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Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the Maywood Site, New Jersey

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RESULTS OF THE RADIOLOGICAL SURVEY AT 80 STATE HIGHWAY 46, LODI, NEW JERSEY (LJ092)

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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, 80 State Highway 46, Lodi, New Jersey (LJ092), was conducted during 1988.

Results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions were not significantly different from normal background levels in the northern New Jersey area.

RESULTS OF THE RADIOLOGICAL SURVEY AT 80 STATE HIGHWAY 46, LODI, NEW JERSEY (LJ092)*

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 streambed 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 80 State Highway 46, Lodi, New Jersey, was conducted during 1988. The survey and sampling of the ground surface, as well as a subsurface investigation, were carried out on June 4 and 8, 1988.

SURVEY METHODS

The radiological survey of the property included: (1) a gamma scan of the entire property surface outdoors, (2) collection of soil samples, and (3) gamma profiles of auger holes. The survey methods followed the plan outlined in Reference 1. 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. To define the extent of possible subsurface soil contamination, auger holes were drilled to depths of approximately 3.7 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 usually made at 15– or 30–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. 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.[4,5] These data are provided for comparison with survey results presented in this report. 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. Gamma exposure rates over the major portion of the property ranged from 2 to 8 μR/h. None of the measurements were elevated.

Auger Hole Soil Samples and Gamma Logging

Varying thicknesses of subsurface soil were sampled from depths of 120 to 365 cm in four of five auger holes (A); their locations are indicated in Fig. 2. Auger hole A1 was drilled, but water immediately filled the hole to four feet; therefore, no samples were taken. The results of analyses of these samples are given in Table 3. Concentrations of ^{226}Ra, ^{232}Th, and ^{238}U in these auger soil samples ranged from 0.25 to 11.5 pCi/g, 0.28 to 1.57 pCi/g, and 0.53 to 12.9 pCi/g, respectively. All values were below DOE criteria for radium and thorium (Table 1).

Gamma logging was performed in each of the 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 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 profiles of the logged auger holes are graphically represented in Figs. 3 through 7.

Elevated readings were found in auger holes A1, A2, A3, and A4 between approximately 1.5 and 2.7 m. All readings in auger hole A5 were below 1000 cpm. As already mentioned, the first exploratory hole (A1) drilled on this property was not sampled due to water filling the hole; however, the hole was logged, and elevated gamma levels (up to 3135 cpm) were noted. Therefore, a second hole (A2) was drilled approximately two feet northwest of A1. After logging A2, this hole was found to have only slightly elevated gamma levels (up to 1635 cpm) at about the same depth as A1. Soil samples were taken from A2, and subsequent analyses of these samples revealed that ^{226}Ra and ^{238}U concentrations were in equilibrium. This equilibrium indicated that the slight elevations in gamma levels were probably due to naturally occurring radioactive materials. Two more holes were drilled in association with A1: auger hole A3, 14 feet to the northwest of A1, and hole A4, 4 feet southeast of A1. Again, slight elevations in gamma levels were found in both holes (A3 and A4) at the same depths as A1 and A2. After analyses of samples from these holes (A3 and A4), the data revealed the same equilibrium condition noticed in A2.

SIGNIFICANCE OF FINDINGS

Measurements and results of soil sample analyses taken at 80 State Highway 46 indicate that the property contained no radionuclide concentrations above DOE guideline values. The slight elevation in gamma measurements found in auger holes A1 through A4 and the corresponding radium/uranium equilibrium in those soil samples are typical of naturally occurring radioactive materials. The ^{232}Th concentrations found on this property were not significantly different from normal background levels for the northern New Jersey area (Table 2). Since ^{232}Th is the primary radionuclide of concern at the MCW site, the slight activity on this property appears to be from a natural source and not the result of processing operations at MCW.

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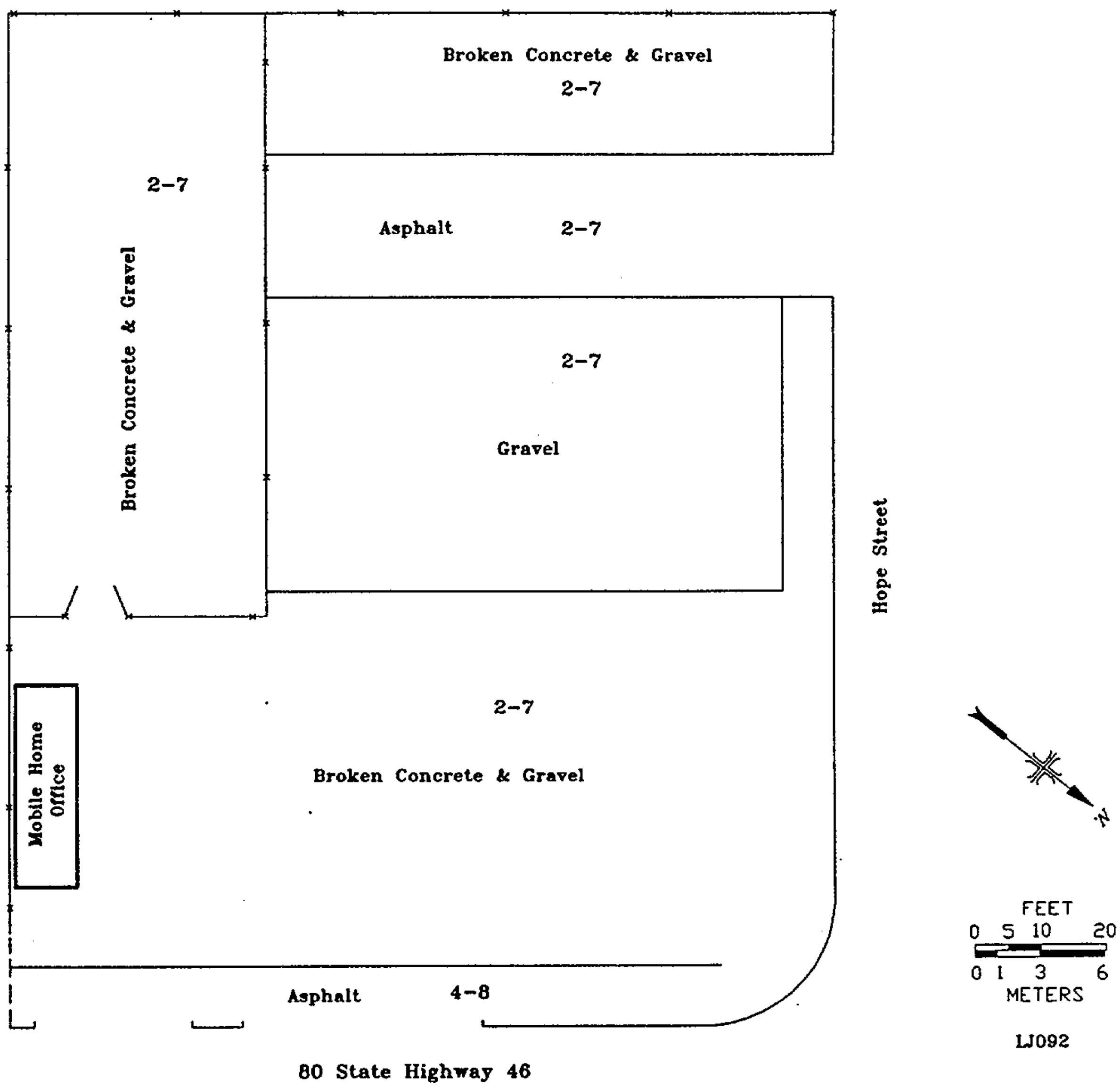

Fig. 1. Gamma radiation levels (μR/h) measured on the surface at 80 State Highway 46, Lodi, New Jersey (LJ092).

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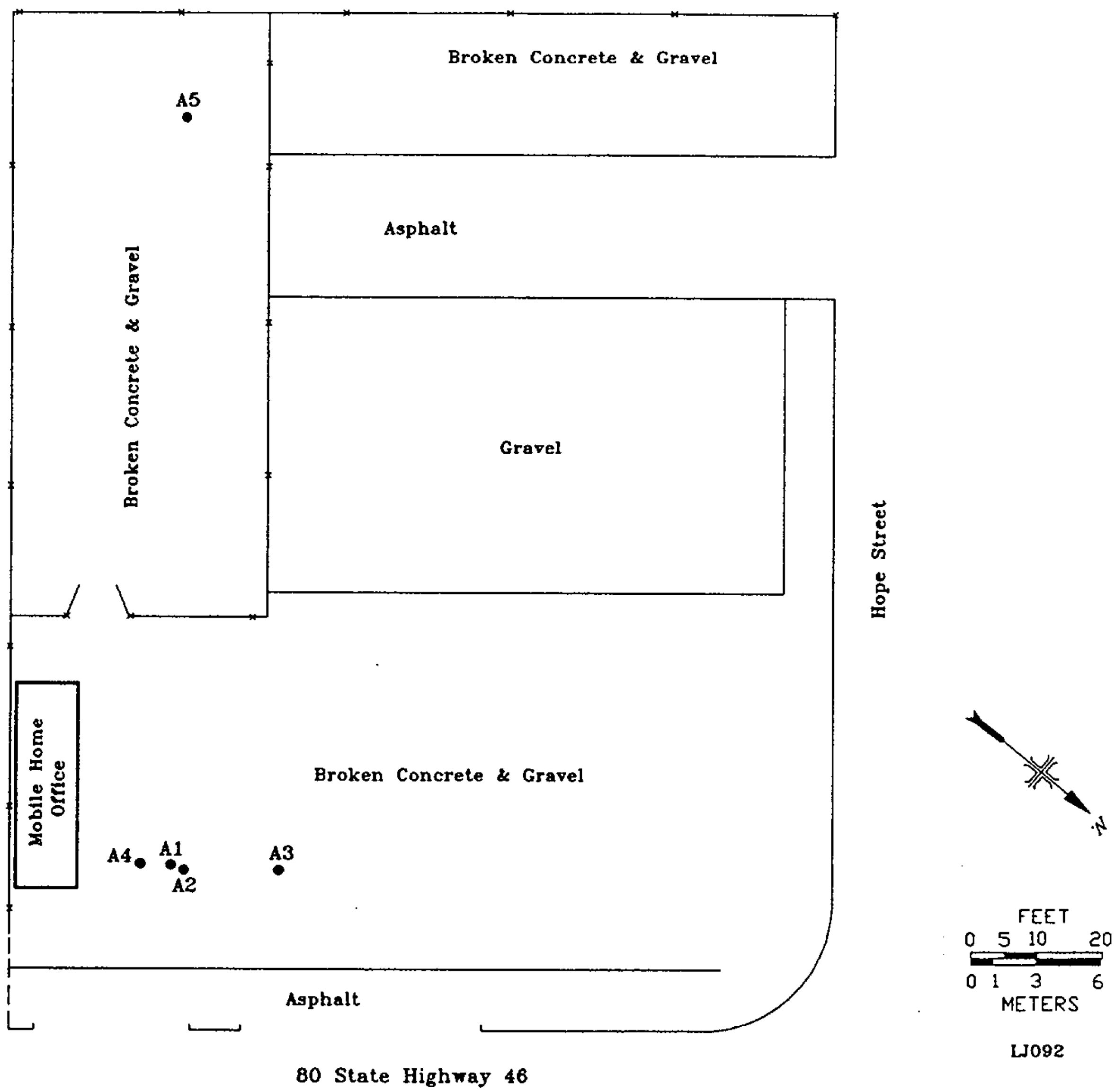

Fig. 2. Diagram showing locations of soil samples taken at 80 State Highway 46, Lodi, New Jersey (LJ092).

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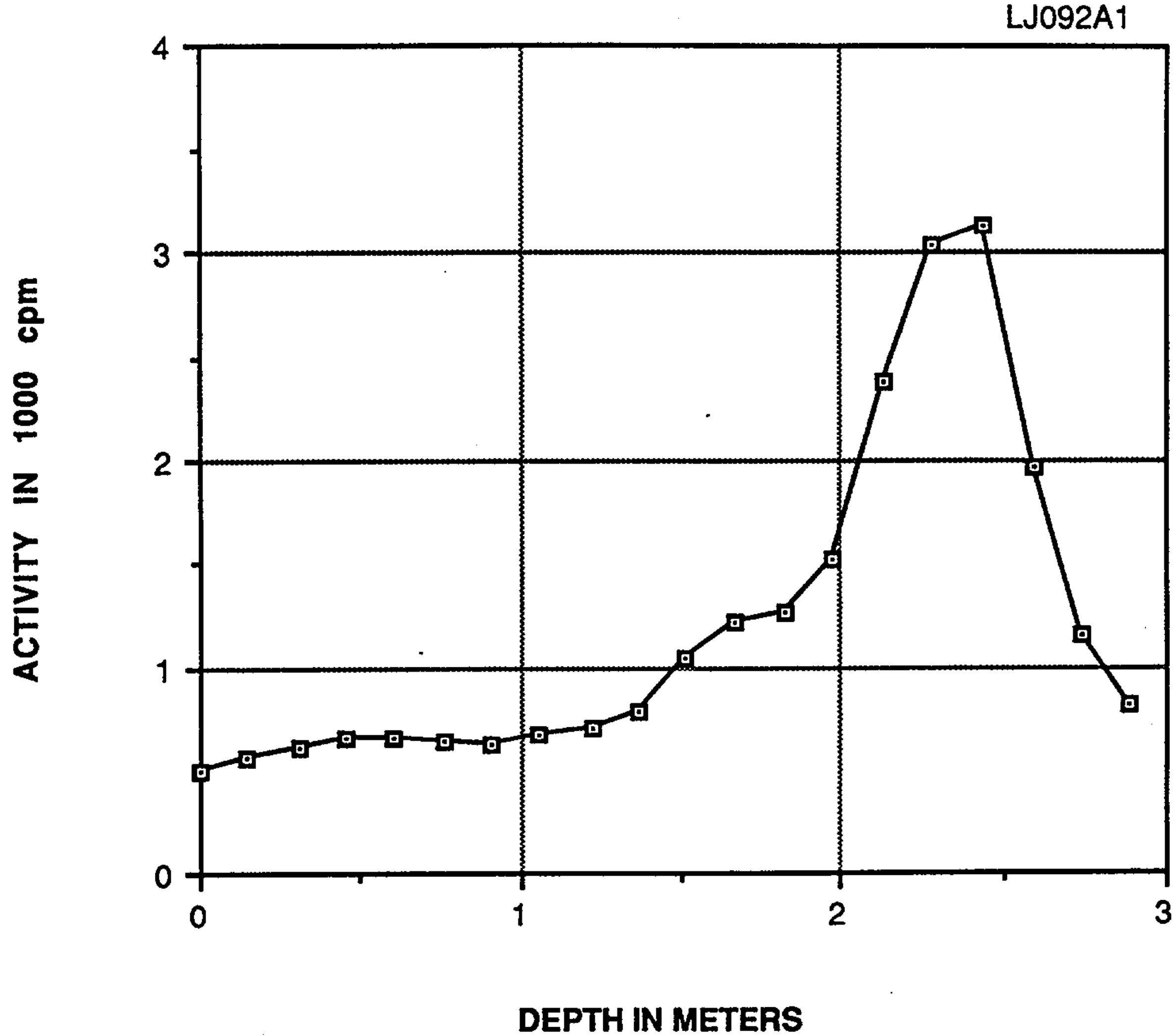

Fig. 3. Gamma profile for auger hole 1 (LJ092A1) at 80 State Highway 46, Lodi, New Jersey.

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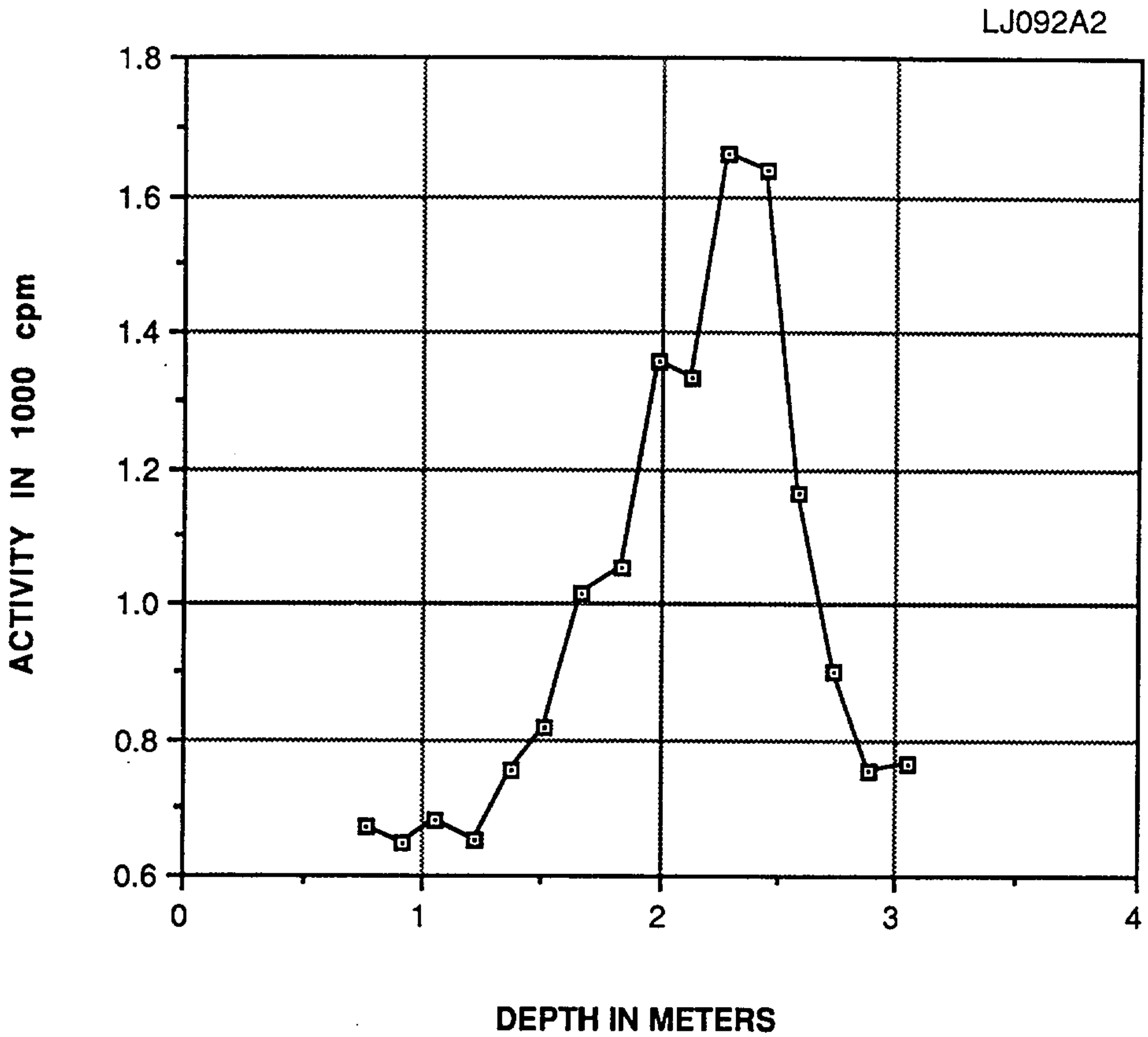

Fig. 4. Gamma profile for auger hole 2 (LJ092A2) at 80 State Highway 46, Lodi, New Jersey.

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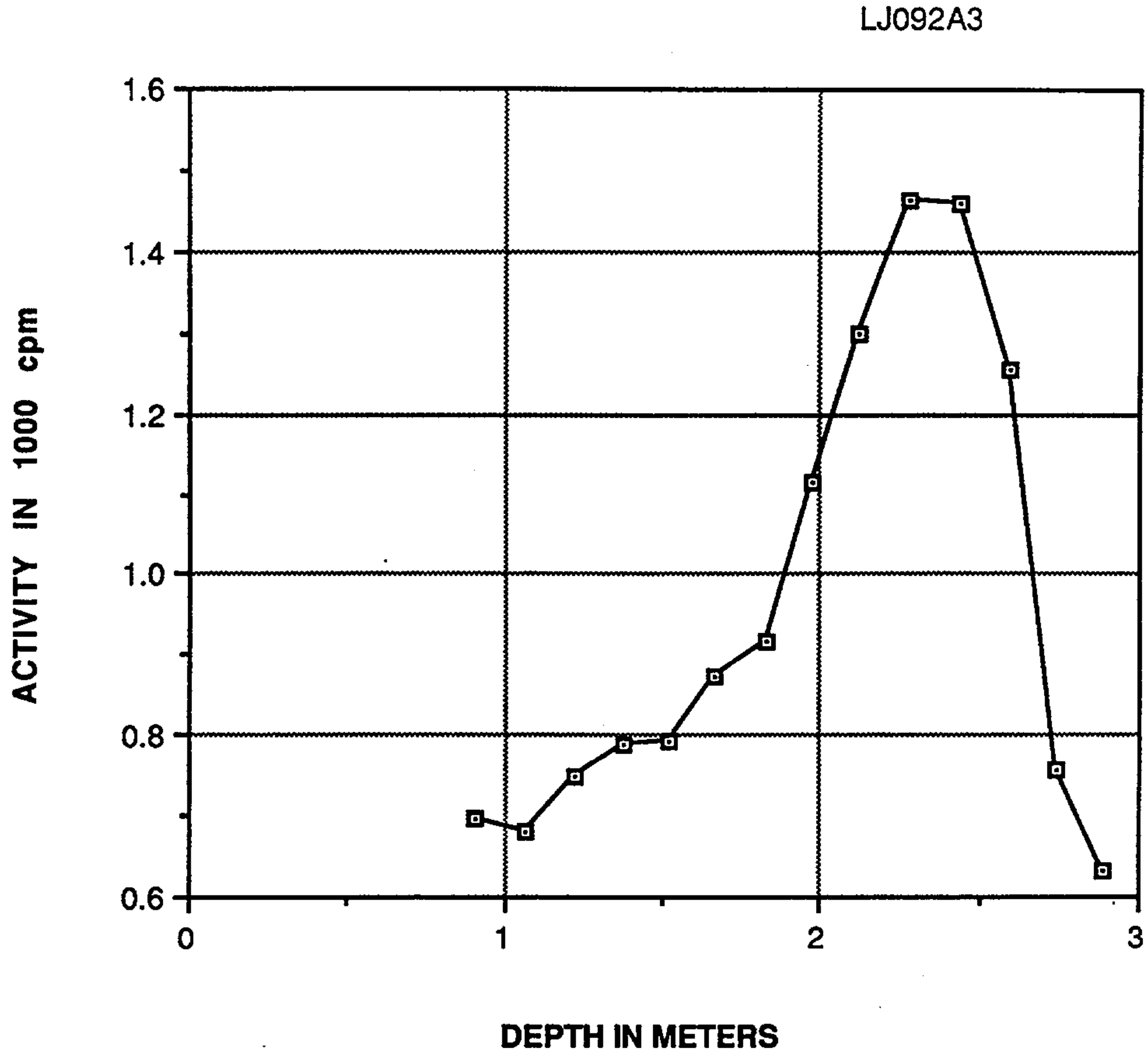

Fig. 5. Gamma profile for auger hole 3 (LJ092A3) at 80 State Highway 46, Lodi, New Jersey.

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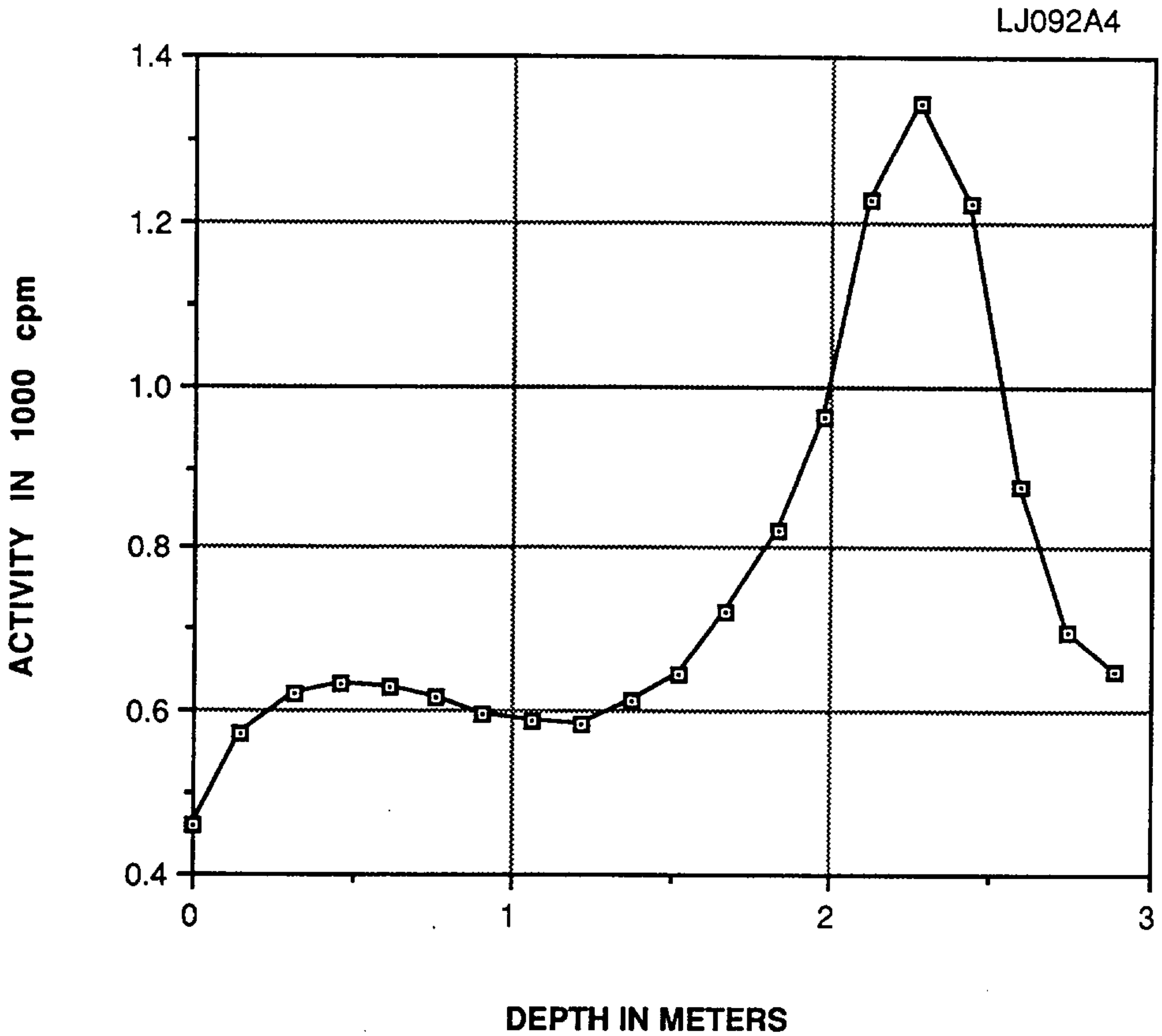

Fig. 6. Gamma profile for auger hole 4 (LJ092A4) at 80 State Highway 46, Lodi, New Jersey.

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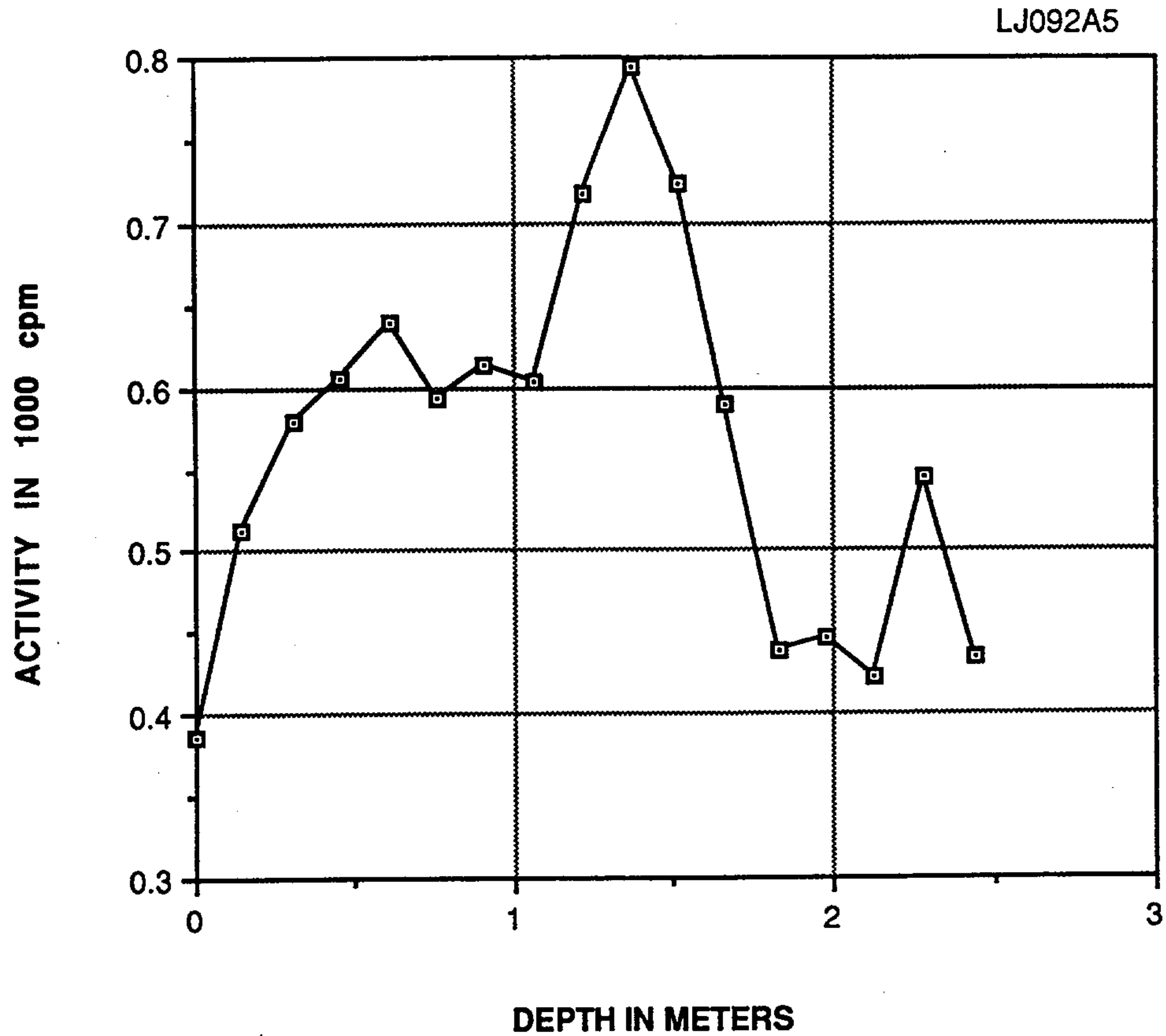

Fig. 7. Gamma profile for auger hole 5 (LJ092A5) at 80 State Highway 46, Lodi, New Jersey.

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 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
	^{238}U	Derived (site specific)

[a]Reference 3.

Table 2. Background radiation levels in soil from the northern New Jersey area

Radionuclide	Concentration (pCi/g)[a]
^{226}Ra	0.9[b]
^{232}Th	0.9[b]
^{238}U	0.9[b]

[a]These values represent an average of normal radionuclide concentrations in this part of the state. Actual values may fluctuate.

[b]Reference 4.

Table 3. Concentrations of radionuclides in soil at 80 State Highway 46, Lodi, New Jersey (LJ092)

Sample[a]	Depth (cm)	Radionuclide concentration (pCi/g)		
		^{226}Ra[b]	^{232}Th[b]	^{238}U[b]
		Auger samples[c]		
A2A	120–135	0.89±0.008	1.02±0.01	1.69±0.45
A2B	185–195	1.60±0.02	0.84±0.03	1.87±0.51
A2C	215–225	5.86±0.08	1.07±0.08	7.18±2.1
A2D	245–255	3.72±0.04	0.93±0.05	<5.3
A2E	255–275	0.81±0.008	0.68±0.01	2.19±0.42
A2F	275–290	0.81±0.009	0.60±0.01	1.12±0.33
A2G	290–305	0.42±0.01	0.48±0.02	<0.77
A2H	305–320	1.64±0.02	0.68±0.04	<1.49
A2I	320–335	0.49±0.006	0.39±0.01	<0.97
A2J	335–350	0.71±0.01	0.48±0.03	<1.0
A2K	350–365	0.38±0.005	0.48±0.01	<0.98
A3A	150–165	0.67±0.02	0.82±0.03	<1.2
A3B	185–195	1.69±0.03	0.99±0.04	<4.2
A3C	215–225	11.5 ±0.02	1.57±0.03	12.9 ±0.50
A3D	245–255	2.10±0.03	0.91±0.04	<4.6
A3E	255–275	0.73±0.02	0.62±0.03	<2.6
A3EE	255–275	4.88±0.01	1.15±0.02	3.43±0.35
A3F	275–290	1.41±0.008	0.73±0.01	1.97±0.44
A3G	290–305	0.42±0.01	0.51±0.02	<2.0
A4A	165–185	0.73±0.02	0.94±0.03	<1.1
A4B	195–205	3.09±0.05	1.04±0.06	<6.9
A4C	215–245	2.51±0.05	1.12±0.06	<6.2
A4D	245–255	1.95±0.01	0.97±0.02	2.6 ±0.84
A4E	255–275	0.62±0.01	0.70±0.03	<3.6
A4F	275–290	0.78±0.007	0.68±0.02	1.10±0.20
A4G	290–305	0.35±0.005	0.45±0.009	0.81±0.17
A5A	185–195	0.91±0.02	0.85±0.04	2.9 ±0.62
A5B	195–215	0.78±0.02	0.84±0.03	<3.5
A5C	215–225	0.56±0.007	0.59±0.01	1.0 ±0.19
A5D	225–245	0.41±0.008	0.45±0.01	0.82±0.19
A5E	245–255	0.54±0.01	0.51±0.02	1.25±0.40
A5F	255–275	0.44±0.02	0.52±0.03	<2.7
A5G	275–290	0.32±0.005	0.34±0.009	0.76±0.15
A5H	290–305	0.25±0.005	0.28±0.008	0.53±0.12

[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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