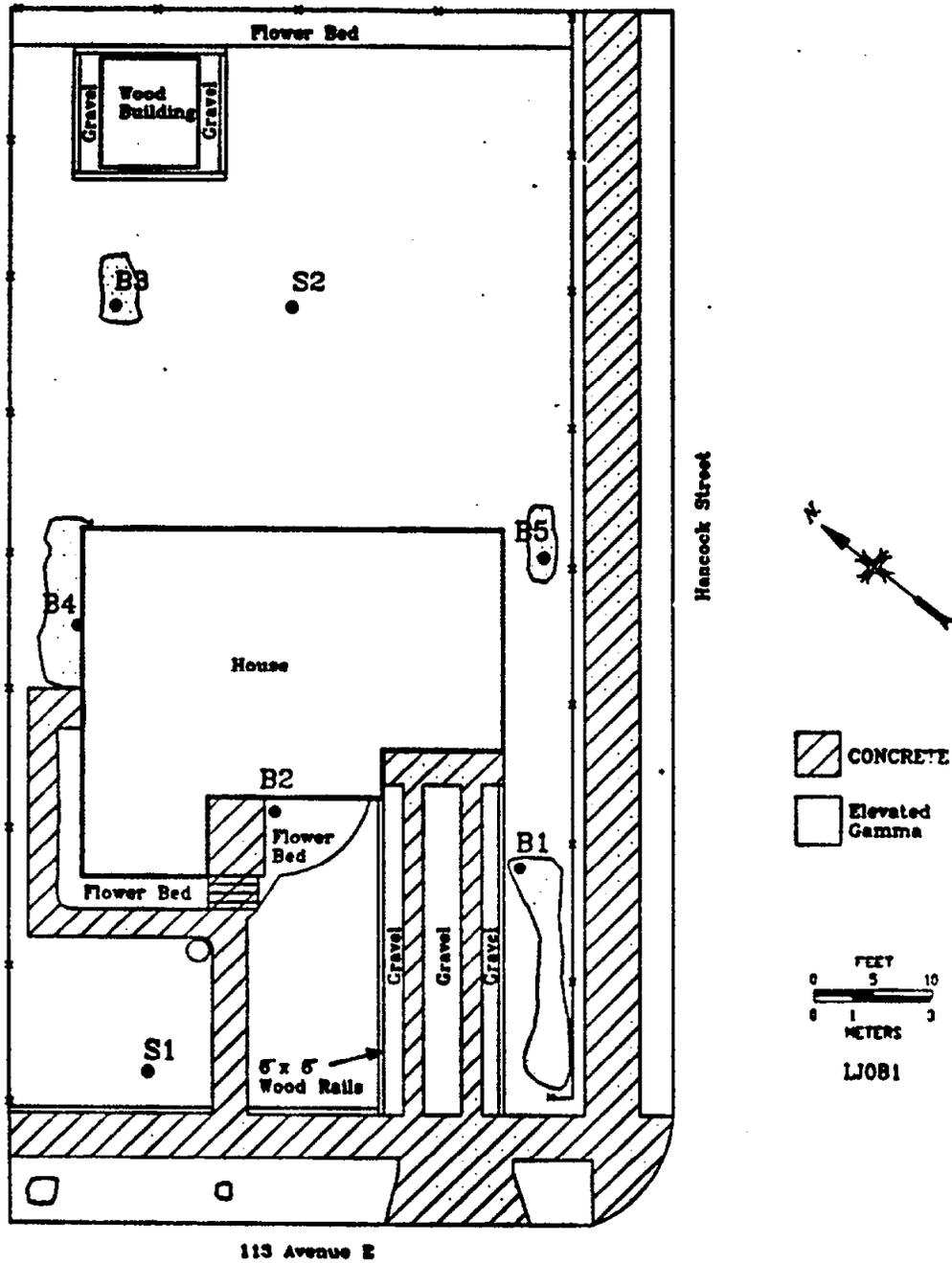


Fig. 2. Diagram showing locations of soil samples taken at 113 Avenue E, Lodi, New Jersey (LJ081).

Table 1. Applicable guidelines for protection against radiation^a

Mode of exposure	Exposure conditions	Guideline value
Radionuclide concentrations in soil	Maximum permissible concentration of the following radionuclides in soil above background levels averaged over 100 m ² area ²³² Th ²³⁰ Th ²²⁸ Ra ²²⁶ Ra	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

^aReference 3.

Table 2. Background radiation levels for the northern New Jersey area

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Gamma exposure at 1 m above ground surface (μ R/h)	8 ^a
Concentration of radionuclides in soil (pCi/g)	
²³² Th	0.9 ^b
²³⁸ U	0.9 ^b
²²⁶ Ra	0.9 ^b

^aReference 4.^bReference 5.

**Table 3. Concentrations of radionuclides in soil at
113 Avenue E, Lodi, New Jersey (LJ081)**

Sample ^a	Depth (cm)	Radionuclide concentration (pCi/g)		
		²²⁶ Ra ^b	²³² Th ^b	²³⁸ U ^b
<i>Systematic samples^c</i>				
S1A	0-15	0.69±0.008	0.97±0.02	<1.3
S1B	15-30	0.75±0.01	0.98±0.02	1.0±0.4
S2A	0-15	0.65±0.2	0.82±0.05	1.9±0.5
S2B	15-30	0.71±0.007	0.79±0.01	1.0±0.2
<i>Biased samples^d</i>				
B1A	0-15	1.8 ±0.2	14 ±0.5	^e
B1B	15-30	2.0 ±0.1	15 ±0.8	7.4±2
B1C	30-45	1.2 ±0.05	5.4 ±0.1	<10.4
B2A	0-15	1.1 ±0.1	4.6 ±0.07	3.1±0.3
B2B	15-30	1.2 ±0.1	4.9 ±0.3	5.0±0.6
B2C	30-45	1.0 ±0.02	3.6 ±0.04	4.0±0.9
B3A	0-15	2.2 ±0.1	15 ±0.04	6.5±0.06
B3B	15-30	1.7 ±0.2	12 ±0.7	7.0±0.1
B3C	30-45	1.1 ±0.04	3.8 ±0.09	<7.1
B4A	0-15	2.0 ±0.2	11 ±0.09	7.5±2
B4B	15-30	1.3 ±0.06	5.2 ±0.2	2.8±2
B5A	0-15	1.5 ±0.04	6.6 ±0.2	7.3±0.08
B5B	15-30	0.87±0.009	2.1 ±0.02	2.0±0.4

^aLocations of soil samples are shown on Fig. 2.

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

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

^dBiased samples are taken from areas shown to have elevated gamma exposure rates.

^eSample was not analyzed for ²³⁸U.

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