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ORNL/RASA-88/38

HEALTH AND SAFETY RESEARCH DIVISION

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

RESULTS OF THE RADIOLOGICAL SURVEY AT 9 REDSTONE LANE LODI, NEW JERSEY (LJ069)

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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, 9 Redstone Lane, Lodi, New Jersey (LJ069), was conducted during 1987.

Measurements at the private property located at 9 Redstone Lane indicate slightly elevated gamma exposure rates in association with cinder-like material observed in logging holes. These elevated levels result from naturally occurring radioactivity present in such substances as ashes and cinders. They are not related to the deposit of residues from processing operations at the MCW site. All other radiological findings conform to the guidelines established by the DOE for the Maywood, New Jersey, area remedial action plan.

RESULTS OF THE RADIOLOGICAL SURVEY AT 9 REDSTONE LANE, LODI, NEW JERSEY (LJ069)*

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 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 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 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.

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 private property at 9 Redstone Lane, Lodi, New Jersey, was conducted during 1987. The survey and sampling of the ground surface, as well as the subsurface investigation, were carried out June 9.

SURVEY METHODS

The radiological survey included: (1) a gamma scan of the entire property outdoors, (2) collection of surface and subsurface soil samples, and (3) gamma profiles of auger holes. No indoor survey measurements were performed.

Using a portable gamma scintillation meter, ranges of measurements were recorded for areas of the property surface. Systematic soil samples were then obtained at randomly selected locations irrespective of gamma exposure rates. To define the extent of possible subsurface soil contamination, an auger hole was drilled to a depth of approximately 1.5 m. A plastic pipe was placed in the 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. 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. 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.

Surface Gamma Radiation Levels

Radiation levels measured during a gamma scan of the surface of the property are given in Fig. 1. Gamma exposure rates ranged from 5 to 12 μR/h with no elevated levels observed.

Systematic Soil Samples

Thirteen systematic soil samples (S) were collected at varying depths from four different locations on the property for radionuclide analyses. Sampling locations are shown in Fig. 2 with results of laboratory analyses provided in Table 3. Concentrations of radium and thorium in these samples ranged from 0.58 to 2.1 pCi/g and 0.65 to 1.8 pCi/g, respectively. Concentrations of radionuclides in some samples were above background (Table 2) but well below DOE criteria.

Auger Hole Soil Samples and Gamma Logging

An auger hole was drilled at the location of systematic soil sample S4 to further investigate the possibility of subsurface contamination. Samples were collected from depths of 75 to 150 cm in the auger hole (A). The results of analyses of these samples are given in Table 3. Concentrations of ^{226}Ra and ^{232}Th in soil samples from the auger hole ranged from 0.98 to 3.1 and 0.94 to 2.5 pCi/g, respectively. All values are less than the DOE criterion for subsurface soil (Table 1).

Gamma logging was performed in the auger hole 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 1000 counts per minute (cpm) or greater generally indicate the presence of elevated concentrations of ^{226}Ra and/or ^{232}Th. Data from the gamma profile of the logged auger hole are graphically represented in Fig. 3. Readings at depths between 0.46 and 1.2 m were greater than 1000 cpm with a maximum reading of 1200 cpm at 1.1 m. The areas of highest gamma readings approximate those having the greatest concentrations of radionuclides shown in Table 3. Shiny, black, cinder-like material was observed in the sampled soil at the locations of elevated measurements. The anomaly is probably not associated with contamination from the MCW site but may be attributed to naturally occurring radioactive substances. Many natural materials such as cinders typically exhibit elevated radiological measurements when compared to surrounding soils.

SIGNIFICANCE OF FINDINGS

Measurements at the private property located at 9 Redstone Lane indicate slightly elevated gamma exposure rates in association with cinder-like material observed in logging holes. These elevated levels result from naturally occurring radioactivity present in such substances and are not associated with residues from processing operations at the MCW site. All other radiological findings conform to the guidelines established by the DOE for the Maywood, New Jersey, area remedial action plan.

REFERENCES

1. W. D. Cottrell, ORNL, to A. J. Whitman, DOE/HQ, correspondence, "Radiological Survey of Private Properties in Lodi, New Jersey" (August 15, 1984).

2. 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*, Oak Ridge National Laboratory, ORNL/TM-8600 (April 1987).

3. U.S. Department of Energy, *Guidelines for Residual Radioactivity at Formerly Utilized Sites, Remedial Action Program and Remote Surplus Facilities Management Program Sites* (Rev. 2, March 1987).

4. T. E. Myrick and B. A. Berven, *State Background Radiation Levels: Results of Measurements Taken During 1975-1979*, Oak Ridge National Laboratory, ORNL/TM-7343 (November 1981).

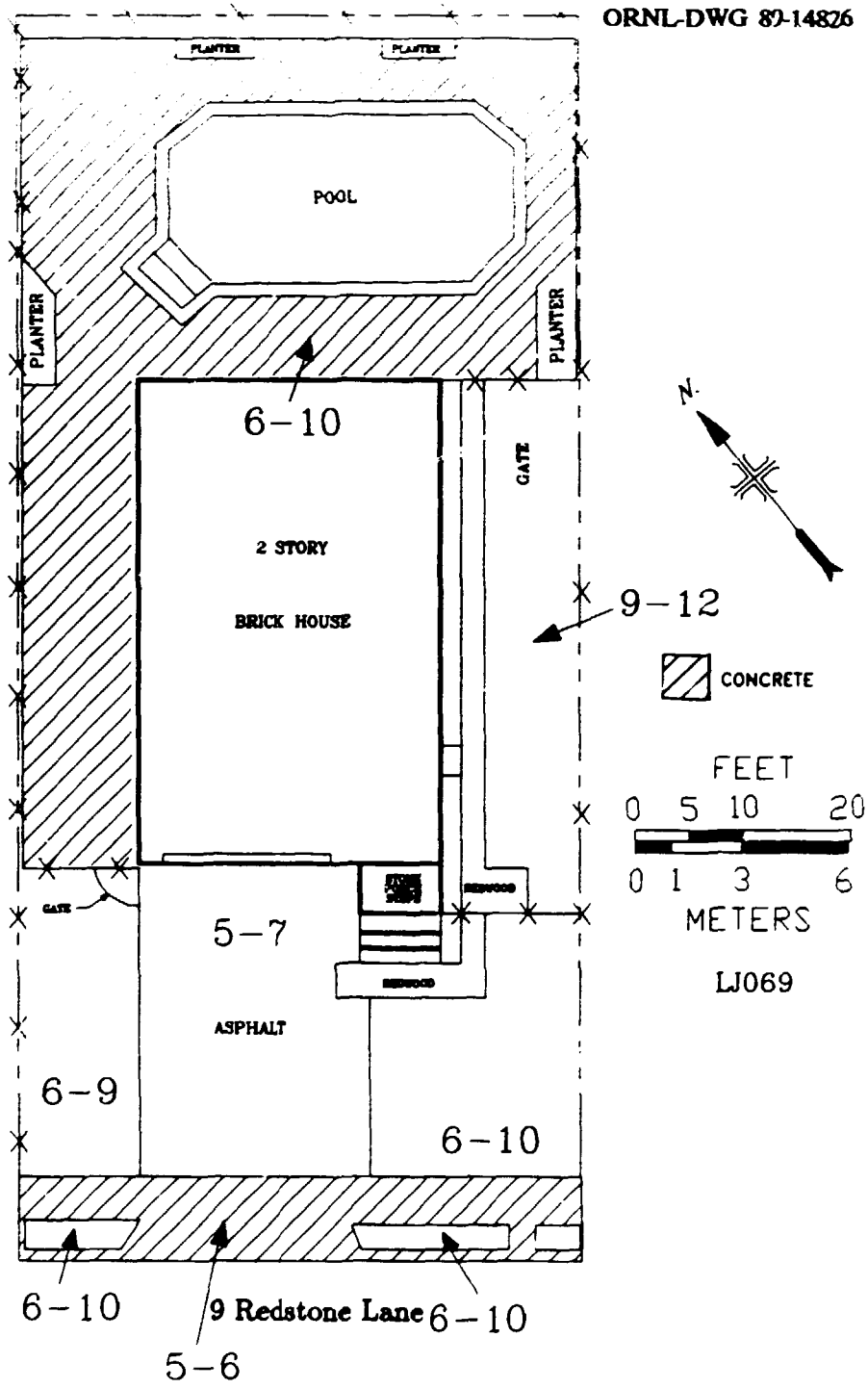
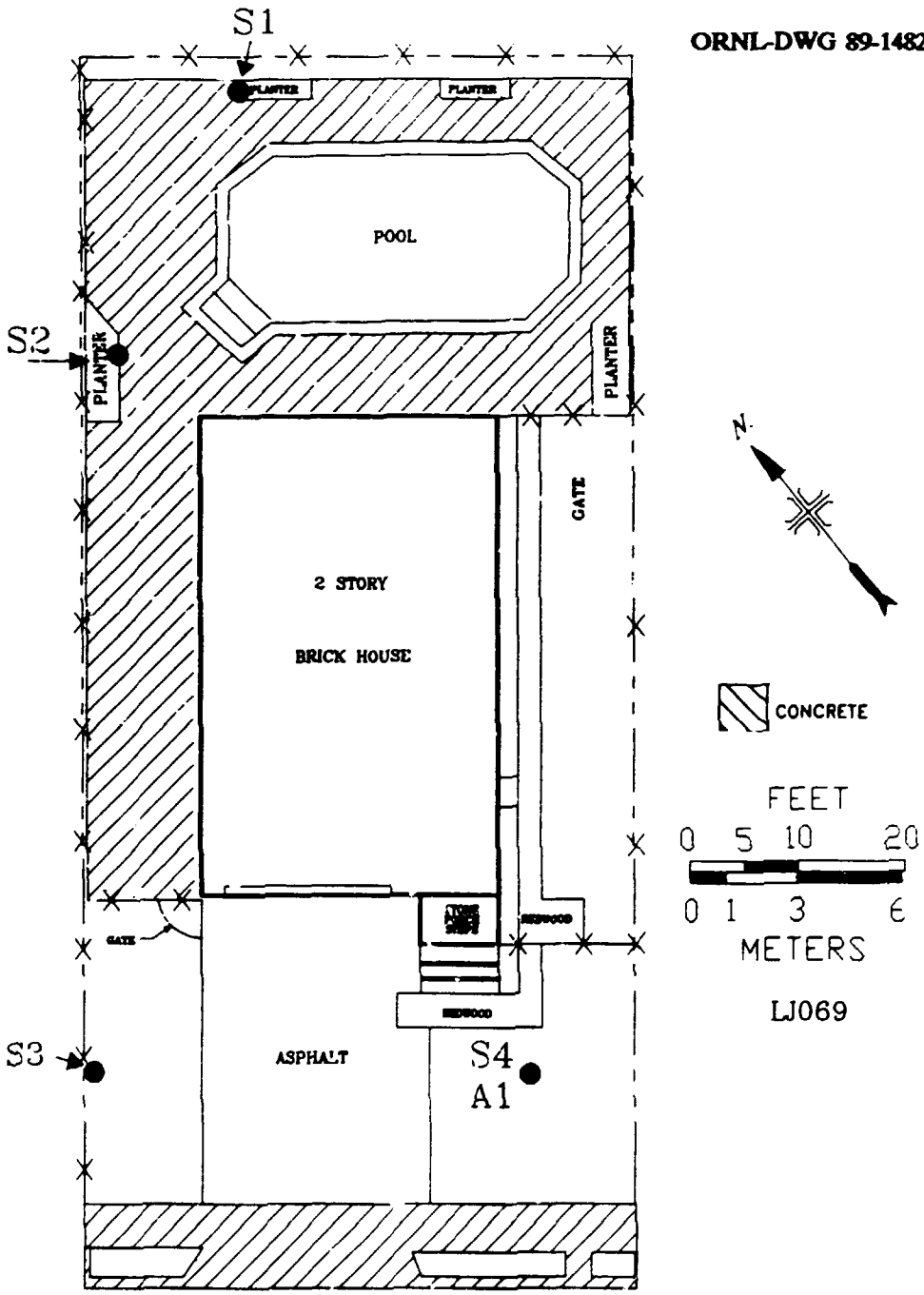


Fig. 1. Gamma radiation levels (μR/h) measured on the surface at 9 Redstone Lane, Lodi, New Jersey (LJ069).



9 Redstone Lane

Fig. 2. Diagram showing locations of soil samples taken at 9 Redstone Lane, Lodi, New Jersey (LJ069).

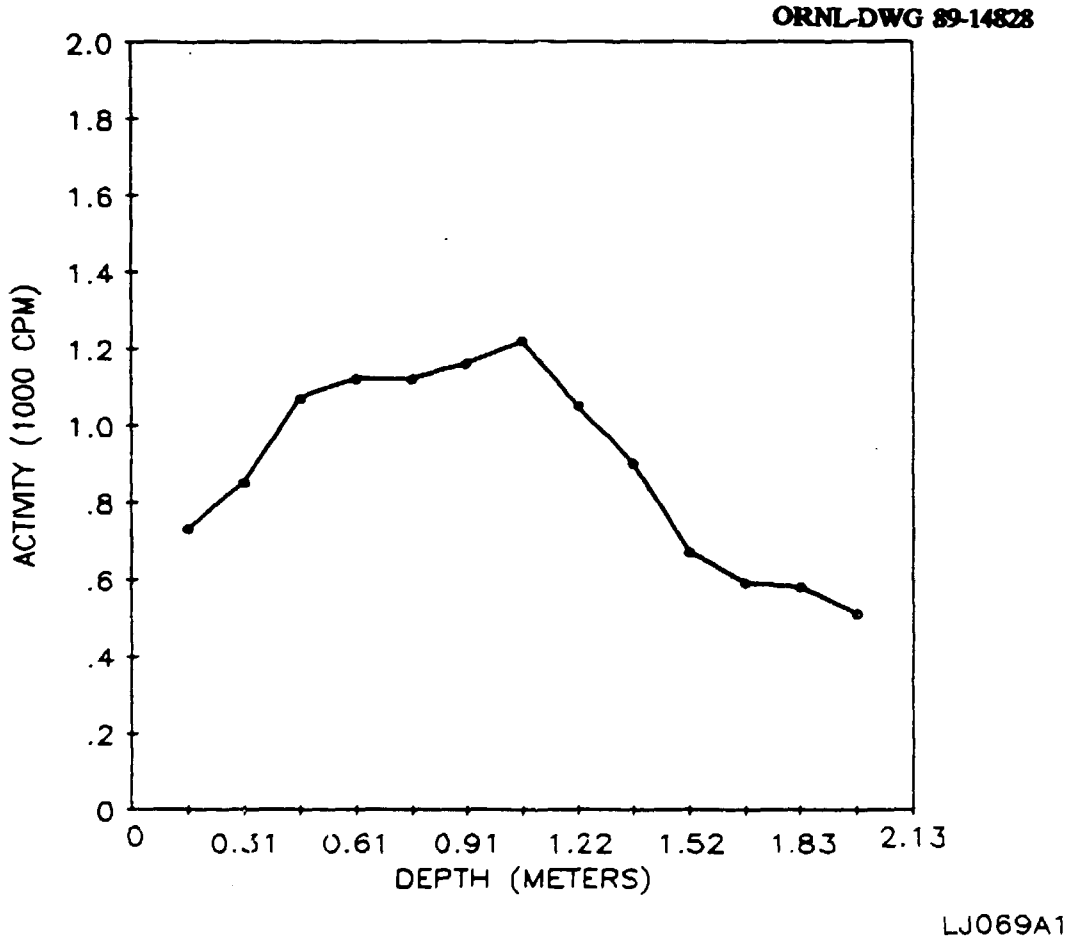


Fig. 3. Gamma profile for auger hole 1 (A1) at 9 Redstone Lane, Lodi, New Jersey (LJ069).

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

[a]U.S. Department of Energy, *Guidelines for Residual Radioactivity at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites* (Rev. 2, March 1987).

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

Type of sample	Radionuclide concentration
Concentration of radionuclides in soil (pCi/g)[a]	
^{232}Th	0.9
^{238}U	0.9
^{226}Ra	0.9

[a]Reference 4.

Table 3. Concentrations of radionuclides in soil at 9 Redstone Lane, Lodi, New Jersey (LJ069)

Sample[a]	Depth (cm)	Radionuclide concentration (pCi/g)	
		^{226}Ra[b]	^{232}Th[b]
	Systematic samples		
S1A	0–15	0.58 ± 0.07	0.69 ± 0.06
S1B	15–30	0.78 ± 0.1	0.91 ± 0.2
S1C	30–45	0.60 ± 0.05	0.65 ± 0.1
S2A	0–15	1.0 ± 0.03	1.0 ± 0.04
S2B	15–30	0.70 ± 0.08	0.73 ± 0.2
S3A	0–15	0.96 ± 0.1	1.2 ± 0.2
S3B	15–30	0.63 ± 0.04	0.85 ± 0.08
S3C	30–45	0.63 ± 0.04	0.78 ± 0.07
S4A	0–15	0.84 ± 0.04	1.4 ± 0.07
S4B	15–30	1.1 ± 0.02	1.3 ± 0.04
S4C	30–45	1.6 ± 0.2	1.5 ± 0.2
S4D	45–60	2.0 ± 0.2	1.6 ± 0.1
S4E	60–75	2.1 ± 0.08	1.8 ± 0.5
	Auger samples[c]		
A1A	75–90	3.1 ± 0.1	2.5 ± 0.2
A1B	90–105	2.2 ± 0.05	1.7 ± 0.2
A1C	105–120	2 ± 0.05	1.8 ± 0.3
A1D	120–135	1.7 ± 0.05	1.4 ± 0.2
A1E	135–150	0.98 ± 0.1	0.94 ± 0.2

[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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