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M-043

Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-81OR20722

RADIOLOGICAL CHARACTERIZATION REPORT FOR THE RESIDENTIAL PROPERTY AT 26 LONG VALLEY ROAD

Lodi, New Jersey

November 1988

Bechtel National, Inc.

057116

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Attention: Peter J. Gross, Director
Technical Services Division

Subject: Bechtel Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-81OR20722
Publication of the Radiological Characterization Reports for the Residential Properties at 7 Branca Court, 11 Branca Court, 16 Long Valley Road, 18 Long Valley Road, 20 Long Valley Road, 22 Long Valley Road, 26 Long Valley Road, 11 Redstone Lane, and the Lodi Municipal Park, in Lodi, New Jersey
Code: 7310/WBS: 138

Reference: Letter from S. K. Oldham (DOE), 88-669 dated October 19, 1988, to B. W. Clemens (BNI), "Final Comments on the Prepublication Draft of the Radiological Characterization Reports for the Residential Properties at 7 Branca Court, 11 Branca Court, 16 Long Valley Road, 18 Long Valley Road, 20 Long Valley Road, 22 Long Valley Road, 26 Long Valley Road, 11 Redstone Lane, and the Lodi Municipal Park, in Lodi, New Jersey," CCN 056527.

Dear Mr. Gross:

Enclosed are six copies each of the published version of the nine characterization reports listed above. Incorporated in these reports are comments based on the reference above and additional discussions between N. C. Ring and S. K. Oldham of your office and J. D. Berger of ORAU.

057116

These publications also incorporate changes in wording regarding site release as requested by S. K. Oldham and A. Avel.

Please notify me should you require additional copies (6-1677).

Very truly yours,

DSherwood

B. W. Clemens for
Project Manager - FUSRAP

CONCURRENCE

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DOE/OR/20722-173

RADIOLOGICAL CHARACTERIZATION REPORT
FOR THE RESIDENTIAL PROPERTY AT
26 LONG VALLEY ROAD
LODI, NEW JERSEY

NOVEMBER 1988

Prepared for

UNITED STATES DEPARTMENT OF ENERGY

OAK RIDGE OPERATIONS OFFICE

Under Contract No. DE-AC05-81OR20722

By

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Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

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ABBREVIATIONS

cm	centimeter
cm^2	square centimeter
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
h	hour
in.	inch
l	liter
l/min	liters per minute
m	meter
m^2	square meter
MeV	million electron volts
μR/h	microroentgens per hour
mi	mile
mi^2	square mile
min	minute
mrad/h	millirad per hour
mrem	millirem
mrem/yr	millirem per year
pCi/g	picocuries per gram
pCi/l	picocuries per liter
WL	working level
yd	yard
yd^3	cubic yards

1.0 INTRODUCTION AND SUMMARY

1.1 INTRODUCTION

The 1984 Energy and Water Appropriations Act authorized the U.S. Department of Energy (DOE) to conduct a decontamination research and development project at four sites, including the site of the former Maywood Chemical Works (now owned by the Stepan Company) and its vicinity properties. The work is being administered by the Formerly Utilized Sites Remedial Action Program (FUSRAP), one of two remedial action programs under the direction of the DOE Division of Facility and Site Decommissioning Projects. The residential properties in Lodi, New Jersey, are included in FUSRAP as vicinity properties. Figure 1-1 shows the location of the Lodi vicinity properties is relation to the former Maywood Chemical Works.

The United States Government initiated FUSRAP in 1974 to identify, clean up, or otherwise control sites where low activity radioactive contamination (exceeding current guidelines) remains from the early years of the nation's atomic energy program or from commercial operations that resulted in conditions Congress has mandated DOE to remedy (Ref. 1).

FUSRAP is currently being managed by DOE Oak Ridge Operations. As the Project Management Contractor for FUSRAP, Bechtel National, Inc. (BNI) is responsible to DOE for planning, managing, and implementing FUSRAP.

1.2 PURPOSE

The purpose of the 1986 survey performed by BNI was to locate the horizontal and vertical boundaries of radionuclide concentrations exceeding remedial action guidelines.

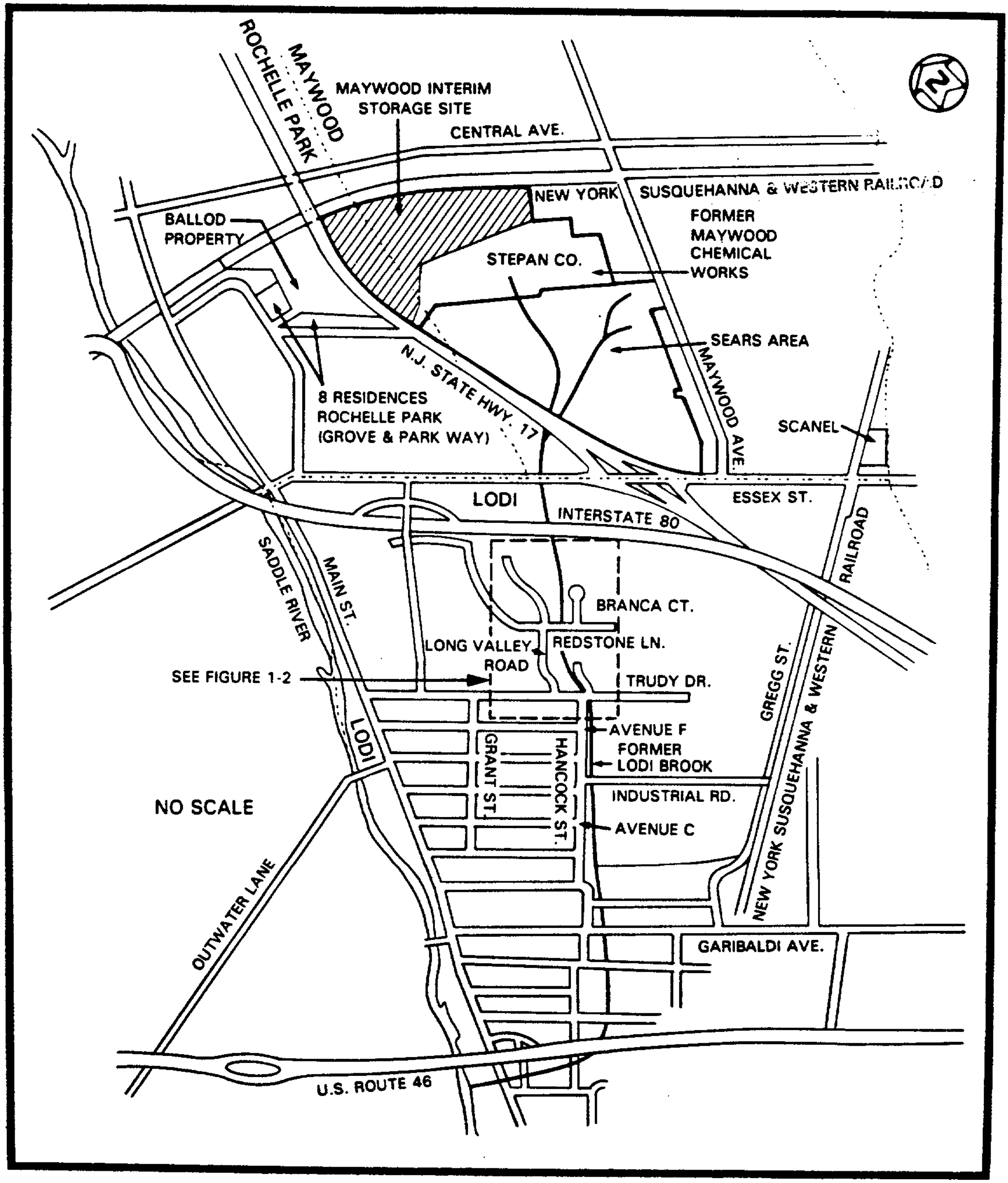

FIGURE 1-1 LOCATION OF LODI VICINITY PROPERTIES

1.3 SUMMARY

This report summarizes the procedures and results of the radiological characterization of the property at 26 Long Valley Road (Figure 1-2) in Lodi, New Jersey, conducted from September through December 1986.

Ultimately, the data generated during the radiological characterization will be used to define the complete scope of remedial action necessary to release the site.

This characterization confirmed that thorium-232 is the primary radioactive contaminant at this property. Results of surface soil samples for 26 Long Valley Road showed maximum concentrations of thorium-232 and radium-226 to be 35.5 and 2.6 pCi/g, respectively. Subsurface soil sample concentrations ranged from 1.0 to 7.7 pCi/g for thorium-232 and from 0.4 to 2.2 pCi/g for radium-226. The average background level in this area for both radium-226 and thorium-232 is 1.0 pCi/g.

Historical information indicates that uranium is not a primary contaminant in this area; therefore, analysis for uranium was not considered critical for this characterization. The soil samples have been archived and, if necessary, can be analyzed for uranium at some future date. Because the major contaminants at the vicinity properties are thorium and radium, the decontamination guidelines provide the appropriate guidance for the cleanup activities. DOE believes that these guidelines are conservatively low for considering potential adverse health effects that might occur in the future from any residual contamination. The dose contributions from uranium and any other radionuclides not numerically specified in these guidelines are not expected to be significant following decontamination. In addition, because the vicinity properties will be decontaminated in a manner to reduce future doses to levels that are as low as reasonably achievable (ALARA), DOE will ensure that most of the radioactivity present at these vicinity properties will be removed during the cleanup (Ref. 2).

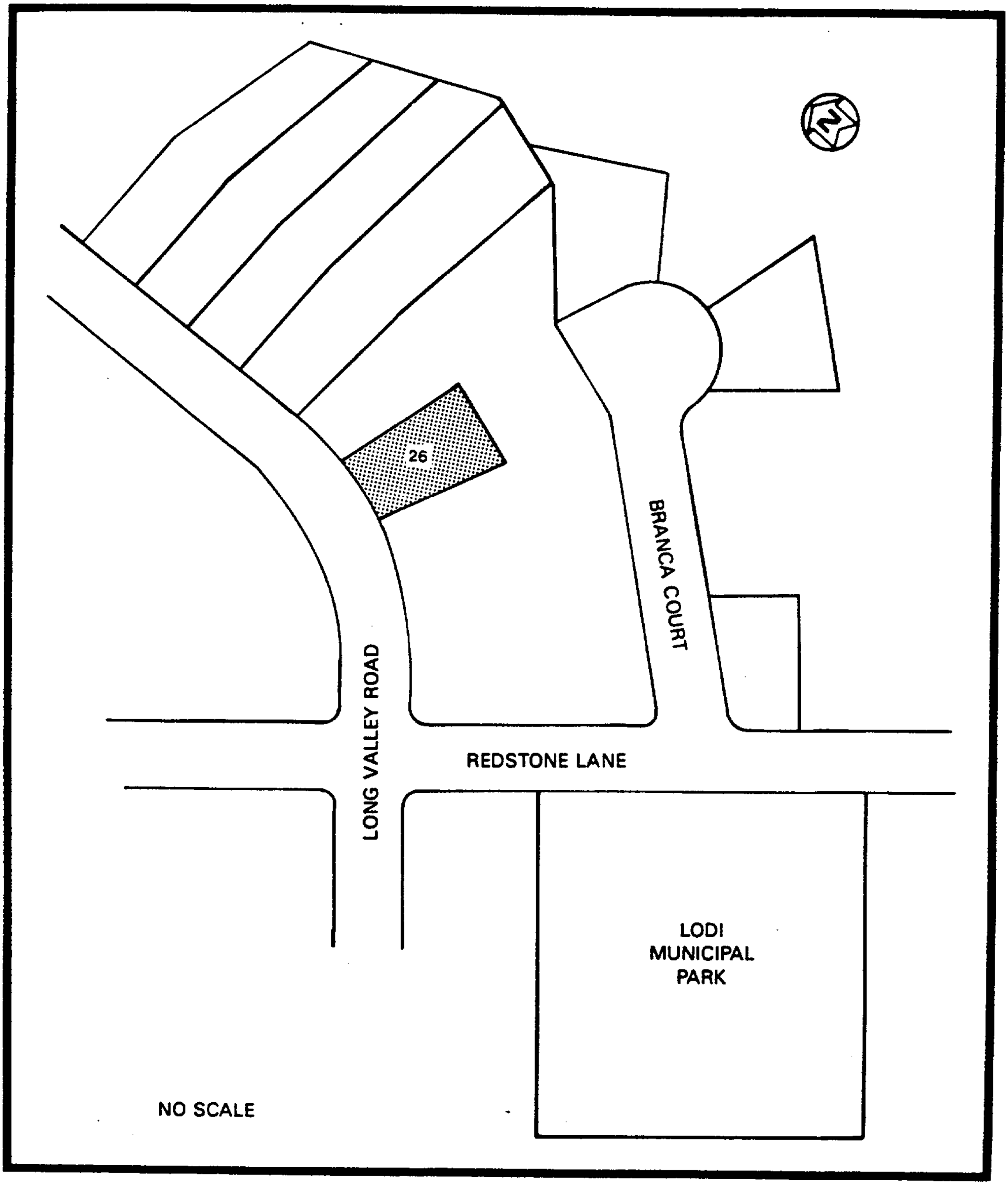

FIGURE 1-2 LOCATION OF 26 LONG VALLEY ROAD

Subsurface investigation by gamma logging showed subsurface contamination ranging from 0.5 to 5.5 ft deep.

Gamma radiation exposure rates ranged from 8 to 17 μR/h, including background. The interior measurement was 7 μR/h, including background.

The radon-222 measurements inside the residence indicated concentrations of less than 0.2 and 0.3 pCi/l, which are within the DOE guideline of 3.0 pCi/l.

Measurements for radon daughters ranged from 0.001 to 0.003 WL, and measurements for thoron daughters ranged from 0.0001 to 0.0008 WL.

2.0 SITE HISTORY

The Maywood Chemical Works was founded in 1895. During World War I (in 1916), the company began processing thorium from monazite sand for use in manufacturing gas mantles for various lighting devices. The company continued this work until 1956. Process wastes from manufacturing operations were pumped to two areas surrounded by earthen dikes (northern and southern diked areas) on property west of the plant. Subsequently, some of the contaminated wastes migrated onto adjacent and vicinity properties.

In 1928 and again between 1944 and 1946, some of the residues from the processing operations were moved from the company's property and used as mulch and fill in nearby low-lying areas. The fill material consisted of tea and cocoa leaves mixed with other material resulting from operations at the plant and apparently also contained thorium process wastes (Ref. 3).

It is not known for certain how the properties in Lodi were contaminated. According to an area resident, fill from an unknown source was brought to Lodi and spread over large portions of the previously low-lying and swampy area. For several reasons, however, a more plausible explanation is that the contamination migrated along a drainage ditch originating on the Maywood Chemical Works property. It can be seen from photographs and tax maps of the area that the course of a previously existing stream known as Lodi Brook, which originated at the former Maywood Chemical Works, generally coincides with the path of contamination in Lodi. The brook was subsequently replaced by a storm drain system as the area was developed. Secondly, samples taken from Lodi properties indicate elevated concentrations of a series of elements known as rare earths. Rare earth elements are typically found in monazite sands, which also include thorium. This type of sand was feedstock at the Maywood Chemical Works, and elevated levels are known to exist in the by-product of the extraction process. Third, the ratio of thorium to other radionuclides found in these Lodi properties is comparable to the ratio found in contaminated material on other properties in Lodi (Ref. 4). And finally, long-time residents of Lodi recall chemical odors in and around the brook in Lodi and steam rising off the water. These observations suggest discharges of contaminants occurring upstream.

The Stepan Chemical Company (now called the Stepan Company) purchased Maywood Chemical Works in 1959. The Stepan Company itself has never been involved in the manufacture or processing of any radioactive materials (Ref. 5).

2.1 PREVIOUS RADIOLOGICAL SURVEYS

January 1981 - The Nuclear Regulatory Commission (NRC) directed that a survey of the Stepan Company property and its vicinity be conducted. Using the Stepan Company plant as the center, a 4-mi^2 aerial survey conducted by the EG&G Energy Measurements Group identified anomalous concentrations of thorium-232 to the north and south of the Stepan Company property. The Lodi residential properties were included in this survey (Ref. 6).

June 1984 - In June 1984, Oak Ridge National Laboratory (ORNL) conducted a "drive by" survey of Lodi using its "scanning van." Although not comprehensive, the survey indicated areas requiring further investigation (Ref. 7).

September 1986 - At the request of DOE, ORNL conducted radiological surveys of the vicinity properties in Lodi, New Jersey, for the purpose of determining which properties contained radioactive contamination in excess of guidelines and would require remedial action (Ref. 8).

2.2 REMEDIAL ACTION GUIDELINES

Table 2-1 summarizes the DOE guidelines for residual contamination. The thorium-232 and radium-226 limits listed in Table 2-1 will be used to determine the extent of remedial action required at the vicinity properties. DOE developed these guidelines to be consistent with the guidelines established by the Environmental Protection Agency (EPA) for the Uranium Mill Tailings Remedial Action Program.

TABLE 2-1

SUMMARY OF RESIDUAL CONTAMINATION GUIDELINES FOR THE LODI VICINITY PROPERTIES

BASIC DOSE LIMITS

The basic limit for the annual radiation dose received by an individual member of the general public is 100 mrem/yr.

SOIL (LAND) GUIDELINES (MAXIMUM ALLOWABLE LIMITS)

Radionuclide	Soil Concentration (pCi/g) above background[a,b,c]
Radium-226 Radium-228 Thorium-230 Thorium-232	5 pCi/g, averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface layer.

STRUCTURE GUIDELINES (MAXIMUM ALLOWABLE LIMITS)

Airborne Radon Decay Products

Generic guidelines for concentrations of airborne radon decay products shall apply to existing occupied or habitable structures on private property; structures that will be demolished or buried are excluded. The applicable generic guideline (40 CFR 192) is: In any occupied or habitable building, the objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL.[d] In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL. Remedial actions are not required in order to comply with this guideline when there is reasonable assurance that residual radioactive materials are not the cause.

External Gamma Radiation

The average level of gamma radiation inside a building or habitable structure on a site shall not exceed the background level by more than 20 μR/h.

Indoor/Outdoor Structure Surface Contamination

	Allowable Residual Surface Contamination[e] (dpm/100 cm^2)		
Radionuclide[f]	Average[g,h]	Maximum[h,i]	Removable[h,j]
Transuranics, Ra-226, Ra-228, Th-230, Th-228 Pa-231, Ac-227, I-125, I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224 U-232, I-126, I-131, I-133	1,000	3,000	200

TABLE 2-1

(continued)

Indoor/Outdoor Structure Surface Contamination (continued)

Radionuclide[f]	Allowable Residual Surface Contamination[e] (dpm/100 cm^2) Average[g,h]	Maximum[h,i]	Removable[h,j]
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000 β-γ	15,000 β-γ	1,000 β-γ

[a]These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If either thorium-230 and radium-226 or thorium-232 and radium-228 are both present, not in secular equilibrium, the guidelines apply to the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that the dose for the mixtures will not exceed the basic dose limit.

[b]These guidelines represent residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100-m^2 surface area.

[c]Localized concentrations in excess of these limits are allowable provided that the average concentration over a 100-m^2 area does not exceed these limits.

[d]A working level (WL) is any combination of short-lived radon decay products in 1 liter of air that will result in the ultimate emission of 1.3 x 10^5 MeV of potential alpha energy.

[e]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[f]Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

[g]Measurements of average contamination should not be averaged over more than 1 m^2. For objects of less surface area, the average shall be derived for each such object.

[h]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

[i]The maximum contamination level applies to an area of not more than 100 cm^2.

[j]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. The numbers in this column are maximum amounts.

3.0 HEALTH AND SAFETY PLAN

BNI is responsible for protecting the health of personnel assigned to work at the site. As such, all subcontractors and their personnel are required to comply with the provisions of the applicable project instructions cited in this section or as directed by the on-site BNI representative.

3.1 SUBCONTRACTOR TRAINING

Before the start of work, all subcontractor personnel attend an orientation session presented by the BNI representative to explain the nature of the material to be encountered in the work and the required personnel monitoring and safety measures.

3.2 SAFETY REQUIREMENTS

Subcontractor personnel must comply with the following BNI requirements.

- Bioassay - Subcontractor personnel submit bioassay samples before or at the beginning of on-site activity, upon completion of the activity, and periodically during site activities as requested by BNI.
- Protective Clothing/Equipment - Subcontractor personnel are required to wear the protective clothing/equipment specified in the subcontract or as directed by the BNI representative.
- Dosimetry - Subcontractor personnel are required to wear, and return daily, the dosimeters and monitors issued by BNI.
- Controlled Area Access/Egress - Subcontractor personnel and equipment entering areas wherein access and egress are controlled for radiation and/or chemical safety purposes are surveyed by the BNI representative for contamination before leaving those areas.
- Medical Surveillance - Upon written direction from BNI, subcontractor personnel who work in areas where hazardous chemicals might exist are given a baseline and periodic health assessment defined in BNI's Medical Surveillance Program.

Radiation and/or chemical safety surveillance of all activities related to the scope of work is under the direct supervision of personnel representing BNI.

The health physics requirements for all activities involving radiation or radioactive material are defined in Project Instruction No. 20.01, the Project Radiation Protection Manual and implementing procedures.

The industrial hygiene requirements for activities involving chemicals or chemically contaminated materials are defined in Project Instruction No. 26.00, the Environmental Hygiene Manual and implementing procedures.

Copies of these project instructions and manuals are located on-site for the use of subcontractor personnel.

4.0 CHARACTERIZATION PROCEDURES

A master grid was established by the surveyor; BNI's radiological support subcontractor, Thermo Analytical/Eberline (TMA/E), established a grid on individual properties. The size of the grid blocks is adjusted to adequately characterize each property. The grid origin allows the grid to be reestablished during remedial action and is correlated with the New Jersey state grid system. All data correspond to coordinates on the characterization grid. The grid and its east and north coordinates are shown on all figures of the property (Sections 4 and 5).

4.1 FIELD RADIOLOGICAL CHARACTERIZATION

4.1.1 Measurements Taken and Methods Used

An initial walkover survey using unshielded gamma scintillation detectors (2-in. by 2-in. thallium-activated sodium iodide probe) to identify areas of elevated radionuclide activity was performed. Near-surface gamma measurements taken using a cone-shielded gamma scintillation detector were also used in determining areas of surface contamination. Using the shielded detector ensured that the majority of the radiation detected by the instrument originated from the ground directly beneath the unit. Shielding against lateral gamma flux, or shine, from nearby areas of contamination minimized potential sources of error in the measurements. The measurements were taken 12 in. above the ground at the intersections of 10-ft grid lines. The shielded detector was calibrated at the Technical Measurements Center (TMC) in Grand Junction, Colorado, to provide a correlation of counts per minute (cpm) to picocuries per gram (pCi/g). This calibration demonstrated that 11,000 cpm corresponds to the DOE guideline of 5 pCi/g plus local average background of 1 pCi/g for thorium-232 in surface soils (Ref. 9).

A subsurface investigation was conducted to determine the depth to which the previously identified surface contamination extends and to locate subsurface contamination where there is no surface manifestation. The subsurface characterization consisted of drilling and gamma logging 13 boreholes (Figure 4-1) using either a 3-in.- or 6-in.-diameter auger bit; holes were drilled to depths determined in the field by the radiological and geological support representatives.

The downhole gamma logging technique was used because the procedure can be completed more quickly than collecting soil samples, and it eliminates the need for analyzing these samples in a laboratory. A 2-in. by 2-in. sodium iodide gamma scintillation detector was used to perform the downhole logging. The instrument was calibrated at TMC where it was determined that a count rate of approximately 40,000 cpm corresponds to the 15-pCi/g subsurface contamination guideline for thorium-232 for subsurface soils. This relationship has also been corroborated in results from previous characterizations where thorium-232 was found (Ref. 9).

Gamma radiation measurements were taken at 6-in. vertical intervals, and determined the depth and concentration of the contamination. The gamma logging data were reviewed to identify trends, regardless of whether concentrations exceeded the guidelines.

4.1.2 Sample Collection and Analysis

To identify surface areas where the level of contamination exceeded the DOE guideline of 5 pCi/g for thorium-232 in surface soils, areas with measurements of more than 11,000 cpm were plotted. Using these data as well as data from previous surveys (Refs. 5, 6, 7, and 8), the locations of biased surface soil samples were selected to better define the limits of contamination. Surface soil samples were taken at 13 locations (Figure 4-2) and analyzed for thorium-232 and radium-226. Each sample was dried, pulverized, and counted for 10 min using an intrinsic germanium detector housed in a lead counting cave lined with cadmium and copper. The pulse height distribution was sorted using a computer-based, multichannel

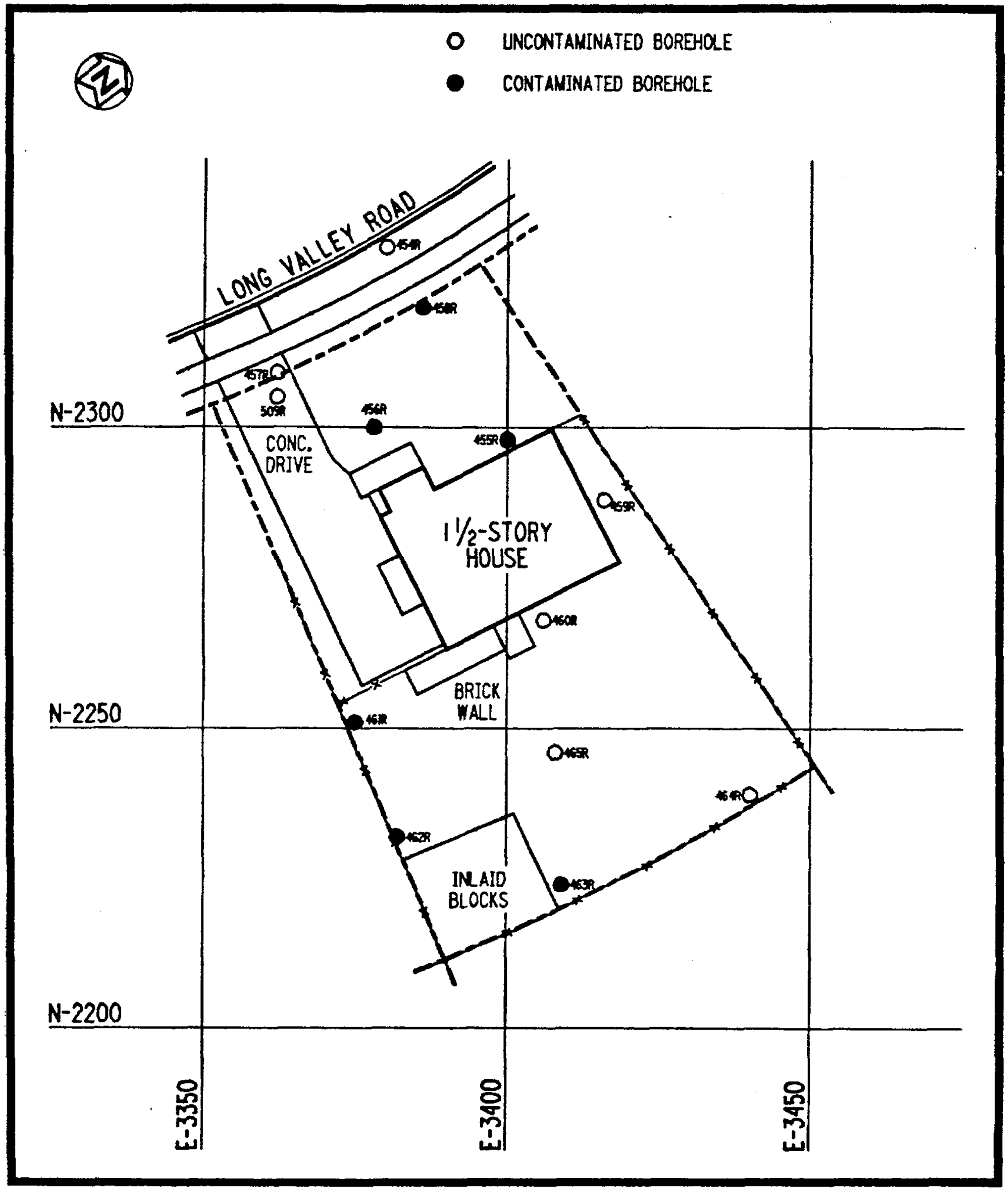

FIGURE 4-1 BOREHOLE LOCATIONS AT 26 LONG VALLEY ROAD

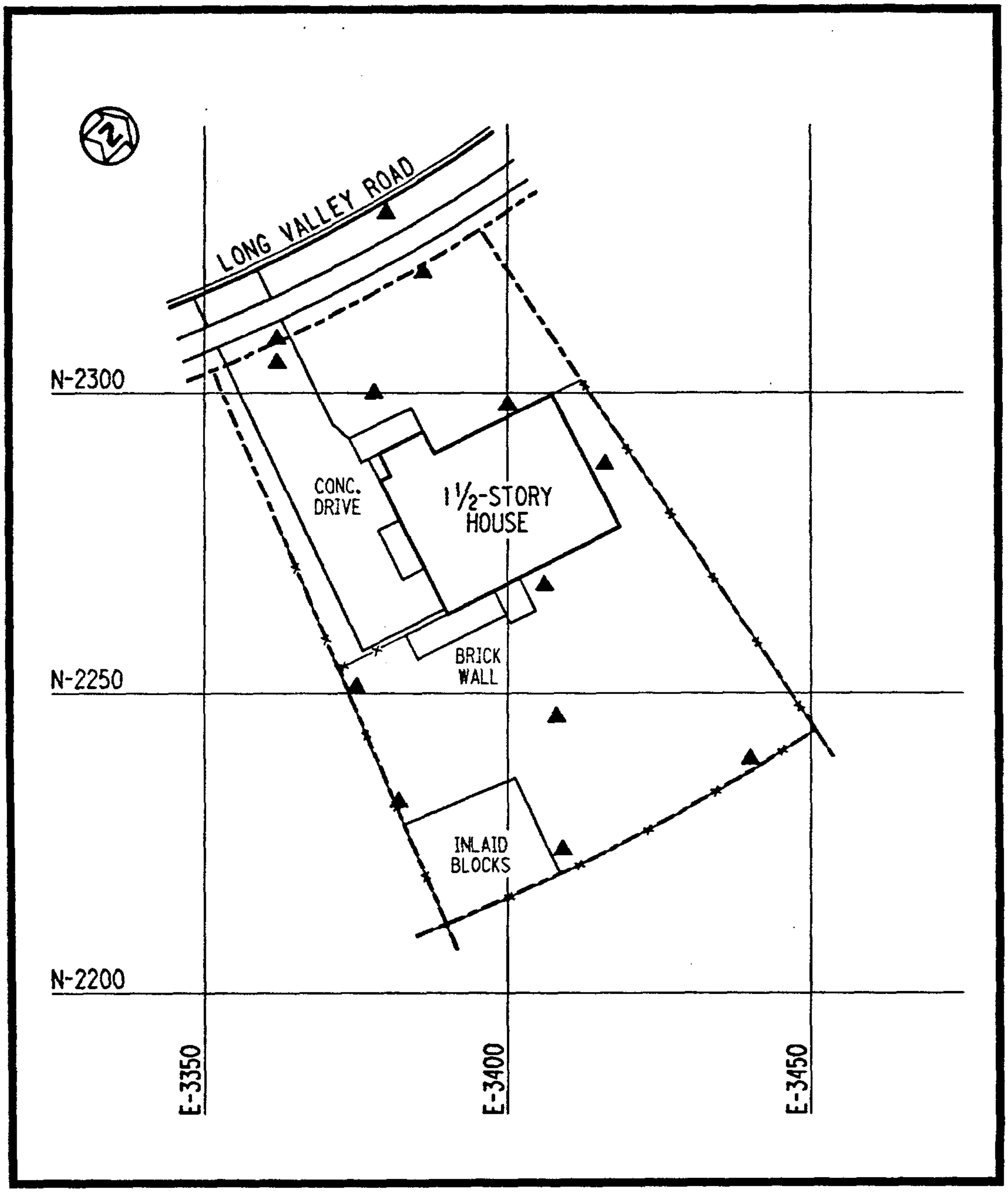

FIGURE 4-2 SURFACE AND SUBSURFACE SOIL SAMPLING LOCATIONS AT 26 LONG VALLEY ROAD

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analyzer. Radionuclide concentrations were determined by comparing the gamma spectrum of each sample with the spectrum of a certified counting standard for the radionuclide of interest.

Subsurface soil samples were collected from 13 locations (Figure 4-2) using the side wall sampling method and were analyzed to compare laboratory soil sample results to downhole gamma radiation measurements. A cup or can attached to a steel pipe or wooden stake was inserted into the borehole and used to scrape samples off the side of the borehole at a specified depth. The subsurface soil samples were analyzed for radium-226 and thorium-232 in the same manner as the surface soil samples.

4.2 BUILDING RADIOLOGICAL CHARACTERIZATION

After evaluating previous radiological survey data as well as data from this characterization, it was suspected that contamination might be present under the foundation of the residence. A radon measurement was obtained to verify the presence of contaminated material under the residence and to estimate potential occupational exposures during future remedial actions.

Indoor radon measurements were taken using the Tedlar bag technique. Using this method, radon measurements are obtained by pumping air into a Tedlar bag at a rate of approximately 2 l/min and transferring the air sample directly into a scintillation cell with an interior coating of zinc sulfide and an end window for viewing the scintillations. Analysis of the sample was simplified by allowing the radon decay products to build up over time. This method allows all the radon decay products to come into secular equilibrium with the radon. The scintillation cell was placed in contact with a photomultiplier tube, and the scintillations were counted using standard nuclear counting instrumentation.

Indoor air sample collection was also performed to determine working levels (WL) of radon and thoron daughters. Measurement of radon daughters was done by collecting an air sample for exactly 5 min through a 0.45-micron membrane filter at a rate of 11 liters/min for a total sample volume of 55 l. Alpha particle activity on the filter paper was counted 40 to 90 min after sampling using an alpha scintillation detector coupled to a count-rate meter or a digital scaler. Measurements for thoron daughters were conducted using the same method as for radon daughters with the exception of the time between collection of the air sample and counting of the alpha particle activity. In the case of thoron daughters, the sample is allowed to age for at least 5 h after sampling before alpha activity is counted. This elapsed time allows radon daughters, which may be present with the thoron daughters, to decay sufficiently so as not to interfere in calculating the working levels for thoron daughters.

Exterior gamma exposure rate measurements were made at six locations throughout the property grid system and at one location inside the residence using either a 2-in. by 2-in. thallium-activated sodium iodide gamma scintillation detector used to detect gamma radiation only, or a pressurized ionization chamber (PIC) (Figure 4-3). The PIC instrument has a response to gamma radiation that is proportional to exposure in roentgens. A conversion factor for gamma scintillation to the PIC was established through a correlation of these two measurements at four locations in the vicinity of the property. The unshielded gamma scintillation detector readings were then used to estimate gamma exposure rates for each location. These measurements were taken 3 ft above the ground, and the locations were determined to be representative of the entire property. Interior measurements are generally obtained with the gamma scintillation instrument rather than the PIC because of its smaller size and the desire to minimize the technician's time inside the residence.

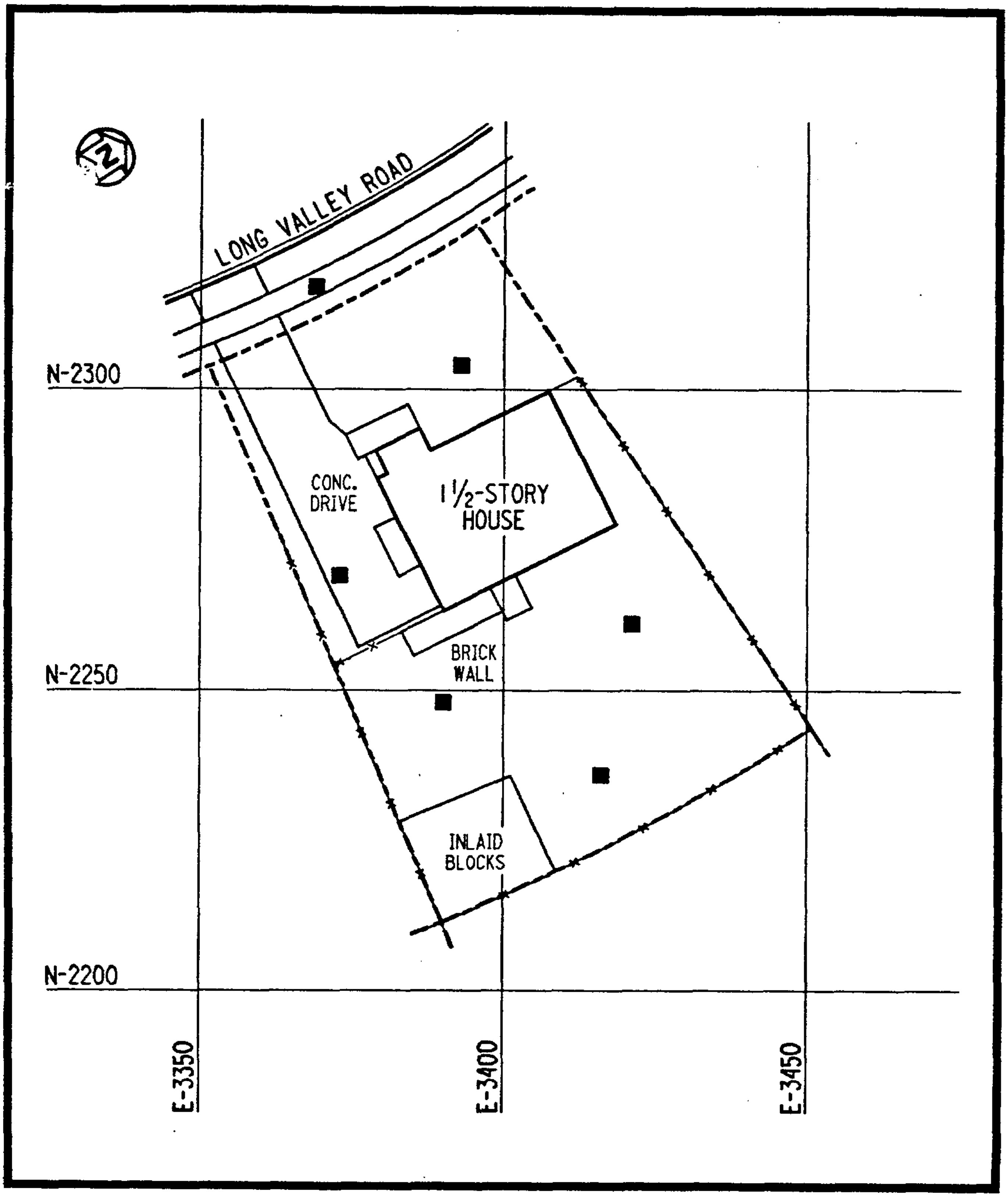

FIGURE 4-3 EXPOSURE RATE MEASUREMENT LOCATIONS AT 26 LONG VALLEY ROAD

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5.0 CHARACTERIZATION RESULTS

5.1 FIELD RADIOLOGICAL CHARACTERIZATION

Near-surface gamma radiation measurements on the property ranged from 3,400 cpm to approximately 23,000 cpm. The average background level for this area is 5,000 cpm. A measurement of 11,000 cpm is approximately equal to the DOE guideline for thorium-232 of 5 pCi/g above background for surface soil contamination. Using this correlation, the near-surface gamma measurements were used to determine the extent of surface contamination as well as the basis for selecting the locations of soil samples.

Surface soil samples taken from 13 locations on the property were analyzed for thorium-232 and radium-226. The concentrations in these samples ranged from 0.9 to 35.5 pCi/g for thorium-232 and from 0.8 pCi/g to 2.6 pCi/g for radium-226. Analysis results for surface soils (depths from 0.0 to 0.5 ft) are provided in Table 5-1. Results showed concentrations of thorium-232 in excess of DOE guidelines (5 pCi/g plus background of 1 pCi/g for surface soils) with a maximum concentration of 35.5 pCi/g. Use of the "less than" (<) notation in reporting results indicates that the radionuclide was not present in concentrations that are quantitative with the instruments and techniques used. The "less than" value represents the lower bound of the quantitative capacity of the instrument and technique used and is based on various factors, including the volume, size, and weight of the sample; the type of detector used; the counting time, and the background count rate. The actual concentration of the radionuclide is less than the value indicated. In addition, since radioactive decay is a random process, a correlation between the rate of disintegration and a given radionuclide concentration cannot be precisely established. For this reason, the exact concentration of the radionuclide cannot be determined. As such, each value that can be quantitatively determined has an associated uncertainty term ($\pm$), which represents the amount by which the actual concentration can be expected to differ from the value given in the table. The uncertainty term has an associated confidence level of 95 percent.

On the basis of near-surface gamma radiation measurements and surface soil sample analysis, contamination of this property is consists of surface and subsurface contamination. Contamination depths range from the surface to 3.5 ft deep. Areas of surface contamination are shown in Figure 5-1 and areas of subsurface contamination are shown in Figure 5-2.

Analysis results for subsurface soil samples given in Table 5-1 (depths from 0.5 to 1.0 ft) are consistent with the gamma logging data in Table 5-2. The results in Table 5-2 showed a range from 7,000 cpm to 140,000 cpm. A measurement of 40,000 cpm is approximately equal to the DOE guideline for subsurface contamination of 15 pCi/g. Analyses of subsurface soil samples showed thorium-232 concentrations ranging from 1.0 to 7.7 pCi/g and radium-226 concentrations ranging from 0.4 to 2.2 pCi/g.

The vertical and horizontal limits of contamination as determined by this characterization effort are being evaluated to determine the volume of contaminated material that will require remedial action. To develop this estimate, BNI will consider the location of the contamination, construction techniques, and safety procedures.

5.2 BUILDING RADIOLOGICAL CHARACTERIZATION

Results of two indoor radon measurements made with the Tedlar bag method indicated that concentrations ranged from less than 0.2 pCi/l to less than 0.3 pCi/l. These measurements were substantially less than the applicable DOE guideline of 3.0 pCi/l (Ref. 10).

Results of measurements for radon daughters ranged from 0.001 to 0.003 WL, and were substantially less than the applicable generic guideline (40 CFR 192) (Ref. 10) of an annual average (or equivalent) radon decay product concentration not to exceed 0.02 WL.

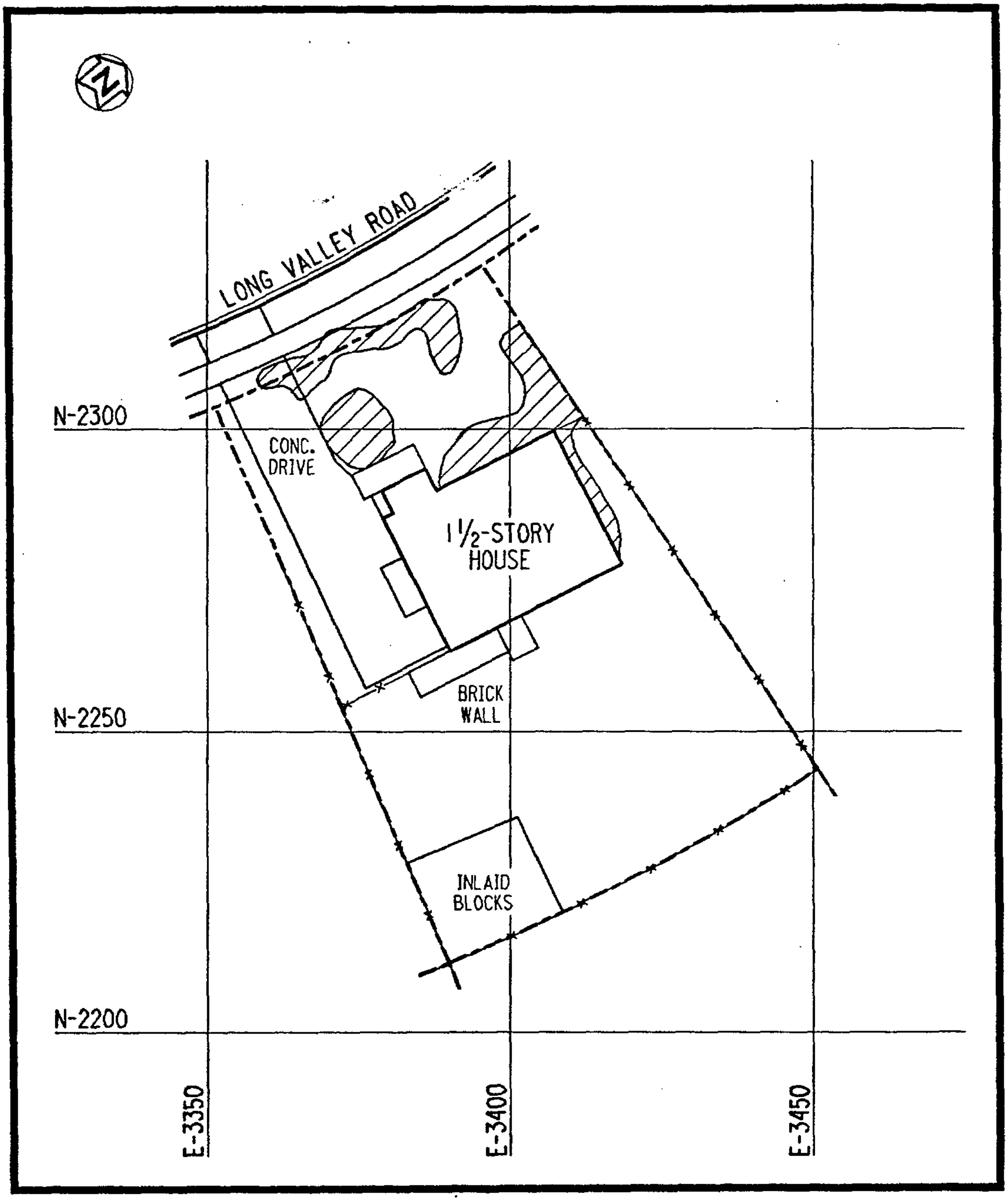

FIGURE 5-1 AREAS OF SURFACE CONTAMINATION AT 26 LONG VALLEY ROAD

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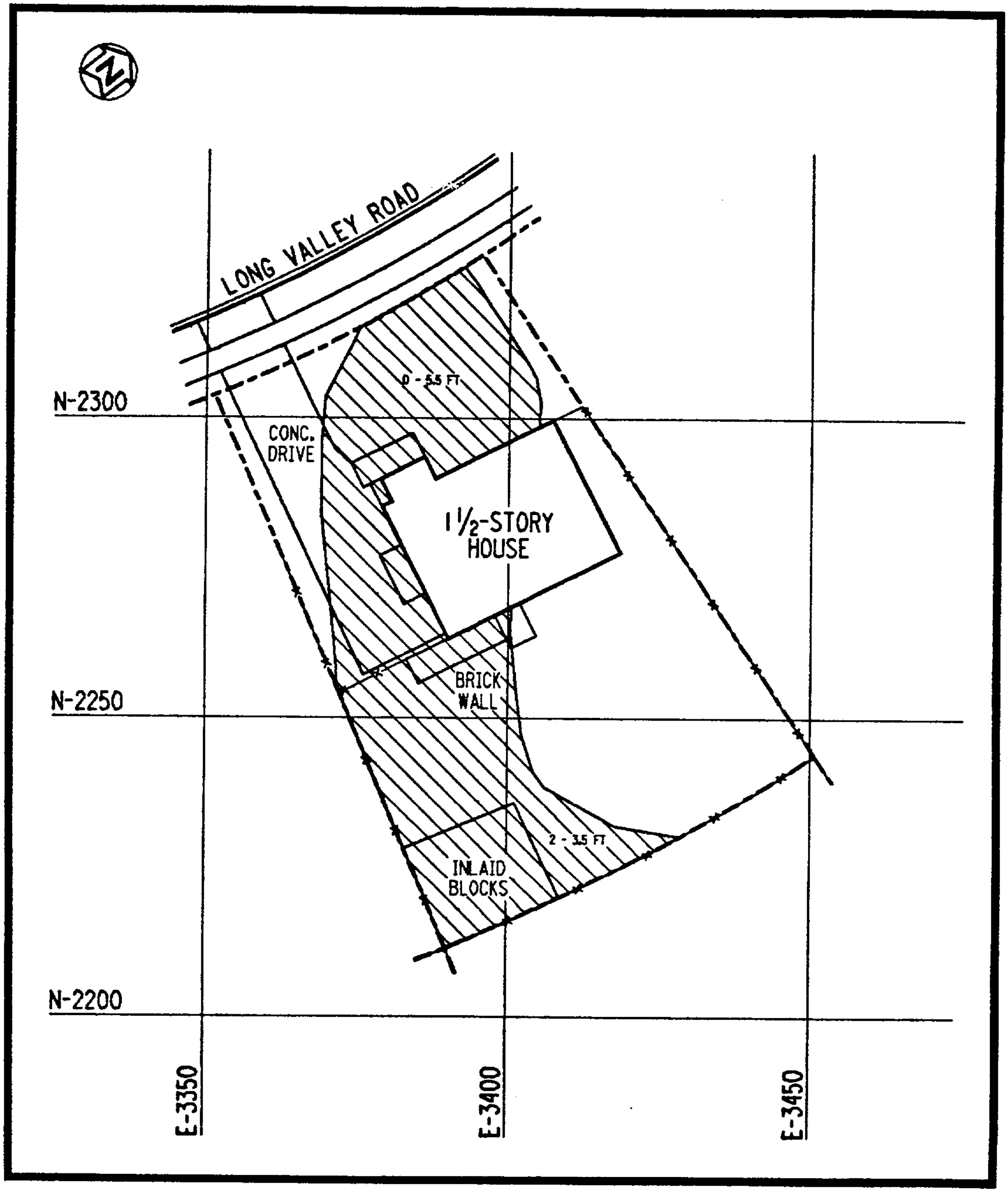

FIGURE 5-2 AREAS OF SUBSURFACE CONTAMINATION AT 26 LONG VALLEY ROAD

Results of measurements for thoron daughters ranged from 0.0001 to 0.0008 WL. The generic guideline is more restrictive for radon-222 (radon) than for radon-220 (thoron) according to NCRP Report No. 50 (Ref. 11), which was used as the guideline for thoron daughter measurements.

Exterior gamma radiation exposure rate measurements ranged from 8 μR/h to 17 μR/h, including background. The indoor exposure rate measurement was 7 μR/h, including background. None of the seven exterior measurements exceeds the DOE guideline of 100 mrem/yr for public exposure. This is based on the assumption of 16 hours occupancy per day for 365 days per year (5,840 hours) and subtracting average background of 9 μR/h (Ref. 12). These results can be found in Table 5-3.

SURFACE AND SUBSURFACE RADIONUCLIDE CONCENTRATIONS IN SOIL
FOR 26 LONG VALLEY ROAD[a]

Page 1 of 2

Coordinates		Depth	Concentration (pCi/g +/- 2 sigma)		
East	North	(ft)	Uranium-238	Radium-226	Thorium-232
3362	2305	0.0 - 0.5	-b-	0.8 +/- 0.1	4.4 +/- 1.4
3362	2305	0.5 - 1.0	-b-	0.9 +/- 0.3	2.4 +/- 0.9
3362	2309	0.0 - 0.5	-b-	< 2.2	10.5 +/- 1.0
3362	2309	0.5 - 1.0	-b-	1.5 +/- 0.6	3.2 +/- 0.4
3375	2251	0.0 - 0.5	-b-	0.8 +/- 0.4	1.4 +/- 0.4
3375	2251	0.5 - 1.0	-b-	0.5 +/- 0.4	3.0 +/- 0.4
3378	2300	0.0 - 0.5	-b-	< 3.0	25.5 +/- 1.3
3378	2300	0.5 - 1.0	-b-	0.8 +/- 0.4	2.9 +/- 0.5
3380	2330	0.0 - 0.5	-b-	1.2 +/- 0.3	1.9 +/- 0.3
3380	2330	0.5 - 1.0	-b-	0.7 +/- 0.4	1.0 +/- 0.3
3382	2232	0.0 - 0.5	-b-	< 2.1	< 3.8
3382	2232	0.5 - 1.0	-b-	0.4 +/- 0.3	2.5 +/- 0.3
3386	2320	0.0 - 0.5	-b-	0.8 +/- 0.4	13.8 +/- 0.5
3386	2320	0.5 - 1.0	-b-	0.7 +/- 0.3	4.5 +/- 0.7
3400	2298	0.0 - 0.5	-b-	2.6 +/- 0.7	35.5 +/- 1.1
3400	2298	0.5 - 1.0	-b-	2.2 +/- 0.5	7.7 +/- 0.8
3406	2268	0.0 - 0.5	-b-	< 1.2	0.9 +/- 0.7
3406	2268	0.5 - 1.0	-b-	1.3 +/- 0.5	3.2 +/- 0.5

(continued)

Coordinates		Depth	Concentration (pCi/g +/- 2 sigma)		
East	North	(ft)	Uranium-238	Radium-226	Thorium-232
3408	2246	0.0 - 0.5	-b-	0.9 +/- 0.4	1.6 +/- 0.3
3408	2246	0.5 - 1.0	-b-	< 1.7	2.0 +/- 0.4
3409	2224	0.0 - 0.5	-b-	< 1.4	1.5 +/- 0.3
3409	2224	0.5 - 1.0	-b-	< 1.4	2.1 +/- 0.4
3416	2288	0.0 - 0.5	-b-	1.2 +/- 0.4	8.5 +/- 0.5
3416	2288	0.5 - 1.0	-b-	< 1.5	1.6 +/- 0.4
3440	2239	0.0 - 0.5	-b-	0.8 +/- 0.5	1.4 +/- 0.4
3440	2239	0.5 - 1.0	-b-	2.1 +/- 0.5	1.1 +/- 0.6

[a]Sampling locations are shown in Figure 4-2.

[b]Analysis not requested.

TABLE 5-2

DOWNHOLE GAMMA LOGGING RESULTS

FOR 26 LONG VALLEY ROAD[a]

Coordinates East	Coordinates North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 454R			
3380	2330	0.5	7000
3380	2330	1.0	9000
3380	2330	1.5	11000
3380	2330	2.0	12000
3380	2330	2.5	12000
3380	2330	3.0	13000
3380	2330	3.5	11000
3380	2330	4.0	11000
3380	2330	4.5	12000
3380	2330	5.0	14000
3380	2330	5.5	13000
3380	2330	6.0	10000
3380	2330	6.5	9000
3380	2330	7.0	10000
3380	2330	7.5	7000
3380	2330	8.0	7000
3380	2330	8.5	7000
Borehole 455R[d]			
3400	2298	0.5	54000
3400	2298	1.0	54000
3400	2298	1.5	39000
3400	2298	2.0	140000
3400	2298	2.5	14000
3400	2298	3.0	13000
3400	2298	3.5	12000
3400	2298	4.0	13000
3400	2298	4.5	13000
3400	2298	5.0	13000
3400	2298	5.5	12000
3400	2298	6.0	13000
3400	2298	6.5	12000
3400	2298	7.0	10000
3400	2298	7.5	9000
3400	2298	8.0	11000

TABLE 5-2
(continued)

Coordinates East	Coordinates North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 456R			
3378	2300	0.5	24000
3378	2300	1.0	29000
3378	2300	1.5	18000
3378	2300	2.0	14000
3378	2300	2.5	14000
3378	2300	3.0	13000
3378	2300	3.5	12000
3378	2300	4.0	13000
3378	2300	4.5	11000
3378	2300	5.0	12000
3378	2300	5.5	120000
3378	2300	6.0	12000
3378	2300	6.5	10000
3378	2300	7.0	9000
3378	2300	7.5	10000
3378	2300	8.0	9000
Borehole 457R[d]			
3362	2309	0.5	18000
3362	2309	1.0	22000
3362	2309	1.5	17000
3362	2309	2.0	14000
3362	2309	2.5	12000
3362	2309	3.0	13000
3362	2309	3.5	12000
3362	2309	4.0	13000
3362	2309	4.5	12000
3362	2309	5.0	12000
3362	2309	5.5	14000
3362	2309	6.0	13000
3362	2309	6.5	12000
3362	2309	7.0	12000
Borehole 458R			
3386	2320	0.5	43000
3386	2320	1.0	36000
3386	2320	1.5	21000

TABLE 5-2

(continued)

Coordinates East	North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 458R (continued)			
3386	2320	2.0	13000
3386	2320	2.5	13000
Borehole 459R[d]			
3416	2288	0.5	19000
3416	2288	1.0	19000
3416	2288	1.5	16000
3416	2288	2.0	13000
3416	2288	2.5	14000
3416	2288	3.0	13000
3416	2288	3.5	12000
3416	2288	4.0	12000
3416	2288	4.5	11000
3416	2288	5.0	13000
3416	2288	5.5	12000
3416	2288	6.0	10000
3416	2288	6.5	12000
3416	2288	7.0	11000
3416	2288	7.5	11000
Borehole 460R			
3406	2268	0.5	12000
3406	2268	1.0	15000
3406	2268	1.5	19000
3406	2268	2.0	15000
3406	2268	2.5	12000
3406	2268	3.0	12000
3406	2268	3.5	11000
3406	2268	4.0	11000
3406	2268	4.5	13000
3406	2268	5.0	15000
3406	2268	5.5	13000
3406	2268	6.0	12000
3406	2268	6.5	12000
Borehole 461R			
3375	2251	0.5	10000
3375	2251	1.0	14000

TABLE 5-2

(continued)

Coordinates East	Coordinates North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 461R (continued)			
3375	2251	1.5	21000
3375	2251	2.0	56000
3375	2251	2.5	37000
3375	2251	3.0	19000
Borehole 462R[d]			
3382	2232	0.5	8000
3382	2232	1.0	11000
3382	2232	1.5	12000
3382	2232	2.0	13000
3382	2232	2.5	16000
3382	2232	3.0	42000
3382	2232	3.5	41000
3382	2232	4.0	24000
3382	2232	4.5	17000
3382	2232	5.0	16000
Borehole 463R[d]			
3409	2224	0.5	8000
3409	2224	1.0	9000
3409	2224	1.5	10000
3409	2224	2.0	11000
3409	2224	2.5	11000
3409	2224	3.0	24000
3409	2224	3.5	30000
3409	2224	4.0	16000
3409	2224	4.5	17000
3409	2224	5.0	12000
3409	2224	5.5	11000
3409	2224	6.0	10000
Borehole 464R[d]			
3440	2239	0.5	7000
3440	2239	1.0	8000
3440	2239	1.5	9000
3440	2239	2.0	10000

TABLE 5-2
(continued)

Coordinates East	North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 464R[d]			
3440	2239	2.5	11000
3440	2239	3.0	13000
3440	2239	3.5	17000
3440	2239	4.0	18000
3440	2239	4.5	17000
3440	2239	5.0	16000
3440	2239	5.5	12000
3440	2239	6.0	11000
3440	2239	6.5	9000
3440	2239	7.0	9000
3440	2239	7.5	9000
Borehole 465R			
3408	2246	0.5	7000
3408	2246	1.0	8000
3408	2246	1.5	9000
3408	2246	2.0	10000
3408	2246	2.5	11000
3408	2246	3.0	13000
3408	2246	3.5	14000
3408	2246	4.0	14000
3408	2246	4.5	12000
3408	2246	5.0	12000
3408	2246	5.5	12000
3408	2246	6.0	10000
3408	2246	6.5	10000
Borehole 509R[d]			
3362	2305	0.5	15000
3362	2305	1.0	13000
3362	2305	1.5	12000
3362	2305	2.0	13000
3362	2305	2.5	12000
3362	2305	3.0	13000
3362	2305	3.5	12000
3362	2305	4.0	12000
3362	2305	4.5	12000

TABLE 5-2
(continued)

Coordinates East	Coordinates North	Depth[b] (ft)	Count Rate[c] (cpm)
Borehole 509R (continued)[d]			
3362	2305	5.0	12000
3362	2305	5.5	12000
3362	2305	6.0	11000
3362	2305	6.5	11000
3362	2305	7.0	9000
3362	2305	7.5	9000
3362	2305	8.0	7000
3362	2305	8.5	7000
3362	2305	9.0	7000
3362	2305	9.5	7000

[a]Borehole locations are shown in Figure 4-1.

[b]The variations in depths of boreholes and corresponding results given in this table are based on the boreholes penetrating the contamination or the drill reaching refusal.

[c]Instrument used was 2-in. by 2-in. thallium-activated sodium iodide gamma scintillation detector.

[d]Bottom of borehole collapsed.

TABLE 5-3

GAMMA RADIATION EXPOSURE RATES

FOR 26 LONG VALLEY ROAD

Coordinates		
East	North	μR/h
3369	2317	17
3373	2269	8
3390	2248	9
3393	2304	17
3416	2236	9
3421	2261	10
INTERIOR OF RESIDENCE		7

Measurements include background.

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APPENDIX A

GEOLOGIC DRILL LOGS FOR 26 LONG VALLEY ROAD

LODI, NEW JERSEY

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	454R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2330; E 3380	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	9.0		9.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				44.2	6.0/38.2 10-9-86 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							44.2				0.0-9.0 ft. <u>SILTY SAND</u> (SM-SC). Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist-saturated at 6.0 ft.; difficult to distinguish between fill and native material. 0.0-5.0 ft. dark reddish brown (10R3/4); few pieces of angular sandstone gravel; numerous grass roots and organics (0.0-0.5 ft). 5.0-6.5 ft. grayish black (N2); few pale green (5G7/2) silty lenses; clayey (SC). 6.5-9.0 ft. dark yellowish brown (10YR4/2).	Borehole drilled 0.0-9.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 6.0 ft. ground water observed.
								5				
							35.2				Bottom of borehole at 9.0 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
26 Long Valley Rd. (LODI)	454R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	455R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2298; E 3400	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	9.0		9.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				44.8	8.0/36.8 10-9-86	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							44.8				0.0-9.0 ft. **SILTY SAND** (SM). Color stratified; fine-to medium-grained; with a few rounded pebbles of various lithologies; soft; poorly consolidated (loose); moist-saturated at 8.0 ft.; difficult to distinguish between fill and native material. 0.0-0.5 ft. grayish black (N2); numerous organics and roots. 0.5-9.0 ft. dark reddish brown (10R3/4); with a few pale green (5G7/2) silty lenses; mixed fill and native material?	Borehole drilled 0.0-9.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation.
								5				
							35.8					8.0 ft. ground water observed.
											Bottom of borehole at 9.0 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER	SITE	HOLE NO.
	26 Long Valley Rd. (LODI)	455R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	456R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2300; E 3378	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	8.5		8.5

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				44.8	6.0/38.8 10-9-86 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							44.8	0–5			0.0-8.5 ft. **SILTY SAND** (SM). Color stratified; fine-to medium-grained; numerous pieces of concrete (0.0-6.0 ft.);and a few pebbles of various lithologies; (6.5-8.5 ft.) moist-saturated at 6.0 ft.; difficult to distinguish between fill and native material. 0.0-1.0 ft. grayish black (N2); numerous organics and grass roots. 1.0-6.0 ft. dark reddish brown (10R3/4); fill? 6.0-6.5 ft. dark yellowish brown (10YR4/2). 6.5-8.5 ft. dark reddish brown.	Borehole drilled 0.0-8.5 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 6.0 ft. ground water observed.
							36.3				Bottom of borehole at 8.5 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
26 Long Valley Rd. (LODI)	456R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	457R

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
26 Long Valley Rd. (LODI)	N 2309; E 3362	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	9.0		9.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				44.4	6.0/38.4 10-9-86 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							44.4				0.0-9.0 ft. SILTY SAND (SM). Fill (0.0-6.0 ft.) and indigenous material. Color stratified; fine-to medium-grained with few numerous pieces of rounded-angular gravel (and occasional cobble) various lithologies in the fill material; soft; unconsolidated (loose); sometimes clayey (SC-OH); moist-saturated at 6.0 ft. 0.0-0.3 ft. moderate brown (5YR3/4); numerous grass roots and organics. 0.3-6.0 ft. dark reddish brown (10R3/4). 6.0-9.0 ft. mottled moderate brown, grayish black (N2), and dark reddish brown; mixed fill and indigenous upper soil horizon?.	Borehole drilled 0.0-9.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 6.0 ft. ground water observed.
								5				
							35.4					
											Bottom of borehole at 9.0 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER	SITE	HOLE NO.
	26 Long Valley Rd. (LODI)	457R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	458R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2320; E 3386	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	3.0		3.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				44.3	/	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							44.3				0.0-3.0 ft. SILTY SAND (SM). Fill material; fine-to medium-grained with few numerous pieces of rounded-angular gravel (and occasional cobble) various lithologies in the fill material; soft; unconsolidated (loose); few sandstone blocks and pieces of gravel; moist. 0.0-0.5 ft. moderate brown (5YR3/4); numerous grass roots and organics. 0.5-3.0 ft. dark reddish brown (10R3/4).	Borehole drilled 0.0-3.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 3.0 ft. auger refusal (cobble?). No ground water observed.
							41.3				Bottom of borehole at 3.0 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
26 Long Valley Rd. (LODI)	458R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	459R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2288; E 3416	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	8.5		8.5

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				43.7	8.5/35.2 10-9-86 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							43.7				0.0-8.5 ft. **SILTY SAND** (SM-SC). Fill and indigenous material. Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist-saturated (see notes). 0.0-5.0 ft. dark reddish brown (10R3/4); occasional pieces of black carboniferous shale and sandstone gravel; numerous grass roots and organics (0.0-0.5 ft.). 5.0-6.0 ft. moderate brown (5YR3/4); clayey (SC). 6.0-8.5 ft. dark reddish brown few rounded quartz pebbles; difficult to distinguish between fill and native material.	Borehole drilled 0.0-8.5 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 4.5-5.0 ft. saturated.
								5				
							35.2 ▽				Bottom of borehole at 8.5 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	8.5 ft. ground water observed.
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
26 Long Valley Rd. (LODI)	459R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	460R

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING
26 Long Valley Rd. (LODI)	N 2268; E 3406	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	6.5		6.5

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				43.4	/	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							43.4				0.0-6.5 ft. <u>SILTY SAND</u> (SM). Fill and indigenous material. Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist. 0.0-1.0 ft. moderate brown (5YR3/4); few rounded cobbles of various lithologies; numerous grass roots and organics. 1.0-6.5 ft. dark reddish brown (10YR3/4); mottled moderate brown (5YR3/4) (4.0-6.5 ft.); numerous pieces of sandstone gravel; few quartz pebbles (4.0-6.5 ft.); difficult to distinguish between fill and native material.	Borehole drilled 0.0-6.5 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. No ground water observed. 6.5 ft. auger refusal (cobble?).
								5				
							36.9				Bottom of borehole at 6.5 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: 26 Long Valley Rd. (LODI) — HOLE NO. 460R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	461R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2251; E 3375	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	3.0		3.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				43.3	/	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							43.3				0.0-3.0 ft. <u>SILTY SAND</u> (SM). Fill. Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); numerous pieces of sandstone gravel; piece of glass (3.0 ft.); moist. 0.0-0.5 ft. moderate brown (5YR3/4); few roots and organics. 0.5-3.0 ft. dark reddish brown (10YR3/4); mottled moderate brown (5YR3/4).	Borehole drilled 0.0-3.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 3.0 ft. auger refusal (cobble?). No ground water observed.
							40.3				Bottom of borehole at 3.0 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER	SITE	HOLE NO.
	26 Long Valley Rd. (LODI)	461R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	462R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2232; E 3382	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	6.5		6.5

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				43.0	/	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							43.0				0.0-6.5 ft. SILTY SAND (SM). Fill and indigenous material. Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist; numerous pieces of sandstone gravel. 0.0-0.5 ft. moderate brown (5YR3/4); 0.5-6.5 ft. dark reddish brown (10YR3/4); mottled moderate brown (5YR3/4); few quartz pebbles; difficult to distinguish between fill and native material.	Borehole drilled 0.0-6.5 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. No ground water observed. 6.5 ft. auger refusal (cobble?).
								5				
							36.5				Bottom of borehole at 6.5 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER	SITE	HOLE NO.
	26 Long Valley Rd. (LODI)	462R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	463R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2224; E 3409	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	7.0		7.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				42.8	/	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							42.8				0.0-7.0 ft. <u>SILTY SAND</u> (SM-SC). Fill and indigenous material. Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist; numerous pieces of sandstone gravel. 0.0-0.5 ft. moderate brown (5YR3/4); few cobbles of various lighologies (fill). 0.5-3.0 ft. ft. dark reddish brown (10YR3/4). 3.0-6.0 ft. dark reddish brown; mottled moderate brown; clayey; mixed fill and floodplain sediments? 6.0-7.0 ft. dark reddish brown; difficult to distinguish between fill and native material.	Borehole drilled 0.0-7.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. No ground water observed. 7.0 ft. auger refusal (cobble?).
								5				
							35.8				Bottom of borehole at 7.0 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
26 Long Valley Rd. (LODI)	463R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	464R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2239; E 3440	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	9.0		9.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				43.2	8.5/34.7 10-9-86 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							43.2					
								5			0.0-9.0 ft. **SILTY SAND** (SM-SC). Fill and indigenous material. Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist-saturated at 8.5 ft. 0.0-1.5 ft. dark yellowish orange (10YR6/6; numerous grass roots and organics. 1.5-4.5 ft. moderate brown (5YR3/4); pieces of plastic (2.0 and 4.0 ft.); numerous rounded quartz pebbles and black shale gravel; fill? 4.5-5.0 ft. grayish black (N2); clayey (SC). 5.0-9.0 ft. dark yellowish brown (YR4/2); native?	Borehole drilled 0.0-9.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation.
							34.2					8.5 ft. ground water observed.
											Bottom of borehole at 9.0 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE	HOLE NO.
26 Long Valley Rd. (LODI)	464R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	465R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Rd. (LODI)	N 2246; E 3408	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-9-86	10-9-86	MORETRENCH	B&S Little Beaver	4"	7.0		7.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				43.1	/ /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							43.1				0.0-7.0 ft. <u>SILTY SAND</u> (SM-SC). Fill and indigenous material. Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist. 0.0-0.5 ft. moderate brown (5YR3/4). 0.5-7.0 ft. dark reddish brown (10YR3/4); mottled moderate brown; numerous pieces of gravel of various lithologies (0.0-4.5 ft.); difficult to distinguish between fill and native material.	Borehole drilled 0.0-7.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. No ground water observed. 7.0 ft. auger refusal (cobble?).
								5				
							36.1				Bottom of borehole at 7.0 ft. Auger spoils were immediately replaced in the hole, 10-9-86.	
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE: 26 Long Valley Rd. (LODI) — HOLE NO. 465R

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501-138	1 OF 1	509R

SITE	COORDINATES	ANGLE FROM HORIZ	BEARING
26 Long Valley Road (LODI)	N 2305; E 3362	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-31-86	10-31-86	MORETRENCH	B&S Little Beaver	4"	11.0		11.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/				44.5	8.0/36.5 10-31-86 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
N/A	NONE	D. McGRANE

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							44.5					
								5, 10			0.0-11.0 ft. <u>SILTY SAND</u> (SM). Fill (0.0-3.0 ft.) and indigenous material (4.0-11.0 ft.); color stratified; fine-to medium-grained; with few-numerous pieces of rounded angular gravel (and occasional cobble) of various lithologies in the fill material; soft; unconsolidated (loose); sometimes clayey (SC-OH); moist-saturated at 8.0 ft. 0.0-0.3 ft. moderate brown (5YR3/4); numerous grass roots and organics. 0.3-3.0 ft. dark reddish brown (10R3/4). 3.0-5.0 ft. moderate brown (5YR3/4); buried upper soil horizon? 5.0-11.0 ft. decomposed sandstone?; dark yellowish brown (10YR4/2) (5.0-8.0 ft.) and dark reddish brown (8.0-11.0 ft.).	Borehole drilled 0.0-11.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 8.0 ft. ground water observed.
							33.5				Bottom of borehole at 11.0 ft. Auger spoils were immediately replaced in the hole, 10-31-86.	
												Description and classification of soil samples by visual examination.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER	SITE	HOLE NO.
	26 Long Valley Road (LODI)	509R