

M-731

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Formerly Utilized Sites Remedial Action Program (FUSRAP)

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# ADMINISTRATIVE RECORD

for the Maywood Site, New Jersey

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**RESULTS OF THE  
RADIOLOGICAL SURVEY  
AT  
72 STATE HIGHWAY 46, LODI,  
NEW JERSEY (LJ093)**

**R. D. Foley  
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**OPERATED BY  
MARTIN MARIETTA ENERGY SYSTEMS, INC.  
FOR THE UNITED STATES  
DEPARTMENT OF ENERGY**

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NEW JERSEY (LJ093)**

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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  $^{232}\text{Th}$ , 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, 72 State Highway 46, Lodi, New Jersey (LJ093), 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 72 STATE HIGHWAY 46, LODI, NEW JERSEY (LJ093)\*

## 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

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\*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 commercial property at 72 State Highway 46, Lodi, New Jersey, was conducted during 1988. The survey and sampling of the ground surface, as well as the subsurface investigation, were carried out on June 5, 1988.

## SURVEY METHODS

The radiological survey of the property included: (1) a gamma scan of the entire property surface 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. If the gamma exposure rates were elevated, a biased soil sample was taken at the point showing the highest gamma radiation level. A systematic soil sample was taken at one location on the property, irrespective of gamma radiation levels.

To define the extent of possible subsurface soil contamination, auger holes were drilled to depths of approximately 3.0 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. 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.<sup>2</sup>

## SURVEY RESULTS

Applicable federal guidelines are summarized in Table 1.<sup>3</sup> The normal background radiation levels for the northern New Jersey area are presented in Table 2.<sup>4</sup> 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.

## Surface 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 4 to 11  $\mu\text{R}/\text{h}$ . Slight elevation in gamma levels is typical of naturally occurring radioactive substances present in bricks, concrete, granite, and other such materials used in paving and building construction. Otherwise, none of the measurements were elevated.

## 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 0.68 to 2.25 pCi/g, 0.97 to 2.54 pCi/g, and 1.69 to <3.3 pCi/g, respectively. All samples were near or only slightly above normal background levels for the northern New Jersey area (Table 2) and well below DOE guidelines for radium and thorium (Table 1).

## Auger Hole Soil Samples and Gamma Logging

Varying thicknesses of subsurface soil were sampled from depths of 135 to 305 cm in one of the four auger holes (A) drilled at separate locations indicated in Fig. 2. Auger holes A2, A3, and A4 were drilled but not sampled due to low gamma levels in these holes. The results of analyses of these samples are given in Table 3. Concentrations of  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$ , and  $^{238}\text{U}$  in these auger soil samples ranged from 0.31 to 0.58 pCi/g, 0.34 to 0.65 pCi/g, and 0.57 to <2.39 pCi/g, respectively; all values were below DOE criteria (Table 1) for radium and thorium as well as near or below background (Table 2).

Gamma logging was performed in each of the four 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  $^{226}\text{Ra}$  and/or  $^{232}\text{Th}$ . Data from the gamma profiles of the logged auger holes are graphically represented in Figs. 3 through 6. All readings were below 1000 cpm.

## SIGNIFICANCE OF FINDINGS

Measurements and results of soil sample analyses taken at 72 State Highway 46 indicate that the property contained no radionuclide concentrations above DOE guideline values. The radionuclide distributions on this property were similar to normal background levels for the northern New Jersey area.

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3. 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).
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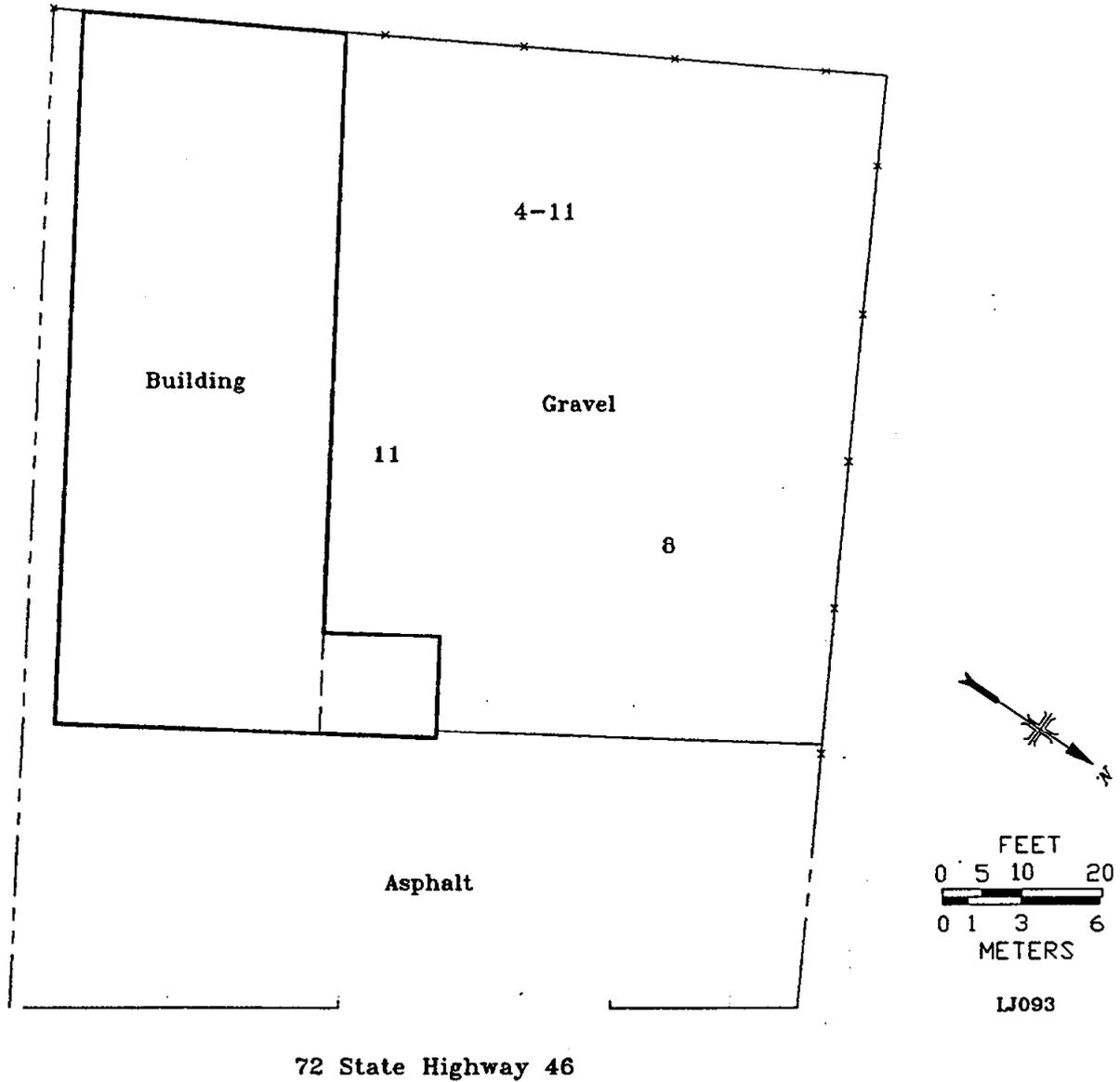


Fig. 1. Gamma radiation levels ( $\mu\text{R/h}$ ) measured on the surface at 72 State Highway 46, Lodi, New Jersey (LJ093).

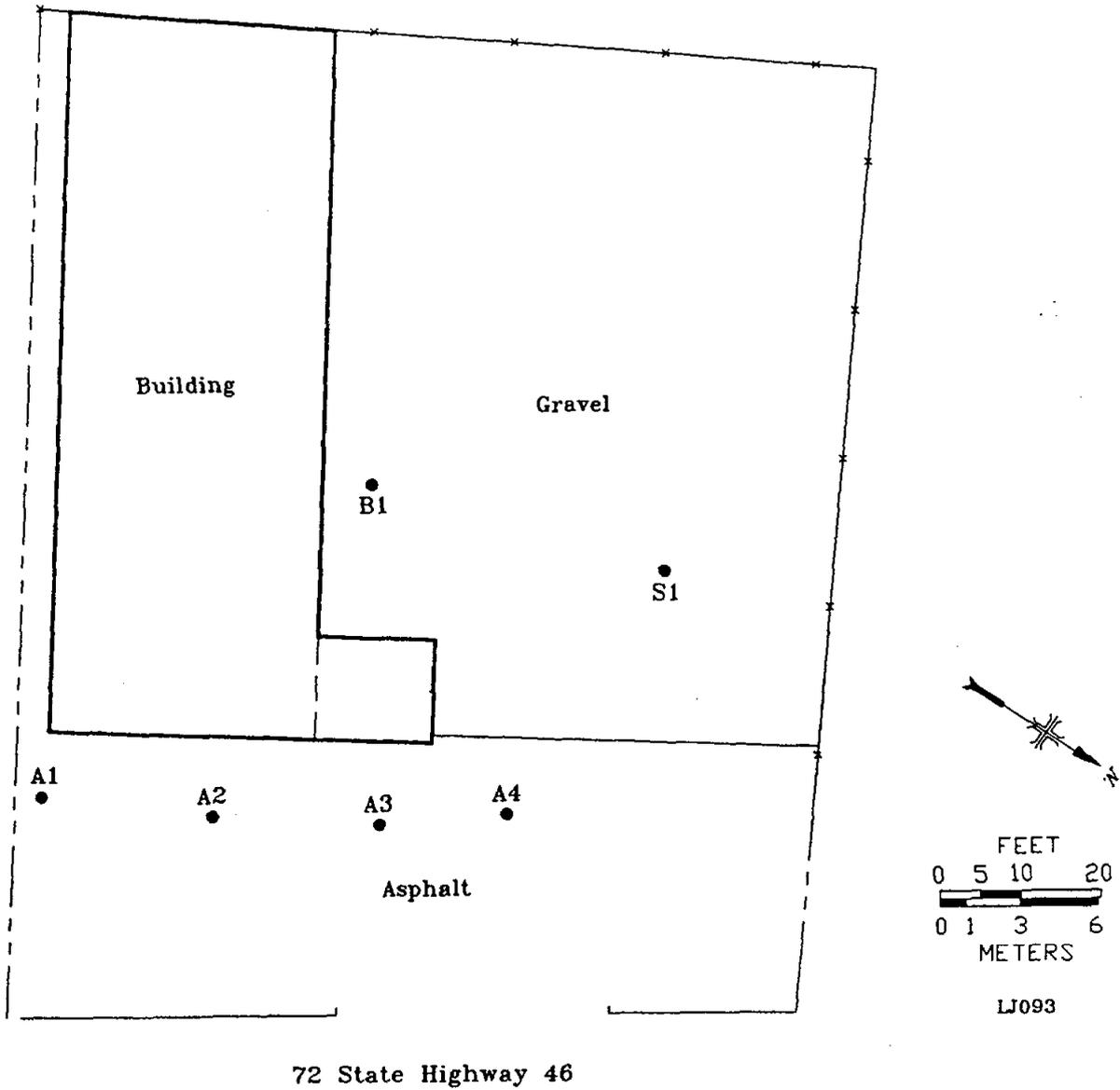


Fig. 2. Diagram showing locations of soil samples taken at 72 State Highway 46, Lodi, New Jersey (LJ093).

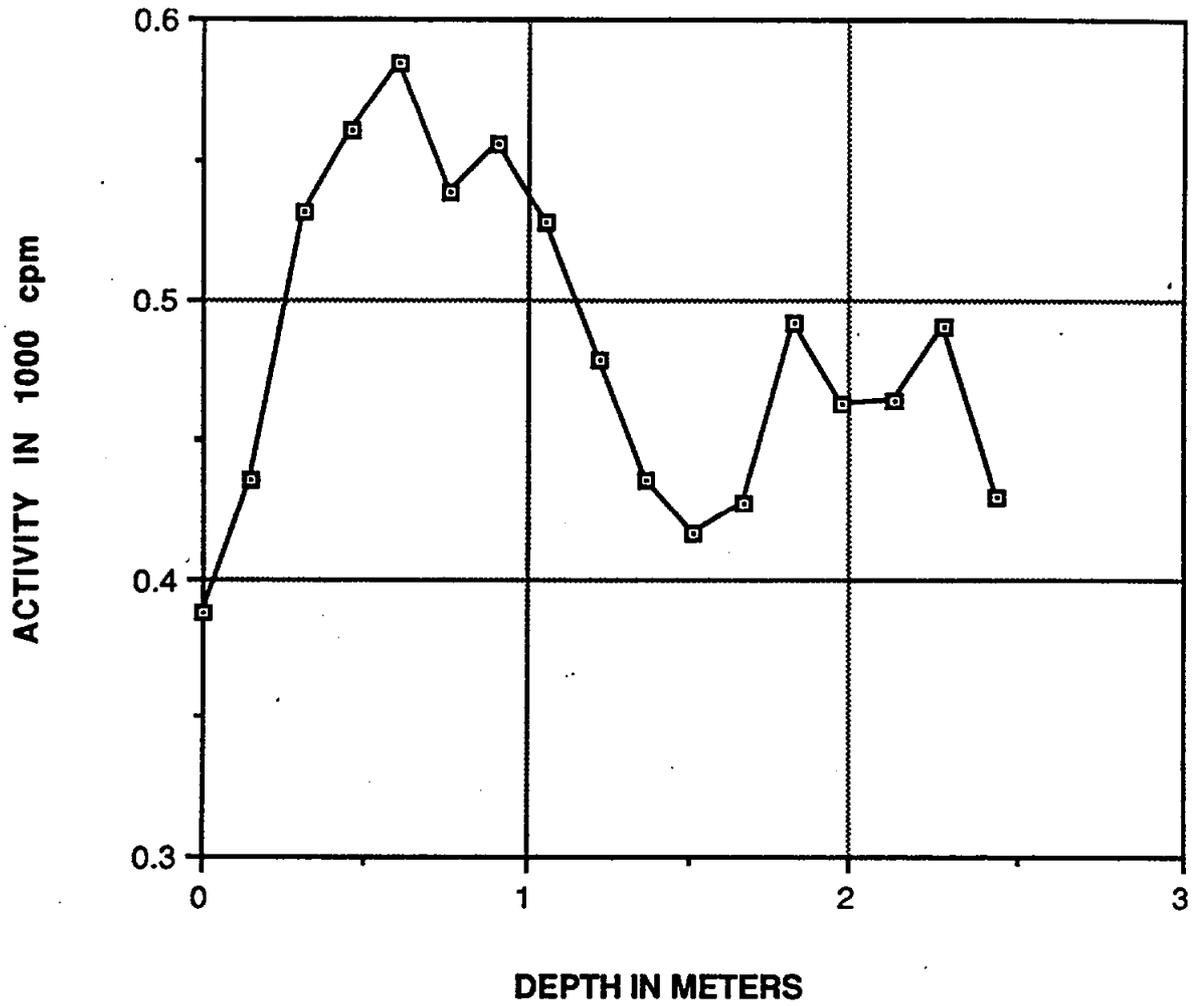


Fig. 3. Gamma profile for auger hole 1 (LJ093A1) at 72 State Highway 46, Lodi, New Jersey.

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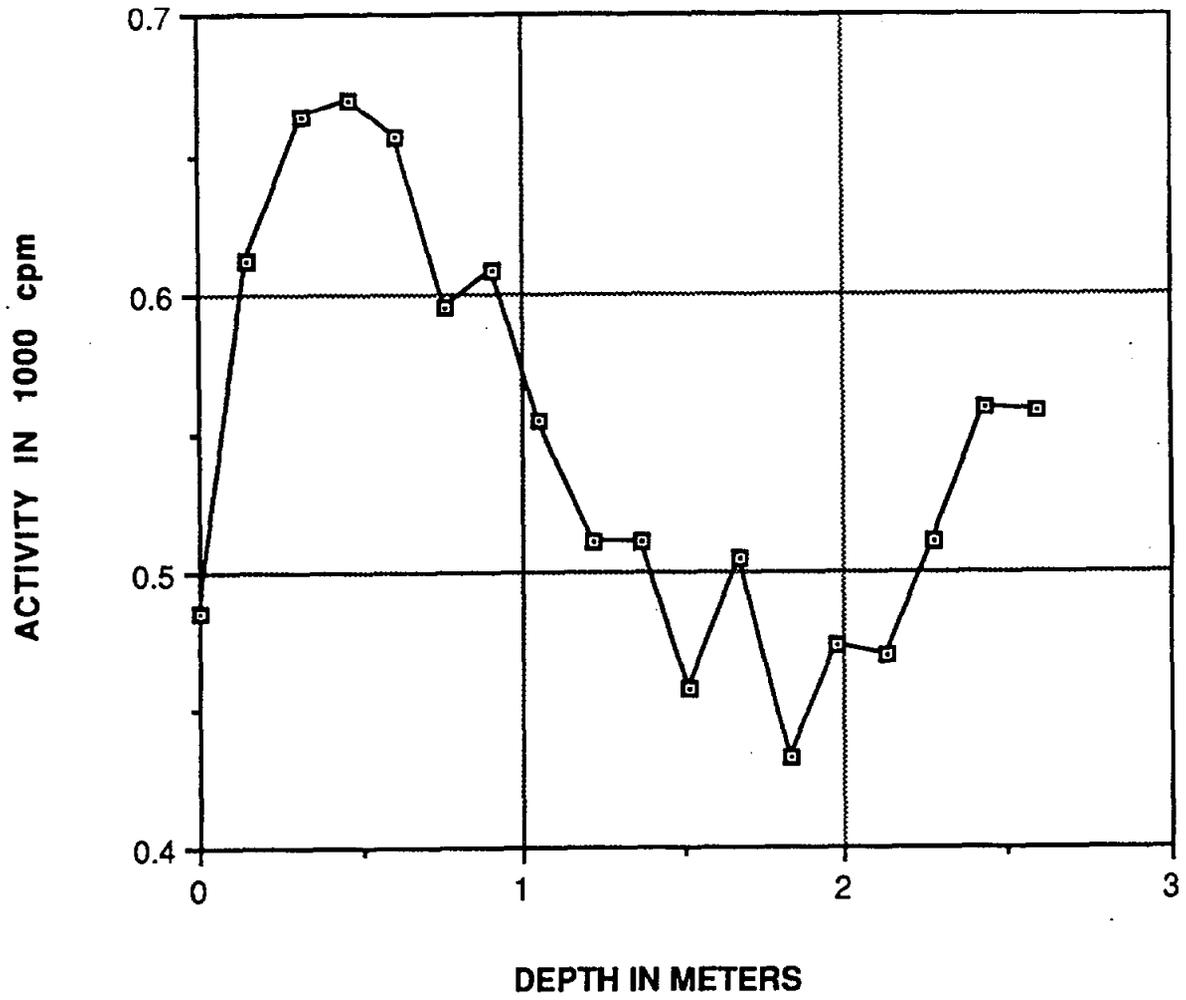


Fig. 4. Gamma profile for auger hole 2 (LJ093A2) at 72 State Highway 46, Lodi, New Jersey.

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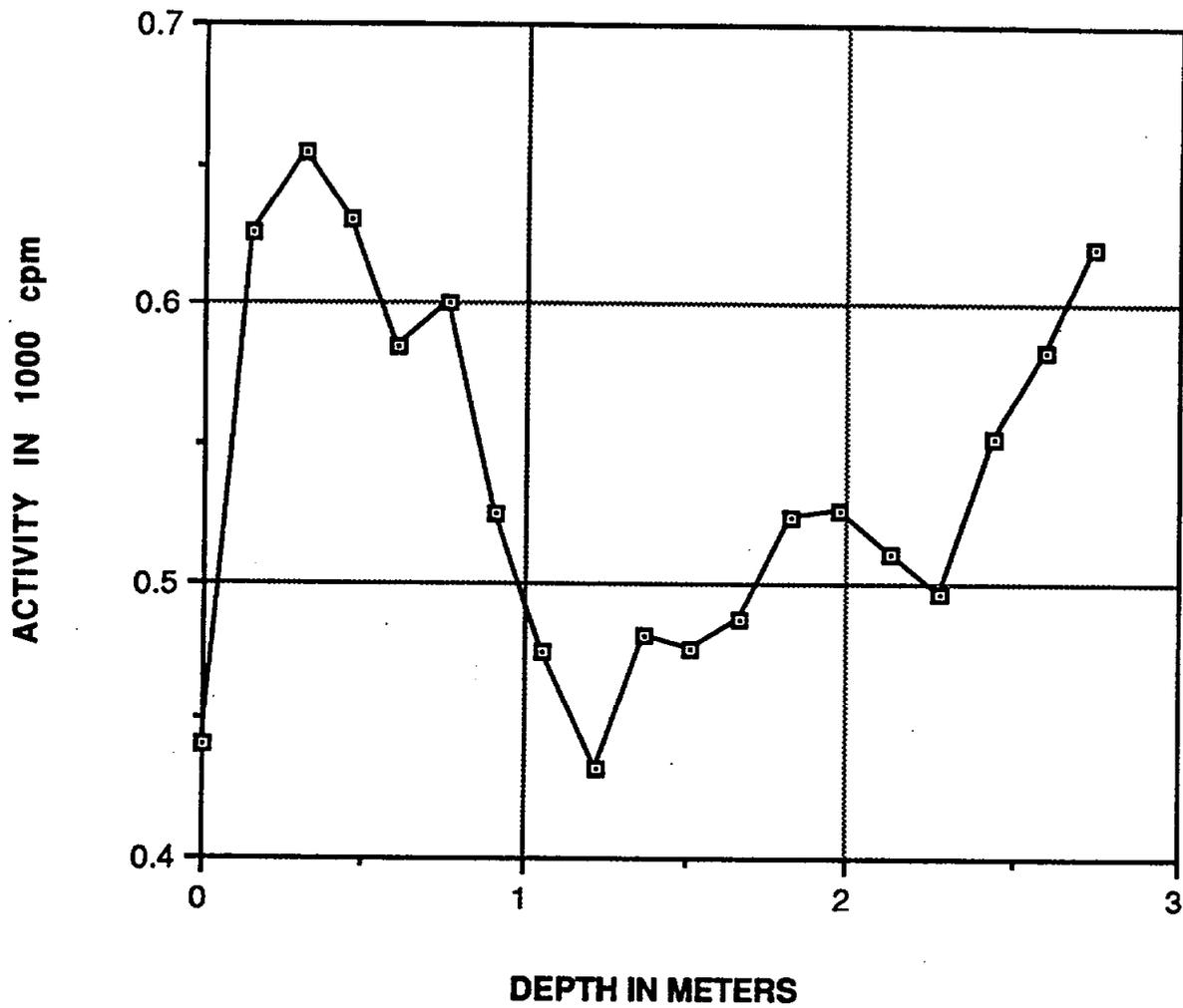


Fig. 5. Gamma profile for auger hole 3 (LJ093A3) at 72 State Highway 46, Lodi, New Jersey.

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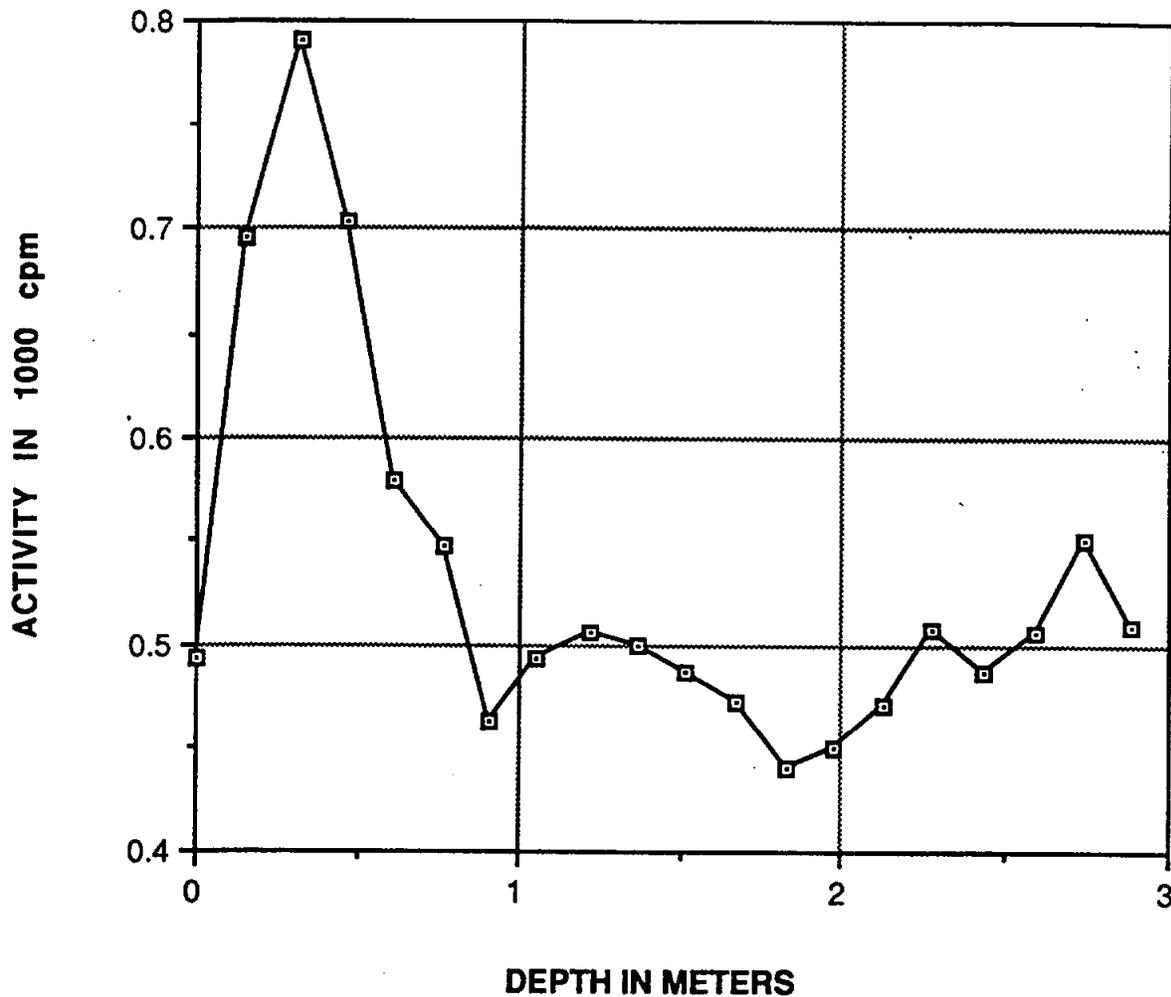


Fig. 6. Gamma profile for auger hole 4 (LJ093A4) at 72 State Highway 46, Lodi, New Jersey.

Table 1. Applicable guidelines for protection against radiation<sup>a</sup>

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 <sup>2</sup> area <sup>232</sup> Th <sup>230</sup> Th <sup>228</sup> Ra <sup>226</sup> Ra <sup>238</sup> U	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 (site specific)

<sup>a</sup>Reference 3.

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

Radionuclide	Concentration (pCi/g) <sup>a</sup>
<sup>226</sup> Ra	0.9 <sup>b</sup>
<sup>232</sup> Th	0.9 <sup>b</sup>
<sup>238</sup> U	0.9 <sup>b</sup>

<sup>a</sup>These values represent an average of normal radionuclide concentrations in this part of the state. Actual values may fluctuate.

<sup>b</sup>Reference 4.

Table 3. Concentrations of radionuclides in soil at  
72 State Highway 46, Lodi, New Jersey (LJ093)

Sample <sup>a</sup>	Depth (cm)	Radionuclide concentration (pCi/g)		
		<sup>226</sup> Ra <sup>b</sup>	<sup>232</sup> Th <sup>b</sup>	<sup>238</sup> U <sup>b</sup>
<i>Systematic samples<sup>c</sup></i>				
S1A	0-15	1.16±0.02	1.05±0.03	<3.3
S1B	15-30	1.87±0.01	1.73±0.02	2.02±0.23
S1C	30-45	2.25±0.01	2.54±0.05	2.49±0.23
S1D	45-60	1.66±0.01	1.82±0.02	2.46±0.47
<i>Biased samples<sup>d</sup></i>				
B1A	0-15	0.93±0.02	1.29±0.03	1.69±0.46
B1B	15-30	0.89±0.02	1.24±0.03	<3.2
B1C	30-45	0.75±0.01	1.05±0.03	2.80±0.50
B1D	45-60	0.68±0.01	0.97±0.03	2.68±0.39
<i>Auger samples<sup>e</sup></i>				
A1A	135-150	0.58±0.01	0.64±0.03	1.50±0.43
A1B	150-165	0.44±0.01	0.54±0.02	<1.86
A1C	165-185	0.41±0.006	0.50±0.01	1.06±0.15
A1D	185-195	0.42±0.005	0.49±0.01	0.71±0.13
A1E	195-215	0.45±0.008	0.53±0.01	<1.29
A1F	215-225	0.31±0.01	0.34±0.02	0.57±0.30
A1G	225-245	0.43±0.01	0.55±0.03	<2.39
A1H	245-255	0.42±0.006	0.48±0.01	1.02±0.34
A1I	275-290	0.39±0.01	0.50±0.02	<0.60
A1J	290-305	0.45±0.007	0.65±0.01	<1.18

<sup>a</sup>Locations of soil samples are shown on Fig. 2.

<sup>b</sup>Indicated counting error is at the 95% confidence level ( $\pm 2\sigma$ ).

<sup>c</sup>Systematic samples are taken at locations irrespective of gamma exposure rates.

<sup>d</sup>Biased samples are taken from areas shown to have elevated gamma exposure rates.

<sup>e</sup>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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