Specific Comments

Comment #1: Volume I Section 2.1.1, Page 2-3, Table II.1:
The fact that background locations C09 and K05 are within the sampling grid may not be appropriate.

Response #1: Concur. These locations may not be appropriate and the method used to choose background stations for the FIDLER survey will be reviewed.

However, for this survey, use of background locations C09 and K05 on July 7, 1994, was acceptable because there was no surface radiological contamination at these locations as indicated by the soil screening results from the Mound Soil Screening Facility. Therefore, the background readings taken at C09 and K05 are not considered to be elevated, and the FIDLER survey data collected on July 7, 1994 are valid.

Comment #2: Volume I, Section 2.14, Page 2-8, Figure 2.3:
The sampling grid should be expanded to the west for radiological testing, particularly around sampling locations M5 and M6.

Response #2: Concur. Expansion of the sampling grid to the west, particularly around sampling locations M5 and M6 for radiological testing is warranted. This sampling will be included as part of a Phase 2 investigation in Area J.

Comment #3: Volume II, Appendix D, Section 1.0, Page 1, Paragraph 5:
Various sampling grid coordinates are recommended for quantitative testing in an effort to determine the environmental significance of the soil gas survey. However, some sample locations which merit further investigation were not mentioned and should be included, because they indicate contamination beyond the Area J boundaries:

Compounds of concern	Sample location(s)
Total Semi-volatile Hydrocarbons	A6 and L10
Halogenated Hydrocarbons	B1
Total Aromatics	D13 and L10

Response #3: Concur. Verification of soil gas results by quantitative testing of soil and groundwater should include sampling locations A6 and L10 for total semi-volatile hydrocarbons, B1 for halogenated hydrocarbons, and D13 and L10 for total aromatics. This will be noted for planning of the Phase 2 investigation.

Specific Comments

Comment #1: Section 2.1.1 Field Work Performed and Procedures
Page 2-3, Table II.1
Two of the eight background stations established for the FIDLER survey are located within the Area J Area of Concern (AOC). Grid points C09 and K05, used as background stations on July 7, 1994, are within the boundaries of the AOC. In addition, Figure 2.3 in Section 2.1.4 shows that elevated surface soil radiological activity, as detected by the Mound Plant Soil Screening Facility, was detected in grid point M06, which was used as a background station for the FIDLER survey on July 6, 1994. The Mound Plant Soil Screening Facility detected elevated surface soil radiological activity at four other grid points outside the defined AOC as well. It seems that the method used to choose background stations for the FIDLER survey needs to be reviewed.

Response #1: Concur. The method used to choose background stations for the FIDLER survey will be reviewed.

However, for this survey, use of background locations C09 and K05 was acceptable because there was no surface radiological contamination at these locations as indicated for the soil screening results from the Mound Soil Screening Facility.

The validity of using background location M06 to determine the contamination criteria (CC) on 7/6/94 is potentially questionable in lieu of the elevated surface soil activity at M06 detected by the Mound Soil Screening Facility. However, after reviewing the FIDLER data collected on 7/6/94 and comparing it to the Out Channel CC determined at background station B13 (also on 7/6/94), no readings exceeded either Out Channel CC and therefore, the readings are acceptable.

Comment #2: Section 2.1.2.1 Field Variance Report
Page 2-5, Paragraph 3
The text stated that the FIDLER crew's failure to take Channel 1 and Channel 2 readings for plutonium and thorium at the point where the Out Channel detected the highest concentration (JE06-16) "did not adversely affect the radiological survey due to the collection of soil screening facility samples." However, a review of Appendix C (Page C-48) shows that a soil sample for screening was not collected at point JE06-16.

Response #2: The text on Page 5, Paragraph 3 of Section 2.1.2.1 should state that the crew's failure to take Channel 1 and Channel 2 readings at the point of highest concentration in the area (JE06-16) "did not adversely affect the radiological survey due to the collection of a soil screening facility sample at grid location F7 (approximately 5 feet from JE06-16). No surface soil radiological activity was detected in this sample."

Comment #3: Section 2.1.4 Presentation of Radiological Data
Pages 2-7 and 2-8, Figures 2.2 and 2.3
A comparison of the elevated activity detected by the FIDLER survey to the elevated activity detected by the Mound Plant Soil Screening Facility shows that the FIDLER survey is not sensitive enough to detect levels of Plutonium-238 and Thorium-232 that are above the D&D cleanup levels, but below some threshold level for the FIDLER instrument. Perhaps finding "cleaner" background stations for the FIDLER survey would help in developing a better correlation between the FIDLER results and the soil screening results.

Response #3: Concur. The use of "cleaner" background stations for the FIDLER survey would help in developing a better correlation between the FIDLER and soil screening results.

Comment #4: Section 2.1.5 Comparison with Historical Radiological Data
Page 2-15, Paragraph 1
The first sentence states that the soil screening investigation indicated the presence of Pu-238 along the western boundary of the AOC. It also showed many other areas with Pu-238 scattered throughout the AOC.

Response #4: The first sentence of paragraph 1, page 2-15 should read as follows: "The results of the soil screening of Area J during the 1994 Phase I investigation indicate the presence of Pu-238 in the surface soil along the western boundary (grid locations M5 and M6), and at 5 additional locations scattered throughout the AOC."

Environmental Restoration Program

OPERABLE UNIT 5
OPERATIONAL AREA PHASE I INVESTIGATION
AREA J FIELD REPORT

MOUND PLANT
MIAMISBURG, OHIO

VOLUME I - TEXT

June 1995

Final (Revision 1)

U.S. Department of Energy
Ohio Field Office

EG&G Mound Applied Technologies

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ACRONYMS

AOC	Area of Concern
CC	contamination criterion
cpm	counts per minute
DCB	dichlorobenzene
DOE	U.S. Department of Energy
DQO	data quality objective
EM	electromagnetic
ER	Environmental Restoration
FIDLER	field instrument for the detection of low-energy radiation
Freon-11	trichlorofluoromethane
Freon-113	trichlorotrifluoroethane
FSP	Field Sampling Plan
kcpm	counts per minute times 1000
NERI	Northeast Research Institute LLC
OU	Operable Unit
pCi/g	picocuries per gram
Pu-238	Plutonium-238
QAPjP	Quality Assurance Project Plan
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
SM/PP	Special Metallurgical/Plutonium Processing
SOP	Standard Operating Procedure
SVOC	semi-volatile organic compound
TCA	trichloroethane
TCE	trichloroethene
Th-232	Thorium-232
VOC	volatile organic compound

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1. INTRODUCTION

Area J has been identified as an area of concern (AOC) within the Operational Area of Operable Unit (OU) 5 (see Figure 1.1). The purposes of the Area J Field Report are to 1) present the results of the radiological, and soil gas reconnaissance surveys and a geophysical survey conducted in Area J as part of a larger OU5 Phase 1 Investigation and 2) identify potential areas of radiological and chemical contamination within Area J.

The data gathered during the Phase 1 Investigation is not remedial investigation (RI) quality. However, as summarized in this report, the data provides a qualitative screen that can be used to determine a strategy for directing possible Phase 2 and Phase 3 investigations. A Phase 2 investigation will be conducted to gather RI quality data from locations with probable contamination, as found during the Phase 1 reconnaissance investigation. This information will be used to refine the data quality objectives (DQOs) to determine if an additional round of sampling (Phase 3) is necessary. The phased approach to data gathering is part of an overall strategy to conduct a remedial investigation/feasibility study (RI/FS) for OU5.

The following sections briefly describe the scope of the Area J Field Report, provide a site description, and review the site land use history, and present the organization of the remainder of this report.

1.1. SCOPE

The scope of the Area J Field Report is to describe the field work performed and to present the data collected at Area J during the Phase 1 investigation conducted from July through September 1994. This work was conducted according to the OU5, South Property, Remedial Investigation/Feasibility Study Work Plan (DOE 1993a) and associated OU5 Field Sampling Plan (FSP) (DOE 1993b). In addition, relevant data available from previous studies are integrated into this report.

1.2. SITE DESCRIPTION

Area J, known as the hillside disposal area, is located on the west slope of the Special Metallurgical/Plutonium Processing (SM/PP) Hill southwest of Building 38 (see Figure 1.2). Area J encompasses approximately four acres with a disposal volume that may exceed 100,000 cubic yards (DOE

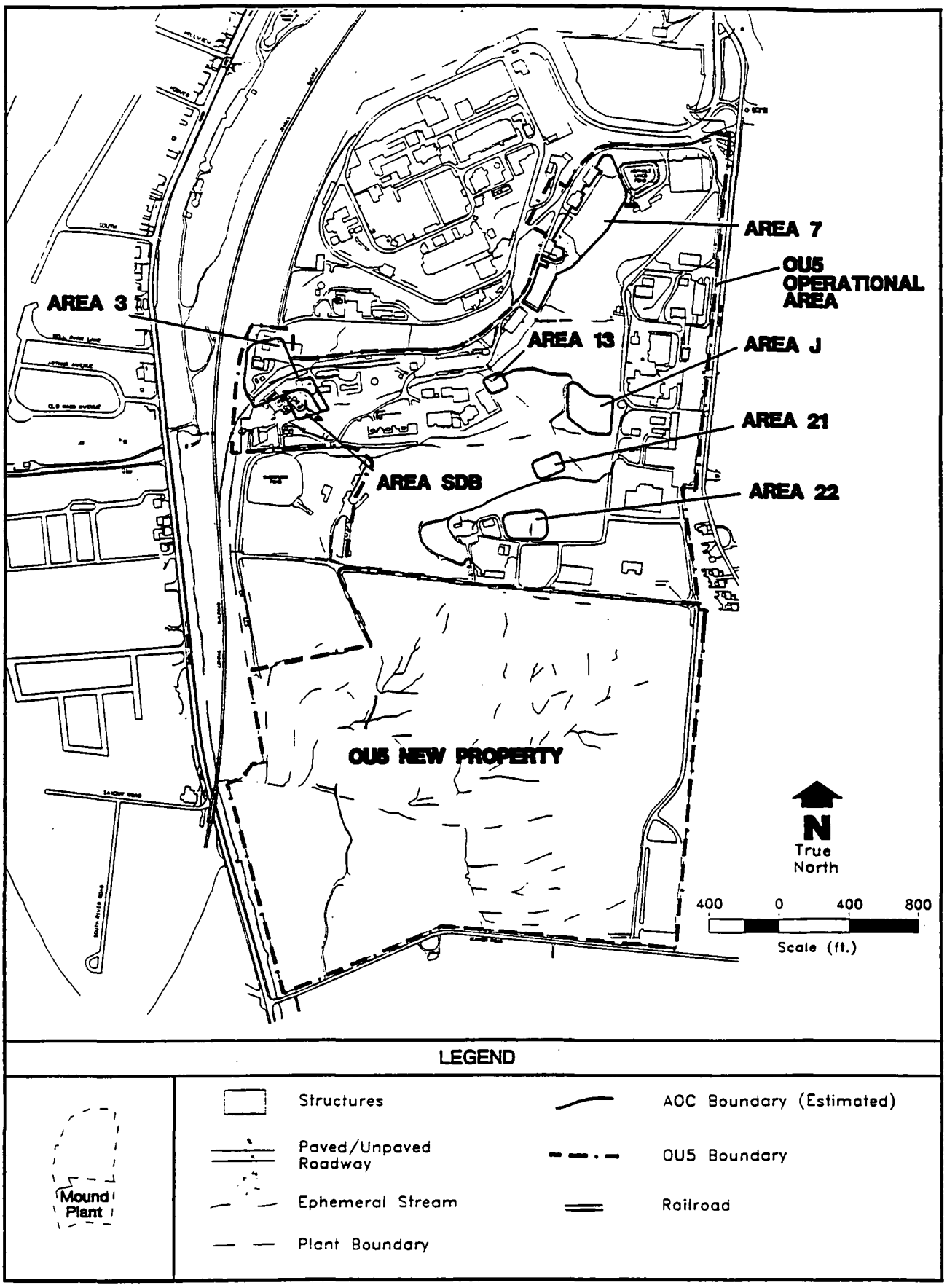

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Figure 1.1. Site Map of Operable Unit 5 Areas of Concern

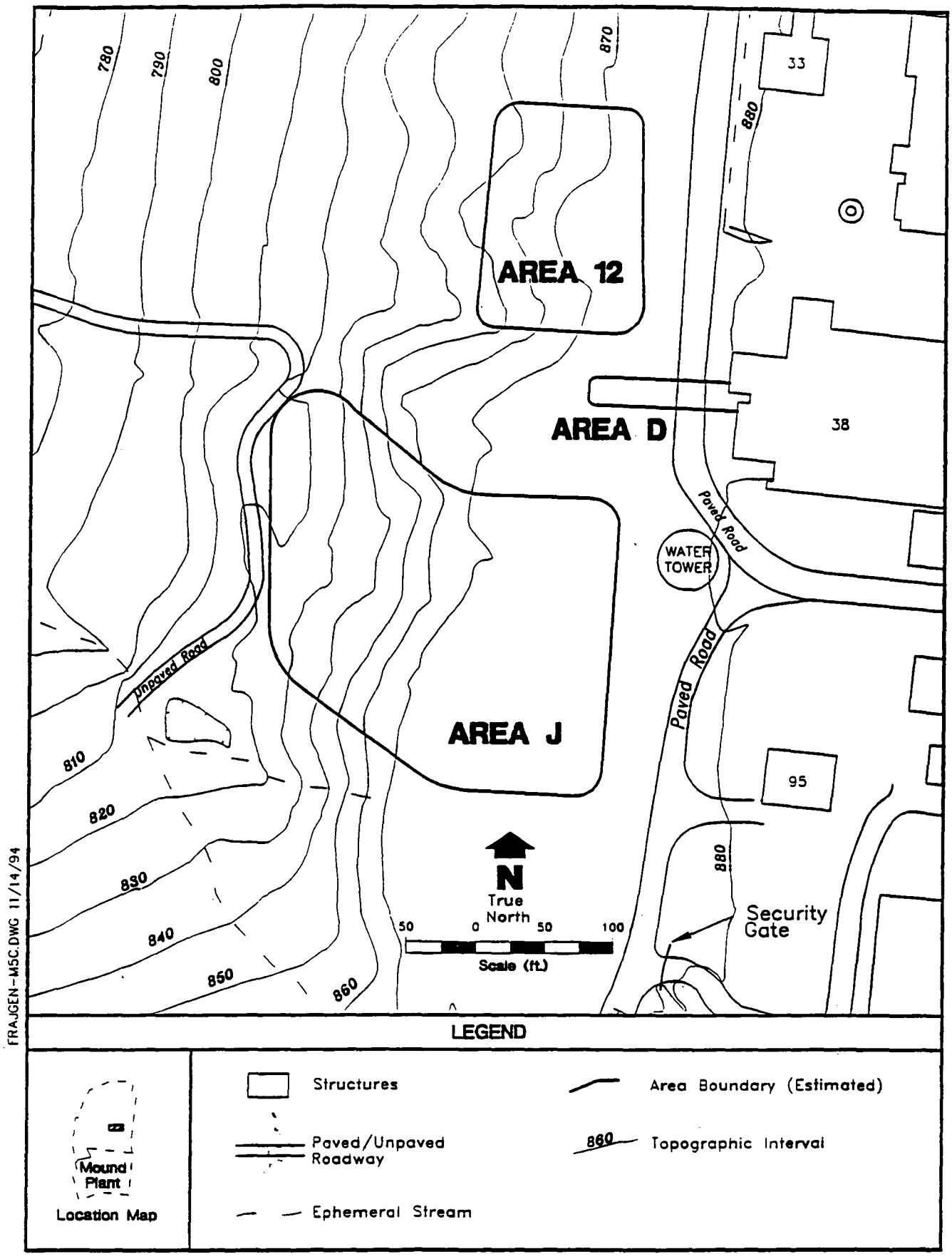

Figure 1.2. Area J, Operable Unit 5

1993c). The upper, eastern portion of Area J is relatively flat. The remainder of Area J extends over the hillside which is steep and covered with small trees and thick vegetation. Surface runoff and a potential groundwater seep at the toe of the slope in Area J drain into a slightly depressed area (DOE 1993c). Mound Plant drawing #FSE 16472 (DOE 1993d) indicates that the depth to bedrock in the upper, relatively flat portion of Area J is three feet. On the hillside, this depth to bedrock varies due to the presence of fill material.

1.3. SITE HISTORY

Area J was used from the early 1950s to the early 1980s for the disposal of construction and building demolition and remodelling debris including excavated soils, pipe, plumbing fixtures, wood, wallboard, roofing materials, and pieces of concrete which were either dumped or bulldozed over the side of the hill in an uncompacted fashion. Chemical contaminants such as laboratory reagents, asbestos, and other hazardous materials may have also been deposited there (DOE 1993c).

The upper, relatively flat portion of Area J was historically used to stage soils contaminated with thorium and plutonium. Soils and other debris were placed there as part of excavation projects, including a water line repair below the adjacent water tower and possible plutonium-contaminated soils from the construction of the overflow pond in the mid-1970s (DOE 1986). Area J may have also been referred to as the dredged materials disposal area (Area 11a) in the map of Hot Waste Burial Sites, reproduced in the OU9, Site Scoping Report: Volume 7 (DOE 1993c).

In 1988, 150 half-size, low specific activity boxes of soil (approximately 150 yd^3) which had been stored in Area J were removed (Rader 1988).

Although records and interviews indicate that no hazardous substances were discarded at the hillside, Area J is a historically uncontrolled area and could have received contaminated materials. Several 55-gallon drums were removed from the hillside for the geophysical survey in 1992. Portions of Area J, are in a position to receive runoff from Areas 12 and D (see Figure 1.2). Because of their usage and disposal at Areas 12 and D, plutonium and thorium are potential contaminants. Other suspected contaminants are paint and paint thinners (DOE 1993a).

1.4. REPORT ORGANIZATION

The remainder of this report presents the results of the Area J Phase 1 investigation. Section 2 summarizes field activities performed and data collected during the radiological survey, the soil gas survey, and the geophysical survey. It also compares significant data from previous investigations with Phase 1 investigation data. Section 3 summarizes the results of the radiological, chemical, and geophysical reconnaissance surveys. References are provided in Section 4. Field logbooks, survey maps, radiological data, soil gas data, and the geophysical data are included in Appendices A, B, C, D and E, respectively, in Volume II.

2. FIELD ACTIVITIES AND DATA SUMMARY

The Area J Phase 1 field activities were conducted to screen this area of concern (AOC) for potential areas of contamination. Reconnaissance activities in Area J consisted of:

- a multi-channel analyzer [field instrument for the detection of low-energy radiation (FIDLER)] survey;
- surface soil sample analyses at the Mound Plant Soil Screening Facility to detect radiological contamination;
- a soil gas survey to detect subsurface volatile and semi-volatile organic chemical contamination; and,
- a geophysical survey to locate near-surface and subsurface objects.

As specified in the FSP (DOE 1993b), the radiological screening was conducted to detect the presence of plutonium-238 (Pu-238) and thorium-232 (Th-232) in Area J. These two radionuclides are the most prevalent radiological contaminants at Mound Plant. The soil gas survey was conducted to detect total aromatic hydrocarbons, total semi-volatile compounds, total C_5 to C_{11} petroleum hydrocarbons, and total halogenated compounds. The geophysical survey was conducted using electromagnetic and magnetometer/gradiometer techniques to locate objects (steel reinforcement bar, drums, etc.) which might interfere with intrusive sampling.

The data collection points for the FIDLER survey, the soil screening activities, and the soil gas survey were established over a 25 feet grid system within the estimated Area J boundary (see Figure 2.1 or Plate 1, Appendix A). The survey map of Area J (Appendix B) shows those points on the grid system located by a registered land surveyor. Before sampling, all transverses of the grid system were cleared of small trees and underbrush and the remaining sample locations were marked with wooden stakes or paint.

The geophysical survey was conducted over a separate ten feet grid system which was established in the same manner as the 25 feet sampling grid system described above. The geophysical survey is described in Section 2.3.

The following sections describe the field activities, the analyses performed, present the results of the Phase 1 investigation, and compare these results with historical data.

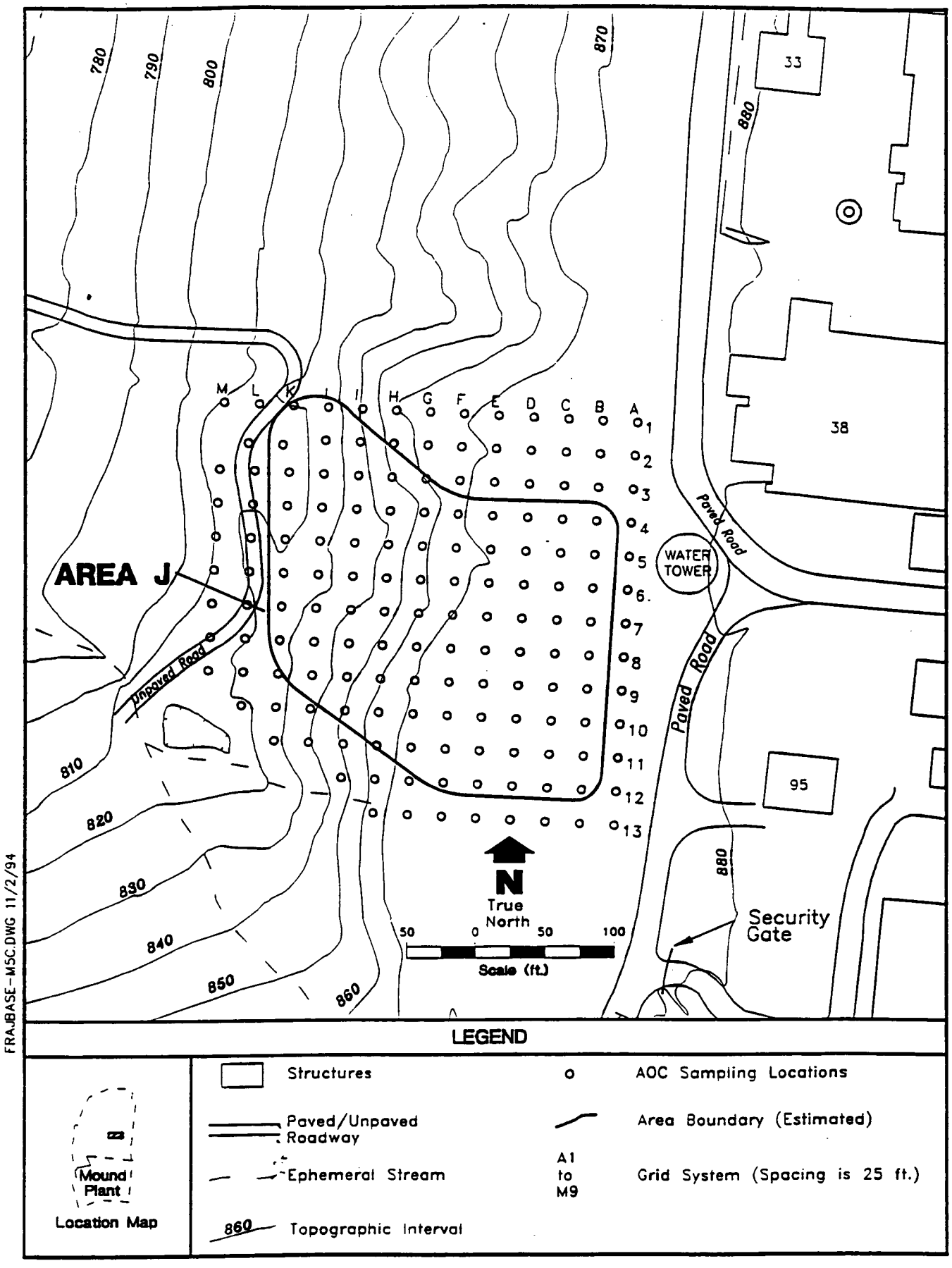

Figure 2.1. Estimated Boundary and Grid System of Area J

2.1. RADIOLOGICAL SURVEY

A FIDLER survey was performed at Area J on July 5, 6, 7, 11, and 12, 1994, per the Mound Standard Operating Procedure (SOP) 6.7, Near Surface and Soil Screening for Low-Energy Gamma Radiation Using the FIDLER.

2.1.1. Field Work Performed and Procedures

Prior to beginning the survey, FIDLER was calibrated and a background station was established as listed in Table II.1. The location of each background station was determined by the terrain to be surveyed (i.e., a rocky area versus grass).

Table II.1. FIDLER and Background Station Information for Area J

Date	FIDLER #	Instrument #	Probe #	Background Station
7/05/94	#2	#3400	#3611	Grid Point L05
7/06/94	#2	#3400	#3611	Grid Point B13
7/06/94	#2	#3400	#3611	Grid Point M06
7/07/94	#2	#3400	#3611	Grid Point C09
7/07/94	#2	#3400	#3611	Grid Point K05
7/11/94	#2	#3400	#3611	Grid Point A01
7/11/94	#2	#3400	#3611	Grid Point A03
7/12/94	#2	#3400	#3611	Grid Point A04

Background and standard source checks for Pu-238 and Th-232 were performed daily and readings were recorded on the card attached to the FIDLER and in the FIDLER logbook (Appendix A.2). Channel 1 readings were recorded in counts per minute (cpm). Channel 2 and the Out Channel readings were recorded in counts per minute times 1000 (kcpm). The standard deviations and the contamination criteria (CC) were calculated for the Out Channel, Channel 1, and Channel 2 and recorded in the FIDLER logbook (see Appendix A.2).

Due to its ability to detect a wide range of isotopes, the Out Channel was selected for screening surface radiological contamination within Area J. The Out Channel responds to a broad range of low-energy gamma rays and x-rays, while Channel 1 primarily responds to Pu-238, and Channel 2 primarily responds to Th-232.

In clear areas, each 25 feet by 25 feet grid block was subdivided into 25 five feet by five feet sections. These sections were surveyed in a serpentine fashion at a rate of 20 feet per minute. The maximum Out Channel reading was taken in each section and recorded in the FIDLER logbook.

Where grid blocks could not be surveyed in a serpentine fashion due to thick vegetation, Out Channel readings were taken at each stake after a one minute stabilization period. The FIDLER operator then walked between stakes perpendicular to Row A, (i.e., A1 to M1, A2 to M2, etc. as depicted in Figure 2.1) at a rate of 20 feet per minute with the FIDLER in the Out Channel mode. If the Out Channel CC was exceeded, Channel 1 and Channel 2 readings were recorded.

A FIDLER was also used during the soil gas survey to monitor the placement of all soil gas samplers and timer calibration samplers (see Section 2.2.1.1). Surface soil samples were also collected for radiological analysis at the Mound Plant Soil Screening Facility.

At each of the soil gas survey locations, grass and organic debris were removed to an approximate depth of three to six inches, if necessary. A 1.5 inch diameter hole was then augered to an approximate depth of 18 inches. A composite soil sample was collected from the augerings (zero - six inches) and placed in a sample container. All sample containers were labeled with pertinent sampling information and transported to the Mound Plant Soil Screening Facility for Th-232 and Pu-238 analysis.

At the Mound Plant Soil Screening Facility, each soil sample was pulverized, placed in a lead cask, and screened using a sodium iodide detector (manufactured by Bicron) coupled to a portable multi-channel analyzer (Stought et al. 1988).

2.1.2. Quality Assurance Summary Report

The field and data analysis variances are summarized in the following subsections.

2.1.2.1. Field Variance Report

The FIDLER survey was completed with no variances from the OU5 Quality Assurance Project Plan (QAPjP) (DOE 1993b). Two variances from the SOP 6.7 involved source checks and scanning techniques.

The first minor variance was the use of Pu-238 and Th-232 sources for the daily source check as opposed to the americium-241 source specified in SOP 6.7. Plutonium and thorium sources were provided by the Mound plant for the required daily check. The second variance from SOP 6.7, the inability to screen the entire area in a serpentine fashion, occurred due to portions of Area J being thickly wooded and very steep. In grid blocks where it was not possible to screen in a serpentine fashion, screening was conducted at and between grid points as described in Section 2.1.1. Forty-four percent of Area J was screened in a serpentine fashion, three percent was partially screened in a serpentine fashion, and 53 percent was screened at grid points only.

2.1.2.2. Data Analysis Variance Report

FIDLER survey data were not formally validated. However, all logbook entries were checked for accuracy, completeness, and format. An error was found in the calculations used to determine the FIDLER contamination criteria (CC). These values were recalculated and compared to the FIDLER survey data. After reviewing the data, several additional locations in Area J were identified as have elevated radiological activity when compared to the recalculated Out Channel CC. Because the corrections were made following the completion of the survey, no Channel 1 or Channel 2 readings were taken at these locations identified as having elevated Out Channel readings.

Soil sampling and monitoring procedures for the soil analysis followed the Mound Plant procedures. No variances were noted.

2.1.3. Health and Safety Summary Report

The FIDLER survey was conducted according to the OU5 South Property RI/FS Health and Safety Plan (DOE 1993e), and the Environmental Restoration Program Site-Specific Health and Safety Plan for OU5 Operational Area - Area J. Health and safety issues were discussed and resolved during daily tailgate

safety briefings conducted by the Site Health and Safety Officer and documented in the Site Manager Logbook (Appendix A.1).

No accidents or safety violations occurred during the FIDLER survey at Area J. On August 23, a health and safety surveillance was conducted; no deviations were found.

2.1.4. Presentation of Radiological Data

Appendix C contains all radiological data collected during the Phase 1 investigation. It includes data from the FIDLER survey and the analytical results of soil samples sent to the Mound Plant Soil Screening Facility.

The FIDLER Survey located three areas of elevated surface radiological activity (above the Out Channel CC) in the southern, eastern, and northwestern portions of Area J. These results are summarized in Table II.2 and shown in Figure 2.2.

Surface soil samples, collected as part of the soil gas survey (see Section 2.2.1.1), were analyzed for Pu-238 and Th-232 at the Mound Plant Soil Screening Facility. Concentrations of Th-232 at or exceeding the Mound Plant Soil Screening Facility detection limit of 2.0 pCi/g were detected at one of the 144 sample locations, F2 (see Figure 2.3). Concentrations of Pu-238 at or exceeding the Mound Plant Soil Screening Facility detection limit of 25 pCi/g were detected at seven of the 144 sample locations. Figure 2.3 shows (1) the locations where concentrations of Pu-238 equal or exceed 25 pCi/g; and (2) the concentration contours where Pu-238 exists at concentrations from 25-50 pCi/g. This information is presented in Table II.3. The concentration of Pu-238 in the surface soil did not exceed 35 pCi/g within the estimated boundary of Area J. Additionally, surface soil sample results indicate that Pu-238 is present outside the estimated Area J boundary along the western boundary of the area at concentrations above 25 pCi/g (see Figure 2.3).

2.1.5. Comparison with Historical Radiological Data

Surface and subsurface soil samples were collected, either within or near Area J from 1983 to 1985 during the Mound Site Survey Project (Stought et al. 1988). Twelve core locations (drilled to a maximum depth of 19.5 feet) and nine surface locations were sampled. The results of the soil sampling conducted under

Table II.2. Summary of Elevated Radiological Activity in Area J (FIDLER SURVEY)
Page 1 of 2

Grid Location	Out Channel Reading (kcpm)	Out Channel CC (kcpm)
L1-01, L1-06, L1-07, L1-10, L1-11, L1-18 to L1-20, L1-24, L1-25	8.0 - 8.5	7.5
L3-01 to L3-03, L3-08 to L3-13, L3-18 to L3-23	6.5 - 8.0	6.2
M3	7.0	
L4-20	9.5	9.1
M4	11.0	
A5-01 to A5-25	6.5 - 7.5	6.2
B5-01 to B5-12, B5-14 to B5-25	6.5 - 7.5	
C5-01 to C5-11, C5-13 to C5-15, C5-17, C5-19, C5-21 to C5-25	6.5 - 7.0	
D5-01 to D5-25	6.5 - 7.5	
E5-01 to E5-25	6.5 - 8.5	
L5	9.5	9.1
M5	11.0	
A6-01 to A6-19, A6-22 to A6-25	6.5 - 7.5	6.2
B6-01 to B6-25	6.5 - 7.5	
C6-01 to C6-25	6.5 - 7.5	
D6-01 to D6-23, D6-25	6.5 - 7.0	
E6-01 to E6-21, E6-23 to E6-25	6.5 - 10.0	
A7-05 to A7-07, A7-14 to A7-16, A7-25	6.5 - 7.0	
B7-09 to B7-11, B7-16, B7-17, B7-19 to B7-25	6.5 - 7.0	
C7-04	6.5	
D7-02, D7-09, D7-22, D7-25	6.5	
E7-04 to E7-08, E7-14, E7-19	6.5	
C9-14, C9-17, C9-18	9.5	9.4
D9-11	9.5	9.4

Table II.2. Summary of Elevated Radiological Activity in Area J (FIDLER SURVEY)
Page 2 of 2

Grid Location	Out Channel Reading (kcpm)	Out Channel CC (kcpm)
D10-06, D10-11	10.0	9.8
E10-01, E10-03, E10-07, E10-08, E10-10 to E10-25	9.5 - 10.0	9.4
F10-04, F10-06, F10-07, F10-13 to F10-19, F10-21, F10-23, F10-24	9.5 - 10.5	
C11-06, C11-07, C11-13 to C11-15, C11-25	10.0	9.8
D11-04 to D11-07, D11-13 to D11-19, D11-21, D11-23 to D11-25	10.0	
E11-01, E11-07, E11-14 to E11-22, E11-24, E11-25	10.0 - 10.5	
F11-09	10.0	
B12-02 to B12-04, B12-06, B12-09, B12-11 to B12-25	10.0	
C12-01 to C12-09, C12-13 to C12-18, C12-22 to C12-25	10.0 - 10.5	
D12-01 to D12-15, D12-17, D12-19 to D12-21, D12-23 to D12-25	10.0 - 11.0	
E12-01 to E12-25	10.0 - 10.5	
F12-03, F12-04, F12-16	10.0	

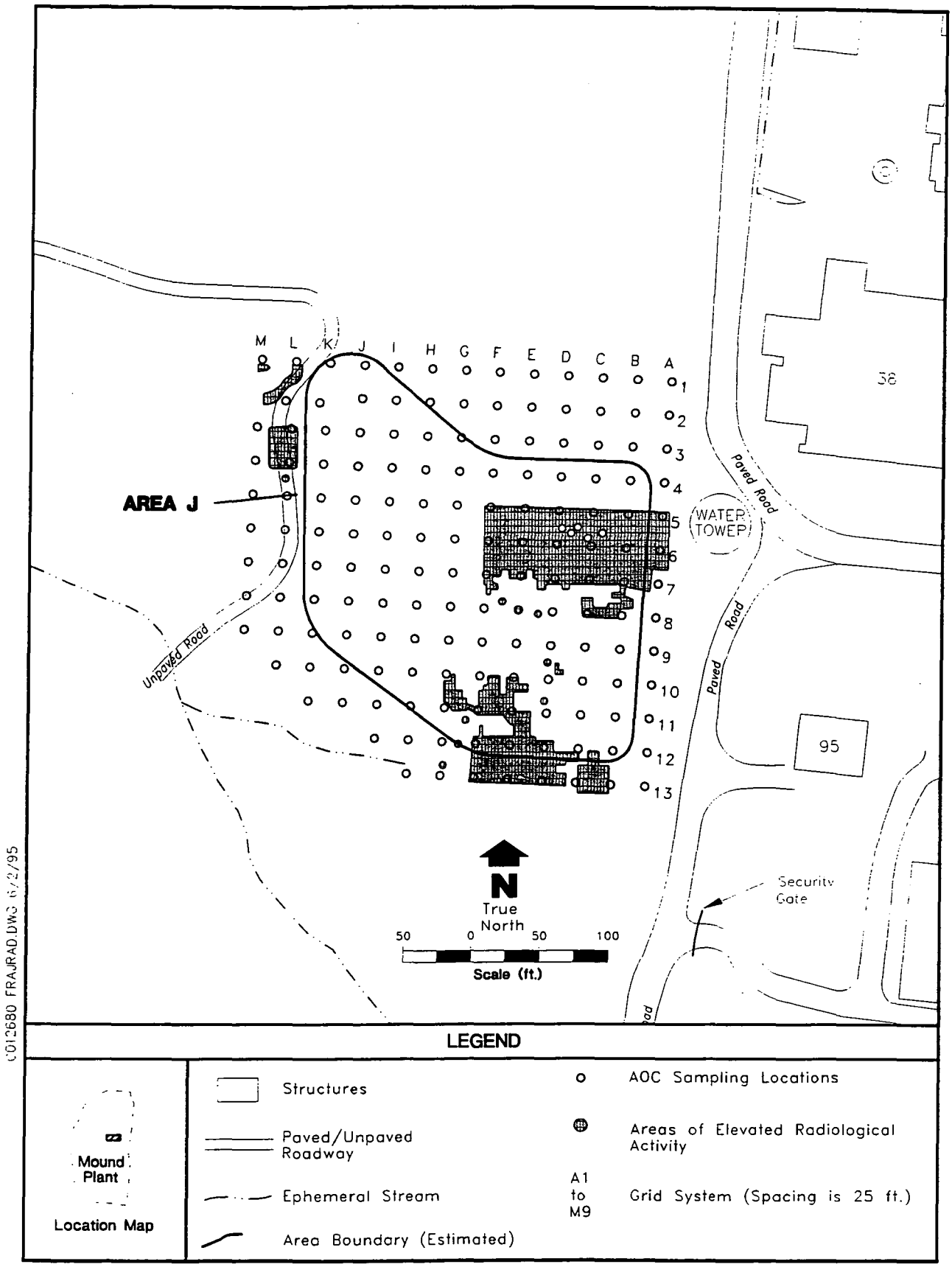

Figure 2.2. Areas of Elevated Surface Radiological Activity (FIDLER Survey)

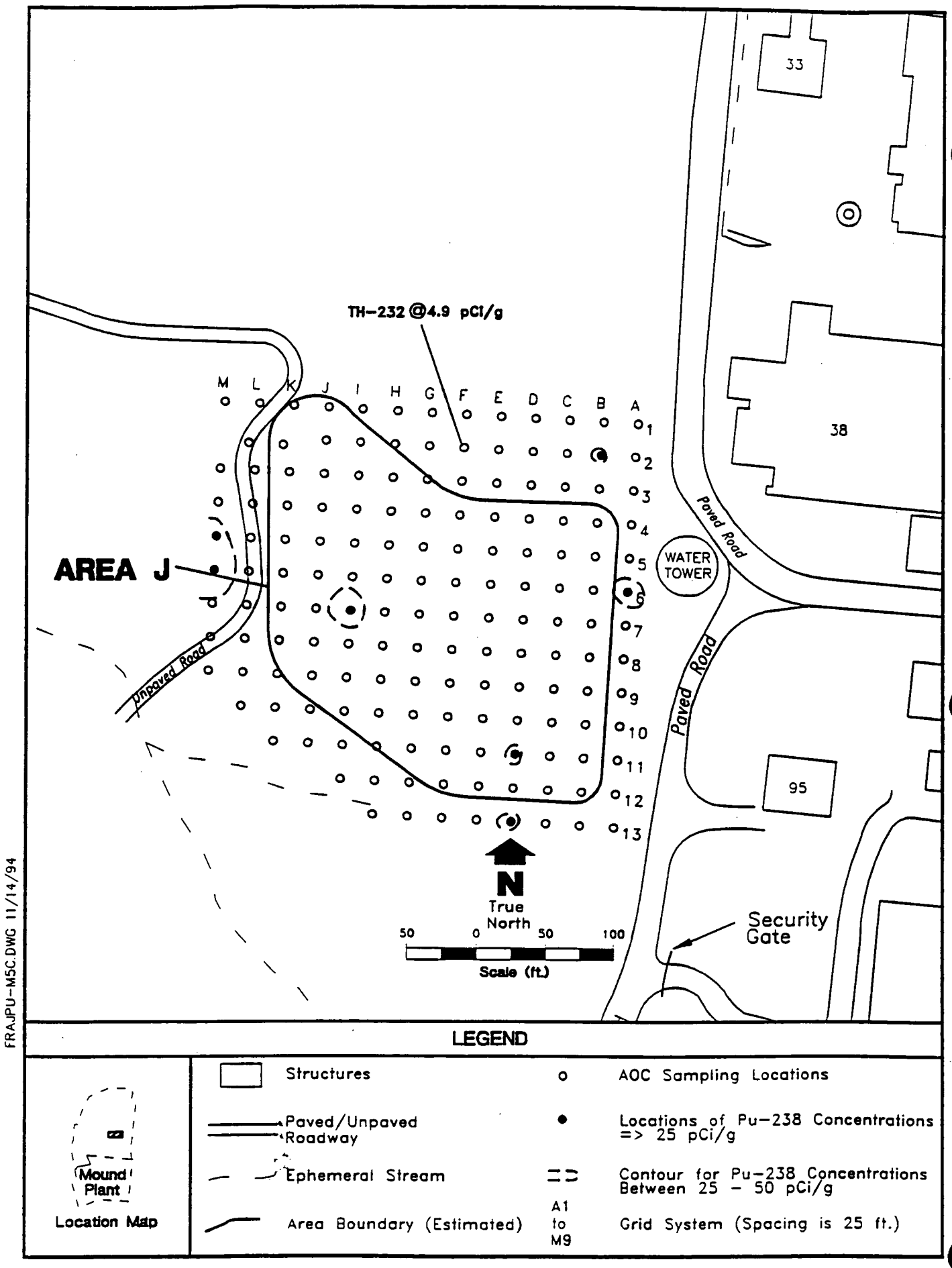

Figure 2.3. Locations of Elevated Surface Soil Radiological Activity

Table II.3. Summary of Elevated Surface Soil Radiological Activity (Soil Screening)

Grid Location[a]	Mound Soil Screening Facility Data	
	Plutonium-238 (pCi/g)	Thorium-232 (pCi/g)
A6	28	ND
B2	31	ND
D11	28	ND
D13	26	ND
F2	ND	4.9
I7	35	ND
M5	27	ND
M6	36	ND

a See Figure 2.3 for grid location

ND Radiological contamination not detected above the Mound Plant Soil Screening Facility detection limit of 25 pCi/g for Pu-238 and 2 pCi/g for Th-232.

the Mound Site Survey Project are summarized in Table II.4 of this report (DOE 1993f). Table II.4 presents the sampling locations where Pu-238 and Th-232 were found at concentrations above 25 pCi/g and 2.0 pCi/g, respectively. The corresponding core and surface soil sampling locations are shown in Figure 2.4.

Four historical samples contained Pu-238 concentrations greater than or equal to 25 pCi/g (core locations C0156, C0158, and surface location S0633). The maximum Pu-238 concentration measured in these samples was 71.30 pCi/g in the sample taken at a depth of 18 inches at core location C0156. Ten samples contained Th-232 concentrations greater than 2.0 pCi/g (core locations C0152, C0156, and C0160). The maximum thorium activity measured was 30.42 pCi/g in a sample taken at a depth of 13.5 feet at core location C0160 (see Table II.4).

Four soil samples were collected during the installation of well 0326 as part of the Mound Plant installation groundwater assessment program. This well is located in Area J near grid coordinate C8. Pu-238 was found at a maximum concentration of 0.159 pCi/g at a depth of zero to five feet. Th-232 was found at a maximum concentration of 0.941 pCi/g at a depth of five to ten feet. Cesium-137, radium-226, strontium-90, tritium, and uranium were also found. Validated analytical results are presented in Appendix C of the OU9 Hydrogeologic Investigation: Soil Chemistry Report (DOE 1994a).

The results of the soil screening of Area J during the 1994 Phase 1 investigation indicate the presence of Pu-238 in the surface soil along the western boundary. These results are not consistent with the results reported in the Mound Site Survey Project which indicate the presence of Pu-238 in the surface soil in the northeastern corner of Area J. Th-232 was found at grid coordinate F2 at 4.9 pCi/g in this investigation but not above 2.0 pCi/g at historical locations S0633 and C0158. Due to the proximity of these locations, these findings are inconclusive.

Table II.4. Summary of Historical Radiological Data Collected in Area J
(Mound Site Survey Project, 1983-1985)
Page 1 of 3

Sample Location[a]	Coordinates		MRC ID No.	Mo-Yr	Depth (inch)	Plutonium-238 (pCi/g)	Thorium (pCi/g)	Tritium (pCi/L)	Cobalt-60 (pCi/g)	Cesium-137 (pCi/g)	Radium-226 (pCi/g)	Americium-241 (pCi/g)
	South	West										
C0150	3055	2590	10479	08-85	18	3.94	b	NR	NR	NR	NR	NR
			10480	08-85	36	1.55	b	NR	3.0	LDL	0.2	LDL
			10481	08-85	54	3.94	b	NR	NR	NR	NR	NR
C0152	3065	2565	1561	04-83	18	2.60	2.80	NR	NR	NR	NR	NR
			1562	04-83	36	0.46	b	NR	NR	NR	NR	NR
			1563	04-83	90	1.89	b	NR	NR	NR	NR	NR
			1564	04-83	108	1.12	b	NR	NR	NR	NR	NR
			1565	04-83	126	1.29	b	NR	NR	NR	NR	NR
			1566	04-83	144	0.06	b	NR	NR	NR	NR	NR
			1567	04-83	162	0.08	b	NR	NR	NR	NR	NR
			1568	04-83	180	0.07	b	NR	NR	NR	NR	NR
			1569	04-83	198	0.27	b	NR	NR	NR	NR	NR
			1570	04-83	216	0.60	b	NR	NR	NR	NR	NR
			1571	04-83	234	5.22	b	NR	NR	NR	NR	NR
C0156	3075	2600	1572	04-83	18	71.30	2.03	NR	NR	NR	NR	NR
			1573	04-83	36	NR	4.30	NR	NR	NR	NR	NR
			1574	04-83	54	6.59	b	NR	NR	NR	NR	NR
			1575	04-83	72	6.45	b	NR	NR	NR	NR	NR

Table II.4. Summary of Historical Radiological Data Collected in Area J
(Mound Site Survey Project, 1983-1985)
Page 2 of 3

Sample Location[a]	Coordinates		MRC ID No.	Mo-Yr	Depth (inch)	Plutonium-238 (pCi/g)	Thorium (pCi/g)	Tritium (pCi/L)	Cobalt-60 (pCi/g)	Cesium-137 (pCi/g)	Radium-226 (pCi/g)	Americium-241 (pCi/g)
	South	West										
C0156	3075	2600	1576	04-83	90	4.81	2.02	NR	NR	NR	NR	NR
			1577	04-83	108	40.90	2.33	NR	NR	NR	NR	NR
			1578	04-83	126	1.08	b	NR	NR	NR	NR	NR
			1579	04-83	144	5.22	b	NR	NR	NR	NR	NR
			1580	04-83	162	3.42	b	NR	NR	NR	NR	NR
			1581	04-83	180	8.67	b	NR	NR	NR	NR	NR
			1582	04-83	198	0.72	b	NR	NR	NR	NR	NR
			1583	04-83	216	4.10	b	NR	NR	NR	NR	NR
			1584	04-83	234	9.93	3.02	NR	NR	NR	NR	NR
C0158[c]	3000	2620	8285	10-84	36	1.95	b	NR	NR	NR	NR	NR
			8286	10-84	72	25.00	b	NR	NR	NR	NR	NR
S0633	3025	2645	2923	10-83	0	47.45	b	6.84	NR	NR	NR	NR
C0160	3180	2745	2411	08-83	18	0.80	b	NR	NR	NR	NR	NR
			2442	08-83	36	2.60	b	NR	LDL	LDL	0.94	LDL
			2443	08-83	108	0.53	b	NR	NR	NR	NR	NR
			2444	08-83	126	0.62	b	NR	NR	NR	NR	NR
			2446	08-83	162	0.66	30.42	NR	LDL	LDL	1	LDL
			2447	08-83	180	3.09	14.58	NR	LDL	LDL	0.9	LDL

Table II.4. Summary of Historical Radiological Data Collected in Area J
(Mound Site Survey Project, 1983-1985)
Page 3 of 3

Sample Location[a]	Coordinates		MRC ID No.	Mo-Yr	Depth (inch)	Plutonium-238 (pCi/g)	Thorium (pCi/g)	Tritium (pCi/L)	Cobalt-60 (pCi/g)	Cesium-137 (pCi/g)	Radium-226 (pCi/g)	Americium-241 (pCi/g)
	South	West										
C0160	3180	2745	2448	08-83	198	2.60	10.32	NR	LDL	LDL	0.7	LDL
			2449	08-83	216	2.42	b	NR	NR	NR	NR	NR
			2450	08-83	234	1.70	5.07	NR	NR	NR	NR	NR
S0639	3125	2820	2924	10-83	0	3.00	b	3.09	NR	NR	NR	NR

[a]Map locations are given using a "C" to designate core locations and an "S" to designate surface locations.
[b]A "b" indicates that the total thorium concentration was less than the Mound Plant Soil Screening Facility detection level of 2.0 pCi/g. Therefore, radiochemical analysis was not performed.
[c]Boring logs indicate that these locations were not sampled to bedrock.
LDL - The measured concentration was below the lower detection limit, estimated to be 0.5 pCi/g for cobalt-60, cesium-137, and americium-241; and 1 pCi/g for radium-226.
MRC ID - Monsanto Research Corporation identification
NR - No result given
pCi/g - picocuries per gram
pCi/mL - picocuries per milliliter

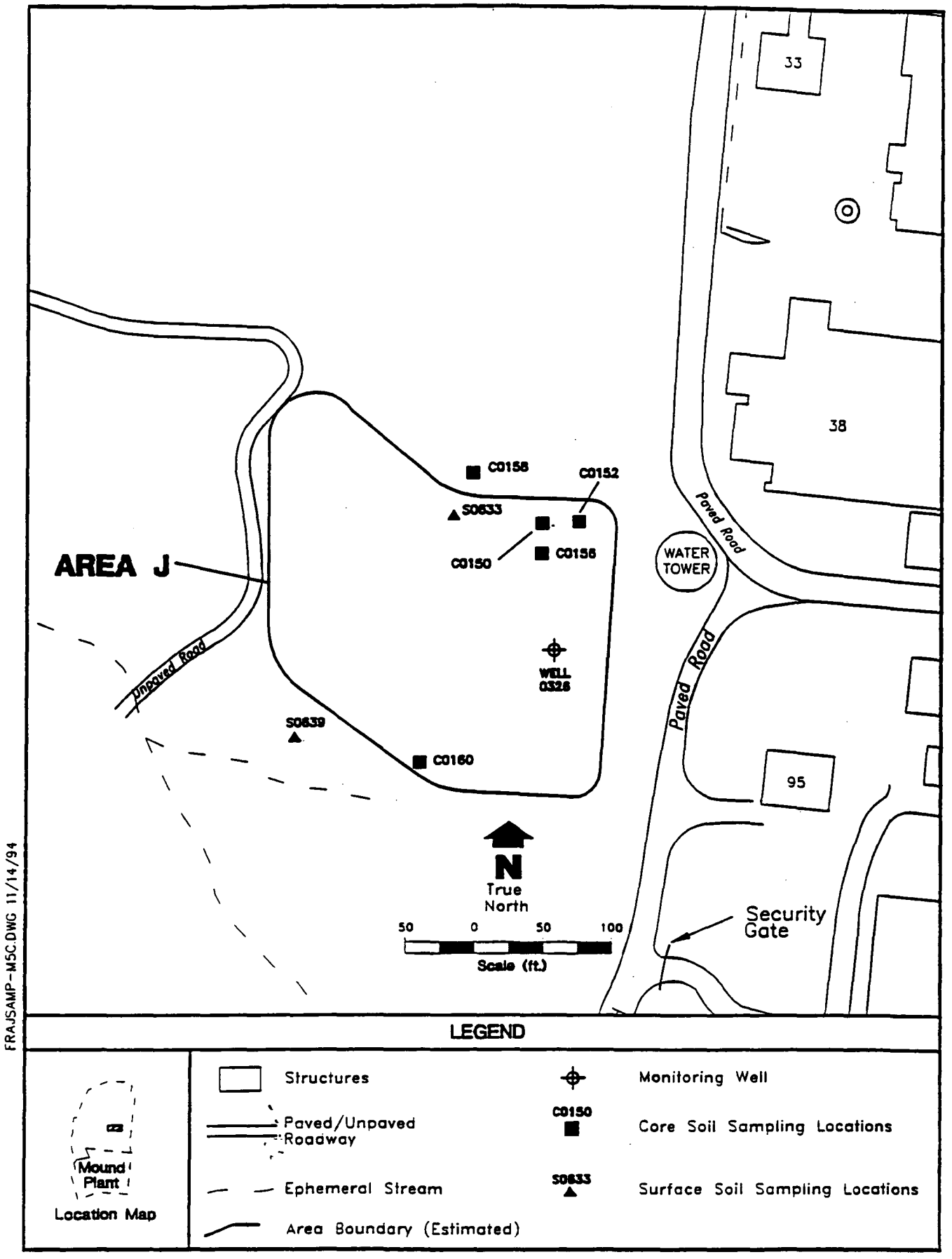

Figure 2.4. Sampling Locations for Historical Radiological Data Collected in Area J (Mound Site Survey Project, 1983-1985)

2.2. SOIL GAS SURVEY

2.2.1. Field Work Performed and Procedures

A soil gas survey was performed at Area J from August 4 to September 1, 1994 per the OU5 QAPjP, Attachment 1, SOP for Petrex Environmental Surveys (DOE 1993b). The survey was completed over the grid system established for Area J (see Figure 2.1).

2.2.1.1. Soil Gas Sampler Installation

Three sets of time calibration samplers (timers) and 157 data samplers (samplers) were installed from August 4 to August 15, 1994. Locations of the timers and samplers are shown in Appendix D, Plate 1. The timers and samplers were installed at depths between 8-18 inches using an electric hammer drill and a 18 x 1.5 inch steel/tungsten carbide-tipped drill bit.

After each use, the drill bit was washed in a phosphate free detergent solution with a synthetic scrub brush, rinsed with deionized water, and allowed to air dry.

A FIDLER was used to monitor placement of all timers and samplers. Soil samples were collected from the sample locations for Pu-238 and Th-232 analysis at the Mound Plant Soil Screening Facility (see Section 2.1.1). Results of the soil screening analyses are summarized in Section 2.1.4 and presented in their entirety in Appendix C.

2.2.1.2. Soil Gas Sampler Retrieval

On August 11, 1994, after one week of exposure, one timer from each of the three timer sets (grid locations D7, G13, and K4) was retrieved, were wiped (checked for radiological contamination), and sent to Northeast Research Institute LLC (NERI) for analysis. On August 17, 1994 the second timer from each of the timer sets was retrieved and sent to NERI. Analysis of these timers indicated that elevated relative levels of volatile and semi-volatile petroleum hydrocarbons were present in the soil gas. Based on the analysis, it was determined that an exposure time of two to three weeks for the samplers was sufficient.

Samplers were retrieved from August 24 to September 1, 1994. Due to hole collapse, seven samplers (A7, B13, C4, F1, F11, F12, and M2) could not retrieved. On September 1, 1994, all retrieved samplers were wiped, prepared for shipment, and sent to NERI. NERI received the samplers on September 2, 1994.

Upon arrival, NERI noted that samplers E12 and C3 were unsuitable for analysis due to scraped wires. Also, sampler L7 was not analyzed because the cap liner had not been removed during exposure. As a result, NERI analyzed 147 samplers on October 18 and 19, 1994.

2.2.2. Quality Assurance Summary Report

The field and laboratory analysis variances are summarized in the following subsections.

2.2.2.1. Field Variance Report

The soil gas survey was completed with minor variances from the SOP for Petrex Environmental Surveys and the Field Sampling Plan (FSP) (DOE 1993b). These variances included decontamination procedures, the number of timers installed, and travel blanks.

One minor variance from the SOP, per instruction from NERI, was the elimination of the methanol rinse step from the decontamination process used for cleaning drill bits.

Two minor variances from the FSP were noted. The first FSP variance was a decrease in the number of timers installed in Area J. The FSP requires four timer sets for an area this size, whereas NERI suggested that three timer sets were sufficient. The second FSP variance was the use of travel blanks. The FSP requires that travel blanks be returned with the timers and samplers, whereas NERI instructed that travel blanks be returned with the samplers only.

2.2.2.2. Laboratory Data Variance Report

Petrex analytical data were not formally validated. However, Soil Gas logbook entries were checked for accuracy, completeness and format. A final report for Area J was received from NERI on November 2, 1994. Sample locations shown on Plate 1 of the NERI report (Appendix D) were checked against the field map to confirm that all sampling locations were correctly plotted; no errors were found. All ion count

values (Table 1, Appendix D) were checked for plot accuracy on Plates 2 through 5, Appendix D. No errors were found.

2.2.3. Health and Safety Summary Report

The soil gas survey was conducted according to the OU5 South Property RI/FS Health and Safety Plan (DOE 1993e), and the Environmental Restoration Program Site-Specific Health and Safety Plan for OU5 Operational Area - Area J. Soil gas locations were screened using a FIDLER to avoid digging in radiologically contaminated soil. Sampling locations were checked for underground utilities to avoid damaging utility lines while digging. Health and safety issues were discussed and resolved during daily tailgate safety briefings conducted by the Site Health and Safety Officer and documented in the Site Manager Logbook (Appendix A).

A minor accident occurred on May 26, 1994, during site clearing and staking in Area J. A member of the clearing team cut his finger on a machete. First aid was administered and hospital care was not required. All personnel were briefed on hazards associated with using clearing equipment. No safety violations occurred during the placement and retrieval of samplers. On August 23, 1994, a health and safety surveillance was conducted. No deviations occurred.

2.2.4. Presentation of Chemical Data

The report of findings of the Petrex soil gas survey is presented in Appendix D. The report discusses the Petrex method, the scope of work, quality assurance/quality control methods, and results. Appendix D, Plates 1 through 5, show sample locations and significant ion counts of targeted compounds. Ion count values are the unit of measure assigned by the mass spectrometer to the relative intensities associated with each compound. These intensity levels do not represent actual concentrations. Soil gas data are considered qualitative in that multiple sources in soil and/or ground water cannot be differentiated.

Based on a review of historical information for Area J and the immediate vicinity, NERI provided analytical data for the following four general classes of compounds in order to assess the potential for the presence of these compounds below the surface:

- total aromatic hydrocarbons,
- total semi-volatile hydrocarbons,
- total oil and grease range hydrocarbons, and
- total halogenated hydrocarbons.

The following subsections describe the distribution of the compounds listed above.

2.2.4.1. Distribution of Total Aromatic Hydrocarbons

Total aromatic hydrocarbons are reported as the combined levels of C_6 to C_{15} aromatic (benzene based) hydrocarbon compounds detected in the soil gas samples.

Most of the samples contained the light and medium weight aromatic hydrocarbons (e.g. benzene, toluene, ethylbenzene/xylene, and C_9 and C_{10} aromatics). Few samples were observed to contain C_{11} or heavier aromatics.

The soil gas survey indicates that total aromatic hydrocarbons are found in a large zone covering most of the northeastern portion of Area J with several smaller zones scattered in the northwest and southwest portions (see Appendix D, Plate 2). The western edge of the large zone roughly parallels the crest of the hill dividing the area.

Numerous small areas within this zone show the highest relative levels of aromatics. These areas are indicative of soil gas composition typical of vapor from weathered light to medium weight fuels. The soil gas from the area defined by samples B5, B6, C5, and C6 is the exception. These samples exhibited characteristics more typical of partially weathered medium to heavy weight fuels or fuel oils.

2.2.4.2. Distribution of Total Semi-Volatile Hydrocarbons

Total semi-volatile hydrocarbons are reported as the combined response to naphthalene, C_{11} through C_{15} alkyl naphthalenes, and C_{12}, C_{14}, and C_{16} polycyclic hydrocarbons. These compounds are constituents of creosote, coal tar, and other heavy, high boiling point fraction petroleum products. Naphthalene, and C_{11} and C_{12} alkyl naphthalenes (e.g. methylnaphthalene and ethyl or dimethylnaphthalene) may also be found in medium to heavy weight fuels and fuel oils.

Most of the samples which yielded an elevated relative response to semi-volatiles, were from elevated relative levels of naphthalene while some were from elevated relative levels of methylnaphthalene. None of the other semi-volatile polycyclic hydrocarbons named above were clearly identified in the samples.

The distribution of total semi-volatile hydrocarbons is shown in Appendix D, Plate 3. Elevated relative levels of naphthalene and methylnaphthalene are found in several small scattered zones throughout Area J. There is one larger zone located in the east central portion of the area, next to the water tank. The soil gas from these zones also exhibited elevated relative levels of other petroleum hydrocarbons, some up to C_{12} in weight. The occurrence of these hydrocarbons in the proportions observed indicate that these hydrocarbons, naphthalene, and methylnaphthalene likely derive from medium to heavy weight fuels.

Only the soil gas at sample location M8 showed a high relative level of naphthalene and methylnaphthalene in the near absence of other petroleum hydrocarbons. This composition is typical of vapors derived from coal tar, creosote, etc.

2.2.4.3. Distribution of Total Oil and Grease Range Hydrocarbons

Total oil and grease range hydrocarbons reported are C_{13}, C_{14}, and C_{15} alkanes, cycloalkanes, alkenes, cycloalkenes, dienes, and alkynes. These compounds make up the base of most common petroleum lubricants and are also constituents of most medium and heavy weight petroleum products used as fuels and heating oils.

The distribution of total oil and grease range hydrocarbons is displayed in Appendix D, Plate 4. Elevated relative levels of these compounds were detected in small zones in the northeast corner of Area J.

The soil gas from most of these zones also contained elevated relative levels of light weight aromatics which indicates that the overall composition is more like the vapor derived from fuels than from lubricants. Only soil gas from sample D2 contained other medium and heavy weight hydrocarbons in proportions suggesting derivation from a lubricant or a medium to heavy weight petroleum product.

2.2.4.4. Distribution of Total Halogenated Hydrocarbons

Total halogenated hydrocarbons are reported as the combined levels of tetrachloroethene (PCE), trichloroethene (TCE), trichloroethane (TCA), dichlorobenzene (DCB), trichlorofluoromethane (Freon-11), and trichlorotrifluoroethane (Freon-113). These compounds are volatile liquids commonly used as solvents, cleaning agents, and refrigerants.

PCE was detected more frequently in the soil gas than the other halogenated hydrocarbons. Thus, most of the relative responses to total halogenated hydrocarbons principally reflect the presence of PCE in the soil gas.

Elevated relative levels of halogenated hydrocarbons occur mostly in a large zone extending over the central and northwestern portions of Area J and in a smaller zone in the northeastern corner (see Appendix D, Plate 5). In addition, there are several small zones (defined by a single sample location) showing moderately elevated relative response to halogenated hydrocarbons.

2.2.5. Comparison with Historical Chemical Data

Historical chemical data from Area J include a 1992 soil gas survey and analytical results of samples collected from well 0326. Table II.5 shows chemical contaminants detected during these historical sampling events. To facilitate comparison with the Petrex soil gas survey, only organic compounds from the four general classes of hydrocarbons listed in Section 2.2.4 of this report were considered.

Well 0326 is located in Area J near grid coordinate C8. It was completed on April 3, 1993 as part of the Mound Plant installation groundwater assessment program. Four soil samples were collected during drilling of the well at 0-5 feet, 5-10 feet, 10-15 feet, and 15-20 feet (DOE 1994a). Pyrene (at estimated quantities) was found at 5-10 feet. Acetone was found at 5-10 feet and at 10-15 feet. Validated analytical soil results are presented in Appendix C of the OU9 Hydrogeologic Investigation: Soil Chemistry Report (DOE 1994a).

Table II.5. Summary of Historical Chemical Data Collected in Area J

Sampling Event	Halogenated Hydrocarbons				Aromatic Hydrocarbons	SVOC	VOC
	PCE	TCE	TCA	Freon-11	Toluene	Pyrene	Acetone
Well 0326						JB(1)	X(1)
1992 Soil Gas Survey	X	X	X	X	X		

(1) found in soil sample(s)
X found in detectable quantities
J estimated concentration or below detection limit
B found in laboratory blank
PCE tetrachloroethene
TCE trichloroethene
TCA trichloroethane

Groundwater samples from well 0326 were collected during the Fall 1993 and Spring 1994 Groundwater Sweeps Program. Freon-113, acetone, and benzoic acid were detected only in the 1993 sampling event. Various phthalate esters and 4-methyl phenol were detected in both the 1993 and the 1994 sampling events.

Analytical data from the Fall 1993 and Spring 1994 Groundwater Sweeps Program are currently unvalidated and are not used for comparison in this report. However, it is anticipated that the data will be validated when Phase 2 investigations (if warranted) are initiated in Area J. At this time, the data will be used in conjunction with Phase 2 analytical results to determine the nature and extent of chemical contamination in Area J.

A soil gas survey was performed at Area J in 1992 (DOE 1993g). A total of 26 samples were collected (see Figure 2.5) and analyzed for various organic compounds, primarily halogenated hydrocarbons. The soil gas sampling was performed by driving sections of drill rod and steel points into the subsurface and drawing soil vapor to a gas collection system mounted on a mobile unit. Soil vapor was analyzed in an on-site mobile laboratory for volatile organic compounds (VOCs). Quality control samples were collected and analyzed throughout the field effort to monitor system efficiency. Targeted contaminant concentrations were reported as parts per billion.

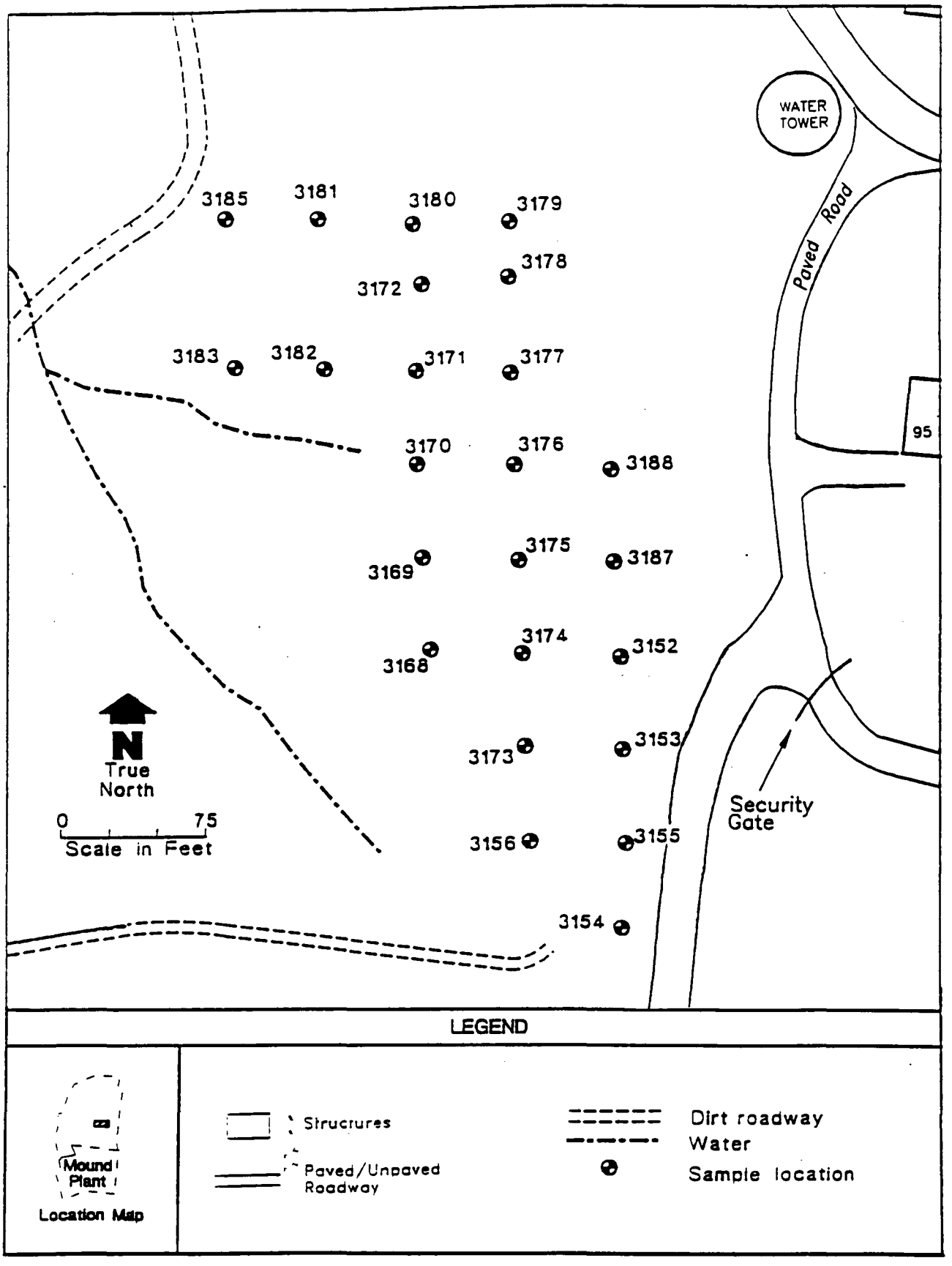

Figure 2.5. Sampling Locations for 1992 Soil Gas Survey in Area J

The halogenated hydrocarbons Freon-11, TCA, and TCE were found in a single sample (#3154) at the extreme southeastern corner of the historical study area. Freon-11 and PCE were also found in a single sample (#3171) located in the north central portion of the study area. TCA and Freon-11 were found in two samples (#3175 and #3187) in the east central portion of the study area. Toluene, an aromatic hydrocarbon, was found in scattered samples (#3153, #3155, and #3168) in the southern portion of the study area.

Table II.5 shows that the 1992 soil gas survey detected the presence of several halogenated hydrocarbons in Area J media. This finding is consistent with the Petrex soil gas survey report which shows dispersion of halogenated hydrocarbons in soil gas over much of Area J (see Appendix D, Plate 5). All the halogenated hydrocarbons listed in Table II.5 were detected by the Petrex soil gas survey, though PCE was detected more frequently than the others.

The aromatic hydrocarbon, toluene, was detected by the 1992 soil gas survey but was not found in soil samples from well 0326. This is consistent with the Petrex soil gas survey which indicates that toluene is the principal aromatic detected in most of the soil gas samples. As such, the dispersion of aromatics over the eastern portion of Area J (see Appendix D, Plate 2) may be due to the presence of toluene in the subsurface soils but not in the groundwater.

The semi-volatile organic compound (SVOC), pyrene, was found in well 0326 soil samples but not in the 1992 soil gas survey. Comparison of these findings with the Petrex soil gas survey is inconclusive. The limited dispersion of SVOCs over Area J (see Appendix D, Plate 3) is due in part to the presence of pyrene in soil gas.

Acetone is a VOC that is very water soluble. Due to this physical characteristic, it is unlikely to enter soil gas vapor phase and was not detected in either soil gas survey. Thus, no correlation can be made to its presence in soil samples from well 0326.

2.3. GEOPHYSICAL SURVEY

A geophysical survey was performed at the northwestern corner of Area J in June and July, 1994. In 1992, another detailed geophysical survey was conducted over approximately 90,000 square feet of Area J (DOE 1993g). The northwestern corner of Area J was not included in the 1992 survey because of the

heavy vegetation. As part of the Phase 1 RI/FS investigation, the geophysical grid established in the 1992 survey was extended into the northwestern corner of Area J to further characterize the area. A grid system with stations every ten feet was established (see Figure 2.6 and Appendix E, Figure E.1). The lines for the survey were oriented in a general north to south and east to west direction.

Two complementary geophysical methods were used in the geophysical survey at Area J: (1) magnetic/magnetic gradient and (2) electromagnetic (EM). The instruments used were the: GEM GSM-19 proton precession magnetometer and gradiometer and, as well as the Geonics EM-31 and the EM34-3 terrain conductivity units. Three surveys (magnetometer/gradiometer, EM-31, and EM34-3) were performed in conjunction with one another to locate objects (e.g., 55-gallon drums, large blocks of concrete, and ferrous and nonferrous metals) that might interfere with well installation and soil borings.

The following subsections summarize the field activities and the evaluation of the data and present the results of the geophysical survey.

2.3.1. Field Work Performed and Procedures

The magnetometer/gradiometer and EM-31 surveys were conducted June 27 through June 30, 1994. The EM34-3 survey was conducted on July 18 and 19, 1994. All three surveys were conducted over the same grid system (see Figure 2.6). The base station for all three surveys was established in an area free of any known magnetic source. This location (near grid point C8) is 150 feet south and 17 feet west of the origin of the survey (line 0N, station 0W).

Data from all surveys were automatically recorded using electronic data logging systems. Automatic logging of the data made it unnecessary to manually record information on field data sheets. A field logbook was maintained to record observations and procedures relative to the survey.

2.3.1.1. Magnetometer/Gradiometer Equipment and Field Operations

Two GEM GSM-19 proton precession magnetometers were used to measure local changes in the total magnetic field and in the magnetic gradient at the site. The base station unit near grid point C8 measured the total magnetic field and was operated continuously throughout the survey in order to detect artificial spikes caused by local electromagnetic sources and magnetic storms. It was also used to measure the daily

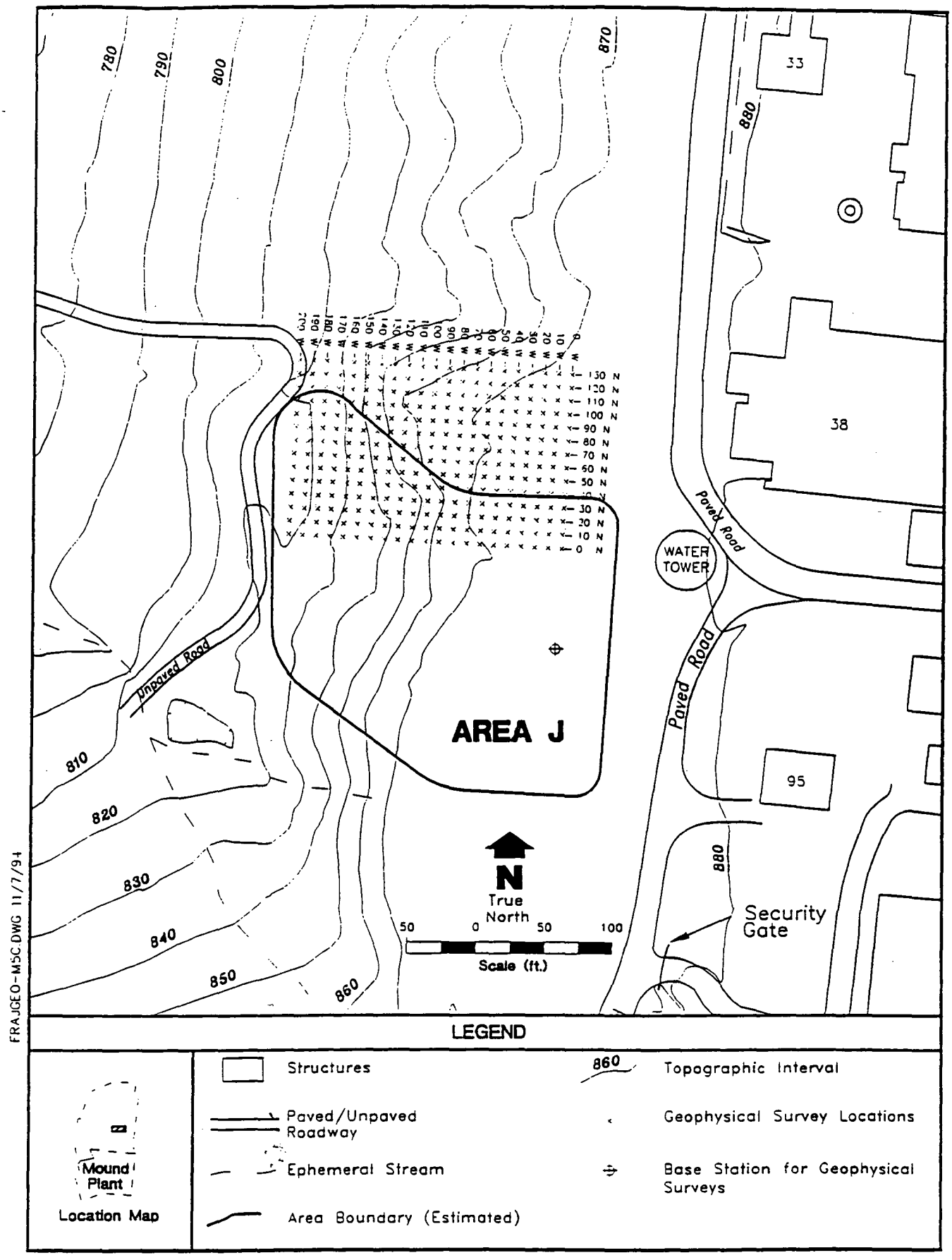

Figure 2.6. 1994 Geophysical Grid Stations of Area J

magnetic drift. The other, mobile unit, was used to measure both the total magnetic field and the magnetic gradient at each of the grid stations. All stations were occupied for the magnetometer/gradiometer investigation.

Both the base station and the mobile unit were synchronized with respect to the regional magnetic field, the time of day, and other aspects of the field operations necessary to automatically correct for the daily magnetic drift. The magnetometer at the base station was checked periodically for proper operation during the survey.

2.3.1.2. Electromagnetic (EM-31) Equipment and Field Operations

A Geonics, Ltd. EM-31 unit was used to measure the apparent electrical conductivity of the shallow subsurface (approximately 0 - 12 feet). The transmitter and receiver coils were fixed at 3.66 meters (12.0 feet) apart and contained within the boom (aluminum staff) of the EM-31 unit. The field survey was conducted with the transmitter coil at the north end of the boom. Field measurements were taken at each station (see Figure 2.6) except where dense vegetation and steep terrain made it impossible.

At each grid station, the data were measured and then recorded automatically using a Polycorder Digital Data Recorder, Geonics Model DL 560/31, compatible with the EM-31 unit.

2.3.1.3. Electromagnetic (EM34-3) Equipment and Field Operations

A Geonics Ltd. EM34-3 electromagnetic unit was used to measure the apparent conductivity at depths greater than that of the EM-31. Unlike the fixed distance between the transmitter and receiver coils (intercoil spacing) in the EM-31, the intercoil spacing of the EM34-3 can be adjusted to 10, 20, or 40 meters (32.8, 65.4, or 131.2 feet respectively). For this survey, the intercoil spacing was adjusted to 10 meters (32.8 feet). The EM34-3 is able to induce electromagnetic penetration of approximately 20 to 40 feet (7 to 12 meters) with the intercoil spacing set at ten meters (32.8 feet). The EM34-3 is generally not sensitive to isolated shallow objects buried less than five feet deep.

This survey was conducted only in the eastern flat portion of Area J because the steep slope would not have allowed the transmitter and the receiver coils to remain level and in the same plane (collinear and coplanar) which would have resulted in unusable data.

The data measure at each station were automatically recorded using a Polycorder Digital Data Recorder, Geonics Model DL 560/34, compatible with the EM34-3 unit.

2.3.2. Quality Assurance Summary Report

The field and data analysis variances are summarized in the following subsections.

2.3.2.1. Field Variance Report

Fourteen east-west lines using 10-foot station spacing were established as the geophysical grid system in Area J. All measurements for all surveys were expected to be taken at the same stations.

For the EM-31 investigation, only ten of the east-west lines were occupied; four lines (lines 10N, 80N, 120N, and 130N) were not completely surveyed. On the steep slope, several stations were not occupied because of inaccessible terrain (line 10N: stations 90W to 200W; line 80N: stations 110W to 200W). The omission of parts of lines 10N and 80N did not significantly impact the EM-31 survey. Line 125N was used instead of lines 120N and 130N because of inaccessible terrain.

For the EM34-3, only the flat eastern area was surveyed (lines 0N to 110N: stations 0W to 80W). The dense vegetation and the steep slope in the remaining areas, made conducting the survey impractical because of the inability to keep the transmitter and receiver coils level and in the same plane.

2.3.2.2. Data Analysis Variance Report

An electric power line exists over a portion of the northwestern edge of the site; because it was not grounded, it did not affect the measurements. The steel manhole covers and the grate located in the flat area produced magnetic and electromagnetic anomalies in their immediate areas. Magnetic storms that might interfere with the geomagnetic field were reported by the Space Environmental Services Center in Boulder, Colorado as having occurred on June 27, 28, and 29. They did not significantly impact the data. Other potential sources of error were not identified.

Data from all three surveys were automatically recorded using electronic data logging systems. To ensure that data was being recorded accurately with respect to location and that readings were within acceptable

ranges, data loggers were viewed at every station. Any errors that were detected could then be corrected in the field.

At the end of the day's survey, the field data were transferred to a backup hard drive and floppy diskette using a portable computer.

The data collected at the base station during the EM-31 and EM34-3 surveys was inspected to determine if the survey was affected by magnetic drift during the survey. Variations greater than five millisiemens per meter, the accuracy of the instruments, were not observed; therefore, corrections for instrument drift were not required. Magnetometer data were reduced to correct for the normal magnetic daily drift. This correction was accomplished automatically using the internal software of the synchronized mobile and base station unit.

A visual inspection of the survey data was made to identify: obvious errors in the data; interference from stray electrical sources; interference from magnetic storms; and interference from other sources that might produce artificial anomalies. No errors or interferences were observed.

The data files from the respective surveys were compiled and merged into other files that were compatible and convenient for analysis, plotting, and interpretations. Presentation of the raw data and resultant maps are in Appendix E.

2.3.3. Health and Safety Summary Report

The geophysical survey was conducted according to the OU5 South Property RI/FS Health and Safety Plan (DOE 1993e), and the Environmental Restoration Program Site-Specific Health and Safety Plan for OU5 Operational Area - Area J. Health and safety issues were discussed and resolved during daily tailgate safety briefings conducted by the Site Health and Safety Officer and documented in the Site Manager Logbook (Appendix A.1).

On June 29, 1994, a member of the geophysical team suffered from a severe case of chigger bites. No sign of chigger infestation was found in the field. The use of additional spray repellent was recommended to prevent reoccurrence of this incidence.

No safety violations were reported during the Geophysical survey at Area J.

2.3.4. Presentation of Geophysical Data

The completed geophysical survey report is presented in Appendix E. The report discusses background information, equipment and field operations, data reduction and analysis, interpretations, and findings.

The geophysical data and field observations indicate that the area contains a wide range of construction debris including concrete blocks with reinforcing steel bars, limestone blocks, steel pipes and valves, ferrous and nonferrous metal, asphalt, plastic, rubber, at least one 55-gallon drum, and other manmade materials. The surface of the steep slope is covered with such debris, and similar debris is probably buried. Similar debris is also probably buried beneath the surface of the flat area.

The northern third of the flat area appears to have relatively few anomalies; one of these is associated with the steel grate overlying the concrete pit and the manhole covers. Field observations suggest that the flat surface of this northern third of the survey area extends beyond the extrapolated topographic break between the flat area and the slope which exists farther south. There is little vegetation on the flat surface which is covered with crushed rock. These three field observations suggest that the northern third of Area J may have been constructed after the other parts of the flat area. The relatively few geophysical anomalies in this area suggest that either no major sources appear to be buried in this area or the crushed rock and soil cover may be sufficiently thick to mask sources that might otherwise cause geophysical anomalies.

If drilling or sampling is planned in this area, care should be taken to avoid penetrating the buried objects identified (See Appendix E, Plates 1 - 8). A diameter of 10 feet around the interpreted location is generally adequate to avoid the objects. However, as indicated elsewhere in this report, other objects may exist within the area of the anomalies. The presence of the larger anomalies will likely mask the smaller source.

2.3.5. Comparison with Historical Geophysical Data

No other geophysical surveys were done prior to the 1992 (DOE 1993g) and 1994 surveys of Area J, therefore no comparisons to historical data can be made.

3. SUMMARY

The results of the reconnaissance (radiological, chemical, and geophysical) surveys conducted in Area J are summarized in this section.

The FIDLER survey indicated three areas of elevated surface radiological activity in the southern, eastern, and northwestern portions of Area J. The soil screening analysis indicated the presence of Pu-238 in isolated locations throughout Area J.

The soil gas survey conducted in Area J indicates the presence of chemical contaminants as summarized below:

- PCE was the most frequently detected halogenated hydrocarbon in Area J soil gas. The halogenated hydrocarbons TCA, TCE, Freon-11, Freon-113, and DCB were detected much less frequently than PCE.

- Elevated levels of petroleum hydrocarbons exist in the subsurface. Most of the samples showed a limited combination of light and medium weight petroleum hydrocarbons of which C_6 to C_9 aromatics and C_4 to C_{10} cycloalkanes and alkenes were prominent. A few of these samples showed elevated levels of the semi-volatile hydrocarbons naphthalene and methylnapthalane.

- The aromatics, cycloalkanes, and alkenes detected are common constituents of most petroleum fuels and oils and many other petroleum-based products. Naphthalene and methylnaphthalene are peculiar to heavier weight petroleum products such as diesel fuel, heating oil, tar, and creosote.

The geophysical survey conducted in Area J indicates that the area contains a wide range of construction debris and other man-made materials buried in some places as deep as 30 feet. The surface of the steep slope is covered with such debris, and similar debris is probably buried. The flat area has construction debris buried beneath the surface.

These results may be used to direct a Phase 2 investigation of Area J in accordance with the Operable Unit 5, Work Plan (DOE 1993a).

4. REFERENCES

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