

057116-04

DOE/OR/20722-170

M-040

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

**RADIOLOGICAL CHARACTERIZATION
REPORT FOR THE RESIDENTIAL
PROPERTY AT 18 LONG VALLEY ROAD**

Lodi, New Jersey

November 1988



Bechtel National, Inc.

057116

Bechtel National, Inc.

Systems Engineers — Constructors

Jackson Plaza Tower
800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37830



Mail Address: P.O. Box 317, Oak Ridge, TN 37831-0317
Telex: 3785873

NOV 1 1988

U.S. Department of Energy
Oak Ridge Operations
Post Office Box 2001
Oak Ridge, Tennessee 37831-8723

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

Peter J. Gross

2

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,

D. Clemens

B. W. Clemens *for*
Project Manager - FUSRAP

CONCURRENCE

BWC/skl:1750x

Enclosures: As stated

SKL	EG			
-----	----	--	--	--

cc: R. G. Atkin, w/o
J. D. Berger, ORAU (w/all enclosures)
G. K. Hovey, w/o
B. A. Hughlett, w/o
M. R. McDougall, TMA/E (w/all enclosures)
S. K. Oldham, w/o
R. Rosen, EPA Region II, w/o
R. E. Swaja, ORNL, w/o
J. F. Wing, w/o

RADIOLOGICAL CHARACTERIZATION REPORT
FOR THE RESIDENTIAL PROPERTY
AT 18 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

N. C. Ring and S. K. Livesay
Bechtel National, Inc.
Oak Ridge, Tennessee
Bechtel Job No. 14501

TABLE OF CONTENTS

	<u>Page</u>
Abbreviations	v
1.0 Introduction and Summary	1
1.1 Introduction	1
1.2 Purpose	1
1.3 Summary	3
2.0 Site History	6
2.1 Previous Radiological Surveys	7
2.2 Remedial Action Guidelines	7
3.0 Health and Safety Plan	11
3.1 Subcontractor Training	11
3.2 Safety Requirements	11
4.0 Characterization Procedures	13
4.1 Field Radiological Characterization	13
4.1.1 Measurements Taken and Methods Used	13
4.1.2 Sample Collection and Analysis	14
4.2 Building Radiological Characterization	17
5.0 Characterization Results	20
5.1 Field Radiological Characterization	20
5.2 Building Radiological Characterization	21
References	32
Appendix A - Geologic Drill Logs for 18 Long Valley Road	A-1

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1-1	Location of Lodi Vicinity Properties	2
1-2	Location of 18 Long Valley Road	4
4-1	Borehole Locations at 18 Long Valley Road	15
4-2	Surface and Subsurface Soil Sampling Locations at 18 Long Valley Road	16
4-3	Exposure Rate Measurement Locations at 18 Long Valley Road	19
5-1	Areas of Surface Contamination at 18 Long Valley Road	22
5-2	Areas of Subsurface Contamination at 18 Long Valley Road	23

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
2-1	Summary of Residual Contamination Guidelines for the Lodi Vicinity Properties	9
5-1	Surface and Subsurface Radionuclide Concentrations in Soil for 18 Long Valley Road	25
5-2	Downhole Gamma Logging Results for 18 Long Valley Road	27
5-3	Gamma Radiation Exposure Rate Measurements for 18 Long Valley Road	31

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 in 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.

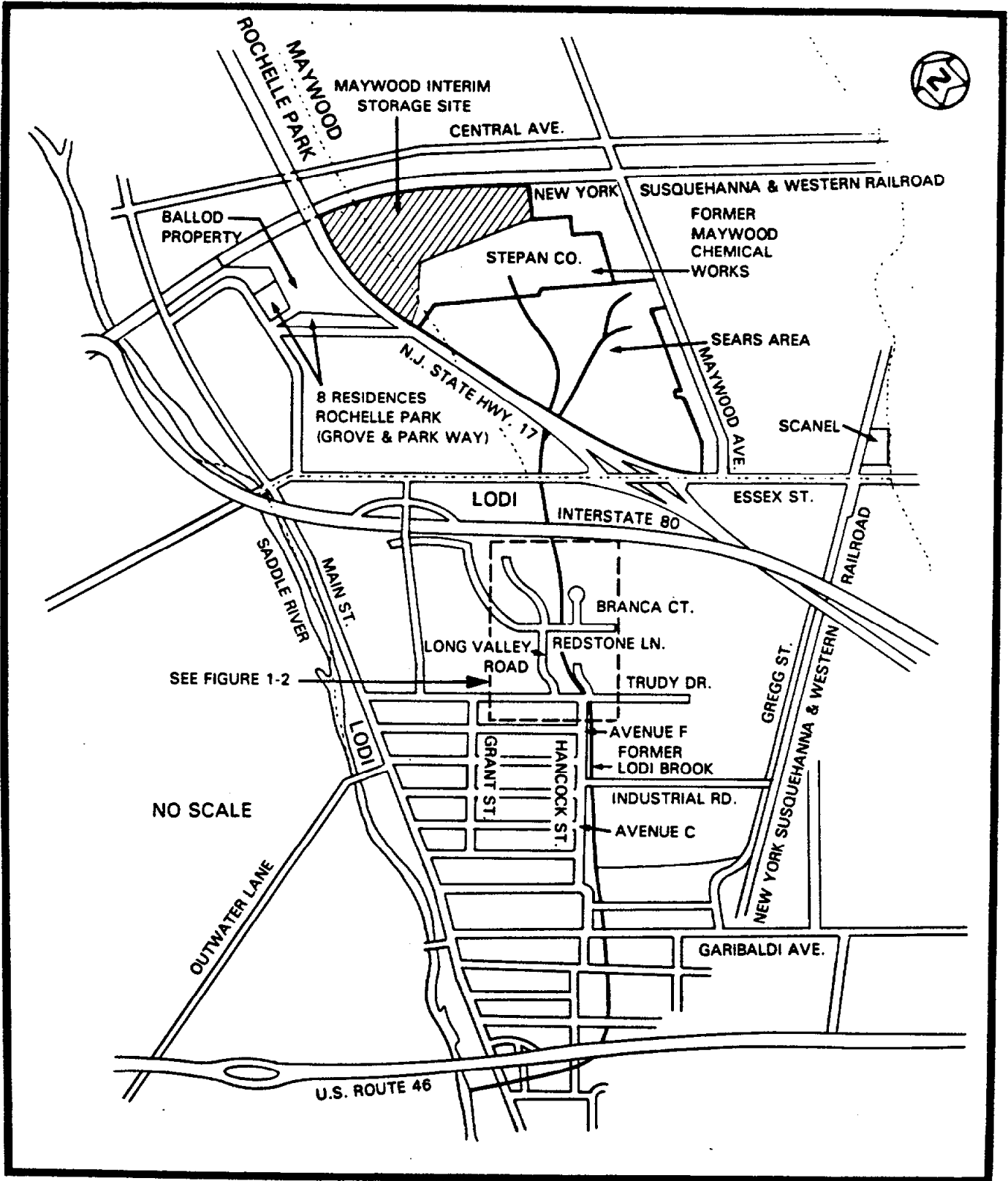


FIGURE 1-1 LOCATION OF LODI VICINITY PROPERTIES

1.3 SUMMARY

This report summarizes the procedures and results of the radiological characterization of the property at 18 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 18 Long Valley Road showed maximum concentrations of thorium-232 and radium-226 to be 58.3 and less than 3.0 pCi/g, respectively. Subsurface soil sample concentrations ranged from 0.9 to 31.9 pCi/g for thorium-232 and from 0.5 to 2.8 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).

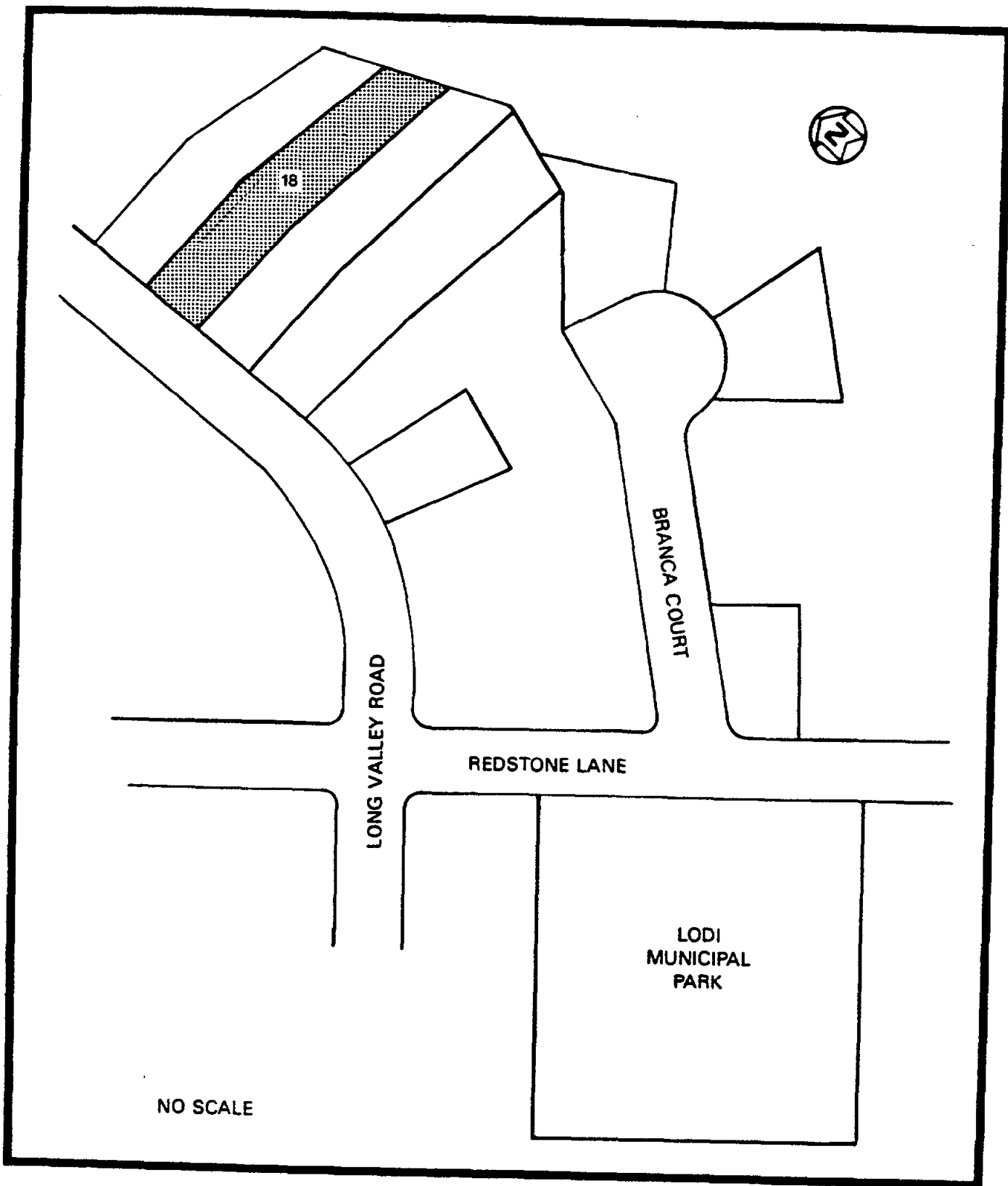


FIGURE 1-2 LOCATION OF 18 LONG VALLEY ROAD

Soil analysis data for this property showed surface contamination. Subsurface investigation by gamma logging and soil analysis indicated contamination to a depth of 2.0 ft.

Exterior gamma radiation exposure measurements ranged from 7 to 12 μ R/h, including background, outside the residence. The measurement inside the residence was 5 μ R/h, including background.

The radon-222 measurements inside the residence indicated a concentration of 0.1 pCi/l, which is within the DOE guideline of 3.0 pCi/l.

Measurements for radon daughters ranged from 0.0007 to 0.002 WL, and measurements for thoron daughters ranged from 0.0001 to 0.0004 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-mi² 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

Page 1 of 2

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)

<u>Radionuclide</u>	<u>Soil Concentration (pCi/g) above background^{a,b,c}</u>
Radium-226	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.
Radium-228	
Thorium-230	
Thorium-232	

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

<u>Radionuclide^f</u>	<u>Allowable Residual Surface Contamination^e</u> <u>(dpm/100 cm²)</u>		
	<u>Average^{g,h}</u>	<u>Maximum^{h,i}</u>	<u>Removable^{h,j}</u>
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)

Page 2 of 2

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

^aThese 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.

^bThese guidelines represent residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100-m² surface area.

^cLocalized concentrations in excess of these limits are allowable provided that the average concentration over a 100-m² area does not exceed these limits.

^dA 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 1.3×10^5 MeV of potential alpha energy.

^eAs 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.

^fWhere surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

^gMeasurements of average contamination should not be averaged over more than 1 m². For objects of less surface area, the average shall be derived for each such object.

^hThe 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.

ⁱThe maximum contamination level applies to an area of not more than 100 cm².

^jThe amount of removable radioactive material per 100 cm² 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 cm² 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.

- o 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.
- o Protective Clothing/Equipment - Subcontractor personnel are required to wear the protective clothing/equipment specified in the subcontract or as directed by the BNI representative.
- o Dosimetry - Subcontractor personnel are required to wear, and return daily, the dosimeters and monitors issued by BNI.
- o 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.
- o 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 12 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 in 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 12 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

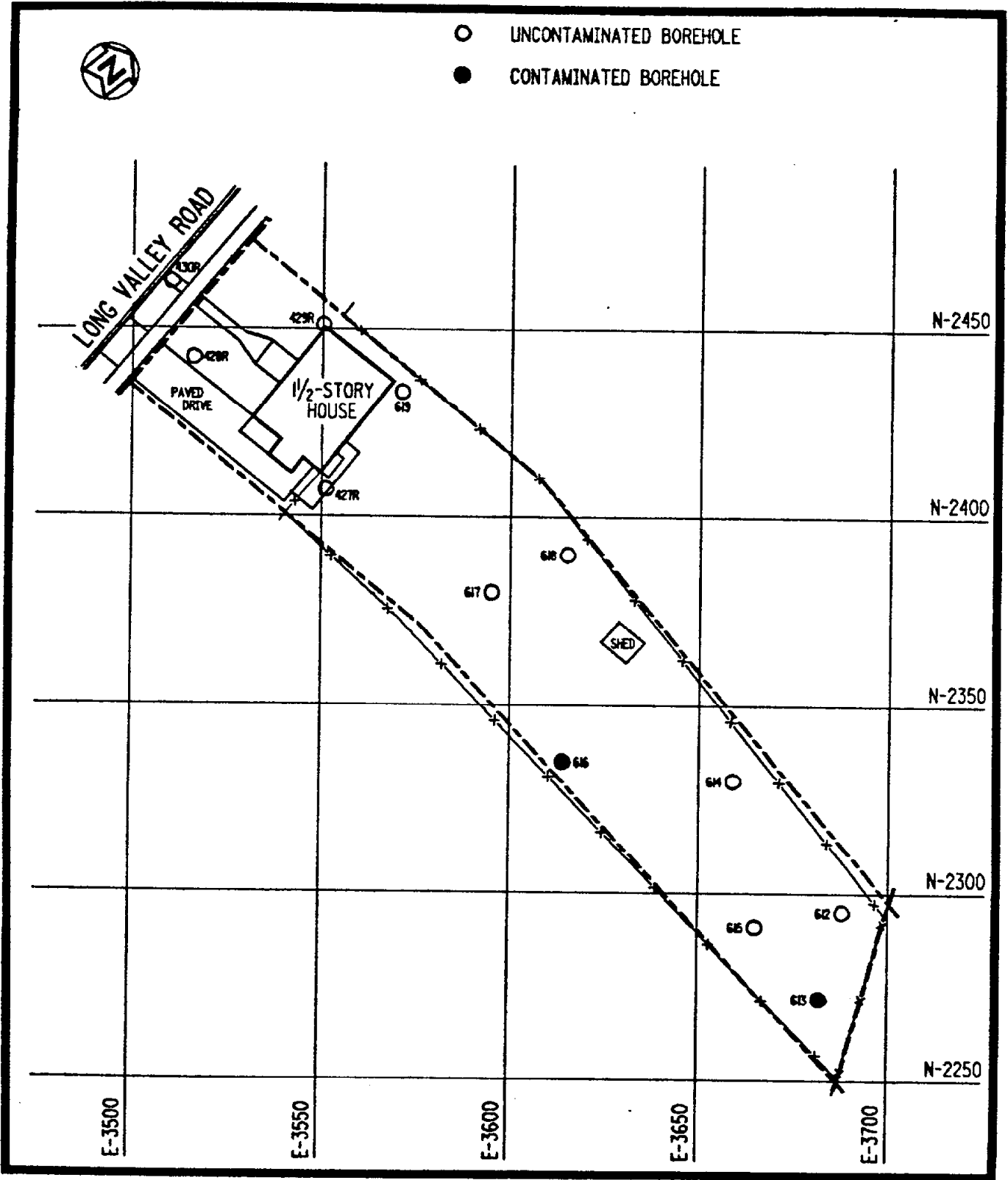


FIGURE 4-1 BOREHOLE LOCATIONS AT 18 LONG VALLEY ROAD

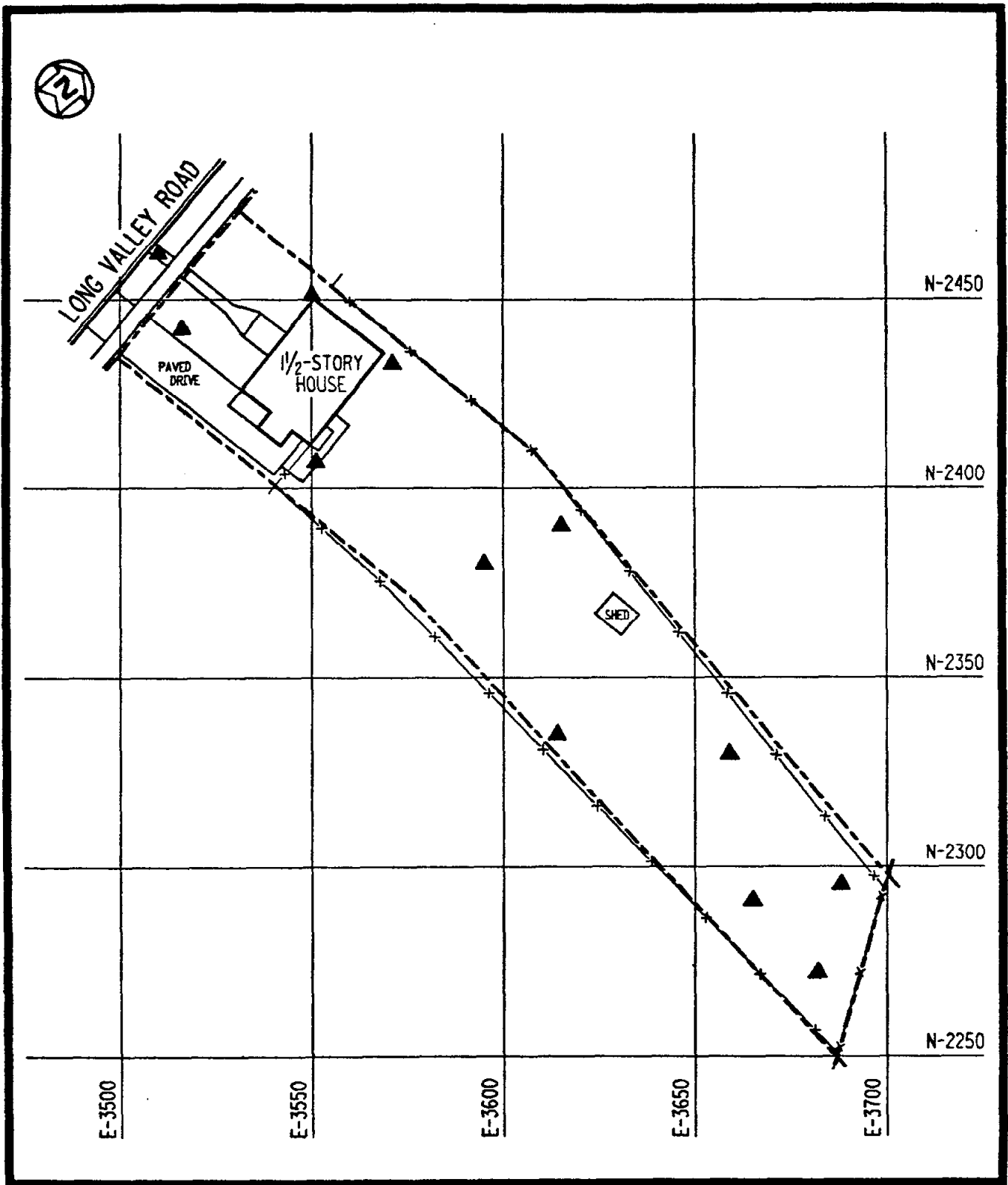


FIGURE 4-2 SURFACE AND SUBSURFACE SOIL SAMPLING LOCATIONS AT 18 LONG VALLEY ROAD

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 12 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.

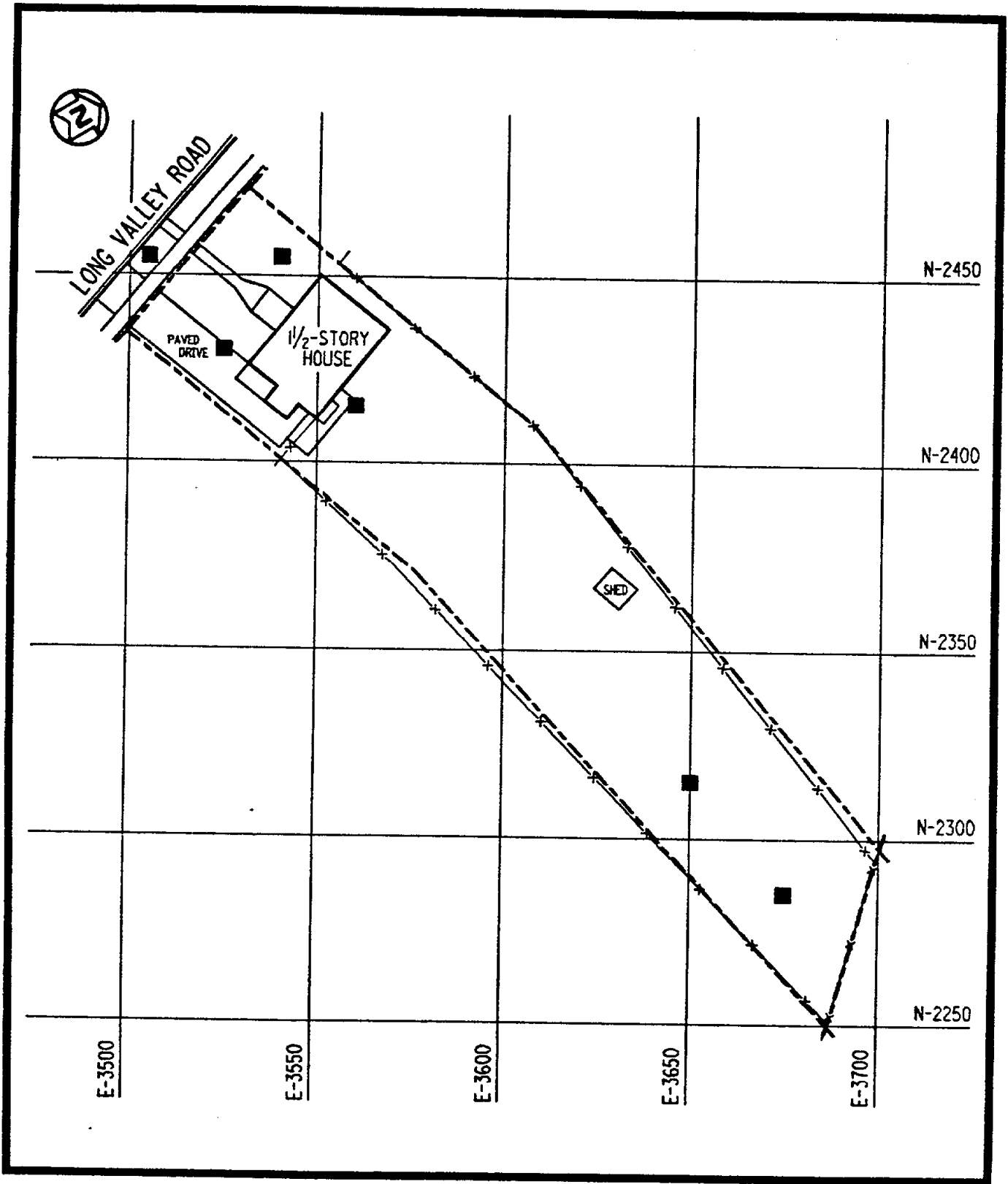


FIGURE 4-3 EXPOSURE RATE MEASUREMENT LOCATIONS AT 18 LONG VALLEY ROAD

5.0 CHARACTERIZATION RESULTS

5.1 FIELD RADIOLOGICAL CHARACTERIZATION

Near-surface gamma radiation measurements on the property ranged from 3,500 cpm to approximately 30,000 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 were taken from several locations on the property (Figure 4-2). These samples were analyzed for thorium-232 and radium-226. The concentrations in these samples ranged from 1.4 to 58.3 pCi/g for thorium-232 and from 0.9 pCi/g to less than 3.0 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 58.3 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.

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 6,000 cpm to 91,000 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 indicated thorium-232 concentrations ranging from 0.9 to 31.9 pCi/g and radium-226 concentrations ranging from 0.5 to 2.8 pCi/g.

On the basis of near-surface gamma radiation measurements, surface and subsurface soil sample analysis, and downhole gamma logging, the contamination of this property is believed to consist primarily of surface contamination with an isolated area of subsurface contamination. The subsurface contamination is located in the backyard of the property near the southeastern corner to a depth of 2.0 ft. Areas of surface contamination are shown in Figure 5-1. The area of subsurface contamination is shown in Figure 5-2.

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 a concentration of 0.1 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 0.0007 to 0.002 WL and were substantially less than the applicable generic

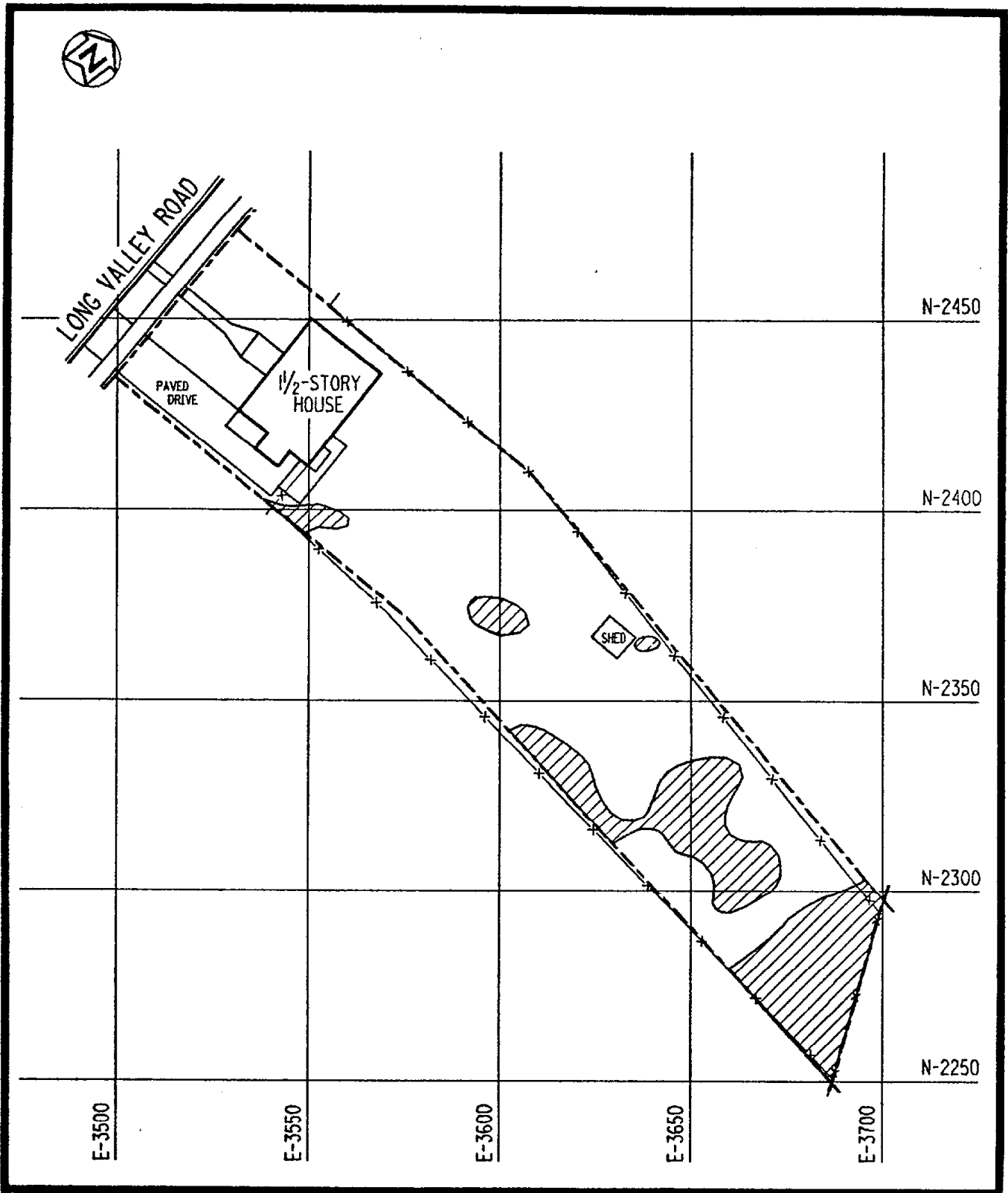


FIGURE 5-1 AREAS OF SURFACE CONTAMINATION AT 18 LONG VALLEY ROAD

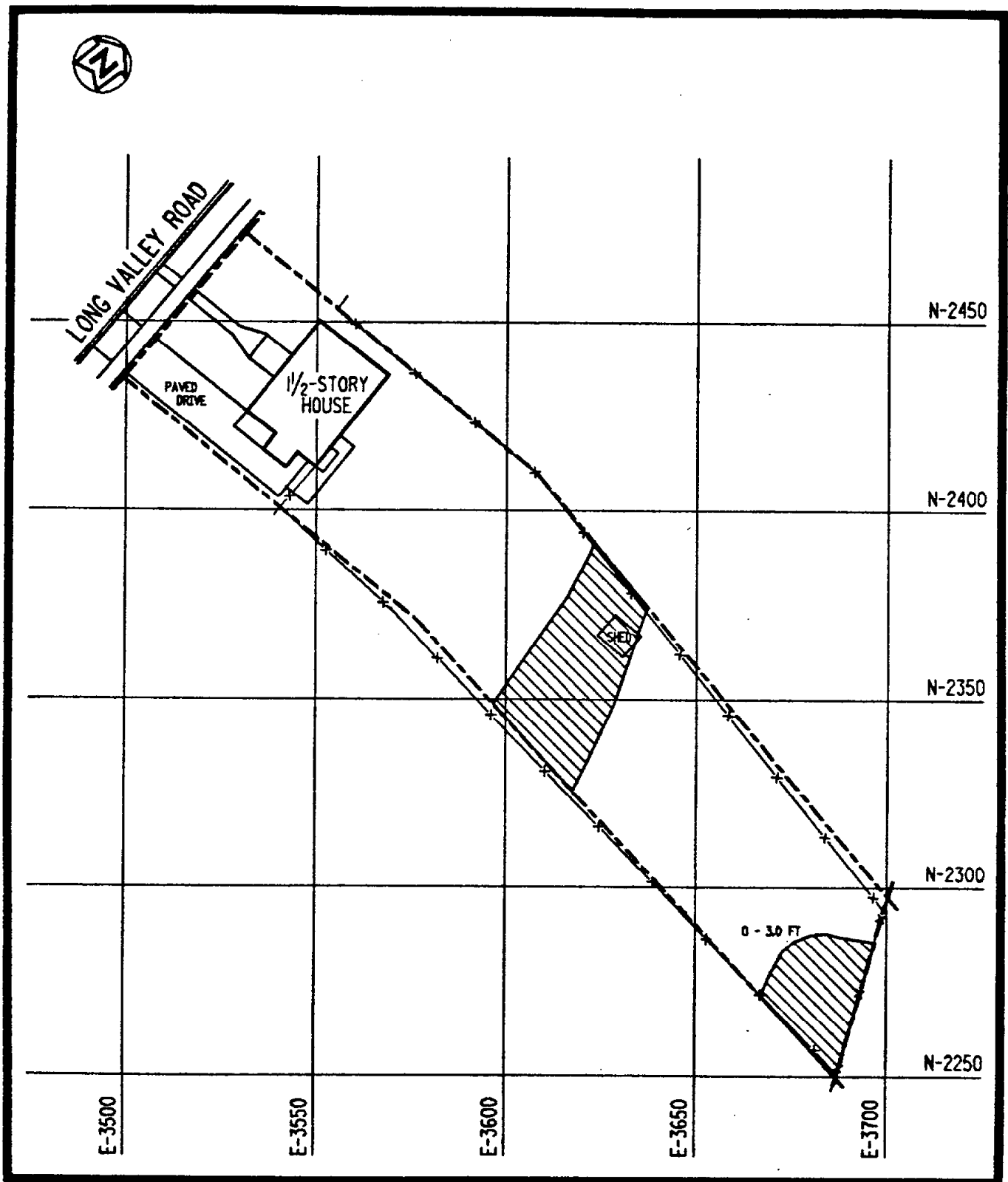


FIGURE 5-2 AREAS OF SUBSURFACE CONTAMINATION AT 18 LONG VALLEY ROAD

guideline (40 CFR 192) (Ref. 10) of an annual average (or equivalent) radon decay product concentration not to exceed 0.02 WL.

Results of measurements for thoron daughters ranged from 0.0001 to 0.0004 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 7 μ R/h to 12 μ R/h, including background. The indoor exposure rate measurement was 5 μ R/h, including background. None of the 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 μ R/h (Ref. 12). These results can be found in Table 5-3.

TABLE S-1

SURFACE AND SUBSURFACE RADIONUCLIDE CONCENTRATIONS IN SOIL
FOR 18 LONG VALLEY ROAD^a

Page 1 of 2

Coordinates		Depth (ft)	Concentration (pCi/g +/- 2 sigma)		
East	North		Uranium-238	Radium-226	Thorium-232
3510	2462	0.0 - 0.5	-b-	1.4 +/- 0.7	1.6 +/- 0.4
3510	2462	0.5 - 1.0	-b-	1.1 +/- 0.6	2.1 +/- 0.6
3516	2242	0.0 - 0.5	-b-	1.9 +/- 0.4	2.5 +/- 0.4
3516	2242	0.5 - 1.0	-b-	2.3 +/- 0.7	1.5 +/- 0.6
3550	2451	0.0 - 0.5	-b-	< 1.1	1.4 +/- 0.2
3550	2451	0.5 - 1.0	-b-	0.5 +/- 0.3	1.2 +/- 0.2
3551	2407	0.0 - 0.5	-b-	< 1.3	3.2 +/- 0.5
3551	2407	0.5 - 1.0	-b-	< 1.6	1.9 +/- 0.4
3571	2433	0.0 - 0.5	-b-	0.9 +/- 0.3	4.1 +/- 0.3
3571	2433	0.5 - 1.0	-b-	1.0 +/- 0.4	1.9 +/- 0.7
3595	2380	0.0 - 0.5	-b-	1.0 +/- 0.4	2.6 +/- 0.4
3595	2380	0.5 - 1.0	-b-	2.8 +/- 0.6	1.1 +/- 0.8
3614	2335	0.0 - 0.5	-b-	1.3 +/- 0.4	5.7 +/- 0.5
3614	2335	0.5 - 1.0	-b-	2.7 +/- 0.8	8.8 +/- 1.1
3615	2390	0.0 - 0.5	-b-	1.0 +/- 0.5	3.3 +/- 0.4
3615	2390	0.5 - 1.0	-b-	1.0 +/- 0.6	0.9 +/- 0.6
3659	2330	0.0 - 0.5	-b-	0.9 +/- 0.4	7.4 +/- 0.4
3659	2330	0.5 - 1.0	-b-	0.9 +/- 0.4	1.1 +/- 0.7

TABLE 3-1
(continued)

Page 2 of 2

Coordinates		Depth (ft)	Concentration (pCi/g +/- 2 sigma)		
East	North		Uranium-238	Radium-226	Thorium-232
3665	2291	0.0 - 0.5	-b-	1.9 +/- 0.7	2.5 +/- 0.3
3665	2291	0.5 - 1.0	-b-	2.4 +/- 0.6	2.6 +/- 0.6
3682	2272	0.0 - 0.5	-b-	< 3.0	58.3 +/- 1.3
3682	2272	0.5 - 1.0	-b-	1.5 +/- 0.8	31.9 +/- 1.3
3688	2295	0.0 - 0.5	-b-	1.0 +/- 0.3	34.0 +/- 0.7
3688	2295	0.5 - 1.0	-b-	0.8 +/- 0.4	2.2 +/- 0.4

^aSampling locations are shown in Figure 4-2.

^bAnalysis not requested.

TABLE 5-2
DOWNHOLE GAMMA LOGGING RESULTS
FOR 18 LONG VALLEY ROAD^a

Page 1 of 4

<u>Coordinates</u>		Depth ^b (ft)	Count Rate ^c (cpm)
East	North		

Borehole 427R^d

3551	2407	0.5	12000
3551	2407	1.0	12000
3551	2407	1.5	12000
3551	2407	2.0	12000
3551	2407	2.5	12000
3551	2407	3.0	12000

Borehole 428R^d

3516	2442	0.5	11000
3516	2442	1.0	12000
3516	2442	1.5	12000
3516	2442	2.0	13000
3516	2442	2.5	12000
3516	2442	3.0	13000
3516	2442	3.5	12000
3516	2442	4.0	12000
3516	2442	4.5	12000
3516	2442	5.0	12000
3516	2442	5.5	12000
3516	2442	6.0	12000
3516	2442	6.5	12000

Borehole 429R^d

3550	2451	0.5	10000
3550	2451	1.0	11000
3550	2451	1.5	12000

Borehole 430R^d

3510	2462	0.5	8000
3510	2462	1.0	10000
3510	2462	1.5	11000
3510	2462	2.0	11000

Borehole 612R^d

3688	2295	0.5	12000
3688	2295	1.0	12000
3688	2295	1.5	13000

TABLE 5-2
(continued)

Page 2 of 4

Coordinates		Depth ^b (ft)	Count Rate ^c (cpm)
East	North		
<u>Borehole 612R (continued)^d</u>			
3688	2295	2.0	13000
3688	2295	2.5	12000
3688	2295	3.0	11000
<u>Borehole 613R^d</u>			
3682	2272	0.5	75000
3682	2272	1.0	91000
3682	2272	1.5	69000
3682	2272	2.0	32000
3682	2272	2.5	15000
3682	2272	3.0	13000
3682	2272	3.5	12000
3682	2272	4.0	13000
<u>Borehole 614R^d</u>			
3659	2330	0.5	13000
3659	2330	1.0	13000
3659	2330	1.5	11000
3659	2330	2.0	12000
3659	2330	2.5	11000
3659	2330	3.0	10000
3659	2330	3.5	9000
3659	2330	4.0	8000
<u>Borehole 615R^d</u>			
3665	2291	0.5	13000
3665	2291	1.0	11000
3665	2291	1.5	12000
3665	2291	2.0	12000
3665	2291	2.5	10000
3665	2291	3.0	10000
3665	2291	3.5	10000
3665	2291	4.0	11000
3665	2291	4.5	10000
<u>Borehole 616R^d</u>			
3614	2335	0.5	42000
3614	2335	1.0	26000

TABLE 5-2
(continued)

Page 3 of 4

<u>Coordinates</u>		Depth ^b (ft)	Count Rate ^c (cpm)
East	North		
<u>Borehole 616R (continued)^d</u>			
3614	2335	1.5	22000
3614	2335	2.0	14000
3614	2335	2.5	11000
3614	2335	3.0	10000
3614	2335	3.5	11000
3614	2335	4.0	10000
3614	2335	4.5	8000
<u>Borehole 617R^d</u>			
3595	2380	0.5	13000
3595	2380	1.0	17000
3595	2380	1.5	17000
3595	2380	2.0	14000
3595	2380	2.5	11000
3595	2380	3.0	10000
3595	2380	3.5	9000
3595	2380	4.0	6000
<u>Borehole 618R^d</u>			
3615	2390	0.5	12000
3615	2390	1.0	11000
3615	2390	1.5	10000
3615	2390	2.0	9000
3615	2390	2.5	9000
3615	2390	3.0	7000
3615	2390	3.5	6000
3615	2390	4.0	8000
<u>Borehole 619R^d</u>			
3571	2433	0.5	13000
3571	2433	1.0	13000
3571	2433	1.5	12000
3571	2433	2.0	12000
3571	2433	2.5	12000
3571	2433	3.0	11000
3571	2433	3.5	11000
3571	2433	4.0	10000
3571	2433	4.5	10000
3571	2433	5.0	8000

TABLE 5-2
(continued)

Page 4 of 4

Coordinates		Depth ^b (ft)	Count Rate ^c (cpm)
East	North		
<u>Borehole 619R (continued)^d</u>			
3571	2433	5.5	8000
3571	2433	6.0	9000

^aBorehole locations are shown in Figure 4-1.

^bThe 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.

^cInstrument used was 2-in. by 2-in. thallium-activated sodium iodide gamma scintillation detector.

^dBottom of borehole collapsed.

TABLE 5-3
 GAMMA RADIATION EXPOSURE RATES
 FOR 18 LONG VALLEY ROAD

<u>Coordinates</u>		$\mu\text{R/h}$
<u>East</u>	<u>North</u>	
3505	2455	7
3525	2430	8
3540	2455	8
3560	2415	9
3650	2315	11
3675	2285	12
INTERIOR OF RESIDENCE		5

Measurements include background.

REFERENCES

1. U.S. Department of Energy. Description of the Formerly Utilized Sites Remedial Action Program, ORO-777, Oak Ridge, TN, September 1980 (as modified by DOE in October 1983).
2. Argonne National Laboratory. Action Description Memorandum, Interim Remedial Actions at Maywood, New Jersey, Argonne, IL, March 1987.
3. Argonne National Laboratory. Action Description Memorandum, Proposed 1984 Remedial Actions at Maywood, New Jersey, Argonne, IL, June 8, 1984.
4. Bechtel National, Inc. Post-Remedial Action Report for the Lodi Residential Properties, DOE/OR/20722-89, Oak Ridge, TN, August 1986.
5. NUS Corporation. Radiological Study of Maywood Chemical, Maywood, New Jersey, November 1983.
6. EG&G Energy Measurements Group. An Aerial Radiologic Survey of the Stepan Chemical Company and Surrounding Area, Maywood, New Jersey, NRC-8109, Oak Ridge, TN, September 1981.
7. Oak Ridge National Laboratory. Results of the Mobile Gamma Scanning Activities in Lodi, New Jersey, ORNL/RASA-84/3, Oak Ridge, TN, October 1984.
8. Oak Ridge National Laboratory. Results of the Radiological Survey at 18 Long Valley Road (LJ052), Lodi, New Jersey, ORNL/RASA-86/39, Oak Ridge, TN, September 1986.
9. Letter, Jeff Brown, Thermo Analytical/Eberline, to Distribution. "Technical Review of Grand Junction Instrument Correlation Study," BNI CCN 035506, March 17, 1986.

10. U.S. Code of Federal Regulations. 40 CFR 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, " Washington, D.C., July 1986.
11. National Council on Radiation Protection and Measurements. Environmental Radiation Measurements, NCRP Report No. 50, Washington, D.C., December 27, 1986.
12. Levin, S. G., R. K. Stoms, E. Kuerze, and W. Huskisson. "Summary of Natural Environmental Gamma Radiation Using a Calibrated Portable Scintillation Counter." Radiological Health Data Report 9:679-695 (1968).

APPENDIX A

GEOLOGIC DRILL LOGS FOR 18 LONG VALLEY ROAD

LODI, NEW JERSEY

GEOLOGIC DRILL LOG				PROJECT			JOB NO.	SHEET NO.	HOLE NO.			
18 Long Valley Rd. (LODI)				N 2407; E 3551			14501-138	1 OF 1	427R			
BEGUN		COMPLETED	DRILLER	DRILL MAKE AND MODEL		SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH			
10-7-86		10-7-86	MORETRENCH	B&S Little Beaver		4"	6.0		6.0			
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER		DEPTH/EL. TOP OF ROCK				
/					44.8	/		/				
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE: DIA./LENGTH			LOGGED BY:						
N/A			NONE			D. McGRANE						
SAMP. TYPE AND DIAM.	SAMP. ADU. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS			ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M.	PRESS. P.S.I.	TIME IN MIN.						
							44.8					
							38.8	5			0.0-6.0 ft. SILTY SAND (SM). Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist. 0.0-0.5 ft. moderate brown (5YR3/4); numerous grass roots and organics. 0.5-3.0 ft. dark yellowish orange (10YR6/6). 3.0-6.0 ft. dark reddish brown (10YR6/6), mottled moderate brown.	Borehole drilled 0.0-6.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation.
											Bottom of borehole at 6.0 ft. Auger spoils were immediately replaced in the hole, 10-7-86.	No 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
18 Long Valley Rd. (LODI)

HOLE NO.
427R

GEOLOGIC DRILL LOG				PROJECT		JOB NO.	SHEET NO.	HOLE NO.				
				FUSRAP		14501-138	1 OF 1	428R				
SITE			COORDINATES			ANGLE FROM HORIZ		BEARING				
18 Long Valley Rd. (LODI)			N 2442; E 3516			Vertical		-----				
BEGUN	COMPLETED	DRILLER		DRILL MAKE AND MODEL		SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH			
10-7-86	10-7-86	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				
					46.2							
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			ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.						
							46.2		5	[Pattern]	<p>0.0-6.0 ft. <u>SILTY SAND (SM)</u>. Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist; difficult to distinguish between fill and natural material.</p> <p>0.0-0.5 ft. moderate brown (5YR3/4); numerous grass roots and organics.</p> <p>0.5-2.5 ft. dark reddish brown (10R3/4); numerous rounded pebbles of various lithologies (fill).</p> <p>2.5-9.0 ft. dark reddish brown, mottled with a few dark yellowish orange (10YR6/6) zones. 5.0 ft. piece of glass (fill).</p>	<p>Borehole drilled 0.0-9.0 ft. using 4" solid-stem augers.</p> <p>Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation.</p>
							37.2				<p>Bottom of borehole at 9.0 ft. Auger spoils were immediately replaced in the hole, 10-7-86.</p>	<p>No ground water observed.</p>
												<p>Description and classification of soil samples by visual examination.</p>

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

18 Long Valley Rd. (LODI)

HOLE NO.
428R

GEOLOGIC DRILL LOG				PROJECT		JOB NO.	SHEET NO.	HOLE NO.			
18 Long Valley Rd. (LODI)				N 2451; E 3550		4501-138	1 OF 1	429R			
BEGUN		COMPLETED		DRILLER		DRILL MAKE AND MODEL		SIZE			
10-7-86		10-7-86		MORETRENCH		B&S Little Beaver		4"			
OVERBURDEN		ROCK (FT.)		TOTAL DEPTH							
2.5				2.5							
CORE RECOVERY (FT./%)		CORE BOXES		SAMPLES		EL. TOP CASING		GROUND EL.			
/								DEPTH/EL. GROUND WATER			
								DEPTH/EL. TOP OF ROCK			
								/			
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	SAMP. REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS			ELEV.	DEPTH	GRAPHICS SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M.	PRESS. P.S.I.	TIME IN MIN.					
										<p>0.0-2.5 ft. SILTY SAND (SM). Color stratified; fine-to medium-grained; with few pieces of gravel and cobbles of various lithologies; soft; unconsolidated; moist.</p> <p>0.0-0.2 ft. moderate brown (5YR3/4); numerous roots and organics.</p> <p>0.2-2.5 ft. dark reddish brown (10R3/4).</p> <p>Bottom of borehole at 2.5 ft. Auger spoils were immediately replaced in the hole, 10-7-86.</p>	<p>Borehole drilled 0.0-2.5 ft. using 4" solid-stem augers.</p> <p>Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation.</p> <p>2.5 ft. auger refusal (cobble). No ground water observed.</p>
										Description and classification of soil samples by visual examination.	

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

SITE
18 Long Valley Rd. (LODI)

HOLE NO.
429R

GEOLOGIC DRILL LOG				PROJECT		JOB NO.	SHEET NO.	HOLE NO.				
18 Long Valley Rd. (LODI)				N 2462; E 3510		14501-138	1 OF 1	430R				
BEGUN		COMPLETED	DRILLER		DRILL MAKE AND MODEL		SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH		
10-7-86		10-7-86	MORETRENCH		B&S Little Beaver		4"	2.5		3.5		
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER		DEPTH/EL. TOP OF ROCK				
/					45.9	/		/				
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			ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M.	PRESS. P.S.I.	TIME IN MIN.						
							45.9					
							42.4				<p>0.0-3.5 ft. SILTY SAND (SM). Color stratified; fine-to medium-grained; with few pieces of gravel and cobbles of various lithologies; soft; unconsolidated; moist.</p> <p>0.0-0.5 ft. moderate brown (5YR3/4); numerous roots and organics.</p> <p>0.5-3.5 ft. dark reddish brown (10R3/4).</p> <p>Bottom of borehole at 3.5 ft. Auger spoils were immediately replaced in the hole, 10-7-86.</p>	<p>Borehole drilled 0.0-3.5 ft. using 4" solid-stem augers.</p> <p>Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation.</p> <p>3.5 ft. auger refusal (cobble). No ground water observed.</p>
SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER											SITE 18 Long Valley Rd. (LODI)	HOLE NO. 430R

GEOLOGIC DRILL LOG										PROJECT		JOB NO.		SHEET NO.		HOLE NO.	
18 Long Valley Road (LODI)										N 229S; E 3688		14501-138		1 OF 1		612R	
18 Long Valley Road (LODI)										N 229S; E 3688		Vertical		-----			
BEGUN		COMPLETED		DRILLER		DRILL MAKE AND MODEL		SIZE		OVERBURDEN		ROCK (FT.)		TOTAL DEPTH			
10-7-86		10-7-86		Moretrench		B&S Little Beaver		4"		3.2		2.8		6.0			
CORE RECOVERY (FT./%)			CORE BOXES		SAMPLES		EL. TOP CASING		GROUND EL.		DEPTH/EL. GROUND WATER		DEPTH/EL. TOP OF ROCK				
/									41.2		/		3.8/37.4				
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" X CORE RECOVERY	WATER PRESSURE TESTS			ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.					
				LOSS IN G.P.M.	PRESS. P.S.I.	TIME IN MIN.											
							41.2										
							37.9				0.0-3.2 ft. SILTY SAND (SM-SC) . Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); dry-slightly moist. 0.0-3.0 ft., dark yellowish brown (10YR4/2). 3.0-3.2 ft., clayey (SC); mottled dark yellowish brown (10YR4/2); pale green (5G7/2) and dark yellowish orange (10YR6/6).	Borehole drilled 0.0-6.0 ft. using 4" solid-stem augers.					
							35.2				3.2-6.0 ft. DECOMPOSED SANDSTONE . Dark reddish brown (10R3/4); fine-grained (argillaceous); soft-to moderately hard; poorly-well cemented; totally decomposed-highly weathered; drill spoils consist of silty sand (SM) and occasional pieces of sandstone gravel.	Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. No ground water observed. 6.0 ft., auger refusal.					
											Bottom of borehole at 6.0 ft. Auger spoils were immediately replaced in the hole, 10-7-86.						
												Description and classification of soil samples by visual examination.					

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

SITE

18 Long Valley Road (LODI)

HOLE NO.

612R

GEOLOGIC DRILL LOG				PROJECT		JOB NO.	SHEET NO.	HOLE NO.		
18 Long Valley Rd. (LODI)				FUSRAP		14501-138	1 OF 1	613R		
SITE			COORDINATES			ANGLE FROM HORIZ		BEARING		
18 Long Valley Rd. (LODI)			N 2272; E 3682			Vertical		-----		
BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH			
10-7-86	10-7-86	MORETRENCH	B&S little beaver	4"	3.5	1.5	5.0			
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK			
/						3.5/37.5				
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	SAMP. REC. CORE REC.	SAMPLE BLOWS "IN" X CORE RECOVERY	LOSS IN G.P.M.	WATER PRESSURE TESTS	ELEV.	DEPTH	GRAPHICS	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							5		<p>0.0 - 3.5 FT. SILTY SAND, (SM-SC). Color stratified; fine to medium-grained; soft; poorly consolidated (loose); dry to moist. 0.0-0.5 ft., dark reddish brown (10 YR 3/4); numerous roots and organics. 0.5-3.0 ft., dark yellow brown (10 YR 4/2). 3.0-3.5 ft., clayey (SC); mottled, dark yellowish brown, pale green (5 G 7/2), and dark yellowish orange (10 YR 6/6).</p> <p>3.5 - 5.0 FT. DECOMPOSED SANDSTONE Dark reddish brown (10 R 3/4); fine grained (argillaceous); soft to moderately hard; poorly to well cemented; totally decomposed to highly weathered; moist. Drill spoils consist of silty sand (SM) and occasional pieces of sandstone gravel.</p> <p>Bottom of boring at 5.0 ft. Borehole backfilled with auger spoils, 10-7-86.</p>	<p>Borehole drilled 0 - 5.0 ft. using 4" solid-stem augers.</p> <p>Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corp. Auger refusal at 5.0 ft.</p> <p>No groundwater observed.</p> <p>Description and classification of soil samples by visual examination.</p>
SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER						SITE		HOLE NO.		
18 Long Valley Rd. (LODI)								613R		

GEOLOGIC DRILL LOG				PROJECT		JOB NO.	SHEET NO.	HOLE NO.						
18 Long Valley Road (LODI)				FUSRAP		14501-138	1 OF 1	614R						
SITE			COORDINATES			ANGLE FROM HORIZ BEARING								
18 Long Valley Road (LODI)			N 2332; E 3661			Vertical -----								
BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH							
10-7-86	10-7-86	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						
/					41.9	6.5/35.4 10-7-86		/						
SAMPLE HAMMER WEIGHT/FALL		CASING LEFT IN HOLE: DIA./LENGTH			LOGGED BY:									
N/A		None			D.McGrane									
SAMP. TYPE AND DIAM.	SAMP. ADU. LEN CORE	SAMP. REC. CORE REC.	SAMP. "N" BLOWS % CORE RECOVERY	WATER PRESSURE TESTS			ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.		
				LOSS IN G.P.M.	PRESS. P.S.I.	TIME IN MIN.								
							41.9				0.0-8.5 ft. SILTY SAND (SM-SC) . Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist-saturated at 6.5 ft. 0.0-2.0 ft. dark yellowish brown (10YR4/2); numerous grass roots and organics. 2.0-3.0 ft. dark yellowish orange (10YR6/6). 3.0-3.5 ft., clayey (SC); mottled dark yellowish brown; pale green (5G7/2), and dark yellowish orange. 3.5-8.5 ft., dark yellowish brown; few roots.	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. 6.5 ft., ground water observed.		
							33.4				Bottom of borehole at 8.5 ft. Auger spoils were immediately replaced in the hole, 10-7-86.	8.5 ft., auger refusal (root?). Description and classification of soil samples by visual examination.		
SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER											SITE	18 Long Valley Road (LODI)	HOLE NO.	614R

GEOLOGIC DRILL LOG				PROJECT		JOB NO.		SHEET NO.		HOLE NO.		
18 Long Valley Rd. (LODI)				N 2291; E 3665		14501-138		1 OF 1		615R		
SITE			COORDINATES				ANGLE FROM HORIZ		BEARING			
18 Long Valley Rd. (LODI)			N 2291; E 3665				Vertical		-----			
BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL		SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH				
10-7-86	10-7-86	MORETRENCH	B&S little beaver		4"	2.5	3.5	6.0				
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER		DEPTH/EL. TOP OF ROCK				
/					41.0	5.5/35.5 10-7-86		2.5/38.5				
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" X CORE RECOVERY	WATER PRESSURE TESTS			ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M.	PRESS. P.S.I.	TIME IN MIN.						
							41.0					
							38.5			0.0 - 2.5 FT. SILTY SAND, (SM) . Dark yellowish brown (10 YR 4/2); fine to medium-grained; soft; poorly consolidated (loose); few roots and organics; moist.	Borehole drilled 0 - 6.0 ft. using 4" solid-stem augers.	
							35.0			2.5 - 6.0 FT. DECOMPOSED SANDSTONE Dark reddish brown (10 R 3/4); fine grained (argillaceous); soft to moderately hard; poorly to well cemented; totally decomposed to highly weathered; moist to saturated at 5.5 ft. Drill spoils consist of silty sand (SM) and occasional pieces of sandstone gravel.		
										Bottom of boring at 6.0 ft. Borehole backfilled with auger spoils, 10-7-86.	Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corp.	
											Groundwater observed, 10-7-86.	
											Description and classification of soil samples by visual examination.	

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

SITE

18 Long Valley Rd. (LODI)

HOLE NO.

615R

GEOLOGIC DRILL LOG				PROJECT		JOB NO.	SHEET NO.	HOLE NO.				
18 Long Valley Road (LODI)				N 2335; E 3610		14501-138	1 OF 1	616R				
BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL		SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH				
10-7-86	10-7-86	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				
/					40.7	5.5/35.2 10-7-86		/				
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	SAMP. REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS			ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M.	PRESS. P.S.I.	TIME IN MIN.						
							40.7					
							31.7				0.0-8.0 ft. SILTY SAND (SM-SC). Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist-saturated at 5.5 ft. 0.0-1.0 ft. grayish black(N2); numerous grass roots and organics; clayey (SC). 1.0-9.0 ft. dark yellowish brown (10YR4/2); mottled moderate brown (5YR3/4) (7.0-9.0 ft.).	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. 5.5 ft., ground water observed.
											Bottom of borehole at 9.0 ft. Auger spoils were immediately replaced in the hole, 10-7-86.	Description and classification of soil samples by visual examination.
SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER											SITE	HOLE NO.
18 Long Valley Road (LODI)											616R	

GEOLOGIC DRILL LOG										PROJECT		JOB NO.		SHEET NO.		HOLE NO.	
SITE										COORDINATES				ANGLE FROM HORIZ		BEARING	
18 Long Valley Road (LODI)										N 2379; E 3597				Vertical		-----	
BEGUN		COMPLETED		DRILLER		DRILL MAKE AND MODEL		SIZE	OVERBURDEN	ROCK (FT.)		TOTAL DEPTH					
10-7-86		10-7-86		Moretrench		B&S Little Beaver		4"	5.0	1.0		6.0					
CORE RECOVERY (FT./%)			CORE BOXES		SAMPLES		EL. TOP CASING		GROUND EL.		DEPTH/EL. GROUND WATER		DEPTH/EL. TOP OF ROCK				
/							41.9		5.0/36.9		10-7-86		5.0/46.9				
SAMPLE HAMMER WEIGHT/FALL				CASING LEFT IN HOLE: DIA./LENGTH				LOGGED BY:									
N/A				None				D.McGrane									
SAMP. TYPE AND DIAM.	SAMP. ADU. LEN CORE	SAMP. REC. CORE REC.	SAMP. BLOWS "IN" X CORE RECOVERY	WATER PRESSURE TESTS			ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.					
				LOSS IN G.P.M.	PRESS. P.S.I.	TIME IN MIN.											
							41.9				0.0-5.0 ft. SILTY SAND (SM-SC) . Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist-saturated to 5.0 ft. 0.0-1.0 ft., dark reddish brown (10R3/4); numerous roots and organics. 1.0-1.5 ft., clayey (SC); mottled dark yellowish brown (10YR4/2); pale green (5G7/2) and dark yellowish orange (10YR6/6). 1.5-5.0 ft., dark yellowish orange.	Borehole drilled 0.0-5.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 5.0 ft., ground water observed.					
							36.9 35.9	5			5.0-6.0 ft. DECOMPOSED SANDSTONE . Dark reddish brown (10R3/4); fine-grained (argillaceous); soft; poorly consolidated; poorly cemented; totally decomposed; moist-saturated at 5.0 ft. Drill spoils consist of silty sand (SM) and occasional pieces of sandstone gravel.						
											Bottom of borehole at 6.0 ft. Auger spoils were immediately replaced in the hole, 10-7-86.						
											Description and classification of soil samples by visual examination.						

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

SITE

18 Long Valley Road (LODI)

HOLE NO. 617R

GEOLOGIC DRILL LOG				PROJECT		JOB NO.	SHEET NO.	HOLE NO.					
18 Long Valley Road (LODI)				FUSRAP		14501-138	1 OF 1	618R					
SITE			COORDINATES			ANGLE FROM HORIZ		BEARING					
18 Long Valley Road (LODI)			N 2390; E 3615			Vertical		-----					
BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH						
10-7-86	10-7-86	Moretrench	B&S Little Beaver	4"	5.0	0.5	5.5						
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK						
/					43.0	5.0/38.0 10-7-86	5.0/38.0						
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" X CORE RECOVERY	WATER PRESSURE TESTS			ELEV.	DEPTH	GRAPHICS	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.		
				LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.							
							43.0						
							38.1 37.5	5		<p>0.0-5.0 ft. SILTY SAND (SM). Fine-to medium-grained; soft; poorly consolidated (loose); moist-saturated at 5.0 ft. 0.0-3.0 ft., dark reddish brown (10R3/4); numerous organics (0.0-0.3 ft.). 3.0-5.0 ft., mottled dark reddish brown (10R3/4) and dark yellowish orange (10YR6/6).</p> <p>5.0-5.5 ft. DECOMPOSED SANDSTONE. Dark reddish brown (10R3/4); fine-grained (argillaceous); soft-moderately hard; poorly well cemented; totally decomposed-highly weathered. Drill spoils consist of silty sand (SM) and occasional pieces of sandstone gravel.</p> <p>Bottom of borehole at 5.5 ft. Auger spoils were immediately replaced in the hole, 10-7-86.</p>	<p>Borehole drilled 0.0-5.5 ft. using 4" solid-stem augers.</p> <p>Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 5.0 ft., ground water observed. 5.5 ft., auger refusal.</p>		
											Description and classification of soil samples by visual examination.		
SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER										SITE	18 Long Valley Road (LODI)	HOLE NO.	618R

GEOLOGIC DRILL LOG										PROJECT		JOB NO.		SHEET NO.		HOLE NO.	
SITE 18 Long Valley Road (LODI)										COORDINATES N 2433; E 3571				ANGLE FROM HORIZ Vertical		BEARING -----	
BEGUN 10-7-86		COMPLETED 10-7-86		DRILLER Moretrench			DRILL MAKE AND MODEL B&S Little Beaver		SIZE 4"	OVERBURDEN 8.0		ROCK (FT.)		TOTAL DEPTH 8.0			
CORE RECOVERY (FT./%)			CORE BOXES		SAMPLES		EL. TOP CASING		GROUND EL. 44.9		DEPTH/EL. GROUND WATER 5.0/39.9 10-7-86		DEPTH/EL. TOP OF ROCK				
SAMPLE HAMMER WEIGHT/FALL N/A				CASING LEFT IN HOLE: DIA./LENGTH None				LOGGED BY: D.McGrane									
SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMP. REC. CORE REC.	SAMP. BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS			ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.					
				LOSS IN G.P.H	PRESS. P.S.I.	TIME IN MIN.											
							44.9				0.0-8.0 ft. SILTY SAND (SM) . Color stratified; fine-to medium-grained; soft; poorly consolidated (loose); moist-saturated at 5.0 ft.. 0.0-0.2 ft., moderate brown (10YRS/4); numerous roots and organics. 0.2-6.0 ft., dark reddish brown (10R3/4); mottled moderate brown. 6.0-8.0 ft., dark reddish brown (10R3/4); decomposed sandstone?	Borehole drilled 0.0-8.0 ft. using 4" solid-stem augers. Site checked for radioactive contamination and hole gamma-logged by Eberline-TMA, Corporation. 5.0 ft., ground water observed.					
							36.9				Bottom of borehole at 8.0 ft. Auger spoils were immediately replaced in the hole, 10-7-86.	8.0 ft., auger refusal.					
												Description and classification of soil samples by visual examination.					

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

18 Long Valley Road (LODI)

HOLE NO.
619R