Environmental Restoration Program

OPERABLE UNIT 5
OPERATIONAL AREA PHASE I INVESTIGATION
NON-AOC FIELD REPORT

MOUND PLANT
MIAMISBURG, OHIO

VOLUME I - TEXT

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ACRONYMS

AOC	Area of Concern
BGS	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylene
CC	contamination criteria
cpm	counts per minute
DCB	dichlorobenzene
DOE	U.S. Department of Energy
dpm	disintegrations per minute
DQA	data quality assessment
DQO	data quality objective
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
mg/L	milligram per liter
µg/L	microgram per liter
µg/kg	microgram per kiligram
mg/kg	milligram per kilogram
MSL	mean sea level
NERI	Northeast Research Institute LLC
Non-AOC	Non-Area of Concern
NPDES	National Pollutant Discharge Elimination System
OU	operable unit
PCE	tetrachloroethene
pCi/g	picocuries per gram
pCi/L	picocuries per liter
ppb	parts per billion
Pu-238	Plutonium-238
Pu-239/240	Plutonium-239/240
K-40	Potassium-40
QAPjP	Quality Assurance Project Plan
QC	quality control
Ra-226	Radium-226
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
SM/PP	Special Metallurgical/Plutonium Processing
SOP	Standard Operating Procedure
SVOC	semi-volatile organic compound
TAL	Target Analyte List
TCA	trichloroethane
TCE	trichloroethene
Th-228	Thorium-228
Th-230	Thorium-230
Th-232	Thorium-232

ACRONYMS (continued)

VOC	volatile organic compound
U-234	Uranium-234
U-235	Uranium-235
U-238	Uranium-238

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1. INTRODUCTION

The purpose of the Operable Unit 5 (OU) 5 Operational Area Non-Area of Concern (Non-AOC) Field Report is to (1) present the results of the radiological and soil gas reconnaissance surveys and the chemical and radiological sampling conducted as part of a larger OU5 Phase 1 Investigation, and to (2) identify potential areas of radiological and chemical contamination.

The data gathered during the Phase 1 Investigation are not remedial investigation (RI) quality. However, as summarized in this report, the data provide a qualitative screen that can be used to determine a strategy for directing Phase 2 and possible Phase 3 investigations. A Phase 2 investigation may be conducted to gather RI quality data from locations with probable contamination, as found during the Phase 1 reconnaissance investigation. That information would 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) of OU5 (DOE 1993a).

OU5, which is approximately 220 acres of the 306 acre Mound Plant, is broadly defined as the Special Metallurgical/Plutonium Processing (SM/PP) Hill, the New Property, and 11 Areas of Concern (AOCs) (see Figure 1.1). The AOCs contain soils of known or suspected radiological and/or chemical contamination. Results of field investigations in seven of the eleven AOCs in OU5 (Areas 3, 7, 13, 21, 22, J, and the Sewage Disposal Building Area) and the New Property are reported in separate field reports.

Though the Non-AOC geographically includes AOCs 8, 9, 10, and 12, a thorough investigation of these areas as AOCs was outside the objectives of this Phase 1 Investigation. AOCs 8, 9, 10, and 12 are to be investigated individually during future studies conducted by the Decontamination and Decommissioning Program at the Mound Plant.

Sampling (radiological and soil gas surveys) was conducted in the areas designated as AOCs 8, 9, 10, and 12 as part of the Non-AOC investigation. However, sampling was minimal and did not constitute a complete investigation of each AOC. Sampling results for these areas will be presented although no comparisons with historical data will be done for this report.

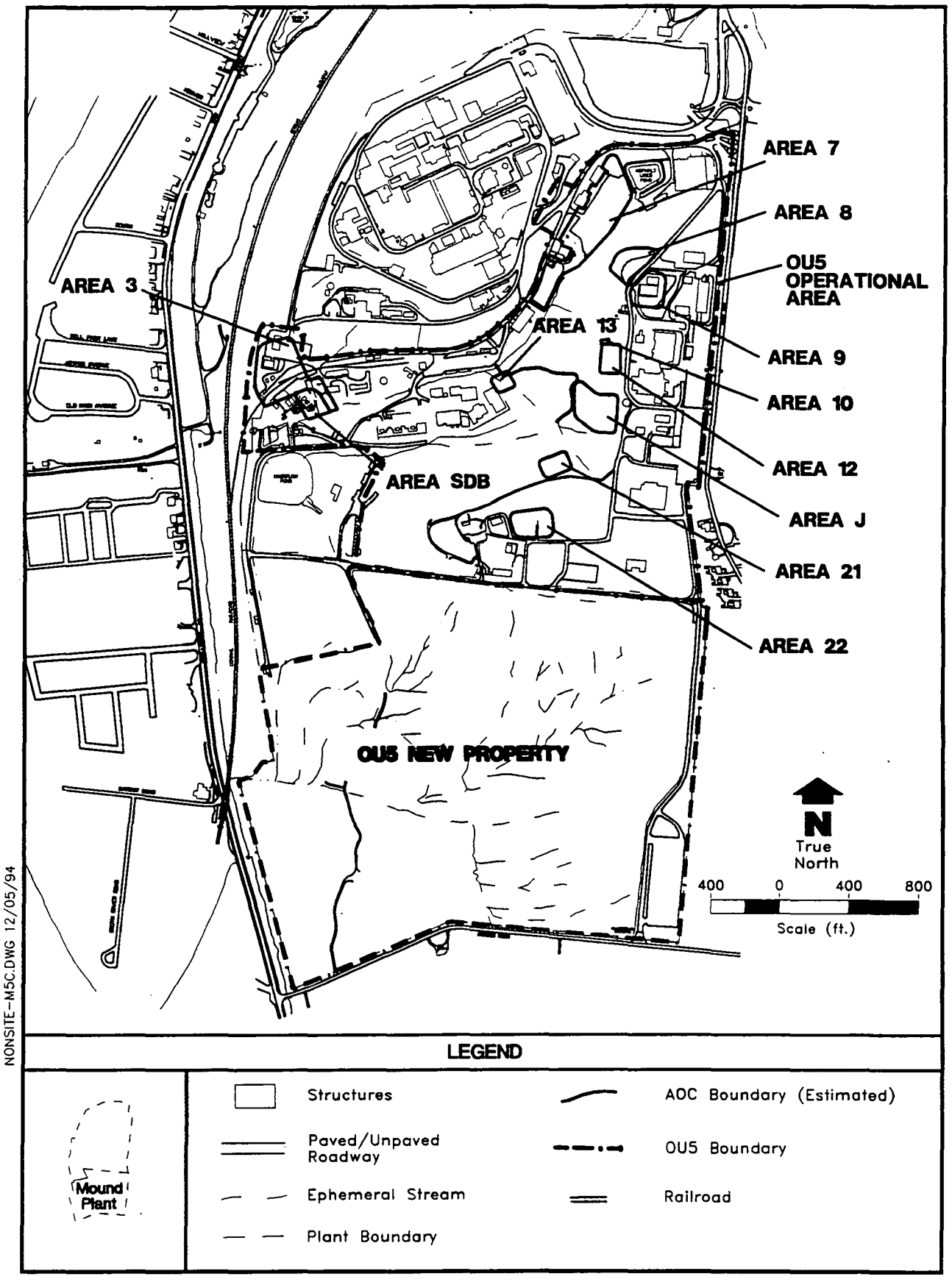


Figure 1.1. Site Map of Operable Unit 5 at the Mound Plant

The balance of the OU5 land area, all that is not defined as the New Property or the AOCs, is identified as the Non-AOC and constitutes the study area for this report (see Figure 1.2). Nested within the Non-AOC study area and included in the Non-AOC investigation are five areas of special interest. These include: (1) a site adjacent to the east side of Building 61, designated "Area 61", (2) the Building 66 lot site containing two fuel tanks, two gas pumps, and a water/oil separator, designated as the "Fuel Area", (3) Building 24, (4) Area H Pyrotechnic Waste Disposal Area, and (5) the Building 34 Firefighting Training Area. These special areas of interest were selected based on findings of a document search (see Appendix B) indicating the possibility that potentially hazardous substances may be present at these sites.

An additional area of interest, not within the Non-AOC, is located along the boundary between OU1 and OU5. Monitoring well W410 was installed in this area of interest and sampled during this field effort to support the OU1 Spoils Disposal Area groundwater monitoring effort (see Figure 1.2).

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

1.1. SCOPE

The scope of the Non-AOC Field Report is to describe the field work performed and to present the data collected during the Phase 1 investigation conducted from June through October 1994. This work was conducted according to the OU5, South Property, RI/FS Work Plan (DOE 1993b) and the associated OU5 Field Sampling Plan (FSP) (DOE 1993a).

1.2. SITE DESCRIPTION

1.2.1. Non-AOC

The Non-AOC study area, which is approximately 100 acres, is comprised of the SM/PP Hill, the valley that lays below, and the plant drainage ditch. Areas of special interest within the Non-AOC include Area 61, the Fuel Area, Building 24, Area H Pyrotechnic Waste Disposal Area, the Building 34 Firefighting Training Area, and monitoring well W410 (see Figure 1.2).

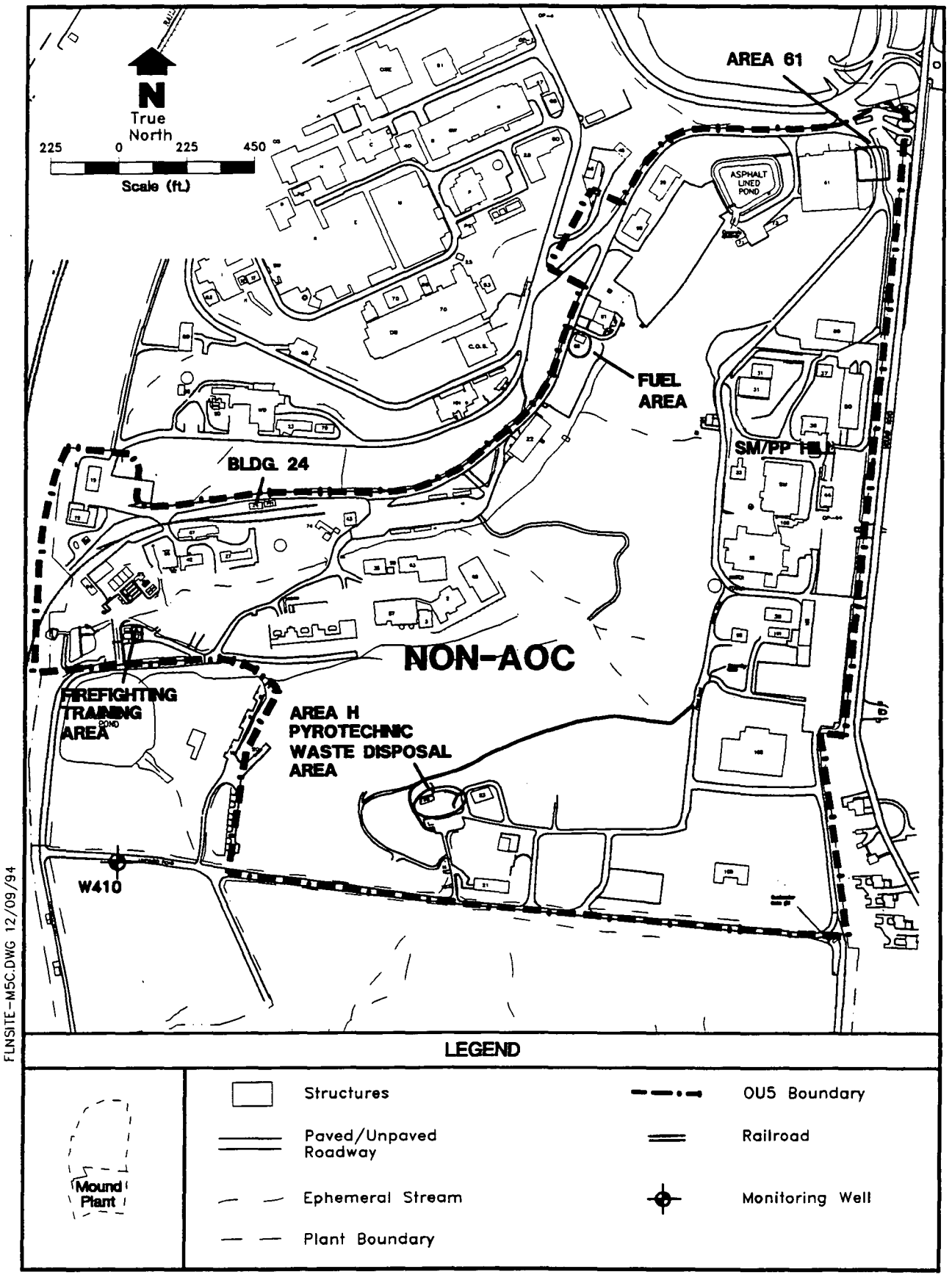


Figure 1.2. Site Map of Non-AOC Study Area

The SM/PP Hill, which is approximately 880 ft above mean sea level (MSL), is occupied by the Special Metallurgical Building formerly used for special metallurgical studies, the old plutonium processing facilities (housed in Building 38), many small buildings, and an asphalt parking lot. The majority of the land surface of the SM/PP Hill is covered with asphalt or concrete. There is a large water tower on the SM/PP Hill's west side providing potable water to the plant. The weathered bedrock underlying the SM/PP Hill is covered by Quaternary deposits less than 20 ft thick. Bedrock outcropping appears on the steep, western slopes of the SM/PP Hill. The western slopes of the SM/PP Hill historically received construction debris and spoils (discarded soils) that reshaped the slopes (DOE 1993a).

The Mound Plant drainage ditch serves as a natural channel for surface water, following roughly a northeast-to-southwest course. It is the collection point for surface water runoff for both the SM/PP and Main Hills. The plant drainage ditch begins at 770 ft MSL just south of Building 51 and extends southwestward to a series of three connected retention basins at 706 ft MSL on the western border of the plant. From the retention basins, the water is released from the plant at an outfall permitted under the National Pollutant Discharge Elimination System (NPDES). The depth to bedrock ranges from 10 to 20 feet near Building 51, at the beginning of the ditch, to approximately 70 feet at the western end, where the ditch exits the plant boundary. This depth to bedrock includes the ditch sediment, the older stream sediments, glacial outwash and glacial till (DOE 1993c).

The valley, part of which is contained within the Non-AOC study area, contains many buildings including explosive production and test firing facilities, explosive storage bunkers, isotope separation facilities, waste disposal operations, warehouses, and offices. The plant valley also contains a 315,000 gallon fuel oil tank and has an extensive number of asphalt roads and parking lots. The steepest portions of the valley slopes are undeveloped and heavily wooded.

The southern portion of the Non-AOC (adjacent to the New Property) is mostly undeveloped except for a staging area for containerized waste, Area H Pyrotechnic Waste Disposal Area, the spoils disposal area, several small buildings, and a gravel access road. Vegetation varies from grassy fields to heavily wooded areas.

1.2.2. Areas of Special Interest

1.2.2.1. Area 61

Area 61, located adjacent to the east side of Building 61, is approximately 100 feet by 100 feet (10,000 ft^2). Building 61 is the shipping and receiving center for the Mound Plant. The eastern edge of Area 61 is an undeveloped grassy area while the remainder of the site is an asphalt road and parking lot. A drainage area comprised of medium-sized rip rap, lies adjacent to the eastern side of the roadway dividing Area 61. It most likely receives run-off from northern slope of the SM/PP Hill (see Figure 1.2).

1.2.2.2. Fuel Area

The Fuel Area is located in the asphalt lot site adjacent to Building 66 and south of Building 51. The area is topographically flat and is bordered by an asphalt road to the west and a gravel drive to the east (see Figure 1.2). The Fuel Area contains two above ground fuel storage tanks on a concrete slab, two gasoline pumps, and an underground water-oil separator. The pumps and the separator are completely surrounded by asphalt. The fuel storage tanks are surrounded by concrete walls which are bordered on two sides by grassy strips.

1.2.2.3. Building 24

Building 24, which lies adjacent to the PH Building, is located in the western portion of the Non-AOC (see Figure 1.2). An asphalt road runs adjacent to the north side of Building 24. Railroad siding is adjacent to the south side of Building 24 with a roll-off box storage area to the west side. Except for the south side, the area surrounding Building 24 has been covered with asphalt or concrete. The area surrounding Building 24 is flat with little or no vegetation.

1.2.2.4. Area H Pyrotechnic Waste Disposal Area

Area H Pyrotechnic Waste Disposal Area, is located in the southern portion of the Non-AOC (see Figure 1.2). The surface topography is fairly flat and vegetation consists mainly of tall grasses. This area is comprised of Building 90, a retort, the pyrotechnic waste shed and biodegradation unit, a thermal treatment

unit, and the pyrotechnic waste disposal area (historical). The retort and pyrotechnic waste shed remain active, while the biodegradation unit, thermal treatment unit, and pyrotechnic waste disposal area are inactive.

The retort, which is attached to the east side of Building 90, is a rotary kilm used to render waste explosives non-reactive at extremely high temperatures. The pyrotechnic waste shed, located northwest of Building 21 in the open burn area, is a temporary storage area for pyrotechnic powders and pyrotechnic-contaminated wastes. The shed also contains the biodegradation unit, which is a portable steel cylinder used to destroy soapy water solutions containing trace amounts of pyrotechnic and explosive compounds by evaporation and/or burning (DOE 1993d). The thermal treatment unit is east of Building 90 in the open burn area and was used to burn explosive wastes. The pyrotechnic waste disposal area was reported to be adjacent to the southern fence line of Area H, but the areal extent is unknown. The area is thought to cover approximately 100 feet by 100 feet (10,000 ft^2).

1.2.2.5. Building 34 Firefighting Training Area

The Building 34 Firefighting Training Area is located south of Building 34 in the lower valley area of the Mound Plant (see Figure 1.2). It consists of two concrete pits used to create fires using diesel fuel for firefighting training purposes. Black-stained soils surround both of the pits (DOE 1992a).

1.2.2.6. Monitoring Well W410

Monitoring Well W410 was installed in the southwestern corner of OU5, between OU1 and the Spoils Disposal Area. It is on the south side of the asphalt access road, and is north of the spoils disposal area which contains piezometer P015 (see Figure 1.2 and Plate 1, Volume I). Vegetation in this area is minimal.

1.2.3. AOCs 8, 9, 10, and 12

Area 8 is located near the top of the SM/PP Hill in an area northwest of Building 31. It is approximately 100 feet by 200 feet (20,000 ft^2). Area 9, located under and around Building 31 on the north end of the SM/PP Hill, is approximately 200 feet by 200 feet (40,000 ft^2). Areas 10 and 12 are located on the western portion of the SM/PP Hill along the main access road. Area 10 lies west of Building 33, just

north of Area 12, and covers an area approximately 100 feet by 150 feet (15,000 ft^2). According to various reports, the size of Area 12 ranges from 19,000 ft^2 to 30,000 ft^2, due to its historical use as a depository for waste materials (DOE 1993a) and its proximity to a side of the SM/PP Hill. The locations of these AOCs are displayed in Figure 1.1.

1.3. SITE HISTORY

1.3.1. Non-AOC

The Non-AOC is comprised of many locations where daily plant activities occur. The limited historical data suggest that, except for the special areas of interest, there presently exist no known additional AOCs within this Phase 1 study area.

1.3.2. Areas of Special Interest

1.3.2.1. Area 61

Very limited historical information has been recorded for Area 61. Prior to the construction of Building 61, the area was used to stage heavy equipment during the 1940s and 1950s. Potential site contaminants include waste oil associated with equipment maintenance (DOE 1992a). Based on historical aerial photographs showing disturbed soils, this area is a suspected burial site and is believed to be a potential release site of volatile organic compounds (VOCs) (DOE 1993e).

1.3.2.2. Fuel Area

Limited historical information has been recorded for the Fuel Area. This area was developed by filling in the original plant drainage ditch channel. Areal photographs indicate that channel filling between Building 51 (north of the Fuel Area) and Building 22 (south of the Fuel Area) occurred in the mid-1970s. An aerial photograph taken in 1979 indicates that the filled area was disturbed with a trench at the northern end (near Building 51). Because of this activity, it is assumed that this was the time frame during which the fuel pumps and water-oil separator were installed in this area. The area between Buildings 51 and 22 was covered by asphalt after 1979, as indicated by a 1981 aerial photograph (DOE 1992b).

Building 51, adjacent to the Fuel Area, contains an incinerator which was used to destroy oil and solvents in the 1970s. The wastes were stored in an underground tank located behind the building. The underground tank was removed in 1990. Sampling of the tank and adjacent soil during a 1992 reconnaissance investigation indicated the presence of trichloroethene (TCE) (DOE 1993e).

1.3.2.3. Building 24

Building 24 is located next to the railroad siding (spur) that has been used extensively for shipping and receiving radioactive materials and radioactively contaminated wastes. Through the 1950s and 1960s, the siding was used for unloading lead casks containing the bismuth/polonium mixtures used in the polonium processing. In the mid-1950s, the siding was the site of the unloading of thorium drums, as well as the decontamination of the boxcars in which the drums were shipped (DOE 1992b).

1.3.2.4. Area H Pyrotechnic Waste Disposal Area

In Area H, the thermal treatment unit began operating in 1968. No information is available regarding the amount of explosive waste material burned in this unit per year, before it became inactive in the early 1990s. The pyrotechnic waste shed and biodegradation unit began operating in 1975. No releases have been documented and no spills were observed during a 1988 inspection (DOE 1993d). The shed is currently used as a temporary storage area for pyrotechnic powders and pyrotechnic-contaminated wastes, while the biodegradation unit is inactive.

Use of the Pyrotechnic Waste Disposal Area began in 1975. Small amounts of waste solvents (primarily acetone) and dissolved pyrotechnic materials, including potassium perchlorate, were mixed with water and filtered. The filtrate was poured onto the ground for treatment by natural biodegradation. The amount of waste materials deposited ranged from 5 to 20 gallons per year (DOE 1993d). The potential contaminants of concern are pyrotechnic constituents and organic solvents (mainly acetone). Wastewater was last deposited in this area in 1985.

The retort began operations in 1984 and is still in service. No information is available regarding the quantity of explosive waste materials rendered nonreactive per year.

1.3.2.5. Building 34 Firefighting Training Area

Building 34 was constructed in 1965 to serve as a center for training emergency personnel. The operating period of the firefighting training pits is not documented. However, it is known that approximately 300 gallons of diesel fuel were used at the pits in 1987 at a rate of three to five gallons per demonstration. The burning of solvents and oils at the pits has not been documented. Information obtained in 1991 indicated that the disposal of lithium was historically conducted in a swampy area at the present location of Building 34 (DOE 1992a).

1.3.2.6. Monitoring Well W410

Monitoring well W410 was installed during this field effort to verify and monitor the contaminants historically detected by piezometer P015.

Piezometer P015, located close to monitoring well W410, was installed on October 26, 1992 as part of the OU1 Spoils Disposal Area groundwater monitoring effort (see Plate 1, Volume I). It was sampled on March 25, 1994 as part of a Mound Plant Groundwater Monitoring program. Eight semi-volatile organic compounds (SVOCs) were detected during this sampling. These results are further discussed in Section 2.5.5.

1.3.3. AOCs 8, 9, 10, and 12

AOCs 8, 9, 10, and 12 are outside the scope of this report and, therefore, no historical data comparisons will be performed. The site history of these areas will not be discussed. For a historical overview, consult the following references:

- DOE 1993c. "Operable Unit 9, Site Scoping Report: Volume 3 - Radiological Site Survey [Revison 1]", U.S. Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico. March 1993.

- DOE 1992b. "Operable Unit 9, Site Scoping Report: Volume 6 - Photo History Report [FINAL]", U.S. Department of Energy, Albuquerque Field Office, Albuquerque, New Mexico. February 1992.

- Halbach, H.L. 1950. "Report No. 3 of Steering Committee for Disposal Units III and IV, (Completion Report for Disposal Unit IV. Runny Meade Road and Dixon Avenue, Dayton, Ohio)." Monsanto Chemical Company report No. MLM-461, Mound Laboratory, Miamisburg, Ohio. April 17, 1950.

1.4. REPORT ORGANIZATION

The remainder of this report presents the results of the Non-AOC Phase 1 investigation. Section 2 summarizes field activities performed and data collected during the radiological and soil gas surveys, the seep sampling, the soil sampling, and well W410 installation and sampling. It also compares the available data, where appropriate, from previous investigations with Phase 1 investigation data. Section 3 summarizes the results of the reconnaissance surveys and the radiological and chemical sampling. References are provided in Section 4. The appendices in Volume II include the field logbooks; the 1994 OU5 Discussion Paper; survey maps; the data quality assessment report; the Petrex® soil gas report; and the radiological, soil gas, and chemical data.

2. FIELD ACTIVITIES AND DATA SUMMARY

The Non-AOC Phase 1 field activities were conducted to screen for potential areas of radiological and chemical contamination. As specified in the OU5 FSP (DOE 1993a) and the OU5 Discussion Paper (see Appendix B), reconnaissance activities in the Non-AOC 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 the presence of surface plutonium-238 (Pu-238) and thorium-232 (Th-232) contamination (the two most prevalent radiological contaminants at Mound Plant);
- a soil gas survey to detect subsurface VOC and SVOC chemical contamination, including total aromatic hydrocarbons, total semi-volatile hydrocarbons, total C_5 to C_{11} petroleum hydrocarbons, and total halogenated hydrocarbons;
- seep sampling to detect chemical and radiological contamination;
- surface soil sampling in Area H Pyrotechnic Waste Disposal Area to detect the presence of explosives;
- surface soil sampling near the Building 34 Firefighting Training Area to detect the presence of Target Analyte List (TAL) metals;
- soil sampling around Building 24 to detect the presence of chemical and radiological contamination; and
- monitoring well W410 installation and sampling (soil and groundwater) to detect the presence of chemical and radiological contamination.

The data collection points for the FIDLER survey, surface soil screening, and soil gas survey were established over a 100-foot grid system for the Non-AOC and a 25-foot grid system for Area 61 (see Plate

1, Volume I). Additional soil screening, soil gas, and surface sampling locations, identified in the OU5 Discussion Paper (see Appendix B), were incorporated into the study using the grid system for the Non-AOC (see Plate 1, Volume I).

The survey map of the Non-AOC (Appendix C) shows those points on the grid system located by a registered land surveyor. Before sampling, all transverse lines of the grid system were cleared east to west of trees and underbrush and the remaining sample locations were marked with wooden stakes or paint.

The following sections present the field activities, the analyses performed, and the results of the Phase 1 investigation. Results for monitoring well W410 and the areas of interest are compared with historical data (when possible).

2.1. RADIOLOGICAL SURVEY

A FIDLER survey was performed at the Non-AOC for eleven days between June 20 to July 21, 1994, and on July 5, 1994, at Building 61, per the Mound Standard Operating Procedure (SOP) 6.7, Near Surface and Soil Screening for Low-Energy Gamma Radiation Using the FIDLER.

A FIDLER was used to monitor the soil surface for the presence of low-energy gamma radiations that accompany some alpha emissions. The FIDLER has three channels; the Out Channel, Channel 1, and Channel 2. Due to its ability to detect a wide range of isotopes, the Out Channel is used to screen for surface radiological contamination. The Out Channel responds to low-energy gamma rays and x-rays. Channel 1 primarily responds to Pu-238 and Channel 2 primarily responds to Th-232.

2.1.1. Field Work Performed and Procedures

The FIDLER survey and surface soil screening activities are presented in the following subsections.

2.1.1.1. FIDLER Survey

Prior to beginning the survey, a FIDLER was calibrated and a background station was established each day. Background and standard source checks for Pu-238 and Th-232 were performed daily and recorded on a card attached to the FIDLER and in the FIDLER logbook (see Appendix A.1). Daily checks,

completed at background stations, provided a statistical basis to determine if survey locations were contaminated. Background station locations were selected based on the terrain to be surveyed and were assumed not to be contaminated based on knowledge of previous site activities. At each background station, Channel 1 readings were taken and recorded in counts per minute (cpm). Channel 2 readings were taken and recorded in counts per minute x 1000 (kcpm). The standard deviations and the contamination criteria (CC) were calculated for Channels 1 and 2 (see Appendix A.1).

Table II.1 presents the background station information for the Non-AOC survey. The background station (not shown in Table II.1) for the Building 61 survey was established using FIDLER #2 (Instrument #3400, Probe #3611) at grid location A1 in Area 61.

Table II.1. FIDLER and Background Station Information for the Non-AOC

Date	FIDLER #	Instrument #	Probe #	Background Station
6/20/94	#1 #2	#3712 #3400	#3713 #3611	SAIC Trailer Stake 3N4
6/21/94	#1 #1 #2 #2	#3712 #3712 #3400 #3400	#3713 #3713 #3611 #3611	Stake 3N4 Stake 1N16 Stake 3N4 Stake 1N16
6/22/94	#2	#3400	#3611	Stake 8N1
6/23/94	#2 #2	#3400 #3400	#3611 #3611	Stake 8N2 Stake 4N23
6/27/94	#2 #2	#3400 #3400	#3611 #3611	Stake 20N6 Stake 26N5
6/28/94	#2	#3400	#3611	Stake 8N2
6/29/94	#2	#3400	#3611	Stake 12N27
6/30/94	#2	#3400	#3611	Stake 3N13
7/6/94	#2	#3400	#3611	Stake 8N22
7/7/94	#2	#3400	#3611	Stake 11N22
7/21/94	#2	#3400	#3611	Stake 11N16

For the Non-AOC FIDLER survey, Channel 1 and 2 readings were recorded at each survey grid after a one minute stabilization period. Using the Out Channel, surveying was completed between staked locations from east to west along grid lines at a rate of 20 feet per minute. Out Channel readings were not recorded unless they exceeded the CC for Channel 2. If readings exceeded the CC, the point of highest activity in the area of elevated activity was located. After a one minute stabilization period, Channel 1, Channel 2, and Out Channel readings were taken at the point of highest activity and recorded in the FIDLER logbook. The FIDLER was then slowly moved radially out from the point of highest activity until the Out Channel reading dropped below the CC, thereby defining the area of elevated activity. The size of the area was recorded in the FIDLER logbook (Appendix A.1) by distance and direction from the point of highest activity.

For the FIDLER survey of Building 61, 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.

2.1.1.2. Surface Soil Screening

During the soil gas survey (see Section 2.2), a FIDLER was used to monitor the placement of all soil samplers and timers. Surface soil samples were also collected at each location 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 0-3 inches, if necessary. A 1.5 inch diameter hole was augered to an approximate depth of 18 inches. A composite soil sample was collected from the augerings from 0-6 inches and analyzed at the Mound Plant Soil Screening Facility for Th-232 and Pu-238.

Where gravel or rocky soil conditions resulted in insufficient soil sample volume, a wipe sample was taken from the drill bit using a 100 square centimeter wipe. Wipe samples were transported to the Health Physics Building and analyzed using a scintillation counter (alpha counter). Results were required to be less than 20 disintegrations per minute (dpm) to continue work in these areas.

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 (FIDLER) (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 for the Non-AOC and Area 61 were completed with no variances from the OU5 Quality Assurance Project Plan (QAPjP) (DOE 1993a). Two minor variances from SOP 6.7 occurred involving source checks and scanning procedures during both surveys.

The first minor variance was that Pu-238 and Th-232 sources were used 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 minor variance was that Out Channel readings taken while scanning between stakes were compared to the Channel 2 CC instead of the Out Channel CC. No impact to data quality occurred because the Channel 2 CC is generally close to, but less than the Out Channel CC.

Soil screening samples were collected for analysis according to Mound Plant procedures. No variances were noted.

2.1.2.2. Data Analysis Variance Report

FIDLER survey data for the Non-AOC and Area 61 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 background values. FIDLER background values were recalculated and compared to the FIDLER survey data. After reviewing the data, several additional locations in the Non-AOC were identified as having elevated radiological activity when compared to the background value. Two areas were identified as having elevated radiological activity in Area 61.

Soil screening was performed according to Mound Plant procedures. No variances were noted. Soil screening data were not formally validated, but were reviewed for accuracy and completeness.

2.1.3. Health and Safety Summary Report

The FIDLER surveys were conducted according to the OU5 South Property RI/FS Health and Safety Plan (DOE 1993f), and the Environmental Restoration Program Site-Specific Health and Safety Plan for OU5 Operational Area. Health and safety issues were discussed and resolved during daily tailgate safety briefings conducted by the Health and Safety Officer and documented in the Site Manager Logbook (Appendix A.2).

No safety violations occurred during the FIDLER surveys. On August 23, a health and safety surveillance was conducted. No deviations were found.

2.1.4. Presentation of Radiological Data

Appendix D contains all radiological data collected during the Phase 1 investigation. It includes data from the FIDLER survey and analytical results of surface soil samples analyzed at the Mound Soil Screening Facility. The results are summarized in the following subsections.

2.1.4.1. FIDLER Survey

The FIDLER survey of the Non-AOC located several areas and points of elevated surface activity as shown in Plate 2 (Volume I) and summarized in Table II.2. Three of these areas were found northwest of Building 31 within the historical boundaries of Area 8. The activity at grid coordinates 19N7 and 20N7 was found on a steep wooded hillside next to a gravel parking lot constructed on fill dirt. The estimated size of the elevated areas for both coordinates is 30 feet by one foot. Activity at grid coordinate 20N6 was located in a grassy area next to the gravel parking lot. This elevated area is estimated to be four feet in diameter based on FIDLER readings. The fourth area, grid coordinate 4N6.5, was found on a small hillside next to a roadway. The size of this elevated area is estimated to be eight feet in diameter.

Additional points of elevated surface activity were identified at grid locations where Channel 1 or Channel 2 readings exceeded their respective CCs (see Table II.2 and Plate 2, Volume I).

Table II.2. Summary of Elevated Surface Radiological Activity in Non-AOC (FIDLER Survey)
Page 1 of 5

Location	Channel 1 (cpm)		Channel 2 (kcpm)		Out Channel (kcpm)
	CC	RDG	CC	RDG	RDG
1N2	114.9	130	6.4	8.0	a
1N3		--		8.0	a
1N4		--		7.0	a
1N5		--		8.0	a
1N6		--		7.5	a
1N14		120		9.0	a
1N15		--		9.0	a
2N2	102.1	--	5.4	9.0	a
2N3		--		8.5	a
2N5		--		6.5	a
2N6		--		6.0	a
2N8		--		6.5	a
2N14		--		8.0	a
2N15	173.2	--	8.7	9.0	a
2N16		--		9.5	a
2N18		--		9.5	a
2N19		--		10.0	a
3N1	114.9	--	6.4	6.5	a
3N2	149.4	--	6.7	8.5	a
3N3		150		8.5	a
3N4		150		9.0	a
3N5	136.8	--	5.2	7.0	a
3N6		--		6.0	a
3N16	200.1	--	9.7	10.0	a
3N17		--		10.5	a
3N18		--		10.0	a
3N19	173.2	--	8.7	9.0	a

Table II.2. Summary of Elevated Surface Radiological Activity in Non-AOC (FIDLER Survey)
Page 2 of 5

Location	Channel 1 (cpm)		Channel 2 (kcpm)		Out Channel (kcpm)
	CC	RDG	CC	RDG	RDG
3N20	130	--	5.2	9.0	a
3N21		--		8.0	a
3N22	138	150	7.3	8.5	a
4N4	136.8	--	5.2	7.0	a
4N6.5		1000		80.0	45.0
4N5		--		5.5	a
4N7		--		6.0	a
4N13	165.3	--	7.6	8.5	a
4N19	173.2	--	8.7	9.5	a
4N20	130	--	5.2	5.5	a
4N22	154	--	6.7	8.0	a
5N13	173.2	--	8.7	9.5	a
5N15		--		9.5	a
5N16	200.1	--	9.7	11.0	a
5N18		--		10.5	a
5N19	130	--	5.2	9.5	a
5N20		--		6.5	a
5N21		--		6.0	a
5N23	138	--		6.5	a
6N3	154	--	6.7	9.0	a
6N7	123.1	140	4.5	9.0	a
6N8	177.7	--	9.3	9.5	a
6N9		--		9.5	a
6N11	173.2	--	8.7	9.5	a
6N12		--		10.0	a
6N13		190	8.7	9.5	a
6N14		---		11.0	a

Table II.2. Summary of Elevated Surface Radiological Activity in Non-AOC (FIDLER Survey)
Page 3 of 5

Location	Channel 1 (cpm)		Channel 2 (kcpm)		Out Channel (kcpm)
	CC	RDG	CC	RDG	RDG
6N15	173.2	--	8.7	10.0	a
6N16		--		10.0	a
6N17		--		10.0	a
6N18	130	---	5.2	9.0	a
6N19		155		7.5	a
6N20		--		6.5	a
6N21		180		6.5	a
7N7	123.1	--	4.5	5.5	a
7N11	173.2	--	8.7	9.5	a
7N12		175		10.5	a
7N15		--		9.5	a
7N16		--		10.0	a
7N18	130	150	5.2	10.0	a
7N19		--		5.5	a
7N21	154	--	6.7	7.5	a
7N23	141.4	--	5.3	8.0	a
7N27		--		8.5	a
8N7	123.1	--	4.5	8.5	a
8N8		--		7.5	a
8N12	202.4	---	10.4	10.5	a
8N16	130	--	5.2	6.0	a
8N17		--		6.0	a
8N20		--		5.5	a
8N23	118.4	--	6.9	7.0	a
8N24	154	--	6.7	7.0	a
9N1	123.1	--	9.9	10.5	a
9N3		125	4.5	5.0	a

Table II.2. Summary of Elevated Surface Radiological Activity in Non-AOC (FIDLER Survey)
Page 4 of 5

Location	Channel 1 (cpm)		Channel 2 (kcpm)		Out Channel (kcpm)
	CC	RDG	CC	RDG	RDG
9N5	123.1	--	4.5	5.5	a
9N7		--		6.0	a
9N14	130	--	5.2	6.0	a
9N15		--		6.0	a
9N27	141.4	--	5.3	7.5	a
10N5	123.1	--	4.5	5.0	a
10N13	130	--	5.2	5.5	a
10N19		--		8.0	a
11N5	123.1	--		5.5	a
11N10	202.4	--	10.4	10.5	a
11N11		--		11.0	a
11N19	154	--	6.7	7.5	a
12N2	123.1	--	4.5	5.0	a
13N1	236.8	--	9.9	10.0	a
14N8	165.3	--	7.6	10.0	a
14N9		--		10.0	a
14N10		--		8.0	a
14N11		--		10.0	a
14N12		--		8.0	a
14N25	154	--	6.7	7.0	a
14N26		--		7.5	a
14N27		--		9.0	a
15N1	236.8	--	9.9	10.0	a
15N3	130	--	5.2	6.0	a
15N7	165.3	--	7.6	8.5	a
15N8		--		9.0	a
15N9		--		10.5	a

Table II.2. Summary of Elevated Surface Radiological Activity in Non-AOC (FIDLER Survey)
Page 5 of 5

Location	Channel 1 (cpm)		Channel 2 (kcpm)		Out Channel (kcpm)
	CC	RDG	CC	RDG	RDG
15N11	165.3	--	7.6	8.5	a
16N1	236.8	--	9.9	10.5	a
16N4	130	150	5.2	9.0	a
17N8	165.3	--	7.6	8.0	a
18N6	130	--	5.2	6.5	a
18N6.5	165.3	460	7.6	46	40
18N8		170	7.6	11.0	a
18N9		--		10.5	a
19N7	170.9	325	7.1	20.0	45.0
19N9		--		9.5	a
20N2	130	--	5.2	6.5	a
20N3		--		6.5	a
20N4	170.9	--	7.1	7.5	a
20N6		375		22.0	30.0
20N7		325		22.5	45.0
21N3		--	7.1	8.0	a
21N5	149.4	--	6.7	10.0	a
22N4		--		9.5	a
22N5		--		8.0	a
23N1	236.8	--	9.9	10.5	a
23N5	149.4	--	6.7	7.0	a
24N4	170.9	--	7.1	7.5	a

CC contamination criteria
cpm counts per minute
kcpm counts per minute times 1000
RDG FIDLER reading
a Out Channel readings were not measured at individual grid locations
-- Reading taken did not exceed CC

Two areas of elevated surface activity were found during the FIDLER survey of Area 61 (see Figure 2.1). Activity in these areas (near grid locations A3 and A4) ranged between 8.5 and 9.0 kcpm using the Out Channel. The Out Channel CC for Area 61 was 8.0 kcpm.

2.1.4.2. Surface Soil Screening

Surface soil samples, collected as part of the soil gas survey (see Section 2.2), 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 six of the 442 sample locations. Figure 2.2 shows the locations where concentrations of Th-232 equal or exceed 2 pCi/g. Concentrations of Pu-238 at or exceeding the Mound Plant Soil Screening Facility detection limit of 25 pCi/g were detected at 51 of the 442 sample locations. This information is summarized in Table II.3.

Plate 3, Volume 1 shows (1) the concentration contours where Pu-238 exists at concentrations from 25-50 pCi/g, and (2) the concentration contours where Pu-238 exists at concentrations greater than 50 pCi/g. The concentration of Pu-238 at the soil surface exceeds 100 pCi/g at one Non-AOC grid location at 16N5 (243 pCi/g).

The concentrations of Pu-238 do not exceed 25 pCi/g in Area 61. The concentration of Th-232 at the soil surface does not exceed 2 pCi/g in Area 61.

2.2. SOIL GAS SURVEY

A soil gas survey was performed in the Non-AOC from June 14 to October 11, 1994 and in Area 61 from August 11 to September 6, 1994. The purpose of the soil gas survey was to locate areas within the Non-AOC, including Area 61, which exhibit potential subsurface contamination by VOCs and SVOCs.

The Non-AOC and Area 61 soil gas surveys were completed over grid systems established for each area. The distance between the sample location points within the sampling grid was 100 feet for the Non-AOC and 25 feet for Area 61 (see Plate 1, Volume I). Due to its size, the soil gas survey for the Non-AOC was divided into five sections designated as North, South, West, East, and Area 61 (see Plate 1, Appendix

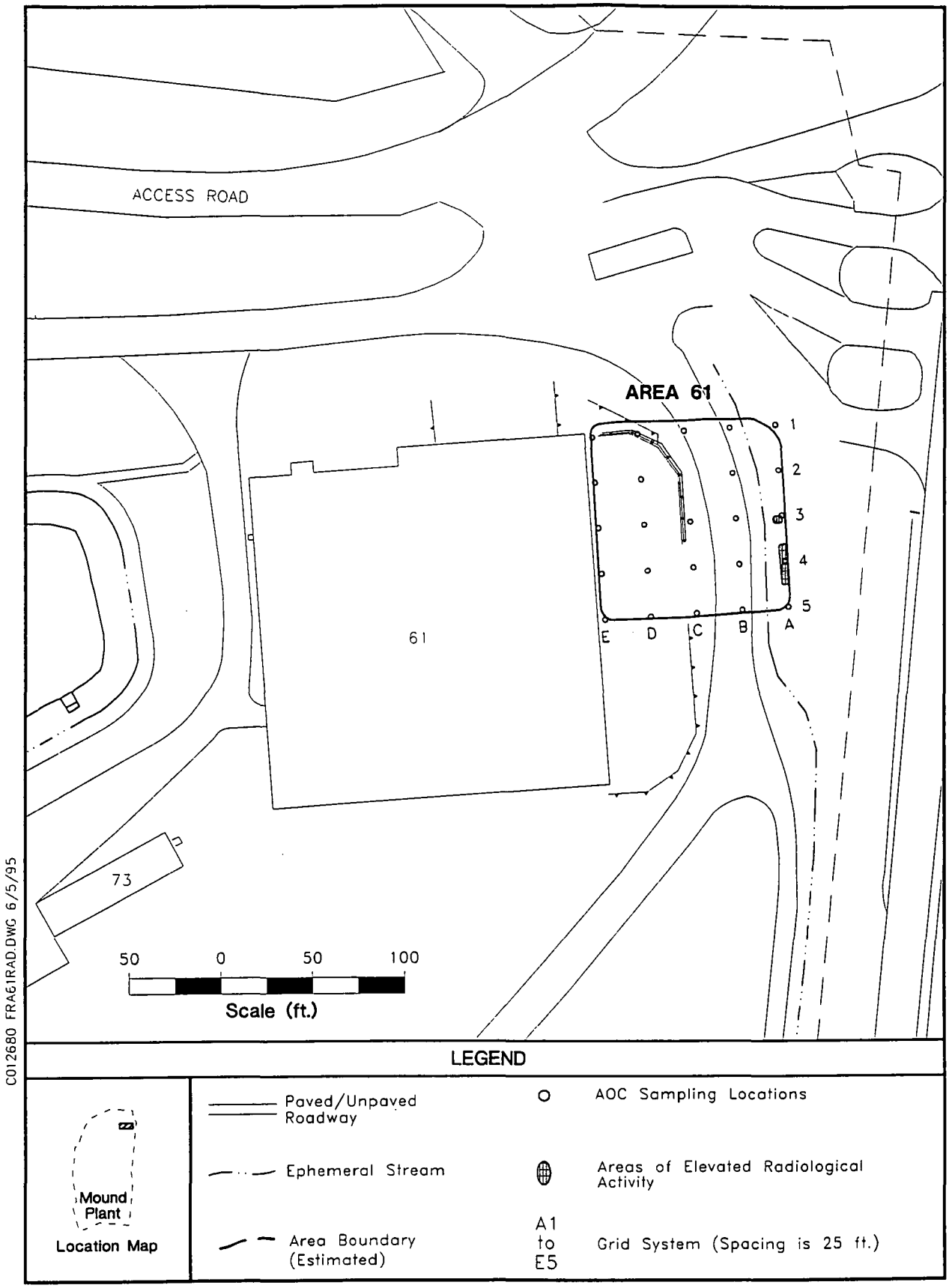


Figure 2.1. Locations of Elevated Radiological Activity in Area 61 (FIDLER Survey)

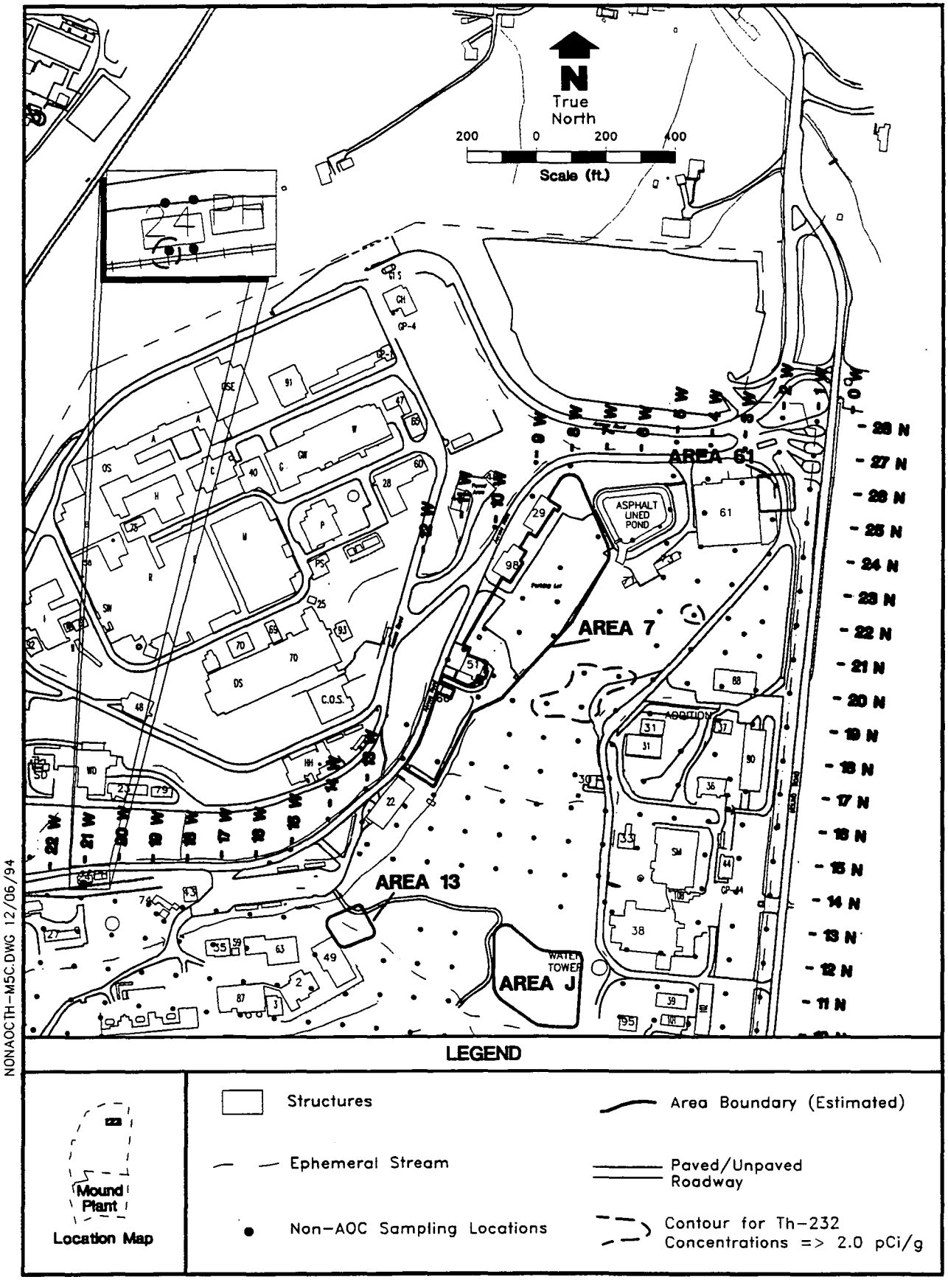


Figure 2.2. Locations of Elevated Surface Soil Th-232 Activity

Table II.3. Summary of Elevated Surface Soil Radiological Activity in the Non-AOC
Page 1 of 2

Grid Location[a]	Mound Soil Screening Facility Data	
	Plutonium-238 (pCi/g)	Thorium-232 (pCi/g)
1N2	25	0.9
1N3	60	ND
1N6	25	ND
1N14	38	ND
1N15	34	ND
2N2	25	ND
2N15	37	ND
2N16	28	ND
2N17	31	ND
2N18	40	ND
3N1	38	ND
3N2	49	ND
3N3	25	ND
3N4	31	ND
3N15	28	ND
3N16	36	ND
3N17	35	ND
3N18	46	ND
4N3	25	ND
4N16	31	ND
4N18	37	ND
4N19	35	ND
5N2	30	ND
5N4	27	ND
5N14	25	ND
5N15	41	ND
5N18	39	ND

Table II.3. Summary of Elevated Surface Soil Radiological Activity
Page 2 of 2

Grid Location[a]	Mound Soil Screening Facility Data	
	Plutonium-238 (pCi/g)	Thorium-232 (pCi/g)
6N9	33	ND
6N14	30	ND
6N16	29	ND
6N17	25	ND
6N19	39	ND
7N14	27	ND
7N18	26	ND
7N23	25	1
9N10	25	ND
11N11	25	ND
12N15	85	ND
15N7	30	ND
16N4	78	ND
16N5	243	ND
19N7	56	15.9
19N8	25 39	2.4 ND
20N6	27	2.6
20N7	37	14.7
22N4	ND	2.0
23N1	25	ND
23N2	26	1
23N5	25	ND
B18001 (Building 24)	38	6.7
21.5N2.5	25	ND

[a] See Plate 1 for grid location

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

E). One subsection of the Non-AOC North, the Fuel Area, was also investigated by sampling 12 locations in this area. It will be discussed as part of the Non-AOC North subsection. Additional soil gas locations added as a result of a document search (Appendix B) were included in the Non-AOC East, Non-AOC West, and Non-AOC South surveys, as appropriate (see Plate 1, Volume I).

Samplers from each of the section were collected and analyzed as separate discrete tasks of the larger soil gas survey of the Non-AOC. Area 61, although encompassed by the Non-AOC North, was surveyed as a fifth and separate section of the Non-AOC.

2.2.1. Field Work Performed and Procedures

A total of 396 soil gas samplers were installed in the Non-AOC and Area 61, per the OU5 QAPjP, SOP for Petrex® Environmental Surveys [Attachment 1] (DOE 1993a). Field activities were recorded in the Soil Gas Logbook (see Appendix A.3).

The duration of in-situ sampler exposure required to attain representative levels of VOCs and SVOCs was determined through the use of exposure time tests specific to each Non-AOC section. These "time tests" were initiated during the first few days of field work within each Non-AOC section. Time test samplers (timers) were installed in pairs at several selected locations within each Non-AOC section. Timers were retrieved and analyzed after seven and 14 days of exposure. Based on the response of the timers to the loading rate of compounds over this period, the approximate duration of exposure required by all samplers within each section was determined.

After sufficient exposure time, samplers were retrieved in the approximate order in which they were installed. This procedure was implemented so that all samplers from the same Non-AOC section were exposed for approximately the same length of time despite differences between actual sampler installation and retrieval dates.

Using an electric rotary hammer drill equipped with an 18 x 1.5 inch steel/tungsten carbide-tipped drill bit, samplers were installed in the Non-AOC and Area 61. Samplers were generally installed at a depth of 18 inches below the surface; however, some samplers were installed at lesser depths (no less than seven inches) due to obstructions. 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 samplers and timers. Soil samples were collected from each of the locations for analysis of radiological contamination at the Mound Plant Soil Screening Facility. Results of the soil screening analyses are summarized in Section 2.1.4.2 and presented in their entirety in Appendix D.

2.2.1.1. Non-AOC South

Soil Gas Sampler Installation

Three sets of timers and 131 data samplers were installed on 10 days between June 14 and July 7, 1994. Locations of the timers and data samplers are shown in Appendix E, Plate 1.

Soil Gas Sampler Retrieval

On June 21, 1994, one timer from each of the three timer sets was retrieved, wiped (checked for radiological contamination), and sent to Northeast Research Institute LLC (NERI) for analysis. The analysis of the timers indicated the following: high response levels of petroleum hydrocarbons at 1N2; low to medium response levels of TCE at 1N18; and trace response levels of hydrocarbons at 7N23. Based on these responses, NERI recommended an exposure time of approximately seven to 14 days per data sampler.

Samplers were extracted on seven days between June 28 and July 21, 1994. The samplers were wiped and prepared for shipment. On July 27, 1994, all of the Non-AOC south samplers were sent as a batch to NERI for analysis. In general, samplers were shipped as a batch for each Non-AOC section for quality control purposes.

2.2.1.2. Non-AOC North

Soil Gas Sampler Installation

Two sets of timers and 92 data samplers were installed on eight days between August 17 and September 14, 1994. Locations of the timers and data samplers are shown in Appendix E, Plate 1.

Soil Gas Sampler Retrieval

On August 23, 1994, one timer from each of the two timer sets was retrieved, wiped, and sent to NERI for analysis. The analysis of the timer at grid coordinate 23N2 indicated low to moderate response levels of light weight hydrocarbons and the analysis of the timer at grid coordinate 26N5 indicated moderate to high response levels of light weight hydrocarbons and trace response levels of tetrachloroethene (PCE). Based on these responses, NERI recommended an exposure time of approximately 12 days per data sampler.

Samplers were extracted on five days between August 29 and September 27, 1994. One sampler, located at grid coordinate 15N9, was not retrieved due to a broken tube. The remaining samplers were wiped and prepared for shipment. On September 27, 1994, the samplers were sent as a batch to NERI for analysis.

2.2.1.3. Non-AOC West

Soil Gas Sampler Installation

Two sets of timers and 85 data samplers were installed on 10 days between August 29 and September 6, 1994. Locations of the timers and data samplers are shown in Appendix E, Plate 1.

Soil Gas Sampler Retrieval

On September 6, 1994, one timer from each of the two timer sets was retrieved, wiped, and sent to NERI for analysis. The analysis of the timers at grid coordinates 9N10 and 8N27 indicated that little to no hydrocarbons were detected. NERI requested that the second timer from each timer set be retrieved after three weeks. The second timers were retrieved and sent to NERI on September 22, 1994, for analysis. The analysis of these timers indicated low levels of hydrocarbons, including some benzene at grid coordinate 9N10 and moderate levels of hydrocarbons, including benzene, toluene, ethylbenzene, and xylene (BTEX), TCE, and PCE at grid coordinate 8N27. Based on these responses, NERI recommended an exposure time of approximately 28 days per sampler.

Samplers were extracted on three days between September 27 and October 1, 1994. Two samplers, 14N25 and 9N15, broke during retrieval. Sample wires were transferred immediately to clean tubes. All

samplers were wiped and prepared for shipment. On October 12, 1994, the samplers were sent as a batch to NERI for analysis.

2.2.1.4. Non-AOC East

Soil Gas Sampler Installation

Two sets of timers and 63 data samplers were installed on nine days between August 24 and September 1, 1994. Locations of the timers and data samplers are shown in Appendix E, Plate 1.

Soil Gas Sampler Retrieval

On August 29, 1994, one timer from each of the two timer sets was retrieved, wiped, and sent to NERI for analysis. The analysis of the timer at grid coordinate 20N4 indicated low levels of C_5 - C_9 hydrocarbons and the timer at grid coordinate 9N7 indicated low levels of C_5 - C_9 hydrocarbons, mainly aromatics (benzene and toluene). NERI requested that the second timer from each timer set be retrieved after 13-14 days of exposure. The second timers were retrieved and sent to NERI on September 6, 1994 for analysis. The analysis of these timers indicated low to moderate levels of petroleum hydrocarbons. Based on these responses, NERI recommended an exposure time of approximately 28 days per data sampler.

Samplers were extracted on four days between September 22 and October 11, 1994. One sampler, at grid coordinate 7N4, broke during retrieval. The wires were extracted and placed in a clean tube. Five samplers at grid coordinates 11N5, 12N3, 15N3, 18N2, and 20N3, could not be retrieved because of broken "guy" wires and/or collapse of the holes. The remaining samplers were wiped and prepared for shipment. On October 12, 1994, the samplers were sent as a batch to NERI for analysis.

2.2.1.5. Area 61

Soil Gas Sampler Installation

One timer set and 25 data samplers were installed on August 11, 1994. Locations of the timers and data samplers are shown in Appendix E, Plate 1.

Soil Gas Sampler Retrieval

On August 17, 1994, the first timer from the timer set was retrieved, wiped, and sent to NERI for analysis. The analysis of the timer at grid coordinate A3 indicated high levels of terpenes, which are byproducts of grass and organic debris. The second timer from the timer set was retrieved and sent to NERI on August 24, 1994 for analysis. The analysis of the second timer indicated that no hydrocarbons were detected. Based on these responses, NERI recommended an exposure time of approximately 21 days per data sampler.

Samples were extracted on September 1 and 6, 1994. Samplers were wiped and prepared for shipment. On September 7, 1994, the samplers were sent as a batch to NERI for analysis.

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 OU5 QAPjP, SOP for Petrex® Environmental Surveys [Attachment 1] and the FSP (DOE 1993a). These variances included decontamination procedures, the number of samplers 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. This variance did not impact the data quality.

The first minor variance from the FSP was a variation in the number of samplers installed during the Non-AOC survey due to conditions in the field. A total of 18 sample locations were deleted from the survey due to the following: two samplers were not installed at 2N15 and 1N19 due to insufficient depth; five samplers were not installed because they were located inside buildings; five samplers were not installed in the fragmentation area near Building 27 because of restricted access; five samplers were not installed in a designated radiological area; and one sampler was not installed due to high FIDLER readings at the site.

A second minor variance from the FSP was the use of travel blanks. The FSP requires that travel blanks be returned with the timers and samples, 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, logbook entries were checked for accuracy, completeness, and format. A final report for the Non-AOC was received from NERI on November 28, 1994. Sample locations shown on Plate 1 of the NERI report (Appendix E) were checked against the field map to confirm that all sampling locations were correctly plotted; no errors were found. A 25 percent quality assurance check of ion count values (Appendix E, Table 1) versus plot accuracy (Appendix E, Plates 2 through 5) yielded no errors.

Five samples were excluded from analysis due to the potential compromise of sample integrity because of the following conditions: soil gas collectors in grid coordinates 4N6 and 1N22 were damaged and missing much of the absorbent charcoal; the sampler at grid coordinate 5N23 was unintentionally installed in the field with the liner still in place; and the samplers at grid coordinates 13N2 and A3 (in Area 61) were shipped without liners between the caps and the sample tubes.

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 1993f). All soil gas locations were screened using a FIDLER to avoid digging in radiologically contaminated soil. All sampling locations were checked for underground utilities to avoid damaging or severing 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.2).

No accidents or safety violations occurred during the soil gas survey. On August 23, 1994, a health and safety surveillance was conducted; no deviations were found.

2.2.4. Presentation of Chemical Data

The report of findings of the Petrex® soil gas survey is presented in Appendix E. The report discusses the Petrex® method, the scope of work, quality assurance/quality control methods, and results. Appendix E, 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 relative intensity levels do not represent actual concentrations. Soil gas data are considered qualitative in that multiple sources in soil and/or groundwater cannot be differentiated.

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 C_5 - C_{11} petroleum hydrocarbons, and
- total halogenated hydrocarbons.

The following subsections describe the distribution of 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_{11} aromatic (benzene based) hydrocarbon compounds detected in the soil gas samples. The majority of the samples contained only the lighter (C_6 through C_9) aromatics. A few samples were observed to contain C_{10} and heavier aromatic hydrocarbons.

The soil gas survey indicates that the areas demonstrating the greatest relative levels of aromatics are the northern and southern portions of the Non-AOC East section and large portions of the Fuel Area and Area 61. Aromatics in the soil gas across the Non-AOC East section occur with combinations of other hydrocarbons in mixtures which are characteristic of weathered fuels. The near isolated occurrences of C_7 and C_8 aromatics, toluene, and ethylbenzene/xylenes in several samples may also indicate the presence of components of solvents or thinners in the subsurface. The presence of a variety of aromatic hydrocarbons was confirmed by Thermal Desorption Gas Chromtograph/Mass Spectrometry (TD-GC/MS)

for 13 samplers submitted for analysis (see Appendix E). The areal distribution of the aromatic hydrocarbons is shown in Appendix E, Plate 2.

In the Fuel Area, the highest relative levels of aromatics occur in the soil gas in the vicinity of the pumps and separator. Elevated levels of aromatics occur within Area 61 principally as components of mixtures of C_4 and C_{13} hydrocarbons common to medium to heavy weight fuels. The zone of elevated relative levels extends the length of the survey area adjacent to Building 61. Elevated levels of aromatics also occur in zones extending to the north and west of Building 61. This distribution may indicate that high levels of aromatics exist beneath Building 61 and may originate from sources associated with the building.

Aromatic hydrocarbons were detected in the soil gas in isolated patches across the remainder of the Non-AOC. High levels of aromatics were detected in the soil gas at grid coordinates 7N26, 25N5, 11N18, 13N26, and 12N21. Numerous structures within the Non-AOC, such as paved roads, railroad spurs, and other structures to which petroleum products may be applied in building or maintenance, may be sources of hydrocarbons in the near surface soil gas yet not be contaminants of subsurface media.

Several locations in the Non-AOC, particularly within the Non-AOC West and Non-AOC North sections, indicated high relative levels of aromatics (grid coordinates 2N3, 2N18, 19N8, 9N11, and 11N11). These locations are seemingly distant and isolated from structures which could be sources for these compounds.

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 (including acenapthene, anthracene, and pyrene). 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 naphthalene are also found in medium to heavy weight fuels and fuel oils.

Samples which yielded an elevated response to semi-volatile hydrocarbons were most likely responding to elevated levels of naphthalene or methylnaphthalene in the soil gas. None of the other semi-volatile polycyclic hydrocarbons named above were clearly identified in the samples. The areal distribution of semi-volatile hydrocarbons is shown in Appendix E, Plate 3.

One small area in the Non-AOC South section exhibited a zone of elevated response levels of semi-volatile hydrocarbons which may relate to potential subsurface contamination. This zone is located west of Building 100 and extends north beyond the access road. An isolated occurrence of semi-volatile hydrocarbons was also identified at grid coordinate 6N11.

The largest zone of semi-volatile hydrocarbons was detected in the southern portion of the Non-AOC East section. The highest response levels were detected northeast of Building 39 at grid coordinate 8N3. The presence of naphthalenics in this sample, as well as in sample 925 (grid corrdinate 13N3), was confirmed by TD-GC/MS analysis. Isolated occurrences of semi-volatiles were identified east of Building 38 and along the property boundary located east of Building 36 in the Non-AOC East section.

A limited number of isolated occurrences of semi-volatile hydrocarbons were identified in the Non-AOC West section. Most were detected along the access roads; however, single samples exhibiting high relative levels were collected east of Buildings 19 and 94.

Elevated relative levels of semi-volatile hydrocarbons were found in the northeastern section of the Non-AOC North section, including Area 61 and the Fuel Area. In Area 61, elevated levels were detected adjacent to the northeastern portion of Building 61 and extend east to the access road. The presence of napthalenics at grid coordinates E2, E3, and E5 was confirmed by TD-GC/MS analysis. Grid coordinate 27N5 showed high relative levels of naphthalene and methylnaphthalene. The presence of naphthalenics was confirmed by TD-GC/MS analysis for this sample location (see Appendix E). Of all the samples collected, that sample exhibited characteristics most like vapor derived from a coal tar, instead of fuels.

In the Fuel Area, sample #1074 (located on the south side of the fuel pumps), exhibited a high relative level of semi-volatile hydrocarbons. The hydrocarbons in this sample occur with a broad mixture of other hydrocarbons typical of the composition of partially weathered fuels. The presence of naphthalenics was confirmed by TD-GC/MS for samples #1072 and #1073 in the fuel area (see Appendix E). Isolated patches of semi-volatile hydrocarbons were also detected west of Building 61 and 33, and northwest of the access road at grid coordinate 26N9.

2.2.4.3. Distribution of Total C_5 to C_{11} Petroleum Hydrocarbons

Total C_5 to C_{11} petroleum hydrocarbons reported include alkanes, cycloalkanes, alkenes, cycloalkenes, dienes (collectively referred to as aliphatics), aromatics, naphthalene, and alkyl naphthalenes. These compounds together make up the bulk of most petroleum fuels, oils, and lubricants. Total C_5 and C_{11} petroleum hydrocarbons are reported to best illustrate the occurrence in soil gas of petroleum product vapor of which aromatic and semi-volatile compounds may not be prominent components.

The areal distribution of total C_5 to C_{11} petroleum hydrocarbons is shown in Appendix E, Plate 4. The distribution of these petroleum hydrocarbons is similar to that of total aromatics, except that aromatics occur more widely across the Non-AOC East section. This finding supports earlier observations that the majority of hydrocarbons in the soil gas likely derive from fuels which contain abundant levels of both aromatics and a broad assortment of aliphatic hydrocarbons.

The distribution of elevated relative levels of total petroleum hydrocarbons within the Non-AOC South and Non-AOC West sections is nearly identical to that of aromatics and exhibited in several large areas. Elevated relative levels of aromatic and aliphatic hydrocarbons occur in several zones surrounding AOC 3 and the AOC SDB grid coordinates 9N25, 9.5N25.5, 12N24, and 13N26. Two additional zones of elevated response to total petroleum hydrocarbons occur in the northwest of the Non-AOC, northwest of the access road which parallels the northwest border of OU5 (at grid coordinates 14N15, 15N14, and 16N13) and on the northern border of the Non-AOC North (at grid coordinates 27N4 and 27N5).

2.2.4.4. Distribution of Total Halogenated Hydrocarbons

Total halogenated hydrocarbons are reported as the combined levels of PCE, TCE, trichlorofluoromethane (Freon-11), trichlorotrifluoroethane (Freon-113), trichloroethane (TCA), and dichlorobenzene (DCB). PCE, TCE, and TCA are volatile liquids commonly used as solvents and cleaning agents of petroleum based products. Freon-11 and Freon-113 are highly volatile liquids used as refrigerants or solvents in vapor degreasers. DCB, as a liquid, is used in solvents and cleaning agents (1,3- and 1,4- isomers) and also a solid used as a fumigant (1,2- isomer).

The areal distribution of total halogenated hydrocarbons in the soil gas is displayed in Appendix E, Plate 5. However, the distribution of specific halogenated compounds in the soil gas throughout the Non-AOC

is limited. PCE was detected more frequently in the soil gas than the other halogenated hydrocarbons. Thus, most of the elevated responses to total halogenated hydrocarbons principally reflect the presence of PCE in the soil gas. The presence of PCE was confirmed in the soil gas by TD-GC/MS at sample locations 8N3, 13N3, and 27N5 in the Non-AOC and D3, D4, E3, and E5 in Area 61.

Exceptions to this rule were the occurrence of pronounced levels of TCE at several locations (grid coordinates 4N14, 9N6, 20N10, 9N21, 10N14, 10N13, 3.5N13.5, 19N10.75, and 8N25); DCB at one locations (grid coordinate 2N18); and chloroform at two locations (grid coordinates 20N7 and 18N8). The highest relative levels of PCE were detected at five locations (7N13, 26.25N2.25, 13N1, 12N18, and 19N10.75).

2.2.5. Historical Chemical Data

No historical chemical data is available for the Non-AOC. Limited historical chemical data is available for comparison to Area 61 and the Fuel Area from a 1992 soil gas survey (DOE 1993e).

2.2.5.1. Non-AOC

Due to the lack of historical data, no comparison can be performed for the Non-AOC soil gas survey for this report.

2.2.5.2. Areas of Special Interest

A soil gas survey was performed in Area 61 and near the Fuel Area in 1992 as part of a reconnaissance sampling investigation (DOE 1993e). A total of 18 samples were collected from 10 locations at various depths near the Fuel Area. Two samples were collected from Area 61. All samples were analyzed for six organic compounds, primarily halogenated hydrocarbons and one aromatic hydrocarbon (toluene). Sample locations for the Fuel Area and Area 61 are shown in Figures 2.3 and 2.4, respectively.

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 VOCs. Quality control samples were collected and analyzed throughout the field effort to monitor system efficiency. Targeted contaminant concentrations were reported as parts per

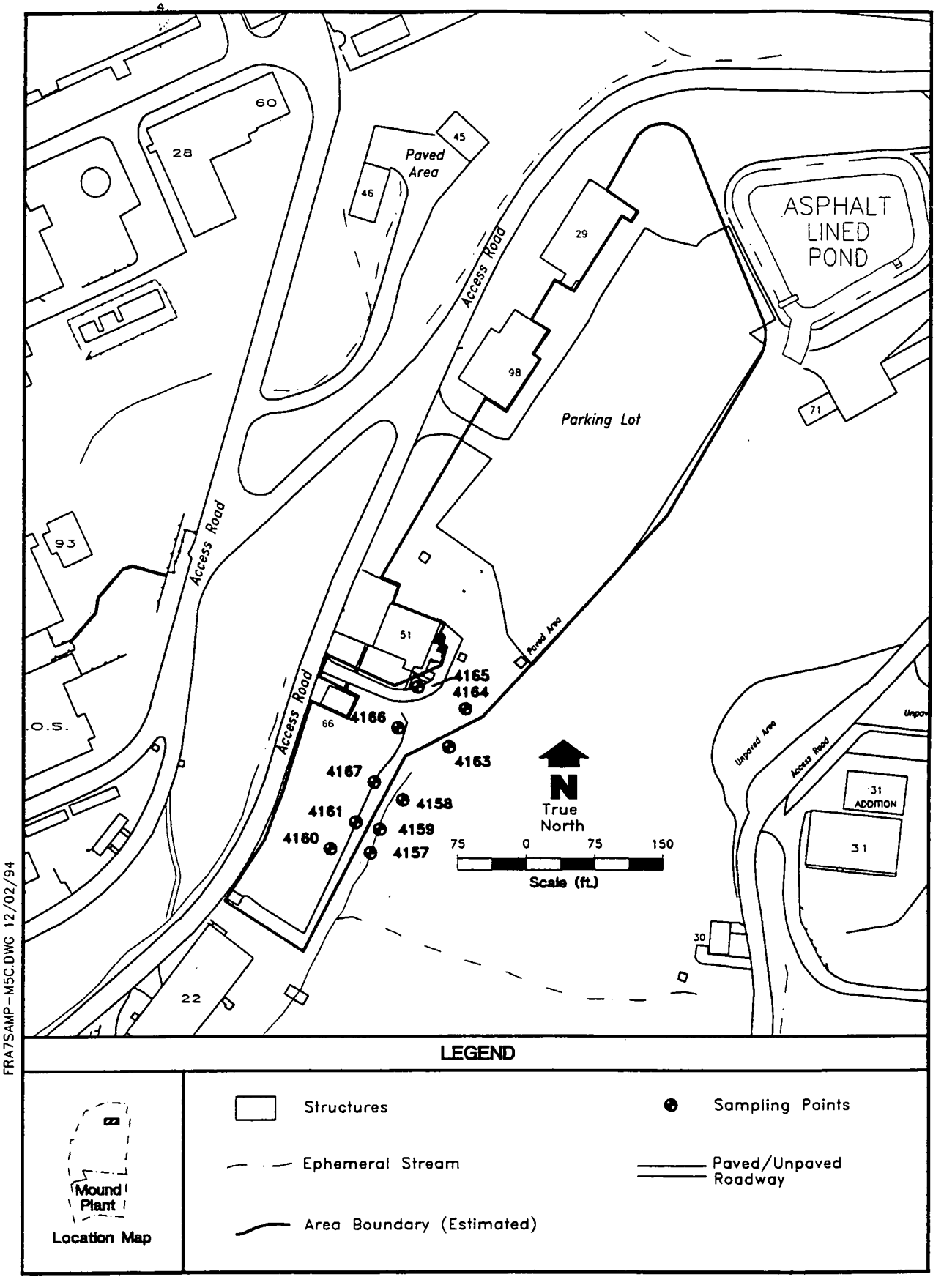


Figure 2.3. Sampling of Historical Soil Gas Data - Fuel Area

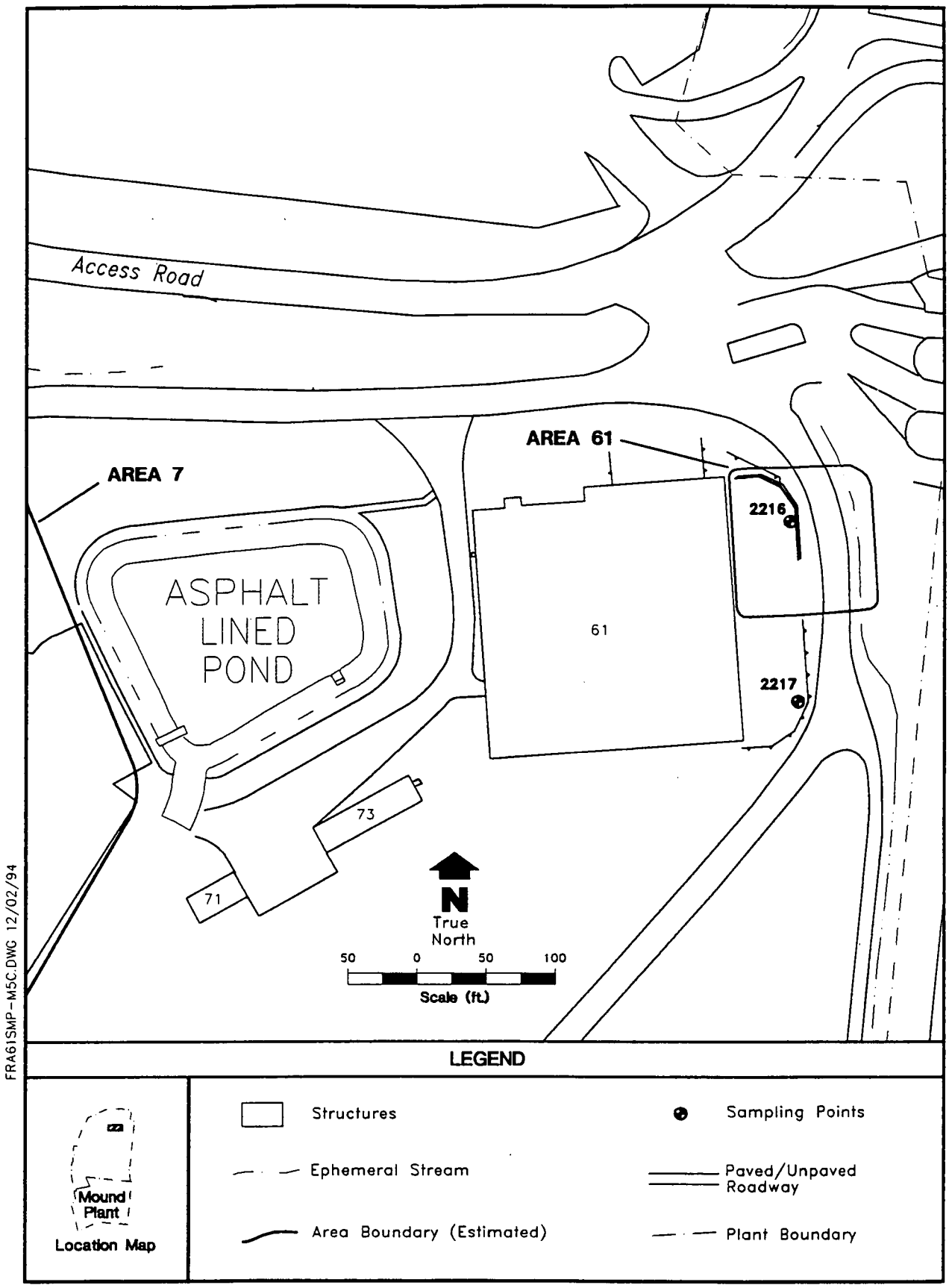


Figure 2.4. Sampling Locations of Historical Soil Gas Data - Area 61

billion (ppb). Table II.4 summarizes the chemical contaminants detected from the Fuel Area and Area 61 sampling effort.

2.2.5.3. Comparison of Historical Chemical Data with Petrex® Soil Gas Survey

The comparison was facilitated by grouping the 1992 detected organic compounds into the four general classes of Petrex® soil gas hydrocarbons listed in Section 2.2.4. This grouping indicated that only two of the four general classes of hydrocarbons were detected in 1992; halogenated and aromatic hydrocarbons.

The halogenated hydrocarbons PCE and TCE were detected at three sample locations during the 1992 soil gas survey as presented in Table II.4 (see Figure 2.3 for location). This finding is consistent with the Petrex® soil gas survey report which indicates high relative levels of PCE and TCE in the Fuel Area (at grid coordinate 19N10.5).

Halogenated hydrocarbons were not detected in Area 61 during the 1992 soil gas survey. This finding is inconsistent with the Petrex® soil gas survey report which indicates zones of elevated halogenated hydrocarbons in the central and northern portions of Area 61 (see Appendix E, Plate 5).

Toluene was detected at one location in Area 61 and three locations in the Fuel Area during the 1992 soil gas survey. This finding is consistent with the Petrex® soil gas survey report which indicates large zones of elevated levels of aromatics (toluene) within Area 61.

2.3. SEEP SAMPLING

Seep water sampling was performed at two locations on July 7 and 11, 1994. Seep water was collected to identify the presence of any potential chemical and radiological contaminants in the seep discharges. No comparative evaluations will be presented in this report.

Table II.4. Summary of Chemical Contamination from Historical Soil Gas Survey-1992

Sampling Event	Halogenated Hydrocarbons						Aromatic Hydrocarbons
	Freon-11	Freon-113	Cis-1,2-DCE	1,1,1-TCA	PCE	TCE	Toluene
Fuel Area							
MND-01-4160-0015			x				xb
MND-01-4161-0015						x	xb
MND-01-4161-0025					x	x	
MND-01-4166-0015	x	x			x	x	
MND-01-4166-0025		x		x	x	x	
MND-01-4167-0015	x		x	x	x	x	xb
MND-01-4167-0025	x			x		x	
Area 61							
MND-01-2216-0005							x

Source: DOE 1993e
x concentration found in reportable quantities
b found in laboratory blank

cis-1,2-DCE cis-1,2-Dichloroethene
1,1,1-TCA 1,1,1-trichloroethane
PCE tetrachloroethene
TCE trichloroethene

2.3.1. Field Work Performed and Procedures

Five potential seeps were identified for this investigation: S01001, S02001, S03001, S04001, and S05001. Seeps S03001, S04001, and S05001 could not be sampled because they were non-producing (dry) at the time of this investigation. Non-AOC seep locations are displayed in Figure 2.5.

One water sample was collected from each of the two seeps, S01001 and S02001, per Mound SOP 2.2, Field Measurements of Ground and Surface Water Samples, and Mound SOP 2.9, Surface Water Sampling. Prior to sampling, all field measurement instruments were calibrated according to Mound SOP 2.2 and recorded in the Seep Logbook (Appendix A.4).

In order to collect a water sample, grass and debris were cleared from the seep and a small catchment basin approximately three inches below ground surface (BGS) was made. To re-establish natural conditions, the seep was allowed to flow for four hours. A sample container was used as a transfer device between the catchment basin and the sample containers. Samples were collected, packaged, and shipped to an OU5 QAPjP approved laboratory according to Mound SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples (see Sample Manager Logbook in Appendix A.5).

2.3.2. Quality Assurance Summary Report

All sampling was conducted in accordance with the OU5 QAPjP (DOE 1993a). Quality control samples were collected and analyzed as specified in the QAPjP. One duplicate sample (S01101) was collected at seep S01001 for quality control (QC) purposes. The field and laboratory variances are summarized in the following subsections.

2.3.2.1. Field Variance Report

Seep water sampling was completed with three minor variances. The first minor variance was to Mound SOP 2.2. Field measurements were obtained from the catchment basin instead of the transfer device. Due to the low flow rate, it was determined that a more accurate instrument reading would be obtained from the seep itself.

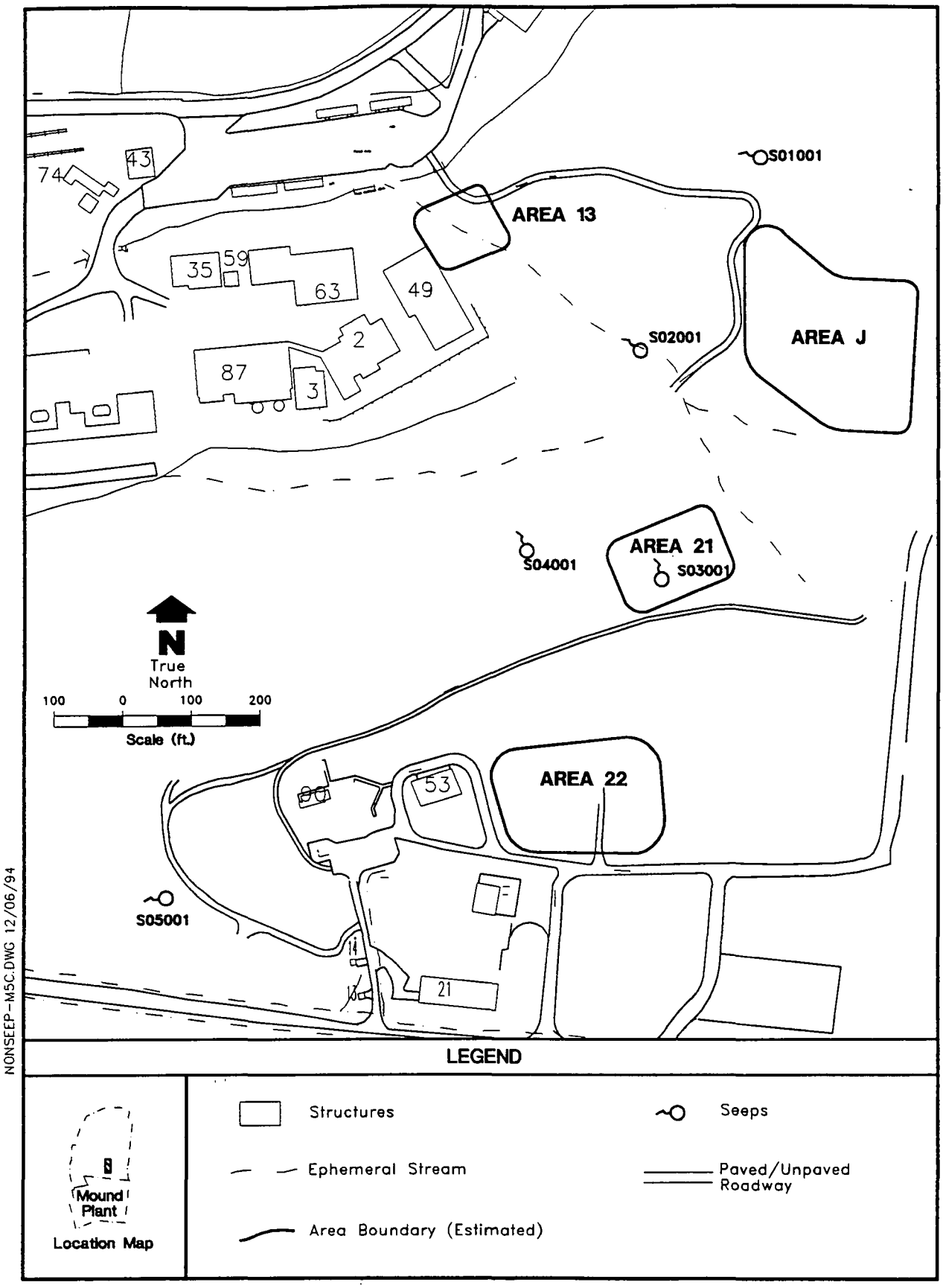


Figure 2.5. Seep Locations in the Non-AOC

The second minor variance was that the seep flow rate could not be measured per Mound SOP 2.10, Stream Flow Measurements Using Flumes, Velocity-Cross Sectional Area, and Direct Volume, due to the extremely slow seep flow rate and the topography. The flow rate at seep S01001 was instead estimated by determining the rate at which the seep discharge replaced one liter of seep water removed from the catchment basin. The discharge from seep S02001 was too slow to estimate.

A third minor variance was the elimination of the equipment rinsate sample to be collected for the seep sampling. Using the sample container as a transfer device eliminated sample collection equipment requiring decontamination, thereby, eliminating the equipment rinsate sample.

2.3.2.2. Laboratory Data Variance Report

Seep samples S01001 and S02001 were analyzed and validated in accordance with the OU5 QAPjP (DOE 1993a) to assure uniform and defensible data quality. A data quality assessment (DQA) report is presented in Appendix G of this report. The DQA was conducted to: (1) incorporate the analytical data validation results with the field QC sample results, (2) evaluate the impact of all QC measures on the overall data quality, and (3) remove all unusable values from the investigation data population.

As a result of the data validation and the DQA, the data generated during this investigation has been determined to be acceptable and in compliance with the OU5 QAPjP stated DQOs.

2.3.3. Health and Safety Summary Report

The seep sampling was conducted according to the OU5 RI/FS Health and Safety Plan (DOE 1993f). No accidents or safety violations occurred during the seep sampling. Because seep sampling is non-intrusive, no FIDLER screening was performed. Health and safety issues were discussed and resolved prior to sampling activities and during daily tailgate briefings.

2.3.4. Presentation of Data

Surface water from two seeps was analyzed for organic, inorganic, and radiological compounds. Validated data is presented in its entirety in Appendix F.1. The following subsections present a summary of the radiological and chemical data.

2.3.4.1. Radiological Data

Radiological compounds detected in seeps S01001 and S02001 and duplicate sample S01101 are presented in Table II.5. Eight radionuclides were detected in seep S01001, eight in duplicate sample S01101, and five in seep S02001.

2.3.4.2. Chemical Data

Chemical compounds detected in seeps S01001 and S02001 and duplicate sample S01101 are presented in Table II.6.

One SVOC (benzoic acid) was detected at estimated quantities (J) in seep S01001 and in duplicate sample S01101. One lanthanide (gadolinium) was detected in seep S01001. No SVOCs or lanthanides were detected in seep S02001 or duplicate sample S01101. Four VOCs (chloroform, TCE, PCE, and Freon-11) were detected in seep S01001 and five (chloroform, TCE, PCE, cis-1,2-dichloroethene and Freon-113) in duplicate S01101. Only one VOC (cis-1,2-dichloroethene) was detected in seep S02001. No pesticides/PCBs or cyanide were detected in any of the samples; anions were detected in all samples.

2.3.4.3. Field Measurements

Table II.7 summarizes the field measurements taken at seeps S01001 and S02001.

2.4. SOIL SAMPLING: AREAS OF SPECIAL INTEREST

Surface soil sampling was performed at Area H Pyrotechnic Waste Disposal Area and the Building 34 Firefighting Training Area on September 14, 1994. Locations were sampled to assess for potential chemical contamination from previous activities at these sites (Appendix B).

Table II.5. Radiological Results from Seeps S01001 and S02001

Parameter	Units	S01001	S01101	S02001
Am-241	pCi/L	---	0.57J	---
K-40	pCi/L	---	352.2	216.1
Pu-238	pCi/L	7.91J	6.54J	---
Pu-239/240	pCi/L	0.24J	---	---
Th-228	pCi/L	1.45J	1.06J	1.38J
Th-230	pCi/L	0.45J	0.09J	---
Th-232	pCi/L	0.34J	---	---
U-234	pCi/L	0.77J	0.95	0.32J
U-238	pCi/L	1.22J	1.34	0.27J
Tritium	pCi/L	1,294.6	1,274.9	1,239.9

--- Compound not detected in seep
J Estimated quantity
pCi/L picocuries per liter
Am americium
K potassium
Pu plutonium
Th thorium
U uranium

Table II.6. Chemical Results from Seep Sampling
Page 1 of 2

Parameter	Units	S01001	S01101	S02001
Volatile Organics				
Chloroform	µg/L	150	150	---
cis-1,2-Dichloroethene	µg/L	---	0.17J	0.054J
Trichloroethene	µg/L	7	7	---
Tetrachloroethene	µg/L	5	5	---
Trichlorotrifuoroethane	µg/L	1.5	1.4	---
Trichlorofluoromethane	µg/L	0.40J	---	---
Semi-volatile Organics				
Benzoic Acid	µg/L	3J	2J	---
Inorganics				
Aluminum	µg/L	6820J	3,100J	3,170J
Antimony	µg/L	1.90	---	---
Barium	µg/L	107	86.3	80.8
Calcium	µg/L	157000	153,000	183,000
Cobalt	µg/L	4.2	1	1.3
Copper	µg/L	6.4	3.7	3
Iron	µg/L	7170J	3,270J	3,560J
Lead	µg/L	4	1.4	2.8
Magnesium	µg/L	46300	45,700	39,800
Manganese	µg/L	162	63.4	644
Potassium	µg/L	7790J	6,160J	5,790J
Sodium	µg/L	233000	241,000	20,900
Vanadium	µg/L	11.3	4.6	5.4
Zinc	µg/L	39	16.4	22.8
Bismuth	µg/L	120	107	95.8
Explosives				
1,3-Dinitrobenzene	µg/L	---	---	0.19J
1,3,5-Trinitrobenzene	µg/L	0.53J	---	---
Lanthanide				
Gadolinium	µg/L	99J	---	---

Table II.6. Chemical Results from Seep Sampling
Page 2 of 2

Parameter	Units	S01001	S01101	S02001
Anions				
Chloride	mg/L	572	572	530
Fluoride	mg/L	0.214	0.19	0.196
Sulfate	mg/L	79.5J	64.5J	97.5J
Nitrate-Nitrite	mg/L	7.6	7.54	0.87
Other Data				
Total Organic Carbon	mg/L	4.32	2.28	2.44
Alkalinity (as $CaCO_3$)	mg/L	322	323	378
Total Dissolved Solids	mg/L	1590	1,650	1,520
Total Suspended Solids	mg/L	8	12	25
Total Phosphorus	mg/L	0.258	0.108	0.107
Kjeldahl Nitrogen	mg/L	---	0.17	0.203J

--- compound not detected in this seep
J Estimated quantity
µg/L microgram per liter
mg/L milligram per liter

Table II.7. Seep Sampling Field Measurements

Parameter	Units	Seep S01001	Seep S02001
pH	s.u.	6.86	7.02
Specific conductance	µmhos/cm	2.51	2.43
Reduction-oxidation potential	mvolts	+47	+128.6
Water Temperature	°C	17.3	14.6
Alkalinity as $CaCo_3$	mg/L	340	383
Dissolved Oxygen	mg/L	6.71	5.03
Air temperature	°C	35	23
Estimated flow rate	gpm	0.05	---

--- flow too low to measure
°C degree Celsius
s.u. standard units
mg/L milligrams per liter
µmhos/cm micromhos per centimeter
gpm gallons per minute

Surface and subsurface soil sampling was conducted at Building 24 on August 8 and 9, 1994. Locations were sampled to assess for potential chemical and radiological contamination from previous activities at this site (Appendix B).

2.4.1. Field Work Performed and Procedures

The field activities and procedures are presented in the following subsections.

2.4.1.1. Decontamination

All sampling equipment was decontaminated prior to sampling following SOP 1.6, General Equipment Decontamination. Decontaminated equipment was wrapped in aluminum foil and stored until use.

2.4.1.2. Surface and Subsurface Soil Sampling

Prior to digging, the sample locations were cleared for underground utilities, and an excavation permit was issued. Surface samples were collected using a stainless steel scoop and bowl following SOP 5.2, Soil Sampling with a Spade and Scoop. Subsurface samples were collected using an auger. An effort was make to prevent inclusion of organic matter, trash, asphalt, and gravel in the sample. Samples were collected, packaged, and shipped according to Mound SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples. Samples were shipped to an OU9 QAPjP approved analytical laboratory for analysis.

Area H Pyrotechnic Waste Disposal Area and the Building 34 Firefighting Training Area

On September 14, 1994, six surface soil samples were collected from the Area H Pyrotechnic Waste Disposal Area for explosive analysis (BB2001, BB3001, BB4001, BB5001, BB6001, and BB7001) (see Figure 2.6). One sample (BB1001) was collected from the Firefighting Training Area (next to Building 34) for TAL metals analysis (see Figure 2.7). All sampling information was recorded for these areas in the Site Manager Logbook (see Appendix A.2.).

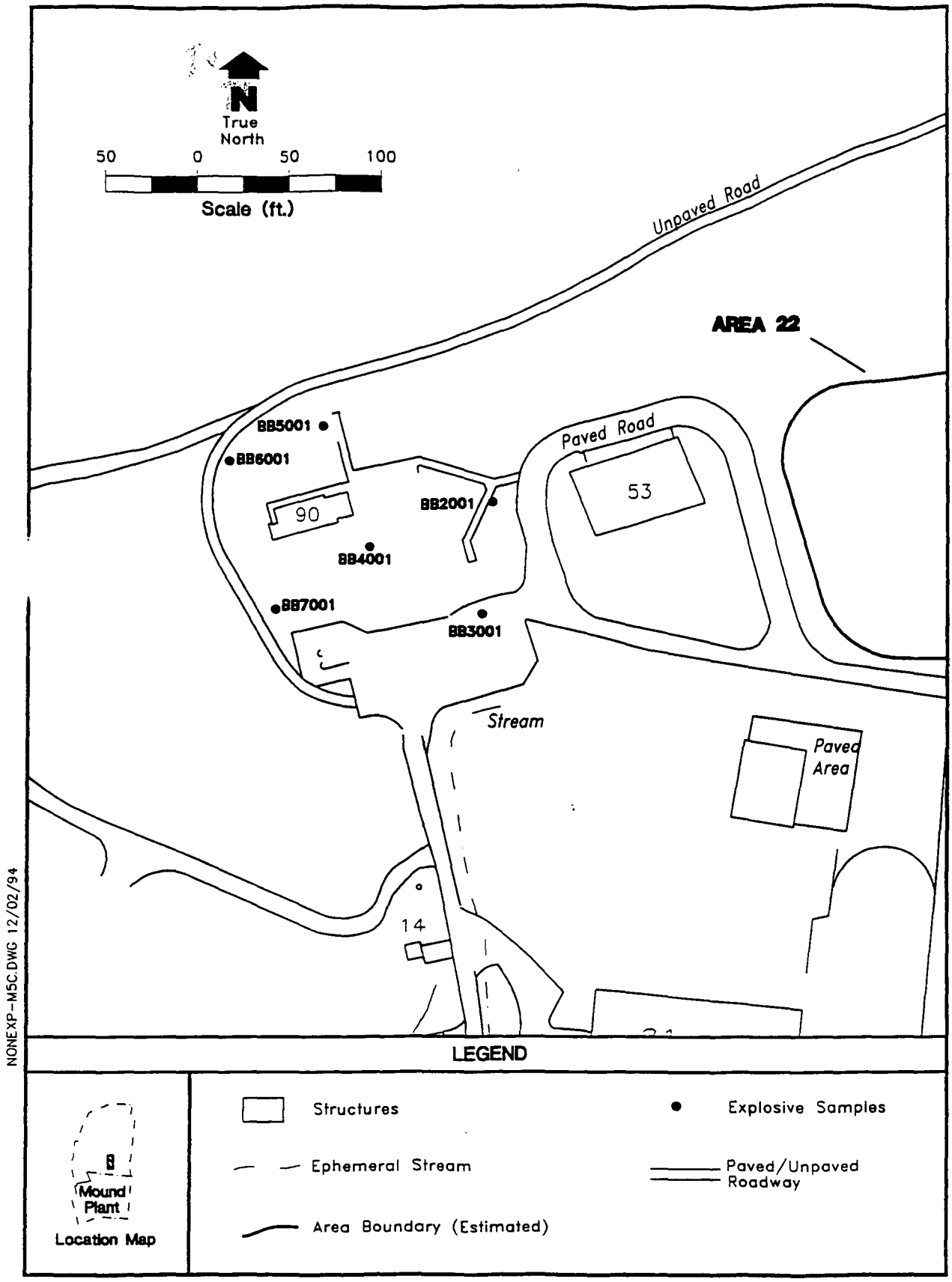


Figure 2.6. Sampling Locations in Area H Pyrotechnic Waste Disposal Area

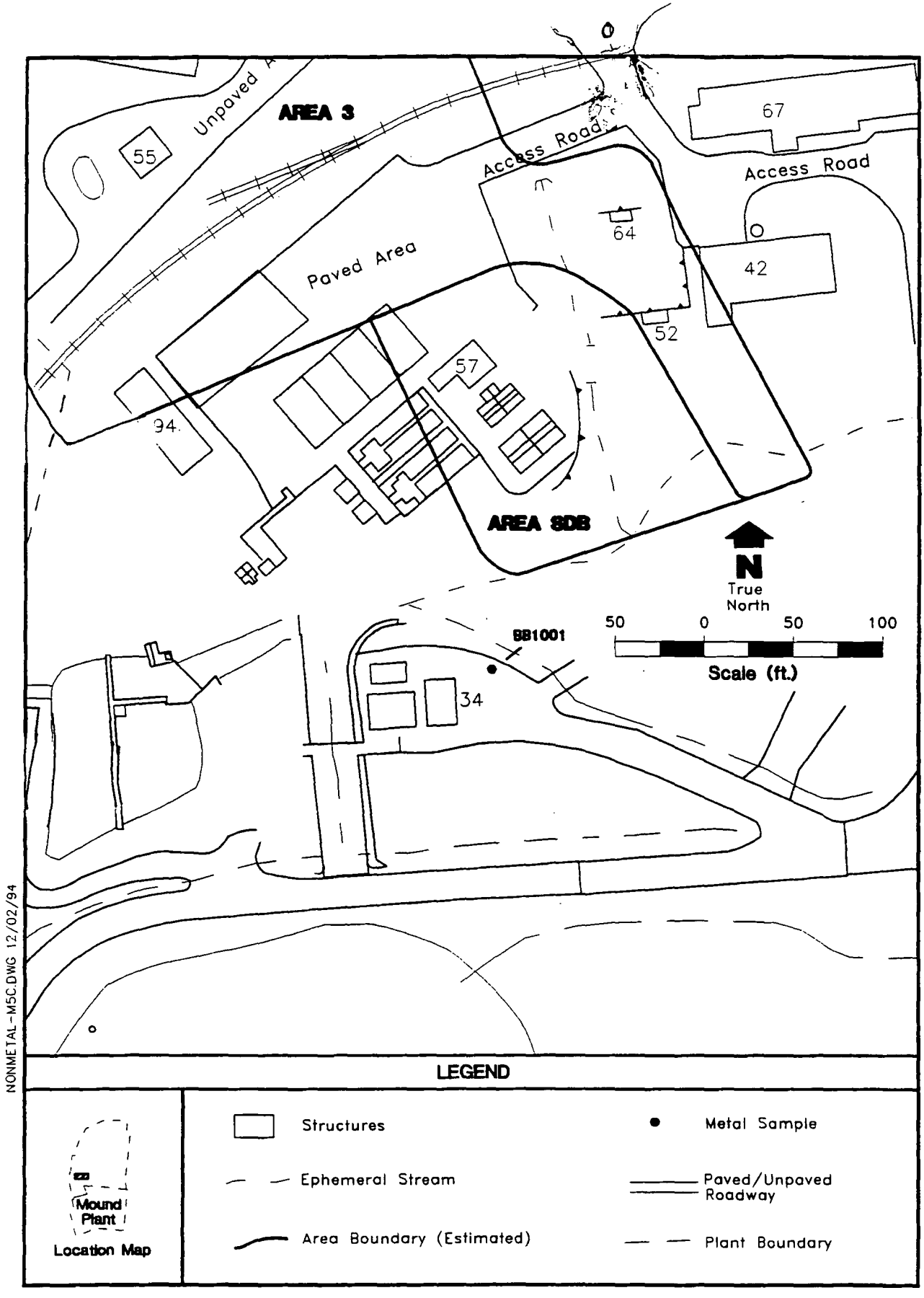


Figure 2.7. Sampling Location in Building 34 Firefighting Training Area

At each sampling location, soil was screened before and during sampling with a FIDLER to detect radiological activity. Surface soil samples were collected and analyzed for Pu-238 and Th-232 at the Mound Plant Soil Screening Facility (see Section 2.1.4.2). Results of the soil screening are presented in Appendix D.

Building 24

A total of four surface soil samples (B17001, B18001, B19001, and B20001) and four subsurface soil samples (B17002, B18002, B19002, and B20002) were collected from the north and south sides of Building 24. Sample boring locations are displayed as B17 through B20 in Figure 2.8.

On August 8, 1994, surface samples, B17001 and B18001, were collected using stainless steel scoops and bowls at soil boring locations B17 and B18, respectively. Prior to sampling, soil boring B17 was moved approximately three feet south because of high FIDLER readings at the original location. FIDLER readings were lower at the new B17 location and allowed work to continue safely. A soil screening sample taken at the original B17 location indicated concentrations of Pu-238 and Th-232 at 26 pCi/g and 5.5 pCi/g, respectively. Subsurface samples, B17002 and B18002, were collected using a hand auger at depths of three feet and 3.6 feet, respectively. Depth was reached by loosening the rocky and compact soil with a spud bar and power auger, and removing the soil with a hand auger. The power auger would not penetrate the compact and rocky soil beyond a depth of three feet.

On August 9, 1994, a burn permit was issued for the use of a generator and impact hammer to remove asphalt plugs to permit sampling at soil boring locations B19 and B20. After the asphalt plugs were removed, surface samples B19001 and B20001 were collected using a stainless steel scoops and bowls. Subsurface samples, B19002 and B20002, were collected from the respective soil boring using a hand auger at a depth of three feet for both samples. Depth was reached by loosening the rocky and compact soil with a spud bar and power auger, and removing the soil with a hand auger. The power auger would not penetrate the compact and rocky soil beyond a depth of three feet.

During digging, a borehole was monitored for combustibles and volatile emissions as described in SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels and SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector.

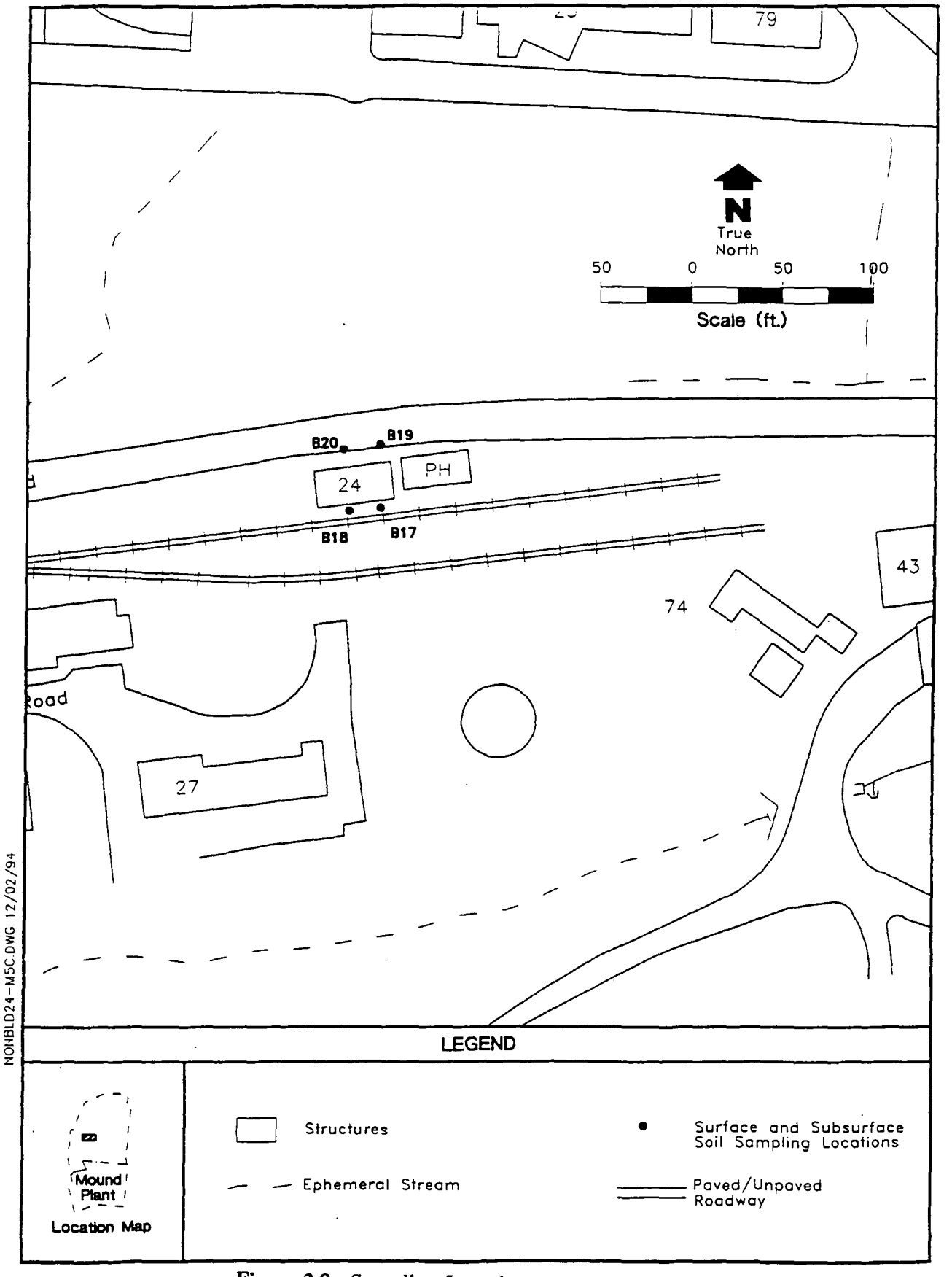


Figure 2.8. Sampling Locations at Building 24

Soil descriptions and all other pertinent information were recorded on the borehole log sheets for the Building 24 sampling according to SOP 4.1, Soil Boring and SOP 5.1, Soil and Rock Borehole Logging and Sampling. Sampling events were recorded in the Soil Boring Logbook (see Appendix A.6) and the Sample Manager Logbook (see Appendix A.5).

At each soil sampling location, soil was screened before and during sampling with a FIDLER to detect radiological activity. Surface soil samples were collected and analyzed for Pu-238 and Th-232 at the Mound Plant Soil Screening Facility (see Section 2.1.4.2). Results of the soil screening are presented in Appendix D.

2.4.2. Quality Assurance Summary Report

All sampling was conducted in accordance with the OU5 QAPjP (DOE 1993a). Quality control samples were collected and analyzed as specified in the QAPjP. Two duplicate quality control samples were collected at sample locations BB2001 and B18002. BB2101 was analyzed for explosives and B18102 was analyzed for radiological compounds only. The field and laboratory data variances are summarized in the following subsections.

2.4.2.1. Field Variance Report

The surface soil sampling was completed with no variances. Subsurface samples at Building 24 were collected at a depth of approximately three feet, instead of the target depth of five feet. The five foot depth was not obtainable due to the inability to penetrate the rocky soil and compact road fill material with a power auger and/or hand auger.

2.4.2.2. Laboratory Data Variance Report

All soil samples were analyzed and validated in accordance with the OU5 QAPjP (DOE 1993a) to assure uniform and defensible data quality. A DQA report is presented in Appendix G of this report. The DQA was conducted to: (1) incorporate the analytical data validation results with the field QC sample results, (2) evaluate the impact of all QC measures on the overall data quality, and (3) remove all unusable values from the investigation has been determined to be acceptable and in compliance with the OU5 QAPjP stated DQOs.

2.4.3. Health and Safety Summary Report

The soil sampling was conducted according to the OU5 South Property RI/FS Health and Safety Plan (DOE 1993f). No accidents or safety violations occurred during the soil sampling.

All sample locations were screened using a FIDLER to avoid digging in radiological contaminated soil. All sampling locations were checked for underground utilities to avoid damaging or severing utility lines while digging. Health and safety issues were discussed and resolved during daily tailgate briefings conducted by the Site Health and Safety Officer and documented in the Site Manager Logbook (Appendix A.2).

During digging, boreholes were monitored for combustibles and volatile emissions as described in SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels and SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector.

2.4.4. Presentation of Data

Six surface soil samples from Area H Pyrotechnic Waste Disposal Area were analyzed for explosives and one surface soil sample from the Building 34 Firefighting Training Area was analyzed for TAL Metals. Four surface and four subsurface soil samples collected at Building 24 were analyzed for radiological, organic, and inorganic compounds.

The following subsections summarize that radiological and chemical soil data from these sampling efforts. Validated data are presented in their entirety in Appendices F.2 and F.3.

2.4.4.1. Radiological Data

Radiological compounds detected in Building 24 soil samples are presented in Table II.8. A total of nine radionuclides were detected in the nine soil samples. Except for potassium-40 (K-40), all other radionuclides were listed at estimated quantities (J) or trace values.

In contrast, concentrations of Pu-238 and Th-232 exceeded the Mound Plant Soil Screening Facility detection limits of 25 pCi/g and 2.0 pCi/g respectively, in two samples collected at Building 24 soil boirng

Table II.8. Radiological Results from Building 24 Soil Samples

Parameter	Units	B17001	B17002	B18001	B18002	B18102	B19001	B19002	B20001	B20002
K-40	pCi/g	---	19.2	---	25.6	25.02	---	---	---	---
Pu-238	pCi/g	0.25J	0.67J	0.31J	---	---	---	---	---	---
Ra-226	pCi/g	0.65J	0.75J	0.65J	---	0.84J	0.36	0.53	0.41	0.52
Th-232	pCi/g	0.08J	0.64J	0.34J	0.8J	0.59J	0.11J	---	0.24J	---
Th-228	pCi/g	---	---	---	1.41J	---	---	---	---	---
Th-230	pCi/g	---	1.75J	---	1.36J	1.11J	---	---	0.64J	---
U-234	pCi/g	0.51J	0.84J	1.64J	0.74J	0.9	0.62J	0.5J	0.31J	0.36J
U-235	pCi/g	---	0.08J	0.1J	---	---	---	0.06j	---	---
U-238	pCi/g	0.46J	0.69J	1.31J	0.8J	0.9	0.41J	0.5J	0.43J	0.55J

--- Compound not detected in sample
J Estimated quantity
K potassium
Ra radium
Pu plutonium
Th thorium
U uranium
pCi/g picocuries per gram

locations, B17 and B18. The concentrations of Pu-238 and Th-232 in the surface soil screening sample collected at soil boring B18 were 38 pCi/g and 6.7 pCi/g, respectively. A soil screening sample taken at the original B17 location indicated concentrations of Pu-238 and Th-232 at 26 pCi/g and 5.5 pCi/g, respectively. No other samples collected at Building 24 had concentrations of Pu-238 or Th-232 that exceeded the Mound Plant Soil Screening Facility detection limits. The results of the soil screening analyses are presented in Appendix D.

2.4.4.2. Chemical Data

In Area H Pyrotechnic Waste Disposal Area, one explosive, nitrobenzene, was detected in the surface soil sample BB6001 at an estimated concentration of 0.38J mg/kg.

In the Building 34 Firefighting Training Area, 22 metals were detected in the surface soil sample BB1001. Four of these metals (calcium, chromium, copper, and nickel) were detected at estimated concentrations. Results are summarized in Table II.9.

At Building 24 chemical compounds were detected in the soil samples. Results are presented in Table II.10. No VOCs or cyanide were detected in the samples. SVOCs were most abundant in surface samples B17001 and B18001 and subsurface sample B17002. Several metals and lanthanides were detected in every sample.

2.4.5. Comparison with Historical Chemical Data

Limited historical chemical data is available for comparison for these areas of interest. No historical chemical data is available for Building 24. Soil sampling was conducted in Area H Pyrotechnic Waste Disposal Area as part of the OU3 Miscellaneous Sites Limited Field Investigation (DOE 1992a), however, no explosives were detected in concentrations above detection limits in any samples.

Soil in the Building 34 Firefighting Training Area was also sampled during the OU3 Limited Field Investigation (DOE 1992a). Subsurface soil samples were collected using hollow stem auger drilling techniques. A total of 21 samples were collected at eight locations and analyzed for several parameters, including TAL metals (see Figure 2.9). Inorganic compounds were not detected, except for antimony in two surface samples (MND33-0111 and -0112) at concentrations of 36.2 and 36.6 mg/kg.

Table II.9. Metals Results from Building 34 Firefighting Training Area Surface Soil Sample BB1001

Parameter	Units	Result
Aluminum	mg/kg	6,240
Arsenic	mg/kg	5.1
Barium	mg/kg	49.5
Beryllium	mg/kg	0.31
Cadmium	mg/kg	1.3
Calcium	mg/kg	79,800J
Chromium	mg/kg	14.6J
Cobalt	mg/kg	4.9
Copper	mg/kg	20.6J
Iron	mg/kg	14,700
Lead	mg/kg	23.1
Magnesium	mg/kg	34,600
Manganese	mg/kg	370
Molybdenum	mg/kg	1.9
Nickel	mg/kg	12.8J
Potassium	mg/kg	1,930
Silver	mg/kg	0.11
Sodium	mg/kg	3,260
Vanadium	mg/kg	15.7
Zinc	mg/kg	96

mg/kg milligram per kilogram
J Estimated quantity

Table II.10. Chemical Results from Building 24 Soil Samples
Page 1 of 4

Parameter	Units	B17001	B17002	B18001	B18002	B19001	B19002	B20001	B20002
Semi-volatile Organics									
Naphthalene	µg/kg	190J	65J	2,200J	---	---	---	---	39J
2-Methylnaphthalene	µg/kg	110J	86J	970J	---	---	---	190J	---
Acenaphthylene	µg/kg	62J	---	---	---	---	---	---	---
Acenaphthene	µg/kg	340J	---	5,500	---	---	---	---	---
Dibenzofuran	µg/kg	160J	---	2,600J	---	---	---	---	---
Fluorene	µg/kg	250J	---	4,000	---	---	---	---	---
Phenanthrene	µg/kg	2,800	290J	22,000	---	---	---	150J	43J
Anthracene	µg/kg	370	---	5,600	---	---	---	---	---
Carbazole	µg/kg	300J	---	4,000	---	---	---	---	---
Di-n-butylphthalate	µg/kg	58J	67J	480J	98J	---	---	670JB	---
Fluoranthene	µg/kg	3,200	510	23,000	---	---	52J	---	58J
Pyrene	µg/kg	3,000	580	25,000	---	---	45J	190J	55J
Benzo(a)anthracene	µg/kg	1,400	330J	10,000	---	---	---	---	---
bis(2-ethylhexyl)phthalate	µg/kg	480	170J	530J	---	39J	54J	82J	---
Benzo(b)fluoranthene	µg/kg	2,600	560	16,000	---	---	56J	130J	52J
Benzo(k)fluoranthene	µg/kg	3,900	860	27,000	---	---	240J	210J	85J
Benzo(a)pyrene	µg/kg	1,200	260J	9,100	---	68J	---	72J	---
Indeno(1,2,3-cd)pyrene	µg/kg	1,000	140J	5400	---	---	---	---	---
Dibenzo(a,h)anthracene	µg/kg	260	---	930J	---	---	---	---	---
Benzo(g,h,i)perylene	µg/kg	2,000	210J	5,800	---	---	---	---	---

Table II.10. Chemical Results from Building 24 Soil Samples
Page 2 of 4

Parameter	Units	B17001	B17002	B18001	B18002	B19001	B19002	B20001	B20002
Semi-volatile Organics									
Chryene	µg/kg	1600	310J	11000	---	48J	40J	180J	42J
Benzoic acid	µg/kg	---	---	---	---	---	---	---	39J
Butylbenzylphthalate	µg/kg	---	---	---	---	---	---	670JB	---
Pesticides/PCBs									
Aroclor-1248	µg/kg	720J	220	---	---	---	---	---	---
Aroclor-1254	µg/kg	830J	200	---	---	---	---	---	---
Endosulfan Sulfate	µg/kg	---	---	---	---	0.39J	---	---	0.7J
Aldrin	µg/kg	---	---	---	---	---	0.8J	1.2J	1.4J
Endrin	µg/kg	---	---	---	0.7J	---	---	---	---
4,4'-DDE	µg/kg	---	---	---	---	---	0.55J	---	---
Dieldrin	µg/kg	---	---	---	---	---	---	---	0.52J
Inorganics									
Arsenic	mg/kg	3.8	5	6.5	4.3	---	2.6	1.9	2.9
Aluminum	mg/kg	3,700	9,050	3,760	12,700	2,950	4,970	1,100	5,160
Barium	mg/kg	29	36.4	52.3	36.9	34	37.6	10.2	59.8
Cadium	mg/kg	0.46	0.25	0.63	---	---	---	---	---
Calcium	mg/kg	89,600J	91,200J	95,500J	75,000J	345,000J	105,000J	107,000J	116,000J
Chromium	mg/kg	12.8	13	9.5	16.8	9.1	6.6	2.7	7.5
Cobalt	mg/kg	4.2	8.4	4.3	11.8	5.4	2.9	1.0	3.2
Copper	mg/kg	26.5	22.4	33.9	19.7	11.6	6.9	3.9	7.7

Table II.10. Chemical Results from Building 24 Soil Samples
Page 3 of 4

Parameter	Units	B17001	B17002	B18001	B18002	B19001	B19002	B20001	B20002
Inorganics (continued)									
Iron	mg/kg	10,300	18,800	11,000	27,200	10,100	6,870	3,310	7,930
Lead	mg/kg	20	11.3	53.7	11.4	8	7.2	2.9	6.9
Magnesium	mg/kg	40,300	25,400	36,000	13,800	73,600	40,600	56,900	43,500
Manganese	mg/kg	249J	512J	300J	549J	615J	238J	134J	277J
Nickel	mg/kg	15.1	17.7	10.1	24.4	12.4	7.1	4.1	7.7
Potassium	mg/kg	1,130	2,980	1,130	3,620	1,210	1,220	641	1,480
Vanadium	mg/kg	10.1	16.6	9.8	20.1	13.4	9.7	9.7	10.4
Zinc	mg/kg	51.7	45.3	95.3	52.5	27.2	20.8	9.4	19.2
Bismuth	mg/kg	65.2	56.8	63.8	38.7	62	66.4	69.1	73.6
Lithium	mg/kg	3.8J	16.6J	5.1J	26.2J	1.8J	4.7J	1.7J	7.1J
Mercury	mg/kg	---	---	0.5	---	---	---	---	---
Beryllium	mg/kg	---	0.45	0.25	0.63	---	---	---	---
Silver	mg/kg	---	---	0.74	---	---	---	---	---
Sodium	mg/kg	---	394	---	544	980	1,020	405	933
Lanthanides									
Cerium	mg/kg	16	15.9	17.4	30.4	---	---	---	---
Gadolinium	mg/kg	64.1J	---	11.2J	55.5J	---	---	---	90J
Lanthanum	mg/kg	5.2	9.1	9.8	10.4	4.6	6.3	---	4.9
Praseodymium	mg/kg	35.4	---	36.1	---	---	---	---	10.7

Table II.10. Chemical Results from Building 24 Soil Samples
Page 4 of 4

Parameter	Units	B17001	B17002	B18001	B18002	B19001	B19002	B20001	B20002
Lanthanides (continued)									
Dypsprosium	mg/kg	---	---	---	4.6	---	---	---	---
Lutetium	mg/kg	---	---	---	0.9	---	---	---	---
Samarium	mg/kg	---	---	---	---	---	---	---	53.1
Anions									
Chloride	mg/kg	61.8J	---	105J	100J	44.6J	345J	56.7J	124J
Fluoride	mg/kg	2.83J	1.96J	6.16J	3.37J	---	---	---	---
Sulfate	mg/kg	178J	492J	303J	427J	108J	53.3J	24.7J	148J
Nitrate-nitrite	mg/kg	4.22	1.91	5.79	1.05	1.76	6.95	2.66	7.62
Other Data									
Total Organic Carbon	mg/kg	6520J	14,500J	10,500J	4,800J	17,600J	7,020J	51,300J	9,650J

--- Not detected in sample
J *Estimated Quantity*
B Estimated due to blank contamination
mg/kg milligram per kilogram
µg/kg microgram per kilogram

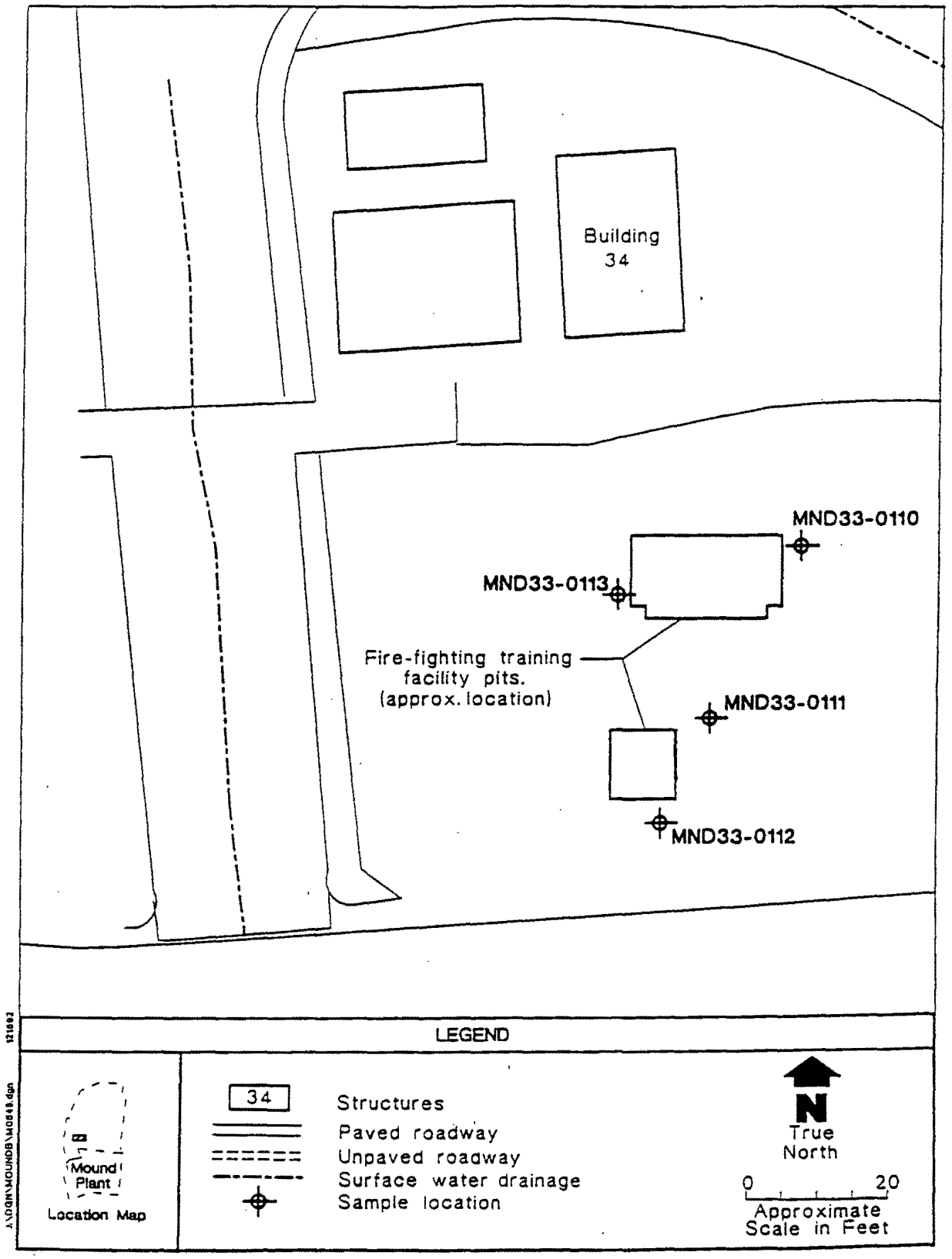


Figure 2.9. Sampling Locations of Historical TAL Metals, Building 34 Firefighting Training Area

The chemical soil data for the Firefighting Training Area from this investigation is not consistent with the historical data. Twenty-two metals (excluding antimony) were detected in surface soil sample BB1001, as opposed to one metal (antimony) detected during the historical study.

2.5. MONITORING WELL W410

Monitoring well W410 was installed, developed, and sampled from July 6 to July 21, 1994. The location of well W410 shown on Plate 1 (Volume I), was selected so that it would be in the vicinity of piezometer P015. Because chemical contaminants were detected in piezometer P015, monitoring well W410 was needed to provide additional groundwater monitoring capabilities.

2.5.1. Field Work Performed and Procedures

The field activities are summarized in the following subsections.

2.5.1.1. Site Preparation

Prior to beginning drilling activity at borehole location B410, the location was cleared for underground utilities and overhead clearances. Once cleared, an excavation permit was issued. An exclusion zone was set up using orange construction barrels with flashers and polypropylene fencing, maintaining a 50-foot clearance from the borehole where possible.

2.5.1.2. Decontamination

All reusable sample equipment, including a submersible pump and tubing, were decontaminated at the beginning of the project, and after each use, following SOP 1.6, General Equipment Decontamination. Decontaminated equipment was wrapped in aluminum foil and stored until use. The drill rig, casing sections, and bailers were steam-cleaned at a temporary decontamination pad at Mound Plant. Liquids were contained by a plastic liner and were transferred to 55-gallon polyethylene drums with a sump pump. Solids were periodically removed and transferred to 55-gallon steel drums.

2.5.1.3. Drilling, Installation, and Development

Borehole advancement for the installation of monitoring well W410 was completed in accordance with SOP 4.1, Soil Boring, using a cable-tool drilling method. The borehole was advanced by forcing the drive casing through unconsolidated material with the hammering action produced by the cable-tool drill rig. Periodically, water was added to the borehole to suspend the cuttings, which were then removed using a bailer.

Once the borehole was advanced to the specified depth, well installation could proceed following SOP 4.3, Monitoring Well Installation. A stainless steel screen and riser were used in the installation. The filter pack consisted of Global #5 quartz sand. The annular space was filled with a cement-bentonite grout to the ground surface. Steel protective casing with a locking cap was placed over top of the well to a depth of approximately 2.5 feet. A square concrete pad was constructed around the protective casing to complete the installation. Figure 2.10 presents the well log for monitoring well W410.

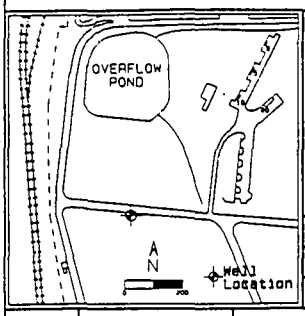
Well W410 was developed according to SOP 4.4, Monitoring Well Development, using a submersible pump.

2.5.1.4. Soil Sampling and Borehole Logging

One surface sample, B41001, was collected using a stainless steel scoop and bowl following SOP 5.2, Soil Sampling with a Spade and Scoop. One subsurface sample, B41002, was collected at a depth of 34-36 feet BGS using a split-spoon sampler. An effort was made to prevent inclusion of organic matter, trash, asphalt, and gravel in the sample. Samples were collected, packaged, and shipped to an OU5 QAPjP approved analytical laboratory according to Mound SOP 1.3, Sample Control and Documentation; SOP 1.4, Sample Containers and Preservation; and SOP 1.5, Guide to the Handling, Packaging, and Shipping of Samples (see Sample Manager Logbook in Appendix A.5).

A soil description and all other pertinent information were recorded in the borehole log sheet according to SOP 4.1, Soil Boring, and SOP 5.1, Soil and Rock Borehole Logging and Sampling (see Appendix A.7).

MOUND / NON-AOC	OU5 OPERATIONAL AREA PHASE I RI/FS FIELD INVESTIGATION	WELL LOG W410	Page 1 of 2



Area of Concern: Non-AOC
Drilling Company: Bowser-Morner
Drilling Method: Cable Tool
Drilling Fluid: Water
Drilling Completed: 7/11/94
Well Installed: 7/12/94, 7/13/94
Logged By: Susan Abston
Total Depth (ft BGS): 41.2

COORDINATES	
State Plane; Northing:	596520.9127
Easting:	1495226.1001
Mound Plant; South:	3145.7534
West:	4657.5850
Ground Surface Elevation (ft MSL):	713.25
Top of Casing Elevation (ft MSL):	715.50

GROUNDWATER	DATE	DEPTH (ft BGS)	COMMENTS
▼	7/11/94	30.95	Encountered during drilling.
▽	7/21/94	32.10	Sample collected.

DEPTH (ft BGS)	SAMPLES: Water	SAMPLES: Soil	WELL CONSTRUCTION	LITHOLOGY	USCS	DESCRIPTION / COMMENTS
			steel protective casing with locking cap (2.25 ft AGS); concrete pad			
0	B41001				CL	0-5.0 CLAY and SILT, trace coarse sand and gravel; dry; 7.5YR4/2 brown.
4					SC	5.0-14.0 CLAY, SILT, and SAND, trace gravel; dry; 7.5YR5/3 brown.
8			cement bentonite grout			
12			2" stainless steel riser			
					SP	14.0-16.0 SAND, some gravel, trace silt; coarse sand; dry.
16					SW	16.0-28.0 SAND, some gravel; fine to coarse sand; dry.
20			(21.48 ft BGS); 3/8" bentonite pellet seal			
24						

Figure 2.10. Well Log of Monitoring Well W410 (Page 1 of 2)

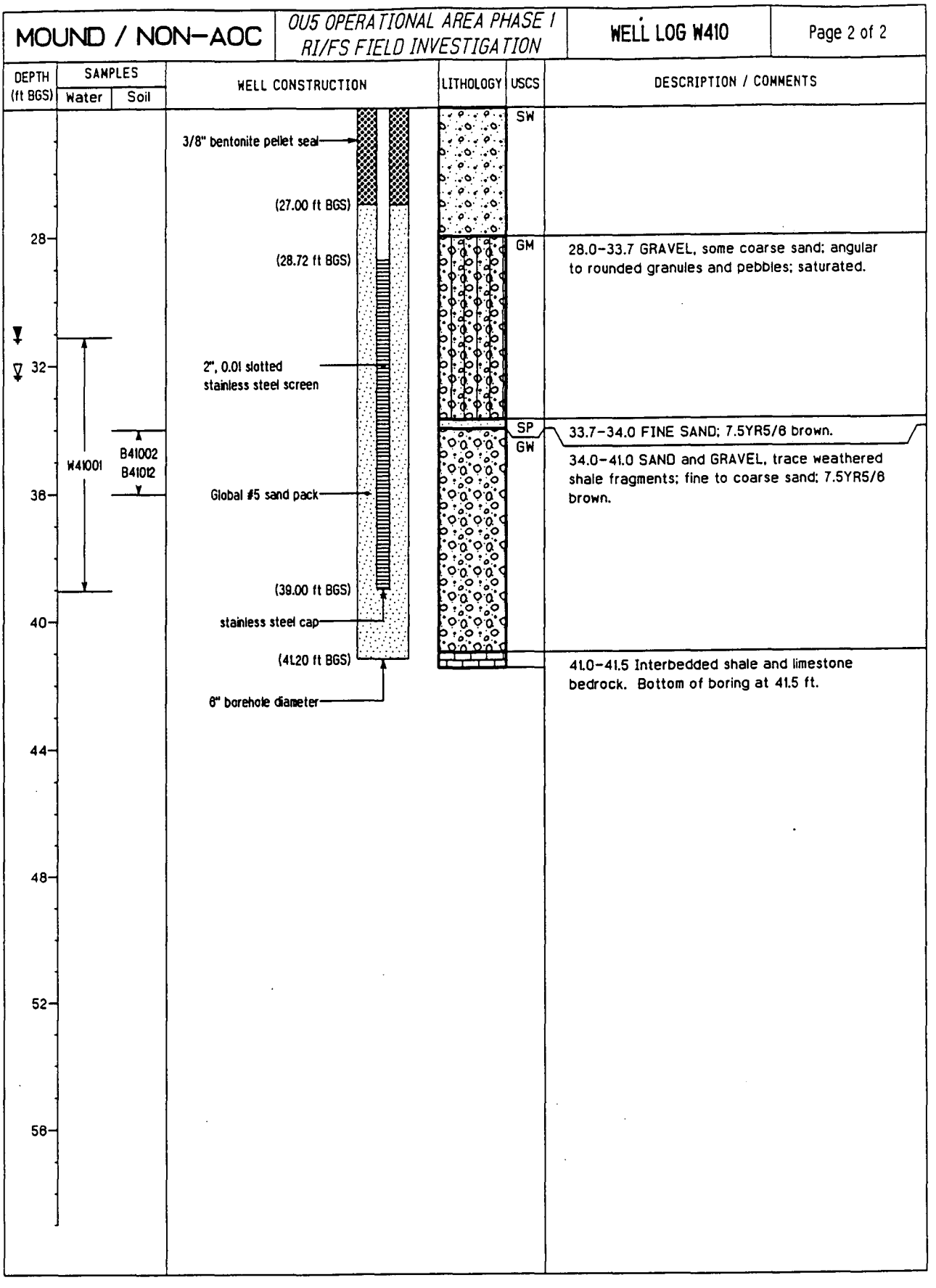


Figure 2.10. Well Log of Monitoring Well W410 (Page 2 of 2)

2.5.1.5. Groundwater Sampling

One groundwater sample, W41001, was collected at well location W410. Following well installation and development, groundwater sampling was completed according to SOP 2.4, Sampling Monitoring Wells with a Bucket-Type Bailer, and SOP 2.8, Sampling for Volatile Organics.

The sample was collected using a submersible pump with flexible polyvinyl chloride tubing, filling the sample jars directly from the tubing. The pump rate was adjusted to permit effective VOC sampling with minimal disturbance of the sample. The sample was collected, packaged, and shipped according to Mound SOP 1.5, Guide to Handling, Packaging, and Shipping of Samples. Immediately after completing the sampling, a final measurement of water parameters was taken. All sampling was recorded in the appropriate sections of the logbook (see Appendix A.7).

2.5.1.6. Investigative Derived Material

The investigative derived material produced during this effort was handled according to SOP 1.15, Guide to Waste Management. It consisted of soil cuttings from drilling, personal protective equipment and other solid waste, development water, and decontamination rinse water and solids.

Soil cuttings produced during drilling were temporarily placed into 55-gallon drums. Since the well was located in a non-paved area and did not exhibit contamination as identified by field screening, the cuttings were spread on the surface around the well once drilling and well installation activities were completed.

All of the solid (non-soil) waste generated was contained in clear plastic garbage bags, including used personal protective equipment, plastic sheeting, and aluminum foil. The waste was screened using a FIDLER before disposal into a solid waste dumpster.

Development and decontamination water was containerized in Department of Transportation approved 55-gallon polyethylene drums, labeled with a standard investigative derived material label, and staged west of Building H. Soil solids from the decontamination pad described in Section 2.5.1..1 were transferred to Department of Transportation-approved 55-gallon steel drums, labeled, and transported to Building 19. Decontamination solutions resulting from methanol and hexane rinses were transferred to the appropriate 5-gallon flash-proof container.

2.5.2. Quality Assurance Summary Report

All sampling was conducted in accordance with the OU5 QAPjP (DOE 1993a). A duplicate subsurface soil sample (B41012) was collected at a depth of 34-36 feet BGS for quality control purposes. The field and laboratory data variances are summarized in the following subsections.

2.5.2.1. Field Variance Report

One variance from SOP 4.3 occurred during monitoring well installation activities. The minor variance was that a six inch diameter borehole was drilled at W410 rather than the eight inch borehole. Because of this variance, a two inch diameter well screen and riser were installed at W410. No impact to the sample integrity occurred because of this variance.

2.5.2.2. Laboratory Data Variance Report

All soil samples and the groundwater sample were analyzed and validated in accordance with the OU5 QAPjP (DOE 1993a) to assure uniform and defensible data quality. A DQA report is presented in Appendix G of this report. The DQA was conducted to: (1) incorporate the analytical data validation results with the field QC sample results, (2) evaluate the impact of all QC measures on the overall data quality, and (3) remove all unusable values from the investigation data population.

As a result of the data validation and the data quality assessment, the data generated during this investigation has been determined to be acceptable and in compliance with the OU5 QAPjP stated DQOs.

2.5.3. Health and Safety Summary Report

The monitoring well activities were conducted according to the OU5 South Property RI/FS Health and Safety Plan (DOE 1993f). No accidents or safety violations occurred during the soil sampling. Health and safety issues were discussed and resolved during daily tailgate briefings conducted by the Site Health and Safety Officer and documented in the Site Manager Logbook (Appendix A.2.).

All soil samples were screened using a FIDLER to avoid exposure to radiologically contaminated soil. The borehole location was checked for underground utilities to avoid damaging or severing utility lines

while drilling. A lock out/tag out procedure was performed at the beginning and end of each day of drilling activities at W410 due to overhead power lines. The lock out/tag outs were performed according to the procedure outlined in the Mound Plant Lock Out/Tag Out Procedures M-3 and 29CFR1910.147.

During drilling, the borehole was monitored for combustibles and volatile emissions as described in: (1) SOP 6.1, Health and Safety Monitoring of Combustible Gas Levels, (2) SOP 6.2, Health and Safety Monitoring of Organic Vapors with a Photoionization Detector, and (3) SOP 6.3 Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector.

2.5.4. Presentation of Data

Two soil samples (and one soil duplicate) and one groundwater sample were analyzed for radiological, organic, and inorganic compounds. Validated data is presented in its entirety in Appendix F.4. The following subsections present a summary of the radiological and chemical data.

2.5.4.1. Radiological Data

Radiological compounds detected in the soil samples and groundwater sample from monitoring well W410 are presented in Table II.11. A total of seven radiological constituents were detected in the soil samples and in the groundwater sample. No Pu-238 or Th-232 was detected by the analytical lab. This is consistent with the Soil Screening Facility results for the soil samples. No concentrations of Pu-238 or Th-232 were detected above the Mound Plant Soil Screening Facility detection limits of 25 pCi/g and 2.0 pCi/g, respectively, for the soil samples.

2.5.4.2. Chemical Data

Chemical compounds detected in the soil samples and groundwater sample from monitoring well W410 are presented in Table II.12. SVOCs and one pesticide/PCB were detected primarily in the surface soil sample B41001. No SVOCs or pesticide/PCBs were detected in the groundwater sample. No VOCs were detected in surface soil sample B41001. VOCs were detected in the subsurface soil samples (B41002 and B41012) and in the groundwater sample (W41001). Metals were detected in all samples; however, no cyanide was detected. Anions (chloride, fluoride, nitrate-nitrite, and sulfate) were detected in the soil samples; only chloride and fluoride were detected in groundwater sample W41001.

Table II.11. Radiological Results from Soil and Groundwater at Monitoring Well W410

Parameter	Soil				Groundwater	
	Units	B41001 (0-0.5 ft BGS)	B41002 (34-36 ft BGS)	B41012[a] (34-36 ft BGS)	Units	W41001
Ra-226	pCi/g	0.43	0.39	0.52	pCi/L	0.89J
Th-230	pCi/g	0.33J	0.49J	0.64J	pCi/L	0.59J
Th-228	pCi/g	---	0.53J	0.37J	pCi/L	---
U-238	pCi/g	0.38	0.45	0.73	pCi/L	0.65
U-234	pCi/g	0.30J	0.40	0.64	pCi/L	0.65J
Tritium	pCi/g	---	---	---	pCi/L	4223.3
U-235	pCi/g	---	---	0.18	pCi/L	0.17
Am-241	pCi/g	---	---	---	pCi/L	0.47J

--- Not detected in sample
a Duplicate sample of B41002
Am americium
J estimated quantity
K potassium
pCi/g picocuries per gram
pCi/L picocuries per liter
Ra radium
Th thorium
U uranium

Table II.12 Chemical Results from Soil and Groundwater at Monitoring Well W410
Page 1 of 2

Parameter	Soil				Groundwater	
	Units	B41001	B41002	B41012	Units	W41001
Volatile Organics						
1,2-Dichloroethene	µg/kg	---	10	15	µg/L	220
Trichloroethene	µg/kg	---	5J	6	µg/L	34
Tetrachloroethene	µg/kg	---	10	11	µg/L	21
Vinyl chloride	µg/kg	---	---	---	µg/L	15J
Chloroform	µg/kg	---	---	---	µg/L	5J
Trichlorotrifluoroethane	µg/kg	---	---	---	µg/L	7J
Semi-Volatile Organics						
Phenanthrene	µg/kg	260J	---	---	µg/L	---
Anthracene	µg/kg	65J	---	---	µg/L	---
Fluoranthene	µg/kg	340J	---	---	µg/L	---
Pyrene	µg/kg	270J	---	---	µg/L	---
Benzo(a)anthracene	µg/kg	170J	---	---	µg/L	---
Chrysene	µg/kg	140J	---	---	µg/L	---
Benzo(b)fluoranthene	µg/kg	290J	---	---	µg/L	---
Benzo(k)fluoranthene	µg/kg	550	---	---	µg/L	---
Benzo(a)pyrene	µg/kg	200J	---	---	µg/L	---
Indeno(1,2,3-cd)pyrene	µg/kg	73J	---	---	µg/L	---
Bis(2-ethylhexyl)phthalate	µg/kg	---	48J	---	µg/L	---
Pesticides/PCBs						
Dieldrin	µg/kg	0.53J	---	---	µg/L	---
Inorganics						
Aluminum	mg/kg	4960J	2310J	2120J	µg/L	1590
Arsenic	mg/kg	4.5	5J	8.1	µg/L	---
Barium	mg/kg	36.2	12	10.7	µg/L	158J
Calcium	mg/kg	152000	121000	131000	µg/L	166000
Chromium	mg/kg	7.6J	4.7	5.4J	µg/L	---

Table II.12. Chemical Compounds Detected in Soil and Groundwater at Monitoring Well W410
Page 2 of 2

Parameter	Soil				Groundwater	
	Units	B41001	B41002	B41012	Units	W41001
Cobalt	mg/kg	3.3	2.7	2.4	µg/L	---
Copper	mg/kg	6.5J	8.3J	7.5J	µg/L	---
Iron	mg/kg	8450	7080	8470	µg/L	2350
Lead	mg/kg	8.4	5.8J	5.6	µg/L	---
Magnesium	mg/kg	48700	55000	53000	µg/L	64500J
Manganese	mg/kg	280J	284J	236J	µg/L	1270J
Nickel	mg/kg	8	8.1	6.9	µg/L	2.3J
Potassium	mg/kg	1670J	735J	630J	µg/L	6840J
Sodium	mg/kg	1160	520	591	µg/L	121000
Vanadium	mg/kg	11.1	7.4	6.9	µg/L	3.1
Zinc	mg/kg	26.1	22.6J	23.4	µg/L	16.3
Bismuth	mg/kg	63.6	77	65.2	µg/L	161
Lithium	mg/kg	7	4.6	4.5	µg/L	22.5
Molybdenum	mg/kg	18.8	22.8	21.50	µg/L	---
Anions						
Chloride	mg/kg	302J	59.5J	72.4J	mg/L	307
Fluoride	mg/kg	6.66J	4.45J	1.33J	mg/L	0.27
Sulfate	mg/kg	605J	---	50.3J	mg/L	---
Nitrate-Nitrite	mg/L	2.45J	2470J	3.79J	mg/L	---
Other Data						
Total Organic Carbon	mg/kg	16,720J	8,940J	11,200J	mg/L	1.93
Total Dissolved Solids	mg/kg	---	---	---	mg/L	134[illegible]
Total Suspended Solids	mg/kg	---	---	---	mg/L	136
Alkalinity	mg/kg	---	---	---	mg/L	379

--- Not detected
J Estimated quantity
µg/kg microgram per kilogram
mg/kg milligrams per kilogram
µg/L microgram per liter

2.5.4.3. Field Measurements

Table II.13 summarizes the field measurements taken for the collection of groundwater sample W41001.

2.5.5. Comparison with Historical Data

No historical soil data is available for comparison with monitoring well W410 soil data. Limited historical groundwater data is available for comparison with W410 analytical data. Piezometer P015, located in the vicinity of monitoring well W410, was sampled on March 25, 1994 as part of the Mound Plant groundwater monitoring program (DOE 1993g). Table II.14 shows chemical contaminants detected during this historical sampling event.

The findings of this investigation are consistent with the March 1994 piezometer P015 groundwater data. Six of the eight SVOCs detected during the March 1994 sampling event were also detected during this sampling effort.

Table II.13. Groundwater Sampling Field Measurements

Parameter	Units	Groundwater Sample W41002	
		Initial Reading	Final Reading
pH	s.u.	7.55	7.32
Reduction-oxidation potential	millivolts	---	167.7
Water temperature	°C	20.9	14.9
Alkalinity as $CaCO_3$	mg/L	---	332
Dissolved oxygen	mg/L	---	16.3
Specific conductance	umhos/cm	1.762	1.791

--- No reading taken
s.u. standard unit
mg/L milligram per liter
°C degrees Celsius
umhos/cm micromhos per centimeter

Table II.14. Piezometer P015 Historical Groundwater Data - March 1994

Parameters	Units	Validated Data Value
1,1,2-trichloro-1,2,2-trifluoroethane	ug/L	2J 2.6
Cis-1,2-dichloroethene	ug/L	120
Trans-1,2-dichloroethene	ug/L	2.4
TCE	ug/L	28
Tetrachloroethane	ug/L	5.3
Freon-11	ug/L	0.7 6.2
Chloroform (trichloromethane)	ug/L	2.7

J estimated quantity
ug/L micrograms per liter

3. SUMMARY

The results of the reconnaissance field efforts conducted in the Non-AOC and the special areas of interest are summarized in this section. While specific conclusions are not drawn from these findings, the results may be used to direct a Phase 2 investigation of the Non-AOC.

3.1. FIDLER SURVEY AND SOIL SCREENING

The FIDLER survey performed in the Non-AOC located several areas and points of elevated surface radiological activity. Three areas are located in the northeastern portion of the Non-AOC in the area historically known as Area 8. The fourth area is in the southeastern portion of the Non-AOC adjacent to the access road. Two areas of elevated surface radiological activity were found in Area 61.

The Soil Screening Facility analyses indicate small areas of elevated concentrations of Pu-238 and Th-232 in the Non-AOC. One area of Pu-238 and Th-232 activity is located in the northeast portion of the Non-AOC in the area historically known as Area 8. Two points of Pu-238 activity are located immediately north of the SM Building in the eastern portion of the Non-AOC. Elevated levels of Pu-238 are also located in the southeast corner of the Non-AOC and in an area west of Area H Pyrotechnic Waste Disposal Area. Several additional isolated locations of Pu-238 activity are scattered throughout the Non-AOC.

3.2. SOIL GAS SURVEY

The soil gas surveys conducted in the Non-AOC, Fuel Area, and Area 61 indicate the presence of chemical contaminants as summarized below:

- Elevated levels of aromatics exist in the subsurface in the northern and southern portions of the non-AOC East and large portions of the Fuel Area and Area 61. Aromatics in the soil gas in the Non-AOC East and Fuel Area occur with combinations of other hydrocarbons in mixtures which are characteristic of weathered fuels. Elevated levels of aromatics occur within Area 61 principally as components of mixtures of C_4 and C_{13} hydrocarbons common to medium to heavy weight fuels.

- PCE was the most frequently detected halogenated hydrocarbon in the Non-AOC and Area 61. Results also indicate pronounced levels of TCE at several locations in the Non-AOC, and dichlorobenzene and chloroform at scattered locations.

- Elevated levels of semi-volatile hydrocarbons naphthalene and methylnaphthalene were found in the northeastern section of the Non-AOC North, including Area 61 and the Fuel Area, and in the southern portion of the Non-AOC East. Naphthalene and methylnaphthalene are predominantly found in heavy weight petroleum products such as diesel fuel, heating oil, tar, and creosote.

- The distribution of petroleum hydrocarbons in the Non-AOC is similar to that of total aromatics. This finding supports earlier observations that the majority of hydrocarbons in the soil gas likely derive from fuels which contain abundant levels of both aromatics and aliphatic hydrocarbons.

3.3. SEEP SAMPLING

The seep sampling conducted in the Non-AOC indicates the presence of radiological and chemical contaminants in the surface water at seeps S01001 and S02001. TCE and PCE were detected in seep S01001. One SVOC (benzoic acid) was detected at estimated quantities (J) in seep S01001 and in duplicate sample S01101. One lanthanide (gadolinium) was detected in seep S01001. No SVOCs or lanthanides were detected in seep S02001 or duplicate sample S01101.

Four VOCs were detected in seep S01001 (chloroform, TCE, PCE, and Freon-11) and five in duplicate S01001 (chloroform, TCE, PCE, and cis-1,2-dichloroethene, and Freon-113). Only one VOC (cis-1,2-dichloroethene) was detected in seep S02001.

No pesticides/PCBs or cyanide were detected in any samples; anions (fluoride, chloride, sulfate, nitrate-nitrite) were detected in all samples.

Eight radionuclides were detected in seep S01001 and in duplicate sample S01101, and five in seep S02001.

3.4. SOIL SAMPLING: AREAS OF SPECIAL INTEREST

In Area H Pyrotechnic Waste Disposal Area, one explosive, nitrobenzene, was detected in surface soil sample BB6001 at an estimated concentration of 0.38J mg/kg.

In Building 34 Firefighting Training Area, 22 metals were detected in the surface soil sample BB1001. Four of these metals (calcium, chromium, copper, and nickel) were detected at estimated concentrations. These results were inconsistent with a historical investigation during which only one metal, antimony, was detected. Antimony was not detected during this investigation.

The soil sampling conducted at Building 24 indicates the presence of radiological and chemical contaminants as summarized below:

- Nine radionuclides were detected in the nine soil samples. Except for K-40, all other radionuclides were listed at estimated quantities (J) or trace values;
- SVOCs were primarily detected in surface soil samples B17001 and B18001, and subsurface soil sample B17002;
- No VOCs or cyanide were detected in the samples;
- Nineteen of the 22 metals were detected in a majority of the eight soil samples.

3.5. MONITORING WELL W410

Soil and groundwater sampling at monitoring well W410 indicates the presence of chemical and radiological contamination as summarized below:

- A total of eight radionuclides were detected in the soil samples and seven radionuclides in the groundwater sample. Tritium was detected at 4223.3 pCi/L in groundwater sample W41001. No Pu-238 or Th-232 was detected by the analytical laboratory. This is

consistent with the Soil Screening Facility results for the soil samples. No concentrations of Pu-238 or Th-232 were detected above the Mound Plant Soil Screening Facility detection limits of 25 pCi/g and 2.0 pCi/g, respectively, for the soil samples.

- Three VOCs (TCE, PCE, and cis-1,2-dichloroethene) were detected in the subsurface soil samples and six VOCs (TCE, PCE, cis-1,2-dichloroethene, vinyl chloride, chloroform, and Freon-113) were detected in groundwater sample W41001.

- No SVOCs or pesticides/PCBs were detected in groundwater sample W41001.

- Metals were detected in all samples; however, no cyanide was detected.

- Anions (chloride, fluoride, sulfate, and nitrate-nitrite) were detected in the soil samples; only chloride and fluoride were detected in groundwater sample W41001.

4. REFERENCES

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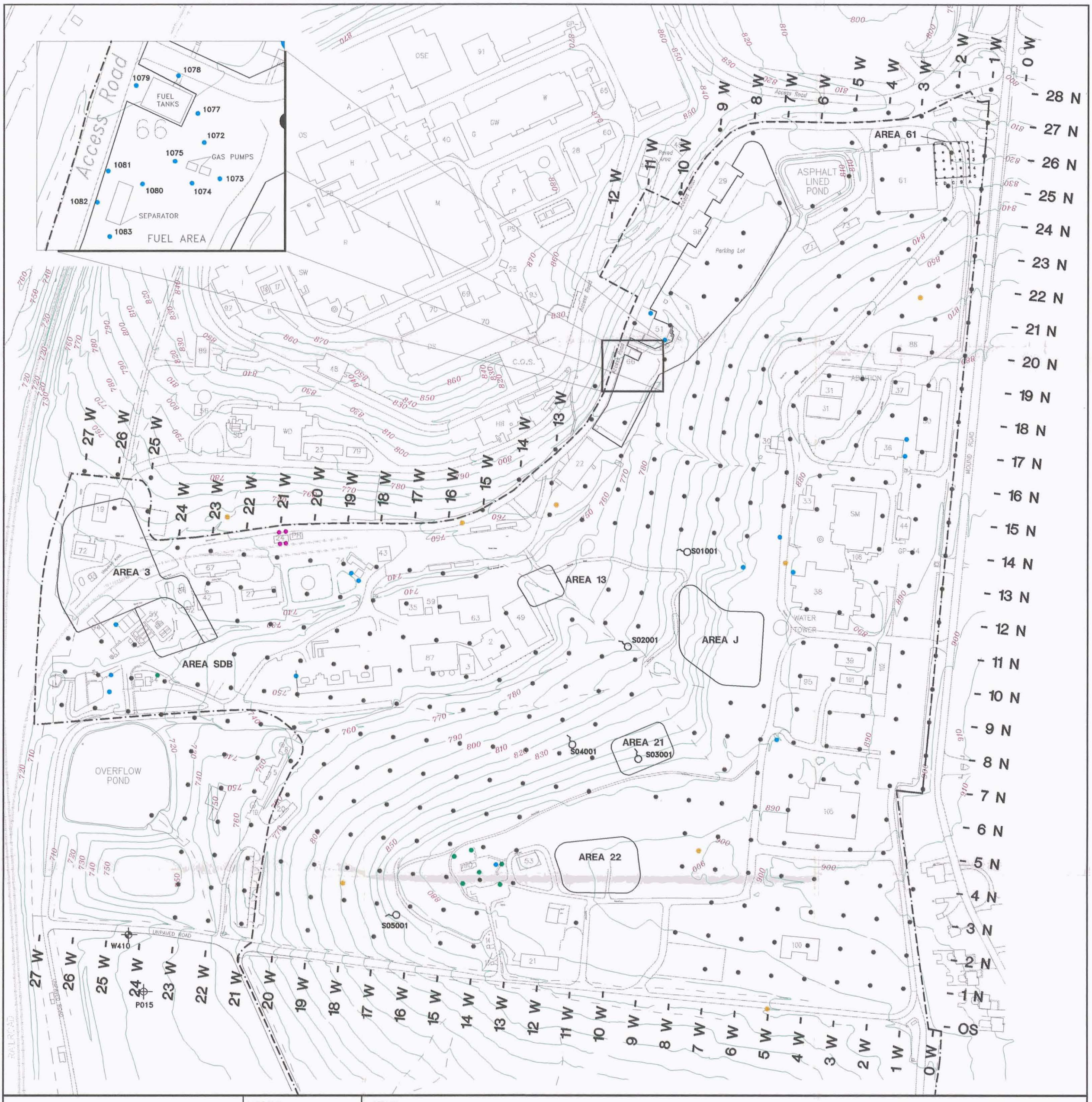
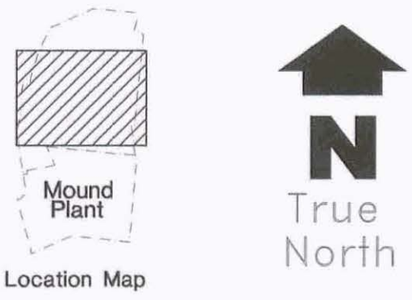
Plates

PLATE 1:	**OU5 Non-AOC Study Area**
PLATE 2:	**Areas of Elevated Surface Radiological Activity (FIDLER Survey)**
PLATE 3:	**Locations of Elevated Surface Soil Pu-238 Activity**





Location Map

Contour Interval 10 ft.

100 0 100 200

SCALE (FEET)

FIGURE:

PLATE 1

TITLE:

OU5 NON-AOC STUDY AREA

LEGEND

- Structures
- Plant Boundary
- Paved/Unpaved Roadway
- Ephemeral Stream
- 700 Contour Line
- OU5 Boundary
- Non-AOC Sampling and Survey Locations: Soil Gas Samples, Soil Screening Facility Radiological Samples, and FIDLER Survey
- Monitoring Well
- Piezometer
- 1 N - 1 W - Grid Lines
- Seeps

Note: Information on Basemap is Derived from the Weston OU9 Site Scoping Report, 1993, & Referenced to the 1927 Ohio State Plane Coordinate System

AREAS OF SPECIAL INTEREST AND ADDITIONAL SAMPLING [a]

- Surface Soil Sampling Locations (Area H Pyrotechnic Waste Disposal Area and Building 34 Firefighting Training Area
- Soil Gas and Soil Screening Facility Radiological Sampling Locations (Fuel Area and Additional Sampling [a])
- Soil Screening Facility Radiological Sampling Locations (Additional Sampling [a])
- Surface and Subsurface Soil Sampling Locations (Building 24)
- a OU5 Discussion Paper (See Appendix B)

NONAOC-M5C.DWG 12/06/94

Mound Plant

Location Map

True North

Contour Interval 10 ft.

100 0 100 200

SCALE (FEET)

FIGURE:

PLATE 2

TITLE:

AREAS OF ELEVATED RADIOLOGICAL ACTIVITY (FIDLER SURVEY)

LEGEND

- Structures
- Plant Boundary
- Paved/Unpaved Roadway
- Ephemeral Stream
- OU5 Boundary
- Seeps
- Non-AOC Sampling and Survey Locations: Soil Gas Samples, Soil Screening Facility Radiological Samples, and FIDLER Survey
- Monitoring Well
- Piezometer
- 1 N - 1 W - Grid Lines
- Points of Elevated Radiological Activity (Fidler Survey)
- Areas of Elevated Radiological Activity (Fidler Survey)

Note: Information on Basemap is Derived from the Weston OU9 Site Scoping Report, 1993, & Referenced to the 1927 Ohio State Plane Coordinate System

AREAS OF SPECIAL INTEREST AND ADDITIONAL SAMPLING [a]

- Surface Soil Sampling Locations (Area H Pyrotechnic Waste Disposal Area and Building 34 Firefighting Training Area
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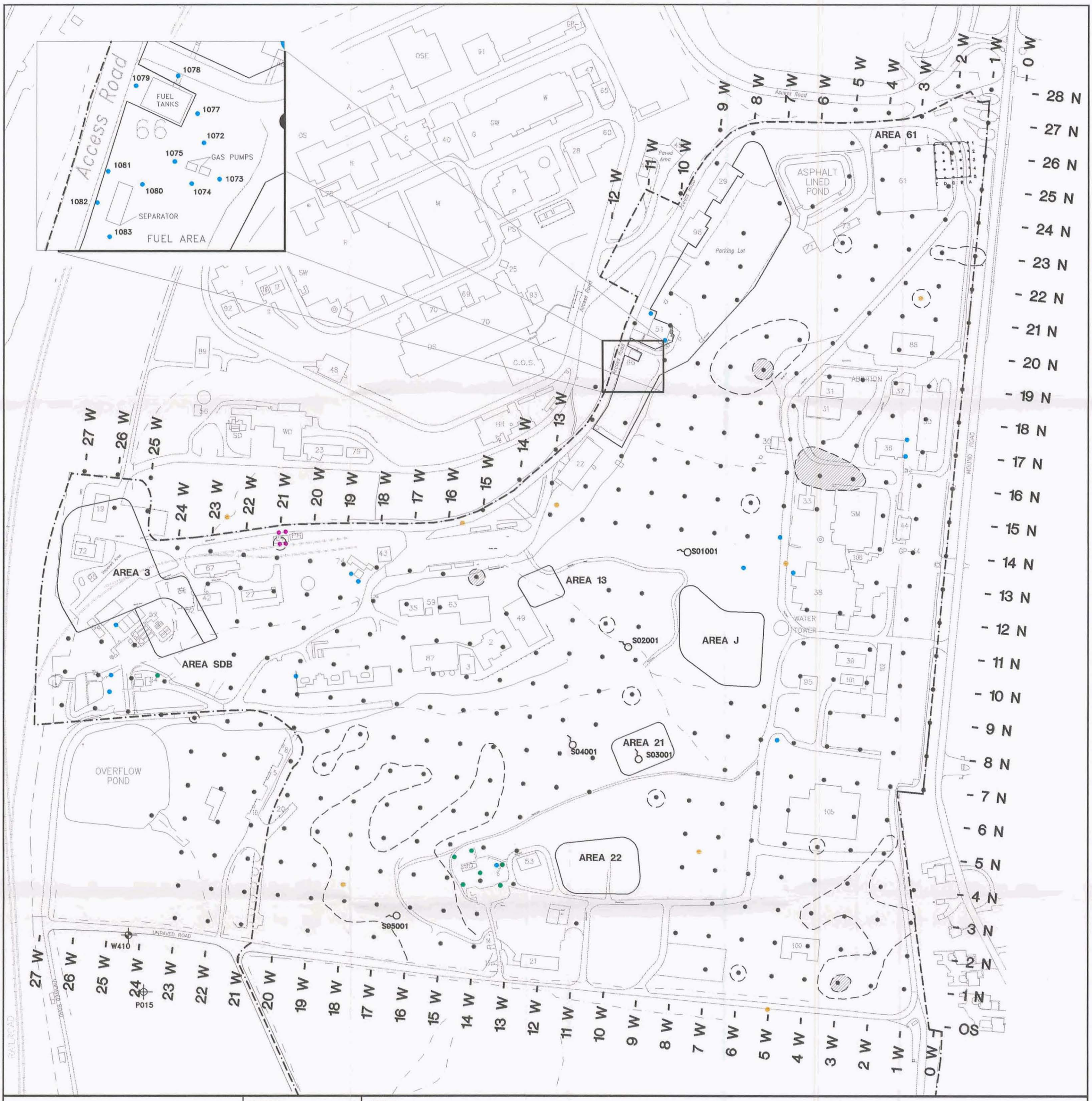
- Soil Screening Facility Radiological Sampling Locations (Additional Sampling [a])
- Surface and Subsurface Soil Sampling Locations (Building 24)

a OU5 Discussion Paper (See Appendix B)

5/30/95 NONRAD.DWG



Mound Plant

Location Map

True North

Contour Interval 10 ft.

100 0 100 200

SCALE (FEET)

FIGURE:

PLATE 3

TITLE:

LOCATIONS OF ELEVATED SURFACE SOIL PU-238 ACTIVITY

LEGEND

- Structures
- Plant Boundary
- Paved/Unpaved Roadway
- Ephemeral Stream
- OU5 Boundary
- Non-AOC Sampling and Survey Locations: Soil Gas Samples, Soil Screening Facility Radiological Samples, and FIDLER Survey
- Monitoring Well
- Piezometer
- 1 N - 1 W - Grid Lines
- Seeps
- Contour for Pu-238 Concentrations Between 25 – 50 pCi/g
- Contour for Pu-238 Concentrations > 50 pCi/g

Note: Information on Basemap is Derived from the Weston OU9 Site Scoping Report, 1993, & Referenced to the 1927 Ohio State Plane Coordinate System

AREAS OF SPECIAL INTEREST AND ADDITIONAL SAMPLING [a]

- Surface Soil Sampling Locations (Area H Pyrotechnic Waste Disposal Area and Building 34 Firefighting Training Area
- Soil Gas and Soil Screening Facility Radiological Sampling Locations (Fuel Area and Additional Sampling [a])
- Soil Screening Facility Radiological Sampling Locations (Additional Sampling [a])
- Surface and Subsurface Soil Sampling Locations (Building 24)

a OU5 Discussion Paper (See Appendix B)

NONPU238-M5C.DWG 12/06/94