M-713

Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for the Maywood Site, New Jersey

US Army Corps of Engineers®

M-713

ORNL/RASA-88/40

HEALTH AND SAFETY RESEARCH DIVISION

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

RESULTS OF THE RADIOLOGICAL SURVEY AT 205 MAIN STREET LODI, NEW JERSEY (LJ075)

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Date of Issue – August 1989

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operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U. S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

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ACKNOWLEDGMENTS

The Division of Facility and Site Decommissioning Projects, U. S. Department of Energy, sponsored the research for this project under contract DE-AC05-84OR21400 with Martin Marietta Energy Systems, Inc. The authors wish to acknowledge the support of J. E. Baublitz, Deputy Director, Office of Remedial Action and Waste Technology; J. J. Fiore, Director, Division of Facility and Site Decommissioning Projects; and members of their staff. The authors also appreciate the contributions of B. C. Littleton and L. J. Jeffers of IR&A Publications Office, A. C. Butler, B. S. Ellis, D. A. Roberts, T. R. Stewart, and W. Winton of the Measurement Applications and Development Group of the Health and Safety Research Division, and M. E. Ward of Don Stone Associates for participation in the collection, analysis, 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, 205 Main Street, Lodi, New Jersey (LJ075), was conducted during 1987 and 1988.

Results of the survey indicated radioactivity in the range of normal background for the northern New Jersey area. Radiological assessments of soil samples from the site demonstrate no radionuclide concentrations in excess of DOE Formerly Utilized Sites Remedial Action Program criteria.

RESULTS OF THE RADIOLOGICAL SURVEY AT 205 MAIN STREET LODI, NEW JERSEY (LJ075)*

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 commercial property at 205 Main Street, Lodi, New Jersey, was conducted during June 2-4, 1987. Additional subsurface sampling was performed June 6-8, 1988.

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, auger holes were drilled to depths ranging from 3 to 6 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. 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.

Surface Gamma Radiation Levels

Gamma exposure rates measured during a scan of the surface of the property are given in Fig. 1. Gamma levels ranged from 3 to 11 μR/h with no areas of elevated measurements found. The observed values are near average background (Table 2).

Systematic Soil Samples

Four systematic soil samples (S) were taken from two 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 0.56 to 1.7 pCi/g and 0.70 to 1.8 pCi/g, respectively. All results are well below DOE criteria (Table 2).

Auger Hole Soil Samples and Gamma Logging

Varying thicknesses of subsurface soil were sampled from depths of 45 to 305 cm in eight of 49 auger holes (A) drilled at separate locations as indicated in Fig. 2. Holes 13 through 49 (near Saddle River) were drilled at locations designed to identify, and sample, the old Lodi Brook streambed. (The former path of the stream was not found in this location). Holes 1 through 12 cross the underground pipe currently carrying Lodi Brook. The results of analyses of these samples are given in Table 3. Concentrations of ^{226}Ra and ^{232}Th in the soil samples ranged from 0.38 to 3.5 pCi/g and 0.49 to 9.8 pCi/g, respectively. Although some radionuclide concentrations are higher than background, all are well below the DOE criterion (Table 1) for subsurface soil.

Gamma logging was performed in each of 19 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. 3 through 26. No measurements $\leq$ 1,000 cpm were noted in holes 2, 4, 6, 11, 15, 19, and 34. Slightly elevated readings with a high of 1,800 cpm were observed as follows: Readings at depths between 1.8 and 2.3 m were greater than 1,000 cpm in auger hole 1, with a maximum reading of 1,300 cpm at 2.3 m. Readings in auger hole 3 were slightly elevated ranging from 900 to 1,000 cpm between 0.61 and 2.3 m, with a maximum of 1,000 cpm at 0.61 m. In hole 5, elevated readings were between 1.4 and 2.4 m, with a maximum of 1,800 cpm at 2.3 m. Elevated readings in hole 7 were between 1.8 and 2.1 m, with a maximum of 1,400 cpm at 2.1 m. In hole 8, measurements were 1,000 cpm at 1.7 and 1.8 m while in auger hole 9, a maximum of 1,400 cpm was observed at 2 m with elevated readings from 1.5 to 2 m. In hole 10, readings were 1,000 cpm from 1.4 to 1.7 m. Measurements of 1,000 cpm were observed at depths of 0.61 to 2.3 m in hole 12 with a maximum of 1,200 cpm at 0.76 m. Gamma levels were 1,000 cpm at 0.6 and 0.76 m in hole 32 and 1,000 to 1,100 cpm in hole 33 (maximum reading at 0.76 m). In hole 45, elevated readings were observed between 0.61 and 1.8 m with the highest level (1,100 cpm) found at 1.5 m. Finally, there were elevated gamma levels from 0.76 to 1.5 m in hole 46 with a maximum of 1,100 cpm at 1.1 m. The areas of highest gamma readings approximately correspond to the greatest concentrations of radionuclides shown in Table 3. Apparent coal ashes were observed coincident with the elevated readings in some holes. The analysis results for auger hole samples are consistent with other samples containing ash that have been collected in the Maywood/Lodi area. The slight elevation in radionuclide concentration in the coal ash is due to the naturally occurring radioactive elements in

coal. However, the elevated concentrations of ^{232}Th found in samples A7 and A9C are somewhat elevated above the maximum found in coal ash in the Maywood/Lodi area. The 9.8 pCi/g ^{232}Th in sample A9C is about twice the level for normal coal ash. The slightly higher concentrations in the string of auger holes 1–12 may be due to current pipe leakage of Lodi Brook or former stream bed material. This string of holes crosses the underground pipe which carries Lodi Brook.

SIGNIFICANCE OF FINDINGS

While some radiological measurements taken at 205 Main Street were greater than background levels typically encountered in the northern New Jersey area, no radiation levels nor radionuclide concentrations exceeded the applicable DOE criteria. With the exception of one or two soil samples, the elevated radionuclide concentrations found were probably associated with naturally enhanced radioactivity characteristic of some environmental materials (i.e., coal ash). In any case, the data confirm that the radiological condition of this property conforms to DOE guidelines for remedial action. Therefore, 205 Main Street does not warrant consideration for inclusion in the DOE remedial action program.

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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).
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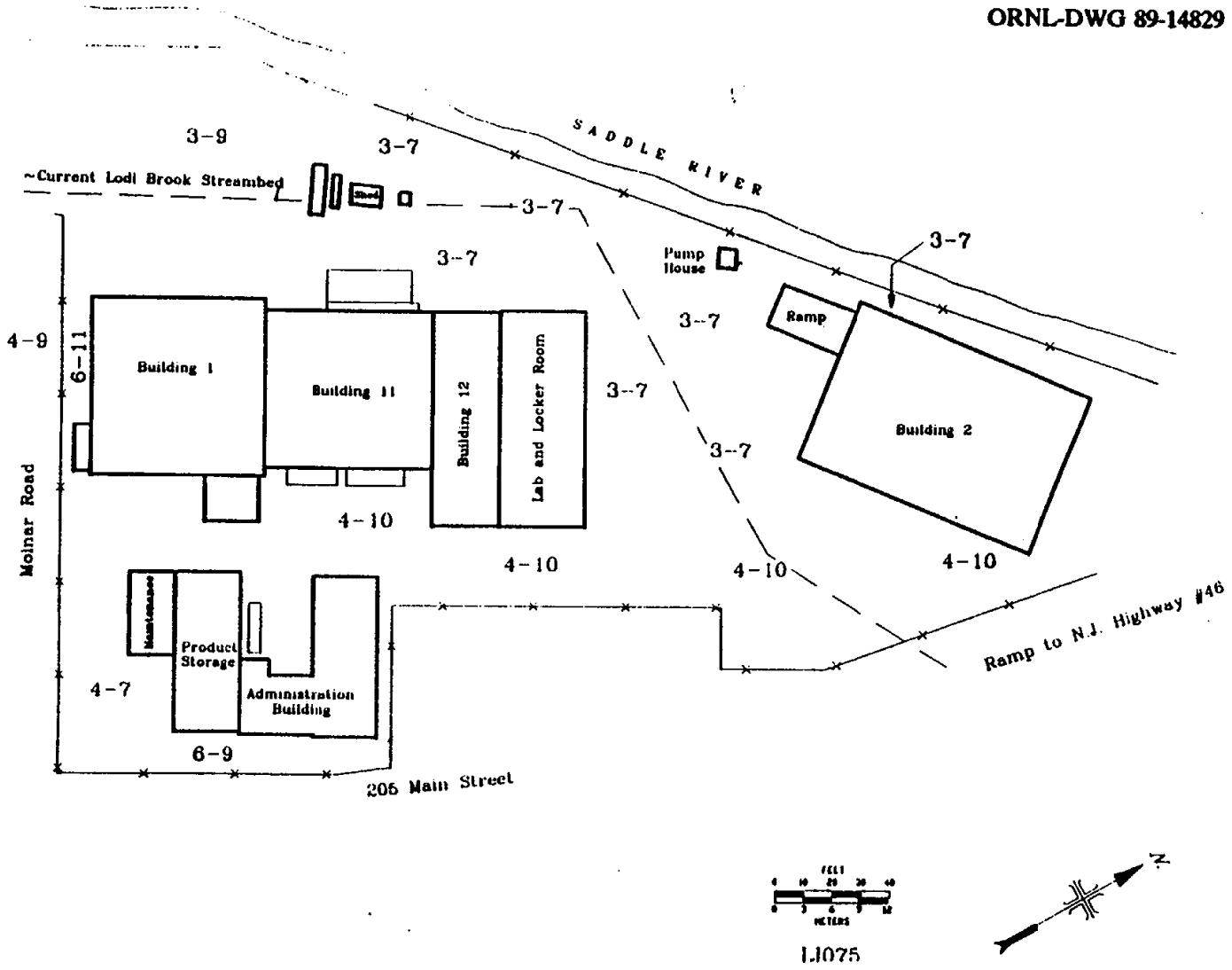

Fig. 1. Gamma radiation levels (μR/h) measured on the surface at 205 Main Street, Lodi, New Jersey (LJ075).

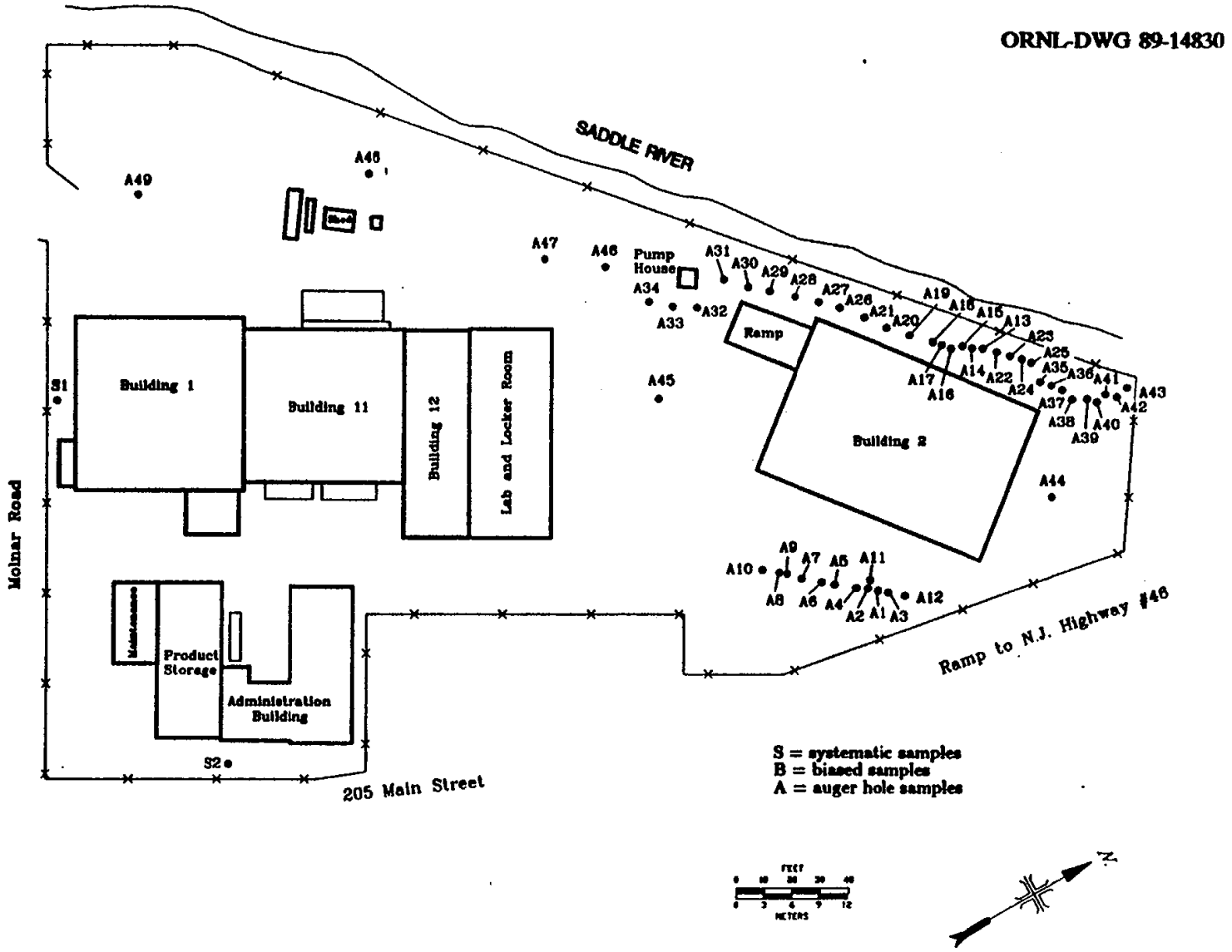

Fig. 2. Diagram showing locations of soil samples taken at 205 Main Street, Lodi, New Jersey (LJ075).

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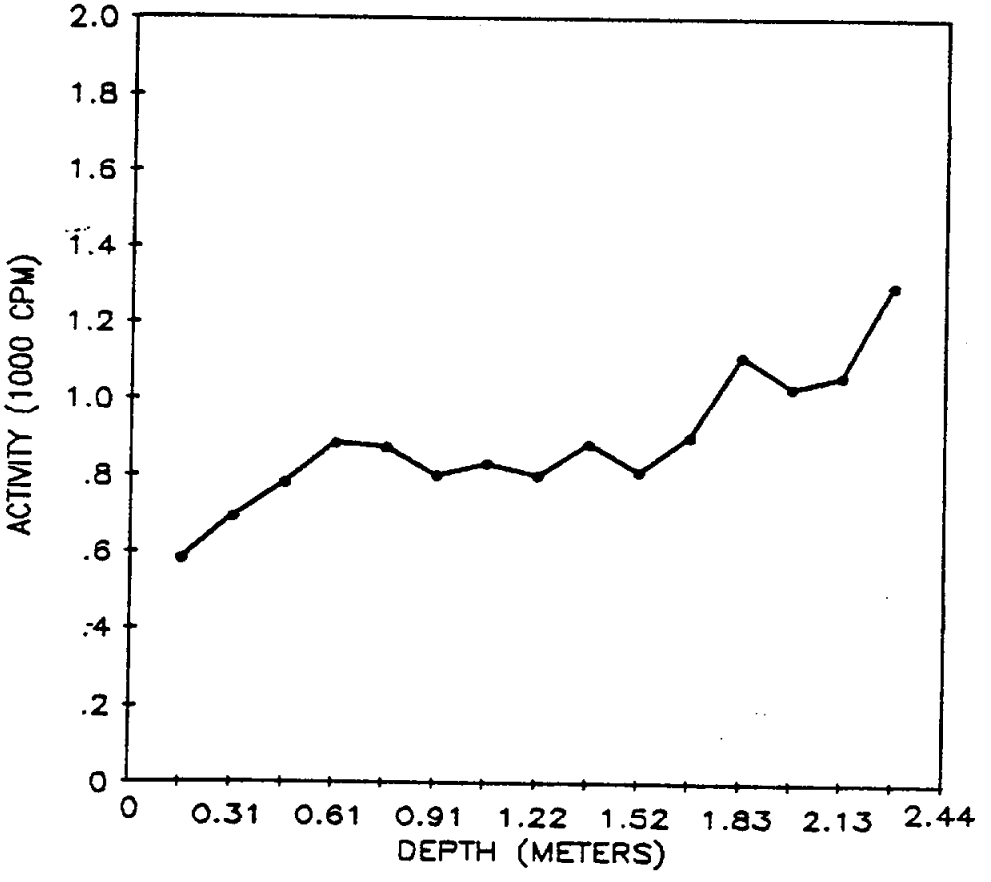

Fig. 3. Gamma profile for auger hole 1 at 205 Main Street, Lodi, New Jersey (LJ075).

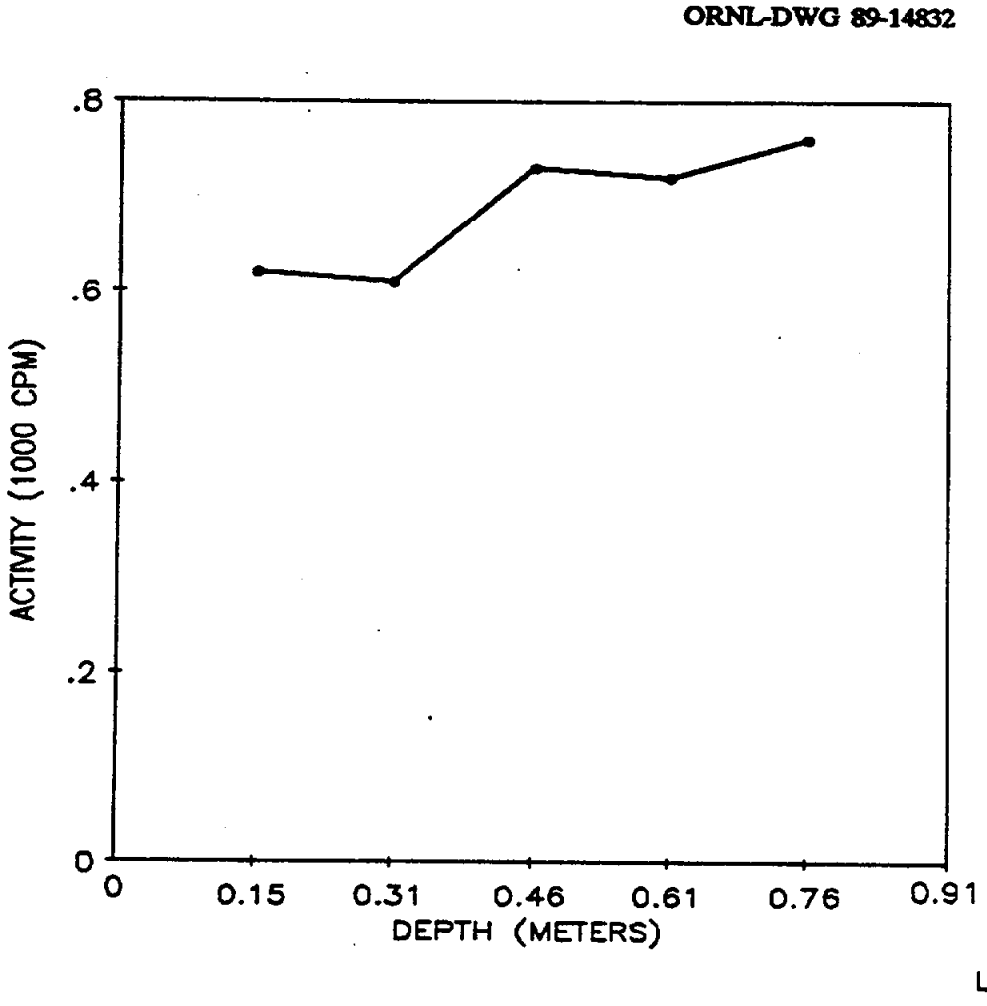

Fig. 4. Gamma profile for auger hole 2 at 205 Main Street, Lodi, New Jersey (LJ075).

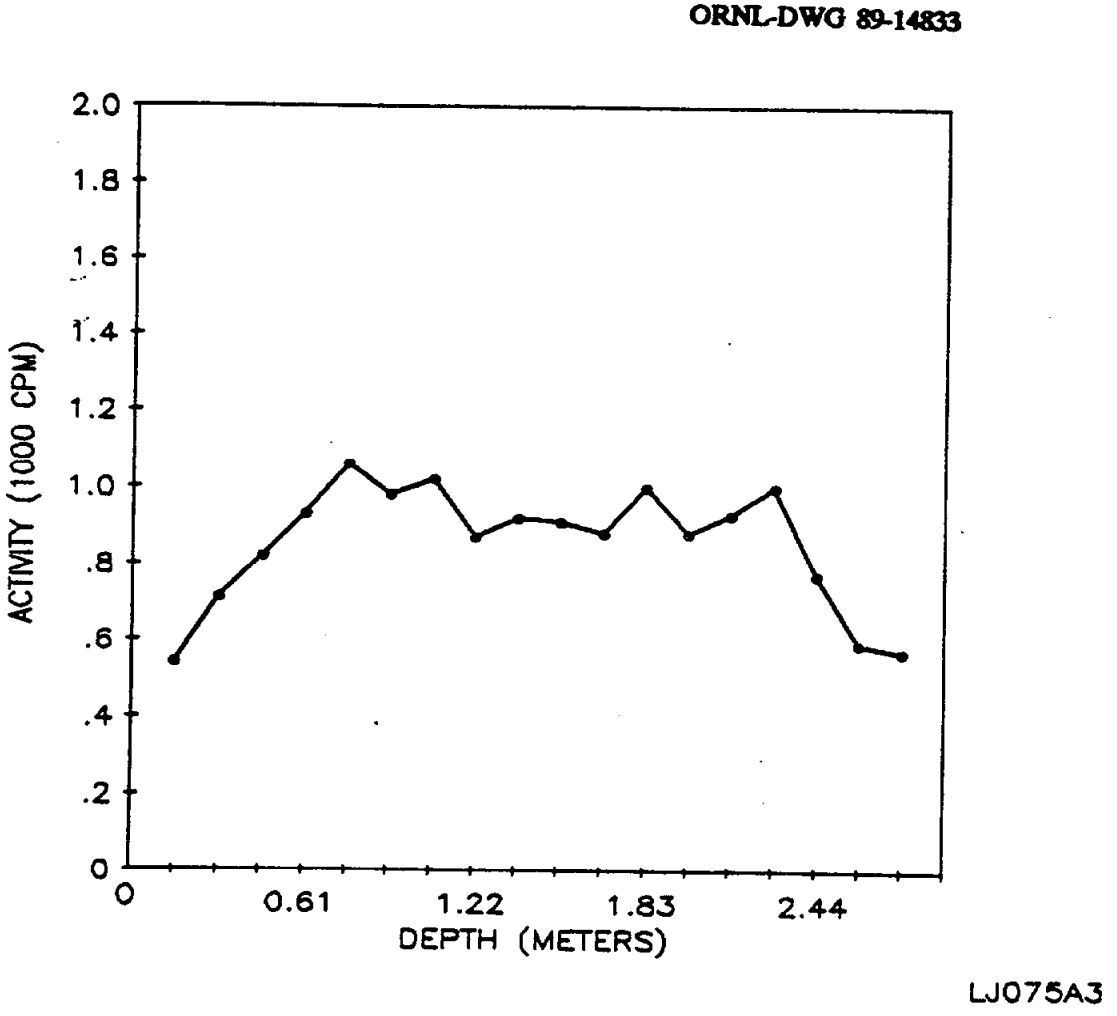

Fig. 5. Gamma profile for auger hole 3 at 205 Main Street, Lodi, New Jersey (LJ075).

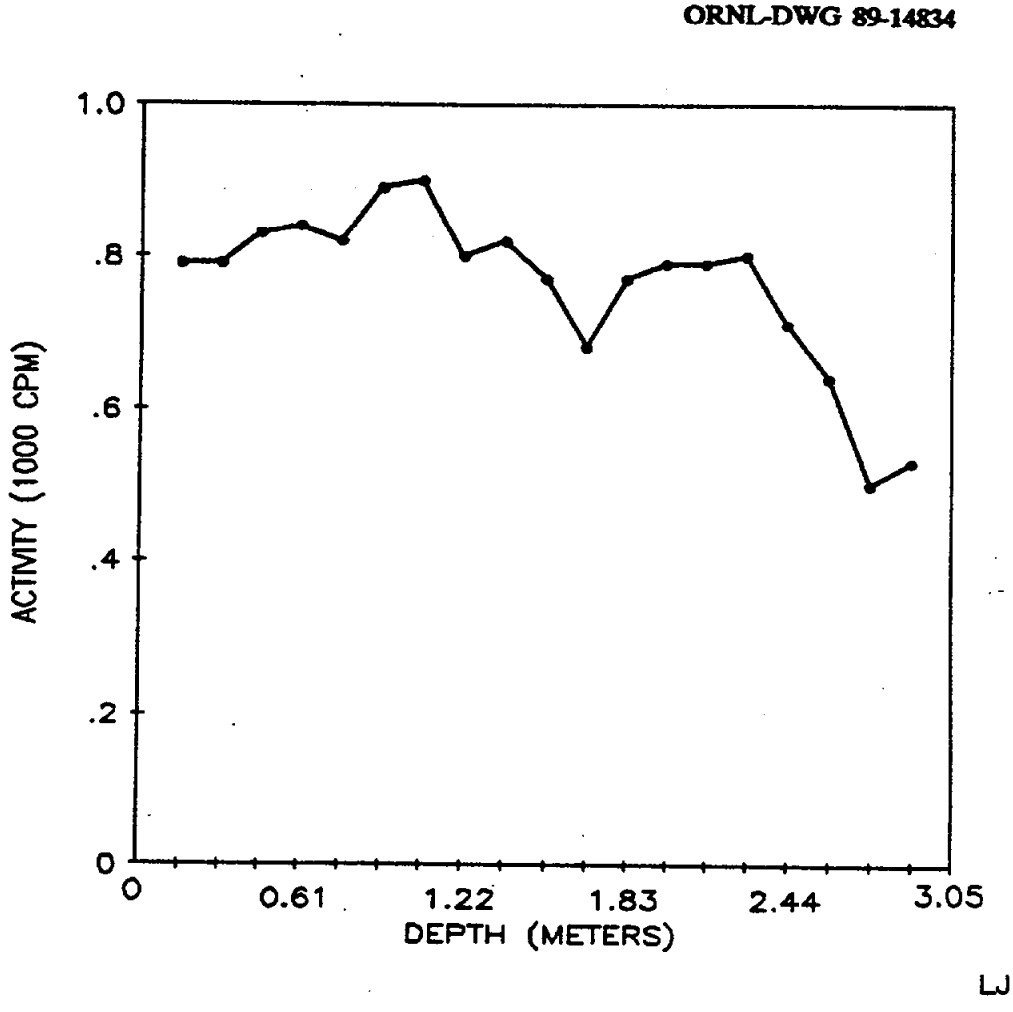

Fig. 6. Gamma profile for auger hole 4 at 205 Main Street, Lodi, New Jersey (LJ075).

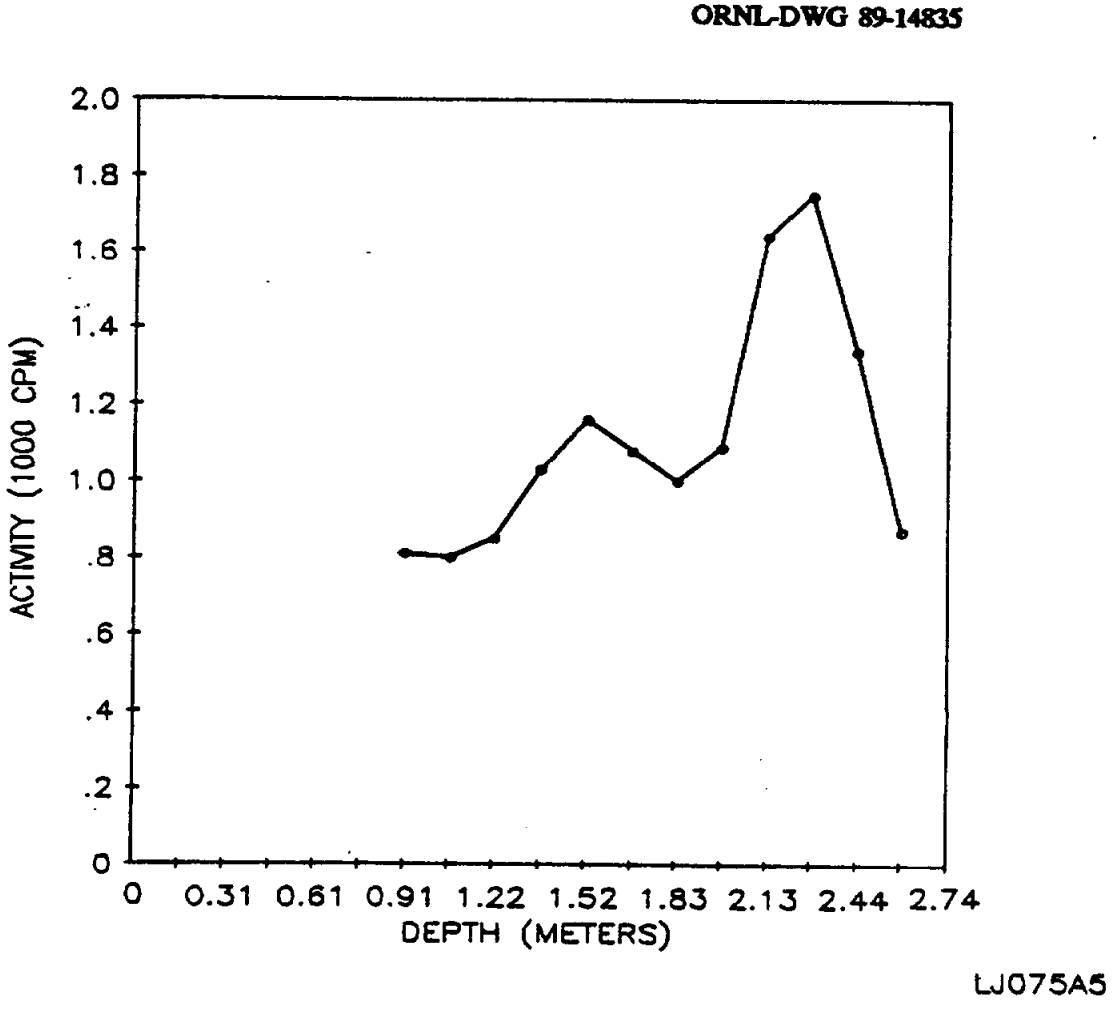

Fig. 7. Gamma profile for auger hole 5 at 205 Main Street, Lodi, New Jersey (LJ075).

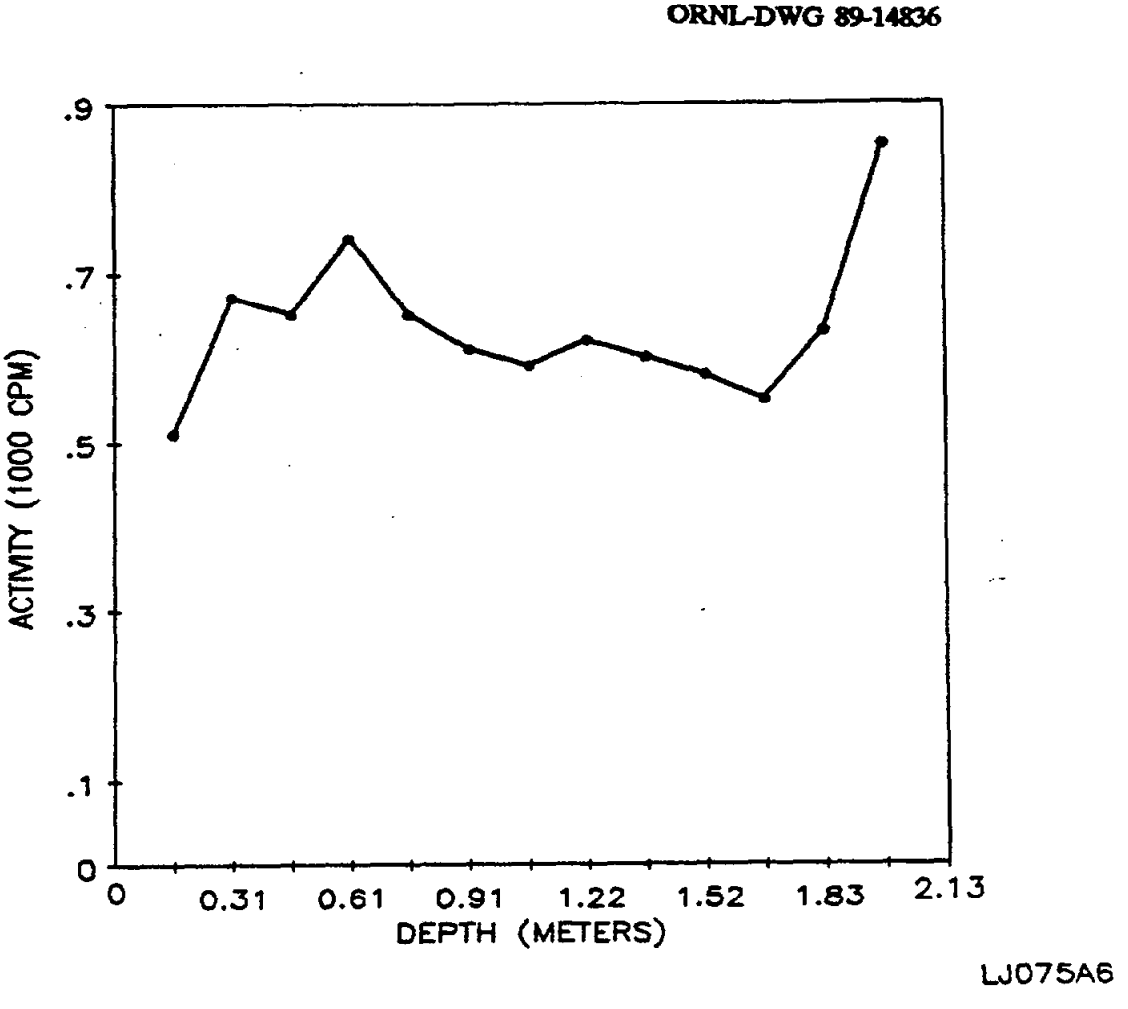

Fig. 8. Gamma profile for auger hole 6 at 205 Main Street, Lodi, New Jersey (LJ075).

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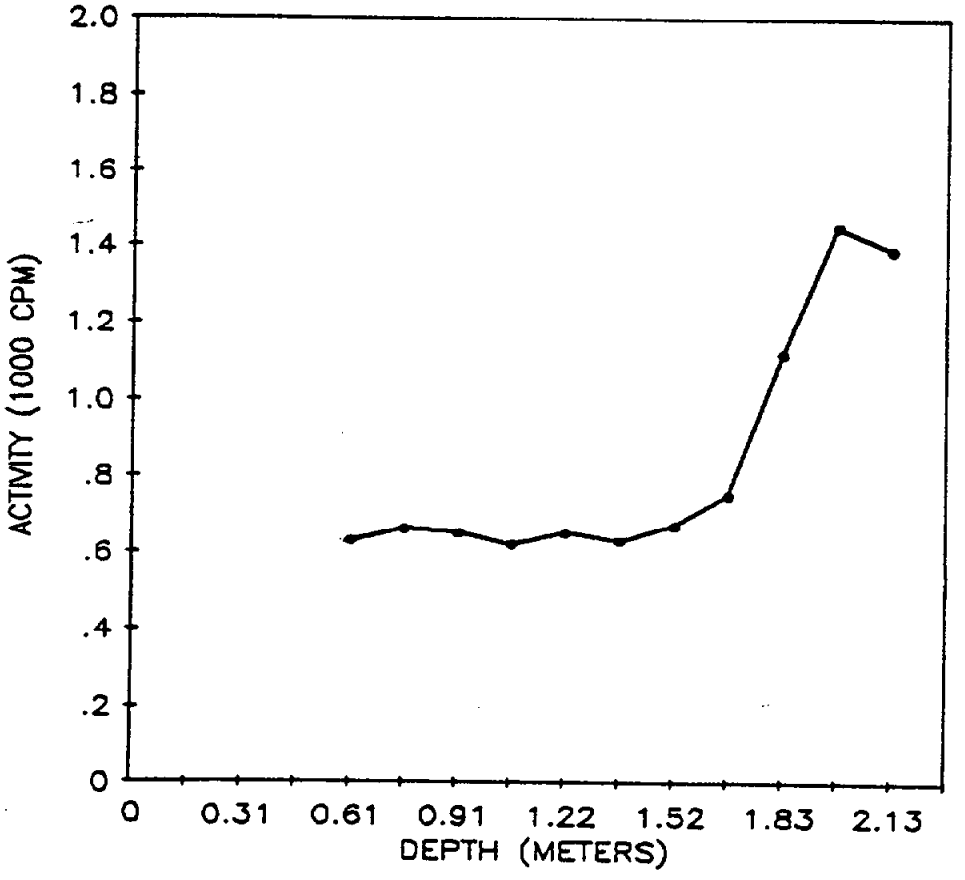

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Fig. 9. Gamma profile for auger hole 7 at 205 Main Street, Lodi, New Jersey (LJ075).

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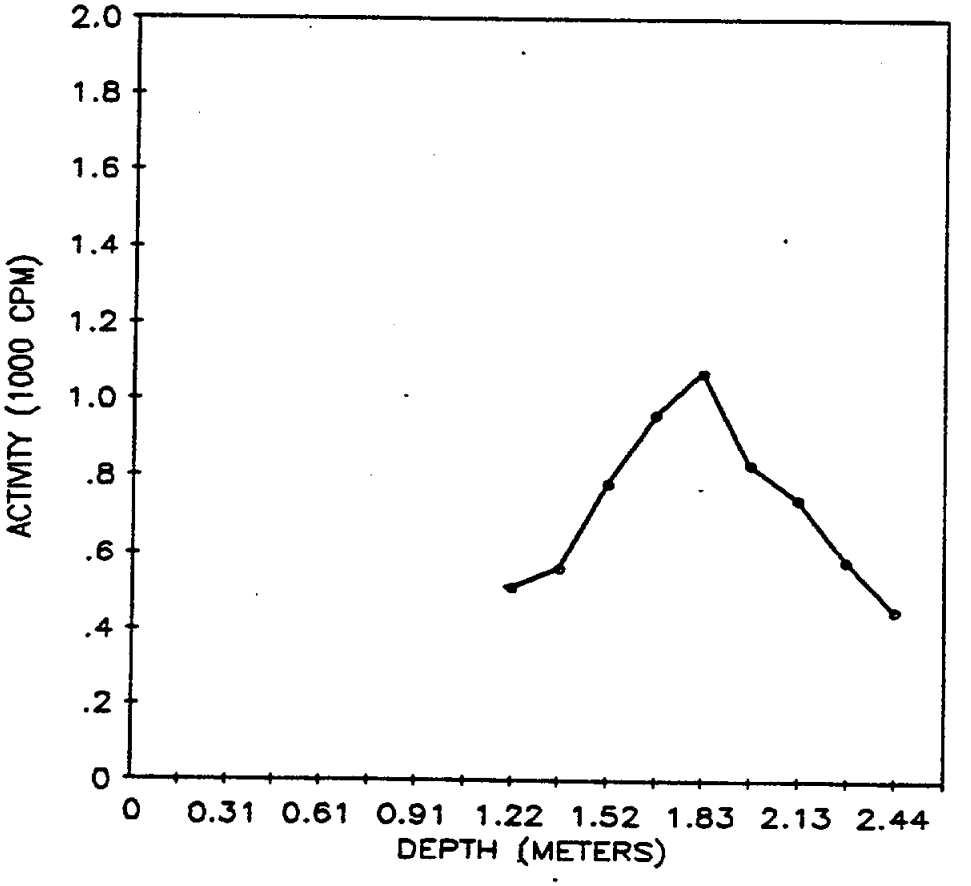

Fig. 10. Gamma profile for auger hole 8 at 205 Main Street, Lodi, New Jersey (LJ075).

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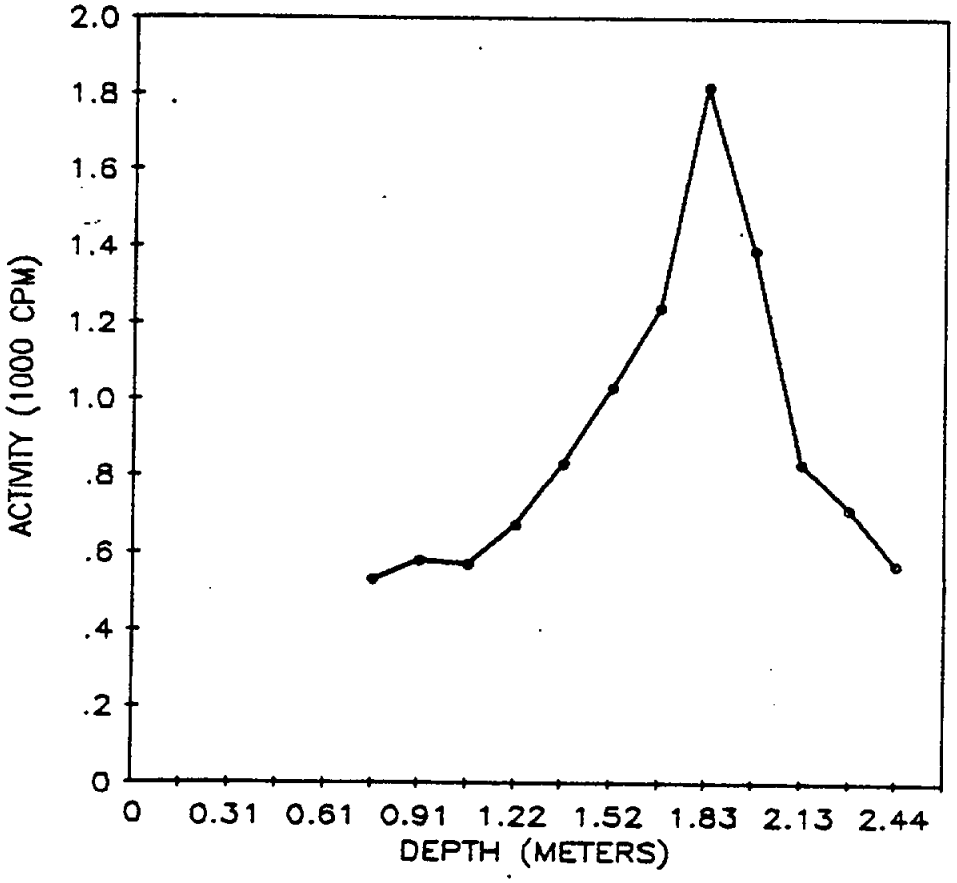

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Fig. 11. Gamma profile for auger hole 9 at 205 Main Street, Lodi, New Jersey (LJ075).

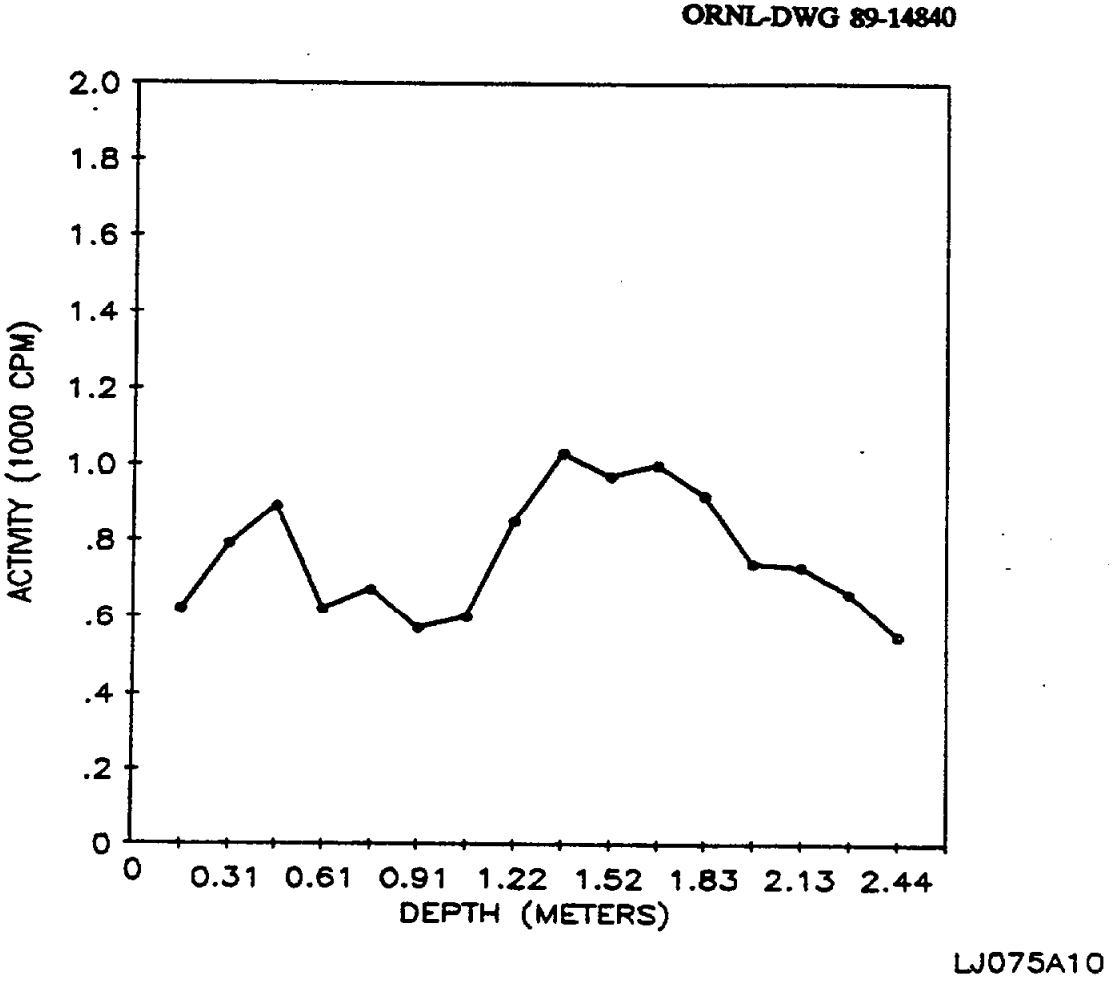

Fig. 12. Gamma profile for auger hole 10 at 205 Main Street, Lodi, New Jersey (LJ075).

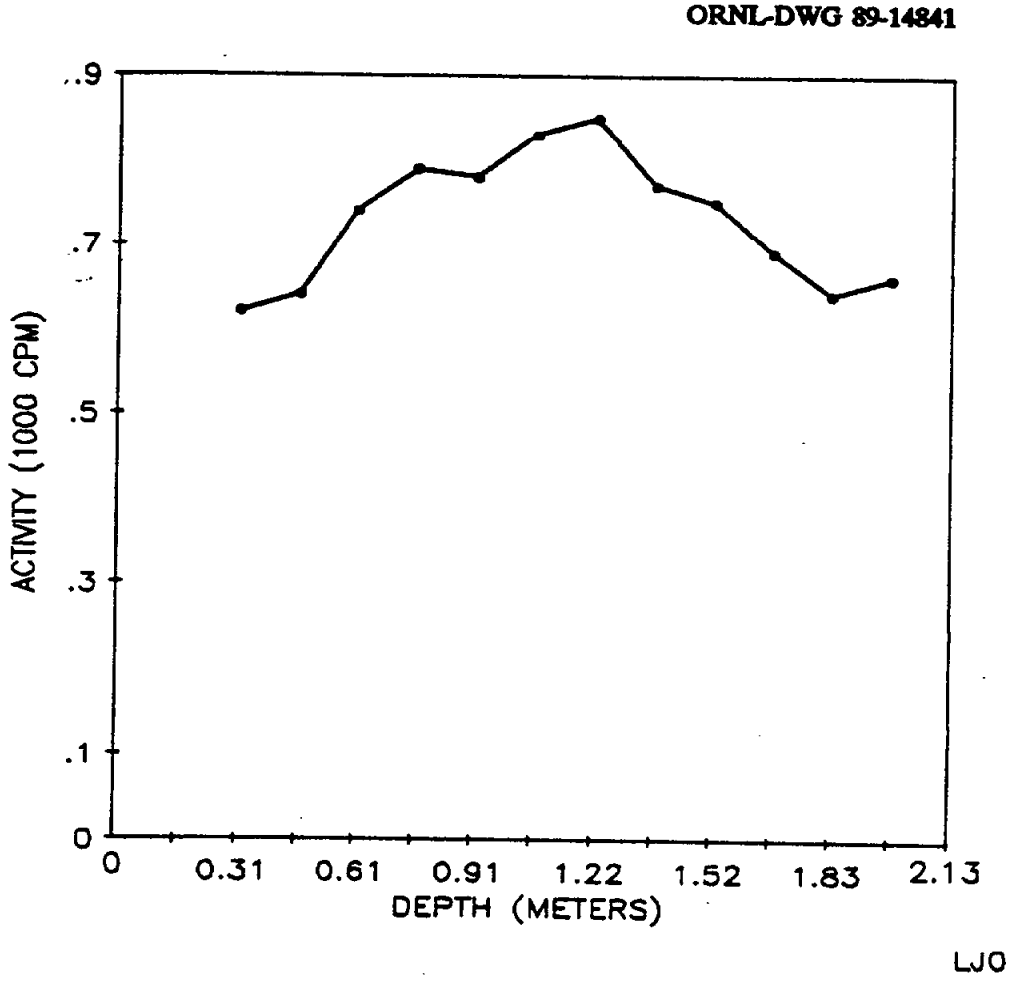

Fig. 13. Gamma profile for auger hole 11 at 205 Main Street, Lodi, New Jersey (LJ075).

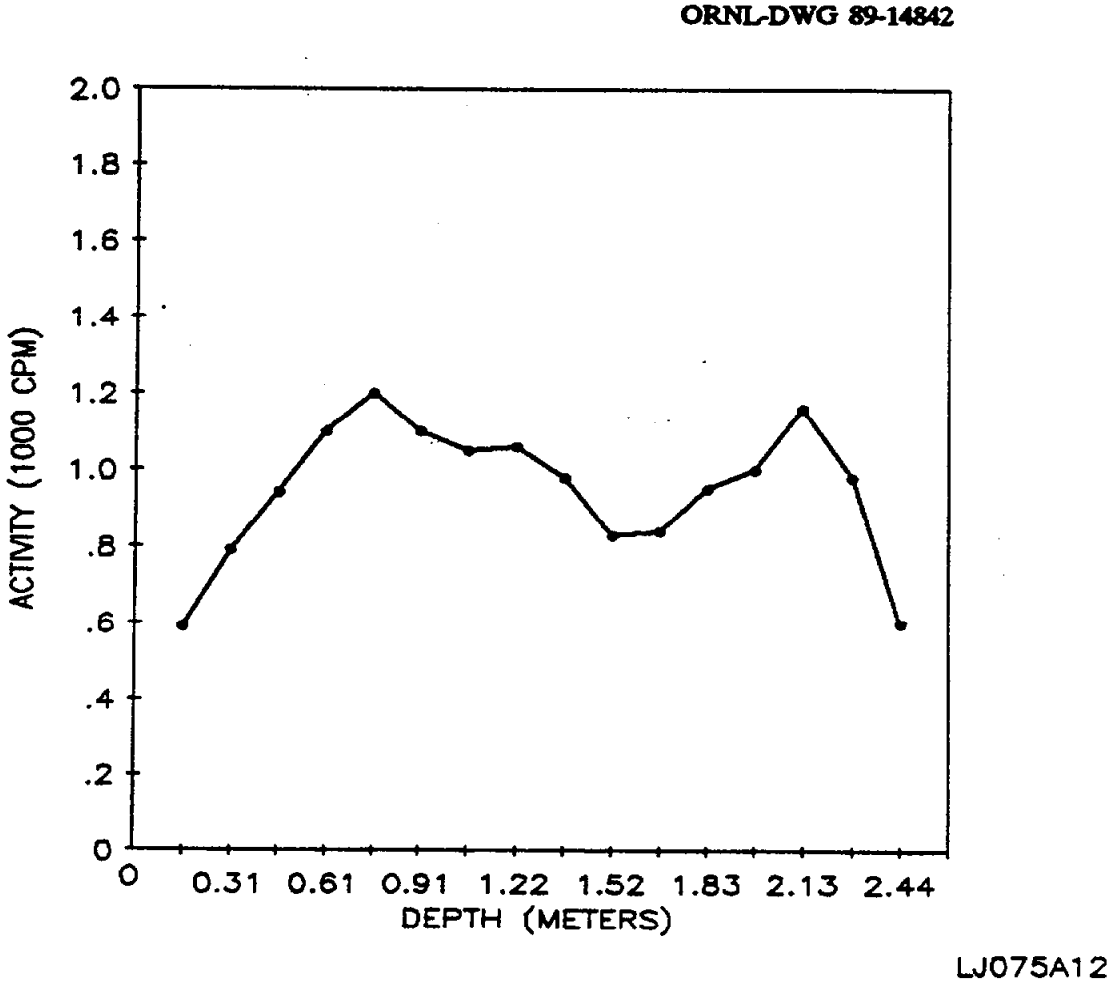

Fig. 14. Gamma profile for auger hole 12 at 205 Main Street, Lodi, New Jersey (LJ075).

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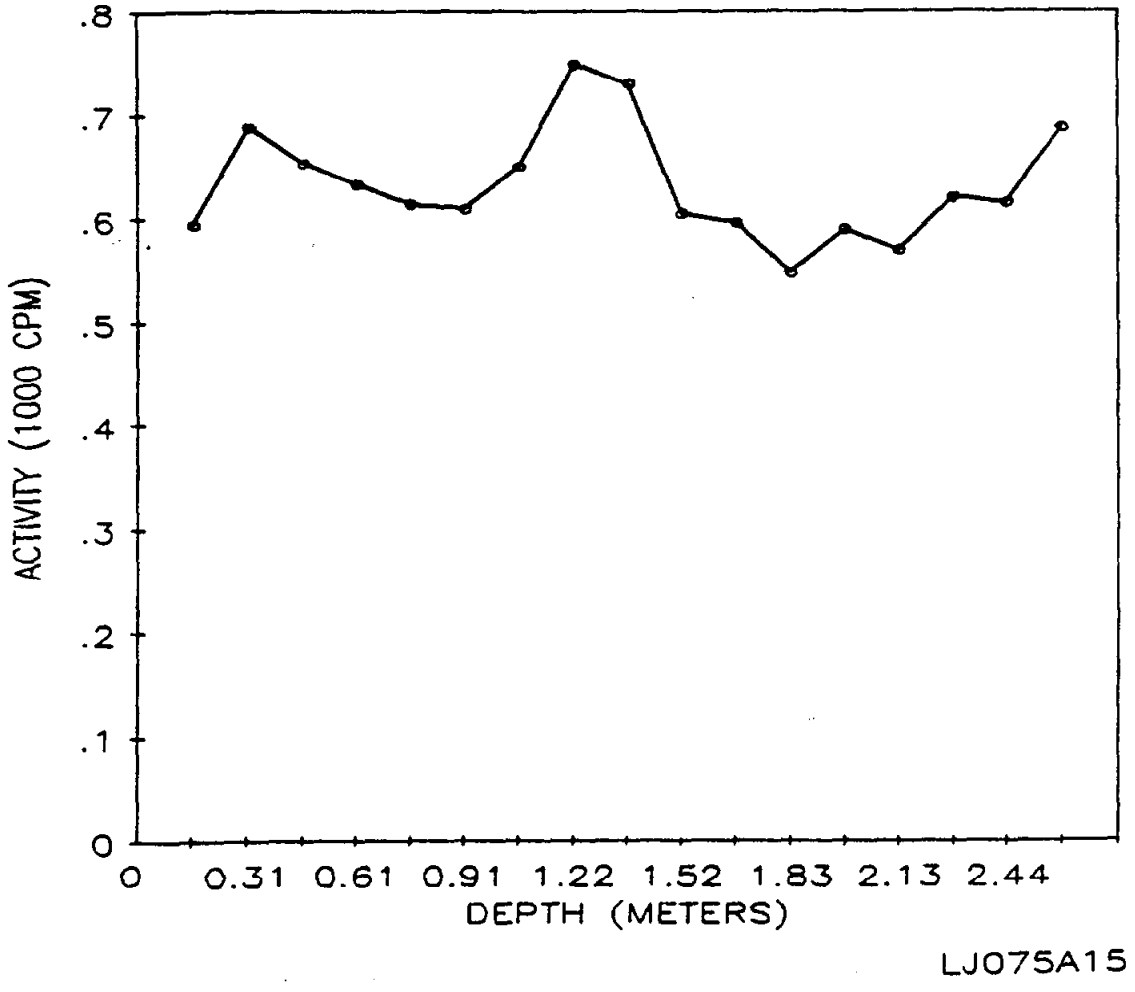

Fig. 15. Gamma profile for auger hole 15 at 205 Main Street, Lodi, New Jersey (LJ075).

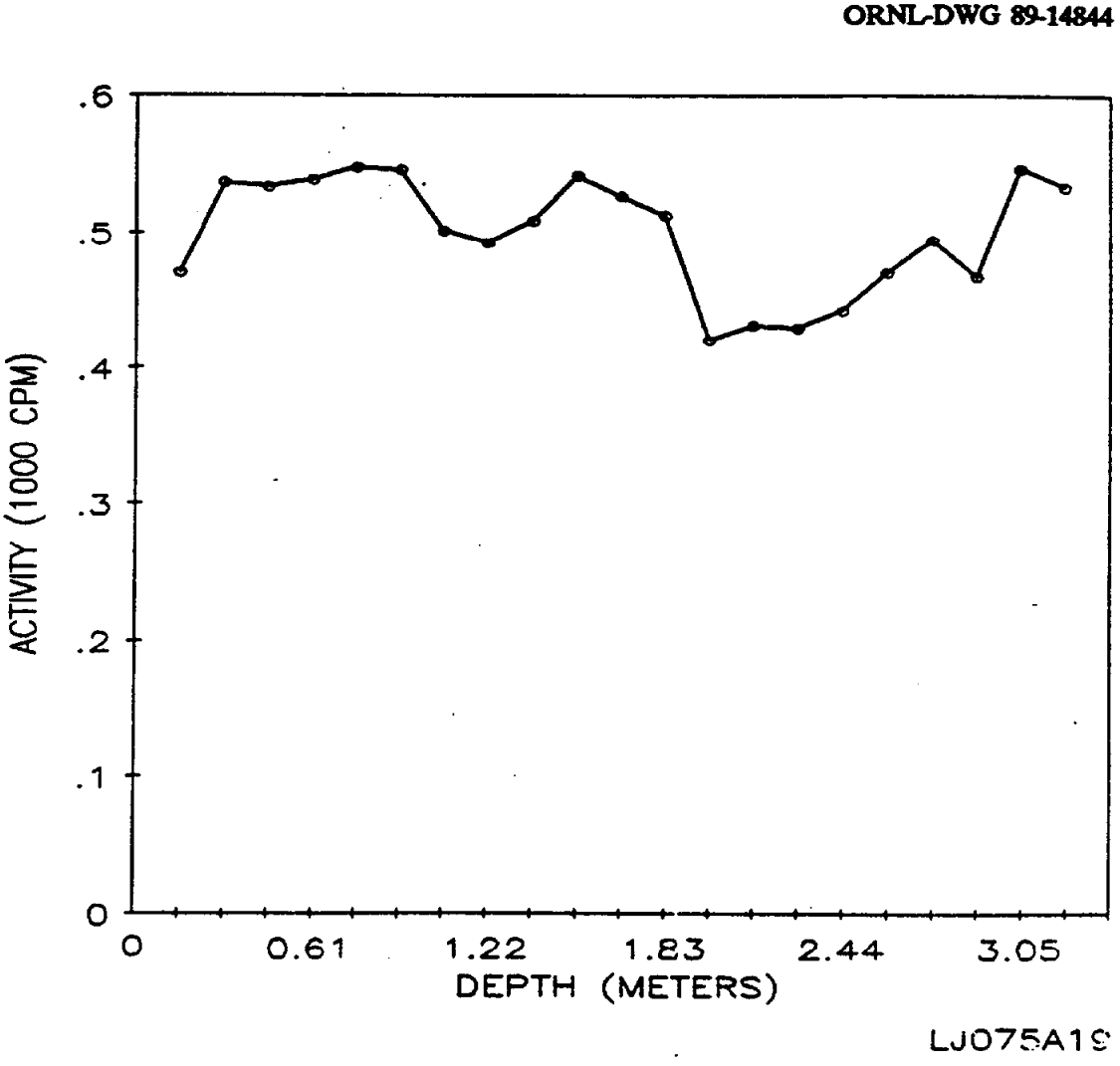

Fig. 16. Gamma profile for auger hole 19 at 205 Main Street, Lodi, New Jersey (LJ075).

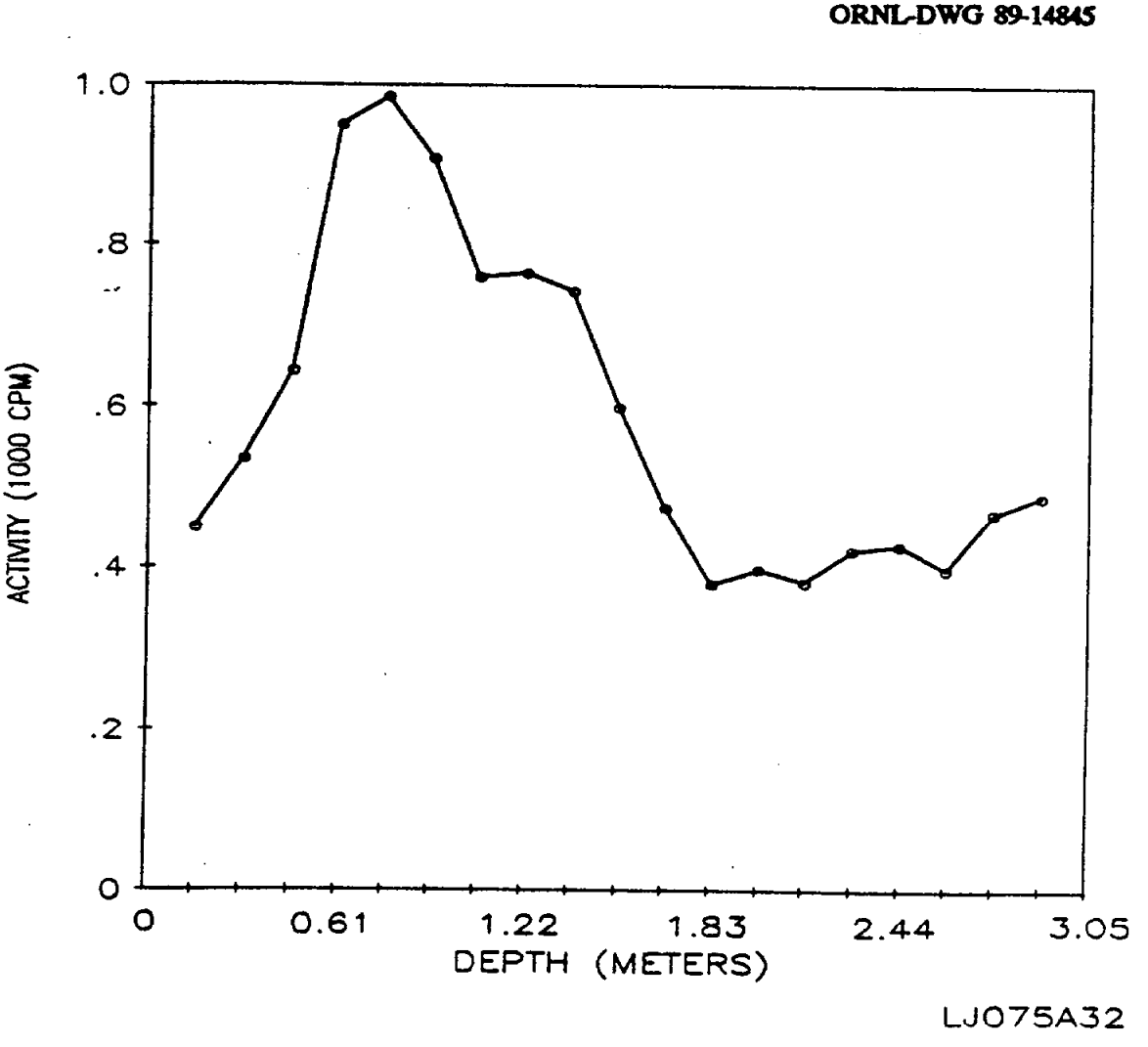

Fig. 17. Gamma profile for auger hole 32 at 205 Main Street, Lodi, New Jersey (LJ075).

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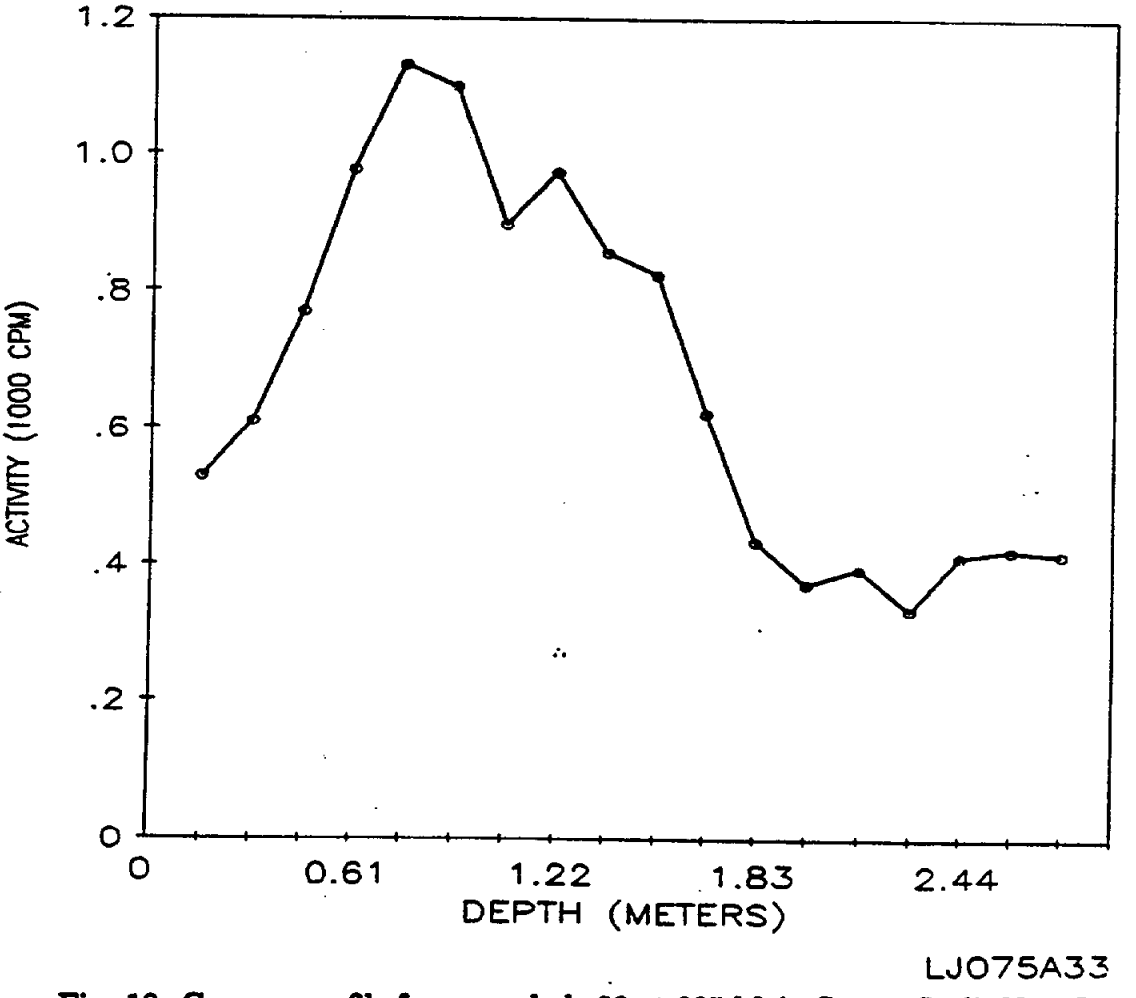

Fig. 18. Gamma profile for auger hole 33 at 205 Main Street, Lodi, New Jersey (LJ075).

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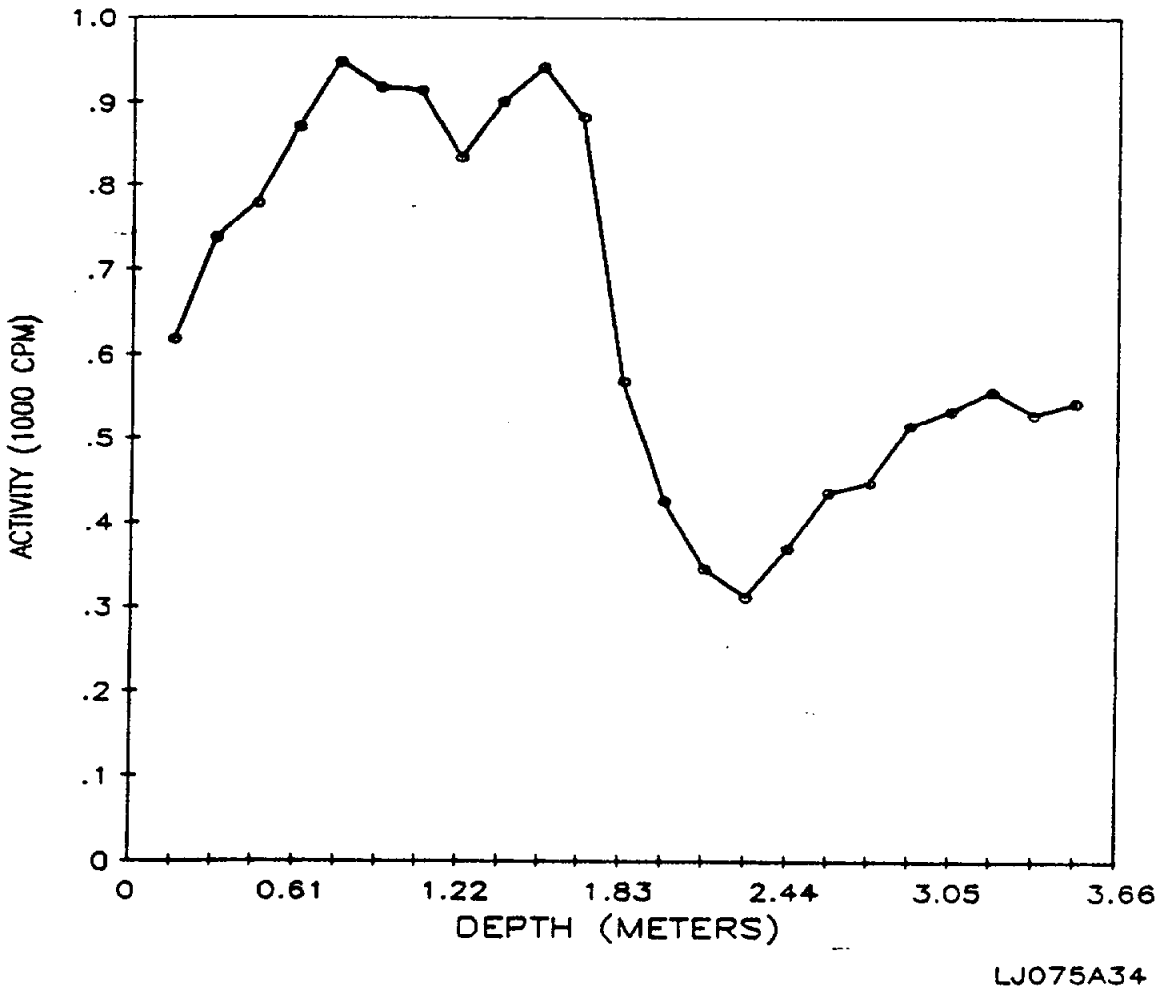

Fig. 19. Gamma profile for auger hole 34 at 205 Main Street, Lodi, New Jersey (LJ075).

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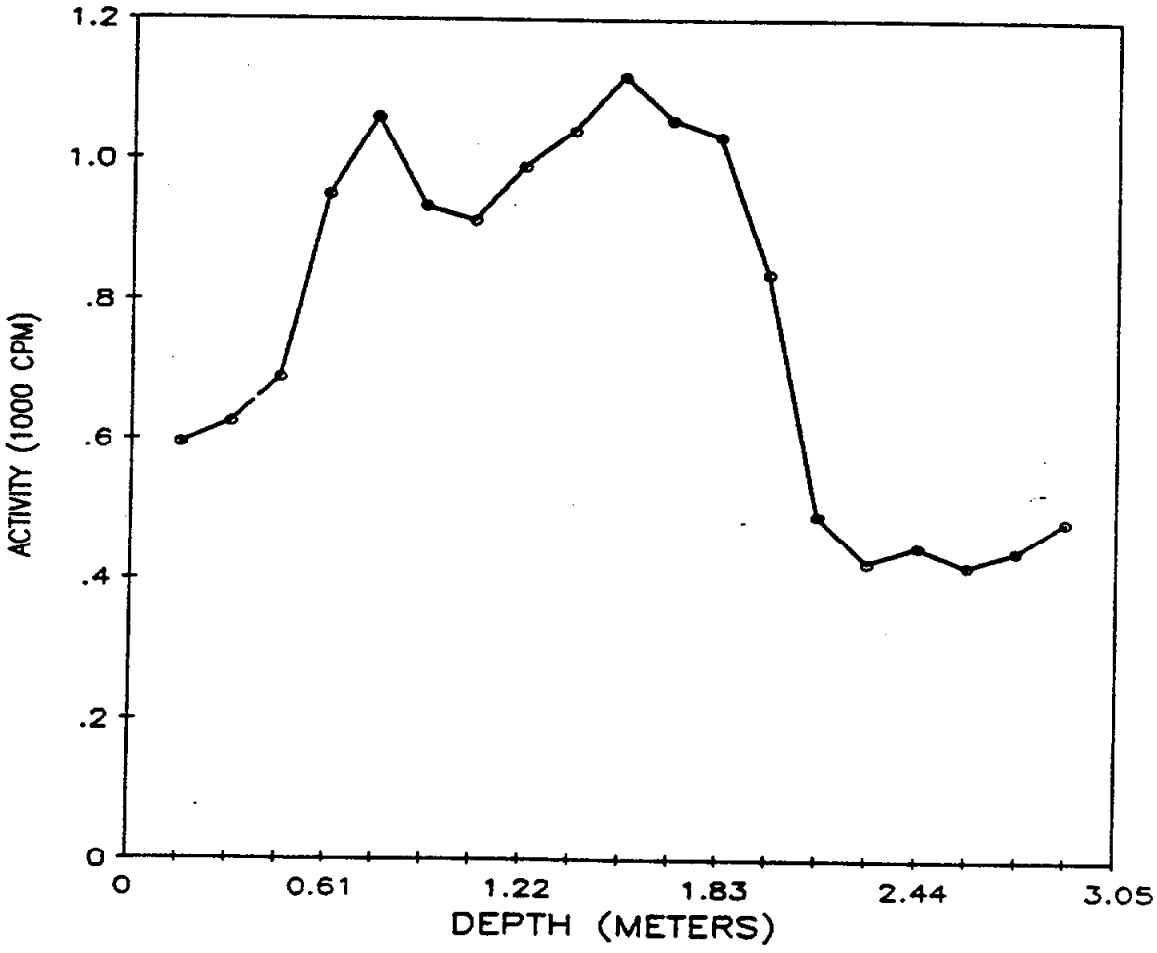

Fig. 20. Gamma profile for auger hole 45 at 205 Main Street, Lodi, New Jersey (LJ075).

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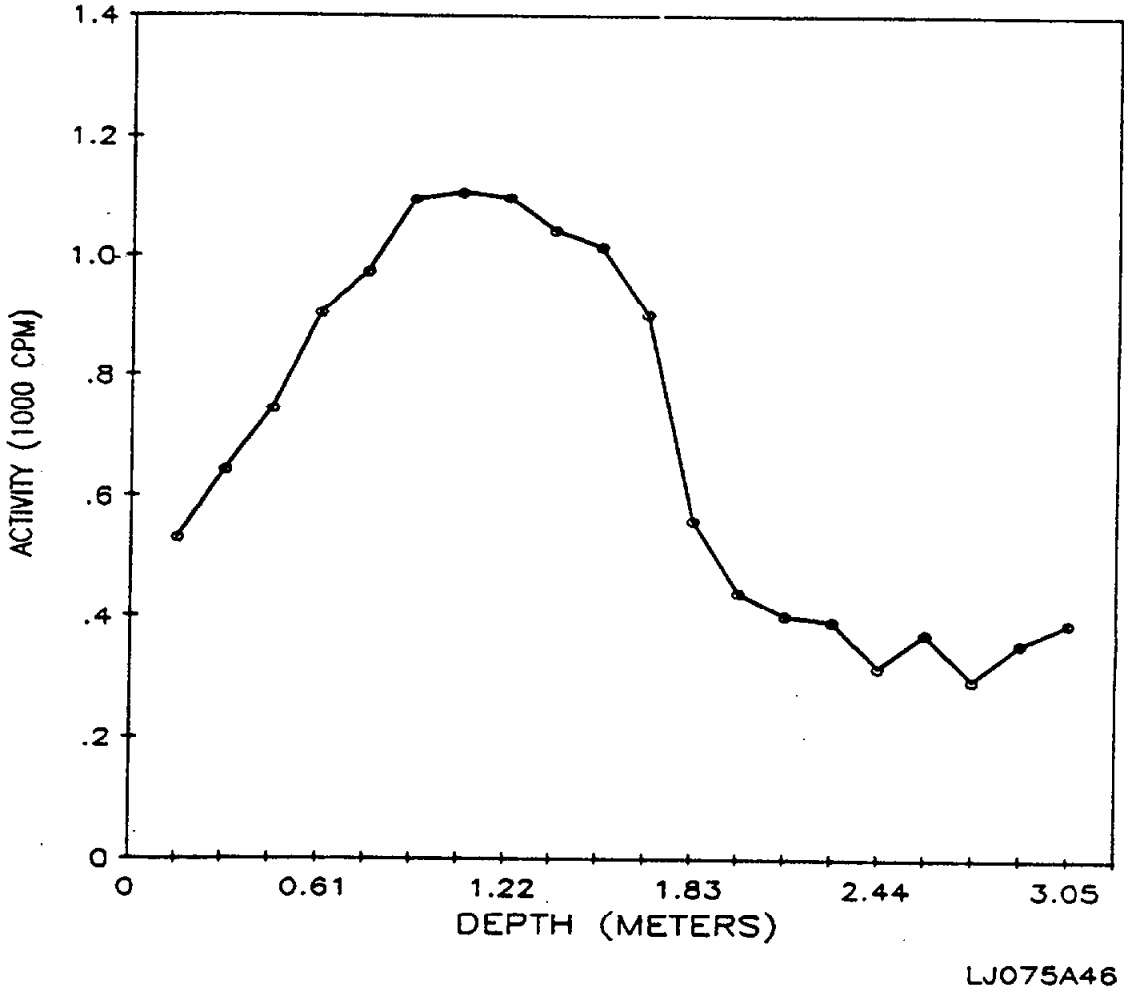

Fig. 21. Gamma profile for auger hole 46 at 205 Main Street, Lodi, New Jersey (LJ075).

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]Reference 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 (μR/h)[a]	8
Concentrations of radionuclides in soil (pCi/g)[b]	
^{232}Th	0.9
^{238}U	0.9
^{226}Ra	0.9

[a]Reference 4.
[b]Reference 5.

Table 3. Concentrations of radionuclides in soil at 205 Main Street, Lodi, New Jersey (LJ075)

Sample[a]	Depth (cm)	Radionuclide concentration (pCi/g)	
		^{226}Ra[b]	^{232}Th[b]
		Systematic samples	
S1A	0–15	1.2 ±0.05	1.3 ±0.04
S1B	15–30	0.74±0.04	0.85±0.08
S2A	0–15	1.7 ±0.1	1.8 ±0.2
S2B	15–30	0.56±0.08	0.70±0.1
		Auger samples[c]	
A3A	135–150	1.2 ±0.09	1.3 ±0.07
A3B	150–165	1.2 ±0.05	1.3 ±0.2
A3C	165–185	1.2 ±0.08	1.5 ±0.4
A3D	185–195	2.1 ±0.2	2.6 ±0.1
A3E	195–215	2.2 ±0.1	2.3 ±0.3
A3F	215–225	2.2 ±0.1	2.3 ±0.2
A3G	225–245	0.68±0.06	0.67±0.09
A3H	245–255	0.61±0.06	0.61±0.02
A3I	255–275	0.43±0.06	0.49±0.05
A5A	185–195	0.82±0.09	2.4 ±0.4
A5B	195–215	0.93±0.1	2.5 ±0.1
A7	185–195	1.9 ±0.3	7.8 ±0.7
A8A	90–105	0.50±0.1	0.67±0.2
A8B	105–120	0.40±0.03	0.50±0.2
A8C	120–135	0.53±0.04	0.60±0.1
A8D	135–150	0.51±0.03	0.65±0.06
A8E	150–165	0.52±0.1	0.65±0.04
A8F	165–185	1.3 ±0.09	1.6 ±0.07
A8G	185–195	1.7 ±0.3	2.4 ±0.6
A8I	215–225	1.3 ±0.1	1.7 ±0.04
A8J	225–255	0.49±0.03	0.56±0.02
A8L	255–275	0.69±0.07	0.77±0.07
A8M	275–290	0.53±0.03	0.68±0.1
A8N	290–305	0.38±0.05	0.52±0.1

Table 3 (continued)

Sample[a]	Depth (cm)	Radionuclide concentration (pCi/g)	
		$^{226}Ra^{b}$	$^{232}Th^{b}$
A9A	150–165	1.3 ±0.2	1.7 ±0.2
A9B	165–185	2.0 ±0.4	4.4 ±0.5
A9C	185–195	3.5 ±0.2	9.8 ±0.2
A9D	195–215	1.8 ±0.1	3.6 ±0.3
A12A	45–60	1.4 ±0.1	1.7 ±0.1
A12B	60–75	1.7 ±0.2	1.8 ±0.04
A12C	75–90	1.5 ±0.05	1.6 ±0.09
A12D	90–105	1.5 ±0.06	1.6 ±0.09
A12E	105–120	1.5 ±0.05	1.6 ±0.1
A12F	120–135	1.7 ±0.07	1.8 ±0.06
A33A	60–75	1.1 ±0.06	1.2 ±0.07
A33B	75–90	1.5 ±0.01	1.7 ±0.02
A33C	90–110	1.4 ±0.01	1.5 ±0.02
A45A	150–170	1.2 ±0.04	1.2 ±0.02

[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 those 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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