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RESULTS OF THE RADIOLOGICAL SURVEY AT 80 HANCOCK STREET (LJ059), LODI, NEW JERSEY

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HEALTH AND SAFETY RESEARCH DIVISION

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R. D. Foley, R. F. Carrier, L. M. Floyd, and J. W. Crutcher

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RESULTS OF THE RADIOLOGICAL SURVEY AT 80 HANCOCK STREET (LJ059), LODI, NEW JERSEY*

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 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 19?0s 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

*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.

with residues from the former MCW, were included as a decontamination research 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 survey discussed in this report is part of that effort and was 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 commercial property at 80 Hancock Street, Lodi, New Jersey, was conducted on September 17, 1986.

SURVEY METHODS

The radiological survey of the property included collection of subsurface soil samples and gamma logging of auger holes. Because logging results clearly indicated the presence of contamination in excess of the applicable guideline (subsequently verified by soil sample analysis), the customary surface scanning of the entire property for gamma exposure rates was not performed. No indoor survey measurements were conducted.

To define the extent of possible subsurface soil contamination, auger holes were drilled to depths of approximately 1.8 m. A plastic pipe was placed in each hole, and a NaI scintillation probe was lowered inside the pipe. The probe was encased in a lead shield with a horizontal row of collimating slits on the side. This collimation allows measurement of gamma radiation intensities resulting from contamination within small fractions of the hole depth. Measurements were made at 30– and 35–cm intervals. If the gamma readings in the hole were elevated, a soil sample was scraped from the wall of the auger hole at the point showing the highest gamma radiation level. The auger hole loggings were used to select locations where further soil sampling would be useful. A split-spoon sampler was used to collect subsurface samples at known depths. In some auger holes, a combination of split-spoon sampling and side-wall scraping was used to collect samples. 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.

Auger Hole Soil Samples and Gamma Logging

Varying thicknesses of subsurface soil were sampled from depths of 0 to 185 cm in auger holes (A) drilled at two separate locations indicated in Fig. 1. The results of analyses of these samples (LJ059A1A–LJ059A2F) are given in Table 3. Concentrations of ^{226}Ra and ^{232}Th in soil samples from the auger holes ranged from 0.53 to 5.1 and 0.64 to 24 pCi/g, respectively. The concentration of ^{232}Th in sample LJ059A1C (24 pCi/g) is above the DOE criterion for subsurface soil (Table 1) and the concentration of ^{226}Ra (5.1 pCi/g) meets that criterion. The elevated levels were found at a depth of 90 to 120 cm.

Gamma logging was performed in each of the two auger holes to characterize and further define the extent of possible contamination. The logging technique used here is not radionuclide specific. However, logging data, in conjunction with soil analyses data, may be used to estimate regions of elevated radionuclide concentrations in auger holes when compared with background levels for the area. Following a comparison of these data, it appears that any shielded scintillator readings of 1,000 counts per minute (cpm) or greater generally indicate the presence of elevated concentrations of ^{226}Ra and/or ^{232}Th. Data from the gamma profiles of the logged auger holes are graphically represented in Figs. 2 and 3. Readings between the surface and a depth of 1.5 m were greater than 1,000 cpm in auger hole 1, with a maximum reading of 7,100 cpm at 1 m. Readings in auger hole 2 were elevated between 0.3 and 1.7 m, with a maximum of 2,300 cpm at 1.5 m.

SIGNIFICANCE OF FINDINGS

Measurements taken at 80 Hancock Street indicate that the property contained radioactive contamination primarily from the ^{232}Th decay chain, with some contamination from ^{226}Ra. These radionuclide distributions are typical of the type of material originating from the processing operations at MCW. The concentration and extent of ^{232}Th on this property were in excess of the applicable DOE criterion (Table 1). This material was found at the location of sample A1 as shown in Fig. 1. Based on the results of this radiological assessment, it is recommended that this site be considered for inclusion in the DOE remedial action program.

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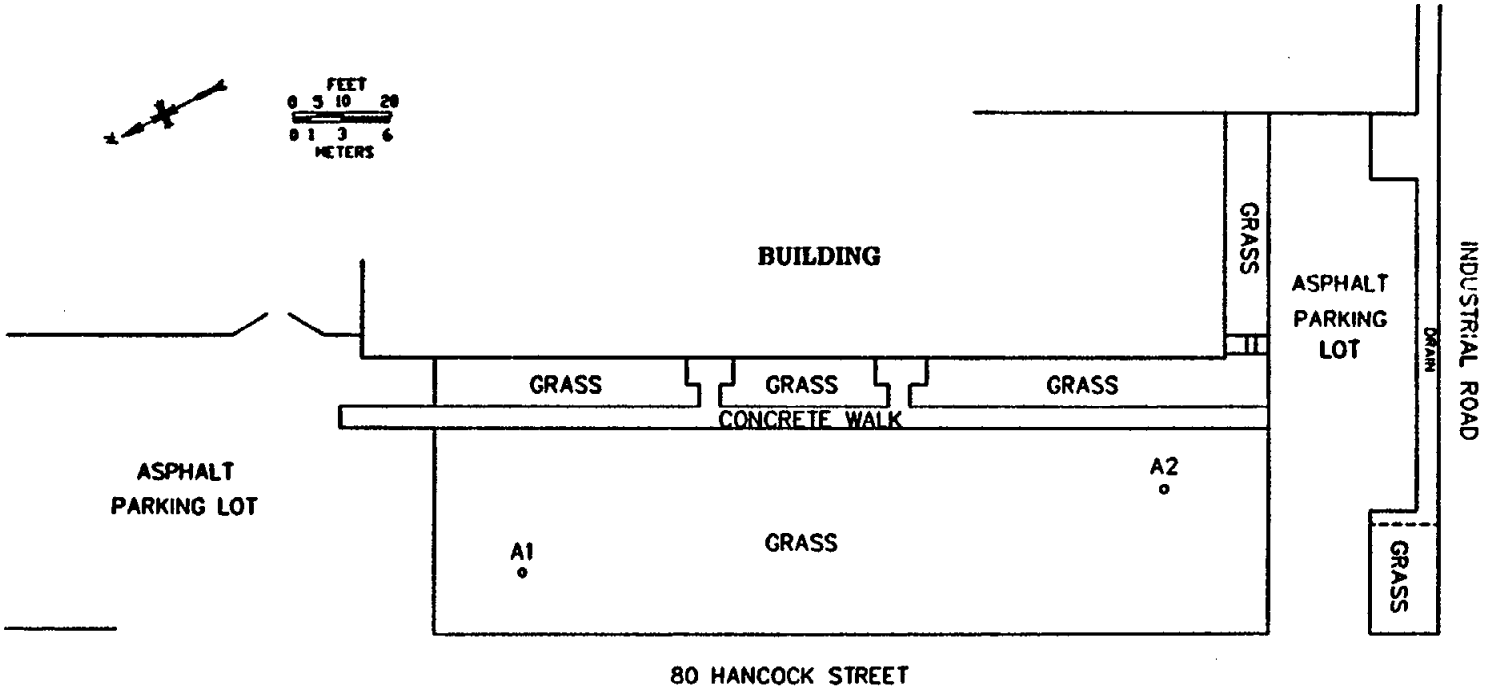

Fig. 1. Diagram showing locations of soil samples at 80 Hancock Street, Lodi, New Jersey (LJ059).

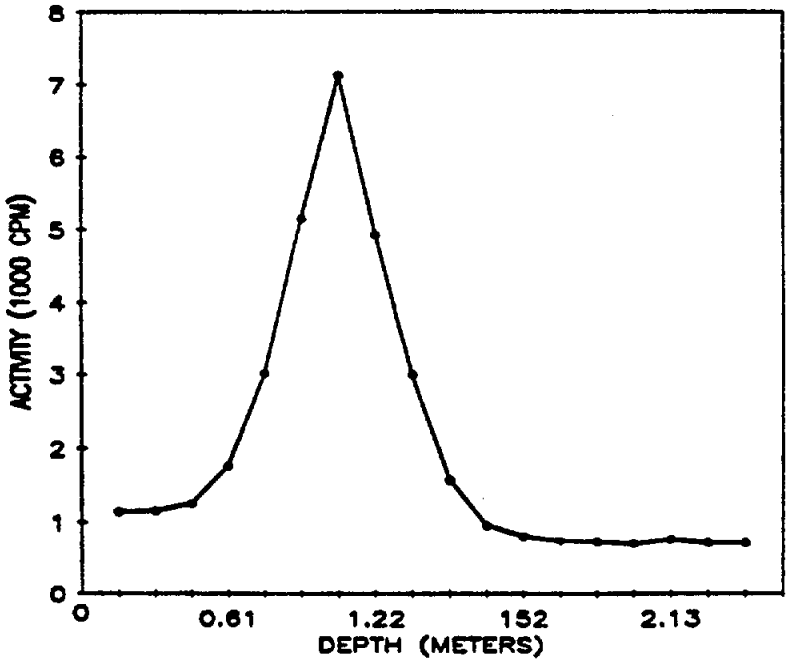

Fig. 2. Gamma profile for auger hole 1 (LJ059A1) at 80 Hancock Street, Lodi, New Jersey.

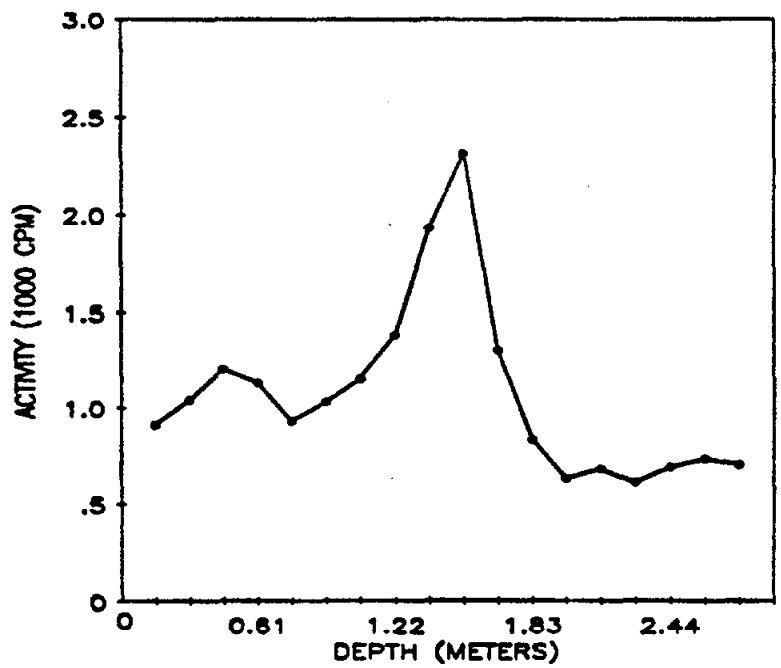

Fig. 3. Gamma profile for auger hole 2 (LJ059A2) at 80 Hancock Street, Lodi, New Jersey.

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 radiomuclides 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

[a]Reference 3.

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

Type of radiation measurement or sample	Radiation level or radionuclide concentration
Concentration of radionuclides in soil (pCi/g)	
^{232}Th	0.9[a]
^{238}U	0.9[a]
^{226}Ra	0.9[a]

[a]Reference 4.

Table 3. Concentrations of radionuclides in soil at 80 Hancock Street, Lodi, New Jersey (LJ059)

Sample[a]	Depth (cm)	Radionuclide concentration (pCi/g)	
		^{226}Ra[b]	^{232}Th[b]
		Auger samples[c]	
A1A	0–30	1.4 ± 0.2	5.3 ± 0.3
A1B	60–90	1.8 ± 0.2	8.1 ± 0.4
A1C	90–120	5.1 ± 0.6	24 ± 0.6
A1D	120–150	1.3 ± 0.07	2.7 ± 0.1
A1E	150–185	0.53 ± 0.08	0.64 ± 0.2
A2A	0–30	0.80 ± 0.08	1.5 ± 0.1
A2B	30–60	0.83 ± 0.1	1.6 ± 0.2
A2C	60–90	0.80 ± 0.04	1.2 ± 0.08
A2D	90–120	0.84 ± 0.08	1.8 ± 0.1
A2E	120–150	0.88 ± 0.3	2.3 ± 0.2
A2F	150–185	1.8 ± 0.2	5.8 ± 0.3

[a]Locations of soil samples are shown on Fig. 2.

[b]Indicated counting error is at the 95% confidence level ($\pm 2\sigma$).

[c]Auger samples are taken from holes drilled to further define the depth and extent of radioactive material. Holes are drilled where the surface may or may not be contaminated.

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